



Annual Report 2021



IRAM Annual Report 2021

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Introduction

Dear colleagues and friends,

Reporting on the year 2021 is a strange undertaking, because many of the difficult circumstances in this year resemble those of the previous year, so that the years are sometimes not easily distinguishable in memory. However, once one looks at the facts, it becomes clear that time has not stood still and much has been accomplished in 2021. Of course, the availability of vaccines has changed everyday life, and other adjustments have also had a positive impact on the work at IRAM. This has kept the observatories and developments “on track” with many very important achievements. As every year, the annual report here highlights a small selection of the many outstanding scientific results and ongoing technical developments.

First among our developments is the fact that we have made significant progress on NOEMA and are now rapidly approaching completion of the fundamental project. Antenna 12 was completed during 2021, and by the end of the year the antenna was ready for commissioning and integration into the array. This marks the end of the successful construction of new antennas for NOEMA, but not the end of the work on antennas, as we will still be upgrading the first generation of antennas over the next two years. Equally impressive were the other steps taken for NOEMA, ranging from the great progress made in building the baseline extension, to upgrading the phase reference with fiber, to successfully phasing all the antennas into an extremely powerful millimeter VLBI station.

Time did not stand still for the 30-meter telescope either, as the upgrade program was prepared in great detail during the year.

However, the central role in progress – and this becomes even more evident in such difficult times – is played by people. In this regard, 2021 was both enlightening and pivotal. IRAM staff continued to show exceptional motivation and flexibility in adapting to the constant difficulties, and they maintained high spirits and focus at work, for which I would like to thank

them sincerely. At the same time, as is normal for a structure of IRAM's size, a significant number of people left IRAM due to retirement or other reasons and were replaced. The most visible personnel change was the replacement of the IRAM Head of Administration and that of the Deputy Station Manager for the 30-meter telescope. It has always been a strength of IRAM to integrate new staff in a friendly and positive manner, giving them the confidence and support they need to make such changes as smooth as possible.

It is clear that IRAM must adapt to the rapidly changing way our observatories operate and the way technical developments are organized. This requires not only the creation of new staff profiles for new positions, but also thinking about new ways of organizing and interacting between the different parts of the Institute and the users, or in other words, reviewing and possibly changing the way we are organized and structured. In recent years, this topic had naturally taken a bit of a back seat due to the strong focus on the development and construction of NOEMA, but should now receive greater attention.

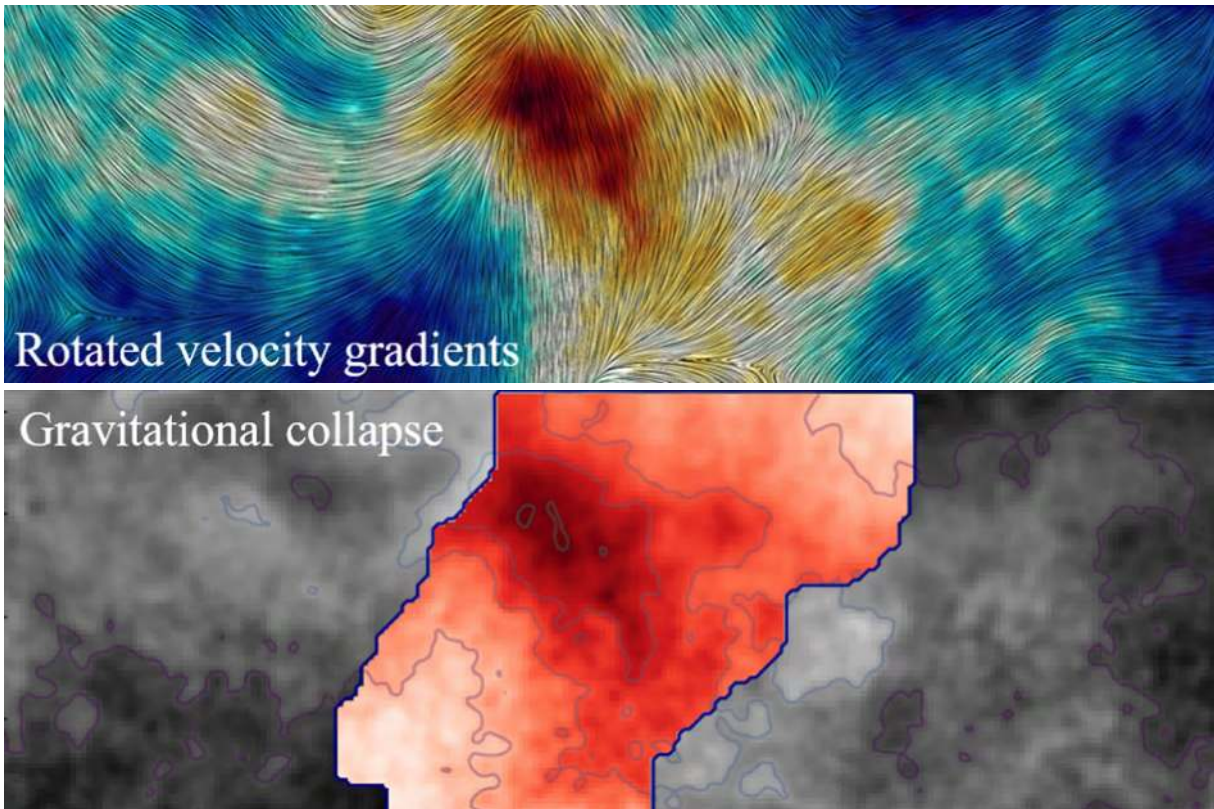
With the great support of our partners, IRAM will continue to innovate, to offer the most advanced millimeter instruments and be an example of successful international scientific collaboration.

Yours sincerely,

Karl Schuster
Director IRAM



Highlights of research with the IRAM telescopes



Credit: Yue Hu et al.

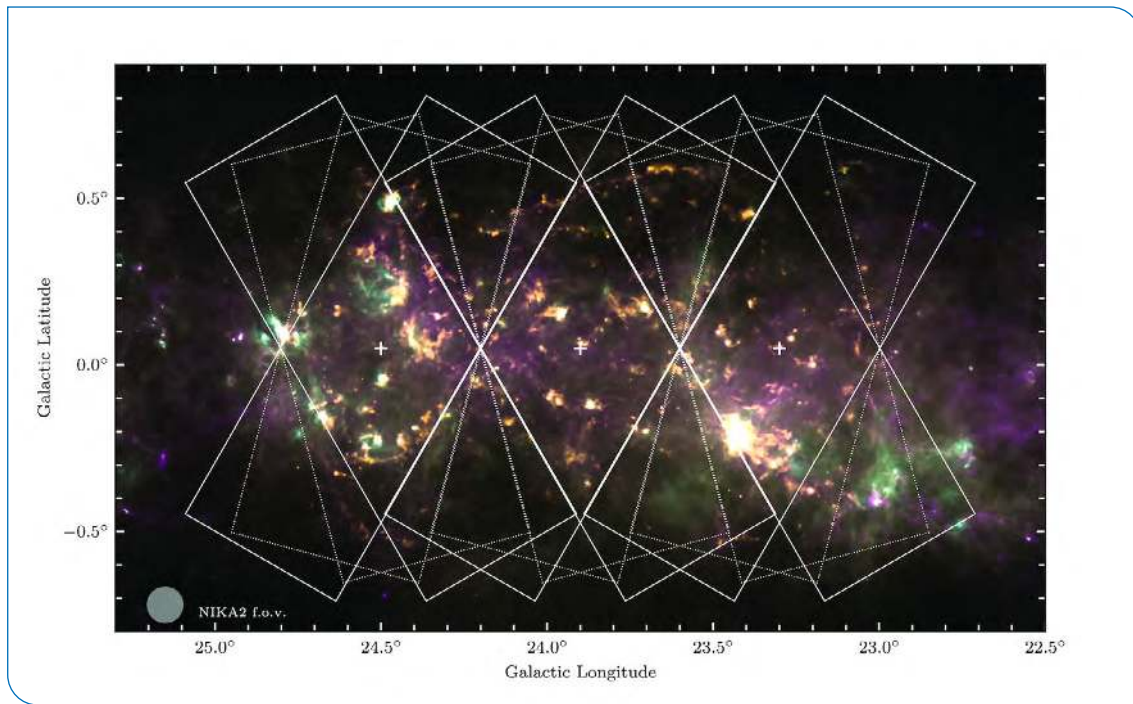
GASTON - a galactic star formation survey with NIKA2

Determining the mechanism by which high-mass stars are formed is essential for our understanding of the energy budget and chemical evolution of galaxies. There are essentially two families of models for the formation of stars that remain under debate: ones in which the formation of high-mass stars follows a scaled-up version of the low-mass star formation models, and ones in which protostars grow in mass as a result of the large-scale gravitational collapse of the parent molecular clump. An attempt was recently made to combine these two families of models to develop a unified model for the formation of massive stars.

By using the NIKA2 camera on the IRAM 30-meter telescope, Andrew Rigby (Cardiff University) and collaborators have embarked on GASTON, a Large Program aimed at conducting a high-sensitivity, large-scale survey of a $\sim 2\text{deg}^2$ region of the inner Galactic Plane (GP), as well as targets in Taurus and Ophiuchus, in order to search for signatures of the transition between the high- and low-mass star formation modes.

The authors extracted structures from the 1.2-mm maps of NIKA2 using dendrogram analysis and, by comparing them to compact source catalogues from Herschel survey data, identified a previously undiscovered population of clumps. Approximately 80% of them are 70- μm -quiet, and may be considered starless candidates. They also find that this population is less massive and cooler, on average, than clumps that have already been identified in the same region of the sky. Further, by classifying the full sample of clumps based upon their infrared brightness as an indicator of evolutionary stage, the researchers provided compelling evidence for clump mass growth, thereby supporting models of high-mass star formation by large-scale gravitational collapse.

The results of this study provide impressive evidence that the large-scale environment around forming stars has an important influence on small-scale disk formation and evolution. Moreover, the authors show that the non-axisymmetric enrichment of fresh material injected into the disk is a possible trigger for the formation of binary, and possibly multiple, star systems.



The GASTON field with rectangles showing the area covered by NIKA2. The background image is a four-color composite of Herschel Hi-GAL and NIKA2 1.15-mm signal-to-noise ratio maps. The circle in the lower left corner shows the sky area covered by the 6.5' field of view of the NIKA2 camera.

Work by Rigby et al. 2021, MNRAS, 502, 4576

Investigating the polarization of the photon ring surrounding M87*

In April 2017, the Event Horizon Telescope (EHT) observed the near-horizon region around the supermassive black hole at the core of the M87 galaxy. These observations revealed a compact, asymmetric, ring-like structure produced by synchrotron emission from relativistic plasma in the close vicinity of the supermassive black hole. In an effort to constrain the theoretical interpretations of the nature of the ring and of relativistic jet-launching theories, the EHT Collaboration conducted a polarimetric analysis of the 2017 data to investigate the structure of magnetic field lines near the event horizon of the black hole.

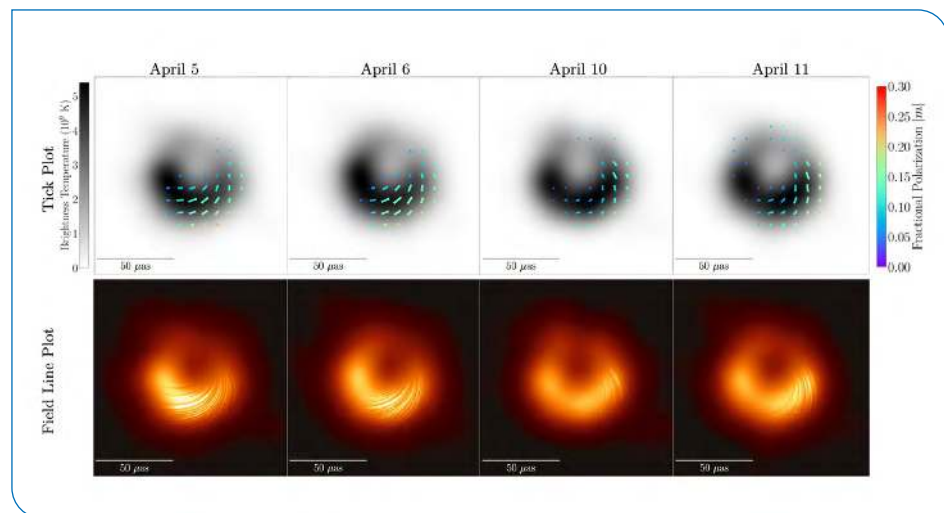
The authors of the study presented the first linear-polarimetric images of the radiation around the black hole shadow and found that only part of the ring is significantly polarized. The resolved fractional linear polarization shows a maximum located in the southwestern part of the ring, where it rises to the ~15% level. The polarization position angles were found to be arranged in a nearly azimuthal pattern. The low fractional linear polarization in the resolved image suggests that the polarization is scrambled on scales smaller than the EHT beam, which the researchers attribute to Faraday rotation internal to the emission region. Although M87's complex broadband spectral energy distribution cannot be accounted for by a single-zone emission model, the researchers estimate the average electron density $\sim 10^{4-7} \text{ cm}^{-3}$, magnetic field strength $B \sim 1-30 \text{ G}$,

and electron temperature $\sim(1-12)\times 10^{10}$ K of the radiating plasma based on a single-zone emission mode, and suggest that the net azimuthal linear polarization pattern results from organized, poloidal magnetic fields in the emission region. In a quantitative comparison with a large library of simulated polarimetric images from general relativistic magnetohydrodynamic simulations, they identify a subset of physical models that matches critical features of the polarimetric EHT observations while producing a relativistic jet of sufficient power. The consistent models are all of magnetically arrested accretion disks, where near-horizon magnetic fields are dynamically important. Based on the models, the authors of the study infer a mass accretion rate onto the black hole in M87 of $(3-20)\times 10^{-4} M_{\odot} \text{ yr}^{-1}$.

Top row: total intensity images M87 are shown in grayscale. Polarization ticks indicate the polarization angles of the electric vector, length indicates the intensity magnitude of the linear polarization, and color indicates the fractional linear polarization.*

Bottom row: polarization "field lines" plotted atop an underlying total intensity image.

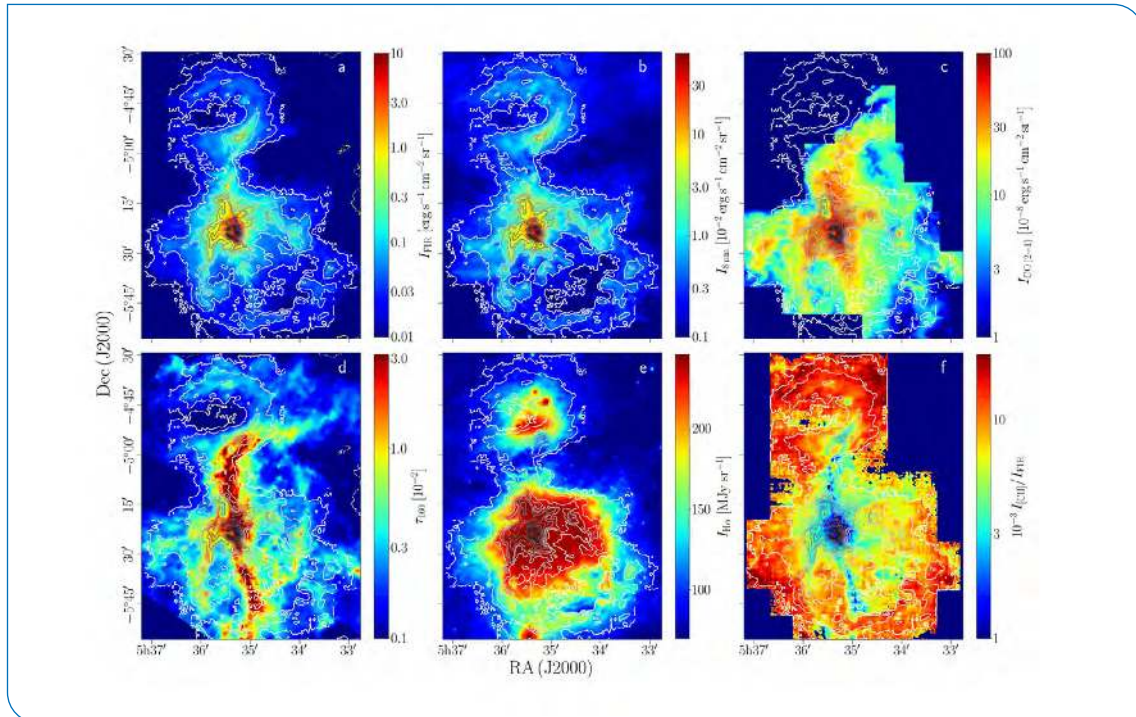
Event Horizon Telescope Collaboration, 2021, ApJ, 910, L12, L13



[CII] 158 μm line emission from Orion A

The 158- μm fine structure line [C II] is one of the dominant coolants of the neutral interstellar medium and thus one of the brightest emission lines in the far infrared (FIR). Not only can it be observed in star-forming regions throughout the Galaxy, but also in the diffuse interstellar medium and in distant galaxies. In an effort to understand the origin of [CII] emission and its relation to other tracers of interstellar gas and dust, an international collaboration led by Cornelia Pabst (Leiden University), surveyed a one-square-degree region of velocity-resolved [CII] emission toward the Orion Nebula complex. They employed Herschel FIR photometric images to determine dust properties, and compared it with velocity-resolved IRAM 30-meter CO(2-1) observations of the molecular gas, H α emission of ionized gas from the ESO/VLT, and Spitzer mid-infrared photometry to trace hot dust and large polycyclic aromatic hydrocarbons (PAH).

The researchers found that the [CII] intensity is tightly correlated with PAH emission in the IRAC 8 μm band and FIR emission from warm dust, but that [CII] was not showing any clear trend with CO(2-1), probably because of the complex structure of the region. They find particularly low [CII]/FIR intensity ratios in the direction of large dust columns, suggesting the interpretation of a [CII] deficit in the form of a FIR excess. Since this seems to be the case in particular for certain regions with deeply embedded protostars, this could also imply that the star formation rate derived from the [CII] emission is underestimated. Pabst and collaborators suspect that this could be due to the [CII] emission stemming from PDR surfaces of molecular clouds with low surface brightness. Future studies of more active regions of high-mass star formation will be critical in verifying the general applicability of these conclusions.

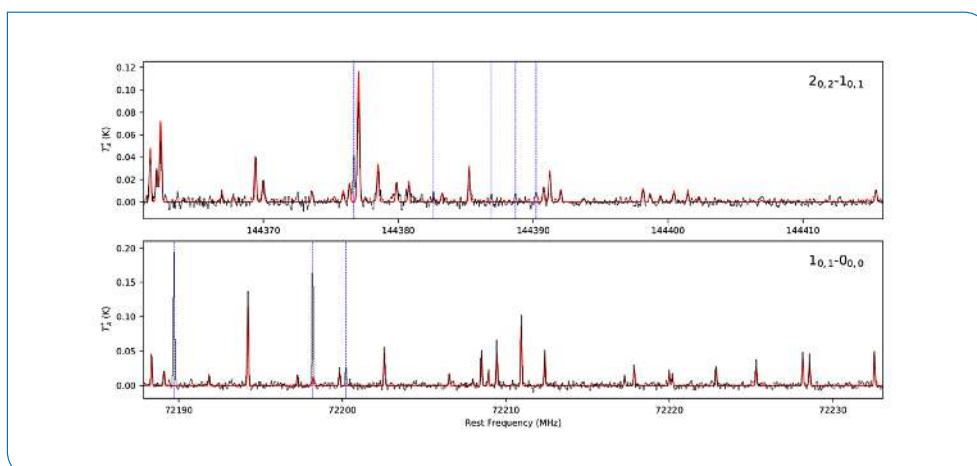


Velocity-integrated [CII] overlaid with contours on the (a) FIR intensity; (b) IRAC 8 μ m intensity; (c) IRAM 30-meter CO(2-1) intensity; (d) dust optical depth τ_{160} ; (e) DSS-2 red-band intensity converted to H α intensity; and (f) [C II]/FIR ratio.

Work by Pabst et al. 2021, A&A, 651, 111

The simplest aminocarbyne detected in space – H₂NC

High spectral resolution line surveys of molecular clouds are invaluable tools for studying molecules in space and fundamental chemical processes. Since the discovery of the first molecular species, many more have been found in space before being characterized in the laboratory. In most cases, their identification is supported by state-of-the-art ab initio calculations, but often, despite these aiding measures, molecular transitions discovered in space remain unidentified. The use of narrow lines observed at high spectral resolution remains one of the most effective means of searching for new molecular species and determining precise spectroscopic parameters.



Lines of H₂NC observed in L483. The computed synthetic spectra for a column density of H₂NC of 10¹² cm⁻², an ortho-to-para ratio of 3, a rotational temperature of 4.0K, and a full width at half maximum of 0.35 km s⁻¹ are shown in red.

Work by Cabezas et al. 2021, A&A, 645, 54

That's how a group of researchers led by Carlos Cabezas (CSIC/Madrid) proceeded to come up with the identification in space of H_2NC , a high-energy isomer of H_2CN that has largely been ignored in chemical and astrochemical studies. The search was motivated by the observation of various unidentified lines in the cold dark cloud L483 using EMIR around 72.2 GHz at the IRAM 30-meter telescope. The researchers followed it up with the successful detections of additional groups of lines at higher frequencies that were in harmonic relation with the lower frequency lines. After an exhaustive high-level assessment of possible carriers, the authors of the study confidently assigned the unidentified transitions to H_2NC .

The authors also detected the molecule in the cold dark cloud B1-b with the IRAM 30-meter telescope and in the $z=0.89$ galaxy in front of the quasar PKS1830–211 with the Yebes 40m telescope. They derived $\text{H}_2\text{NC}/\text{H}_2\text{CN}$ abundance ratios of ~ 1 in L483 and B1-b and 0.27 toward PKS1830–211 and conclude that the $\text{H}_2\text{NC}/\text{H}_2\text{CN}$ ratio is likely to behave as the HNC/HCN ratio, with values close to one in cold dense clouds and below one in diffuse clouds. The authors also suggest that the $\text{N}+\text{CH}_3$ and $\text{C}+\text{NH}_3$ reactions are the most likely to produce H_2NC in interstellar clouds. Further studies on these two reactions are needed to evaluate the yield of H_2NC , however.

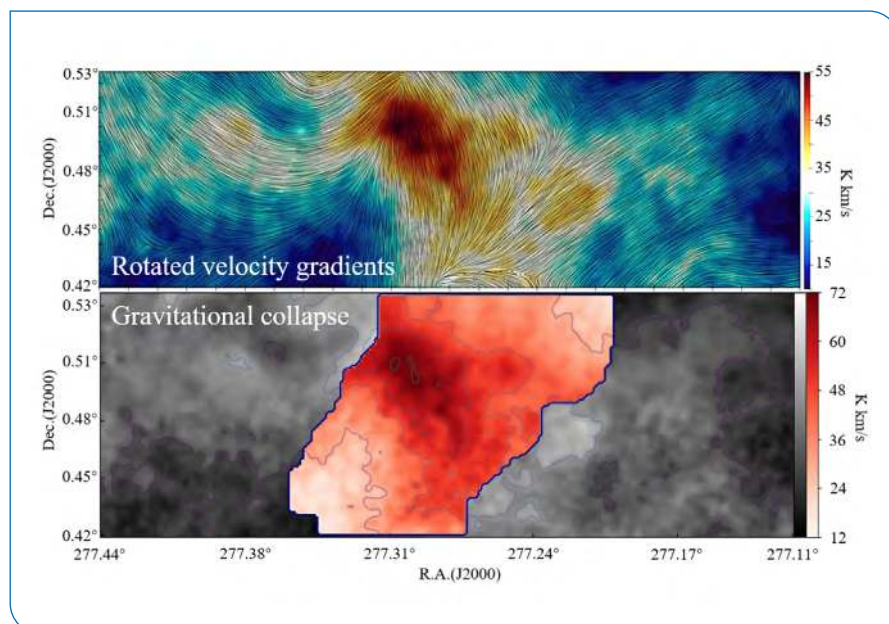
Gravitational collapse in the Serpens G3–G6 molecular cloud

A number of observational and numerical studies suggest that the interaction of turbulent supersonic flows and magnetic fields generates high-density fluctuations that serve as nurseries for new stars, but the energy balance between these forces and the subsequent gravitational collapse of these regions remains a subject of intense debate. To get insight into the relative role of turbulence, magnetic fields, and self-gravity in the formation of stars, Yue Hu (University of Wisconsin-Madison) and collaborators made use of a set of statistical methods, including the velocity gradients technique (VGT), to reveal regions of gravitational collapse and quiescent areas where turbulent motions, thermal pressure, and magnetic support dominate over gravitational energy.

Top: the VGT map obtained from ^{13}CO (1–0) for the Serpens G3–G6 south clump.

Bottom: the gravitationally collapsing regions (red area) identified by VGT.

Work by Hu et al. 2021, ApJ, 912, 2

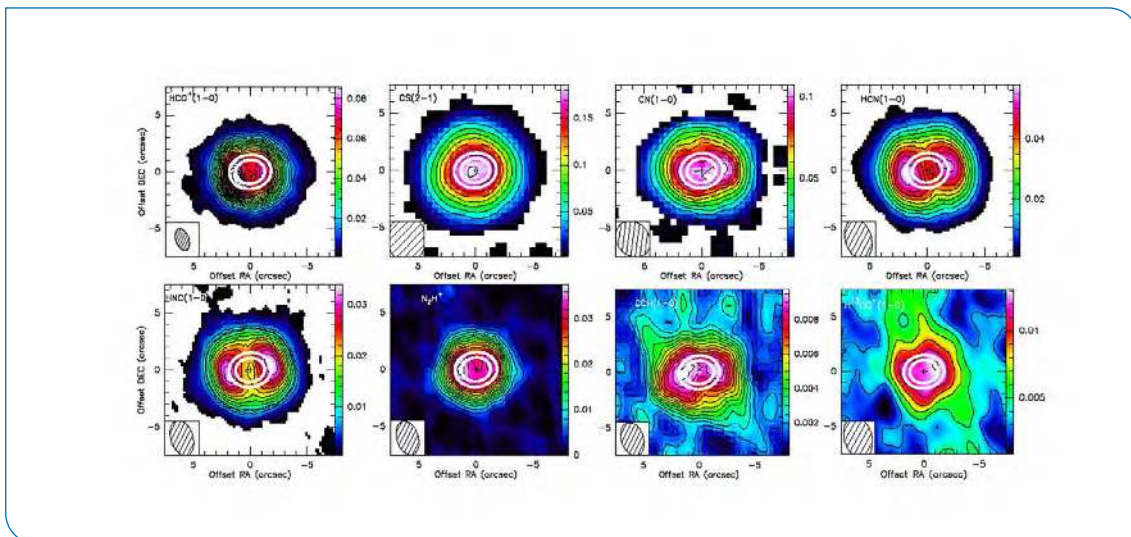


The authors of the study applied these techniques to IRAM 30-meter telescope on-the-fly observations of the $^{13}\text{CO}(1-0)$ emission in the Serpens G3–G6 molecular cloud. By combining the data with polarized dust emission from Planck observations and with H_2 column densities obtained with Herschel, they suggest that the Serpens G3–G6 south clump is undergoing a gravitational collapse and that it happens at volume density $\geq 10^3 \text{cm}^{-3}$. Using different tools, they also estimate the magnetic field strength projected on the plane of the sky to 100–120 μG , and find that the Serpens G3–G6 south clump's total magnetic field energy dominates

the energy budget of the supersonic Serpens G3–G6 south clump and that the turbulence is mainly driven by compressive forces. The authors conclude that the gravitational collapse could well be triggered in a supersonic and sub-Alfvénic cloud.

First detection of thioxoethenylidene in a protoplanetary disk – C_2S

Molecular line surveys are among the main tools to probe the structure and physical conditions of protoplanetary disks, the birthplace of planets. The large radial and vertical dependences of the temperature and density of the gas in these disks lead to complex chemical reactions and compositions, making molecular spectroscopy an important tool to investigate the molecular inventory and chemical evolution of planetary systems. However, the chemical patterns become intricate when the protoplanetary disks harbor a multiple star system in which some stars are surrounded by an inner and a common outer disk. Investigating how the gas and dust transiting from the outer disk to the inner disks is chemically processed then becomes a key problem in evaluating how planet formation can differ in multiple and single star systems.



From left to right, top to bottom: velocity-integrated maps of $HCO^+(1-0)$, $CS(2-1)$, $CN(1-0)$, $HCN(1-0)$, $HNC(1-0)$, N_2H^+ , C_2H , and $H^{13}CO^+(1-0)$. The white ellipses mark the approximate inner and outer edges of the outer dust ring.

Work by Phuong et al. 2021, A&A, 653, L5

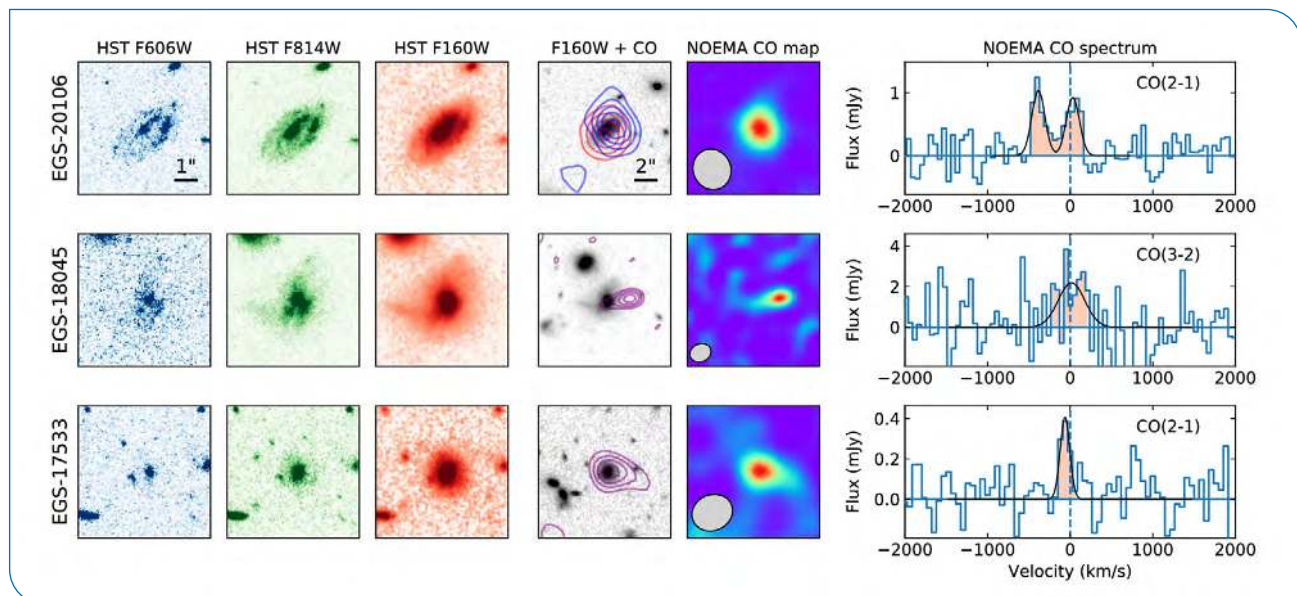
In an effort to address this challenge, by characterizing the chemical and physical properties of the large and dense protoplanetary disk surrounding GG Tau A, a well-known triple T Tauri system, Nguyen Thi Phuong (LAB/Bordeaux) and collaborators used the NOEMA interferometer and performed a first deep spectral survey in the 70–115 GHz frequency range. While deriving molecular densities and abundances for a number of key molecules, an unforeseen byproduct emerged from the spectral analysis: the first detection of the thioxoethenylidene molecule (C_2S) in a protoplanetary disk.

The authors found that the abundance of the newly detected C_2S molecule is about 20 times lower than that of CS . According to them, the detection of this molecule in the outer region of the disk, as well as an upper limit on the abundance of OCS , reinforces the problem of understanding the chemistry of sulphur in the disks. To date, no chemical model is yet able to correctly predict the abundances of CS , H_2S , H_2CS and C_2S or of those whose detection is less significant, such as SO and OCS . The authors conclude that the detection of this new molecule represents a further step towards more coherent chemical models, thereby gradually paving the way to understanding the physics and chemistry of the disks where planets are born.

Massive Galaxies Undergoing Quenching at $z \sim 1$

To reproduce the observed population of massive, quiescent galaxies, models of galaxy formation introduce a quenching mechanism that turns off star formation in massive systems. Although this can usually be achieved by feedback from active galactic nuclei (AGNs), there is a lack of conclusive observational evidence supporting such a scenario. The observed diversity of quiescent galaxies in terms of their structure and stellar populations suggests that there must be more than one quenching process. The lack of molecular gas as fuel for star formation, as well as turbulence affecting the collapse of molecular gas, are possible mechanisms preventing the formation of new stars.

To gain further insight into the role of gas consumption in galaxy extinction at high redshift, a group of researchers led by Sirio Belli (MPE/Garching) presented an in-depth study of the molecular gas content and stellar population properties of three massive galaxies at $1 < z < 1.3$ in different stages of quenching. CO emission from each of the three galaxies is detected in deep NOEMA observations, allowing the researchers to derive molecular gas fractions of 13%–23%. By reconstructing the star formation histories, they find evidence for recent rejuvenation in one object, slow quenching in another, and rapid quenching in the third system. To further constrain the underlying quenching process, they explored the depletion times for these three objects and compared it to other samples in the literature, and found that recently quenched galaxies and star-forming galaxies have similar depletion times, while older quiescent systems have longer depletion times. These results offer new, important constraints for physical models of galaxy quenching, but the authors of the study argue that only by performing a detailed study of the stellar and gas content on a large sample of quiescent galaxies will it be possible to better understand the mechanisms leading to galaxy quenching.



6" × 6" HST images from ACS/F606W (blue), ACS/F814W (green), and WFC3/F160W (red). The next two panels are 12" × 12" and show the F160W image with the CO contours in steps of 1σ overlaid and the CO integrated map, with the beam shown in gray. The last panel shows the NOEMA spectrum of the CO emission line, together with the Gaussian fit.

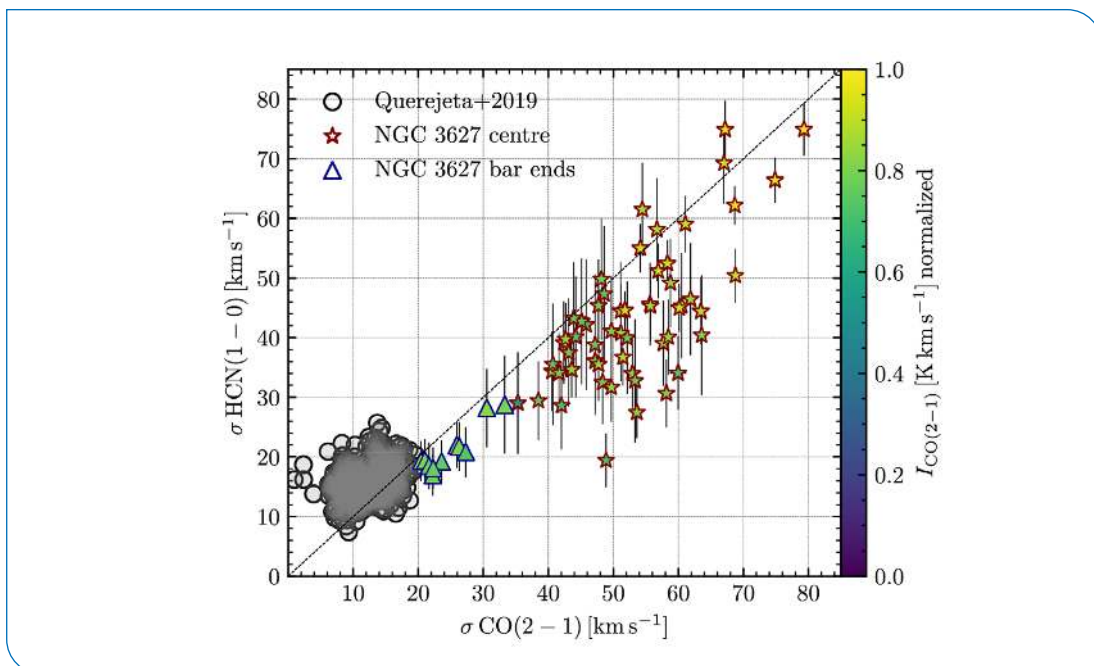
Work by Belli et al. 2021, *ApJ*, 909, L11

Probing the dense molecular gas in NGC 3627

How the densest phase of the interstellar medium varies in different Galactic environments is still poorly understood. Yet, it is in these environments that the processes leading to star formation are initiated. So far, extragalactic surveys have mainly used the ^{12}CO line to identify these regions, but although the line is particularly bright and well suited to determine molecular masses, it is not well suited to measure masses in areas of high gas density. To probe the latter, molecules with transitions at higher critical densities turn out to be more appropriate.

To characterize the gas properties in the densest regions in a nearby star-forming galaxy, Ivana Bešlić (Argelander-Institut/Germany) and collaborators initiated a NOEMA project to observe a set of molecular tracers of dense gas (HCN, HNC, HCO^+) and CO isotopologues (^{13}CO , C^{18}O) in NGC 3627. Although these observations were supplemented by low-resolution IRAM 30-meter data, they represent one of the highest angular resolution maps of dense gas tracers across the disk of a nearby spiral galaxy (100pc). These tracers were combined with ALMA $^{12}\text{CO}(2-1)$ data and used to assess the properties of the dense molecular gas and their variation as a function of galactocentric distance, molecular gas, and star formation. The authors of the study found that the $\text{HCN}(1-0)/\text{CO}(2-1)$ integrated intensity ratio does not correlate with the amount of recent star formation. Instead, the $\text{HCN}(1-0)/\text{CO}(2-1)$ ratio depends on the galactic environment, with differences between the galaxy centre, bar, and bar-end regions. Moreover, the dense gas in the central 600 pc appears to produce stars less efficiently despite containing a higher fraction of dense molecular gas than the bar ends where the star formation is enhanced. In assessing the dynamics of the dense gas, the authors note that the $\text{HCN}(1-0)$ and $\text{HCO}^+(1-0)$ emission lines have several velocity components toward the bar-end regions that correspond to the previously identified features of ^{12}CO emission. These features suggest that the complex dynamics of these regions could enhance star formation.

According to the authors, it is important to extend this work to observations with higher sensitivity to observe even fainter molecular lines and thus improve the understanding of the densest phases of the interstellar medium and its ability to form stars.



HCN(1-0) velocity dispersion compared to $^{12}\text{CO}(2-1)$. The dashed line indicates equal velocity dispersion. The points from the center of NGC 3627 are marked as stars, whereas points coming from the bar ends are labelled as triangles.

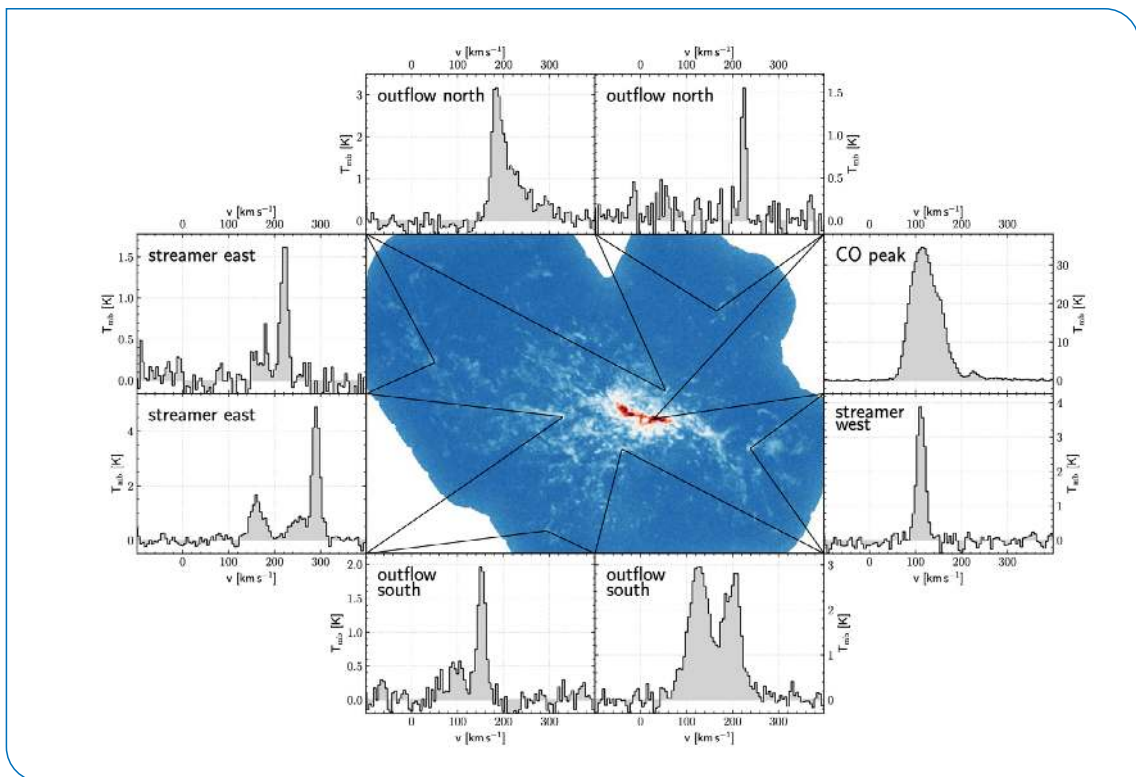
Work by Bešlić et al. 2021, *MNRAS*, 506, 963

High-fidelity Imaging of the Molecular Gas in and around M82

Galaxy-wide outflows driven by star formation are considered to be crucial drivers of galaxy evolution. Stellar feedback caused by intense central star formation activity can trigger such outflows and cause significant fractions of baryons to escape the main body of the galaxy. While there is ample evidence for galactic outflows, detailed characterization is limited to only a few local systems where the relevant processes can be spatially resolved with high sensitivity. In particular, the physical characterization of the outflowing gas mass is important because it affects the ability of a galaxy to form stars in the future. The fate of the molecular gas in the outflow is in itself not clear. Outflowing molecular clumps may be shocked and vaporized by the fast and hot outflowing gas, or they may act as condensation seeds that gain mass, momentum, and velocity from the intense cooling of the hot gas.

A group of researchers led by Nico Krieger (MPIA/Germany) set out to test which of these possibilities actually takes place in the molecular outflows in and around the nearby starburst galaxy M82. This would have significant implications for the interpretation of observational data, as well as for our understanding of the physical processes that drive the cool phases of galaxy outflows. To accomplish this, they mapped the $^{12}\text{CO}(1-0)$ line emission over a ~ 25 arcmin² extended region with a 154-pointing mosaic with NOEMA around M82. The observations, supplemented by zero- and short-spacing observations at the IRAM 30-meter telescope, achieved a spatial resolution of ~ 30 pc ($\sim 1.9''$) at a spectral resolution of 5 km s⁻¹, sufficient to resolve the molecular gas in the central starburst disk, the outflow, and the tidal streamers.

The resulting moment and peak brightness maps show a striking amount of structure. Using a clump decomposition algorithm, they were able to statistically analyze the physical properties such as sizes R , linewidths σ , and masses of about 2000 molecular clouds. To first order, the properties of the clouds are very similar, regardless of their environment and so are the size-linewidth relationships σ^2/R of the clouds.



NOEMA $^{12}\text{CO}(1-0)$ mosaic of the nearby starburst galaxy M82. The color wedge is adjusted to highlight the weak emission in the molecular streams and outflows.

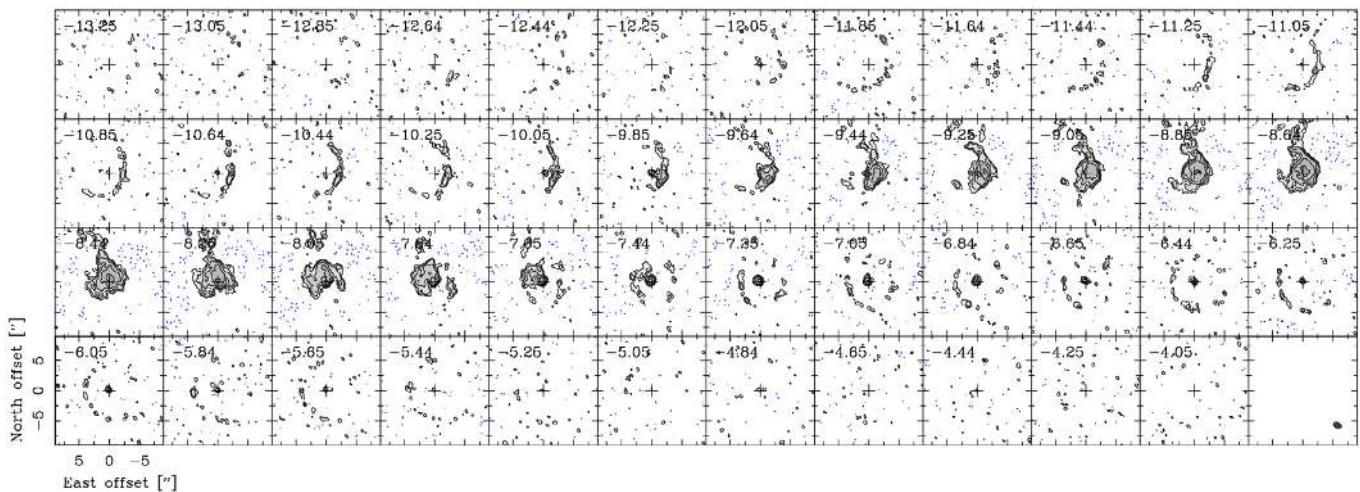
Work by Krieger et al. 2021, *ApJ*, 915, L3

The distribution of clouds in the σ^2/R versus column density space suggests that external pressure does not play a significant role in setting their physical parameters in the outflow and streamers. They find that the clouds in the streamers stay approximately constant in size ($R \sim 50$ pc) and mass ($M \sim 10^5 M_{\odot}$), and do not vary with their projected distance from the center of M82. The clouds in the outflow, on the other hand, appear to decrease in size and mass with distance toward the southern outflow. The reduction in the molecular gas luminosity could be indicative of cloud evaporation of embedded clouds in the hot outflow.

In the future, Krieger and collaborators plan to incorporate ^{13}CO data to obtain an independent surface density estimator that would allow a more accurate assessment of the dynamic state of clouds in the outflow and streamers.

Keplerian disks and outflows – a new class of binary post-AGB stars

The spectacular evolution from the spherical circumstellar envelopes of AGB stars to post-AGB nebulae showing fast bipolar outflows takes place in a very short time (~ 1000 yr). The accepted scenario to explain this evolution assumes that a companion accretes material from a rotating disk, subsequently initiating an outflow, similarly to what occurs in protostars. However, the effect of binarity in post-AGB stars and the mass balance between outflow-dominated and disk-dominated stars is still poorly understood. While there are a handful of well-studied disk-dominated stars (Red Rectangle, AC Her, IW Car, and IRAS 08544–4431), very little is known on the properties of outflow-dominated stars.



NOEMA velocity channel maps of ^{13}CO (2–1) from 89 Her. The beam size is $0.74'' \times 0.56''$, the major axis being oriented at $\text{PA} = 28^\circ$.

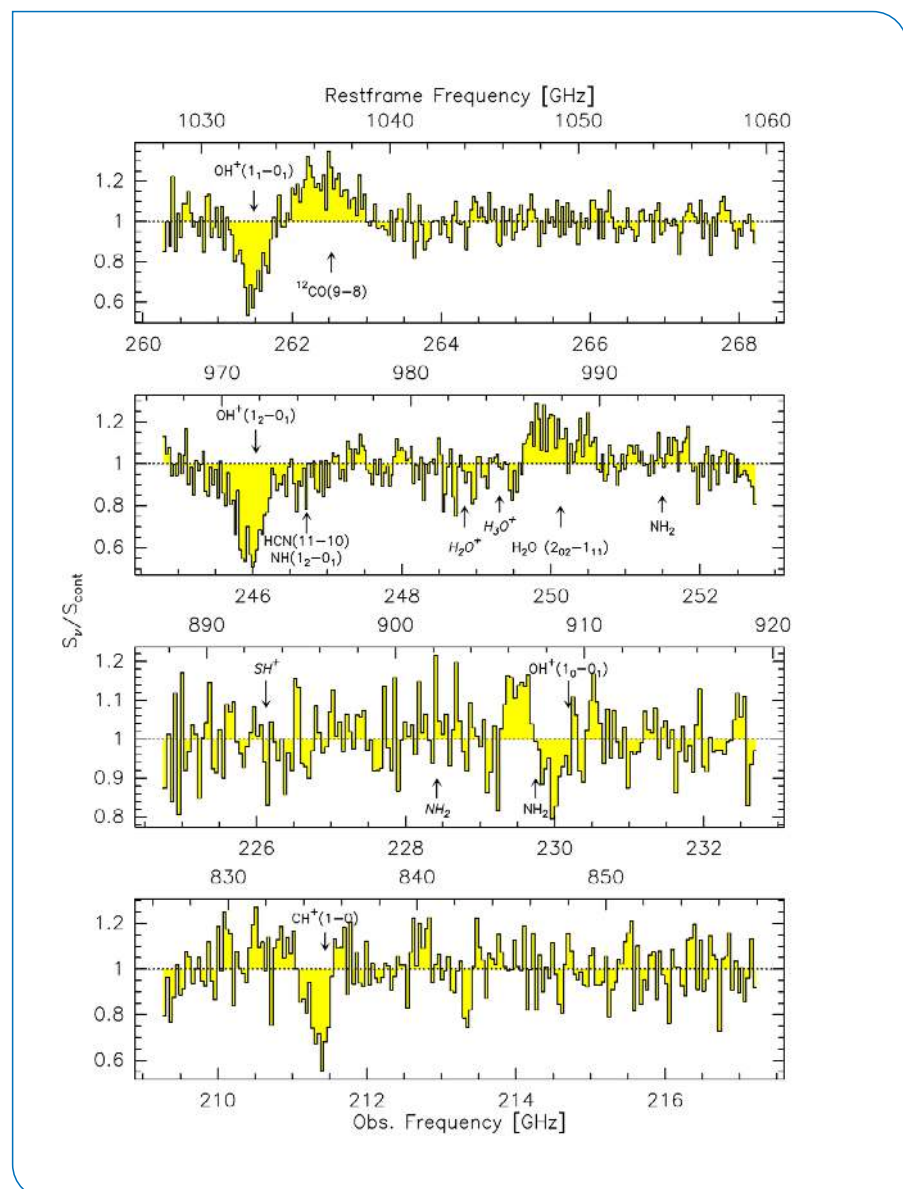
Work by Gallardo Cava et al. 2021, *A&A*, 649, A93

Iván Gallardo Cava (OAN/Madrid) and his collaborators took up the challenge with NOEMA and observed a sample of post-AGB stars with rotating disks where the dominant component of the mass was supposed to be in the outflow. Using high angular resolution observations of ^{12}CO J=2-1 in AC Her, IRAS 19125+0343 and R Sct, and the ^{12}CO and ^{13}CO J=2-1 transitions in 89 Her, they derived several properties, including the structure, density and temperature distributions, as well as the dynamical properties of the nebulae. For example, they estimated for AC Her the mass of the outflow to be $\leq 5\%$ of the total mass of the nebula, for Her 89 the mass of the hourglass-shaped outflow to be $\sim 50\%$, for IRAS 19125+0343 the mass of the outflow to be $\sim 70\%$, and lastly for R Sct the mass of the very extended outflow surrounding the disk to be $\sim 75\%$.

The results obtained on IRAS 19125+0343 and R Sct motivated the researchers to introduce a new subclass of binary post-AGB stars, for which the outflow is the dominant mass component of the nebula, and where 89 Her lies on the verge between both subclasses.

A close-up of a luminous star-forming galaxy at $z = 3$

Extragalactic imaging surveys with the Herschel Space Observatory have led to a decisive turnaround in the search for dust-obscured star-forming galaxies, but it was not until the advent of millimeter and submillimeter facilities such as NOEMA and ALMA that accurate redshifts could be measured for these galaxies, paving



Spectra of HerBS-89a in the 245-268 GHz and 209-233 GHz ranges. The spectra were normalized to the continuum. All detected molecular emission and absorption lines are labelled. Molecular lines that fall within the observed frequency ranges but could not be detected appear in italics.

Work by Berta et al. 2021, A&A, 646, 122

the way to a better understanding of their nature, physics, and evolution over cosmic time. One of these Herschel galaxies stood out for its bright 2mm continuum (4.6 mJy) and the width of its CO lines (1100 km s⁻¹): HerBS-89a, a dust-enshrouded galaxy $z=2.95$.

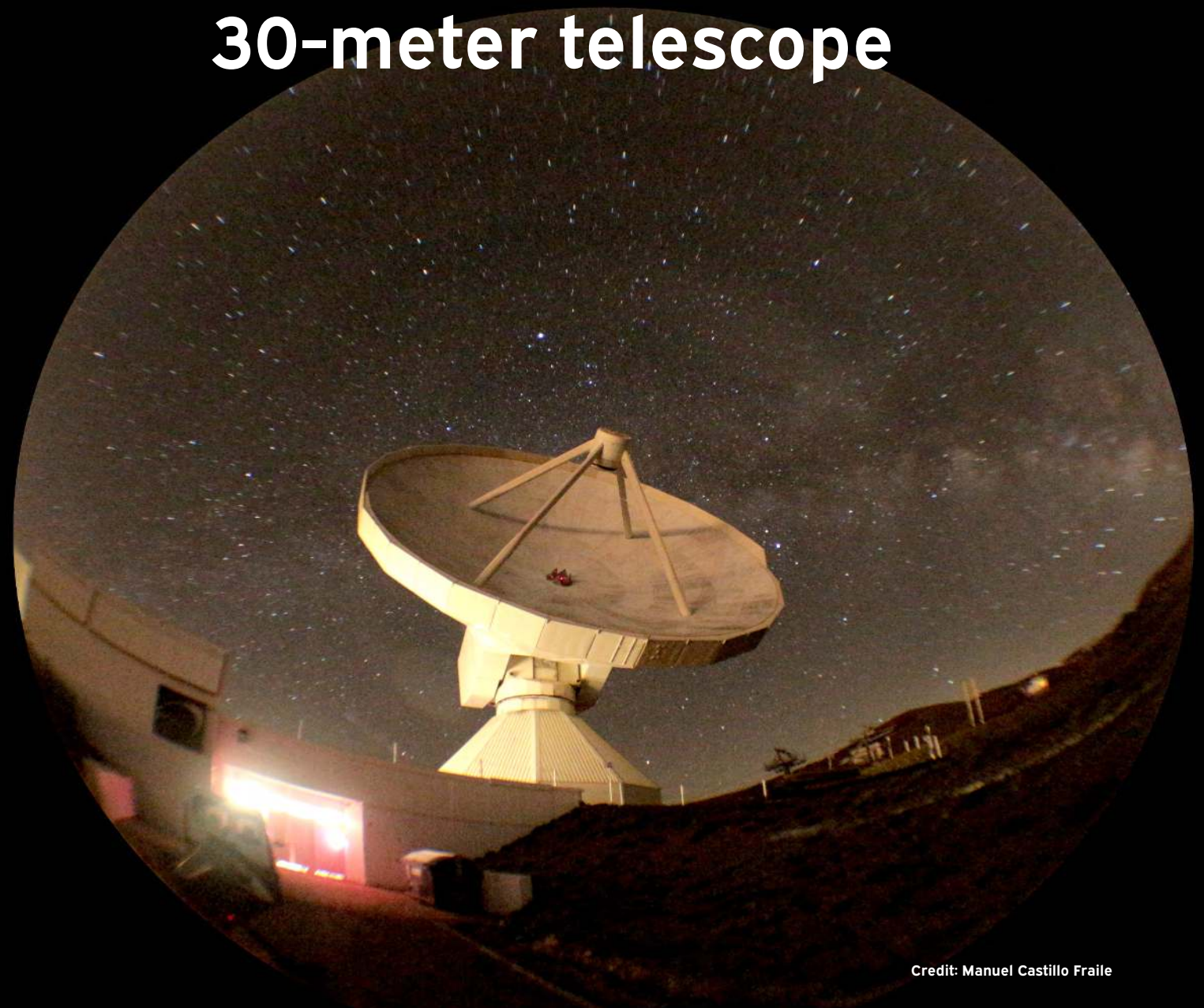
By exploiting the sensitivity of NOEMA, a group of researchers led by Stefano Berta (IRAM/France) have spurred efforts to learn more about the physical and dynamical conditions of the molecular gas and dust in this galaxy. They obtained images with unprecedented angular resolution (0.3"), which revealed a partial Einstein ring. Together with the emission lines of ¹²CO(9-8) and H₂O(2₀₂-1₁₁) they reported the detection of several molecular lines, including: the fundamental transitions of OH⁺ in absorption; the molecular ion CH⁺ (1-0) in absorption and tentatively in emission; two transitions of NH₂ in emission; and HCN (11-10) and NH(1₂-0₁) in absorption.

Using the photometric redshift of the lensing galaxy, which they estimated to about 0.9 from GTC data, they reconstructed the structure of HerBS-89a in the source plane, and were thus able to probe the intrinsic dust and molecular gas emission on an angular scale as small as 0.1" (800 pc). While they were not able to clearly distinguish between a single galaxy and a merging galaxy pair, they preferred the latter as it better accounted for the broad line widths observed in HerBS-89a. They supplemented the NOEMA data with JVLA observations of the ¹²CO(1-0) line to obtain a reliable estimate of the total mass of the molecular gas of $2.1 \pm 0.4 \cdot 10^{11} M_{\odot}$. Combined with the star formation rate of $614 \pm 5 M_{\odot} \text{yr}^{-1}$ this leads to a depletion timescale of $3.4 \pm 1.0 \cdot 10^8$ years.

The OH⁺ and CH⁺ absorption lines, which are known to probe low density molecular gas, have their main velocity component redshifted by 100 km s⁻¹ relative to the global CO reservoir, suggesting that NOEMA detected a rare example of gas inflow from the surroundings onto the galaxy HerBS-89a.

The study shows that facilities like NOEMA and ALMA are capable of unravelling the complex physics of a starburst system in the early universe from the kinematics of the innermost regions to inflows of low-density molecular gas.

30-meter telescope



Credit: Manuel Castillo Fraile

The Covid-19 pandemic has still conditioned the observatory life in 2021, although in less extent than in 2020. Most of the observations have been carried out in remote operation mode. The operating efficiency has been quite high, since more than 65% of the time has been dedicated to science observations.

The 30-meter upgrade project has experienced a significant boost along 2021. In close contact with the contractor company, the new servo control of the telescope is getting shaped, going through a comprehensive revision of requirements, critical design review, procurement of parts and design of the new software components required to accommodate the new hardware. The way is paved towards an on-site deployment in 2022.

The 10th edition of the IRAM 30-meter School on Millimetre Astronomy was held for the first time in on-line format in November 2021. Not only lectures but also practical hands-on work at the telescope was planned and carried out, taking advantage of the experience gained in the remote observing mode. Overall, the experience has been satisfactory and the feedback positive, although the on-site, face-to-face mode is still widely preferred by both students and lecturers.

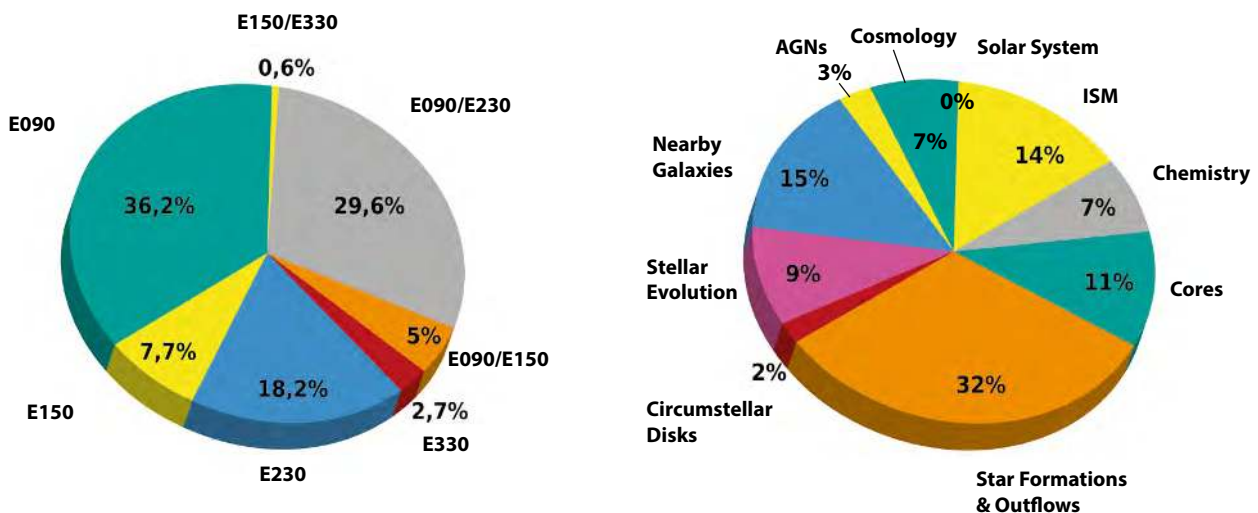
Astronomical projects

During 2021, a total of 195 projects were observed. This number includes 4 large programs with NIKA2 and 2 with EMIR, 20 short-spacing projects, 6 Director's time projects, and 16 VLBI projects. About half of these projects were scheduled in pool weeks.

Galactic topics were addressed by 75% of the scheduled projects, with a strong focus on the star forming interstellar medium and the ISM in general. About a quarter of all projects were devoted to nearby galaxies, AGNs, and the distant universe.

The bulk of the observations, 85%, were conducted using the EMIR heterodyne frontend. The 3 mm E090 band of EMIR was used during 70% of the EMIR time, about half in single-band mode and the other half in dual-band mode. The 1 mm band E230 was used during almost half of the observing hours with EMIR, 18% in single-band mode and 30% in double-band mode. The NIKA2 continuum camera was used 16% of the time.

Because of the still ongoing Covid-19 pandemic, the vast majority of observations were conducted remotely, which was made possible by the fast, stable fibre link to the 30-meter telescope. Only 16 astronomers could visit the 30-meter telescope in the last month of the year, when the Covid-19 situation improved somewhat for a couple of weeks. Within the year, two groups of master students and their tutors successfully observed their projects, one in remote and the second one on-site.

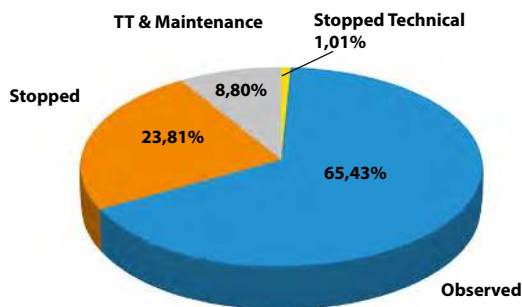


Usage of EMIR bands in 2021 and time distribution of scientific categories observed in 2021.

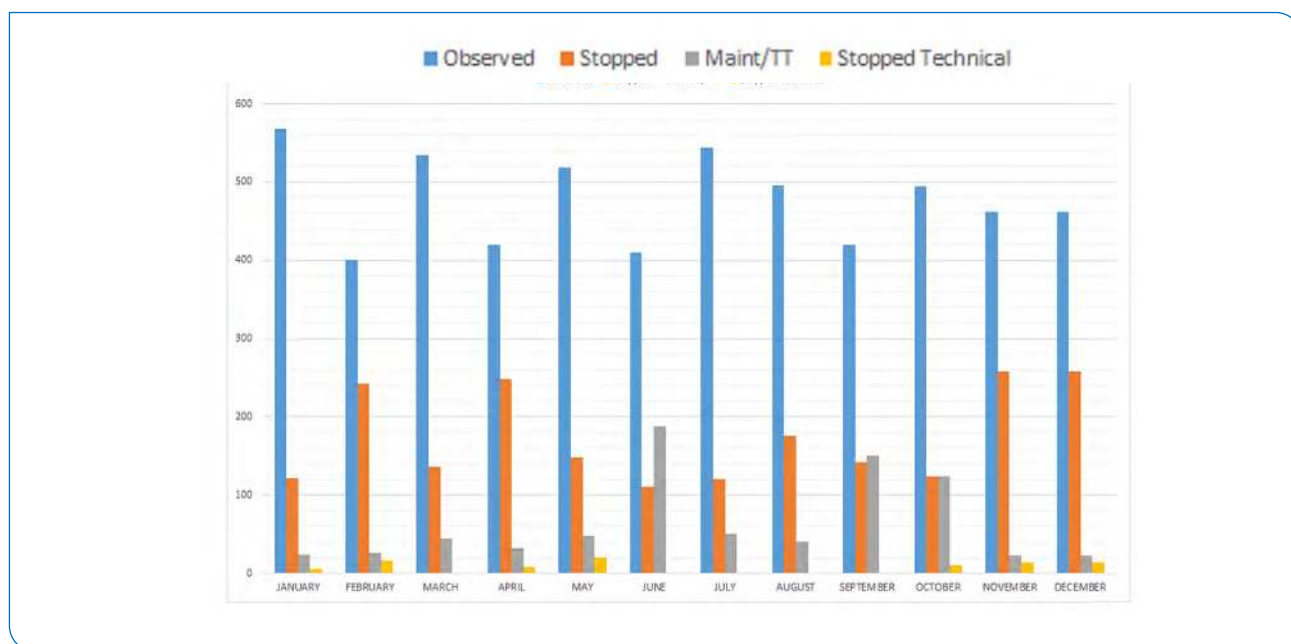
Observatory operation

The impact of the Covid-19 pandemic and its different waves has again altered the normal operation of the observatory during 2021. The 30-meter telescope has been operated in remote visitor mode, or service mode when remote observations were not possible. However, as a step back to the normal situation, remote AoD shifts were progressively replaced by the traditional on-site ones (specially for pool observations). The positive evolution of the pandemic in Europe, and specifically in Spain, allowed the partial re-opening of the observatory to on-site visitors at the start of the winter semester 2021 but this was unfortunately severely challenged by the subsequent sharp increase of the infection incidence provoked by the omicron variant.

The observing efficiency has been remarkable: more than 65% of the total available time was allocated to scientific observations with either EMIR or NIKA2. The fraction of time lost due to adverse weather conditions was around 24%, similar to that in 2019, although higher than that reported in 2020 (around 18%). The time fraction spent in maintenance and technical time was close to 9% (slightly higher than other years due to preparatory work for the telescope upgrade). Finally, the time lost due to technical problems remains extremely low, around 1%.



30-meter telescope distribution 2021 (left) and by month (bottom). More than 65% of the time was dedicated to science observations.



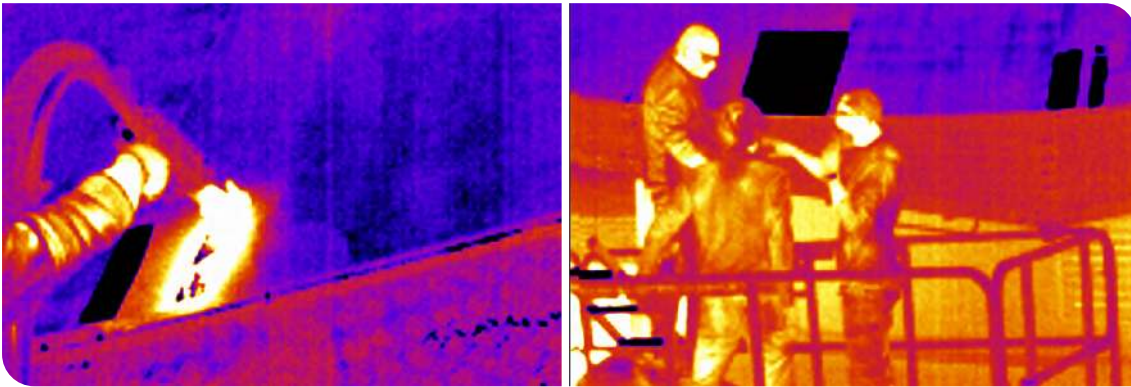
Maintenance and telescope upgrade activities

Despite the Covid-19 pandemic, the technical activities have been normalized at the 30-meter telescope. The support to the daily operation of the observatory has been regularized including the preventive and corrective maintenance of systems, equipment and facilities. In parallel, important efforts have been dedicated to the preparation and start of the upgrade of the 30-meter that will take place in the near future.

The 30-meter upgrade project, named ASSSA (Spanish acronym for "Upgrade of the Servo System and Antenna Surface") is focussed in two main areas of improvement: the 30-meter Servo Control and the antenna reflector surface. Preparation tasks have been carried out in close connection with the company awarded with the contract for the arrangement of the on-site works in different aspects related with technical support, safety and logistics. A key step for the Servo Control improvement has been to ensure that the new actuators and sensors can properly replace the old ones, i.e. that the new hardware matches the current physical, electrical and computing interfaces.

An advanced feasibility study for the upgrade of the 30-meter antenna surface was also performed. In particular, a procedure to remove the old layer of paint, based on a high-power laser beam, has been developed and tested at the telescope. Paint thickness measurements were done by the IRAM team, before and after the paint removal. Thermal images were captured during all the intervention to ensure that the laser heating does not affect the panels

This method does not present a risk to the safety of the panels and at the same time does not require disassembly from their frames. The proposal for the application of the new paint also contemplates doing it without dismantling the panels, so in principle the good alignment that currently exists would not be lost. To better understand the characteristics of the paint, several tests have been carried out on aluminum sheets with properties similar to those of the antenna panels. Reflection losses have been measured in the millimeter spectrum and found to be low and adequate for the requirements of radio telescopes.



Thermal IR images taken during the laser cleaning tests carried out at the 30-meter.

It is planned that part of the upgrade works will be initiated before the road is free from snow. Thus, in order to allow the start of the works, two containers were deployed in July 2021 close to the antenna, one with various equipment and another empty to store and retire the replaced hardware.

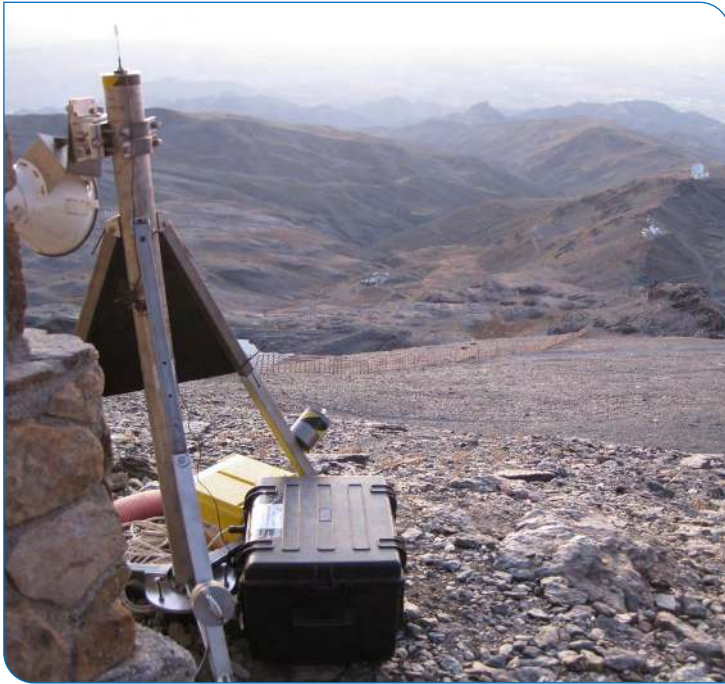


Installation of containers with equipment for the telescope upgrade.

Frontends

EMIR

After many years in operation the complete Sumitomo cryocooler of the EMIR receiver was replaced, including the outer jacket that normally is kept during yearly maintenances. Following the replacement, the cold temperatures are now much lower and back to the nominal values.



Holography

In anticipation of the work to upgrade the surface of the antenna, the holographic measurements, carried out for the last time in 2014, have been repeated. Far-field maps have been made on the Alphasat satellite, which will still be available at least for a couple more years. Measurements have also been made in the near field with the IRAM made portable transmitter installed near the Pico Veleta summit.

The holography transmitter, installed close to the Pico Veleta peak, and pointing towards the 30-meter telescope.

Backends

New versions of the firmware and driver for the broadband continuum detector were installed, allowing sample rates up to 50 kHz (up from 10 kHz) for pulsar observations and analysis of power fluctuations of heterodyne receivers. The reliability has been improved as a side effect: no failure has been recorded after about one year of operation, while the preceding version was failing 5 to 10 times in a similar period.

The local oscillator used for the folding of the upper part of the intermediate frequency band has been replaced by a slightly higher frequency unit (16 GHz instead of 15.68 GHz). The modification allows to reach even lower frequencies. In particular the highly demanded transition of the DCO⁺ molecule can now be reached with the higher resolution of the FTS backend. Also, it is now possible to cover continuously a 32 GHz bandwidth with only two receiver setups.

A new bonding machine has been purchased to replace the ancient model for which spare parts were no more available. Its first task will be to contact diodes for the new batch of continuum detectors. The Granada lab has also been equipped with a modern oscilloscope.

VLBI

During the year 2021, the IRAM 30-meter team has participated in the preparation and execution of the EHT and GMVA campaigns as well as in the supervision and maintenance of all the equipment installed at the telescope.

The EHT campaign was performed in Spring 2021 at 1.3 mm and 0.8 mm and produced good quality fringes in all frequencies with the other telescopes of the collaboration. The GMVA campaign was conducted successfully during the Autumn 2021 at 3 mm.

Different improvements have been implemented in the VLBI systems, in order to enhance and optimize the observation campaigns. As VLBI sessions required on-site intervention, it was impossible to perform the campaigns remotely. In order to deal with that issue, a partial implementation of a remote control has been done through the use of VNC connections both for the observations and the frequency setup. In order to ensure the quality of the observations, the VLBI monitor program and the quality of the metadata files produced has been improved.

Computers & Softwares

During 2021, new equipment has been deployed in Granada and Pico Veleta. The Granada Data Centre has been provided with a new UPS with more capacity to ensure the operation of all the equipment. A new video conference system has been installed both in Granada and Pico Veleta similar to the devices installed in Grenoble. Also, to reinforce the synchronisation of the Pico Veleta systems, a new GPS NTP server has been put in place on the roof of the observatory building.

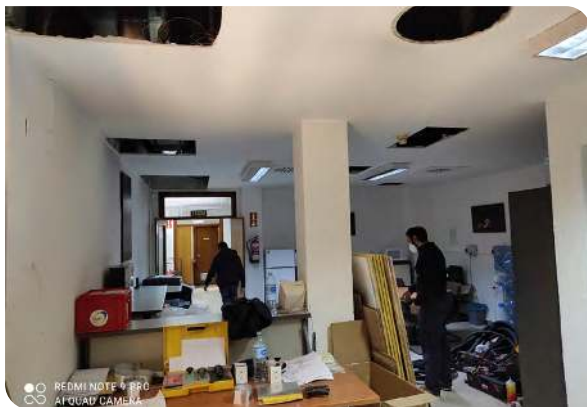
The Computer Group has begun a migration of control configuration services to more modern technologies. Several services are already fully switched over. Existing old, «unmanaged» network switches and hubs were replaced with full-featured equipment, giving the Computer Group better network visibility and stability at the 30-meter observatory. Furthermore, a new TAPAS interface with MMS in Grenoble has been enabled to report observed time of projects and automatic creation of project accounts in our systems.

In order to protect all the systems, its data and user's privacy, several actions were carried out to ensure the computer security against malware and hacking. Users with elevated administrative access migrated their login keys to smartcards in an effort to reduce attack surface of computing infrastructure.

Facilities

Granada

A major upgrade of the Granada offices was implemented in 2021, when the new air conditioning system was put into operation after 8 months of work. Now, this long-awaited replacement of the old equipment allows IRAM to operate a modern, much more ecological system. It is equipped with an air quality probe that regulates its flow according to the occupation of the building.



The Granada offices during the A/C installation work.

Pico Veleta Observatory

As all IRAM staff and visitors know, the quality of the food provided at the 30-meter telescope is a very important aspect of the observatory operation! To make sure these high standards can be kept or further improved, a new freezer chamber has been installed in the kitchen area. It replaces the four small chest freezers that were available, and allows all the frozen food to be stored in one place, which facilitates its control and correct manipulation.

10th IRAM School on Millimetry Astronomy

The IRAM 30-meter Summer School is a mature event organized every two years. The usual venue is the ski resort of Pradollano, close to the observatory site. However, due to the special circumstances derived from the Covid-19 pandemic, the 10th edition was held in on-line format, on 15-19, 22 and 23 November 2021.

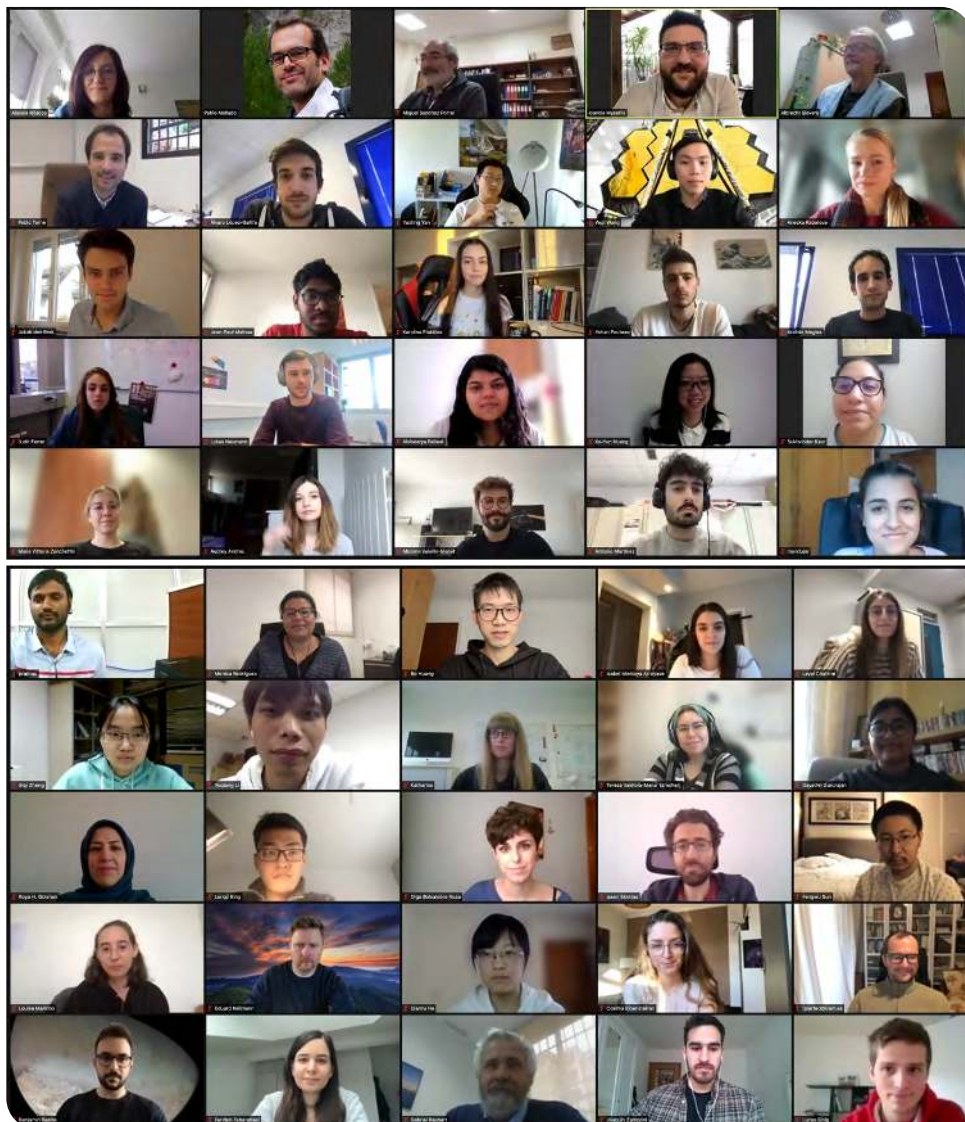
The 30-meter Summer School combined topics on (sub)millimeter astronomy with technical lectures on instrumentation, observing techniques, and data processing and, very importantly, with observations carried out at the 30-meter telescope: the students and trainers formed small groups to develop one science topic, prepared the science case, conducted the observations at the telescope (in remote access mode), reduced and analyzed the data and finally presented the results on the last day of the school.

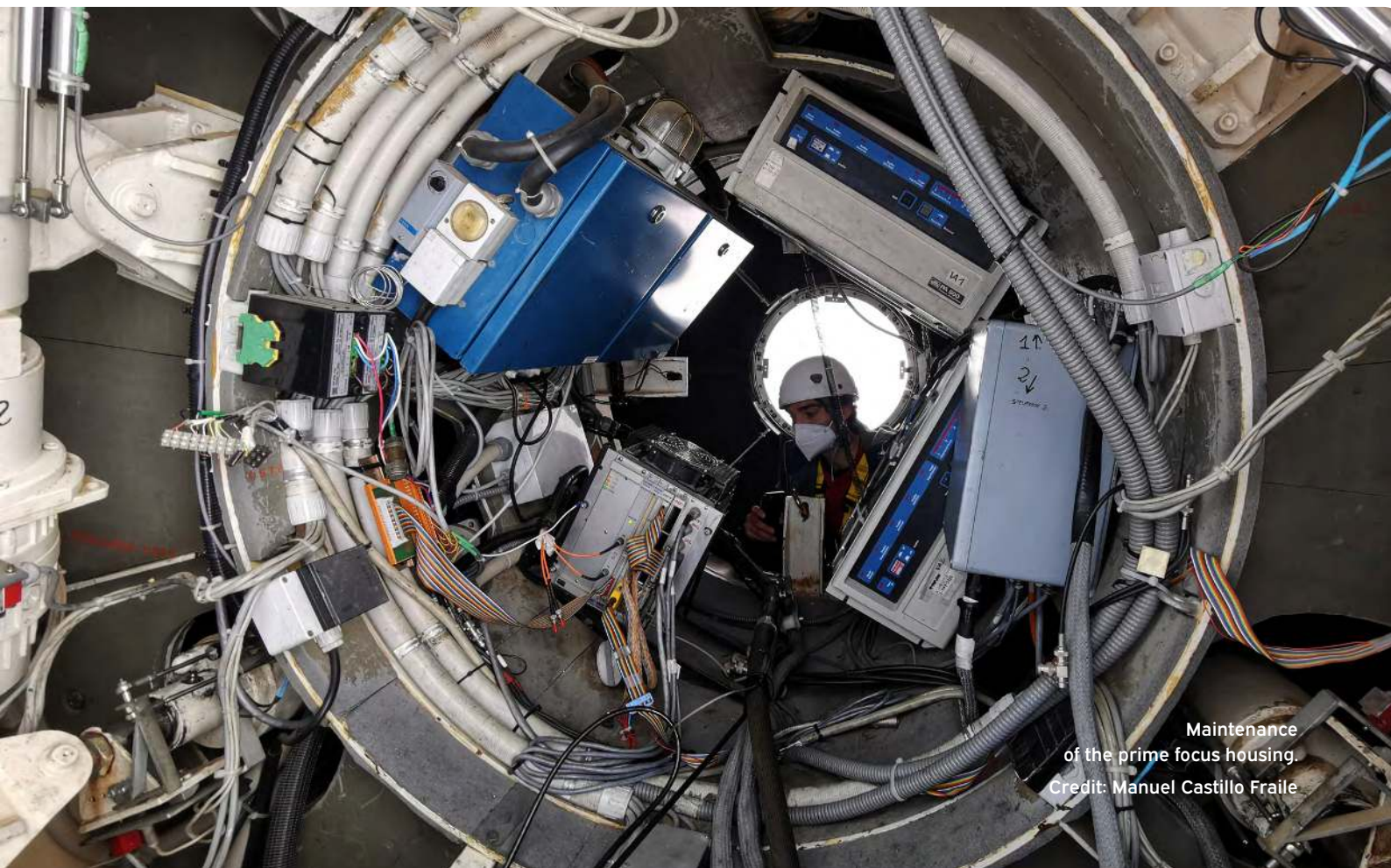
Lectures were given by experienced scientists and 30-meter observers, covering a wide range of scientific and technical topics. As usual, besides general areas of interest for 30-meter users, we added lectures on a specific hot topic: this year was devoted to the NOEMA interferometer, and in particular to the synergies between this facility and the 30-meter.

The school was fully on-line, with lectures and tutorials given on Zoom. In addition, the Discord online platform was used for interchanging information, helpdesk services, issuing announcements and uploading files. Most questions to speakers were also issued through dedicated Discord channels. All the talks were recorded to allow deferred attendance (something useful given the wide range of time zones of the attendees). The event ran very smoothly: no problems were reported in connections and the practical sessions at the telescope were conducted flawlessly by trainers. Data reduction was carried out using the computing facilities at Pico Veleta, without issues.

A satisfaction survey was conducted among the participants and the school obtained very positive feedback (4.13/5 for the lectures and 4.44/5 for the practical sessions). Hopefully, the 11th edition will be able to recover the traditional face-to-face format.

School virtual group picture.





Maintenance
of the prime focus housing.
Credit: Manuel Castillo Fraile

NOEMA



Credit: Jérémie Boissier

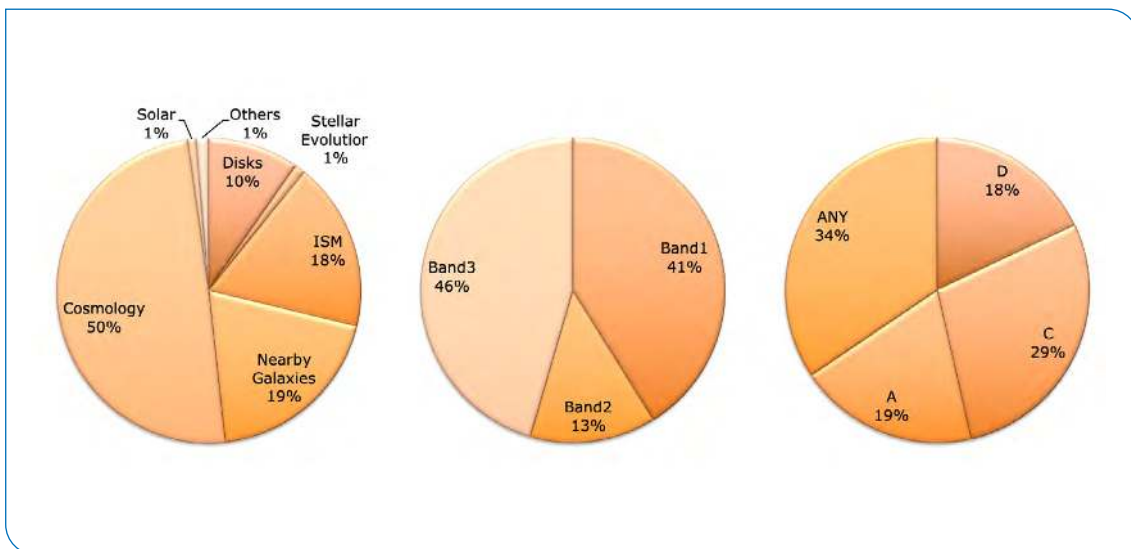
The NOEMA observatory has seen several remarkable accomplishments in 2021: the deployment of the correlator's phasing-up capabilities for very-long-baseline interferometry (VLBI) followed by the first participation of the phased array in the Event Horizon Telescope (EHT) and Global mm-VLBI array (GMVA) campaigns, the completion of the western track extension and the commissioning of a new station (W47) at the outer end of this track, the commissioning of the last NOEMA antenna (12) and the readiness of the observatory to perform first astronomical observations with full NOEMA. Work on these projects was successful despite the difficulties associated with the Covid-19 pandemic.

The NOEMA observatory continued its efficient operation, characterized by the high availability of antennas and instruments and low technical downtime. The antennas, receivers and the correlator all performed well throughout the year. To take advantage of the best weather periods and the most extended configuration (A) of NOEMA, technical activities were kept to a strict minimum during the winter period. All scientific observations were performed in service observation mode only.

Scientific operations

Weather conditions at the NOEMA observatory were slightly below-average until June, but showed a marked improvement in the second half of the year compared to previous years. To fully exploit the winter conditions at the beginning of the year, the interferometer reached its most extended configuration (A) with all eleven antennas at the beginning of February. The array was moved to the middle configuration (C) in late March, to the most compact configuration (D) in early April, and back to the C configuration in mid-October when the atmospheric phase stability had settled considerably. As in 2020, the observatory did not see any operational interruption this year due to the Covid-19 pandemic. Despite the difficult working conditions, the observatory was able to deliver the last NOEMA antenna toward the end of the year, retrofit two more first-generation antennas, equip two more antennas with dual band receivers, perform the annual preventive maintenance on the antennas, work on commissioning new instrumentation, and maintain full scientific productivity of the interferometer throughout the year. By the end of the year, NOEMA was able to perform astronomical observations with all 12 antennas.

The program committee met twice during the year, around four weeks after the deadlines for the submission of proposals. Including projects carried forward from 2020, science goals from 128 proposals were scheduled in 2021, including science from two Large Programs and four Max-Planck-IRAM Observatory Programs (MIOP). This corresponds to 275 individual sub-projects that received time on the interferometer. All proposals were submitted and evaluated through PMS, the web-based Proposal Management System. The proposals to which time was granted in the course of the year are listed at the end of the annual report.



Requested observing time by science category, receiver band and array configuration.

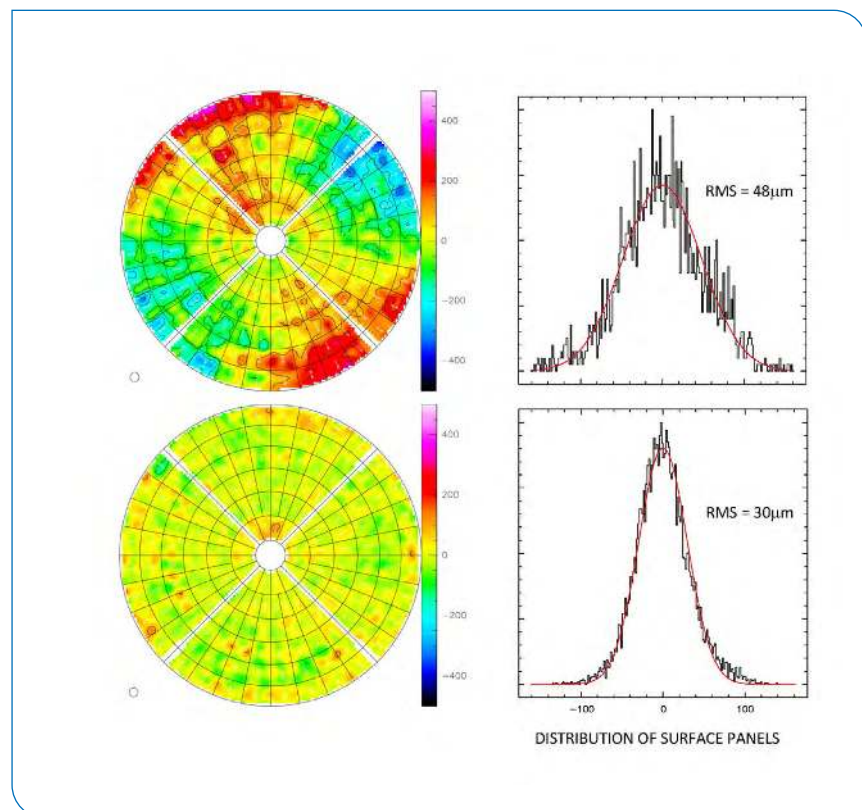
NOEMA continued to provide unique and exciting scientific results and to demonstrate its effectiveness at exploring the interstellar medium in galaxies in the high-redshift Universe. As in previous years, the observing time requested to carry out galactic research was less than the time requested for extragalactic science (69%). This testifies to the enduring and widespread interest of the extragalactic community, which has been persistently growing over the past few years. The largest amount of observing time was invested in the compact and intermediate configurations of the interferometer between spring and autumn.

The percentage of observing time invested in 2021 on science programs was on average 44% of the total time, or equivalently, 161 days. An additional 23% were invested on technical operations and developments: receiver tunings for user projects (11%); software work, commissioning, technical verifications and installation of new equipment (10%); and array reconfigurations (2%). The remaining 33% was lost due to weather constraints.

Antenna 12 commissioning

The integration of Antenna 12 into the array was the most significant event and among the most exciting activities of the commissioning and science operations (NCSO) team in the year. The start of the NCSO phase of Antenna 12 began on December 14, 2021, with the delivery of the antenna to the commissioning team. The goal of the NCSO was to take the antenna from the stage reached at the end of construction to an instrument that meets scientific requirements. This stage, which is aimed at finding those characteristics that are not within the specifications, provides first quantitative information on the antenna performance in terms of sensitivity, image quality and accuracy. To achieve this objective, the NCSO team worked in close collaboration with the computing, engineering and construction teams, and used specific test procedures already applied to the preceding antennas. The commissioning activities included: antenna safety checks; pointing, focus and tracking accuracy verifications; improvements of the surface accuracy using phase-coherent holography; and the assessment of a number of key performance indicators such as the antenna interferometric efficiency. First results from the NCSO of Antenna 12 helped to improve operational reliability and to identify areas where work had to be done. Ultimately, after first fringes on December 16 and a successful commissioning campaign, which demonstrated NOEMA's once again increased performance, Antenna 12 joined the array and began routine scientific operations.

Surface panel distributions of Antenna 12 relative to the ideal paraboloidal surface (left) and associated surface RMS (right). On the top, holographic results of the antenna surface after delivery to astronomical commissioning; on the bottom, improved antenna surface after two iterations of panel adjustments.



Other commissioning activities

One of the main projects currently being carried out at the NOEMA observatory is the east-west baseline extension of the interferometer. The goal is to extend the baseline from 760 m to about 1664 m to provide NOEMA with high-contrast imaging capabilities down to 0.1" spatial resolution at 345 GHz. The project foresees a 744 m extension of the eastern track with 4 new stations (E161, E148, E122, E59) and a 160 m extension of the western track with the construction of a single station (W47) at the end of the track. While construction work

on the eastern track extension is scheduled for completion in 2022, the western track was completed in the fall of 2021 and became available for astronomical observations.

To this end, two further important advances were made this year. One of them concerns the testing of an integrated safety braking system on Antenna 8. Such a system is necessary to prevent the antennas from traveling unsecured over a ground slope of 1.5% to the outermost stations of the extended tracks. A second notable advance was the testing of a prototype system for the transmission of the LO references to the outermost stations using optical fibers. Recent observations at station W47 have shown that the system meets the functional and system requirements. In the future, all stations will be operated exclusively via optical fibers.

In order to achieve a sustainable balance between scientific production, commissioning activities and antenna maintenance, considerable efforts were made, as in previous years, to establish effective coordination between the activities of the science operations group and the technical departments, in particular the antennas maintenance.

The maintenance program also included work in connection with the retrofitting program of the first-generation antennas. Major milestones completed this fall included the completion of the electrical refurbishment of Antenna 4 and the replacement of the subreflector positioning system with a hexapod on Antennas 4 and 6. At the end of September, both antennas were declared technically ready for science operations and made available for routine astronomical observations. Work on the retrofitting of the remaining first-generation antennas (2, 3, 5) will continue in 2022.

As part of the maintenance program, the surface quality of all antennas was checked by holographic measurements – the positioners of the surface panels were readjusted during the maintenance period and iteratively improved when necessary. By the end of the year, the primary surfaces of all antennas were set to an average accuracy of $37\mu\text{m}$ RMS.

The first two 14-channel units of the new 22 GHz radiometers were installed on Antennas 9 and 10. Together with the prototype on Antenna 8, NOEMA operated routinely all three radiometers at the end of the year. All three showed excellent performance despite being operated in compatibility mode with the previous generation of radiometers. Work on the software to use the full capacity of the new radiometers is advancing and is expected to be implemented in 2022.

In the framework of the Dual Band Receiver (DBR) project, two more antennas (10, 12) were equipped with DBRs towards the end of the year. The in-depth commissioning of these receivers will take place next year.

User support

The NOEMA Science Operations Group (SOG) provides technical support and expertise on NOEMA to researchers and visiting astronomers who have questions about the instruments, observing procedures, data reduction and calibration, pipeline data processing, and archiving of NOEMA data.

In normal times, IRAM headquarters hosts a regular stream of visiting astronomers from around the world who stay at the institute for periods ranging from a few days to a few months. Unfortunately, due to the Covid 19 pandemic, no visiting astronomer could be accommodated in 2021, and community support had to be provided solely via video communication. In-person support will resume in 2022, once sanitary precautions are lifted.

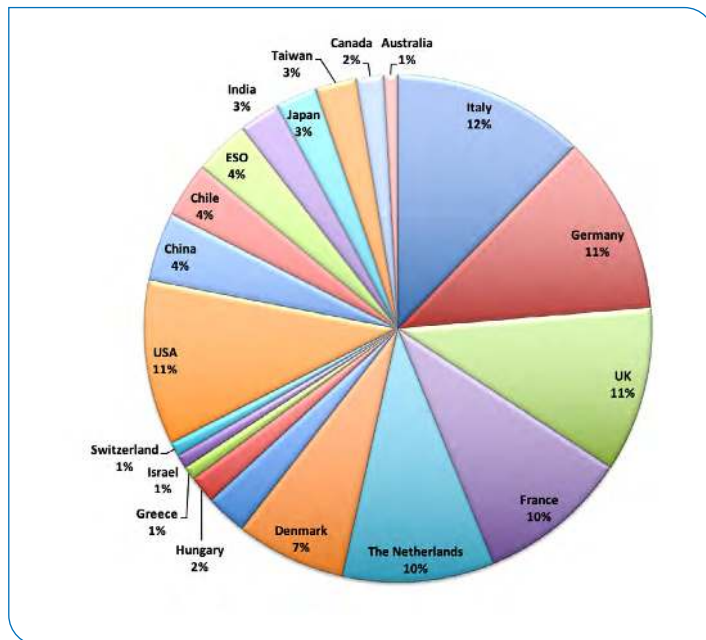
Advice and support for the calibration and analysis of 65 NOEMA projects was provided by remote screen sharing to 66 astronomers from Europe and overseas on a total of 335 days. Compared to the years prior to the Covid-19 measures, the overall level of remote user support has increased drastically. IRAM astronomers have also led or collaborated on 41 projects in which they were directly involved.

Work is underway to enable the principal investigators to quickly view the scientific outcomes obtained by the automatic data calibration and reduction pipeline following each observed track. The results will then be accessible via a website in the form of reports, calibrated data cubes, and visibility data.

Data archives

The data headers of observations carried out with the NOEMA and the former Plateau de Bure interferometer are conjointly archived at the Centre de Données astronomiques de Strasbourg (CDS), and are available for viewing via the CDS search tools. The archive is updated at the CDS every 6 months (May and October) and with a delay of 12 months from the end of a scheduling semester in which a project was observed in order to keep some of the information confidential until that time.

Access to the raw data of scientific projects is possible upon request at any time after the expiration of the proprietary period. While for Large Programs this period is set to end 18 months after the end of the last scheduling semester in which the program was observed, the proprietary period of science data from standard NOEMA observing programs is set to terminate 36 months after the end of the last scheduling semester. For Large Programs the science data archive additionally provides open access to calibrated images, data cubes, and visibility data.



RadioNet PI User Distribution 2021.

Opticon-RadioNet Pilot

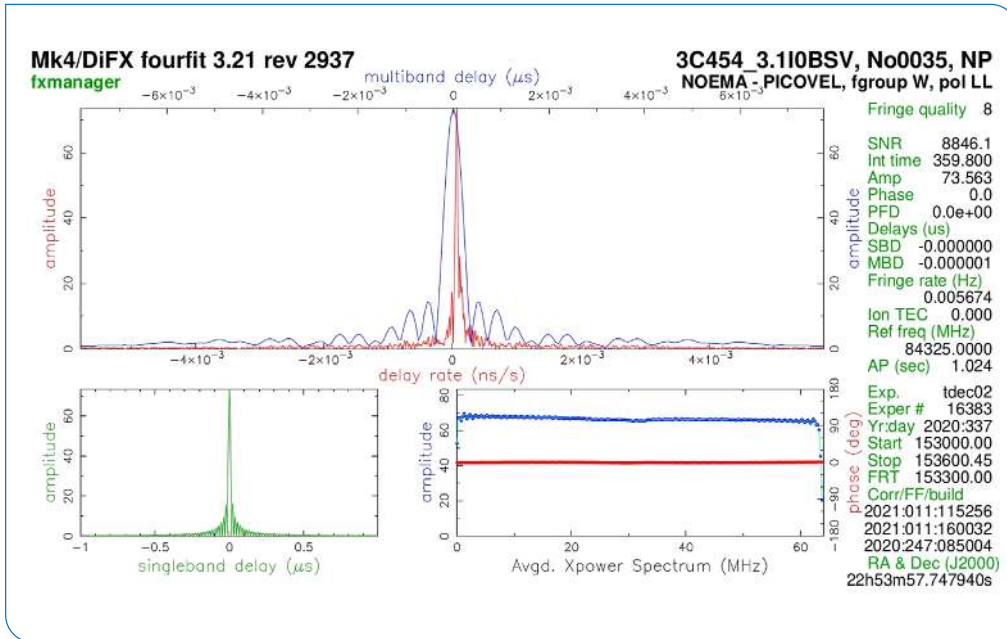
The successful pan-European RadioNet initiative, which expired in December 2020, has been replaced by the Opticon-RadioNet Pilot (ORP). This program, which remains part of the EU Horizon2020 research framework program, started on March 1, 2021. Since then, NOEMA has received 87 eligible proposals from researchers affiliated with scientific institutions from 11 European countries and associated. The IRAM Program Committee recommended 55 of these proposals.

Due to the ongoing Covid-19 pandemic, travel to the Grenoble headquarters was not possible, and all supported projects were calibrated by the principal investigators using their IRAM local contact scientist in remote data reduction sessions.

VLBI

The NOEMA phased array mode was tested in December 2020 and operated successfully in the Event Horizon Telescope (EHT) and Global Millimeter VLBI Array (GMVA) sessions of 2021. The technical challenges of this new observing mode were huge, and represent an increase in complexity, computing power and performance by several orders of magnitude compared to what was previously possible. NOEMA now phases all its antennas, with the exception of one antenna that is kept outside the phasing as a reference antenna for calibration purposes. Although recording is currently limited to 64 Gbits/sec, the full bandwidth of the PolyFiX correlator can be phased. Another improvement was provided by the implementation of INCA, the active beamformer software, which allows dynamic rephasing of the array on a time scale of a few seconds, increasing the coherence of the summation of all antenna signals.

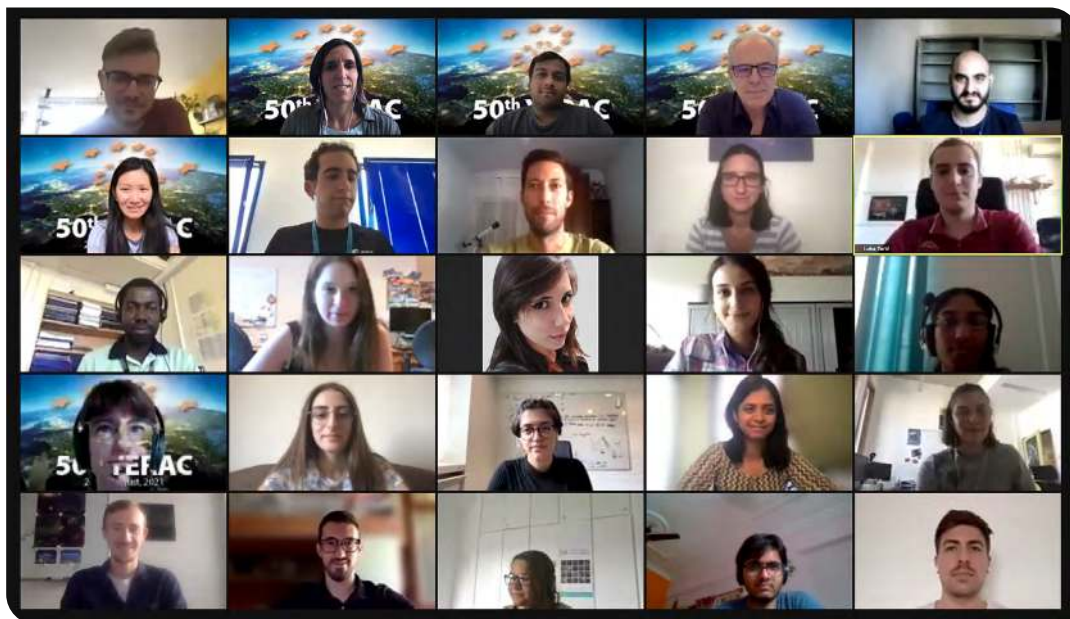
In joining the global VLBI campaigns, NOEMA provided a new boost of sensitivity on all connected baselines. Both the IRAM 30-meter and NOEMA observatories participated successfully in the April EHT and GMVA campaigns. It was the first participation of the phased NOEMA to the EHT and NOEMA successfully observed 83% of the 1.3 mm scans, and 100% of the scheduled 0.8 mm test observations.



First 3 mm fringes between phased NOEMA and Pico Veleta.

YERAC

IRAM hosted the 50th Young European Radio Astronomers Conference (YERAC) from August 24 to 27, 2021. Because of the pandemic, the conference, which was originally scheduled to take place in 2020, was held virtually. The YERAC is a unique opportunity for graduate and doctoral students, as well as young postdoctoral researchers to meet together, present their work, discuss research done by others, and learn from each other's experience. The school was limited to a total of 52 researchers from Europe (39) and overseas (13) with a very even gender balance (24:28). The presentations of the participants are available on the IRAM website.



Group of participants at the 50th Young European Radio Astronomers Conference.

Covid-19 management at the observatory

Following the success of the protocols put in place in 2020 to fight against Covid-19 while maintaining the observatory's activities at an acceptable level, construction works essential for NOEMA have been relaunched while guaranteeing a high level of health security.

To host the personnel necessary for these works, fourteen additional single rooms have been put in place, a second refectory and a relaxation area, dedicated to the personnel of the building site have been added and a cleaning team for the disinfection of all common parts of the site has been engaged. These actions allowed to decouple at most the various activities of the site.

In addition, a permanent monitoring of Covid suspected cases and the possibility to perform antigenic tests on site, carried out by the nurse of the observatory, allowed the realization of all our activities without any cluster to be deployed.



Top: Additional living quarters for personnel of the building site et relaxation area.



Bottom: Dedicated refectory and relaxation area for construction workers

Maintenance, construction and retrofit of antennas

For the ninth and last year in a row, maintenance had to be carried out in conjunction with the construction of a new antenna (A12).

As in 2020, the antenna construction work had a very strong impact on the maintenance schedule, leaving only one place in the assembly hall, and monopolizing part of the site's staff. However, contrary to previous years, the decision was taken to move one by one the eleven already existing antennas into the hall, in order to guarantee maintenance of high quality for all telescopes.

During this period, and in parallel to the usual operations, the retrofits of the telescopes continued with the end of the upgrade of the Azimuth and Elevation movement systems on Antenna 4 and 5, the installation of the hexapods on Antenna 4 and 6, and the installation of an emergency brake prototype on the translation of Antenna 8. Indeed, 4 of the 5 new stations being built in the track extension project are not located at the same altitude as the rest of the interferometer. As a consequence, a part of the new tracks is inclined with a up to 1.5% slope, requiring the installation of a safety device allowing to stop the movements of the telescope in case of serious failure of the translation system. All these actions have significantly prolonged the maintenance period of the interferometer which covered eight full months from May to December 2021, also due to bad weather.

Antenna 12 left the assembly hall on 14/12 and was directly taken in charge by the commissioning group for the first tests and the fine tuning of its dish. The hall was then left empty, which had not occurred for a decade!

Site Development and Maintenance

Most of the efforts were dedicated to the extension of the East-West track. Following the abandonment of the project by the company that was to carry out the track extension work, a new call for tenders was urgently issued in order to remedy this failure as soon as possible.

Intense negotiations with companies specializing in mountain work made it possible to identify a group of companies capable of resuming the work as early as the end of the spring, while implementing the highly restrictive protocols related to the Covid-19 pandemic.

As for the previous construction work carried out on the site, specific tools and procedures have to be used to transport the materials necessary for the construction of the extended tracks and new antenna stations. The difficult access of the plateau at 2500 meters altitude makes it necessary to disassemble the big machines, to transport them in pieces of max. 6 tons with the material ropeway to the observatory and to reassemble them on site.



Left: Aggregate bucket adapted to the material ropeway.

Top: Construction equipment being assembled

The work resumed at the end of May 2021 and lasted until the fall when it stopped due to climatic degradation. This allowed the initial schedule to be followed, delivering the entire West track with 160 meters of track, including station W47. Additionally, the civil engineering of station E59 was completed while maintaining access to station E68 and the East track with stations E122 and E148 has been partially completed.

The installation of instrumentation channels from W47 to E59 has been done and is covering approximately 850 meters. Despite the suspension of the work site due to the arrival of winter, supplies have continued to be provided to ensure that the various elements necessary for the resumption of the work site as soon as possible in 2022 are on site (concrete slabs, aggregates, water, etc.).

Work will continue during the summer period with delivery of all the track extensions, including the fibre optic cable necessary for the signal transport scheduled for the end of October 2022 at the latest.



Situation of the track construction site on 21/10/2021.

Maintenance of the site

The year 2021 was marked by the refurbishment of part of the 20 kV power line that supplies the observatory. Heavily degraded by erosion of the ground, the old line was removed and replaced by a new and better protected line, taking another, less exposed path. The cables being located in a particularly steep area, a company specialized in acrobatic works, as well as a “spider shovel” were necessary for the realization of these works which lasted several months.

Thanks to a very careful preparation of these repair works, the exchange of the cables has been possible without disrupting the power supply of the observatory.

It should be noted that the intense construction activity during the last years, combined with the pandemic, did not allow the realization of a basic maintenance of the observatory buildings. Reduced to a minimum by the circumstances, an important effort is to be foreseen in the future years to realize the maintenance of our aging buildings, which are almost 40 years old for some of them.



Realization of the works on the 20kV line.



Credit: Patrick Grillet

Grenoble headquarters



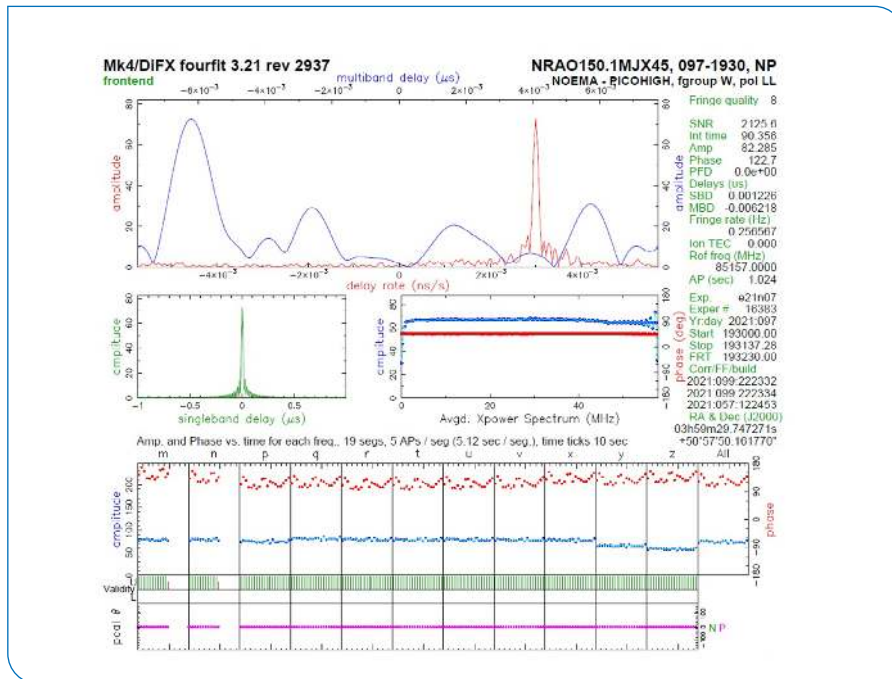
Credit: Sonja Moreau

BACKEND GROUP

VLBI at NOEMA

After the fabrication and successful test of a new batch of VDIF formatter cards, the NOEMA PolyFiX correlator became able to support 4GHz 2SB Dual Polarization at a rate of 64Gb/s, as required for the EHT VLBI observations.

Some firmware corrections and enhancement were also introduced to smooth the backend operation during the VLBI sessions. This work has resulted in a successful participation to the EHT and GMVA 2021 sessions during which high quality fringes were detected in both configurations.



3 mm VLBI fringes between the phased NOEMA and the 30-meter telescope.

Antenna Reference Transport over fiber

The LOREFoF (LO Reference over Fiber) project aims at replacing the coax cables by optical fiber to transport the LO reference signal from the central source to the antennas.

Following the characterization step of last year, the first versions of proto units were installed and functionally tested early 2021 in the NOEMA central building and the receiver cabin. These tests were then completed by mid-2021 on an already existing antenna station, temporarily modified to support additional optical fibers dedicated to the antenna reference transport. The On-Sky observations showed acceptable performances compared to the current reference transport over coax cables.



The optical roundtrip system is designed with the Laser transmitter and optical receiver located in the upper left corner.

After this validation of the hardware implementation, a second version of the LOREFoF racks was developed and fabricated with the goal of testing the very first new antenna station delivered by end October (W47 at the end of the extended West track). With a yet longer optical fiber section running into the gutter alongside the antenna track, the phase reference was exhibiting larger phase drifts as expected but the current phase correction system was still able to compensate for them.

LO Control System clean-up

In view of the arrival of the LOREFoF subsystem, the LO Control System of the central building has been migrated into new cabinets to be able to accommodate the 2 x 12 new LOREFoF base racks that will support the antenna reference transport over fiber.

Pending the reference optical transport to be completely deployed, the LO Control System has still to support the current reference transport over HiQ cables as well. This results in numerous interweaved cables toward a coax patch panel. For the telescope operators in charge of setting up the changes of the antenna array configuration, access to this patch panel has been reorganized and simplified.

Migration of the LO Control system into closed cabinets with empty space ready to accommodate the future optical reference racks.



Digital correlator



The PolyFiX correlator fully populated for operation with 12 antennas.

With the arrival of the NOEMA 12th antenna by the end of 2021, the last digitizer cards have been installed in the PolyFiX correlator. Together with the installation of all VLBI formatter boards, the PolyFiX correlator hardware system is now fully populated and is operating at its maximum capacity.

After the standard resolution and the VLBI modes, the development of a new set of PolyFiX firmwares started by mid-2021 in view of offering a new processing mode to the users. It will provide a 250 kHz channel spacing over the full 32 GHz bandwidth of the NOEMA receivers. By the end of 2021, laboratory tests were successful thus allowing an implementation early 2022 for commissioning at NOEMA. This 3rd mode will be available to serve more specific observational needs by Mid-2022.

Work for the PolyFiX-2 correlator system to prepare for operation with the Dual-Band Receivers has also been pursued all along 2021.

Laboratory tests and system integration tests of the digital correlator boards have been

completed. The production of the Readout boards has also been done in sufficient quantity to cover operation needs throughout the machine lifetime. Lab and system tests of this new batch of boards will take place early next year.

Regarding the PolyFIX-2 IF processor, procurement of the critical parts is on-going. Although the wideband optical links are suffering delivering delays, near half of the planned acceptance tests have been performed so that these critical devices can be integrated safely in the final assembly. Furthermore, RF components for the 4-12 GHz spectrum slicers have been sampled and re-evaluated. This will make sure that nearly 10 years after their initial production release, they are still offering the required availability and performances before buying them in large quantity.

NOEMA Operation Technical Support

In addition to its development activities, the Backend group is providing technical support to the NOEMA observatory to maintain the Backend equipment or to smooth its operation.

In 2021, the periodic maintenance of the NOEMA Maser had to be performed. The hydrogen tank was refilled and additional 10 MHz outputs were added in view of introducing new master synthesizers which will provide their best phase noise performance once phase-locked to a 10 MHz external reference.

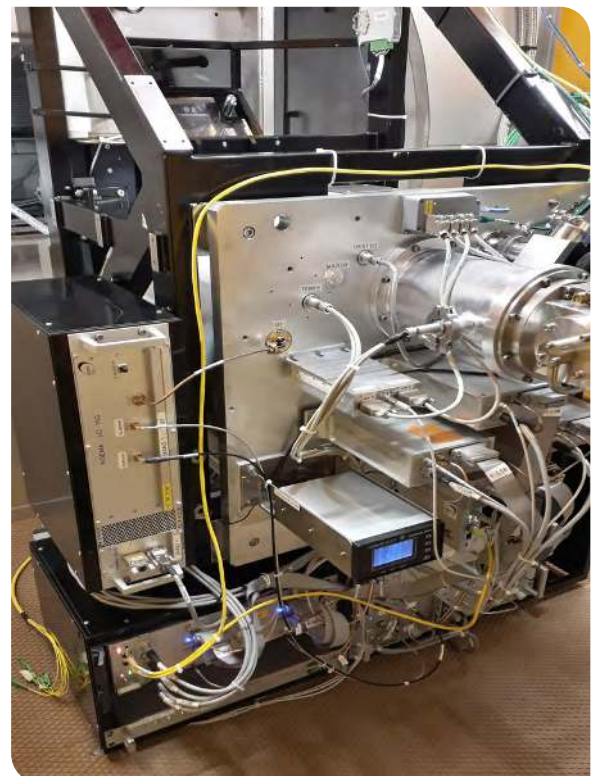
Also, the Time & Frequency reference system has suffered some unexpected failures that required a frequency distribution unit to be repaired. This provided the opportunity to install additional spare equipment and to further think on introducing some fastswitching capability that would allow continuous Backend operation with almost no interruption of the observations in the future.

FRONTEND GROUP

NOEMA receivers

The year 2021 marked a major milestone for the Frontend group with the completion of the two last NOEMA receivers. One of them was used to equip the 12th and last NOEMA antenna in October 2021 while the other is the 13th receiver, allowing therefore to have a spare receiver.

After a year of minimal maintenance in 2020 due to Covid-19 limitations, in 2021 normal maintenance could be performed. In particular, a 5-day maintenance campaign in July 2021 was experimented, where two teams of people accessed all antennas to perform preventive maintenance, repairs and upgrades as required.



Installation of the receiver on the 12th NOEMA antenna in October 2021.

Dual-Band NOEMA receivers



View of a dual-band receiver as installed on Antenna 10 in December 2021.

The dual-band project for NOEMA advanced well in 2021. This project will allow observing, when desired, the 3 mm and 1.3 mm bands simultaneously. The first prototype system was installed in 2019 on Antenna 9 and in 2021, two more antennas were equipped with this system, Antennas 10 and 12. The new systems incorporate some modifications compared to the first prototype, which should allow improving the receiver calibration, when used in dual-band mode.

Upgrading the existing receivers into dual-band mode involves a minimal list of changes to be carried on, mainly changing the warm optics. The main constraint is that it requires a new support structure, the so called "chassis A" (a black metallic frame that supports the receiver). All dual-band support structures were ordered in 2021 and will be delivered early 2022. Pending final validations, the goal is to transform all receivers into dual-frequency capable systems by end of 2023. To make full use of the instrument IF bandwidths, this will need a full second correlator, doubling the number of warm IF chains and laser-based transport of the IF signal via optical fibers.

NOEMA electronic local oscillators (YIG)

Currently the least reliable NOEMA receiver system part is the Gunn-based local oscillator which utilizes motorized parts. The failure rate is on average one failure per month. The new all-electronic oscillators, based on YIG oscillators, are much more reliable (about one failure per year), and therefore the main priority and goal for the electronic upgrades is to change all Gunn-based oscillators into YIG oscillators. As of end of 2021, eight Band 1 YIG LO chains and one Band 2/3 YIG oscillators (for 12 antennas) are available. In 2022, all Band 1 oscillators will be using YIGs and by end of 2023, all Bands 2/3 should be equipped with YIGs.



Production of local oscillator electronic boxes (LO YIG) for Band 1 and Bands 2/3.

NOEMA new generation water vapor radiometers

In 2021, the production of seven new generation radiometers was launched, upon the successful validation of a prototype installed on Antenna 8 since 2019, which underwent several improvements.

The first two radiometers were assembled, tested and installed on Antennas 9 and 10 in December 2021. Five additional WVR-2G will be finalized by mid-2022, allowing therefore to equip all NOEMA antennas with radiometers.



Installation of a new generation radiometer on Antenna 9 in December 2021.

Phase monitoring project

This project which started in 2018 in close collaboration with the SMA group from the Center for Astrophysics (Harvard, USA), aims at providing a real-time, permanent monitoring system of the observing conditions for the NOEMA interferometer. In 2021, the study of the 3-station system infrastructure progressed well. In particular, the location at the NOEMA site for the three antennas was identified and mechanical designs for their support structures were proposed and are undergoing evaluations by an external company, in particular for their resistance to the wind conditions at NOEMA. The electronic and software redesign also started to provide a more maintainable and upgradable system in 2021.

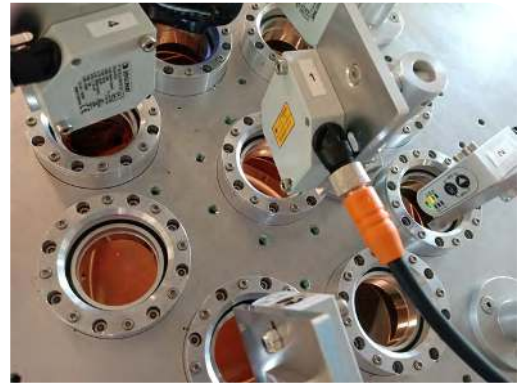
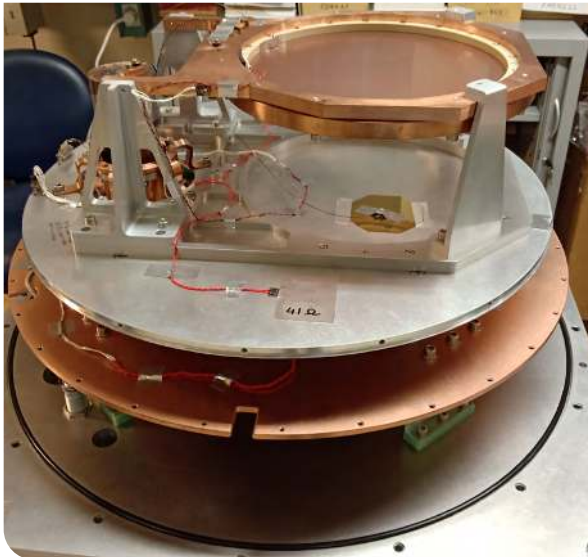
AETHRA Radionet - Multibeam

Even though the European project Radionet-AETHRA was finalized in 2020, IRAM is continuing the development of the prototype multibeams developed for AETHRA, to serve as test beds for the 30-meter larger multibeams.

One of the multibeam prototypes developed for AETHRA was a 3x3 direct amplifier (LNAs) in the 70-116 GHz frequency range, developed in close collaboration with the MPIfR in Bonn, the Fraunhofer Institute in Freiburg (IAF) and INAF. In 2021, the cryostat was equipped and tested with 3 pixels out of the 9 and all warm optics and the calibration system was fabricated. Tests of this receiver are planned at the IRAM 30-meter telescope in 2022.

CMD test cryostat

A new test receiver for cold mirror deformation (CMD) studies is in use since end of 2020. It was used in 2021 to measure the NIKA-2 dichroic thermal deformations while cooling. The system uses a laser array and measures the reflected signals' positions during cooling to estimate deformations.



Left: Inner part of the CMD test cryostat. The NIKA-2 large dichroic can be seen on top, connected to the 15K stage of the cryostat.

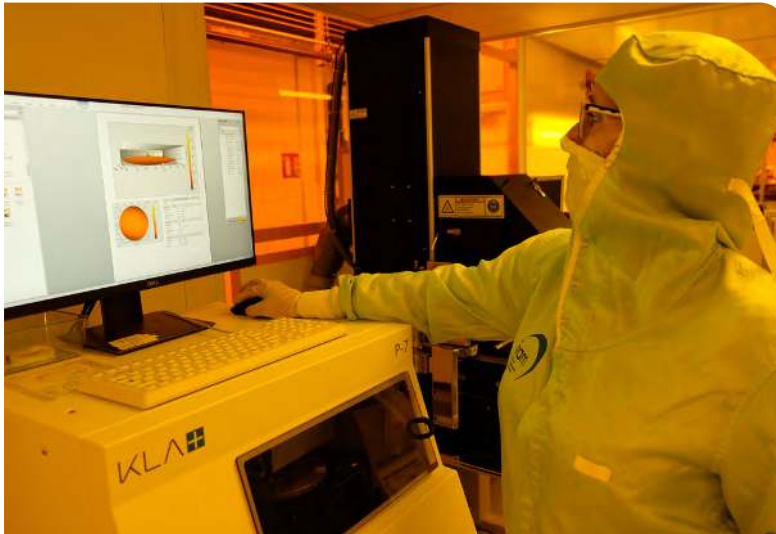
Right: View of the front plate with the 9 optical windows and some of the laser measurement systems.

SUPERCONDUCTING DEVICES GROUP

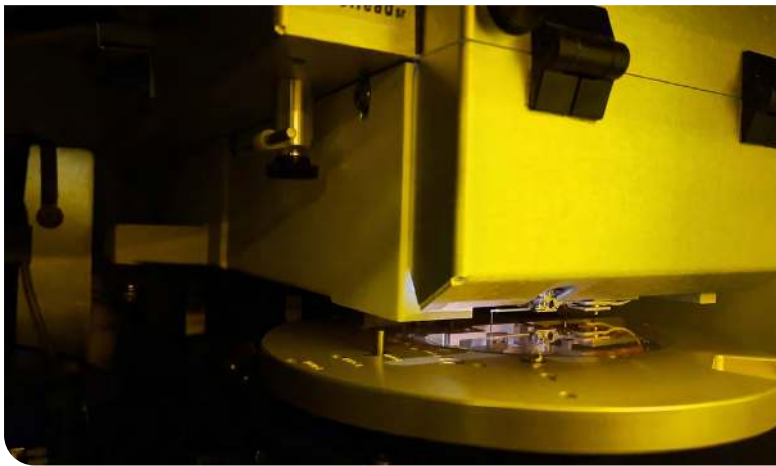
As in the last few years, the superconducting devices group has focused most of its work to development of new technologies for upcoming instruments. At the same time, we have continued to work on upgrading the machine park, to be ready for future demanding projects such as the multibeam receivers for the 30-meter telescope. In our investment plan of the last years, we have chosen to invest in tools that allow for large scale quality control by automated procedures. This will allow us to increase device yield in order to satisfy the future demand for both SIS and KID devices that are as uniform as possible.

Machine park upgrades

The beginning of 2021 marked the arrival of a new surface profiler. This tool utilizes a very sharp stylus to scan the surface of samples, and is able to measure thickness variations in the 10 nm range. It is used to measure film thicknesses and film stress, and thus is an essential part of device quality control. The new equipment has the possibility of automated measurements, which facilitates a more detailed view of on-wafer variations of film thickness, allowing a better control of process parameters and therewith a more reliable production of large device series.



The new stylus profiler measuring thin film stress on a 4-inch wafer.



Dichroic filters

In September 2021, the decision was taken to equip the future dual-band receiver modules for NOEMA with in-house developed dichroic filters. These filters have already comparable or better performances than the commercially available filters, and we have investigated different technological approaches to improve their performances even more. For this reason, we have started the development of a copper plating process, which replaces the current gold plating. Copper has a two times better electrical conductivity, which should improve the filter characteristics. As a side advantage, the new process promises to improve both filter cost and fabrication time, two important factors in series production. Comparative tests with gold-plated filters will be performed early 2022, and series production is foreseen straight after.

KID development

A detailed study of device variation on a 4000-pixel kinetic inductance detector array was finished this year. The variations in the lateral dimensions of the inductor lines, of the order of 10-20% for lines of 2.5 μm width, were shown to be the main cause for frequency scatter (yielding cross-talk) and variation in pixel sensitivity. The frequency scatter can be repaired on a telescope class array of 100 mm diameter, at the only expense of an extra lithography step. An investigation of the underlying cause of this width variation has been started, in order to improve the fabrication process. In these investigations, the 2019 investment in an e-beam lithography system capable of handling 100 mm diameter wafers is of paramount importance, since it allows for both a detailed automated quality control measuring critical dimensions of thousands of pixels, as well as for process improvement using e-beam lithography.

MECHANICAL GROUP

Mechanical workshop

The IRAM workshop has dealt with a total of 116 requests for mechanical components, 101 of which were handled internally, and 15 were subcontracted to outside companies.

As every year, the major activity was the production of a large number of microwave components, mixers, couplers, horns for various projects, including NOEMA, the Dual Band Receiver, the new radiometers and many prototypes and items related to receiver developments.

Several items
for the Dual Band Receiver
project (mirrors, assembling parts).



Antenna 12 delivery

Construction of Antenna 12 has started beginning of year 2020. End of 2021, the construction was successfully completed and the antenna was delivered to the commissioning team mid of December. This was a major milestone in the NOEMA project, after almost a decade of antenna construction and the successful delivery of 6 antennas.

Antenna 12 – Décembre 2021.



Safety braking device of antenna

In the framework of the antenna track extension project, the profile of the East/West tracks is no longer horizontal but with a slope of about 1.5%. As a consequence, in case of failure of the antenna translation motors (which also ensure the braking of the antennas), it is mandatory to add an emergency braking system to ensure the safety of the personnel and of the antennas.

In November, after more than 3 years of studies, calculations and tests on a test bench, the technical team installed the new emergency brake system called “backstop” on Antenna 8. With the track extension on the West side (up to station W47) completed, we were able to run a series of functional tests on the flat track as well as on the slope, in order to validate the new emergency brake system. We concluded that:

- When all four drive motors are functional, the antenna goes up the slope without any problem and the stopping of the antenna is ensured, even in the slope.
- If two of the four motors are no longer functional, the antenna can no longer climb the slope by itself.
- One functional motor is not sufficient to prevent the antenna from slipping along the slope.
- The antenna in freewheel mode and released at zero speed on the slope reaches after less than 1 meter its normal fast forward speed (1 km/h); after about 4 m of freewheel, the antenna reaches more than five times its normal fast speed.
- The backstop brakes work extremely well: the antenna can be stopped at any speed (tested at speeds up to 5 times the normal fast speed).
- The disk backstop system slows the antenna progressively and thus avoids the risk of damage to the antenna components.

These results validate the new emergency brake system and the next step of the project is thus the installation of this system on at least 4 new antennas before the final delivery of the antenna track extensions.



Left: Integration of the new braking device on Antenna 8.

Top: Freewheel braking test.

COMPUTER GROUP

NOEMA developments

Control room upgrade. The operating systems of the NOEMA main computers have been upgraded to CentOS7. The control room workstations have been also replaced by small form factor mini computers that can drive up to 6 monitors. These devices run with almost no noise and can be installed behind the monitors to save space on the desk and improve ergonomics. To simplify the network wiring, the operator computers are now directly connected to the main interferometer Ethernet switch thanks to new RJ45-to-SFP+ modules.

Data Logger Service. Data Logger Service (DLS) from the EtherLab project has been deployed, in order to record thousands of monitoring signals from NOEMA into a database. IRAM staff can then query or plot values of any of these signals as a function of time to diagnose operational issues. With more than 13,000 signals recorded every second and kept for one year, IRAM is actually operating the world-largest DLS database, and obviously some technical bottlenecks to support such an amount of data had to be overcome. In particular a Supermicro all-flash-array running TrueNAS had to be purchased to provide enough input/output operations per second (IOPS).

Absolute position sensors. A study has been initiated to check if absolute position sensors with built-in accelerometer, gyroscope and compass could help to improve the safety sun detector. Therefore, a dedicated module has been installed in the Antenna 12 back structure to start a test campaign. The values will be recorded with DLS and compared with the encoder values.

AKD2. For years, first-generation Kollmorgen AKD servo-drives were used to set into motion NOEMA antennas but IRAM must now anticipate that they will soon reach their end-of-sales: the design is already a decade old and the manufacturer has just released a new generation (AKD2G) of servo-drives to replace them. Therefore, a sketch to validate the NOEMA Antenna Control Software with Kollmorgen AKD2G has been built, to be sure that the observatory will never lack of spares in the next decade.

Tango Controls. A study of the opportunity to use Tango Controls to modernize the NOEMA control system has been started. Tango Controls is a free open source device-oriented controls toolkit for controlling any kind of hardware or software and building supervisory control and data acquisition (SCADA) systems.



Grenoble computing environment

Backup MacBook with Timemachine. To backup the fleet of MacBooks available in the institute, a Timemachine server has been configured. The MacBook computers are automatically backed up when they are physically connected on the IRAM network. The backups are encrypted with the user password, so they are protected against unauthorized access.

[Isilon data server at IRAM Grenoble.](#)

SCIENCE SOFTWARE ACTIVITIES

Scientific software developments for NOEMA

2021 was a very productive year for the NOEMA observatory. It started with successful observations in the Very Long Baseline Interferometry mode at frequencies up to 350 GHz, and it ended with the commissioning of the last antenna to complete the NOEMA interferometer. Meanwhile, the atmospheric phase corrections procedure was adapted for the use of the new generation water vapor radiometers, three more antennas were equipped with the new optics required for simultaneous dual-frequency observations, and a new antenna station (W47) was delivered. All of these hardware projects required adaptation of the scientific software to make the best possible use of NOEMA during data acquisition and calibration.

Continuous upgrade of the data processing tools

Even though the Covid-19 pandemic affected working conditions for a second year, the scientific software development and support team maintained most of its standard activities. Here some of the most notable achievements in 2021:

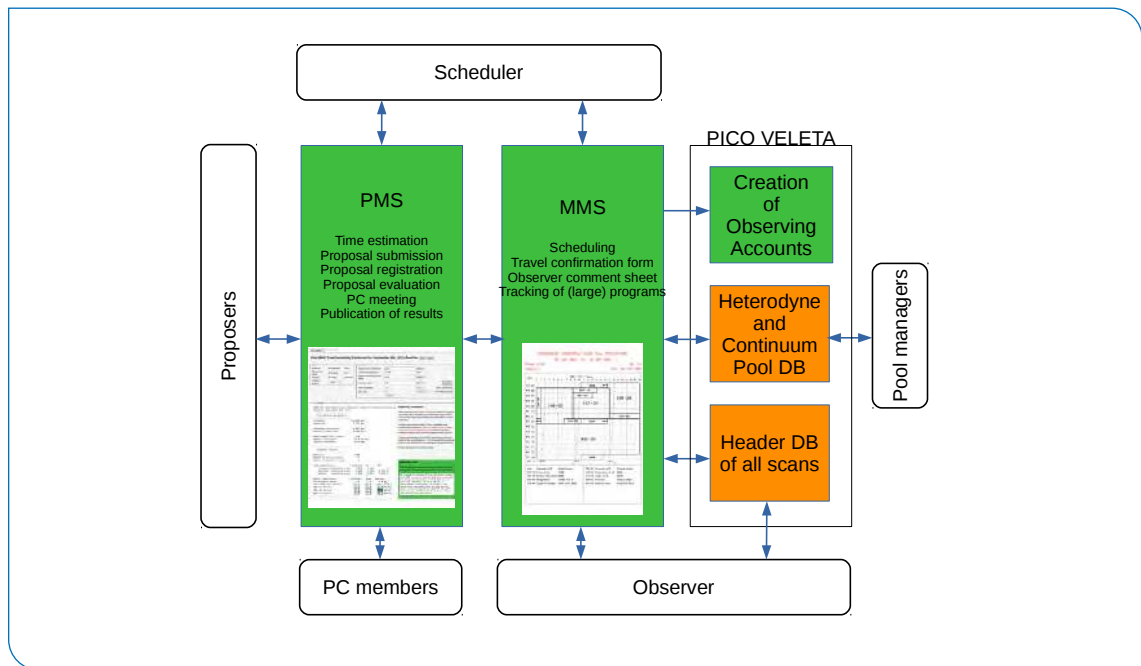
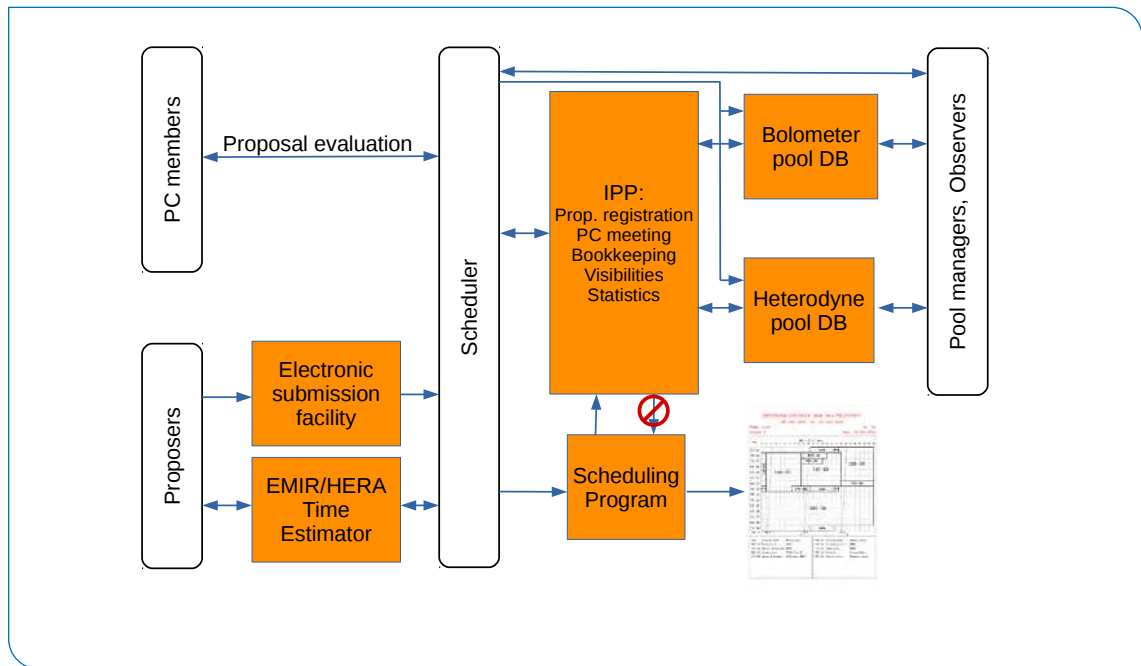
- The IRAM 30-meter frequency scheme was updated to improve continuity of frequency coverage for line surveys with multiple tunings.
- NIKA2 instrument calibration procedures were improved. In this context, an extensive study was conducted to refine the atmospheric calibration.
- Additionally, NOEMA pipeline was optimized to better calibrate the broad high frequency bandpass by taking into account the spectral index of the calibrator's continuum emission. This is an important progress to make the best use of NOEMA's wide bandwidth.
- Last but not least, the compilation environment of all scientific software at both the IRAM 30-meter telescope and the NOEMA observatory was updated with the use of modern virtual computers, and the compilation was ported to the new Apple M1 ARM processors.

Scheduling of the IRAM 30-meter telescope

The Observation Management System (OMS) is planned as a set of independent web-based tools with a similar look-and-feel in order to handle observing projects from proposal submission to the distribution of data to the principal investigators.

A new application called Monitoring Management System (MMS), which handles all planning tasks for the 30-meter system has been in development since late 2020, and became operational in October 2021. The tool includes: 1) the import of all projects accepted by the Program Committee (PC) for the running semester; 2) the scheduling of standard projects; 3) the scheduling of pool weeks and technical sessions; 4) the scheduling of Large Programs over several years; 5) the scheduling of Directorial Discretionary Time requests accepted during a semester; 6) the automatic creation of observing accounts at the telescope; 7) the quasi-real-time monitoring of projects directly at the telescope to determine if they are complete or need additional observation time; and 8) the elaboration of statistics on past observing periods. Further work is ongoing to import into MMS the two forms that observers need to fill in: the trip confirmation form for the organization of travels to the telescope, and the comment sheet by which the observatory receives feedback from observers at the end of an observing run.

This new tool integrates the management of observations at the IRAM 30-meter telescope into a modern information retrieval system. Before the introduction of OMS, the same management was performed using several independent tools which were not interconnected. This meant that the telescope scheduler was the only key actor in the manual transfer of information between other parties, such as the proposers, PC members, observers, and pool managers, and from one tool to another. In the current system, the same parties have access to the information through databases that communicate with each other. This greatly simplifies the flow of information and minimizes the risk of errors.



Comparison of the information flow for the management of observations before (top) and after (bottom) the implementation of the Observation Management System at the IRAM 30-meter telescope.



Personnel & Finance



Credit: Romain Messmer

Administration

The dematerialization of all administrative procedures has continued in 2021. The Phoenix purchasing software has been replaced by a new software, much more flexible and fully integrated in the accounting system. After a period of exchange with the various departments in order to define the best possible setup, the software was installed in July 2021 for a test phase and has been operational since October 2021. This new software will allow IRAM to manage the entire purchasing process including the validation process in a dematerialized way.

In 2022, IRAM Spain will be integrated in this environment in order to harmonize the administrative processes. The next step will be to optimize and dematerialize the travel arrangements and expenses support by a new software.

Staff

IRAM employed an average headcount of 119.12 FTEs in 2021 (90.31 in France and 28.81 in Spain). Statistics show a stable proportion of 27% women at IRAM. IRAM continues to have good results in 2021 in terms of the equal pay index between men and women.

An important focus of training was achieved in 2021 with the training of the group leaders in the technique of yearly professional interviews with their employees. These professional interviews allow group leaders to better target the skills of employees and to help them to evolve in their careers.

IRAM continues to give high priority to staff training. Unfortunately, due to the Covid-19 pandemic, many training sessions had to be canceled. A side effect was the reduction of the training expenditures by -27% in comparison to the initial 2021 budget.

An agreement has been signed between IRAM and a new health insurance company in Spain in order to significantly improve the access of the IRAM staff to a rapid health service.

Financial situation of IRAM

Operating

Income in k€	Actual 2021
Associates' contribution	13 181
Other income	1 247
Total income	14 428

Expenses in k€	Actual 2021
Operation (staff costs and operating expenses)	13 971
Total expenditure	13 971

Investments

Expenses in k€	Actual 2021
Base Investment	1 381
Specific projects	5 885
Total	7 266

The Covid-19 pandemic had no significant financial impact for the Institute. Similarly to 2020, IRAM has noted a significant decrease in mission and travel expenses and to a lesser extent training costs. The challenge for the coming year will be to cope with the increase of electricity costs and more generally with the increase of the inflation.

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 DESCAMPS-PROTEAU Cécile
 MOREAU Sonja
 SERLET Murielle
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Director
 Deputy Director

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 FERREIRA Dina
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Head of Administration

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 BERJAUD Catherine
 BERTA Stephano
 BOUSCASSE Laure
 BREMER Michael
 BROGUIERE Dominique
 BUTLER Kirsty May
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 CONTURSI Alessandra
 CORTZEN Isabella
 DE SOUZA MAGALHAES Victor
 DURAND KWOK Jaimey
 DZIB QUIJANO Sergio
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 KRAMER Carsten
 KRIPS Melanie
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 PIETU Vincent
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 WINTERS Jan
 WONG Ka Tat
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Head of Astronomy & Science Support Group

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 GARNIER Olivier
 LECLERCQ Samuel
 MAHIEU Sylvain
 MAIER Doris
 MOUTOTE Quentin
 PARIOLEAU Magali
 PERRIN Guillaume
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 GEOFFROY Daniel
 SASSELLA Rémi

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 BARBIER Arnaud
 BILLON-PIERRON Dominique
 GOUPY Johannes

Head of Superconducting Devices Group

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 CHALAIN Julien
 DUMONTROT Patrick
 MICHAUD Jean-Yves
 REYGAZA Mickaël
 ROCHE Jean-Christophe

Head of Computer Group

Mechanical Group

LEFRANC Bastien
 COUTANSON Laurent
 DANNEEL Jean-Marc
 JUBARD Vincent
 LAZARO Gaëtan
 PASCAUD Victor

Head of Mechanical Group

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GAUTIER Bertrand
BOISSIER Jérémie
 AZPEITIA Jean-Jacques
 CASALI Julien
 CASTELLAZZI Claire
 CAYOL Alain
 CHAUDET Patrick
 COMBE Kevin
 CONSEIL Yann
 CONVERS Bruno
 DAN Michel
 DI LEONE Cécile
 LAPEYRE Laurent
 LE CORRE François-Gildas
 LEONARDON Sophie
 MASNADA Lilian
 MOURIER Yvan
 RAMBAUD André
 SALGADO Emmanuel
 SARRAZIN Jérémy
 ZANINELLO Pierre

Station Manager
 Deputy Station Manager

IRAM 30-meter telescope, Granada, Spain

SÁNCHEZ PORTAL Miguel
CASTILLO FRAILE Manuel
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30-METER TELESCOPE

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122-16	Galactic Star Formation with NIKA2 (GASTON)	Nicolas Peretto, Philippe Andre, Alexandre Beelen, Alain Benoit, Aurelien Bideaud, Nicolas Billot, O. Bourrion, M. Calvo, A. Catalano, Gregoire Coiffard, Barbara Comis, Francois-Xavier Desert, S. Doyle, Carsten Kramer, Samuel Leclercq, Juan Macias-Perez, Frederic Mayet, A. Monfardini, François Pajot, Enzo Pascale, Laurence Perotto, Giampaolo Pisano, Nicolas Ponthieu, Vincent Reveret, Alessia Ritacco, Louis Rodriguez, Charles Romero, Florian Rupp, Karl-Friedrich Schuster, Albrecht Sievers, Robert Zylka, Remi Adam, Peter Ade, Frederique Motte, Aurore Bacmann, Andrew Rigby, Isabelle Ristorcelli, Pablo García, Anaëlle Maury, Jean-Francois Lestrade, Yoshito Shimajiri, Andrea Bracco, Bilal Ladjelate, Ana Duarte Cabral, Sarah Ragan, Jane Greaves
160-16	Interpreting the Millimetre Emission of Galaxies with IRAM and NIKA (IMEGIN)	Suzanne Madden, Jonathan Davies, Carsten Kramer, Nicolas Peretto, Enzo Pascale, W Gear, Steve Eales, Matthew Smith, Israel Hermelo, Remi Adam, Francois-Xavier Desert, S. Doyle, Ruth Evans, Christopher Clark, Helene Roussel, Annie Hughes, Peter Ade, Philippe Andre, Alexandre Beelen, Alain Benoit, Aurelien Bideaud, Nicolas Billot, O. Bourrion, M. Calvo, A. Catalano, Gregoire Coiffard, Barbara Comis, Samuel Leclercq, Juan Macias-Perez, Frederic Mayet, A. Monfardini, François Pajot, Laurence Perotto, Giampaolo Pisano, Nicolas Ponthieu, Vincent Reveret, Alessia Ritacco, Louis Rodriguez, Charles Romero, Florian Rupp, Karl-Friedrich Schuster, Albrecht Sievers, Robert Zylka
192-16	The NIKA2 Cosmological Legacy Survey (N2CLS)	Guilaine Lagache, Alexandre Beelen, Nicolas Ponthieu, Remi Adam, H. Aussel, Matthieu Bethermin, Veronique Buat, Frederic Boone, Emanuele Daddi, David Elbaz, Daizhong Liu, Morgane Cousin, Francois-Xavier Desert, Juan Macias-Perez, Denis Burgarella, Herve Dole, Peter Ade, Philippe Andre, Alain Benoit, Aurelien Bideaud, Nicolas Billot, O. Bourrion, M. Calvo, A. Catalano, Gregoire Coiffard, Barbara Comis, S. Doyle, Carsten Kramer, Samuel Leclercq, Frederic Mayet, A. Monfardini, François Pajot, Enzo Pascale, Laurence Perotto, Giampaolo Pisano, Vincent Reveret, Alessia Ritacco, Louis Rodriguez, Charles Romero, Florian Rupp, Karl-Friedrich Schuster, Albrecht Sievers, Robert Zylka
199-16	High-resolution tSZ observations of a large sample of clusters of galaxies (NIKA2SZ)	Frederic Mayet, Barbara Comis, Remi Adam, Peter Ade, Nabila Aghanim, Philippe Andre, Monique Arnaud, Rafael Barrera Delgado, Iacopo Bartalucci, Alexandre Beelen, Alain Benoit, Aurelien Bideaud, Nicolas Billot, O. Bourrion, M. Calvo, A. Catalano, Nicolas Clerc, Gregoire Coiffard, Marco De Petris, Francois-Xavier Desert, Marian Douspis, S. Doyle, Chiara Ferrari, Carsten Kramer, Samuel Leclercq, Juan Macias-Perez, Jean-Baptiste Melin, A. Monfardini, Francois Pajot, Enzo Pascale, Laurence Perotto, Giampaolo Pisano, Etienne Pointecouteau, Nicolas Ponthieu, Gabriel Pratt, Vincent Reveret, Alessia Ritacco, Louis Rodriguez, Charles Romero, Jose Alberto Rubino Martin, Florian Rupp, Karl-Friedrich Schuster, Albrecht Sievers, Robert Zylka, H. Aussel
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094-20	NIKA2 insights into the dust evolution in prestellar cores	Isabelle Ristorcelli, Mika Juvela, Karine Demyk, Nathalie Ysard, Deborah Paradis, Julien Montillaud, Jean-Philippe Bernard, Alessia Ritacco, Nicolas Ponthieu, V.-M. Pelkonen, Tie Liu, Peregrine McGehee, Helene Roussel, R. Paladini, Alexy Louis
095-20	Unveiling the dust properties of prestellar cores with NIKA2	Chenlin Zhou, Isabelle Ristorcelli, Charlotte Vastel, Julien Montillaud, Mika Juvela, Helene Roussel
096-20	Dust and gas evolution in two prestellar GEMS cores of TMC1	Carsten Kramer, Asuncion Fuente, Paola Caselli, Santiago Garcia-Burillo, Rafael Bachiller, Valentine Wakelam, Nuria Marcelino, Izaskun Jimenez-Serra, Jason Kirk, Jaime Pineda, Belen Tercero, Pierre Gratier, Alvaro Hacar, Sandra Trevino-Morales, Tony Mroczkowski, Charles Romero, Ana Chacón-Tanarro, Mario Tafalla, David Navarro Almada, Marina Rodriguez Baras
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099-20	Confirming the detection of ethanol toward the L1544 pre-stellar core	Izaskun Jimenez-Serra, Paola Caselli, Belen Tercero, Pablo de Vicente, Silvia Spezzano
100-20	Confirming the detection of methylamine (CH ₃ NH ₂) towards L1544	Silvia Spezzano, Paola Caselli, Izaskun Jimenez-Serra
101-20	Understanding the chemical and physical structure of the pre-stellar core L1544: an excitation study	Silvia Spezzano, Paola Caselli
102-20	Testing the contribution of the gas-phase formation of CH ₃ CN	Shaoshan Zeng, Nami Sakai, Nadia Murillo, Serena Viti, Izaskun Jimenez-Serra, Yao-Lun Yang
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112-20	Does an accretion streamer of a planet-forming Class I disk reach core scales?	Dominique Segura-Cox, Jaime Pineda, Anika Schmiedeke, Maria Maureira
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119-20	Extended SiO Emission in IRDCs: Tracing the Assembly of Massive Clumps?	Wonju Kim, Fabien Louvet, Nicolas Peretto, Adam Avison, Di Li, Ken'ichi Tatematsu, Jinjin Xie, Bethany Jones, James Urquhart, Gary Fuller
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126-20	Blowing bubbles over the Milky Way	Bilal Ladjelate, Jean-Francois Lestrade, Stefano Berta, Matthieu Bethermin
127-20	HCN 1-0 and H ¹³ CN 1-0 mapping toward massive star forming regions with accurate distances	Shu Liu, Junzhi Wang, Juan Li, Kai Yang, Yan Gong
128-20	The interaction between H II regions and their neighbour massive clumps	Feng-Yao Zhu, Junzhi Wang, Yaoting Yan

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130-20	The Currents of Space: Dynamical Flows at the Onset of Star Birth	Giuliana Cosentino, Jonathan Tan, Chi Yan Law, Izaskun Jimenez-Serra, Francesco Fontani, Ashley Thomas Barnes, Jonathan Henshaw
131-20	Turbulence and protostellar outflows in the Cepheus dense clumps	Pierre Guillard, Anaëlle Maury
132-20	Identifying regions of gravitational collapse and outflows within magnetized molecular clouds	Yue Hu, Alexander Lazarian, Laura Fissel, Dana Alina
134-20	Characterizing the region that interacts with gamma-rays in the IC443 SNR	Pierre Dell'Ova, Antoine Gusdorf, Maryvonne Gerin, Denise Riquelme, Rolf Güsten, Martin Houde, Marco Padovani, Alexandre Marcowith, Alessia Ritacco
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139-20	Molecular survey of young stellar objects in Taurus: H_2S .	Pablo Riviere-Marichalar, David Navarro Almada, Asuncion Fuente, Ignacio Mendigutía, Benjamín Montesinos, David Barrado y Navascues, Gisela Esplugues
140-20	A Unique Opportunity to Measure the Continuum Optical Depth of a Protoplanetary Disk via Background Illumination	Ian Czekala, Romane Le Gal, Alice Booth, Eugene Chiang, Arthur Bosman, Karin Öberg, Ryan Loomis, Richard Teague, Charles Law, Jane Huang
141-20	Classification of Class 0/I sub-stellar objects	Basmah Riaz, Wing-Fai Thi
142-20	Nearby Evolved Stars Survey (NESS)	Manali Jesty, Karl M. Menten, Peter Scicluna, Francisca Kemper, Ka Tat Wong, Sofia Wallstrom, Iain McDonald, Friedrich Wyrowski, Jan Wouterloot, Sundar Srinivasan, Hiroshi Imai, Thavisha Dharmawardena, Eric Lagadec
144-20	The formation of Fullerenes in Planetary Nebulae: A radio astronomy view	Jose Jairo Díaz-Luis, Javier Alcolea, Domingo Anibal Garcia Hernandez, Valentin Bujarrabal, Arturo Manchado
145-20	Unveiling the building blocks of dust grains	Jose Cernicharo, Juan R. Pardo, Michel Guelin, Luis Velilla Prieto, Carlos Cabezas, Celina Bermudez, Marcelino Agundez, Jose Pablo Fonfria, Guillermo Quintana-Lacaci
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147-20	Circumstellar envelopes of AGB stars: exploring the onset of axisymmetric nebulae. II	Jose Jairo Díaz-Luis, Javier Alcolea, Valentin Bujarrabal, Miguel Santander-García, Arancha Castro-Carrizo, Miguel Gomez-Garrido, J.-F. Desmurs
148-20	Looking for phosphine in C-rich evolved stars	Jose Pablo Fonfria, Luis Velilla Prieto, Marcelino Agundez, Guillermo Quintana-Lacaci, Jose Cernicharo, Sarah Massalkhi, Miguel Santander-García, Juan R. Pardo, Valentin Bujarrabal, Javier Alcolea, Nuria Marcelino
149-20	The O-rich to C-rich transition in AGB stars	Marcelino Agundez, Jose Pablo Fonfria, Sarah Massalkhi, Jose Cernicharo
150-20	Puzzling outflows from red supergiants: the case of NML Cyg	Elvire De Beck, Holly Andrews, Guillermo Quintana-Lacaci, Lucy Ziurys, Ambesh Pratik Singh
151-20	Surviving in the Helix: a study of isotopic selective photodissociation	Luis Velilla Prieto, Hans Olofsson, Wouter Vlemmings, Theo Khouri, Elvire De Beck, Maryam Saberi
153-20	Enhancement of ^{13}C in Planetary Nebulae: New Insights into AGB Nucleosynthesis?	Deborah Rose Schmidt, Lucy Ziurys, Neville Woolf
154-20	Disks orbiting white dwarfs and post-AGB stars	Valentin Bujarrabal, Iván Gallardo Cava, Miguel Gomez-Garrido, Javier Alcolea, Miguel Santander-García
155-20	Molecules in a classical nova GK Per	Helena Mazurek, Karl M. Menten, Tomasz Kaminski
156-20	Resolved CO Observations in M31: Connecting GMCs to Diffuse Molecular Gas, Continued	Christopher Faesi, Jan Forbrich, Charles Lada, Sebastien Viaene, Jonathan Toomey, Glen Petitpas
157-20	Exploring the gas properties of cold, inter-arm GMCs and Identifying the velocity field of the stream-like inter-arm structures in M31	Sihan Jiao, Di Li, Jingwen Wu, Zhiyu Zhang, HauYu Baobab Liu, Yuxin Lin, Chao-Wei Tsai
158-20	The molecular gas mass in the dwarf elliptical NGC 205	Frank Israel, Christof Buchbender

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159-20	Resolving N_2H^+ (1-0) emission for the first time across the disk of a normal, star-forming galaxy: NGC6946.	Maria Jesus Jimenez Donaire, Mario Tafalla, Jérôme Pety, Jens Kauffmann, Eva Schinnerer, Antonio Usero, Frank Bigiel, Simon Glover, Johannes Puschig, Miguel Querejeta, Daizhong Liu, Ana Chacón-Tanarro, Ashley Thomas Barnes, Diederik Kruijssen, Toshiki Saito, Axel García-Rodríguez, Melanie Chevance, Ivana Beslic, Thomas Williams, Quentin Salome, Ralf Klessen
160-20	A detailed census of the key drivers of CO excitation: Metallicity, Radiation Field and the CO(2-1)/CO(1-0) Ratio Across M101	Jakob den Brok, Frank Bigiel, Antonio Usero, Eva Schinnerer, Jeremy Chastenet, Ashley Thomas Barnes, Kathryn Kreckel, Adam Leroy, Johannes Puschig, Ivana Beslic, Cosima Eibensteiner
161-20	The diffuse dust emission in NGC4214	Katharina Lutz, Caroline Bot, chris clark
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165-20	Confirming the tentative detection of CO in the nearest ultra-diffuse galaxy	David Valls-Gabaud, David Clements, Monica Rodriguez, Francoise Combes
166-20	Unveiling the merger history of double-peak galaxies	Daniel Maschmann, Anne-Laure Melchior, Francoise Combes, Barbara Mazzilli-Ciraulo
168-20	A Dusty Ultra-Diffuse Galaxy in the Coma Cluster	David Valls-Gabaud, David Clements, Monica Rodriguez, Joseph Cairns
169-20	Do Changing-look AGNs reside in the gas-rich environment?	Xiaoling Yu, Yong Shi
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171-20	The connection between molecular gas, star formation, and radio-mode AGN feedback in MaNGA galaxies	Sarah Leslie, Dominika Wylezalek, Matus Rybak, Jacqueline Hodge, Dipanjan Mukherjee, Hiddo Algera, Raffaella Morganti, Huub Rottgering, Daizhong Liu, Martin Hardcastle, Celia Mulcahey, Christian Fendt
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174-20	MAPI: Monitoring AGN with Polarimetry at the IRAM 30m Telescope	Ivan Agudo, Carolina Casadio, Efthalia Traianou, Jae-Young Kim, Nicholas MacDonald, Thomas Krichbaum, Eduardo Ros, Anton Zensus, Helmut Wiesemeyer, Clemens Thum, Ioannis Myserlis, Juan Escudero, Antonio Fuentes, Jose L. Gomez, Alan Marscher, Svetlana Jorstad, Emmanouil Angelakis, Venkatessh Ramakrishnan
175-20	A Pilot Cosmological NIKA2 Survey in The North Ecliptic Pole Field	Denis Burgarella, Stephen Serjeant, Samuel Boissier, David Clements, Gianfranco De Zotti, Michal J. Michalowski, Kouichiro Nakanishi, Alain Omont, M. Ouchi, Chris Pearson, Tsutomu Takeuchi, M. Vaccari, I. Valtchanov, Glenn White, Fangting Yuan, Nicolas Ponthieu, Veronique Buat, Ambra Nanni, Jana Bogdanoska, Yoshiki Toba
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182-20	Intracluster medium properties of the first massive clusters selected independently of their baryon content	Stefano Andreon, Alberto Moretti, Bilal Ladjelate, Ginevra Trinchieri
183-20	High Angular Resolution tSZ Mapping of the Most Massive Galaxy Clusters at $z > 0.9$	Mark Brodwin, Marshall Bautz, Bandon Decker, Daniel Marrone, Michael McDonald, Alexandra Pope, Adam Stanford, Dominika Wylezalek, Florian Ruppig, Frederic Mayet, Laurence Perotto, Juan Macias-Perez, Florian Keruzore, Juan Francisco Macias-Perez
184-20	Distinguishing between envelope and embedded disk chemistry of Class I YSOs	Romane Le Gal, Karin Öberg, Ana Lopez-Sepulcre, Charlotte Vastel, Jane Huang, Francois Menard, Charles Law, Bertrand Lefloch, Cecilia Ceccarelli, Cecile Favre, Eleonora Bianchi, Clement Baruteau, Asuncion Fuente, Pablo Riviere-Marichalar, Anaëlle Maury, David Navarro Almaila, Edwin A. Bergin, Emmanuel Caux

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E01-20	The one-sided illumination of L183 and L134 as traced by CO isotopologues	Laurent Pagani, Dimitri Arramy
E02-20	Solving the $CO(2-1)/(1-0)$ Line Ratio Discrepancy in M51	Jakob den Brok, Johannes Puschnig, Antonio Usero, Frank Bigiel, Toshiki Saito, Eva Schinnerer, Adam Leroy
E03-20	A Dusty Ultra-Diffuse Galaxy in the Coma Cluster	David Valls-Gabaud, David Clements, Monica Rodriguez, Joseph Cairns, Angel Bongiovanni
E04-20	30m telescope observations of molecular lines in post-AGB disks: AC Herculis. Final chapter	Iván Gallardo Cava, Valentin Bujarrabal, Javier Alcolea, Miguel Gomez-Garrido, Miguel Santander-Garcia
GMVA-20B-339-MK18	The nature of molecular gas in the jet-launching region of young radio galaxy.	Dongjin Kim, Thomas Krichbaum, Biagina Boccardi, Alan L. Roy, Eduardo Ros, Anton Zensus, Anne-Kathrin Baczko, Jae-Young Kim, Violette Impellizzeri, Uwe Bach, Matthias Kadler

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GMVA-20B-220-ML10	Jet Meets Black Hole in M87: Breaking New Ground with GMVA+ALMA	Rusen Lu, Jongho Park, Thomas Krichbaum, Masanori Nakamura, Keiichi Asada, Jae-Young Kim, Kazuhiro Hada, Fumie Tazaki, Kazunori Akiyama, Tomohisa Kawashima, Jordy Davelaar, Anton Zensus, Rebecca Azulay, Lindy Blackburn, Katherine Bouman, Geoffrey Bower, Silke Britzen, Michael Bremer, Avery Broderick, Sunil Chandra, Ilje Cho, Geoffrey Crew, S. Doeleman, Akihiro Doi, Heino Falcke, V. Fish, Gabriele Giovannini, Jose L. Gomez, Marcello Giroletti, Ruben Herrero-Illana, Paul Ho, Mareki Honma, David Hughes, Violette Impellizzeri, Makoto Inoue, Sara Issaoun, David James, Michael Janssen, Wu Jiang, Michael Johnson, Motoki Kino, Shoko Koyama, Michael Lindqvist, Elisabetta Liuzzo, Andrei Lobanov, Laurent Loinard, Nicholas MacDonald, Sera Markoff, Ivan Marti-Vidal, Alan Marscher, Satoki Matsushita, Jonathan McKinney, Hugo Messias, Monika Moscibrodzka, Shin Mineshige, Yosuke Mizuno, Hiroshi Nagai, Gopal Narayanan, Scott Noble, Monica Orienti, Yurii Pidopryhora, Oliver Porth, Hung-Yi Pu, Luciano Rezzolla, Eduardo Ros, H. Rottmann, Kazi Rygl, David Sanchez-Arguelles, Tuomas Savolainen, Karl-Friedrich Schuster, Zhiqiang Shen, Hotaka Shiokawa, Kenji Toma, Pablo de Vicente, John Wardle, Maciek Wielgus
EVI-20	Magnetic field and Rotation Measure at the jet base of QSO 3C273	Tuomas Savolainen, Thomas Krichbaum, Kazunori Akiyama, Keiichi Asada, Lindy Blackburn, Katherine Bouman, Geoffrey Crew, V. Fish, Ciriaco Goddi, Jose L. Gomez, Kazuhiro Hada, Talvikki Hovatta, Michael Janssen, Svetlana Jorstad, Jae-Young Kim, Rusen Lu, Daniel Marrone, Alan Marscher, Yosuke Mizuno, Masanori Nakamura, Shane O'Sullivan, Venkatesh Ramakrishnan, Eduardo Ros, H. Rottmann, Alan Roy, J. Wagner, Maciek Wielgus, Feng Yuan, Anton Zensus, Alexander Tchekhovskoy
GMVA-20B-234-MG8	Imaging massive binary black hole candidate OJ287 with the GMVA+ALMA	Jose L. Gomez, Thomas Krichbaum, Guangyao Zhao, Antonio Fuentes, Andrei Lobanov, Stefanie Komossa, Alan Marscher, Svetlana Jorstad, Gabriele Bruni, Yuri Kovalev, Carolina Casadio, Jae-Young Kim, Ivan Marti-Vidal, Jeffrey Hodgson, Roman Gold, Kazunori Akiyama, Michael Johnson, Sera Markoff, Laurent Loinard, Brissa Gomez-Miller, Uwe Bach, Ivan Agudo, Yosuke Mizuno, Jose M. Marti, Manel Perucho, Eduardo Ros, Silke Britzen, Rusen Lu, Geoffrey Crew, Anton Zensus, H. Rottmann, Tuomas Savolainen, Efthalia Traianou, Sara Issaoun, Michael Janssen, Keiichi Asada, Lindy Blackburn, Masanori Nakamura, Venkatesh Ramakrishnan, Rocco Lico, Marshall Cohen, Stanislaw Zola, Achamveedu Gopakumar, Lankeswar Dey, Shoko Koyama, Elisabetta Liuzzo, Violette Impellizzeri, Ruben Herrero-Illana, Hugo Messias, Jongho Park, Jun Yi Koay, Ilje Cho
001-21	Ground-based truth of the composition of Rosetta target 67P/Churyumov-Gerasimenko	Nicolas Biver, Dominique Bockelee-Morvan, Jacques Crovisier, Raphael Moreno, Gabriel Paubert, Stefanie Milam, Dariusz C. Lis, Jeremie Boissier, Neil Dello Russo, Martin Cordiner, Ronald Vervack, Nathan Roth, Boncho Bonev, Michael A. Disanti
002-21	The interaction between turbulence, magnetic fields, filaments, and star formation in Serpens south molecular zone	Yue Hu, Alexander Lazarian, Laura Fissel
003-21	The Interplay of Gravity and Turbulence: Testing the Threshold	Qianru He, Gary Fuller, Wonju Kim, Alessio Traficante
004-21	Cloud-Cloud Collisions in Infrared Dark Clouds: Dynamical Flows at the Onset of Star Birth	Giuliana Cosentino, Paola Caselli, Francesco Fontani, Izaskun Jimenez-Serra, Jonathan Tan, Jonathan Henshaw, Chi Yan Law, Ruben Fedriani, Prasanta Gorai, Ashley Thomas Barnes, Chia-Jung Hsu
006-21	The HCN/CO ratio in galactic clouds	Mario Tafalla, Antonio Usero, Alvaro Hacar, Maria Jesus Jimenez Donaire, Jouni Kainulainen
007-21	Unveiling the dust properties of prestellar cores with NKA2	Chenlin Zhou, Isabelle Ristorcelli, Charlotte Vastel, Julien Montillaud, Karine Demyk
008-21	A search for the HCCS ⁺ cation in TMC-1	Jose Cernicharo, Carlos Cabezas, Laurent Margules, Stephane Bailleux, Roman Motiyenko, Marcelino Agundez, Belen Tercero, Juan R. Pardo, Nuria Marcelino, Pablo de Vicente, Luyao Zou, Yasuki Endo
009-21	A search for thiomethoxy (CH ₃ S) towards TMC-1	Jose Cernicharo, Laurent Margules, Carlos Cabezas, Marcelino Agundez, Juan R. Pardo, Nuria Marcelino, Belen Tercero, Pablo de Vicente
010-21	Probing the dust and gas evolution in starless cores	Carsten Kramer, Asuncion Fuente, Paola Caselli, Mario Tafalla, Santiago Garcia-Burillo, Rafael Bachiller, Valentine Wakelam, Nuria Marcelino, Izaskun Jimenez-Serra, Jason Kirk, Jaime Pineda, Belen Tercero, Pierre Gratier, Alvaro Hacar, Sandra Trevino-Morales, Ana Chacón-Tanarro, Charles Romero, David Navarro Almada, Marina Rodriguez Baras
011-21	Deuteration of sulfur bearing species in starless cores	Asuncion Fuente, Gisela Esplugues, Jean-Christophe Loison, David Navarro Almada, Paola Caselli, Pablo Riviere-Marichalar, Valentine Wakelam, Silvia Spezzano, Marina Rodriguez Baras, Octavio Roncero, Guillermo M. Munoz Caro, Carsten Kramer, Romane Le Gal
012-21	Tracing CO Depletion with N ₂ H ⁺ , through the Ice-Forming Regions of the B35a Dense Core	Zak Luka Smith, Giulia Perotti, Jes Jorgensen, Lars E. Kristensen, Jennifer Noble, Helen Fraser

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013-21	Tracing the chemistry in Perseus starless cores	Shaoshan Zeng, Nami Sakai, Yao-Lun Yang, Nadia Murillo, Yichen Zhang, Ziwei Zhang
014-21	Is the L1287 core globally contracting?	Lev Pirogov, Peter Zemlyanukha, Ivan Ohanderov
015-21	Deuterium fractionation along the filamentary infrared dark cloud G11.36+0.80	Oskari Miettinen
016-21	The abundance of gas-phase sulfur in the dense interstellar medium	Pierre Hily-Blant, Guillaume Pineau des Forets, David Flower, Alexandre Faure, Romane Le Gal
017-21	Mapping the large scale magneto-kinematics and outflow feedback around the isolated massive protostar G28.2-0.05	Law Chi Yan, Giuliana Cosentino, Prasanta Gorai, Jonathan Tan, Yichen Zhang
018-21	Probing the peak of the prestellar core mass function in Perseus	Michael Mattern, Vera Konyves, Pedro Palmeirim, hamza ajeddig, Philippe Andre
020-21	Confirming the detection of methylamine (CH_3NH_2) towards L1544	Silvia Spezzano, Paola Caselli, Izaskun Jimenez-Serra
021-21	Constraining the diffuse envelope surrounding L1544	Judit Ferrer Asensio, Paola Caselli, Silvia Spezzano, Felipe Alves, Olli Sipilä, Elena Redaelli
022-21	Unveiling the kinematics of the large-scale envelope in L1544	Elena Redaelli, Ana Chacón-Tanarro, Paola Caselli, Jaime Pineda, Mario Tafalla, Silvia Spezzano
023-21	Confirming the detection of ethanol toward the L1544 pre-stellar core	Izaskun Jimenez-Serra, Paola Caselli, Belen Tercero, Pablo de Vicente, Silvia Spezzano
024-21	Securing deuterated methanol (CH_3OD) in the prestellar core L1544	Beatrice Marie Kulterer, Maria Drozdovskaya, Paola Caselli, Izaskun Jimenez-Serra, Silvia Spezzano, Jaime Pineda, Maria Maureira, Luca Bizzocchi
027-21	Do large-scale shock interactions set the initial conditions for star formation?	Giuliana Cosentino, Paola Caselli, Francesco Fontani, Izaskun Jimenez-Serra, Jonathan Tan, Jonathan Henshaw, Ashley Thomas Barnes, Chi Yan Law, Prasanta Gorai, Ruben Fedriani, Chia-Jung Hsu
028-21	Toward understanding the deficit of protonated hydrogen cyanide in Serpens South	Yan Gong, Junzhi Wang, Christian Henkel, Karl M. Menten, Arnaud Belloche, Arshia Jacob, Gisela Ortiz Leon, Michael Rugel, Xindi Tang, Donghui Quan, Friedrich Wyrowski, Fujun Du, Wenjin Yang
030-21	Probing the filaments velocity shear in a low star formation region	Simon Delcamp, Pierre Hily-Blant
031-21	Silicon isotope ratios in the Milky Way	Yaoting Yan, Christian Henkel, Karl M. Menten, Yan Gong, Jiangshui Zhang
032-21	Do hot cores exist in the low-Z environment of the outer Galaxy?	Arnaud Belloche, Robin Garrod, Karl M. Menten
033-21	Sulfur chemistry and isotopic ratios in the Milky Way	Yaoting Yan, Christian Henkel, Karl M. Menten, Jiangshui Zhang, Yan Gong, Youxin Wang
035-21	Unveiling Grain Growth in Very dense Galactic Cores from NIR to mm wavelengths	Karine Demyk, R. Paladini, Isabelle Ristorcelli, Mika Juvela, Nathalie Ysard, Joao Alves, Laurie Chu, E. Dartois, Bruce Draine, Yasuhiro hasegawa, Brandon Hensley, Wanggi Lim, Alberto Noriega-Crespo, Laurent Paganí, Deborah paradis, Yvonne Pendleton, Giulia Perotti, Jonathan Tan
036-21	Survey of sulfuretted species in Taurus protoplanetary disks	Pablo Riviere-Marichalar, Romane Le Gal, Asuncion Fuente, David Navarro Almaya, Gisela Esplugues, Marina Rodriguez Baras
038-21	Probing non-polar molecules through their protonated form	Marcelino Agundez, Jose Cernicharo, Nuria Marcelino
039-21	Revealing the cloud to core feeding in a chemically-rich young protostellar system	Maria Maureira, Dominique Segura-Cox, Anika Schmededeke, Paola Caselli, Jaime Pineda, Silvia Spezzano
040-21	Exploring chemical diversity in massive star-forming regions	Prasanta Gorai, Jonathan Tan, Chi Yan Law, Giuliana Cosentino, Yichen Zhang
042-21	CHEMOUT: CHEMical complexity of star-forming regions in the OUTer Galaxy	Francesco Fontani, Maria Teresa Beltran, Laura Colzi, Paola Caselli, Davide Elia, Leonardo Testi, Laura Magrini, Victor Rivilla, Alvaro Sanchez-Monge, Luca Bizzocchi
043-21	Unveiling the origin of nitrogen fractionation	Laura Colzi, Izaskun Jimenez-Serra, Serena Viti, Victor Rivilla, Sandra Trevino-Morales
044-21	Spectral survey of hot corinos	Marina Rodriguez Baras, Asuncion Fuente, Pablo Riviere-Marichalar, Gisela Esplugues, David Navarro Almaya, Belen Tercero, Tomas Alonso-Albi
045-21	TIME FILLER: Blowing bubbles over the Milky Way	Bilal Ladjelate, Jean-Francois Lestrade, Stefano Berta, Matthieu Bethermin, Angel Bongiovanni, Miguel Sánchez Portal
046-21	The molecular cloud dynamics and carbon budget around the NGC7538 HII region	Nicola Schneider, Henrik Beuther, Sumeyye Suri, Volker Ossenkopf-Okada, Robert Simon, Markus Roellig, Slawa Kabanovic
047-21	3mm spectroscopic mapping toward W49A	Yaoting Yan, Shu Liu, Junzhi Wang

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048-21	From multi-line observations to GMC physics: The Orion B case	Maryvonne Gerin, Jérôme Pety, Antoine Roueff, Sebastien Bardeau, Emeric Bron, Jocelyn Chanussot, Pierre Chainais, Mathilde Gaudel, Javier R. Goicoechea, Pierre Gratier, Viviana Guzman Veloso, Annie Hughes, Jouni Kainulainen, David Languignon, Jacques Le Bourlot, Franck Le Petit, François Levrier, Harvey Liszt, Karin Öberg, Jan Orkisz, Nicolas Peretto, Albrecht Sievers, Evelyne Roueff, Miriam G. Santa Maria, Victor de Souza Magalhães, Pierre-Antoine Thouvenin
049-21	Is G31.41+0.31 a result of star formation in a hub-filament system?	Maria Teresa Beltran, M. S. Nanda Kumar, Victor Rivilla
050-21	Mapping the North America and Pelican Nebulae	Alvaro Sanchez-Monge, Shuo Kong, Hector Arce, John Bally, John Carpenter, Adam Ginsburg, Paul F. Goldsmith, Darek LIS, Peregrine McGehee, Fumitaka Nakamura, Volker Ossenkopf-Okada, Peter Schilke, Yoshito Shimajiri, Sumeyye Suri, veena vs
051-21	CF ⁺ in PDRs around different types of HII regions	Maria S. Kirsanova, Anna Punanova
052-21	How does the environment impacts an active star formation region: a NIKA2 vista	Julien Montillaud, Charlotte Vastel, Isabelle Ristorcelli, Mika Juvela, Chenlin Zhou, Rebeka Bögner, Dana Alina
053-21	The Excitation of Deuterated Species in the Spine of the Swan, DR21	Ivalu Barlach Christensen, Friedrich Wyrowski, Dmitry Semenov
054-21	Ionisation triggered by the HB3 supernova remnant: combining FERMI and IRAM	Valentine Wakelam, Pierre Gratier, Marianne Lemoine, Nathalie Brouillet, E. Dartois, Marin Chabot, Thierry Reposeur, Marie-Hélène Grondin, Jean-Christophe Loison
055-21	Studying the effects of shocks/UV photons/X-rays on the Sgr C molecular gas	Jairo Vladimir Armijos Abendano, Miguel Angel Requena-Torres, Sergio Martin Ruiz, Victor Rivilla, Jesus Martin-Pintado
056-21	Mapping the [¹⁸ O/ ¹⁷ O] Isotope Abundance Ratio in the Galactic Center	Pablo García, Robert Simon, Martin Steinke
057-21	Investigating the Origin and Star Formation Activity in the Expanding Molecular Ring in the Galactic Centre	veena vs, Peter Schilke, Alvaro Sanchez-Monge, Wladimir Eduardo Banda-Barragan
058-21	The next generation of protostellar clusters in the Central Molecular Zone	Victor Rivilla, Izaskun Jimenez-Serra, Jesus Martin-Pintado, Laura Colzi, Shaoshan Zeng
059-21	Tracing Mass Loss Due to an Encounter Between the DO Tau and HV Tau Disks	Jane Huang, Edwin A. Bergin, Romane Le Gal, Karin Öberg, Stefano Facchini
060-21	Exploring the molecular inventory of the famous FU Orionis star V1057 Cygni	Karl M. Menten, Arnaud Belloche, Claudia Cyganowski, Zsafia Szabo, Agnes Kospal, Peter Abraham
061-21	Exploring the very large outflow of 89 Herculis	Iván Gallardo Cava, Valentin Bujarrabal, Javier Alcolea, Miguel Gomez-Garrido
062-21	Nearby Evolved Stars Survey	Manali Jesty, Karl M. Menten, Peter Scicluna, Sofia Wallstrom, Yan Gong
066-21	Resolved CO Observations in M31: Connecting GMCs to Diffuse Molecular Gas, Continued	Christopher Faesi, Jan Forbrich, Charles Lada, Sebastien Viaene, Glen Petitpas
067-21	Amount of molecular gas in NGC205	Frank Israel, Christof Buchbender
068-21	Dense gas fraction and star formation along one arm of IC 342	Wenjin Yang, Junzhi Wang, Yan Gong, Yaoting Yan, Shanghuo li
072-21	Capturing the molecular content of LSB galaxies: the bright starburst in UGC731	Maria Jesus Jimenez Donaire, Sarah Leslie, Jason Young
075-21	Molecular gas in the spiral-rich nearby cluster Abell 262	Nikki Zabel, Julia Healy, Christine Wilson, Timothy Davis, Marc Verheijen, Toby Brown, Tirna Deb
076-21	Revealing the Molecular Reservoir of the Largest Spiral Galaxy	Mark Gorski, Pauline Barmby, Susanne Aalto, Sabine König
077-21	Molecular gas in intra-cluster multiphase orphan cloud	Pavel Jachym, Ming Sun, Masafumi Yagi, Chong Ge, Rongxin Luo, Francoise Combes, Anezka K abatova
078-21	Molecular Emission in Intermediate Seyfert Galaxies	Alenka Negrete, Monica Rodriguez, Angel Bongiovanni, Miguel Sánchez Portal, Yair Krongold, Irene Cruz-Gonzalez, Erika Benitez, Sara Cazzoli, Anahi Caldu-Primo, Edgar Cortez, Anna Lia Longinotti, Arturo Gomez-Ruiz
079-21	Probing the effect of the cluster environment on molecular gas of distant brightest cluster galaxies	Gianluca Castignani, Francoise Combes, Philippe Salome, Lauro Moscardini, Mario Radovich, Matteo Maturi
080-21	Time sequence of merging galaxies, and evolution path at z=0.07	Barbara Mazzilli-Ciraulo, Anne-Laure Melchior, Francoise Combes, Daniel Maschmann
081-21	Re-visiting molecular absorption towards two Blazars: PKS 1413+135 and B3 1504+377	Tommy Wiklind, Francoise Combes
082-21	Molecular gas properties in CO-luminous protocluster galaxies	Maria del Carmen Polletta, Matthew Lehnert, Herve Dole, Brenda Frye
083-21	The Star Formation and the Environments of Radio Galaxies at z > 4	Yali Shao, Axel Weiss, Karl M. Menten, Ran Wang

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084-21	Probing the structure of a distant merging galaxy cluster	Matteo Maturi, Lauro Moscardini, Remi Adam, Gianluca Castignani, Mario Radovich
085-21	Deep tSZ and kSZ imaging of a triple-merger system within a supercluster	Kaustuv Basu, Ankur Dev, Juan Macias-Perez, A. Monfardini, Esra Bulbul, A. Merloni, Thomas Reiprich, Duy Hoang, Matthias Klein, Marcus Brueggen, Frank Bertoldi
086-21	ARSENAL: intermediate Redshift Sz cluster N1kA2 time filter: a demo run	Francois-Xavier Desert, Remi Adam, Nabila Aghanim, Philippe Andre, H. Aussel, Iacopo Bartalucci, Alain Benoit, O. Bourrion, Denis Burgarella, M. Calvo, Marco De Petris, Marian Douspis, S. Doyle, Eduard Driessen, Florian Kerzore, Carsten Kramer, Bilal Ladjelate, Guilaine Lagache, Jean-Francois Lestrade, P. Mouskops, Frederic Mayet, Jean-Baptiste Melin, A. Monfardini, Miren Muñoz Echevarria, Laurence Perotto, Juan Macias-Perez, Etienne Pointecouteau, Nicolas Ponthieu, Gabriel Pratt, Vincent Reveret, Alessia Ritacco, Charles Romero, Jose Alberto Rubino Martin, Florian Ruppig, Helene Roussel, Laura Salvati, Albrecht Sievers, Karl-Friedrich Schuster
087-21	POLAMI: Polarimetric Monitoring of AGN at Millimeter Wavelengths	Ivan Agudo, Carolina Casadio, Juan Escudero, Antonio Fuentes, Giacomo Bonnoli, Jose Enrique Ruiz, Jose L. Gomez, Clemens Thum, Ioannis Myserlis, Alan Marscher, Svetlana Jorstad, Efthalia Traianou, Joana Kramer, Nicholas MacDonald, Thomas Krichbaum, Eduardo Ros, Helmut Wiesemeyer, Anton Zensus, Jae-Young Kim, Venkatesh Ramakrishnan
090-21	The gas flow at multiple scales in star-formation	Jaime Pineda, Dominique Segura-Cox, Paola Caselli, Roberto Neri, Nichol Cunningham, Maria Maureira, Anika Schmiedeke, Silvia Spezzano, Stella Offner, Michael Kuffmeier, Mike Chen, Maria Teresa Valdivia Mena
091-21	Pre-stellar chemistry and dynamics in a massive infrared dark cloud	Ashley Thomas Barnes, Paola Caselli, Izaskun Jimenez-Serra, Jonathan Henshaw, Francesco Fontani, Jaime Pineda, Anna Punanova, Jonathan Tan, Giuliana Cosentino, Prasanta Gorai
092-21	Characterizing two modes of protostellar accretion with NOEMA: do the turbulent and magnetic energies regulate the growth of solar-type stars ?	Valentin le Gouellec, Anaëlle Maury
093-21	Probing the spatial origin of cyclopropenylidene isotopologues toward HH211	Sigurd Sigersen Jensen, Silvia Spezzano, Paola Caselli, Jaime Pineda, Dominique Segura-Cox
094-21	Core mass function and cloud-cloud collision in intermediate-mass star-forming regions	Fabien Louvet, Nichol Cunningham, Pierre Didelon, Frederique Motte, Antoine Gusdorf, Timea Csengeri, Sylvain Bontemps, Thomas Nony
095-21	Large scale spiral arms in AB Aur	Pablo Riviere-Marichalar, Dominique Segura-Cox, Jaime Pineda, Paola Caselli, Roberto Neri, Asuncion Fuente
096-21	Dust properties, temperatures, and the HCN X-factor of individual Giant Molecular Clouds in the Andromeda Galaxy, using unique NOEMA/SMA synergies	Jan Forbrich, Charles Lada, Christopher Faesi, Glen Petitpas, Sebastien Viaene, Jérôme Pety, Jonathan Toomey
097-21	Unveiling the cause for star formation suppression in bar regions by GMC observations toward the nearest barred galaxy Maffei 2	Fumiya Maeda, Kouji Ohta, Yusuke Fujimoto, Asao Habe, Yoshihisa ASADA
098-21	Dense Molecular Gas in the Outflow of M82	Fabian Walter, Alberto D. Bolatto, Nico Krieger, Axel Weiss, Adam Leroy, Sylvain Veilleux, Pierre Guillard, Matthew Lehnert, Dragan Salak, Rebecca Levy, Laura Lenkic, Maria Jesus Jimenez Donaire, Kimberly Emig
099-21	The First Cloud-by-Cloud Dense Gas Map of an External Galaxy	Eva Schinnerer, Frank Bigiel, Jérôme Pety, Antonio Usero, Adam Leroy, Annie Hughes, Miguel Querejeta, Cinthya Herrera Contreras, Ashley Thomas Barnes, Ilin Lazar, Cosima Eibensteiner, Jakob den Brok, Daizhong Liu, Johannes Puschner, Toshiki Saito, Axel García-Rodríguez, Sharon Meidt, Eric Emsellem, Jonathan Henshaw, Melanie Chevance, Diederik Kruijssen, Alex Hygate, Andreas Schruba, Maria Jesus Jimenez Donaire
D01-21	Hydrogen cyanide of the comet C/2020 T2 (Palomar)	Zhen Wang
EHT-2021.1.00767.V	Ultra-high resolution imaging of 3C84	Georgios Filippou Paraschos, Jae-Young Kim, Thomas Krichbaum, Maciek Wielgus, Tuomas Savolainen, Efthalia Traianou, Anton Zensus, Jeffrey Hodgson, Junghwan Oh, Yosuke Mizuno, Silke Britzen, Mikhail Lisakov, Rusen Lu, Zhiqiang Shen, Nicholas MacDonald, Eduardo Ros, Uwe Bach, Ilse Van Bemmel, Vassilis Mpsketzis
EHT-2021.1.00889.V	Delving Deeper into PKS 1510-089	Nicholas MacDonald, Thomas Krichbaum, Carolina Casadio, Rusen Lu, Eduardo Ros, Alan Marscher, Svetlana Jorstad, Jae-Young Kim
EHT-2021.1.00906.V	Capturing Real-Time Black Hole Dynamics in Sgr A*	Geoffrey Bower, Roman Gold, Andrew Chael, Kotaro Moriyama, V. Fish, Kazuhiro Hada, Sera Markoff, Eduardo Ros, Katherine Bouman, Chi-kwan Chan, Guangyao Zhao, Bong Won Sohn, Michael Johnson, Keiichi Asada, Lindy Blackburn, Mariafelicia De Laurentis, Kazunori Akiyama, Huib van Langevelde

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EHT-2021.1.00910.V	Connecting the black hole shadow and jet base in M87	Geoffrey Bower, Kazuhiro Hada, Huib van Langevelde, Sera Markoff, Remo Tilanus, Roman Gold, Keiichi Asada, Thomas Krichbaum, Jae-Young Kim, Tomohisa Kawashima, Rusen Lu, Jongho Park, Angelo Ricarte, Lindy Blackburn, Chi-kwan Chan, Geoffrey Crew, H. Rottmann, Lynn Matthews, V. Fish, Daniel Marrone, Monika Moscibrodzka, Ivan Marti-Vidal, Feryal Ozel, Bong Won Sohn, Kazunori Akiyama, George Wong, Lia Medeiros, Alejandra Jimenez-Rosales, Andrew Chael
EHT-2021.1.01324.V	Testing the binary black hole model for OJ287 with the EHT+ALMA	Jose L. Gomez, Thomas Krichbaum, Stefanie Komossa, Andrei Lobanov, Alan Marscher, Gabriele Bruni, Svetlana Jorstad, Yuri Kovalev, Carolina Casadio, Jae-Young Kim, Rusen Lu, Eduardo Ros, Anton Zensus, Silke Britzen, Tuomas Savolainen, Keiichi Asada, Masanori Nakamura, Kazunori Akiyama, Makoto Inoue, Kazuhiro Hada, Yosuke Mizuno, Mauri Valtonen, Achamveedu Gopakumar, Sunil Chandra, Sera Markoff, Ivan Marti-Vidal, Venkatesh Ramakrishnan, Geoffrey Crew, Cornelia Mueller, Hiroshi Nagai, Monika Moscibrodzka, Christian Fromm, Josep Marti, Manel Perucho, Staszek Zola, Alexander Tchekhovskoy, Adam Ingram, Matthew Liska, Michiel van der Klis, Antonio Fuentes, Luciano Rezzolla, Antonio Alberdi Odriozola, Michael Johnson, Dimitrios Psaltis, S. Doeleman, Guangyao Zhao, Rocco Lico, Sara Issaoun, Geoffrey Bower, Huib van Langevelde, Efthalia Traianou, Maciek Wielgus, Shami Chatterjee, Lankeswar Dey
EHT-2021.1.01431.V	Revealing the magnetic field in the jet acceleration zone of the Crazy Diamond	Efthalia Traianou, Thomas Krichbaum, Eduardo Ros, Jose L. Gomez, Georgios Filippos Paraschos, Joana Kramer, Antonio Fuentes, Rocco Lico, Nicholas MacDonald, Dongjin Kim, Felix Poetzl, Anton Zensus, Venkatesh Ramakrishnan, Guangyao Zhao, Ilje Cho, Svetlana Jorstad
EHT-2021.1.01458.V	Resolving the gamma-ray emission region and the jet collimation profile in TeV blazar Mrk 501	Shoko Koyama, Keiichi Asada, Motoki Kino, Masanori Nakamura, Kazuhiro Hada, Marcello Giroletti, Gabriele Giovannini, Monica Orienti, Eduardo Ros, Thomas Krichbaum, David Paneque, Kotaro Niinuma, Guangyao Zhao, Rocco Lico, Hiroshi Nagai, Kazunori Akiyama, Jan Carlos Algaba, Wen-Ping Lo, Michael Nowak, Mislav Balokovic, Venkatesh Ramakrishnan, Zhiqiang Shen, Anton Zensus, Silke Britzen, Svetlana Jorstad, Sunil Chandra, Feng Yuan, Ye-Fei Yuan, Timothy Davis, Jose L. Gomez, Tuomas Savolainen, David James, Mark Gurwell, Norbert Schartel, Yuzhu Cui, Heino Falcke, Daniela Dorner
GMVA-21A-209-MP2	Where is the black hole in 3C84 located?	Georgios Filippos Paraschos, Thomas Krichbaum, Jeffrey Hodgson, Junghwan Oh, Jae-Young Kim, Tuomas Savolainen, Efthalia Traianou, David Hughes, Michael Bremer, Anton Zensus
GMVA-21B-164-MT2	Moving and stationary shocks interaction after a gamma-ray flare in TXS2013+370	Efthalia Traianou, Matthias Kadler, Thomas Krichbaum, Dongjin Kim, Roberto Angioni, Anne-Kathrin Baczko, Biagina Boccardi, Eduardo Ros, Uwe Bach, Anton Zensus
GMVA-21B-281-MT4	Probing Relativistic Jets through mm-VLBI of X-ray Binaries	Alexandra Tetarenko, Venkatesh Ramakrishnan, Maciek Wielgus, Geoffrey Bower, Thomas Krichbaum, Eduardo Ros, Sera Markoff
GMVA-21A-336-MB18	Bulk acceleration and jet internal structure in NGC315	Biagina Boccardi, Thomas Krichbaum, Manel Perucho, V. Karamanavis, Uwe Bach, Eleonora Torresi, Paola Grandi, Georgios Filippos Paraschos, Anton Zensus

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D20AB	Completing z-GAL: the Comprehensive Redshift Survey of Bright Herschel Galaxies	Pierre Cox, Tom Bakx, Helmut Dannerbauer, Roberto Neri
D20AG	Request for Continued Observations of AT2020xnd: Establishing A New Class of Millimeter-Bright Transients	Anna Ho, Yuhan Yao, Daniel Perley, David Kaplan, Dougal Dobie, Andrew O'Brien
E20AA	NOEMA-SPONGE	Daniel Rybarczyk, Snezana Stanimirovic
E20AB	A systematic search for ultra-bright strongly lensed galaxies in the Planck all-sky survey	Mattia Negrello, Gianfranco De Zotti, Matteo Bonato, Tiziana Trombetti, Carlo Burigana, Amvrosiadis Aristeidis, Roberto Neri, Stefano Berta, Pierre Cox
E21AA	Constraining the Synchrotron Spectrum of Radio-bright TDE AT2021sdu	Tanmoy Laskar, Kate D. Alexander, Tarraneh Eftekhari, Dheeraj Pasham, Ryan Chornock, Raffaella Margutti, James Miller-Jones, Yvette Cendes
L19MA	Galactic star formation MIOP: From clouds to cores	Karl M. Menten, Friedrich Wyrowski, Henrik Beuther, Gisela Ortiz Leon, Thanh Dat Hoang, Antonio Hernandez-Gomez, Sumeyye Suri, Caroline Gieser, Nicola Schneider, Tímea Csengeri, Sylvain Bontemps, Frederique Motte, Nichol Cunningham, Jan Martin Winters, Ka Tat Wong, Wonju Kim
L19MB	From Protostars to Planet-Forming Disks	Paola Caselli, Thomas Henning, Jaime Pineda, Dominique Segura-Cox, Dmitry Semenov, Bo Zhao, Mario Tafalla, Grigori Smirnov-Pinchukov, Cecilia Ceccarelli, Edwige Chapillon, Nichol Cunningham, Anne Dutrey, Stephane Guilloteau, Izaskun Jimenez-Serra, Ana Lopez-Sepulcre, Sebastian Marino, Maria Maureira, Roberto Neri, Vincent Pietu, Asuncion Fuente
L19MD	NOEMA3D: a Comprehensive Census of the Molecular Gas Distribution & Kinematics of Massive Main-Sequence Star Forming Galaxies at the Peak and Winding Down of Galaxy Formation Activity	Reinhard Genzel, Roberto Neri, Linda Tacconi, Natascha Förster Schreiber, Dieter Lutz, Karl-Friedrich Schuster, Alessandra Contursi, Melanie Krips, Stefano Berta, Fabian Walter, Axel Weiss, T. Naab, Richard Davies, Minju Lee, Sedona Price, Thomas Taro Shimizu, Eckhard Sturm, Hannah Uebler, Françoise Combes, David Elbaz, Pierre Cox, Santiago Garcia-Burillo, Antonio Usero, Alberto D. Bolatto, Monica Rubio, Tadayuki Kodama, Rodrigo Herrera-Camus, Ken-Ichi Tadaki, Alvio Renzini, Amiel Sternberg, Andreas Burkert, Avishai Dekel, S. Wuyts, Cinthya Herrera Contreras
L19ME	From Protostars to Planet-Forming Disks	Paola Caselli, Thomas Henning, Jaime Pineda, Dominique Segura-Cox, Dmitry Semenov, Bo Zhao, Mario Tafalla, Grigori Smirnov-Pinchukov, Cecilia Ceccarelli, Edwige Chapillon, Nichol Cunningham, Anne Dutrey, Stephane Guilloteau, Izaskun Jimenez-Serra, Ana Lopez-Sepulcre, Sebastian Marino, Maria Maureira, Roberto Neri, Vincent Pietu, Asuncion Fuente
M19AA	The First Cloud-by-Cloud Dense Gas Map of an External Galaxy	Eva Schinnerer, Frank Bigiel, Jerome Pety, Antonio Usero, Adam Leroy, Annie Hughes, Miguel Querejeta, Cinthya Herrera Contreras, Ashley Thomas Barnes, Ilin Lazar, Cosima Eibensteiner, Jakob den Brok, Daizhong Liu, Johannes Puschniig, Toshiki Saito, Axel Garcia-Rodriguez, Sharon Meidt, Eric Emsellem, Jonathan Henshaw, Melanie Chevance, Diederik Kruijssen, Alex Hygate, Andreas Schrubba, Maria Jesus Jimenez Donaire
M21AA	NOEMA forming-Clusters Evolution survey (NICE): unveiling the physics of galaxies and structure assembly at $2 < z < 3.5$	Emanuele Daddi, Tao Wang, Luwenjia Zhou, Shuowen Jin, Vinodiran Arumugam, Laure Ciesla, Yan-mei Chen, Rosemary Coogan, Ivan Delvecchio, Chiara D'Eugenio, David Elbaz, Alexis Finoguenov, Raphael Gobat, Qiusheng Gu, Carlos Gomez-Guijarro, Boris Sindhu Kalita, Aurelien Le Bail, Daizhong Liu, Lu Shiyang, Georgios Magdis, Benjamin Magnelli, Eva Schinnerer, Yong Shi, Veronica Strazzullo, Mike Rich, Qinghua Tan, Francesco Valentino, Mengyuan Xiao, Zhiyu Zhang, Yijun Wang, Zheng Cai, Jiasheng Huang, Y. Sophia Dai, Yu Gao
S20AL	Disruption or Assembly? The Origin of the Widespread SiO Emission in a Massive IRDC	Wonju Kim, Gary Fuller, Nichol Cunningham, Nicolas Peretto, Fabien Louvet, Di Li, Jinjin Xie, Bethany Jones, Ken'ichi Tatematsu, Adam Avison, James Urquhart, Ka Tat Wong
S20AM	Marking the End of Evolution: The association of class II methanol masers with high-mass star formation	Nichol Cunningham, Gary Fuller, Adam Avison, Alessio Traficante, Bethany Jones, Shari Breen, Wonju Kim
S20BD	Mapping two Relic Compact Elliptical Galaxies	Françoise Combes, Philippe Salome, Valeria Olivares
S20BJ	Probing Merger-driven Gas Inflows in Dual-AGNs	Meicun Hou, Zhiyuan Li, Zongnan Li, Xin Liu
S21AA	The Transition from CO- to H ₂ O-Dominated Outgassing in Recently Discovered Oort Cloud Comet C/2021 A1 (Leonard)	Nathan Roth, Stefanie Milam, Martin Cordiner, Jeremie Boissier, Dominique Bockelee-Morvan, Nicolas Biver, Michael A. Disanti, Boncho Bonev, Neil Dello Russo, Steven Charnley
S21AD	The gas flow at multiple scales in star-formation	Jaime Pineda, Dominique Segura-Cox, Paola Caselli, Roberto Neri, Nichol Cunningham, Maria Maureira, Anika Schmiedeke, Silvia Spezzano, Stella Offner, Michael Kuffmeier, Mike Chen, Maria Teresa Valdivia Mena
S21AE	Density and velocity structure of a quiescent portion of the OMC 3 filament	Philippe Andre, Yoshito Shimajiri, Eva Ntormousi, Doris Arzoumanian
S21AF	Pre-stellar chemistry and dynamics in a massive infrared dark cloud	Ashley Thomas Barnes, Paola Caselli, Izaskun Jimenez-Serra, Jonathan Henshaw, Francesco Fontani, Jaime Pineda, Anna Punanova, Jonathan Tan, Giuliana Cosentino, Prasanta Gorai

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S2IAH	The Water Content and D/H ratio of Protostellar Envelopes	Merel van 't Hoff, Edwin A. Bergin
S2IAI	Characterizing two modes of protostellar accretion with NOEMA: do the turbulent and magnetic energies regulate the growth of solar-type stars ?	Valentin le Gouellec, Anaëlle Maury
S2IAL	A Robust Mass Determination of FU Ori Objects	Jenny Calahan, Edwin A. Bergin, Ke Zhang
S2IAN	Probing Hierarchical Gas Fragmentation and Evolution of the Young Star Formation Regions in NGC 2264	Benjamin Thomasson, Stuart Lumsden, Frederique Motte, Estelle Moraux, Isabelle Joncour, Thomas Nony, Yohan Pouteau, Nichol Cunningham
S2IAO	Linking fragmentation with the evolutionary stage in twin hubs in the IRDC G14.225-0.506	Gemma Busquet, Nacho Anez, Josep Miquel Girart, Ana Lopez-Sepulcre, Aina Palau, Robert Estalella, Anaëlle Maury, Maud Galametz, Bo Huang, Qizhou Zhang
S2IAP	Disentangling the Spatial Distributions and Kinematics of COMs in W3(H ₂ O)	Susanna Widicus Weaver, Darek LIS, Hayley Bunn, Gustavo Cruz-Diaz, Jonathan Rebelsky, William Thompson, Connor Wright, Katarina Yocum
S2IAQ	CO, CF ⁺ and CN absorption line study as a bridge between hydrides and heavier species in the diffuse interstellar medium	Wonju Kim, David Neufeld, Peter Schilke, Arshia Jacob, Maryvonne Gerin, Karl M. Menten, Friedrich Wyrowski, Alvaro Sanchez-Monge
S2IAS	Toward a complete volume limited sample of Herbig disks	Alex Cridland, Alice Booth, Lucas Stapper, Michiel R. Hogerheijde, Ewine F. Van Dishoeck
S2IAT	Constraining the gas mass of protoplanetary disks using rare CO isotopologues: DM Tau case	Riccardo Franceschi, Dmitry Semenov, Sierk van Terwisga, Grigori Smirnov-Pinchukov, Thomas Henning
S2IAW	The first robust mass measurement of a Herbig disk	Ke Zhang, Leon Trapman
S2IAY	Long-lived, luminous millimeter transients from engine-powered stellar explosions in dense environments	Anna Ho, Daniel Perley, Yuhan Yao
S2IBA	Search for circumnuclear gas in nearby radio galaxies	Dongjin Kim, Christian Henkel, Thomas Krichbaum, Anton Zensus, Biagina Boccardi, Françoise Combes, Michael Bremer
S2IBC	Deriving Gas Masses with CO isotopologues in the Central 400pc of the Fireworks Galaxy, NGC6946	Cosima Eibensteiner, Ashley Thomas Barnes, Eva Schinnerer, Frank Bigiel, Johannes Puschnig, Ivana Beslic, Jakob den Brok, Daizhong Liu, Antonio Usero, Adam Leroy, David S. Meier, Torsten Boker, Toshiki Saito
S2IBE	Dense Molecular Gas in the Outflow of M82	Fabian Walter, Alberto D. Bolatto, Nico Krieger, Axel Weiss, Adam Leroy, Sylvain Veilleux, Pierre Guillard, Matthew Lehnert, Dragan Salak, Rebecca Levy, Laura Lenkic, Maria Jesus Jimenez Donaire, Kimberly Emig
S2IBH	Evolution Before the Merger: Structure & Kinematics of Molecular Gas in NGC 5218	John Gallagher, Sabine König, Ralf Kotulla, Elena D'Onghia, Susanne Aalto, Flora Stanley
S2IBI	Approaching the central engine in radio-quiet AGN	Pierre-Olivier Petrucci, Ehud Behar, Mickael Coriat, Vincent Pietu, Stephane Corbel, Gilles Henri, Julien Malzac, Maica Clavel, Samuel Barnier, Jonathan Ferreira, Renaud Belmont, Jerome Rodriguez
S2IBJ	Dense gas tracers in radio galaxies with signatures of AGN-suppressed star formation	Nicole Nesvadba, Reinier Janssen
S2IBL	Unraveling the Physics that Enables Lyman Alpha Escape	Johannes Puschnig, Matthew Hayes, Göran Östlin, Toshiki Saito, Ivana Beslic, Melanie Krips
S2IBM	Mapping molecular gas in the most spectacular Halpha nebula in group cool cores	Ming Sun, Françoise Combes, Alastair Edge, William R. Forman, Hao Chen
S2IBP	The impact of jets on the cold molecular gas in radio galaxies	Raffaella Morganti, Suma Murthy, Pierre Guillard, Tom Oosterloo, Dipanjan Mukherjee, Santiago Garcia-Burillo
S2IBQ	Unveiling a merger event at z=0.09	Barbara Mazzilli-Ciraulo, Anne-Laure Melchior, Françoise Combes, Daniel Maschmann
S2IBR	Looking for molecular gas in Super Spiral Galaxies	Philippe Salome, Françoise Combes
S2IBT	Confirming the possible CO molecular outflow in ultraluminous infrared QSO IRAS F07599+6508	Qinghua Tan, Emanuele Daddi, Yu Gao, Caina Hao, Alain Omont, Kotaro Kohno, Xianzhong Zheng
S2IBX	A rapidly cooling core cluster after a merging: CHIPS1911+4455	Françoise Combes, Gianluca Castignani, Philippe Salome
S2IBY	Molecular Gas Content and Star Formation Efficiencies of Barred Spiral Galaxies in the Green Valley at Half the Hubble Time	Elena D'Onghia, Zhiyuan Ji, Mauro Giavalisco, Giulia Rodighiero, Matthew Bershad, Laura Morselli, Paolo Cassata, Rachel Lee McClure
S2IBZ	Probing gas fueling in two distant star-forming brightest cluster galaxies (BCGs)	Pascale Jablonka, Gianluca Castignani, Michael Balogh, Françoise Combes, Philippe Salome, Adam Muzzin
S2ICB	A comprehensive survey of dense gas tracers in high-z star-forming galaxies	Matus Rybak, Paul van der Werf, Marta Frias Castillo, Serena Viti, Dominik A. Riechers, Fabian Walter, Jacqueline Hodge
S2ICC	Constraining the nature of low-luminosity SMGs	Helmut Dannerbauer, Nikolaus Sulzenauer, Anastasio Diaz-Sanchez

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S2ICF	Resolving the [C I] and Mid-J CO Line Emission from Giant Molecular Clouds in Strongly Lensed Starbursts at $z = 2-3$	Kevin Harrington, Axel Weiss, Eric Faustino Jimenez-Andrade, Frank Bertoldi, David Frayer, Patrick Kamieneski, Q. Daniel Wang, Amit Vishwas, Nichol Cunningham, Gordon Stacey, Daizhong Liu, Brenda Frye, Helmut Dannerbauer, Anastasio Diaz-Sanchez, Tom Bakx, Abhinav Tyagi, Massimo Pascale, Nick Foo, Jack Thompson, Benjamin Magnelli
S2ICG	The impact of extreme AGN-driven outflows on the molecular gas reservoir unveiled by NOEMA	V. Mainieri, Chiara Circosta, Alessandra Contursi, Manuela Bischetti, Chiara Feruglio, Darshan Kakkad, Enrico Piconcelli, Giustina Vietri, Samuel Ward
S2ICI	A quest for massive molecular gas reservoirs within the cosmic web filaments at $z = 2.3$	Hideki Umehata, Yoichi Tamura, Kotaro Kohno, Kouichiro Nakanishi, Yuichi Matsuda, Mariko Kubo
S2ICK	Molecular Gas and Dynamics in an Exemplar System for AGN Feedback at $z=2.5$	Ryan Trainor, Eduardo Banados, Scott Chapman, Chuck Steidel, Gwen Rudie
S2ICL	Direct Measurements of the CMB Temperature across Cosmic History	Dominik A. Riechers, Axel Weiss, Fabian Walter, Chris L. Carilli, Pierre Cox, Roberto Decarli, Roberto Neri
S2ICO	Dusty galaxies as signposts for distant protocluster cores at $z>3-4$	Katarina Kraljic, Darko Donevski, Allison Man, Tom Bakx, Anna Feltré, Christopher Lovell, Laya Ghodsi, Pauline Vielzeuf
S2ICS	NOEMA's unobscured view on the host galaxies of a $z\sim 3.3$ binary quasar	Jan-Torge Schindler, Eduardo Banados, Fabian Walter, Marcel Neeleman, Joseph Hennawi, Roberto Decarli
S2ICT	A direct comparison of the ground-state [C I] and CO lines in a high-redshift SMG	Marta Frias Castillo, Jacqueline Hodge, Matus Rybak, Paul van der Werf, Dominik A. Riechers, Fabian Walter, Roberto Decarli
S2ICW	Spectroscopic Redshifts of Distant, Moderately-Luminous Submillimeter Galaxies	Michael Rosenthal, Amy Barger, Lennox Cowie, Logan Jones
S2IDA	A large number of unknown dusty galaxies at $z>5$: near-infrared dropouts (resubmission)	Daizhong Liu, Eva Schinnerer, Benjamin Magnelli, Emanuele Daddi, Shuowen Jin, Sarah Leslie, Alexander Karim
S2IDD	Excitation of the molecular gas in the host galaxies of the optically faint quasars at $z\sim 6$	Ran Wang, Jianan Li, Roberto Neri, Roberto Decarli, Fabian Walter, Jeff Wagg, Frank Bertoldi, Chris L. Carilli, Alain Omont, Pierre Cox, Bram Venemans, Karl M. Menten, Yali Shao, Michael A. Strauss
S2IDG	The origin of extreme [C II] and FIR continuum emission in the radio and X-ray brightest quasars at $z>6$	Yana Khusanova, Eduardo Banados, Fabian Walter, Bram Venemans, Roberto Decarli, Chiara Mazzucchelli, Mladen Novak, Sofia Rojas
S2IDH	HYPeRluminous quasars at the Epoch of Reionization (HYPERION) Survey with NOEMA	Chiara Feruglio, Luca Zappacosta, Enrico Piconcelli, Manuela Bischetti, Fabrizio Fiore, Roberta Tripodi, Simona Gallerani, Stefano Carniani, Livia Vallini, Michele Ginolfi
S2IDI	A molecular line scan on the IR-luminous quasar PJ083+11 at $z=6.34$	Roberto Decarli, Irham Taufik Andika, Knud Jahnke, Masafusa Onoue, Antonio Pensabene, Fabian Walter, Eduardo Banados, Bram Venemans
S2IDK	The host galaxy of the most distant radio-quasar known at $z=7$	Eduardo Banados, Yana Khusanova, Sofia Rojas, Chiara Mazzucchelli, Roberto Decarli, Bram Venemans, Fabian Walter
S2IDL	Unveiling the Nature of a Dust-reddened Quasar Hosting a Ten-Billion Solar Mass Black Hole at $z=7.1$	Jinyi Yang, Bram Venemans, Xiaohui Fan, Feige Wang, Fabian Walter, Roberto Decarli, Fuyan Bian
S2IDM	Vigorously Turbulent Starburst Core in a Red Quasar Host at $z=7.2$	Seiji Fujimoto, Fabian Walter, Gabriel Brammer, Darach J. Watson, Francesco Valentino, Georgios Magdis, Luis Colina, Melanie Krips, Vasily Kokorev, Isabella Cortzen, Sune Toft, Charles Steinhardt, M. Vestergaard, Rui Marques-Chaves, Michele Ginolfi, Raffaella Schneider, Rosa Valiante
W18CS	Probing the molecular gas content in galaxies with gas flows: a test case for self-regulated star formation models	Nicolas Bouche, Thierry Contini, Jonathan Freundlich, Leo Michel-Dansac, Ilane Schroetter, Johan Richard, Johannes Zabl
W19AG	Envelope to Disk: The Composition of Accretion	Dominique Segura-Cox, Jaime Pineda, Paola Caselli, Anika Schmiedeke, Nichol Cunningham, Maria Maureira
W19AI	Are disk asymmetries driven by large scale accretion flows?	Jaime Pineda, Anika Schmiedeke, Paola Caselli, Dominique Segura-Cox, Bo Zhao, Nichol Cunningham, Roberto Neri, Maria Maureira
W20AA	The intriguing mm-spectrum of Iapetus	Emmanuel Lellouch, Alice Le Gall, Lea E Bonnefoy, Cedric Leyrat, Raphael Moreno, Jeremie Boissier
W20AD	Carbon-grain Sublimation: A New Top-down Component of Protostellar Chemistry	Merel van 't Hoff, Edwin A. Bergin, Jes Jorgensen, Ke Zhang
W20AE	The Water Content and D/H ratio of Protostellar Envelopes	Merel van 't Hoff, Edwin A. Bergin
W20AF	Connecting scales in protostellar disk formation	Edwin A. Bergin, Merel van 't Hoff, Felipe Alarcon, Arthur Bosman, Jane Huang, Kamber Schwarz, Jenny Calahan, John Tobin
W20AH	Chemically and Kinematically Probing into the Disks of Two Class 0 Protostars	Dominique Segura-Cox, Jaime Pineda, Paola Caselli, Thomas Henning, Dmitry Semenov, Bo Zhao, Mario Tafalla, Grigori Smirnov-Pinchukov, Cecilia Ceccarelli, Edwige Chapillon, Nichol Cunningham, Anne Dutrey, Stephane Guilloteau, Izaskun Jimenez-Serra, Ana Lopez-Sepulcre, Sebastian Marino, Maria Maureira, Roberto Neri, Vincent Pietu, Asuncion Fuente
W20AI	In search for prebiotic molecules towards solar-like protostars	Sheng-Li Qin

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W20AJ	Distinguishing between envelope and embedded disk chemistry of Class I YSOs	Romane Le Gal, Karin Öberg, Ana Lopez-Sepulcre, Charlotte Vastel, Jane Huang, Francois Menard, Charles Law, Bertrand Lefloch, Cecilia Ceccarelli, Cecile Favre, Eleonora Bianchi, Clement Baruteau, Asuncion Fuente, Pablo Riviere-Marichalar, Anaëlle Maury, David Navarro Almada, Edwin A. Bergin, Emmanuel Caux
W20AQ	The OMC-2 FIR6c outflow: A new astrochemical laboratory	Mathilde Bouvier, Ana Lopez-Sepulcre, Cecilia Ceccarelli, Nadia Balucani, Claudio Codella, Marta De Simone, Joan Enrique-Romero, Bertrand Lefloch, Pedro Ruben Rivera-Ortiz, Nami Sakai, Andre Schutzer, Fanny Vazart, Satoshi Yamamoto
W20AS	Core mass function and cloud-cloud collision in intermediate-mass star-forming regions	Fabien Louvet, Nichol Cunningham, Pierre Didelon, Frederique Motte, Antoine Gusdorf, Tímea Csengeri, Sylvain Bontemps, Thomas Nory
W20AV	CORE+: Deuterium and shock chemistry in high-mass star-forming regions	Caroline Gieser, Sumeyye Suri, Henrik Beuther, Tímea Csengeri, Dmitry Semenov, Peter Schilke, Maria Teresa Beltran, Jan Martin Winters, Thomas Möller, Siyi Feng, Luca Moscadelli, James Urquhart, Qizhou Zhang, Silvia Leurini, Hans Zinnecker, S. Longmore, Aina Palau, Pamela Klaassen, Aida Ahmadi, Rolf Kuiper, Hendrik Linz, Roberto Galvan-Madrid, Friedrich Wyrowski, Alvaro Sanchez-Monge, Stuart Lumsden
W20BA	Cosmic Ray acceleration caught in the act: W51C	Rolf Guesten, Rebeca Aladro, Helmut Wiesemeyer
W20BB	Investigating the deuterium fraction in the diffuse and translucent clouds through sensitive absorption observations	Luo Gan, Zhiyu Zhang, Siyi Feng, Thomas Bisbas
W20BC	The Molecular Content of Small Protoplanetary Disks	Vincent Pietu, Melisse Jean-Paul, Anne Dutrey, Stephane Guilloteau, Edwige Chapillon, Emmanuel Di Folco
W20BE	Probing a Protoplanetary Disk's Interaction with Its Environment	Jane Huang, Myriam Benisty, Edwin A. Bergin, Arthur Bosman, Jaehan Bae, Sean Andrews
W20BG	Molecular inventory of AB Aur: sulphuretted species	Pablo Riviere-Marichalar, Asuncion Fuente, Clement Baruteau, Romane Le Gal, Roberto Neri, Sandra Trevino-Morales, David Navarro Almada, Enrique Macias, Alvaro Ribas, Gisela Esplugues
W20BI	Mapping the complex molecular outflows of the RSG NML Cyg	Holly Andrews, Guillermo Quintana-Lacaci, Elvire De Beck, Lucy Ziurys, Ambesh Pratik Singh
W20BJ	The unsettled environment of Betelgeuse with NOEMA after the Great Dimming	Miguel Montarges, Fabrice Herpin, W. Homan, Eric Lagadec, Anita M. S. Richards, Ka Tat Wong, Alex de Koter, Pierre Kervella, Emily Cannon, Claudia Paladini, Taissa Danilovich, Sofia Wallstrom, Andrea Dupree, Andrea Chiavassa, Thavisha Dharmawardena, Peter Scicluna, Guy Perrin, Gioia Rau, William Danchi, Stephen Ridgway, Karl M. Menten, Iain McDonald, Albert Zijlstra, Ryan Norris, Steve Mairs
W20BK	Determining the cause of the extremely unusual behaviour of Betelgeuse with NOEMA	Thavisha Dharmawardena, Karl M. Menten, Ka Tat Wong, Iain McDonald, Albert Zijlstra, Steve Mairs, Peter Scicluna, Miguel Montarges, Anita M. S. Richards, Fabrice Herpin
W20BL	Mapping the structures of 21-micron sources: IRAS 06530-0213	Yong Zhang, Jun-ichi Nakashima, Sheng-Li Qin, Qiu Jian-Jie
W20BN	Dust properties, temperatures, and the HCN X-factor of individual Giant Molecular Clouds in the Andromeda Galaxy, using unique NOEMA/SMA synergies	Jan Forbrich, Charles Lada, Christopher Faesi, Glen Petitpas, Sebastien Viaene, Jerome Pety, Jonathan Toomey
W20BO	Long-lived, luminous millimeter transients from engine-powered stellar explosions in dense environments	Anna Ho, Daniel Perley, Yuhan Yao, Shrinivas Kulkarni
W20BT	Resolving optically thin dense gas tracers towards the starburst galaxy M82	Fei Li, Zhiyu Zhang, Junzhi Wang, Shanghuo Li
W20BV	CO observation of a star-forming S0 galaxy PGC 44685 with multi star-forming knots	Lu Shiyong, Xue Ge, Qiusheng Gu
W20BY	Weighing the binary black hole system in 3C66B	Kyoko Onishi, Satoru Iguchi, Hiroshi Sudou, Susanne Aalto
W20CD	Cold molecular outflow in PG 1211+143 with a strong X-ray ultrafast outflow	Misaki Mizumoto, Takuma Izumi, Kotaro Kohno
W20CF	Imaging the molecular gas content in low-redshift luminous AGN-starburst systems	Ran Wang, Jinyi Shangguan, Luis Ho, Roberto Neri, Juan Molina Tobar, Qinyue Fei
W20CG	Unveiling the MS to SB transition with a sample of intermediate redshift ULIRGs	Santiago Garcia-Burillo, Dimitra Rigopoulou, Georgios Magdis, Miguel Pereira Santaella, Françoise Combes, Ismael Garcia-Bernet, Almudena Alonso-Herrero, Axel Weiss
W20CK	Properties of Faint SubMillimeter Galaxies: paving the way for JWST	Veronique Buat, Jorge Zavala, Denis Burgarella, Caitlin Casey, Laure Ciesla, Casey Papovich, Mark Dickinson, David Elbaz, Justin Spilker, Emanuele Daddi
W20CO	Tracing the Molecular Gas in GW-recoil Candidate 3C 186	Gianluca Castignani, Françoise Combes, Marco Chiaberge, Eileen Meyer, Roberto Decarli, Grant R. Tremblay, M. Dotti

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W20CW	The molecular gas properties of high-z galaxies as traced by [CII] and CO	Isabella Cortzen, Roberto Neri, Pierre Cox, Stefano Berta, Anthony Young, Alain Omont, Flora Stanley, Tom Bakx, Helmut Dannerbauer, Alexandre Beelen, Dominik A. Riechers, Axel Weiss, Andrew Baker, Steve Eales, Rob Ivison, Shuowen Jin, R. Gavazzi, Stephen Serjeant, Lucia Marchetti, Mattia Negrello, Matthew Lehnert, Melanie Krips, Ismael Perez-Fournon, Asantha Cooray, Chentao Yang, Sheona Urquhart, Hugo Messias, Veronique Buat, Catherine Vlahakis, Paul van der Werf, Loretta Dunne, Andrew Harris
W20DA	The gas mass fraction, spatial distribution and kinematics of star forming galaxies at $z \sim 2$	Elena D'Onghia, Paolo Cassata, Zhiyuan Ji, Giulia Rodighiero, Laura Morselli, Mauro Gialalisco, Matthew Bershad
W20DB	Molecular gas across the circum-galactic medium of Enormous Ly α Nebulae	Qiong Li, Jiangtao Li, Ran Wang, Jianan Li
W20DC	A multi-phase, multi-scale, multi-wavelength investigation of quasar feedback at high redshift. NOEMA: The dense molecular component.	Pasquier Noterdaeme, Sergei Balashev, Jens-Kristian Krogager, Françoise Combes, Neeraj Gupta, Raghunathan Srikanth
W20DD	A Survey of CO(3-2) in the 20Mpc environment of HSI549+19, the most overdense protocluster known at $z > 2$	Scott Chapman, Frank Bertoldi, Ian Smail, Chuck Steidel, Yuichi Matsuda, Manuel Aravena, Nikolaus Sulzenauer
W20DH	A Massively Star-forming Proto-cluster in the GOODS-N	Logan Jones, Amy Barger, Lennox Cowie, Michael Rosenthal
W20DK	Unveiling the host galaxies of the most luminous quasars at $z \sim 3.5$	Jan-Torge Schindler, Bram Venemans, Fabian Walter, Eduardo Banados, Marcel Neeleman
W20DM	A critical test of the nature of cold dust in submillimeter bright galaxies at $z \sim 4$	Emanuele Daddi, Shuowen Jin, Georgios Magdis, Daizhong Liu, Eva Schinnerer, Francesco Valentino, Yu Gao, Antonello Calabró, Isabella Cortzen
W20DN	A survey for atomic carbon and CO at $z \sim 4$	Axel Weiss, Scott Chapman, Mark Swinbank, Ian Smail, Fabian Walter, Jack Birkin, Jacqueline Hodge, Chian-Chou Chen, Ryley Hill, Rob Ivison, Julie Wardlow, Yuichi Matsuda, Paul van der Werf
W20DR	Towards probing the gas and dust in intense starbursts and AGN in the first 2 Gyrs with IRAM and LOFAR: A pilot study	Nicole Nesvadba, Rachel Cochrane, Philip Best, Rohit Kondapally, Kenneth Duncan
W20DX	NOEMA line scans toward $z > 5$ candidate ALMA-AzTEC SMGs (Continue)	Soh Ikarashi, Rob Ivison, Karina Caputi, Kotaro Kohno
W20DZ	A large number of unknown dusty galaxies at $z > 5$: near-infrared dropouts from ALMA archival data mining	Daizhong Liu, Eva Schinnerer, Benjamin Magnelli, Emanuele Daddi, Shuowen Jin, Sarah Leslie, Alexander Karim
W20EB	First Millimeter-wave Detection of the Brightest Object at $z > 5$	Antony A Stark, Mike Gladders, Gourav Khullar, Matthew Bayliss, Keren Sharon, Sasha Brownsberger
W20EE	Identifying $z > 6$ submillimeter galaxy from PdBI heritage	Shuowen Jin, Helmut Dannerbauer, Matthew Lehnert, Jose Miguel Rodriguez Espinosa
W20EG	NOEMA [CII] survey of UV-faint $z > 6$ quasars in extreme starbursts	Eduardo Banados, Roberto Decarli, Chiara Mazzucchelli, Fabian Walter, Yana Khusanova, Jan-Torge Schindler, Masafusa Onoue, Bram Venemans, Anna-Christina Eilers
W20EH	Unveiling the nature of the most optically-dark galaxies at $z \sim 6$	David Elbaz, Emanuele Daddi, Xinwen Shu, Kotaro Kohno, Laure Ciesla, XianZhong Zheng, Maximilien Franco, Tao Wang, Daizhong Liu
W20EM	Resolved [CII] Kinematics and ISM Properties of a $z > 6$ Galaxy	Natascha Förster Schreiber, Rodrigo Herrera-Camus, Linda Tacconi, Reinhard Genzel, Roberto Neri, Dieter Lutz, Karl-Friedrich Schuster, Melanie Krips, Stefano Berta, Fabian Walter, T. Naab, Richard Davies, Minju Lee, Sedona Price, Thomas Taro Shimizu, Eckhard Sturm, Hannah Uebler, Françoise Combes, David Elbaz, Pierre Cox, Santiago Garcia-Burillo, Alberto D. Bolatto, Tadayuki Kodama, Ken-Ichi Tadaki, Alvio Renzini, Amiel Sternberg, Andreas Burkert, Avishai Dekel, S. Wuyts, Antonio Usero, Monica Rubio, Axel Weiss
W20EO	A Vigorously Star-forming Red Quasar Firstly Discovered at $z > 7$	Seiji Fujimoto, Gabriel Brammer, Sune Toft, Georgios Magdis, Francesco Valentino, Charles Steinhardt, Isabella Cortzen, Luis Colina, Rui Marques-Chaves, Thomas R. Greve, M. Vestergaard, Peter Jakobsen, Vasily Kokorev
W21AC	NOEMA-SPONGE: Chemistry and dark molecular gas in the diffuse ISM	Daniel Rybarczyk, Snezana Stanimirovic
W21AI	The complex organic chemistry of FUor objects	Audrey Coutens, Fernando Cruz-Saenz de Miera, Agnes Kospal, Anne Dutrey, Stephane Guilloteau
W21BE	Confirming the presence of oxygen-rich gas in a protoplanetary disk around a T Tauri star	Jane Huang, Edwin A. Bergin, Romane Le Gal, Arthur Bosman, Myriam Benisty, Jaehan Bae, Sean Andrews
W21BU	Approaching the radio-quiet AGN central engine	Pierre-Olivier Petrucci, Vincent Pietu, Ehud Behar, Stefano Bianchi, Stephane Corbel, Gilles Henri, Mickael Coriat, Samuel Barnier, Renaud Belmont, Maica Clavel, Julien Malzac, Jonathan Ferreira
W21BW	Looking for the CO component of the multi-phase outflow in Mrk79	Anelise Audibert, Apostolos Kolokotronis, Kalliopi Dasyra, Françoise Combes
W21CL	Gas fueling in one of the strongest cool core BCGs	Philippe Salome, Gianluca Castignani, Françoise Combes

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W21CV	A Complete Census on the Counterparts of DSFGs in GOODS-N	Longji Bing, Guilaine Lagache, Alexandre Beelen, Matthieu Bethermin, Nicolas Ponthieu, Roberto Neri, Stefano Berta, Alain Omont, Veronique Buat, Denis Burgarella, Laure Ciesla, Francois-Xavier Desert, David Elbaz, Mengyuan Xiao, Juan Macias-Perez, Laurence Perotto, Jean-Francois Lestrade, Miguel Sanchez Portal
W21CZ	The circum-galactic environment of the most luminous quasars	Enrico Piconcelli, Chiara Feruglio, Fabrizio Fiore, Manuela Bischetti, Stefano Carniani, Michele Ginolfi, Angela Bongiorno
W21DD	The gas physico-chemical properties in the Cloverleaf Quasar: Detection of high excitation lines.	Michel Guelin, Alain Omont, Carsten Kramer, Jose Cernicharo, Belen Tercero, Chentao Yang
W21DF	Feedback and Fueling at the Peak of Cosmic Evolution	Pierre Cox, Roberto Neri, Tom Bakx, Stefano Berta, Kirsty Butler, Alain Omont, Paul van der Werf, Andrew Baker, Anthony Young, Alexandre Beelen, Diana Ismail, Asantha Cooray, Dominik A. Riechers, Flora Stanley, Veronique Buat, Loretta Dunne, Simon Dye, Sheona Urquhart, Steve Eales, Helmut Dannerbauer, Melanie Krips, R. Gavazzi, Rob Ivison, David Hughes, Lucia Marchetti, Edoardo Borsato, Guilaine Lagache, Chentao Yang, Hugo Messias, Ismael Perez-Fournon, Stephen Serjeant, Catherine Vlahakis, Axel Weiss, Shuowen Jin, Nima Chartab, Matthew Lehnert
W21DH	CO(7-6)/[C I] followup of SMGs in the 20Mpc environment of HSI549+19, the most overdense protocluster known at $z > 2$	Scott Chapman, Frank Bertoldi, Ian Smail, Chuck Steidel, Yuichi Matsuda, Manuel Aravena, Nikolaus Sulzenauer
W21EC	The host galaxies of the most distant radio quasars at $z > 6$	Eduardo Banados, Yana Khusanova, Sofia Rojas, Chiara Mazzucchelli, Roberto Decarli, Bram Venemans, Fabian Walter, Jan-Torge Schindler
W21ED	Dust masses of $z \sim 6$ QSOs from the HYPERION sample	Chiara Feruglio, Roberta Tripodi, Manuela Bischetti, Luca Zappacosta, Fabrizio Fiore, Enrico Piconcelli, Rosa Valiante, Valentina D'Odorico, Simona Gallerani, Stefano Carniani, Michele Ginolfi
W21EF	Confirming the Most Massive Submm Galaxy at the Node of Remarkable Galaxy Overdensiy at $z = 6.57$	Seiji Fujimoto, Yoshiaki Ono, Yuichi Harikane, M. Ouchi
EHT-2021.00767.V	Ultra-high resolution imaging of 3C84	Georgios Filippos Paraschos, Jae-Young Kim, Thomas Krichbaum, Maciek Wielgus, Tuomas Savolainen, Efthalia Traianou, Anton Zensus, Jeffrey Hodgson, Junghwan Oh, Yosuke Mizuno, Silke Britzen, Mikhail Lisakov, Rusen Lu, Zhiqiang Shen, Nicholas MacDonald, Eduardo Ros, Uwe Bach, Ilse Van Bemmel, Vassilis Mpisketzis
EHT-2021.00889.V	Delving Deeper into PKS 1510-089	Nicholas MacDonald, Thomas Krichbaum, Carolina Casadio, Rusen Lu, Eduardo Ros, Alan Marscher, Svetlana Jorstad, Jae-Young Kim
EHT-2021.00906.V	Capturing Real-Time Black Hole Dynamics in Sgr A*	Geoffrey Bower, Roman Gold, Andrew Chael, Kotaro Moriyama, V. Fish, Kazuhiro Hada, Sera Markoff, Eduardo Ros, Katherine Bouman, Chi-kwan Chan, Guangyao Zhao, Bong Won Sohn, Michael Johnson, Keiichi Asada, Lindy Blackburn, Mariafelicia De Laurentis, Kazunori Akiyama, Huib van Langevelde
EHT-2021.00910.V	Connecting the black hole shadow and jet base in M87	Geoffrey Bower, Kazuhiro Hada, Huib van Langevelde, Sera Markoff, Remo Tilanus, Roman Gold, Keiichi Asada, Thomas Krichbaum, Jae-Young Kim, Tomohisa Kawashima, Rusen Lu, Jongho Park, Angelo Ricarte, Lindy Blackburn, Chi-kwan Chan, Geoffrey Crew, H. Rottmann, Lynn Matthews, V. Fish, Daniel Marrone, Monika Moscibrodzka, Ivan Marti-Vidal, Feryal Ozel, Bong Won Sohn, Kazunori Akiyama, George Wong, Lia Medeiros, Alejandra Jimenez-Rosales, Andrew Chael
EHT-2021.01324.V	Testing the binary black hole model for OJ287 with the EHT+ALMA	Jose L. Gomez, Thomas Krichbaum, Stefanie Komossa, Andrei Lobanov, Alan Marscher, Gabriele Bruni, Svetlana Jorstad, Yuri Kovalev, Carolina Casadio, Jae-Young Kim, Rusen Lu, Eduardo Ros, Anton Zensus, Silke Britzen, Tuomas Savolainen, Keiichi Asada, Masanori Nakamura, Kazunori Akiyama, Makoto Inoue, Kazuhiro Hada, Yosuke Mizuno, Mauri Valtonen, Achamveedu Gopakumar, Sunil Chandra, Sera Markoff, Ivan Marti-Vidal, Venkatesh Ramakrishnan, Geoffrey Crew, Cornelia Mueller, Hiroshi Nagai, Monika Moscibrodzka, Christian Fromm, Josep Marti, Manel Perucho, Staszek Zola, Alexander Tchekhovskoy, Adam Ingram, Matthew Liska, Michiel van der Klis, Antonio Fuentes, Luciano Rezzolla, Antonio Alberdi Odriozola, Michael Johnson, Dimitrios Psaltis, S. Doleman, Guangyao Zhao, Rocco Lico, Sara Issaoun, Geoffrey Bower, Huib van Langevelde, Efthalia Traianou, Maciek Wielgus, Shami Chatterjee, Lankeswar Dey
EHT-2021.01431.V	Revealing the magnetic field in the jet acceleration zone of the Crazy Diamond	Efthalia Traianou, Thomas Krichbaum, Eduardo Ros, Jose L. Gomez, Georgios Filippos Paraschos, Joana Kramer, Antonio Fuentes, Rocco Lico, Nicholas MacDonald, Dongjin Kim, Felix Poetzl, Anton Zensus, Venkatesh Ramakrishnan, Guangyao Zhao, Ilje Cho, Svetlana Jorstad
EHT-2021.01458.V	Resolving the gamma-ray emission region and the jet collimation profile in TeV blazar Mrk 501	Shoko Koyama, Keiichi Asada, Motoki Kino, Masanori Nakamura, Kazuhiro Hada, Marcello Giroletti, Gabriele Giovannini, Monica Orienti, Eduardo Ros, Thomas Krichbaum, David Paneque, Kotaro Niinuma, Guangyao Zhao, Rocco Lico, Hiroshi Nagai, Kazunori Akiyama, Jan Carlos Algaba, Wen-Ping Lo, Michael Nowak, Mislav Balokovic, Venkatesh Ramakrishnan, Zhiqiang Shen, Anton Zensus, Silke Britzen, Svetlana Jorstad, Sunil Chandra, Feng Yuan, Ye-Fei Yuan, Timothy Davis, Jose L. Gomez, Tuomas Savolainen, David James, Mark Gurwell, Norbert Schartel, Yuzhu Cui, Heino Falcke, Daniela Dorner
GMVA-20B-339-MK18	The nature of molecular gas in the jet- launching region of young radio galaxy.	Dongjin Kim, Thomas Krichbaum, Biagina Boccardi, Alan L. Roy, Eduardo Ros, Anton Zensus, Anne-Kathrin Bacsko, Jae-Young Kim, Violette Impellizzeri, Uwe Bach, Matthias Kadler

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GMVA-20B-220-ML10	Jet Meets Black Hole in M87: Breaking New Ground with GMVA+ALMA	Rusen Lu, Jongho Park, Thomas Krichbaum, Masanori Nakamura, Keiichi Asada, Jae-Young Kim, Kazuhiro Hada, Fumie Tazaki, Kazunori Akiyama, Tomohisa Kawashima, Jordy Davelaar, Anton Zensus, Rebecca Azulay, Lindy Blackburn, Katherine Bouman, Geoffrey Bower, Silke Britzen, Michael Bremer, Avery Broderick, Sunil Chandra, Ilje Cho, Geoffrey Crew, S. Doeleman, Akihiro Doi, Heino Falcke, V. Fish, Gabriele Giovannini, Jose L. Gomez, Marcello Giroletti, Ruben Herrero-Illana, Paul Ho, Mareki Honma, David Hughes, Violette Impellizzeri, Makoto Inoue, Sara Issaoun, David James, Michael Janssen, Wu Jiang, Michael Johnson, Motoki Kino, Shoko Koyama, Michael Lindqvist, Elisabetta Liuzzo, Andrei Lobanov, Laurent Loinard, Nicholas MacDonald, Sera Markoff, Ivan Marti-Vidal, Alan Marscher, Satoki Matsushita, Jonathan McKinney, Hugo Messias, Monika Moscibrodzka, Shin Mineshige, Yosuke Mizuno, Hiroshi Nagai, Gopal Narayanan, Scott Noble, Monica Orienti, Yurii Pidopryhora, Oliver Porth, Hung-Yi Pu, Luciano Rezzolla, Eduardo Ros, H. Rottmann, Kazi Rygl, David Sanchez-Arguelles, Tuomas Savolainen, Karl-Friedrich Schuster, Zhiqiang Shen, Hotaka Shiokawa, Kenji Toma, Pablo de Vicente, John Wardle, Maciek Wielgus
EVI-20	Magnetic field and Rotation Measure at the jet base of QSO 3C273	Tuomas Savolainen, Thomas Krichbaum, Kazunori Akiyama, Keiichi Asada, Lindy Blackburn, Katherine Bouman, Geoffrey Crew, V. Fish, Ciriaco Goddi, Jose L. Gomez, Kazuhiro Hada, Talvikki Hovatta, Michael Janssen, Svetlana Jorstad, Jae-Young Kim, Rusen Lu, Daniel Marrone, Alan Marscher, Yosuke Mizuno, Masanori Nakamura, Shane O'Sullivan, Venkatesh Ramakrishnan, Eduardo Ros, H. Rottmann, Alan Roy, J. Wagner, Maciek Wielgus, Feng Yuan, Anton Zensus, Alexander Tchekhovskoy
GMVA-20B-244-mk17	Core Dynamics and Expansion of the Neutrino Blazars TXS 0506+056 and PKS1502+103	Matthias Kadler, Eduardo Ros, Marcello Giroletti, Sara Buson, Thomas Krichbaum, Hongmin Cao, Karl Mannheim, Manel Perucho, Roopesh Ojha, Luis Wachter
GMVA-20B-234-MG8	Imaging massive binary black hole candidate OJ287 with the GMVA+ALMA	Jose L. Gomez, Thomas Krichbaum, Guangyao Zhao, Antonio Fuentes, Andrei Lobanov, Stefanie Komossa, Alan Marscher, Svetlana Jorstad, Gabriele Bruni, Yuri Kovalev, Carolina Casadio, Jae-Young Kim, Ivan Marti-Vidal, Jeffrey Hodgson, Roman Gold, Kazunori Akiyama, Michael Johnson, Sera Markoff, Laurent Loinard, Brissa gomez-Miller, Uwe Bach, Ivan Agudo, Yosuke Mizuno, Jose M. Marti, Manel Perucho, Eduardo Ros, Silke Britzen, Rusen Lu, Geoffrey Crew, Anton Zensus, H. Rottmann, Tuomas Savolainen, Efthalia Traianou, Sara Issaoun, Michael Janssen, Keiichi Asada, Lindy Blackburn, Masanori Nakamura, Venkatesh Ramakrishnan, Rocco Lico, Marshall Cohen, Stanislaw Zola, Achamveedu Gopakumar, Lankeswar Dey, Shoko Koyama, Elisabetta Liuzzo, Violette Impellizzeri, Ruben Herrero-Illana, Hugo Messias, Jongho Park, Jun Yi Koay, Ilje Cho
GMVA-21A-209-MP2	Where is the black hole in 3C84 located?	Georgios Filippos Paraschos, Thomas Krichbaum, Jeffrey Hodgson, Junghwan Oh, Jae-Young Kim, Tuomas Savolainen, Efthalia Traianou, David Hughes, Michael Bremer, Anton Zensus
GMVA-21B-164-MT2	Moving and stationary shocks interaction after a gamma-ray flare in TXS2013+370	Efthalia Traianou, Matthias Kadler, Thomas Krichbaum, Dongjin Kim, Roberto Angioni, Anne-Kathrin Baczkó, Biagina Boccardi, Eduardo Ros, Uwe Bach, Anton Zensus
GMVA-21b-281-MT4	Probing Relativistic Jets through mm-VLBI of X-ray Binaries	Alexandra Tetarenko, Venkatesh Ramakrishnan, Maciek Wielgus, Geoffrey Bower, Thomas Krichbaum, Eduardo Ros, Sera Markoff

Publications

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2722	Searching for Star Fuel	Konchady, Tarini	2021, AAS Nova Highlight, id.7347
2723	Observational Constraints on the Chemical Complexity and Physical Properties of Starless and Prestellar Cores in the Taurus Molecular Cloud	Scibelli, S.; Shirley, Y.	2021, 37th Annual New Mexico Symposium, 16
2724	A Small-Scale Investigation of Molecular Emission toward the Tip of the Western Lobe of W50/SS433	Liu, Qian-cheng; Chen, Yang; Jiang, Bing; Zhang, Xiao; Zhou, Ping	2021, 43rd COSPAR Scientific Assembly, 43, 1466
2725	Gas and stellar dynamics in Stephan's Quintet. Mapping the kinematics in a closely interacting compact galaxy group	Yttergren, M.; Misquitta, P.; Sánchez-Monge, Á.; Valencia-S, M.; Eckart, A.; Zensus, A.; Peitl-Thiesen, T.	2021, A&A, 656, A83
2726	Signatures of UV radiation in low-mass protostars. I. Origin of HCN and CN emission in the Serpens Main region	Mirocha, Agnieszka; Karska, Agata; Gronowski, Marcin; Kristensen, Lars E.; Tychoniec, Lukasz; Harsono, Daniel; Figueira, Miguel; Gladkowski, Marcin; Żółtowski, Michał	2021, A&A, 656, A146
2727	Discovery of HCCCO and C5O in TMC-1 in TMC-1 with the QUIJOTE line survey	Cernicharo, J.; Agúndez, M.; Cabezas, C.; Tercero, B.; Marcelino, N.; Fuentetaja, R.; Pardo, J. R.; de Vicente, P.	2021, A&A, 656, L21
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2732	Comparing the spatial and kinematic distribution of gas and young stars around the shell-like structure in the CMa OBI association	Gregorio-Hetem, J.; Lefloch, B.; Hetem, A.; Montmerle, T.; Fernandes, B.; Mendoza, E. F.; De Simone, M.	2021, A&A, 654, A150
2733	Molecular gas and star formation within 12 strong galactic bars observed with IRAM-30 m	Díaz-García, S.; Lisenfeld, U.; Pérez, I.; Zurita, A.; Verley, S.; Combes, F.; Espada, D.; Leon, S.; Martínez-Badenes, V.; Sabater, J.; Verdes-Montenegro, L.	2021, A&A, 654, A135
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2735	The TOPGöt high-mass star-forming sample. I. Methyl cyanide emission as tracer of early phases of star formation	Mininni, C.; Fontani, F.; Sánchez-Monge, A.; Rivilla, V. M.; Beltrán, M. T.; Zahorecz, S.; Immer, K.; Giannetti, A.; Caselli, P.; Colzi, L.; Testi, L.; Elia, D.	2021, A&A, 653, A87
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2738	Multifrequency high spectral resolution observations of HCN toward the circumstellar envelope of Y Canum Venaticorum	Fonfría, J. P.; Montiel, E. J.; Cernicharo, J.; DeWitt, C. N.; Richter, M. J.; Lacy, J. H.; Greathouse, T. K.; Santander-García, M.; Agúndez, M.; Massalkhi, S.	2021, A&A, 651, A8
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2743	Whistler wave occurrence and the interaction with strahl electrons during the first encounter of Parker Solar Probe	Jagarlamudi, V. K.; Dudok de Wit, T.; Froment, C.; Krasnoselskikh, V.; Larosa, A.; Bercic, L.; Agapitov, O.; Halekas, J. S.; Kretzschmar, M.; Malaspina, D.; Moncuquet, M.; Bale, S. D.; Case, A. W.; Kasper, J. C.; Korreck, K. E.; Larson, D. E.; Pulupa, M.; Stevens, M. L.; Whittlesey, P.	2021, A&A, 650, A9
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2746	Warm ISM in the Sgr A complex. II. The [C/N] abundance ratio traced by [CII] 158 μ m and [NIII] 205 μ m observations toward the Arched Filaments at the Galactic center	García, P.; Abel, N.; Röllig, M.; Simon, R.; Stutzki, J.	2021, A&A, 650, A86
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2637	Star formation scaling relations at > 100 pc from PHANGS: Impact of completeness and spatial scale	Pessa, I.; Schinnerer, E.; Belfiore, F.; Emsellem, E.; Leroy, A. K.; Schrub, A.; Kruijssen, J. M. D.; Pan, H. -A.; Blanc, G. A.; Sanchez-Blazquez, P.; Bigiel, F.; Chevance, M.; Congiu, E.; Dale, D.; Faesi, C. M.; Glover, S. C. O.; Grasha, K.; Groves, B.; Ho, I.; Jiménez-Donaire, M.; Klessen, R.; Kreckel, K.; Koch, E. W.; Liu, D.; Meidt, S.; Pety, J.; Querejeta, M.; Rosolowsky, E.; Saito, T.; Santoro, F.; Sun, J.; Usero, A.; Watkins, E. J.; Williams, T. G.	2021, A&A, 650, A134
2638	Searching for pulsars in the Galactic centre at 3 and 2 mm	Torne, P.; Desvignes, G.; Eatough, R. P.; Kramer, M.; Karuppusamy, R.; Liu, K.; Noutsos, A.; Wharton, R.; Kramer, C.; Navarro, S.; Paubert, G.; Sanchez, S.; Sanchez-Portal, M.; Schuster, K. F.; Falcke, H.; Rezzolla, L.	2021, A&A, 650, A95
2639	Fragmentation and kinematics in high-mass star formation. CORE-extension targeting two very young high-mass star-forming regions	Beuther, H.; Gieser, C.; Suri, S.; Linz, H.; Klaassen, P.; Semenov, D.; Winters, J. M.; Henning, Th.; Soler, J. D.; Urquhart, J. S.; Syed, J.; Feng, S.; Möller, T.; Beltrán, M. T.; Sánchez-Monge, Á.; Longmore, S. N.; Peters, T.; Ballesteros-Paredes, J.; Schilke, P.; Moscadelli, L.; Palau, A.; Cesaroni, R.; Lumsden, S.; Pudritz, R.; Wyrowski, F.; Kuiper, R.; Ahmadi, A.	2021, A&A, 649, A113
2640	An underlying universal pattern in galaxy halo magnetic fields	Myserlis, Ioannis; Contopoulos, Ioannis	2021, A&A, 649, A94
2641	xCOLD GASS and xGASS: Radial metallicity gradients and global properties on the star-forming main sequence	Lutz, K. A.; Sainlonge, A.; Catinella, B.; Cortese, L.; Eisenhauer, F.; Kramer, C.; Moran, S. M.; Tacconi, L. J.; Vollmer, B.; Wang, J.	2021, A&A, 649, A39
2642	The jet collimation profile at high resolution in BL Lacertae	Casadio, C.; MacDonald, N. R.; Boccardi, B.; Jorstad, S. G.; Marscher, A. P.; Krichbaum, T. P.; Hodgson, J. A.; Kim, J. -Y.; Traianou, E.; Weaver, Z. R.; Gómez Garrido, M.; González García, J.; Kallunki, J.; Lindqvist, M.; Sánchez, S.; Yang, J.; Zensus, J. A.	2021, A&A, 649, A153
2643	Molecular composition of comet 46P/Wirtanen from millimetre-wave spectroscopy	Biver, N.; Bockelée-Morvan, D.; Boissier, J.; Moreno, R.; Crovisier, J.; Lis, D. C.; Colom, P.; Cordiner, M. A.; Milam, S. N.; Roth, N. X.; Bonev, B. P.; Dello Russo, N.; Vervack, R. J.; DiSanti, M. A.	2021, A&A, 648, A49
2644	Keplerian disks and outflows in post-AGB stars: AC Herculis, 89 Herculis, IRAS 19125+0343, and R Scuti	Gallardo Cava, I.; Gómez-Garrido, M.; Bujarrabal, V.; Castro-Carrizo, A.; Alcolea, J.; Van Winckel, H.	2021, A&A, 648, A93
2645	Gas phase Elemental abundances in Molecular clouds (GEMS). IV. Observational results and statistical trends	Rodríguez-Baras, M.; Fuente, A.; Rivière-Marichalar, P.; Navarro-Almada, D.; Caselli, P.; Gerin, M.; Kramer, C.; Roueff, E.; Wakelam, V.; Esplugues, G.; García-Burillo, S.; Le Gal, R.; Spezzano, S.; Alonso-Albi, T.; Bachiller, R.; Cazaux, S.; Commerçon, B.; Goicoechea, J. R.; Loison, J. C.; Treviño-Morales, S. P.; Roncero, O.; Jiménez-Serra, I.; Laas, J.; Hacar, A.; Kirk, J.; Lattanzi, V.; Martín-Doménech, R.; Muñoz-Caro, G.; Pineda, J. E.; Tercero, B.; Ward-Thompson, D.; Tafalla, M.; Marcelino, N.; Malinen, J.; Friesen, R.; Giuliano, B. M.	2021, A&A, 648, A120
2646	The CALYPSO IRAM-PdBI survey of jets from Class 0 protostars. Exploring whether jets are ubiquitous in young stars	Podio, L.; Tabone, B.; Codella, C.; Gueth, F.; Maury, A.; Cabrit, S.; Lefloch, B.; Maret, S.; Belloche, A.; André, P.; Anderl, S.; Gaudel, M.; Testi, L.	2021, A&A, 648, A45
2647	SEEDISCS. I. Molecular gas in galaxy clusters and their large-scale structure: The case of CL14111-1148 at $z > 0.5$ (Corrigendum)	Spérone-Longin, D.; Jablonka, P.; Combes, F.; Castignani, G.; Krips, M.; Rudnick, G.; Zaritsky, D.; Finn, R. A.; De Lucia, G.; Desai, V.	2021, A&A, 648, C1

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2649	Multi-wavelength observations and modelling of a quiescent cloud LDN1512	Saajasto, Mika; Juvela, Mika; Lefèvre, Charlène; Pagani, Laurent; Ysard, Nathalie	2021, A&A, 647, A109
2650	Bottlenecks to interstellar sulfur chemistry. Sulfur-bearing hydrides in UV-illuminated gas and grains	Goicoechea, J. R.; Aguado, A.; Cuadrado, S.; Roncero, O.; Pety, J.; Bron, E.; Fuente, A.; Riquelme, D.; Chapillon, E.; Herrera, C.; Duran, C. A.	2021, A&A, 647, A10
2651	SEEDisCS. I. Molecular gas in galaxy clusters and their large-scale structure: The case of CL1411.1-1148 at $z > 0.5$	Spérone-Longin, D.; Jablonka, P.; Combes, F.; Castignani, G.; Krips, M.; Rudnick, G.; Zaritsky, D.; Finn, R. A.; De Lucia, G.; Desai, V.	2021, A&A, 647, A156
2652	The Otelo survey as a morphological probe. Last ten Gyr of galaxy evolution. The mass-size relation up to $z = 2$	Nadolny, Jakub; Bongiovanni, Ángel; Cepa, Jordi; Cerviño, Miguel; Pérez García, Ana María; Pović, Mirjana; Pérez Martínez, Ricardo; Sánchez-Portal, Miguel; de Diego, José A.; Pintos-Castro, Irene; Alfaro, Emilio; Castañeda, Héctor O.; Gallego, Jesús; Jesús González, J.; Ignacio González-Serrano, J.; Lara-López, Maritza A.; Padilla Torres, Carmen P.	2021, A&A, 647, A89
2653	Multi-scale view of star formation in IRAS 21078+5211: from clump fragmentation to disk wind	Moscadelli, L.; Beuther, H.; Ahmadi, A.; Gieser, C.; Massi, F.; Cesaroni, R.; Sánchez-Monge, Á.; Bacciotti, F.; Beltrán, M. T.; Csengeri, T.; Galván-Madrid, R.; Henning, Th.; Klaassen, P. D.; Kuiper, R.; Leurini, S.; Longmore, S. N.; Maud, L. T.; Möller, T.; Palau, A.; Peters, T.; Pudritz, R. E.; Sanna, A.; Semenov, D.; Urquhart, J. S.; Winters, J. M.; Zinnecker, H.	2021, A&A, 647, A114
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2656	Seeds of Life in Space (SOLIS). XI. First measurement of nitrogen fractionation in shocked clumps of the L1157 protostellar outflow	Benedettini, M.; Viti, S.; Codella, C.; Ceccarelli, C.; Neri, R.; López-Sepulcre, A.; Bianchi, E.; Busquet, G.; Caselli, P.; Fontani, F.; Lefloch, B.; Podio, L.; Spezzano, S.; Vastel, C.	2021, A&A, 645, A91
2657	Continuity of accretion from clumps to Class 0 high-mass protostars in SDC335	Avison, A.; Fuller, G. A.; Peretto, N.; Duarte-Cabral, A.; Rosen, A. L.; Traficante, A.; Pineda, J. E.; Güsten, R.; Cunningham, N.	2021, A&A, 645, A142
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2660	Tracers of the ionization fraction in dense and translucent gas. I. Automated exploitation of massive astrochemical model grids	Bron, Emeric; Roueff, Evelyne; Gerin, Maryvonne; Pety, Jérôme; Gratier, Pierre; Le Petit, Franck; Guzman, Viviana; Orkisz, Jan H.; de Souza Magalhaes, Victor; Gaudel, Mathilde; Vono, Maxime; Bardeau, Sébastien; Chainais, Pierre; Goicoechea, Javier R.; Hughes, Annie; Kainulainen, Jouni; Languignon, David; Le Bourlot, Jacques; Levrier, François; Liszt, Harvey; Öberg, Karin; Peretto, Nicolas; Roueff, Antoine; Sievers, Albrecht	2021, A&A, 645, A28
2661	$C^{18}O$, ^{13}CO , and ^{12}CO abundances and excitation temperatures in the Orion B molecular cloud. Analysis of the achievable precision in modeling spectral lines within the approximation of the local thermodynamic equilibrium	Roueff, Antoine; Gerin, Maryvonne; Gratier, Pierre; Levrier, François; Pety, Jérôme; Gaudel, Mathilde; Goicoechea, Javier R.; Orkisz, Jan H.; de Souza Magalhaes, Victor; Vono, Maxime; Bardeau, Sébastien; Bron, Emeric; Chanussot, Jocelyn; Chainais, Pierre; Guzman, Viviana V.; Hughes, Annie; Kainulainen, Jouni; Languignon, David; Le Bourlot, Jacques; Le Petit, Franck; Liszt, Harvey S.; Marchal, Antoine; Miville-Deschênes, Marc-Antoine; Peretto, Nicolas; Roueff, Evelyne; Sievers, Albrecht	2021, A&A, 645, A26
2662	PHANGS-ALMA: Cloud Scale CO 2-1 Imaging of 90 Galaxies	Leroy, A.; Schinnerer, E.; Hughes, A.; Rosolowsky, E.; Schrubba, A.; Blanc, G.; Faesi, C.; Liu, D.; Pety, J.; Saito, T.; Usero, A.; Phangs-Alma Collaboration	2021, BAAS, 53, 208.03

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2665	SOFIA-upGREAT Imaging Spectroscopy of the [C II] 158 μm Fine-structure Line of the Sgr B Region in the Galactic Center	Harris, A. I.; Güsten, R.; Requena-Torres, M. A.; Riquelme, D.; Morris, M. R.; Stacey, G. J.; Martin-Pintado, J.; Stutzki, J.; Simon, R.; Higgins, R.; Risacher, C.	2021, ApJ, 921, 33
2666	Rotating Motion of the Outflow of IRAS 16293-2422 A1 at Its Origin Point Near the Protostar	Oya, Yoko; Watanabe, Yoshimasa; López-Sepulcre, Ana; Ceccarelli, Cecilia; Lefloch, Bertrand; Favre, Cécile; Yamamoto, Satoshi	2021, ApJ, 921, 12
2667	Leveraging the ALMA Atacama Compact Array for Cometary Science: An Interferometric Survey of Comet C/2015 ER61 (PanSTARRS) and Evidence for a Distributed Source of Carbon Monosulfide	Roth, Nathan X.; Milam, Stefanie N.; Cordiner, Martin A.; Bockelée-Morvan, Dominique; Biver, Nicolas; Boissier, Jérémie; Lis, Dariusz C.; Remijan, Anthony J.; Charnley, Steven B.	2021, ApJ, 921, 14
2668	The Evolving Interstellar Medium of Star-forming Galaxies, as Traced by Stardust	Kokorev, Vasily I.; Magdis, Georgios E.; Davidzon, Iary; Brammer, Gabriel; Valentino, Francesco; Daddi, Emanuele; Ciesla, Laure; Liu, Daizhong; Jin, Shuowen; Cortzen, Isabella; Delvecchio, Ivan; Giménez-Arteaga, Clara; Gómez-Guijarro, Carlos; Sargent, Mark; Toft, Sune; Weaver, John R.	2021, ApJ, 921, 40
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2670	An 86 GHz Search for Pulsars in the Galactic Center with the Atacama Large Millimeter / submillimeter Array	Liu, Kuo; Desvignes, Gregory; Eatough, Ralph P.; Karuppusamy, Ramesh; Kramer, Michael; Torne, Pablo; Wharton, Robert; Chatterjee, Shami; Cordes, James M.; Crew, Geoffrey B.; Goddi, Ciriaco; Ransom, Scott M.; Rottmann, Helge; Abbate, Federico; Bower, Geoffrey C.; Brinkerink, Christiaan D.; Falcke, Heino; Noutsos, Aristeidis; Hernández-Gómez, Antonio; Jiang, Wu; Johnson, Michael D.; Lu, Ru-Sen; Pidopryhora, Yurii; Rezzolla, Luciano; Shao, Lijing; Shen, Zhiqiang; Wex, Norbert	2021, ApJ, 914, 30
2671	The GADOT Galaxy Survey: Dense Gas and Feedback in Herschel-selected Starburst Galaxies at Redshifts 2 to 6	Riechers, Dominik A.; Cooray, Asantha; Pérez-Fournon, Ismael; Neri, Roberto	2021, ApJ, 913, 141
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2674	Discovery of an Edge-on Circumstellar Debris Disk around BD+45° 598: A Newly Identified Member of the β Pictoris Moving Group	Hinkley, Sasha; Matthews, Elisabeth C.; Lefevre, Charlene; Lestrade, Jean-Francois; Kennedy, Grant; Mawet, Dimitri; Stapelfeldt, Karl R.; Ray, Shrishmoy; Mamajek, Eric; Bowler, Brendan P.; Wilner, David; Williams, Jonathan; Ansdell, Megan; Wyatt, Mark; Lau, Alexis; Phillips, Mark W.; Fernandez, Jorge; Gagné, Jonathan; Bubb, Emma; Sutcliffe, Ben J.; Wilson, Thomas J. G.; Matthews, Brenda; Ngo, Henry; Piskorz, Danielle; Crepp, Justin R.; Gonzalez, Erica; Mann, Andrew W.; Mace, Gregory	2021, ApJ, 912, 115
2675	The Polarized Image of a Synchrotron-emitting Ring of Gas Orbiting a Black Hole	Narayan, Ramesh; Palumbo, Daniel C. M.; Johnson, Michael D.; Gelles, Zachary; Himwich, Elizabeth; Chang, Dominic O.; Ricarte, Angelo; Dexter, Jason; Gammie, Charles F.; Chael, Andrew A.; Event Horizon Telescope Collaboration; Akiyama, Kazunori; Alberdi, Antxon; Alef, Walter; Algaba, Juan Carlos; Anantua, Richard; Asada, Keiichi; Azulay, Rebecca; Baczko, Anne-Kathrin; Ball, David; Baloković, Mislav; Barrett, John; Benson, Bradford A.; Bintley, Dan; Blackburn, Lindy; Blundell, Raymond; Boland, Wilfred; Bouman, Katherine L.; Bower, Geoffrey C.; Boyce, Hope; Bremer, Michael; Brinkerink, Christiaan D.; Brissenden, Roger; Britzen, Silke; Broderick, Avery E.; Brogiere, Dominique; Bronzwaer, Thomas; Byun, Do-Young; Carlstrom, John E.; Chan, Chi-kwan; Chatterjee, Shami;	2021, ApJ, 912, 35

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2676	FAUST. II. Discovery of a Secondary Outflow in IRAS 15398-3359: Variability in Outflow Direction during the Earliest Stage of Star Formation?	Okoda, Yuki; Oya, Yoko; Francis, Logan; Johnstone, Doug; Inutsuka, Shu-ichiro; Ceccarelli, Cecilia; Codella, Claudio; Chandler, Claire; Sakai, Nami; Aikawa, Yuri; Alves, Felipe O.; Balucani, Nadia; Bianchi, Eleonora; Bouvier, Mathilde; Caselli, Paola; Caux, Emmanuel; Charnley, Steven; Choudhury, Spandan; De Simone, Marta; Dulieu, Francois; Durán, Aurora; Evans, Lucy; Favre, Cécile; Fedele, Davide; Feng, Siyi; Fontani, Francesco; Hama, Tetsuya; Hanawa, Tomoyuki; Herbst, Eric; Hirota, Tomoya; Imai, Muneaki; Isella, Andrea; Jiménez-Serra, Izaskun; Kahane, Claudine; Lefloch, Bertrand; Loinard, Laurent; López-Sepulcre, Ana; Maud, Luke T.; Maureira, María José; Menard, Francois; Mercimek, Seyma; Miotello, Anna; Moellenbrock, George; Mori, Shoji; Murillo, Nadia M.; Nakatani, Riouhei; Nomura, Hideko; Oba, Yasuhiro; O'Donoghue, Ross; Ohashi, Satoshi; Ospina-Zamudio, Juan; Pineda, Jaime E.; Podio, Linda; Rimola, Albert; Sakai, Takeshi; Segura-Cox, Dominique; Shirley, Yancy; Svoboda, Brian; Taquet, Vianney; Testi, Leonardo; Vastel, Charlotte; Viti, Serena; Watanabe, Naoki; Watanabe, Yoshimasa; Witzel, Arezu; Xue, Ci; Zhang, Yichen; Zhao, Bo; Yamamoto, Satoshi	2021, ApJ, 910, 11
2677	Turbulent Gas in Lensed Planck-selected Starbursts at $z > 1-3.5$	Harrington, Kevin C.; Weiss, Axel; Yun, Min S.; Magnelli, Benjamin; Sharon, C. E.; Leung, T. K. D.; Vishwas, A.; Wang, Q. D.; Frayer, D. T.; Jiménez-Andrade, E. F.; Liu, D.; García, P.; Romano-Díaz, E.; Frye, B. L.; Jarugula, S.; Bădescu, T.; Berman, D.; Dannerbauer, H.; Díaz-Sánchez, A.; Grassitelli, L.; Kamieneski, P.; Kim, W. J.; Kirkpatrick, A.; Lowenthal, J. D.; Messias, H.; Puschnig, J.; Stacey, G. J.; Torne, P.; Bertoldi, F.	2021, ApJ, 908, 95

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2678	Resolving the Dust-to-Metals Ratio and CO-to-H ₂ Conversion Factor in the Nearby Universe	Chiang, I-Da; Sandstrom, Karin M.; Chastenet, Jérémy; Herrera, Cinthya N.; Koch, Eric W.; Kreckel, Kathryn; Leroy, Adam K.; Pety, Jérôme; Schrubba, Andreas; Utomo, Dyas; Williams, Thomas	2021, ApJ, 907, 29
2679	PHANGS-ALMA: Arcsecond CO(2-1) Imaging of Nearby Star-forming Galaxies	Leroy, Adam K.; Schinnerer, Eva; Hughes, Annie; Rosolowsky, Erik; Pety, Jérôme; Schrubba, Andreas; Usero, Antonio; Blanc, Guillermo A.; Chevance, Mélanie; Emsellem, Eric; Faesi, Christopher M.; Herrera, Cinthya N.; Liu, Daizhong; Meidt, Sharon E.; Querejeta, Miguel; Saito, Toshiki; Sandstrom, Karin M.; Sun, Jiayi; Williams, Thomas G.; Anand, Gagandeep S.; Barnes, Ashley T.; Behrens, Erica A.; Belfiore, Francesco; Benincasa, Samantha M.; Bešlić, Ivana; Bigiel, Frank; Bolatto, Alberto D.; den Brok, Jakob S.; Cao, Yixian; Chandar, Rupali; Chastenet, Jérémy; Chiang, I.-Da; Congiu, Enrico; Dale, Daniel A.; Deger, Sinan; Eibensteiner, Cosima; Egorov, Oleg V.; García-Rodríguez, Axel; Glover, Simon C. O.; Grasha, Kathryn; Henshaw, Jonathan D.; Ho, I.-Ting; Kepley, Amanda A.; Kim, Jaeyeon; Klessen, Ralf S.; Kreckel, Kathryn; Koch, Eric W.; Kruijssen, J. M. Diederik; Larson, Kirsten L.; Lee, Janice C.; Lopez, Laura A.; Machado, Josh; Mayker, Ness; McElroy, Rebecca; Murphy, Eric J.; Ostriker, Eve C.; Pan, Hsi-An; Pessa, Ismael; Puschnig, Johannes; Razza, Alessandro; Sánchez-Blázquez, Patricia; Santoro, Francesco; Sardone, Amy; Scheuermann, Fabian; Sliwa, Kazimierz; Sormani, Mattia C.; Stuber, Sophia K.; Thilker, David A.; Turner, Jordan A.; Utomo, Dyas; Watkins, Elizabeth J.; Whitmore, Bradley	2021, ApJ Supp. Series, 257, 43
2680	Molecules with ALMA at Planet-forming Scales (MAPS). XII. Inferring the C/O and S/H Ratios in Protoplanetary Disks with Sulfur Molecules	Le Gal, Romane; Öberg, Karin I.; Teague, Richard; Loomis, Ryan A.; Law, Charles J.; Walsh, Catherine; Bergin, Edwin A.; Ménard, François; Wilner, David J.; Andrews, Sean M.; Aikawa, Yuri; Booth, Alice S.; Cataldi, Gianni; Bergner, Jennifer B.; Bosman, Arthur D.; Cleeves, L. Ilse; Czekala, Ian; Furuya, Kenji; Guzmán, Viviana V.; Huang, Jane; Ilee, John D.; Nomura, Hideko; Qi, Chunhua; Schwarz, Kamber R.; Tsukagoshi, Takashi; Yamato, Yoshihide; Zhang, Ke	2021, ApJ Supp. Series, 257, 12
2681	Molecules with ALMA at Planet-forming Scales (MAPS). XVI. Characterizing the Impact of the Molecular Wind on the Evolution of the HD 163296 System	Booth, Alice S.; Tabone, Benoît; Ilee, John D.; Walsh, Catherine; Aikawa, Yuri; Andrews, Sean M.; Bae, Jaehan; Bergin, Edwin A.; Bergner, Jennifer B.; Bosman, Arthur D.; Calahan, Jenny K.; Cataldi, Gianni; Cleeves, L. Ilse; Czekala, Ian; Guzmán, Viviana V.; Huang, Jane; Law, Charles J.; Le Gal, Romane; Long, Feng; Loomis, Ryan A.; Ménard, François; Nomura, Hideko; Öberg, Karin I.; Qi, Chunhua; Schwarz, Kamber R.; Teague, Richard; Tsukagoshi, Takashi; Wilner, David J.; Yamato, Yoshihide; Zhang, Ke	2021, ApJ Supp. Series, 257, 16
2682	Molecules with ALMA at Planet-forming Scales (MAPS). XIX. Spiral Arms, a Tail, and Diffuse Structures Traced by CO around the GM Aur Disk	Huang, Jane; Bergin, Edwin A.; Öberg, Karin I.; Andrews, Sean M.; Teague, Richard; Law, Charles J.; Kalas, Paul; Aikawa, Yuri; Bae, Jaehan; Bergner, Jennifer B.; Booth, Alice S.; Bosman, Arthur D.; Calahan, Jenny K.; Cataldi, Gianni; Cleeves, L. Ilse; Czekala, Ian; Ilee, John D.; Le Gal, Romane; Guzmán, Viviana V.; Long, Feng; Loomis, Ryan A.; Ménard, François; Nomura, Hideko; Qi, Chunhua; Schwarz, Kamber R.; Tsukagoshi, Takashi; van't Hoff, Merel L. R.; Walsh, Catherine; Wilner, David J.; Yamato, Yoshihide; Zhang, Ke	2021, ApJ Supp. Series, 257, 19
2683	Molecules with ALMA at Planet-forming Scales (MAPS). XIV. Revealing Disk Substructures in Multiwavelength Continuum Emission	Sierra, Anibal; Pérez, Laura M.; Zhang, Ke; Law, Charles J.; Guzmán, Viviana V.; Qi, Chunhua; Bosman, Arthur D.; Öberg, Karin I.; Andrews, Sean M.; Long, Feng; Teague, Richard; Booth, Alice S.; Walsh, Catherine; Wilner, David J.; Ménard, François; Cataldi, Gianni; Czekala, Ian; Bae, Jaehan; Huang, Jane; Bergner, Jennifer B.; Ilee, John D.; Benisty, Myriam; Le Gal, Romane; Loomis, Ryan A.; Tsukagoshi, Takashi; Liu, Yao; Yamato, Yoshihide; Aikawa, Yuri	2021, ApJ Supp. Series, 257, 14
2684	Molecules with ALMA at Planet-forming Scales (MAPS). V. CO Gas Distributions	Zhang, Ke; Booth, Alice S.; Law, Charles J.; Bosman, Arthur D.; Schwarz, Kamber R.; Bergin, Edwin A.; Öberg, Karin I.; Andrews, Sean M.; Guzmán, Viviana V.; Walsh, Catherine; Qi, Chunhua; van't Hoff, Merel L. R.; Long, Feng; Wilner, David J.; Huang, Jane; Czekala, Ian; Ilee, John D.; Cataldi, Gianni; Bergner, Jennifer B.; Aikawa, Yuri; Teague, Richard; Bae, Jaehan; Loomis, Ryan A.; Calahan, Jenny K.; Alarcón, Felipe; Ménard, François; Le Gal, Romane; Sierra, Anibal; Yamato, Yoshihide; Nomura, Hideko; Tsukagoshi, Takashi; Pérez, Laura M.; Trapman, Leon; Liu, Yao; Furuya, Kenji	2021, ApJ Supp. Series, 257, 5
2685	Molecules with ALMA at Planet-forming Scales (MAPS). III. Characteristics of Radial Chemical Substructures	Law, Charles J.; Loomis, Ryan A.; Teague, Richard; Öberg, Karin I.; Czekala, Ian; Andrews, Sean M.; Huang, Jane; Aikawa, Yuri; Alarcón, Felipe; Bae, Jaehan; Bergin, Edwin A.; Bergner, Jennifer B.; Boehler, Yann; Booth, Alice S.; Bosman, Arthur D.; Calahan, Jenny K.; Cataldi, Gianni; Cleeves, L. Ilse; Furuya, Kenji; Guzmán, Viviana V.; Ilee, John D.; Le Gal, Romane; Liu, Yao; Long, Feng; Ménard, François; Nomura, Hideko; Qi, Chunhua; Schwarz, Kamber R.; Sierra, Anibal; Tsukagoshi, Takashi; Yamato, Yoshihide; van't Hoff, Merel L. R.; Walsh, Catherine; Wilner, David J.; Zhang, Ke	2021, ApJ Supp. Series, 257, 3

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2686	Molecules with ALMA at Planet-forming Scales (MAPS). XIII. HCO ⁺ and Disk Ionization Structure	Aikawa, Yuri; Cataldi, Gianni; Yamato, Yoshihide; Zhang, Ke; Booth, Alice S.; Furuya, Kenji; Andrews, Sean M.; Bae, Jaehan; Bergin, Edwin A.; Bergner, Jennifer B.; Bosman, Arthur D.; Cleeves, L. Ilseidore; Czekala, Ian; Guzmán, Viviana V.; Huang, Jane; Ilee, John D.; Law, Charles J.; Le Gal, Romane; Loomis, Ryan A.; Ménard, François; Nomura, Hideko; Öberg, Karin I.; Qi, Chunhua; Schwarz, Kamber R.; Teague, Richard; Tsukagoshi, Takashi; Walsh, Catherine; Wilner, David J.	2021, ApJ Supp. Series, 257, 13
2687	Molecules with ALMA at Planet-forming Scales (MAPS). VI. Distribution of the Small Organics HCN, C ₂ H, and H ₂ CO	Guzmán, Viviana V.; Bergner, Jennifer B.; Law, Charles J.; Öberg, Karin I.; Walsh, Catherine; Cataldi, Gianni; Aikawa, Yuri; Bergin, Edwin A.; Czekala, Ian; Huang, Jane; Andrews, Sean M.; Loomis, Ryan A.; Zhang, Ke; Le Gal, Romane; Alarcón, Felipe; Ilee, John D.; Teague, Richard; Cleeves, L. Ilseidore; Wilner, David J.; Long, Feng; Schwarz, Kamber R.; Bosman, Arthur D.; Pérez, Laura M.; Ménard, François; Liu, Yao	2021, ApJ Supp. Series, 257, 6
2688	Molecules with ALMA at Planet-forming Scales (MAPS). VIII. CO Gap in AS 209-Gas Depletion or Chemical Processing?	Alarcón, Felipe; Bosman, Arthur D.; Bergin, Edwin A.; Zhang, Ke; Teague, Richard; Bae, Jaehan; Aikawa, Yuri; Andrews, Sean M.; Booth, Alice S.; Calahan, Jenny K.; Cataldi, Gianni; Czekala, Ian; Huang, Jane; Ilee, John D.; Law, Charles J.; Le Gal, Romane; Liu, Yao; Long, Feng; Loomis, Ryan A.; Ménard, François; Öberg, Karin I.; Schwarz, Kamber R.; van't Hoff, Merel L. R.; Walsh, Catherine; Wilner, David J.	2021, ApJ Supp. Series, 257, 8
2689	Molecules with ALMA at Planet-forming Scales (MAPS). X. Studying Deuteration at High Angular Resolution toward Protoplanetary Disks	Cataldi, Gianni; Yamato, Yoshihide; Aikawa, Yuri; Bergner, Jennifer B.; Furuya, Kenji; Guzmán, Viviana V.; Huang, Jane; Loomis, Ryan A.; Qi, Chunhua; Andrews, Sean M.; Bergin, Edwin A.; Booth, Alice S.; Bosman, Arthur D.; Cleeves, L. Ilseidore; Czekala, Ian; Ilee, John D.; Law, Charles J.; Le Gal, Romane; Liu, Yao; Long, Feng; Ménard, François; Nomura, Hideko; Öberg, Karin I.; Schwarz, Kamber R.; Teague, Richard; Tsukagoshi, Takashi; Walsh, Catherine; Wilner, David J.; Zhang, Ke	2021, ApJ Supp. Series, 257, 10
2690	Molecules with ALMA at Planet-forming Scales (MAPS). XVII. Determining the 2D Thermal Structure of the HD 163296 Disk	Calahan, Jenny K.; Bergin, Edwin A.; Zhang, Ke; Schwarz, Kamber R.; Öberg, Karin I.; Guzmán, Viviana V.; Walsh, Catherine; Aikawa, Yuri; Alarcón, Felipe; Andrews, Sean M.; Bae, Jaehan; Bergner, Jennifer B.; Booth, Alice S.; Bosman, Arthur D.; Cataldi, Gianni; Czekala, Ian; Huang, Jane; Ilee, John D.; Law, Charles J.; Le Gal, Romane; Long, Feng; Loomis, Ryan A.; Ménard, François; Nomura, Hideko; Qi, Chunhua; Teague, Richard; van't Hoff, Merel L. R.; Wilner, David J.; Yamato, Yoshihide	2021, ApJ Supp. Series, 257, 17
2691	Molecules with ALMA at Planet-forming Scales (MAPS). XVIII. Kinematic Substructures in the Disks of HD 163296 and MWC 480	Teague, Richard; Bae, Jaehan; Aikawa, Yuri; Andrews, Sean M.; Bergin, Edwin A.; Bergner, Jennifer B.; Boehler, Yann; Booth, Alice S.; Bosman, Arthur D.; Cataldi, Gianni; Czekala, Ian; Guzmán, Viviana V.; Huang, Jane; Ilee, John D.; Law, Charles J.; Le Gal, Romane; Long, Feng; Loomis, Ryan A.; Ménard, François; Öberg, Karin I.; Pérez, Laura M.; Schwarz, Kamber R.; Sierra, Anibal; Walsh, Catherine; Wilner, David J.; Yamato, Yoshihide; Zhang, Ke	2021, ApJ Supp. Series, 257, 18
2692	Molecules with ALMA at Planet-forming Scales. XX. The Massive Disk around GM Aurigae	Schwarz, Kamber R.; Calahan, Jenny K.; Zhang, Ke; Alarcón, Felipe; Aikawa, Yuri; Andrews, Sean M.; Bae, Jaehan; Bergin, Edwin A.; Booth, Alice S.; Bosman, Arthur D.; Cataldi, Gianni; Cleeves, L. Ilseidore; Czekala, Ian; Huang, Jane; Ilee, John D.; Law, Charles J.; Le Gal, Romane; Liu, Yao; Long, Feng; Loomis, Ryan A.; Macías, Enrique; McClure, Melissa; Ménard, François; Öberg, Karin I.; Teague, Richard; van Dishoeck, Ewine; Walsh, Catherine; Wilner, David J.	2021, ApJ Supp. Series, 257, 20
2693	Molecules with ALMA at Planet-forming Scales (MAPS). IV. Emission Surfaces and Vertical Distribution of Molecules	Law, Charles J.; Teague, Richard; Loomis, Ryan A.; Bae, Jaehan; Öberg, Karin I.; Czekala, Ian; Andrews, Sean M.; Aikawa, Yuri; Alarcón, Felipe; Bergin, Edwin A.; Bergner, Jennifer B.; Booth, Alice S.; Bosman, Arthur D.; Calahan, Jenny K.; Cataldi, Gianni; Cleeves, L. Ilseidore; Furuya, Kenji; Guzmán, Viviana V.; Huang, Jane; Ilee, John D.; Le Gal, Romane; Liu, Yao; Long, Feng; Ménard, François; Nomura, Hideko; Pérez, Laura M.; Qi, Chunhua; Schwarz, Kamber R.; Soto, Daniela; Tsukagoshi, Takashi; Yamato, Yoshihide; van't Hoff, Merel L. R.; Walsh, Catherine; Wilner, David J.; Zhang, Ke	2021, ApJ Supp. Series, 257, 4
2694	Molecules with ALMA at Planet-forming Scales (MAPS). I. Program Overview and Highlights	Öberg, Karin I.; Guzmán, Viviana V.; Walsh, Catherine; Aikawa, Yuri; Bergin, Edwin A.; Law, Charles J.; Loomis, Ryan A.; Alarcón, Felipe; Andrews, Sean M.; Bae, Jaehan; Bergner, Jennifer B.; Boehler, Yann; Booth, Alice S.; Bosman, Arthur D.; Calahan, Jenny K.; Cataldi, Gianni; Cleeves, L. Ilseidore; Czekala, Ian; Furuya, Kenji; Huang, Jane; Ilee, John D.; Kurtovic, Nicolas T.; Le Gal, Romane; Liu, Yao; Long, Feng; Ménard, François; Nomura, Hideko; Pérez, Laura M.; Qi, Chunhua; Schwarz, Kamber R.; Sierra, Anibal; Teague, Richard; Tsukagoshi, Takashi; Yamato, Yoshihide; van't Hoff, Merel L. R.; Waggoner, Abygail R.; Wilner, David J.; Zhang, Ke	2021, ApJ Supp. Series, 257, 1
2695	Molecules with ALMA at Planet-forming Scales (MAPS). II. CLEAN Strategies for Synthesizing Images of Molecular Line Emission in Protoplanetary Disks	Czekala, Ian; Loomis, Ryan A.; Teague, Richard; Booth, Alice S.; Huang, Jane; Cataldi, Gianni; Ilee, John D.; Law, Charles J.; Walsh, Catherine; Bosman, Arthur D.; Guzmán, Viviana V.; Gal, Romane; Le; Öberg, Karin I.; Yamato, Yoshihide; Aikawa, Yuri; Andrews, Sean M.; Bae, Jaehan; Bergin, Edwin A.; Bergner, Jennifer B.; Cleeves, L. Ilseidore; Kurtovic, Nicolas T.; Ménard, François; Nomura, Hideko; Pérez, Laura M.; Qi, Chunhua; Schwarz, Kamber R.; Tsukagoshi, Takashi; Waggoner, Abygail R.; Wilner, David J.; Zhang, Ke	2021, ApJ Supp. Series, 257, 2

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2696	Molecules with ALMA at Planet-forming Scales (MAPS). XV. Tracing Protoplanetary Disk Structure within 20 au	Bosman, Arthur D.; Bergin, Edwin A.; Loomis, Ryan A.; Andrews, Sean M.; van't Hoff, Merel L. R.; Teague, Richard; Öberg, Karin I.; Guzmán, Viviana V.; Walsh, Catherine; Aikawa, Yuri; Alarcón, Felipe; Bae, Jaehan; Bergner, Jennifer B.; Booth, Alice S.; Cataldi, Gianni; Cleeves, L. Ilseadore; Czekala, Ian; Huang, Jane; Ilee, John D.; Law, Charles J.; Le Gal, Romane; Liu, Yao; Long, Feng; Ménard, François; Nomura, Hideko; Pérez, Laura M.; Qi, Chunhua; Schwarz, Kamber R.; Sierra, Anibal; Tsukagoshi, Takashi; Yamato, Yoshihide; Wilner, David J.; Zhang, Ke	2021, ApJ Supp. Series, 257, 15
2697	Molecules with ALMA at Planet-forming Scales (MAPS). VII. Substellar O/H and C/H and Superstellar C/O in Planet-feeding Gas	Bosman, Arthur D.; Alarcón, Felipe; Bergin, Edwin A.; Zhang, Ke; van't Hoff, Merel L. R.; Öberg, Karin I.; Guzmán, Viviana V.; Walsh, Catherine; Aikawa, Yuri; Andrews, Sean M.; Bergner, Jennifer B.; Booth, Alice S.; Cataldi, Gianni; Cleeves, L. Ilseadore; Czekala, Ian; Furuya, Kenji; Huang, Jane; Ilee, John D.; Law, Charles J.; Le Gal, Romane; Liu, Yao; Long, Feng; Loomis, Ryan A.; Ménard, François; Nomura, Hideko; Qi, Chunhua; Schwarz, Kamber R.; Teague, Richard; Tsukagoshi, Takashi; Yamato, Yoshihide; Wilner, David J.	2021, ApJ Supp. Series, 257, 7
2698	Molecules with ALMA at Planet-forming Scales (MAPS). IX. Distribution and Properties of the Large Organic Molecules HC ₃ N, CH ₃ CN, and c-C ₃ H ₂	Ilee, John D.; Walsh, Catherine; Booth, Alice S.; Aikawa, Yuri; Andrews, Sean M.; Bae, Jaehan; Bergin, Edwin A.; Bergner, Jennifer B.; Bosman, Arthur D.; Cataldi, Gianni; Cleeves, L. Ilseadore; Czekala, Ian; Guzmán, Viviana V.; Huang, Jane; Law, Charles J.; Le Gal, Romane; Loomis, Ryan A.; Ménard, François; Nomura, Hideko; Öberg, Karin I.; Qi, Chunhua; Schwarz, Kamber R.; Teague, Richard; Tsukagoshi, Takashi; Wilner, David J.; Yamato, Yoshihide; Zhang, Ke	2021, ApJ Supp. Series, 257, 9
2699	Molecules with ALMA at Planet-forming Scales (MAPS). XI. CN and HCN as Tracers of Photochemistry in Disks	Bergner, Jennifer B.; Öberg, Karin I.; Guzmán, Viviana V.; Law, Charles J.; Loomis, Ryan A.; Cataldi, Gianni; Bosman, Arthur D.; Aikawa, Yuri; Andrews, Sean M.; Bergin, Edwin A.; Booth, Alice S.; Cleeves, L. Ilseadore; Czekala, Ian; Huang, Jane; Ilee, John D.; Le Gal, Romane; Long, Feng; Nomura, Hideko; Ménard, François; Qi, Chunhua; Schwarz, Kamber R.; Teague, Richard; Tsukagoshi, Takashi; Walsh, Catherine; Wilner, David J.; Yamato, Yoshihide	2021, ApJ Supp. Series, 257, 11
2700	Molecular Cloud Cores with High Deuterium Fractions: Nobeyama Mapping Survey	Tatematsu, Ken'ichi; Kim, Gwanjeong; Liu, Tie; Evans, II, Neal J.; Yi, Hee-Weon; Lee, Jeong-Eun; Wu, Yuefang; Hirano, Naomi; Liu, Sheng-Yuan; Dutta, Somnath; Sahu, Dipen; Sanhueza, Patricio; Kim, Kee-Tae; Juvela, Mika; Tóth, L. Viktor; Fehér, Orsolya; He, Jinhua; Ge, Jixing; Feng, Siyi; Choi, Minh; Kang, Miju; Thompson, Mark A.; Fuller, Gary A.; Li, Di; Ristorcelli, Isabelle; Wang, Ke; di Francesco, James; Eden, David; Ohashi, Satoshi; Kandori, Ryo; Vastel, Charlotte; Hirota, Tomoya; Sakai, Takeshi; Lu, Xing; Nguyễn Lu'Ō'Ng, Quang; Shinnaga, Hiroko; Kim, Jungha; Scope Collaboration; Jcmt Large Program	2021, ApJ Supp. Series, 256, 25
2701	Massive Compact Disks around FU Orionis-type Young Eruptive Stars Revealed by ALMA	Kóspál, Á.; Cruz-Sáenz de Miera, F.; White, J. A.; Ábrahám, P.; Chen, L.; Csengeri, T.; Dong, R.; Dunham, M. M.; Fehér, O.; Green, J. D.; Hashimoto, J.; Henning, Th.; Hogerheijde, M.; Kudo, T.; Liu, H. B.; Takami, M.; Vorobyov, E. I.	2021, ApJ Supp. Series, 256, 30
2702	PHANGS-ALMA Data Processing and Pipeline	Leroy, Adam K.; Hughes, Annie; Liu, Daizhong; Pety, Jérôme; Rosolowsky, Erik; Saito, Toshiaki; Schinnerer, Eva; Schruha, Andreas; Usero, Antonio; Faesi, Christopher M.; Herrera, Cinthya N.; Chevance, Mélanie; Hygate, Alexander P. S.; Kepley, Amanda A.; Koch, Eric W.; Querejeta, Miguel; Śliwa, Kazimierz; Will, David; Wilson, Christine D.; Anand, Gagandeep S.; Barnes, Ashley; Belfiore, Francesco; Bešlić, Ivana; Bigiel, Frank; Blanc, Guillermo A.; Bolatto, Alberto D.; Boquien, Mèdéric; Cao, Yixian; Chandar, Rupali; Chastenet, Jérémy; Chiang, I.-Da; Congiu, Enrico; Dale, Daniel A.; Deger, Sinan; den Brok, Jakob S.; Eibensteiner, Cosima; Emsellem, Eric; García-Rodríguez, Axel; Glover, Simon C. O.; Grasha, Kathryn; Groves, Brent; Henshaw, Jonathan D.; Jiménez Donaire, María J.; Kim, Jaeyeon; Klessen, Ralf S.; Kreckel, Kathryn; Kruijssen, J. M. Diederik; Larson, Kirsten L.; Lee, Janice C.; Mayker, Ness; McElroy, Rebecca; Meidt, Sharon E.; Mok, Angus; Pan, Hsi-An; Puschig, Johannes; Razza, Alessandro; Sánchez-Blaquez, Patricia; Sandstrom, Karin M.; Santoro, Francesco; Sardone, Amy; Scheuermann, Fabian; Sun, Jiayi; Thilker, David A.; Turner, Jordan A.; Ubeda, Leonardo; Utomo, Dyas; Watkins, Elizabeth J.; Williams, Thomas G.	2021, ApJ Supp. Series, 255, 19
2703	NOEMA High-fidelity Imaging of the Molecular Gas in and around M82	Krieger, Nico; Walter, Fabian; Bolatto, Alberto D.; Guillard, Pierre; Lehnert, Matthew; Leroy, Adam K.; Pety, Jérôme; Emig, Kimberly L.; Levy, Rebecca C.; Krips, Melanie; Rix, Hans-Walter; Salak, Dragan; Weiss, Axel; Veilleux, Sylvain	2021, ApJL, 915, L3
2704	The Otelo Survey: The Star Formation Rate Evolution of Low-mass Galaxies	Cedrés, Bernabé; Pérez-García, Ana María; Pérez-Martínez, Ricardo; Cerviño, Miguel; Gallego, Jesús; Bongiovanni, Ángel; Cepa, Jordi; Navarro Martínez, Rocío; Nadolny, Jakub; Lara-López, Maritza A.; Sánchez-Portal, Miguel; Alfaro, Emilio J.; de Diego, José A.; González-Otero, Mauro; Jesús González, J.; Ignacio González-Serrano, J.; Padilla Torres, Carmen P.	2021, ApJL, 915, L17
2705	The First Radio Spectrum of a Rapidly Rotating A-type Star	White, Jacob Aaron; Tapia-Vázquez, F.; Hughes, A. G.; Moór, A.; Matthews, B.; Wilner, D.; Aufdenberg, J.; Fehér, O.; Hughes, A. M.; De la Luz, V.; McNaughton, A.; Zapata, L. A.	2021, ApJL, 912, L5

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2706	Broadband Multi-wavelength Properties of M87 during the 2017 Event Horizon Telescope Campaign	EHT MWL Science Working Group; Algaba, J. C.; Anczarski, J.; Asada, K.; Baloković, M.; Chandra, S.; Cui, Y.-Z.; Falcone, A. D.; Giroletti, M.; Goddi, C.; Hada, K.; Haggard, D.; Jorstad, S.; Kaur, A.; Kawashima, T.; Keating, G.; Kim, J.-Y.; Kino, M.; Komossa, S.; Kravchenko, E. V.; Krichbaum, T. P.; Lee, S.-S.; Lu, R.-S.; Lucchini, M.; Markoff, S.; Neilsen, J.; Nowak, M. A.; Park, J.; Principe, G.; Ramakrishnan, V.; Reynolds, M. T.; Sasada, M.; Savchenko, S. S.; Williamson, K. 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2707	Polarimetric Properties of Event Horizon Telescope Targets from ALMA	Goddi, Ciriaco; Martí-Vidal, Iván; Messias, Hugo; Bower, Geoffrey C.; Broderick, Avery E.; Dexter, Jason; Marrone, Daniel P.; Moscibrodzka, Monika; Nagai, Hiroshi; Algaba, Juan Carlos; Asada, Keiichi; Crew, Geoffrey B.; Gómez, José L.; Impellizzeri, C. M. Violette; Janssen, Michael; Kadler, Matthias; Krichbaum, Thomas P.; Lico, Rocco; Matthews, Lynn D.; Nathanail, Antonios; Ricarte, Angelo; Ros, Eduardo; Younsi, Ziri; Akiyama, Kazunori; Alberdi, Antxon; Alef, Walter; Anantua, Richard; Azulay, Rebecca; Baczko, Anne-Kathrin; Ball, David; Baloković, Mislav; Barrett, John; Benson, Bradford A.; Bintley, Dan; Blackburn, Lindy; Blundell, Raymond; Boland, Wilfred; Bouman, Katherine L.; Boyce, Hope; Bremer, Michael; Brinkerink, Christiaan D.; Brissenden, Roger; Britzen, Silke; Brogiere, Dominique; Bronzwaer, Thomas; Byun, Do-Young; Carlstrom, John E.; Chael, Andrew; Chan, Chi-kwan; Chatterjee, Shami; Chatterjee, Koushik; Chen, Ming-Tang; Chen, Yongjun; Chesler, Paul M.; Cho, Ilje; Christian, Pierre; Conway, John E.; Cordes, James M.; Crawford, Thomas M.; Cruz-Osorio, Alejandro; Cui, Yuzhu; Davelaar, Jordy; De Laurentis, Mariafelicia; Deane, Roger; Dempsey, Jessica; Desvignes, Gregory; Doleman, Sheperd S.; Eatough, Ralph P.; Falcke, Heino; Farah, Joseph; Fish, Vincent L.; Fomalont, Ed; Ford, H. Alyson; Fraga-Encinas, Raquel; Freeman, William T.; Friberg, Per; Fromm, Christian M.; Fuentes, Antonio; Galison, Peter; Gammie, Charles F.; García, Roberto; Gentaz, Olivier; Georgiev, Boris; Gold, Roman; Gómez-Ruiz, Arturo I.; Gu, Minfeng; Gurwell, Mark; Hada, Kazuhiro; Haggard, Daryl; Hecht, Michael H.; Hesper, Ronald; Ho, Luis C.; Ho, Paul; Honma, Mareki; Huang, Chih-Wei L.; Huang, Lei; Hughes, David H.; Inoue, Makoto; Issaoun, Sara; James, David J.; Jannuzi, Buell T.; Jeter, Britton; Jiang, Wu; Jimenez-Rosales, Alejandra; Johnson, Michael D.; Jorstad, Svetlana; Jung, Taehyun; Karami, Mansour; Karuppusamy, Ramesh; Kawashima, Tomohisa; Keating, Garrett K.; Kettenis, Mark; Kim, Dong-Jin; Kim, Jae-Young; Kim, Jongsoo; Kim, Junhan; Kino, Motoki; Koay, Jun Yi; Kofuji, Yutaro; Koch, Patrick M.; Koyama, Shoko; Kramer, Michael; Kramer, Carsten; Kuo, Cheng-Yu; Lauer, Tod R.; Lee, Sang-Sung; Levis, Aviad; Li, Yan-Rong; Li, Zhiyuan; Lindqvist, Michael; Lindahl, Greg; Liu, Jun; Liu, Kuo; Liuzzo, Elisabetta; Lo, Wen-Ping; Lobanov, Andrei P.; Loinard, Laurent; Lonsdale, Colin; Lu, Ru-Sen; MacDonald, Nicholas R.; Mao, Jirong; Marchili, Nicola; Markoff, Sera; Marscher, Alan P.; Matsushita, Satoki; Medeiros, Lia; Menten, Karl M.; Mizuno, Izumi; Mizuno, Yosuke; Moran, James M.; Moriyama, Kotaro; Müller, Cornelia; Musoke, Gibwa; Mejías, Alejandro Mus; Nagar, Neil M.; Nakamura, Masanori; Narayan, Ramesh; Narayanan, Gopal; Natarajan, Iniyana; Neilsen, Joey; Neri, Roberto; Ni, Chunhong; Noutsos, Aristeidis; Nowak, Michael A.; Okino, Hiroki; Olivares, Héctor; Ortiz-León, Gisela N.; Oyama, Tomoaki; Özel, Feryal; Palumbo, Daniel C. M.; Park, Jongho; Patel, Nimesh; Pen, Ue-Li; Pesce, Dominic W.; Piétu, Vincent; Plambeck, Richard; PopStefanija, Aleksandar; Porth, Oliver; Pötzel, Felix M.; Prather, Ben; Preciado-López, Jorge A.; Psaltis, Dimitrios; Pu, Hung-Yi; Ramakrishnan, Venkatesh; Rao, Ramprasad; Rawlings, Mark G.; Raymond, Alexander W.; Rezzolla, Luciano; Ripperda, Bart; Roelofs, Freek; Rogers, Alan; Rose, Mel; Roshanineshat, Arash; Rottmann, Helge; Roy, Alan L.; Ruszczyk, Chet; Rygl, Kazi L. J.; Sánchez, Salvador; Sánchez-Arguelles, David; Sasada, Mahito; Savolainen, Tuomas; Schloerb, F. Peter; Schuster, Karl-Friedrich; Shao, Lijing; Shen, Zhiqiang; Small, Des; Sohn, Bong Won; SooHoo, Jason; Sun, He; Tazaki, Fumie; Tetarenko, Alexandra J.; Tiede, Paul; Tilanus, Remo P. J.; Titus, Michael; Toma, Kenji; Torne, Pablo; Trent, Tyler; Traianou, Efthalia; Trippe, Sascha; van Bemmell, Ilse; van Langevelde, Huib Jan; van Rossum, Daniel R.; Wagner, Jan; Ward-Thompson, Derek; Wardle, John; Weintraub, Jonathan; Wex, Norbert; Wharton, Robert; Wielgus, Maciek; Wong, George N.; Wu, Qingwen; Yoon, Doosoo; Young, André; Young, Ken; Yuan, Feng; Yuan, Ye-Fei; Zensus, J. Anton; Zhao, Guang-Yao; Zhao, Shan-Shan; Bruni, Gabriele; Gopakumar, A.; Hernández-Gómez, Antonio; Herrero-Illana, Ruben; Ingram, Adam; Komossa, S.; Kovalev, Y. Y.; Muters, Dirk; Perucho, Manel; Rösch, Florian; Valtonen, Mauri	2021, ApJL, 910, L14
2708	The Diverse Molecular Gas Content of Massive Galaxies Undergoing Quenching at $z > 1$	Belli, Sirio; Contursi, Alessandra; Genzel, Reinhard; Tacconi, Linda J.; Förster-Schreiber, Natascha M.; Lutz, Dieter; Combes, Françoise; Neri, Roberto; García-Burillo, Santiago; Schuster, Karl F.; Herrera-Camus, Rodrigo; Tadaki, Ken-ichi; Davies, Rebecca L.; Davies, Richard I.; Johnson, Benjamin D.; Lee, Minju M.; Leja, Joel; Nelson, Erica J.; Price, Sedona H.; Shangqun, Jinyi; Shimizu, T. Taro; Tacchella, Sandro; Übler, Hannah	2021, ApJL, 909, L11

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2709	First M87 Event Horizon Telescope Results. VIII. Magnetic Field Structure near The Event Horizon	Event Horizon Telescope Collaboration; Akiyama, Kazunori; Algaba, Juan Carlos; Alberdi, Antxon; Alef, Walter; Anantua, Richard; Asada, Keiichi; Azulay, Rebecca; Baczko, Anne-Kathrin; Ball, David; Baloković, Mislav; Barrett, John; Benson, Bradford A.; Bintley, Dan; Blackburn, Lindy; Blundell, Raymond; Boland, Wilfred; Bouman, Katherine L.; Bower, Geoffrey C.; Boyce, Hope; Bremer, Michael; Brinkerink, Christiaan D.; Brissenden, Roger; Britzen, Silke; Broderick, Avery E.; Brogiere, Dominique; Bronzwaer, Thomas; Byun, Do-Young; Carlstrom, John E.; Chael, Andrew; Chan, Chi-kwan; Chatterjee, Shami; Chatterjee, Koushik; Chen, Ming-Tang; Chen, Yongjun; Chesler, Paul M.; Cho, Ilje; Christian, Pierre; Conway, John E.; Cordes, James M.; Crawford, Thomas M.; Crew, Geoffrey B.; Cruz-Osorio, Alejandro; Cui, Yuzhu; Davelaar, Jordy; De Laurentis, Mariafelicia; Deane, Roger; Dempsey, Jessica; Desvignes, Gregory; Dexter, Jason; Doleman, Sheperd S.; Eatough, Ralph P.; Falcke, Heino; Farah, Joseph; Fish, Vincent L.; Fomalont, Ed; Ford, H. Alyson; Fraga-Encinas, Raquel; Friberg, Per; Fromm, Christian M.; Fuentes, Antonio; Galison, Peter; Gammie, Charles F.; García, Roberto; Gelles, Zachary; Gentaz, Olivier; Georgiev, Boris; Goddi, Ciriaco; Gold, Roman; Gómez, José L.; Gómez-Ruiz, Arturo I.; Gu, Minfeng; Gurwell, Mark; Hada, Kazuhiro; Haggard, Daryl; Hecht, Michael H.; Hesper, Ronald; Himwich, Elizabeth; Ho, Luis C.; Ho, Paul; Honma, Mareki; Huang, Chih-Wei L.; Huang, Lei; Hughes, David H.; Ikeda, Shiro; Inoue, Makoto; Issaoun, Sara; James, David J.; Jannuzi, Buell T.; Janssen, Michael; Jeter, Britton; Jiang, Wu; Jimenez-Rosales, Alejandra; Johnson, Michael D.; Jorstad, Svetlana; Jung, Taehyun; Karami, Mansour; Karuppusamy, Ramesh; Kawashima, Tomohisa; Keating, Garrett K.; Kettenis, Mark; Kim, Dong-Jin; Kim, Jae-Young; Kim, Jongsoo; Kim, Junhan; Kino, Motoki; Koay, Jun Yi; Kofuji, Yutaro; Koch, Patrick M.; Koyama, Shoko; Kramer, Michael; Kramer, Carsten; Krichbaum, Thomas P.; Kuo, Cheng-Yu; Lauer, Tod R.; Lee, Sang-Sung; Levis, Aviad; Li, Yan-Rong; Li, Zhiyuan; Lindqvist, Michael; Lico, Rocco; Lindahl, Greg; Liu, Jun; Liu, Kuo; Liuzzo, Elisabetta; Lo, Wen-Ping; Lobanov, Andrei P.; Loinard, Laurent; Lonsdale, Colin; Lu, Ru-Sen; MacDonald, Nicholas R.; Mao, Jirong; Marchili, Nicola; Markoff, Sera; Marrone, Daniel P.; Marscher, Alan P.; Martí-Vidal, Iván; Matsushita, Satoki; Matthews, Lynn D.; Medeiros, Lia; Menten, Karl M.; Mizuno, Izumi; Mizuno, Yosuke; Moran, James M.; Moriyama, Kotaro; Moscibrodzka, Monika; Müller, Cornelia; Musoke, Gibwa; Mus Mejias, Alejandro; Michalik, Daniel; Nadolski, Andrew; Nagai, Hiroshi; Nagar, Neil M.; Nakamura, Masanori; Narayan, Ramesh; Narayanan, Gopal; Natarajan, Iniyana; Nathanail, Antonios; Neilsen, Joey; Neri, Roberto; Ni, Chunchong; Noutsos, Aristeidis; Nowak, Michael A.; Okino, Hiroki; Olivares, Héctor; Ortiz-León, Gisela N.; Oyama, Tomoaki; Özel, Feryal; Palumbo, Daniel C. M.; Park, Jongho; Patel, Nimesh; Pen, Ue-Li; Pesce, Dominic W.; Piétu, Vincent; Plambeck, Richard; PopStefanija, Aleksandar; Porth, Oliver; Pötzl, Felix M.; Prather, Ben; Preciado-López, Jorge A.; Psaltis, Dimitrios; Pu, Hung-Yi; Ramakrishnan, Venkatesh; Rao, Ramprasad; Rawlings, Mark G.; Raymond, Alexander W.; Rezzolla, Luciano; Ricarte, Angelo; Ripperda, Bart; Roelofs, Freek; Rogers, Alan; Ros, Eduardo; Rose, Mel; Roshanineshat, Arash; Rottmann, Helge; Roy, Alan L.; Ruszczyk, Chet; Rygl, Kazi L. J.; Sánchez, Salvador; Sánchez-Arguelles, David; Sasada, Mahito; Savolainen, Tuomas; Schloerb, F. Peter; Schuster, Karl-Friedrich; Shao, Lijing; Shen, Zhiqiang; Small, Des; Sohn, Bong Won; SooHoo, Jason; Sun, He; Tazaki, Fumie; Tetarenko, Alexandra J.; Tiede, Paul; Tilanus, Remo P. J.; Titus, Michael; Toma, Kenji; Torne, Pablo; Trent, Tyler; Traianou, Efthalia; Trippe, Sascha; van Bemmelen, Ilse; van Langevelde, Huib Jan; van Rossum, Daniel R.; Wagner, Jan; Ward-Thompson, Derek; Wardle, John; Weintroub, Jonathan; Wex, Norbert; Wharton, Robert; Wielgus, Maciek; Wong, George N.; Wu, Qingwen; Yoon, Doosoo; Young, André; Young, Ken; Younsi, Ziri; Yuan, Feng; Yuan, Ye-Fei; Zensus, J. Anton; Zhao, Guang-Yao; Zhao, Shan-Shan	2021, ApJL, 910, L13

N°	Title	Author	Reference
2710	First M87 Event Horizon Telescope Results. VII. Polarization of the Ring	Event Horizon Telescope Collaboration; Akiyama, Kazunori; Algaba, Juan Carlos; Alberdi, Antxon; Alef, Walter; Anantua, Richard; Asada, Keiichi; Azulay, Rebecca; Baczko, Anne-Kathrin; Ball, David; Baloković, Mislav; Barrett, John; Benson, Bradford A.; Bintley, Dan; Blackburn, Lindy; Blundell, Raymond; Boland, Wilfred; Bouman, Katherine L.; Bower, Geoffrey C.; Boyce, Hope; Bremer, Michael; Brinkerink, Christiaan D.; Brissenden, Roger; Britzen, Silke; Broderick, Avery E.; Brogiere, Dominique; Bronzwaer, Thomas; Byun, Do-Young; Carlstrom, John E.; Chael, Andrew; Chan, Chi-kwan; Chatterjee, Shami; Chatterjee, Koushik; Chen, Ming-Tang; Chen, Yongjun; Chesler, Paul M.; Cho, Ilje; Christian, Pierre; Conway, John E.; Cordes, James M.; Crawford, Thomas M.; Crew, Geoffrey B.; Cruz-Osorio, Alejandro; Cui, Yuzhu; Davelaar, Jordy; De Laurentis, Mariafelicia; Deane, Roger; Dempsey, Jessica; Desvignes, Gregory; Dexter, Jason; Doeleman, Sheperd S.; Eatough, Ralph P.; Falcke, Heino; Farah, Joseph; Fish, Vincent L.; Fomalont, Ed; Ford, H. Alyson; Fraga-Encinas, Raquel; Freeman, William T.; Friberg, Per; Fromm, Christian M.; Fuentes, Antonio; Galison, Peter; Gammie, Charles F.; García, Roberto; Gentaz, Olivier; Georgiev, Boris; Goddi, Ciriaco; Gold, Roman; Gómez, José L.; Gómez-Ruiz, Arturo I.; Gu, Minfeng; Gurwell, Mark; Hada, Kazuhiro; Haggard, Daryl; Hecht, Michael H.; Hesper, Ronald; Ho, Luis C.; Ho, Paul; Honma, Mareki; Huang, Chih-Wei L.; Huang, Lei; Hughes, David H.; Ikeda, Shiro; Inoue, Makoto; Issaoun, Sara; James, David J.; Jannuzi, Buell T.; Janssen, Michael; Jeter, Britton; Jiang, Wu; Jimenez-Rosales, Alejandra; Johnson, Michael D.; Jorstad, Svetlana; Jung, Taehyun; Karami, Mansour; Karuppusamy, Ramesh; Kawashima, Tomohisa; Keating, Garrett K.; Kettenis, Mark; Kim, Dong-Jin; Kim, Jae-Young; Kim, Jongsoo; Kim, Junhan; Kino, Motoki; Koay, Jun Yi; Kofuji, Yutaro; Koch, Patrick M.; Koyama, Shoko; Kramer, Michael; Kramer, Carsten; Krichbaum, Thomas P.; Kuo, Cheng-Yu; Lauer, Tod R.; Lee, Sang-Sung; Levis, Aviad; Li, Yan-Rong; Li, Zhiyuan; Lindqvist, Michael; Lico, Rocco; Lindahl, Greg; Liu, Jun; Liu, Kuo; Liuzzo, Elisabetta; Lo, Wen-Ping; Lobanov, Andrei P.; Loinard, Laurent; Lonsdale, Colin; Lu, Ru-Sen; MacDonald, Nicholas R.; Mao, Jirong; Marchili, Nicola; Markoff, Sera; Marrone, Daniel P.; Marscher, Alan P.; Martí-Vidal, Iván; Matsushita, Satoki; Matthews, Lynn D.; Medeiros, Lia; Menten, Karl M.; Mizuno, Izumi; Mizuno, Yosuke; Moran, James M.; Moriyama, Kotaro; Moscibrodzka, Monika; Müller, Cornelia; Musoke, Gibwa; Mejías, Alejandro Mus; Michalik, Daniel; Nadolski, Andrew; Nagai, Hiroshi; Nagar, Neil M.; Nakamura, Masanori; Narayan, Ramesh; Narayanan, Gopal; Natarajan, Iniyar; Nathanail, Antonios; Neilsen, Joey; Neri, Roberto; Ni, Chunhong; Noutsos, Aristeidis; Nowak, Michael A.; Okino, Hiroki; Olivares, Héctor; Ortiz-León, Gisela N.; Oyama, Tomoaki; Özel, Feryal; Palumbo, Daniel C. M.; Park, Jongho; Patel, Nimesh; Pen, Ue-Li; Pesce, Dominic W.; Piétu, Vincent; Plambeck, Richard; PopStefanija, Aleksandar; Porth, Oliver; Pötzl, Felix M.; Prather, Ben; Preciado-López, Jorge A.; Psaltis, Dimitrios; Pu, Hung-Yi; Ramakrishnan, Venkatesh; Rao, Ramprasad; Rawlings, Mark G.; Raymond, Alexander W.; Rezzolla, Luciano; Ricarte, Angelo; Ripperda, Bart; Roelofs, Freek; Rogers, Alan; Ros, Eduardo; Rose, Mel; Roshanineshat, Arash; Rottmann, Helge; Roy, Alan L.; Ruszczyk, Chet; Rygl, Kazi L. J.; Sánchez, Salvador; Sánchez-Arguelles, David; Sasada, Mahito; Savolainen, Tuomas; Schloerb, F. Peter; Schuster, Karl-Friedrich; Shao, Lijing; Shen, Zhiqiang; Small, Des; Sohn, Bong Won; Soohoo, Jason; Sun, He; Tazaki, Fumie; Tetarenko, Alexandra J.; Tiede, Paul; Tilanus, Remo P. J.; Titus, Michael; Toma, Kenji; Torne, Pablo; Trent, Tyler; Traianou, Efthalia; Trippe, Sascha; van Bemmelen, Ilse; van Langevelde, Huib Jan; van Rossum, Daniel R.; Wagner, Jan; Ward-Thompson, Derek; Wardle, John; Weintraub, Jonathan; Wex, Norbert; Wharton, Robert; Wielgus, Maciek; Wong, George N.; Wu, Qingwen; Yoon, Doosoo; Young, André; Young, Ken; Younsi, Ziri; Yuan, Feng; Yuan, Ye-Fei; Zensus, J. Anton; Zhao, Guang-Yao; Zhao, Shan-Shan	2021, ApJL, 910, L12
2711	Understanding and minimizing resonance frequency deviations on a 4-in. kilo-pixel kinetic inductance detector array	Shu, S.; Calvo, M.; Goupy, J.; Leclercq, S.; Catalano, A.; Bideaud, A.; Monfardini, A.; Driessen, E. F. C.	2021, ApPhL, 119, 092601
2712	The far-infrared spectroscopic surveyor (FIRSS)	Rigopoulou, D.; Pearson, C.; Ellison, B.; Wiedner, M.; Okada, V. Ossenkopf; Tan, B. K.; Garcia-Bernete, I.; Gerin, M.; Yassin, G.; Caux, E.; Molinari, S.; Goicoechea, J. R.; Savini, G.; Hunt, L. K.; Lis, D. C.; Goldsmith, P. F.; Aalto, S.; Magdis, G.; Kramer, C.	2021, Experimental Astron., 51, 699-728
2713	THEZA: TeraHertz Exploration and Zooming-in for Astrophysics	Gurvits, Leonid I.; Paragi, Zsolt; Casasola, Viviana; Conway, John; Davelaar, Jordy; Falcke, Heino; Fender, Rob; Frey, Sándor; Fromm, Christian M.; Miró, Cristina García; Garrett, Michael A.; Giroletti, Marcello; Goddi, Ciriaco; Gómez, José-Luis; van der Gucht, Jeffrey; Guirado, José Carlos; Haiman, Zoltán; Helmich, Frank; Humphreys, Elizabeth; Impellizzeri, Violette; Kramer, Michael; Lindqvist, Michael; Linz, Hendrik; Liuzzo, Elisabetta; Lobanov, Andrei P.; Mizuno, Yosuke; Rezzolla, Luciano; Roelofs, Freek; Ros, Eduardo; Rygl, Kazi L. J.; Savolainen, Tuomas; Schuster, Karl; Venturi, Tiziana; Wiedner, Martina C.; Zensus, J. Anton	2021, Experimental Astron., 51, 699-728

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2714	Galaxy evolution studies in clusters: the case of Cl0024 + 1652 cluster galaxies at $z > 0.4$	Beyoro-Amado, Zeleke; Pović, Mirjana; Sánchez-Portal, Miguel; Belay Tessema, Solomon; Getachew-Woreta, Tilahun; Glace Team	2021, IAU, 356, 163-168
2715	Heterodyne Receiver for Origins	Wiedner, Martina C.; Aalto, Susanne; Amatuucci, Edward G.; Baryshev, Andrey; Battersby, Cara; Belitsky, Victor; Bergin, Edwin A.; Borgo, Bruno; Carter, Ruth C.; Caux, Emmanuel; Cooray, Asantha; Corsetti, James A.; De Beck, Elvire; Delorme, Yan; Desmaris, Vincent; Dipirro, Michael J.; Ellison, Brian; Di Giorgio, Anna M.; Eggens, Martin; Gallego, Juan-Daniel; Gerin, Maryvonne; Goldsmith, Paul F.; Goldstein, Christophe; Helmich, Frank; Herpin, Fabrice; Hills, Richard E.; Hogerheijde, Michiel R.; Hunt, Leslie K.; Jellema, Willem; Keizer, Geert; Krieg, Jean-Michel; Kroes, Gabby; Laporte, Philippe; Laurens, André; Leisawitz, David T.; Lis, Dariusz C.; Martins, Gregory E.; Mehdi, Imran; Meixner, Margaret; Melnick, Gary; Milam, Stefanie N.; Neufeld, David A.; Nguyen Tuong, Napoléon; Plume, René; Pontoppidan, Klaus M.; Quertier-Dagorn, Benjamin; Risacher, Christophe; Staguhn, Johannes G.; Tong, Edward; Viti, Serena; Wyrowski, Friedrich	2021, JATIS, 7, 011007
2716	Multi-epoch searches for relativistic binary pulsars and fast transients in the Galactic Centre	Eatough, R. P.; Torne, P.; Desvignes, G.; Kramer, M.; Karuppusamy, R.; Klein, B.; Spitler, L. G.; Lee, K. J.; Champion, D. J.; Liu, K.; Wharton, R. S.; Rezzolla, L.; Falcke, H.	2021, MNRAS, 507, 5053-5068
2717	The time-dependent distribution of optical polarization angle changes in blazars	Kiehlmann, S.; Blinov, D.; Lioudakis, I.; Pavlidou, V.; Readhead, A. C. S.; Angelakis, E.; Casadio, C.; Hovatta, T.; Kylafis, N.; Mahabal, A.; Mandarakas, N.; Myserlis, I.; Panopoulou, G. V.; Pearson, T. J.; Ramaprakash, A.; Reig, P.; Skalidis, R.; Słowiowska, A.; Tassis, K.; Zensus, J. A.	2021, MNRAS, 507, 225-243
2718	Where infall meets outflows: turbulent dissipation probed by CH ⁺ and Ly α in the starburst/AGN galaxy group SMM J02399-0136 at $z \approx 2.8$	Vidal-García, A.; Falgarone, E.; Arrigoni Battaia, F.; Godard, B.; Ivison, R. J.; Zwaan, M. A.; Herrera, C.; Frayer, D.; Andreani, P.; Li, Q.; Gavazzi, R.	2021, MNRAS, 506, 2551-2573
2719	Dense molecular gas properties on 100 pc scales across the disc of NGC 3627	Bešlić, I.; Barnes, A. T.; Bigiel, F.; Puschign, J.; Pety, J.; Herrera Contreras, C.; Leroy, A. K.; Usero, A.; Schinnerer, E.; Meidt, S. E.; Emsellem, E.; Hughes, A.; Faesi, C.; Kreckel, K.; Belfiore, F. M. C.; Chevance, M.; den Brok, J. S.; Eibensteiner, C.; Glover, S. C. O.; Grasha, K.; Jimenez-Donaire, M. J.; Klessen, R. S.; Kruijssen, J. M. D.; Liu, D.; Pessa, I.; Querejeta, M.; Rosolowsky, E.; Saito, T.; Santoro, F.; Schruba, A.; Sormani, M. C.; Williams, T. G.	2021, MNRAS, 506, 963-988
2720	Properties of cold molecular gas in four type-1 active galaxies hosting outflows	Runnoe, Jessie C.; Gültekin, Kayhan; Rupke, David; López-Sepulcre, Ana	2021, MNRAS, 505, 6017-6036
2721	Early science with the Large Millimeter Telescope: a 1.1 mm AzTEC survey of red-Herschel dusty star-forming galaxies	Montaña, A.; Zavala, J. A.; Aretxaga, I.; Hughes, D. H.; Ivison, R. J.; Pope, A.; Sánchez-Argüelles, D.; Wilson, G. W.; Yun, M.; Cantua, O. A.; McCrackan, M.; Michałowski, M. J.; Valiante, E.; Arumugam, V.; Casey, C. M.; Chávez, R.; Colín-Beltrán, E.; Dannerbauer, H.; Dunlop, J. S.; Dunne, L.; Eales, S.; Ferrusca, D.; Gómez-Rivera, V.; Gómez-Ruiz, A. I.; de la Luz, V. H.; Maddox, S. J.; Narayanan, G.; Omont, A.; Rodríguez-Montoya, I.; Serjeant, S.; Schloerb, F. P.; Velázquez, M.; Ventura-González, S.; van der Werf, P.; Zeballos, M.	2021, MNRAS, 505, 5260-5282
2722	The complex variability of blazars: time-scales and periodicity analysis in S4 0954+65	Raiteri, C. M.; Villata, M.; Larionov, V. M.; Jorstad, S. G.; Marscher, A. P.; Weaver, Z. R.; Acosta-Pulido, J. A.; Agudo, I.; Andreeva, T.; Arkharov, A.; Bachev, R.; Benítez, E.; Berton, M.; Björklund, I.; Borman, G. A.; Bozhilov, V.; Carnerero, M. I.; Carosati, D.; Casadio, C.; Chen, W. P.; Damjanovic, G.; D'Ammando, F.; Escudero, J.; Fuentes, A.; Giroletti, M.; Grishina, T. S.; Gupta, A. C.; Hagen-Thorn, V. A.; Hart, M.; Hiriart, D.; Hou, W. -J.; Ivanov, D.; Kim, J. -Y.; Kimeridze, G. N.; Konstantopoulou, C.; Kopatskaya, E. N.; Kurtanidze, O. M.; Kurtanidze, S. O.; Lähteenmäki, A.; Larionova, E. G.; Larionova, L. V.; Marchili, N.; Markovic, G.; Minev, M.; Morozova, D. A.; Myserlis, I.; Nakamura, M.; Nikiforova, A. A.; Nikolashvili, M. G.; Otero-Santos, J.; Ovcharov, E.; Pursimo, T.; Rahimov, I.; Righini, S.; Sakamoto, T.; Savchenko, S. S.; Semkov, E. H.; Shakhovskoy, D.; Sigua, L. A.; Stojanovic, M.; Strigachev, A.; Thum, C.; Tornikoski, M.; Traianou, E.; Troitskaya, Y. V.; Troitskiy, I. S.; Tsai, A.; Valcheva, A.; Vasilyev, A. A.; Vince, O.; Zaharieva, E.	2021, MNRAS, 504, 5629-5646
2723	On the duration of the embedded phase of star formation	Kim, Jaeyeon; Chevance, Mélanie; Kruijssen, J. M. Diederik; Schruba, Andreas; Sandstrom, Karin; Barnes, Ashley T.; Bigiel, Frank; Blanc, Guillermo A.; Cao, Yixian; Dale, Daniel A.; Faesi, Christopher M.; Glover, Simon C. O.; Grasha, Kathryn; Groves, Brent; Herrera, Cinthya; Klessen, Ralf S.; Kreckel, Kathryn; Lee, Janice C.; Leroy, Adam K.; Pety, Jérôme; Querejeta, Miguel; Schinnerer, Eva; Sun, Jiayi; Usero, Antonio; Ward, Jacob L.; Williams, Thomas G.	2021, MNRAS, 504, 487-509
2724	GASTON: Galactic Star Formation with NIKA2 - evidence for the mass growth of star-forming clumps	Rigby, A. J.; Peretto, N.; Adam, R.; Ade, P.; Anderson, M.; André, P.; Andrianasolo, A.; Aussel, H.; Bacmann, A.; Beelen, A.; Benoît, A.; Berta, S.; Bourrion, O.; Bracco, A.; Calvo, M.; Catalano, A.; De Petris, M.; Désert, F. -X.; Doyle, S.; Driessen, E. F. C.; García, P.; Gomez, A.; Goupy, J.; Kéruszoré, F.; Kramer, C.; Ladjelate, B.; Lagache, G.; Leclercq, S.; Lestrade, J. -F.; Macías-Pérez, J. F.; Manskopf, P.; Mayet, F.; Monfardini, A.; Perotto, L.; Pisano, G.; Ponthieu, N.; Révêret, V.; Ristorcelli, I.; Ritacco, A.; Romero, C.; Roussel, H.; Ruppín, F.; Schuster, K.; Shu, S.; Sievers, A.; Tucker, C.; Watkins, E. J.	2021, MNRAS, 502, 4576-4596

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2725	Evolution of dust porosity through coagulation and shattering in the interstellar medium	Hirashita, Hiroyuki; Il'in, Vladimir B.; Pagani, Laurent; Lefèvre, Charlène	2021, MNRAS, 502, 15-31
2726	Giant molecular cloud catalogues for PHANGS-ALMA: methods and initial results	Rosolowsky, Erik; Hughes, Annie; Leroy, Adam K.; Sun, Jiayi; Querejeta, Miguel; Schrupa, Andreas; Usero, Antonio; Herrera, Cinthya N.; Liu, Daizhong; Pety, Jérôme; Saito, Toshiki; Bešlić, Ivana; Bigiel, Frank; Blanc, Guillermo; Chevance, Mélanie; Dale, Daniel A.; Deger, Sinan; Faesi, Christopher M.; Glover, Simon C. O.; Henshaw, Jonathan D.; Klessen, Ralf S.; Kruijssen, J. M. Diederik; Larson, Kirsten; Lee, Janice; Meidt, Sharon; Mok, Angus; Schinnerer, Eva; Thilker, David A.; Williams, Thomas G.	2021, MNRAS, 502, 1218-1245
2727	GLACE survey: Galaxy activity in ZwCl0024+1652 cluster from strong optical emission lines	Beyoro-Amado, Zeleke; Sánchez-Portal, Miguel; Bongiovanni, Ángel; Pović, Mirjana; Tessema, Solomon B.; Pérez-Martínez, Ricardo; Pérez García, Ana María; Cerviño, Miguel; Nadolny, Jakub; Cepa, Jordi; González-Serrano, J. Ignacio; Pintos-Castro, Irene	2021, MNRAS, 501, 2430-2450
2728	A new leptohadronic model applied to the first simultaneous multiwavelength data set for Cygnus X-1	Kantzas, D.; Markoff, S.; Beuchert, T.; Lucchini, M.; Chhotray, A.; Ceccobello, C.; Tetarenko, A. J.; Miller-Jones, J. C. A.; Bremer, M.; Garcia, J. A.; Grinberg, V.; Uttley, P.; Wilms, J.	2021, MNRAS, 500, 2112-2126
2729	Event Horizon Telescope observations of the jet launching and collimation in Centaurus A	Janssen, Michael; Falcke, Heino; Kadler, Matthias; Ros, Eduardo; Wielgus, Maciek; Akiyama, Kazunori; Baloković, Mislav; Blackburn, Lindy; Bouman, Katherine L.; Chael, Andrew; Chan, Chi-kwan; Chatterjee, Koushik; Davelaar, Jordy; Edwards, Philip G.; Fromm, Christian M.; Gómez, José L.; Goddi, Ciriaco; Issaoun, Sara; Johnson, Michael D.; Kim, Junhan; Koay, Jun Yi; Krichbaum, Thomas P.; Liu, Jun; Liuzzo, Elisabetta; Markoff, Sera; Markowitz, Alex; Marrone, Daniel P.; Mizuno, Yosuke; Müller, Cornelia; Ni, Chunhong; Pesce, Dominic W.; Ramakrishnan, Venkatessh; Roelofs, Freek; Rygl, Kazi L. J.; van Bemmell, Ilse; Event Horizon Telescope Collaboration; Alberdi, Antxon; Alef, Walter; Algaba, Juan Carlos; Anantua, Richard; Asada, Keiichi; Azulay, Rebecca; Baczko, Anne-Kathrin; Ball, David; Ball, David; Barrett, John; Benson, Bradford A.; Bintley, Dan; Bintley, Dan; Blundell, Raymond; Boland, Wilfred; Boland, Wilfred; Bower, Geoffrey C.; Boyce, Hope; Bremer, Michael; Brinkerink, Christiaan D.; Brissenden, Roger; Britzen, Silke; Broderick, Avery E.; Brogiere, Dominique; Bronzwaer, Thomas; Byun, Do-Young; Carlstrom, John E.; Chatterjee, Shami; Chen, Ming-Tang; Chen, Yongjun; Chesler, Paul M.; Cho, Ilje; Christian, Pierre; Conway, John E.; Cordes, James M.; Crawford, Thomas M.; Crew, Geoffrey B.; Cruz-Osorio, Alejandro; Cui, Yuzhu; Cui, Yuzhu; De Laurentis, Mariafelicia; Deane, Roger; Dempsey, Jessica; Desvignes, Gregory; Dexter, Jason; Doeleman, Sheperd S.; Eatough, Ralph P.; Farah, Joseph; Farah, Joseph; Fish, Vincent L.; Fomalont, Ed; Ford, H. Alyson; Fraga-Encinas, Raquel; Friberg, Per; Friberg, Per; Fuentes, Antonio; Galison, Peter; Gammie, Charles F.; García, Roberto; Gelles, Zachary; Gentaz, Olivier; Georgiev, Boris; Georgiev, Boris; Gold, Roman; Gold, Roman; Gómez-Ruiz, Arturo I.; Gu, Minfeng; Gurwell, Mark; Hada, Kazuhiro; Haggard, Daryl; Hecht, Michael H.; Hesper, Ronald; Himwich, Elizabeth; Ho, Luis C.; Ho, Paul; Honma, Mareki; Huang, Chih-Wei L.; Huang, Lei; Hughes, David H.; Ikeda, Shiro; Inoue, Makoto; Inoue, Makoto; James, David J.; Jannuzi, Buell T.; Jannuzi, Buell T.; Jeter, Britton; Jiang, Wu; Jimenez-Rosales, Alejandra; Jimenez-Rosales, Alejandra; Jorstad, Svetlana; Jung, Taehyun; Karami, Mansour; Karuppusamy, Ramesh; Kawashima, Tomohisa; Keating, Garrett K.; Kettenis, Mark; Kim, Dong-Jin; Kim, Jae-Young; Kim, Jae-Young; Kim, Jongsoo; Kino, Motoki; Kino, Motoki; Kofuji, Yutaro; Koyama, Shoko; Kramer, Michael; Kramer, Carsten; Kramer, Carsten; Kuo, Cheng-Yu; Lauer, Tod R.; Lee, Sang-Sung; Levis, Aviad; Li, Yan-Rong; Li, Zhiyuan; Lindqvist, Michael; Lico, Rocco; Lindahl, Greg; Lindahl, Greg; Liu, Kuo; Liu, Kuo; Lo, Wen-Ping; Lobanov, Andrei P.; Loinard, Laurent; Lonsdale, Colin; Lu, Ru-Sen; MacDonald, Nicholas R.; Mao, Jirong; Marchili, Nicola; Marchili, Nicola; Marchili, Nicola; Marscher, Alan P.; Martí-Vidal, Iván; Matsushita, Satoki; Matthews, Lynn D.; Medeiros, Lia; Menten, Karl M.; Mizuno, Izumi; Mizuno, Izumi; Moran, James M.; Moriyama, Kotaro; Moscibrodzka, Monika; Moscibrodzka, Monika; Musoke, Gibwa; Mejías, Alejandro Mus; Nagai, Hiroshi; Nagar, Neil M.; Nakamura, Masanori; Narayan, Ramesh; Narayanan, Gopal; Natarajan, Iniyar; Nathanail, Antonios; Neilsen, Joey; Neri, Roberto; Neri, Roberto; Noutsos, Aristeidis; Nowak, Michael A.; Okino, Hiroki; Olivares, Héctor; Ortiz-León, Gisela N.; Oyama, Tomoaki; Özel, Feryal; Palumbo, Daniel C. M.; Park, Jongho; Patel, Nimesh; Pen, Ue-Li; Pen, Ue-Li; Piétu, Vincent; Plambeck, Richard; PopStefanija, Aleksandar; Porth, Oliver; Pötzl, Felix M.; Prather, Ben; Preciado-López, Jorge A.; Psaltis, Dimitrios; Pu, Hung-Yi; Pu, Hung-Yi; Rao, Ramprasad; Rawlings, Mark G.; Raymond, Alexander W.; Rezzolla, Luciano; Ricarte, Angelo; Ripperda, Bart; Ripperda, Bart; Rogers, Alan; Rogers, Alan; Rose, Mel; Roshanineshat, Arash; Rottmann, Helge; Roy, Alan L.; Ruszczyk, Chet; Ruszczyk, Chet; Sánchez, Salvador; Sánchez-Argüelles, David; Sasada, Mahito	2021, Nature Astronomy, 5, 1017-1028

N°	Title	Author	Reference
2729 (cont.)	Event Horizon Telescope observations of the jet launching and collimation in Centaurus A	Savolainen, Tuomas; Schloerb, F. Peter; Schuster, Karl-Friedrich; Shao, Lijing; Shen, Zhiqiang; Small, Des; Sohn, Bong Won; SooHoo, Jason; Sun, He; Tazaki, Fumie; Tetarenko, Alexandra J.; Tiede, Paul; Tilanus, Remo P. J.; Titus, Michael; Torne, Pablo; Trent, Tyler; Traianou, Efthalia; Trippe, Sascha; van Bemmell, Ilse; van Langevelde, Huib Jan; van Rossum, Daniel R.; Wagner, Jan; Ward-Thompson, Derek; Wardle, John; Weintroub, Jonathan; Wex, Norbert; Wharton, Robert; Wharton, Robert; Wong, George N.; Wu, Qingwen; Yoon, Doosoo; Young, André; Young, Ken; Younsi, Ziri; Yuan, Feng; Yuan, Ye-Fei; Zensus, J. Anton; Zhao, Guang-Yao; Zhao, Shan-Shan	2021, Nature Astronomy, 5, 1017-1028
2730	Constraints on black-hole charges with the 2017 EHT observations of M87*	Kocherlakota, Prashant; Rezzolla, Luciano; Falcke, Heino; Fromm, Christian M.; Kramer, Michael; Mizuno, Yosuke; Nathanail, Antonios; Olivares, Héctor; Younsi, Ziri; Akiyama, Kazunori; Alberdi, Antxon; Alef, Walter; Algaba, Juan Carlos; Anantua, Richard; Asada, Keiichi; Azulay, Rebecca; Baczo, Anne-Kathrin; Ball, David; Baloković, Mislav; Barrett, John; Benson, Bradford A.; Bintley, Dan; Blackburn, Lindy; Blundell, Raymond; Boland, Wilfred; Bouman, Katherine L.; Bower, Geoffrey C.; Boyce, Hope; Bremer, Michael; Brinkerink, Christiaan D.; Brissenden, Roger; Britzen, Silke; Broderick, Avery E.; Brogiere, Dominique; Bronzwaer, Thomas; Byun, Do-Young; Carlstrom, John E.; Chael, Andrew; Chan, Chi-kwan; Chatterjee, Shami; Chatterjee, Koushik; Chen, Ming-Tang; Chen, Yongjun; Chesler, Paul M.; Cho, Ilje; Christian, Pierre; Conway, John E.; Cordes, James M.; Crawford, Thomas M.; Crew, Geoffrey B.; Cruz-Osorio, Alejandro; Cui, Yuzhu; Davelaar, Jordy; De Laurentis, Mariafelicia; Deane, Roger; Dempsey, Jessica; Desvignes, Gregory; Doleman, Sheperd S.; Eatough, Ralph P.; Farah, Joseph; Fish, Vincent L.; Fomalont, Ed; Fraga-Encinas, Raquel; Friberg, Per; Ford, H. Alyson; Fuentes, Antonio; Galison, Peter; Gammie, Charles F.; García, Roberto; Gentaz, Olivier; Georgiev, Boris; Goddi, Ciriaco; Gold, Roman; Gómez, José L.; Gómez-Ruiz, Arturo I.; Gu, Minfeng; Gurwell, Mark; Hada, Kazuhiro; Haggard, Daryl; Hecht, Michael H.; Hesper, Ronald; Ho, Luis C.; Ho, Paul; Honma, Mareki; Huang, Chih-Wei L.; Huang, Lei; Hughes, David H.; Ikeda, Shiro; Inoue, Makoto; Issaoun, Sara; James, David J.; Januzzi, Buell T.; Janssen, Michael; Jeter, Britton; Jiang, Wu; Jimenez-Rosales, Alejandra; Johnson, Michael D.; Jorstad, Svetlana; Jung, Taehyun; Karami, Mansour; Karuppusamy, Ramesh; Kawashima, Tomohisa; Keating, Garrett K.; Kettenis, Mark; Kim, Dong-Jin; Kim, Jae-Young; Kim, Jongsoo; Kim, Junhan; Kino, Motoki; Koay, Jun Yi; Kofuji, Yutaro; Koch, Patrick M.; Koyama, Shoko; Kramer, Carsten; Krichbaum, Thomas P.; Kuq, Cheng-Yu; Lauer, Tod R.; Lee, Sang-Sung; Levis, Aviad; Li, Yan-Rong; Li, Zhiyuan; Lindqvist, Michael; Lico, Rocco; Lindahl, Greg; Liu, Jun; Liu, Kuo; Liuzzo, Elisabetta; Lo, Wen-Ping; Lobanov, Andrei P.; Loinard, Laurent; Lonsdale, Colin; Lu, Ru-Sen; MacDonald, Nicholas R.; Mao, Jirong; Marchili, Nicola; Markoff, Sera; Marrone, Daniel P.; Marscher, Alan P.; Martí-Vidal, Iván; Matsushita, Satoki; Matthews, Lynn D.; Medeiros, Lia; Menten, Karl M.; Mizuno, Izumi; Moran, James M.; Moriyama, Kotaro; Moscibrodzka, Monika; Müller, Cornelia; Musoke, Gibwa; Mejías, Alejandro; Mus, Nagai; Hiroshi; Nagar, Neil M.; Nakamura, Masanori; Narayan, Ramesh; Narayanan, Gopal; Natarajan, Iniyam; Neilsen, Joseph; Neri, Roberto; Ni, Chunhong; Noutsos, Aristeidis; Nowak, Michael A.; Okino, Hiroki; Ortiz-León, Gisela N.; Oyama, Tomoaki; Özel, Feryal; Palumbo, Daniel C. M.; Park, Jongho; Patel, Nimesh; Pen, Ue-Li; Pesce, Dominic W.; Piétu, Vincent; Plambeck, Richard; PopStefanija, Aleksandar; Porth, Oliver; Pötzl, Felix M.; Prather, Ben; Preciado-López, Jorge A.; Psaltis, Dimitrios; Pu, Hung-Yi; Ramakrishnan, Venkatesh; Rao, Ramprasad; Rawlings, Mark G.; Raymond, Alexander W.; Ricarte, Angelo; Ripperda, Bart; Roelofs, Freek; Rogers, Alan; Ros, Eduardo; Rose, Mel; Roshanineshat, Arash; Rottmann, Helge; Roy, Alan L.; Ruszczyk, Chet; Rygl, Kazi L. J.; Sánchez, Salvador; Sánchez-Arguelles, David; Sasada, Mahito; Savolainen, Tuomas; Schloerb, F. Peter; Schuster, Karl-Friedrich; Shao, Lijing; Shen, Zhiqiang; Small, Des; Sohn, Bong Won; SooHoo, Jason; Sun, He; Tazaki, Fumie; Tetarenko, Alexandra J.; Tiede, Paul; Tilanus, Remo P. J.; Titus, Michael; Toma, Kenji; Torne, Pablo; Trent, Tyler; Traianou, Efthalia; Trippe, Sascha; van Bemmell, Ilse; van Langevelde, Huib Jan; van Rossum, Daniel R.; Wagner, Jan; Ward-Thompson, Derek; Wardle, John; Weintroub, Jonathan; Wex, Norbert; Wharton, Robert; Wielgus, Maciek; Wong, George N.; Wu, Qingwen; Yoon, Doosoo; Young, André; Young, Ken; Yuan, Feng; Yuan, Ye-Fei; Zensus, J. Anton; Zhao, Guang-Yao; Zhao, Shan-Shan; EHT Collaboration	2021, Phys. Review D, 103, 104047
2731	Direct evidence for Cooper pairing without a spectral gap in a disordered superconductor above T _c	Bastiaans, Koen M.; Chatzopoulos, Damianos; Ge, Jian-Feng; Cho, Doohee; Tromp, Willem O.; van Ruitenbeek, Jan M.; Fischer, Mark H.; de Visser, Pieter J.; Thoen, David J.; Driessen, Eduard F. C.; Klapwijk, Teunis M.; Allan, Milan P.	2021, Science, 374, 608-611
2732	Rapidly Varying Anisotropic Methanol (CH ₃ OH) Production in the Inner Coma of Comet 46P/Wirtanen as Revealed by the ALMA Atacama Compact Array	Roth, Nathan X.; Milam, Stefanie N.; Cordiner, Martin A.; Bockelée-Morvan, Dominique; DiSanti, Michael A.; Boissier, Jérémie; Biver, Nicolas; Crovisier, Jacques; Russo, Neil Dello; Bonev, Boncho P.; Qi, Chunhua; Remijan, Anthony J.; Charnley, Steven B.; Gibb, Erika L.; Val-Borro, Miguel de; Jehin, Emmanuel	2021, The Planetary Science Journal, 2, 55

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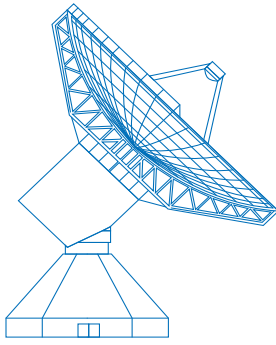
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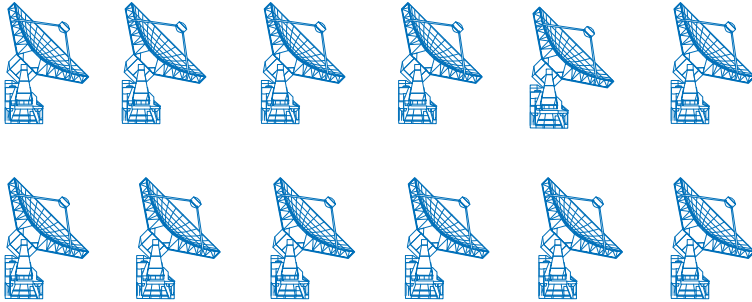
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30-meter telescope, Pico Veleta



12 x 15-meter Interferometer, NOEMA

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