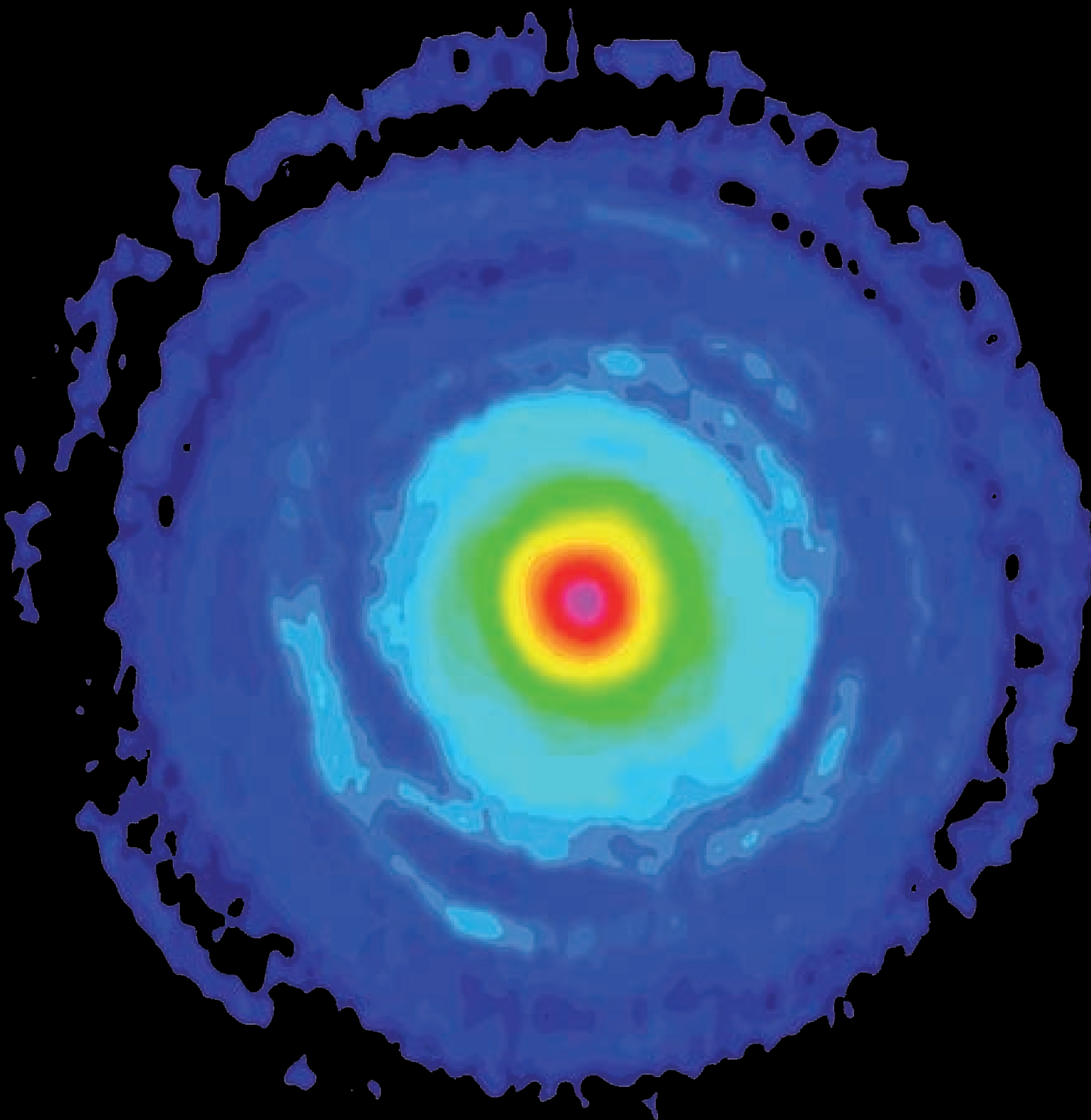
IRAM Annual Report 2008



iram
Institut de
Radioastronomie
Millimétrique

IRAM Annual Report 2008

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Introduction

In the year 2008, IRAM continued its ambitious program of accomplishments including many scientific discoveries, the testing of new instrumentation and promising technical developments.

The number of proposals submitted both for the 30-meter and the Plateau de Bure interferometer continued to increase, reflecting both the improvement of the instrumental performances and the steady growth of the community interested in using facilities operating at millimeter wavelengths. The number of scientific papers published in 2008 amounted to 138 publications. Highlights, that are described in the annual report, include the detection of large amounts of molecular gas in 'normal' galaxies at high redshifts; maps in carbon monoxide of nearby galaxies indicating that the star formation rate is in linear proportion to the surface density of molecular gas; the surprising detection of molecular gas in the outer filaments of a galaxy in the Perseus cluster, likely tracing outward flowing winds; results in astrochemistry both in external galaxies, in the Milky Way and in evolved stars, including the detection and mapping of new complex molecules and molecular anions; further detailed studies of proto-planetary objects probing the inner structure of the dust disk and observations of the outburst activity in comet Holmes.

At the 30-meter telescope many improvements were made including further work on the New Control System and the tracking of the telescope, as well as the preparation for the new 4 GHz bandwidth receivers planned for installation in Spring 2009. About 70% of the total time was used for observations and the pool observations were able to make an efficient use of the best weather conditions. Both the 1.3 mm heterodyne instrument (HERA) and the bolometer camera (MAMBO), operating at 1.3 mm, were again highly requested, producing some of the most significant scientific results from the 30-meter telescope. To prepare for the next generation of bolometric cameras at the 30-meter, an improved version of the prototype Goddard-IRAM-Super-Conducting-2-Milllimeter Observer (GISMO), a 8x16 pixel camera operating at 2 mm, was tested successfully for the second time.

As in the past years, the activities at the Plateau de Bure Interferometer were numerous. Due to good weather conditions, in particular during the winter period, the programs requesting the longest baseline configurations could all take advantage of the high sensitivity of the new receivers covering the 3, 2 and 1 mm atmospheric windows, leading to new spectacular discoveries in the exploration of the early universe and the study of the matter around young stellar objects. Over the year, about 50% of the total time could be used for astronomical observations. During the maintenance period, further work was done to meet the next milestones for the interferometer, specifically the installation of WideX, a broadband correlator covering 4 GHz bandwidth in each polarization with a channel spacing of 2 MHz, which is planned for the end of 2009, as well as a new receiver that will operate in the 277-371 GHz band, scheduled for the end of 2010. The panel replacement of four of the array antennas is proceeding on schedule, with the refurbishment of the first antenna (number 4) completed last October. The new aluminum panels have a much-improved surface with a final accuracy of 48 microns. The current plan is to refurbish a second antenna in 2009 and the two last ones in 2010, in time for the installation of the new receivers operating at the highest frequencies. Further work was done to make the interferometer even more efficient, such as investigating the potential of the frequency-offset technique, relaxing the sun avoidance constraints and improving the 22 GHz radiometric absolute phase-correction scheme, all of which are described this report.

The technical groups have been very active on many fronts in 2008. In particular, they were working on the fabrication, assembly and verification of the new Eight Mixer Receiver (EMIR) for the 30-meter telescope, and the building of the large bandwidth correlator (WideX) for the Plateau de Bure interferometer. In parallel, they have been involved in further technical research and development, partly supported by European money, which is outlined in this report and which largely benefit the performance of the IRAM instruments.

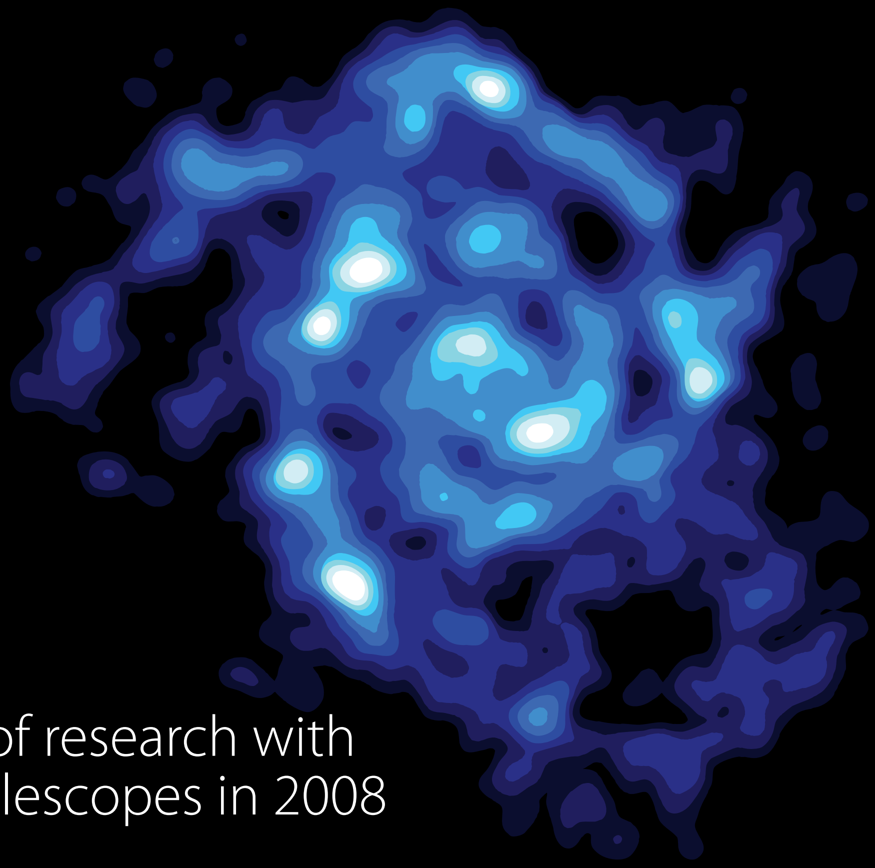
Almost all of the groups at IRAM are involved in the ALMA construction. The main activities are: the work on the sampler digitizer clocks and fine delay system for the ALMA backend, which is now finalized with all 68 units delivered; the development of the software for the antenna calibration; and the production of the Band 7 cartridges where the largest part of the activity in 2008 was devoted to the procuring of components, the setting up of the equipment, and the hiring of additional staff with the goal to ramp up to the foreseen production rate of one cartridge delivered every three weeks at the beginning of 2009.

The wide range of successful activities at IRAM is ultimately reflected in the global scientific output based on observations done at the 30-meter telescope and/or the Plateau de Bure interferometer. Over the past years, both instruments have undergone gradual and major changes that have significantly increased their capabilities and efficiency. This trend is continuing and the following years will see further improvements on many fronts. To increase the public outreach, a large effort was made in 2008 and subsequently, to bring to a wider audience the activities and scientific results of the institute through exhibitions, conferences and press releases.

Another important milestone, reached in December 2008, was the selection of the Leitner Company to rebuild the Plateau de Bure cable car. As foreseen by Leitner, construction would start in 2009 with the goal to have an operational cable car in 2010. This major decision marks an important date for the institute and for its future that would not have been possible without the unfailing support of the Members of the Council and the Partners as well as all those who have contributed to make this decision possible.

Finally, in the longer-term future, IRAM started discussions about a possible enhancement of the Plateau de Bure Interferometer, which would double the number of antennas, equip them with very large bandwidth receivers and extend the baselines. This project, called NOEMA (Northern Extended Millimeter Array), will transform the current interferometer into a new, quantitatively different and much more powerful instrument. Combined with ongoing developments in technology, this new facility, which will be entirely dedicated to millimeter astronomy, will allow investigation of the fundamental and challenging issues of modern astronomy on an entirely new level. If completed, it will be a key partner to ALMA and a trailblazer in astronomy for the coming decades.

Photomontage of the Plateau de Bure interferometer with the six additional antennas planned in the NOEMA project.



Highlights of research with the IRAM telescopes in 2008

Among the many projects at the IRAM telescopes, done or published in 2008, a few highlights were :

High-redshift galaxies: The interferometer has detected large amounts of molecular gas from "ordinary" massive galaxies, indicating "low efficiency" star formation in massive disks at redshift 1.5.

The star formation law in galaxies: Maps of CO in nearby galaxies with the 30m telescope have been combine with UV, IR, and H-I data to show that the star formation rate is linearly proportional to the surface density of molecular gas.

Central cluster galaxies: New observations with the 30m telescope detect molecular gas in the outer filaments around NGC 1275, at the core of the Perseus cluster, out to an astonishing radius of 50 kpc from the center of the galaxy.

Chemistry of nuclear starburst regions: An interferometer study of the reactive ion HOC^+ in the inner disk of the galaxy M82 shows that the ion chemisty is occurring in UV-photon dominated regions (PDRs), not X-ray dominated regions (XDRs).

Evidence for star formation's self-regulating feedback in the nucleus of IC 342: New high-resolution maps of HCN and CO show that the molecular gas is on the outside of a circumnuclear ring of H II regions, suggesting that feedback from a nuclear starburst stops the flow of gas into the center of the galaxy IC 342.

Diffuse gas in our Galaxy: New hybrid maps (interferometer+single dish) trace bright, turbulent CO surrounding the line of sight through our Galaxy, in the direction of the extragalactic source NRAO 150.

Young low-mass stars: New high-resolution interferometer maps in the 1.3mm dust continuum confirm the hidden binary nature of the young stellar system HH 30.

Young high-mass stars: First detection outside the Galactic center, of the simplest sugar, glycoaldehyde, in the massive young stellar object G31.41+0.31.

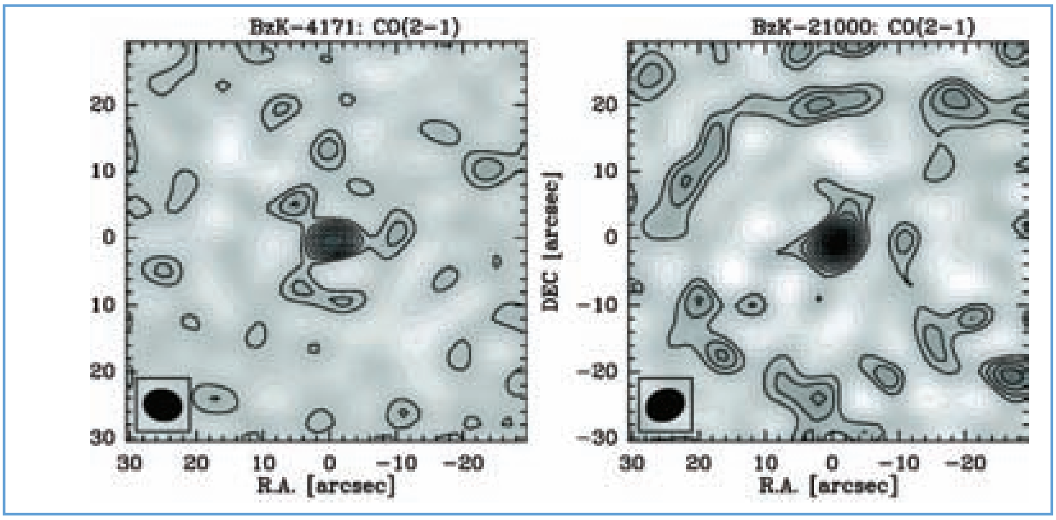
Evolved stars' circumstellar chemistry: Detection with the 30m telescope of the anion C5N – and vibrationally excited C6H in the carbon star IRC +10216.

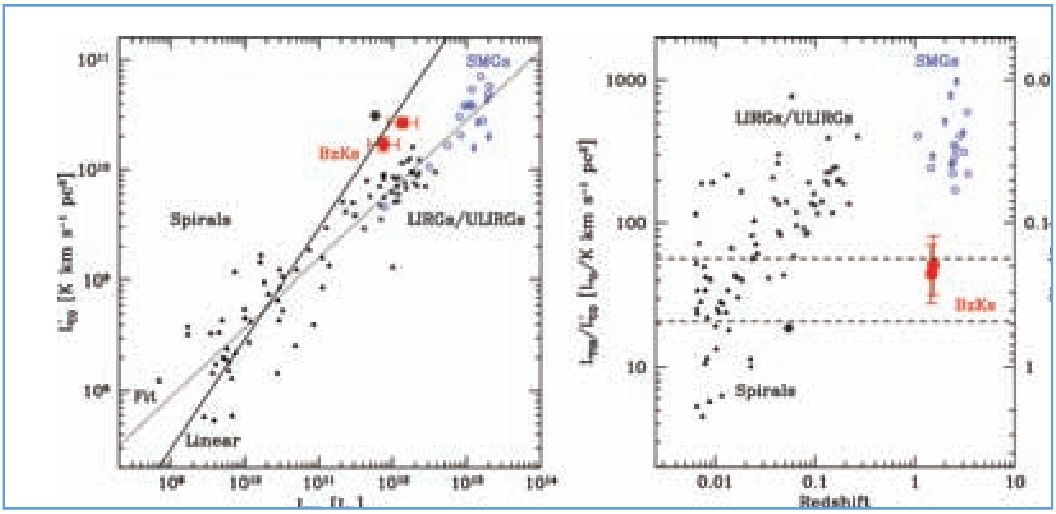
Evolved Stars: New interferometer maps provide evidence for a high-excitation layer within the circumstellar shell around the yellow hypergiant star AFGL 2343.

Solar system: Spectra from the 30m telescope indicate a large excess of the N-15 isotope in HCN and CN in comet Holmes. Comparison of IRAM data on the comet's dust flux with other radio and optical data suggests the cause of the outburst was explosive sublimation of water ice sealed beneath a thick, ice-free, dust crust.

HIGH-REDSHIFT GALAXIES

“Low efficiency” star formation in z = 1.5 ULIRGs. Galaxies at earlier cosmic epochs formed stars at much higher rates than they do today. The typical rate of star formation 10 billion years ago (redshift 2) was up to 30 times higher than it is today, probably because galaxies had more gas, and because the volume of the universe was 30 times smaller than now, so the gas-rich galaxy-galaxy mergers that create starbursts were more frequent. But what about the high-redshift galaxies that were also forming stars at “low efficiency”? --- i.e., the galaxies that were converting gas into stars at about the same rate as the well-know spiral galaxy disks in our local universe? Up to now, it has been difficult to observe such “non-extreme” objects to detect their CO emission. With a combination of the new generation of high-sensitivity millimeter receivers and a new search technique for “normal” galaxies in the optical and near-infrared B, z, and K bands, it now becomes possible to start to find such “normal” galaxies at high redshift. The IRAM Interferometer has been used to detect the CO(2-1) lines from two of these objects at redshifts near z = 1.5. The galaxies are called BzK-4171 (position J123626+6208, z =1.465) and BzK-21000 (position J123710+6223, z =1.522). The CO intensities are about 0.7 Jy km/s, the CO redshifts agree with optical redshifts measured at the Keck telescope, the CO positions agree with VLA radio continuum positions, the CO linewidths are ~500 km/s, and the molecular gas mass in each galaxy is about 2 x 10^{10} M_{sun}. In Hubble Space Telescope images, the starlight in these two galaxies has half-light radii of 4.4 and 5.5 kpc (0.5”) and declines exponentially with radius, as in disk galaxies (Daddi et al. 2008, ApJ, 673, L21).





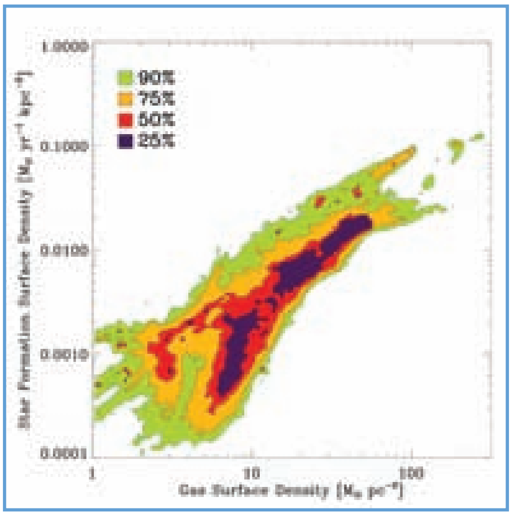
CO in massive disk galaxies at z = 1.5, with low IR-to-CO ratio.

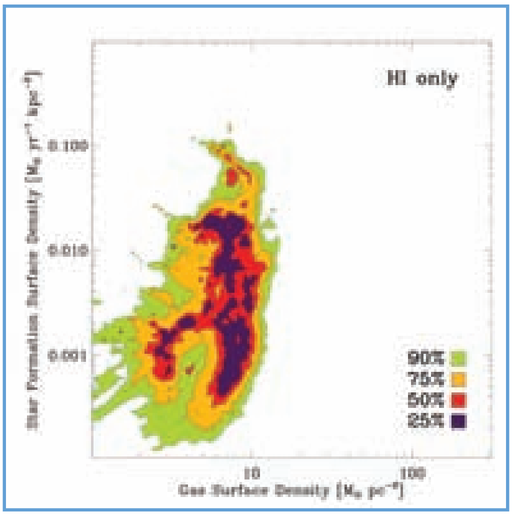
Upper panels: Interferometer maps of the line-integrated CO(2-1) emission from two, “ordinary” massive high-redshift galaxies. The interferometer beam (lower left corners) is about 6”.

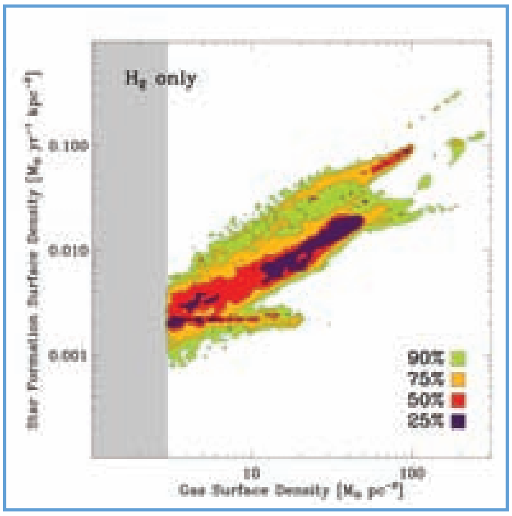
Lower panels : CO luminosity vs. far-IR luminosity (left) and the IR-to-CO ratio vs. redshift (right) for various galaxies. The two newly-detected BzK galaxies (red dots) have about 10 times less far-IR emission than high-redshift submillimeter galaxies (SMGs) (Daddi et al. 2008, ApJ, 673, L21).

NEARBY GALAXIES: THE STAR FORMATION LAW ON SUB-KPC SCALES

A comprehensive analysis has been made of the relation between star formation and gas surface density, at sub-kpc resolution in 18 nearby galaxies. This study has estimated molecular hydrogen mass from CO(2-1) maps made with the HERA multibeam heterodyne receiver at the IRAM 30m telescope, combined with high-resolution maps of neutral hydrogen from the VLA, 24-micron data from the Spitzer space telescope, UV data from the Galaxy Evolution Explorer (GALEX) space telescope, and CO(1-0) data from the BIMA array. The aim was to study how star formation changes between the centers of spiral galaxies, dominated by molecular hydrogen, to their outskirts, dominated by atomic hydrogen, which are similar to H_I rich late-type dwarf galaxies. The results show that, contrary to the earlier Schmidt and Schmidt-Kennicut laws, in spiral galaxies, the star formation rate per pc^2 is strictly linearly proportional to H_2 surface density, so that H_2 forms stars at constant efficiency. The mean time to convert the molecular gas to stars is 2 Gyr. Most galaxies show little or no correlation between the star formation rate and the surface density of atomic hydrogen. All this suggests that stars form in molecular clouds, and the relation with the gas surface density measures the filling factor of molecular clouds, rather than changing conditions in the gas. In all the galaxies (dwarfs and spirals), the data show a sharp saturation of H_I surface density at 9 M_{sun} / pc^2. Above this limit, all the gas is in molecular form. (Bigiel et al. 2008, AJ, 136, 2846 ; Leroy et al. 2008, AJ, 136, 2782).







The star formation law on sub-kpc scales.

Upper left: star formation rate (SFR) vs. total ($H_I + H_2$) gas surface density. The diagram can be broken up into two regions:

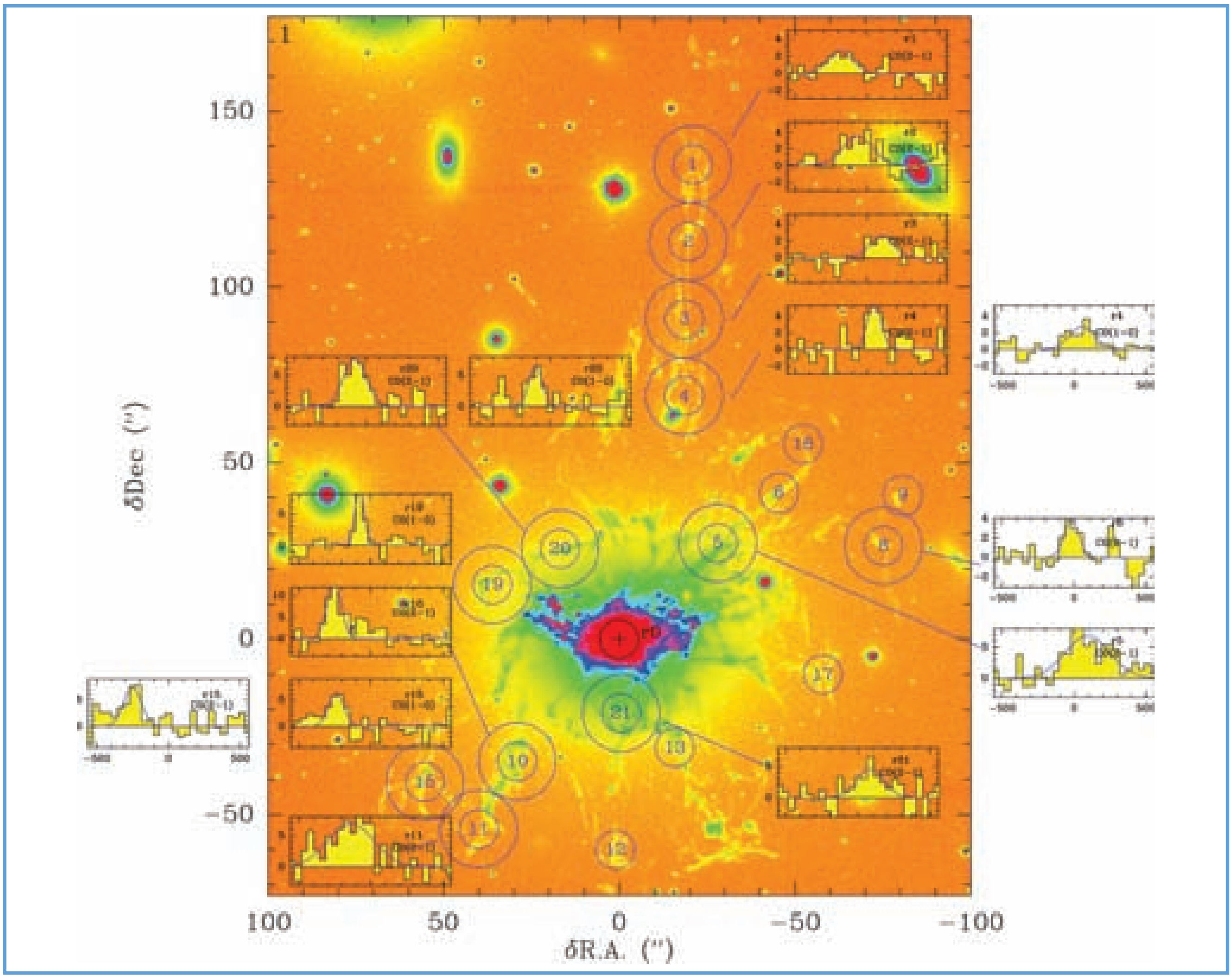
Upper right: SFR vs. H_I gas only; there is little or no correlation of star formation with H_I. Note the saturation of H_I at a threshold of 9 M_{sun} / pc^2.

Lower left: SFR vs. H_2 gas only, showing that star formation is linearly proportional to H_2 surface density

(Bigiel et al. 2008, AJ, 136, 2846 ; Leroy et al. 2008, AJ, 136, 2782).

CENTRAL CLUSTER GALAXIES

Molecular Gas in the outer filaments around NGC 1275. The two previous annual reports showed results from both IRAM observatories on detections of CO in the network of ionised filaments surrounding NGC 1275, the central galaxy at the core of the Perseus cluster (D = 75 Mpc, 1" = 350 pc). Follow-up observations with the 30m telescope have now detected the CO(1-0) and (2-1) lines in the even more distant filaments. In particular, the CO lines are now detected all along the distant northern filament, out to a position at 150" or a projected radius of 50 kpc from the center of the galaxy. Summed over all the different filaments, the total mass of molecular gas is large ~10^9 M_{sun}. This is 10% of the mass of molecular gas detected in the central 5-kpc region of this giant galaxy. The molecular gas in the filaments has line-of-sight velocities similar to those of the Hα emission seen at the same positions. The origin of the filaments is unclear, but their formation is very likely related to the outward-flowing wind, or "feedback" from 3C84, the powerful AGN at the center of NGC 1275. The optical Hα-line filaments may be on the outside of expanding bubbles of hot, ionised gas surrounding the relativistic jets from the supermassive black hole. As the hot (107 K) gas rises buoyantly out of the gravitational field of the central galaxy, dense parts of the bubbles' outer edges cool to form the ionised (10,000 K) filaments, and some of this cooler gas is drawn back in, behind the expanding bubbles, to fall back into the large galaxy where it originated. The cooler (≤ 100 K) clumps within the filaments have typically 10^7 M_{sun} of molecular gas, which can be detected in CO lines (Salomé et al. 2009, A&A, 484,317).



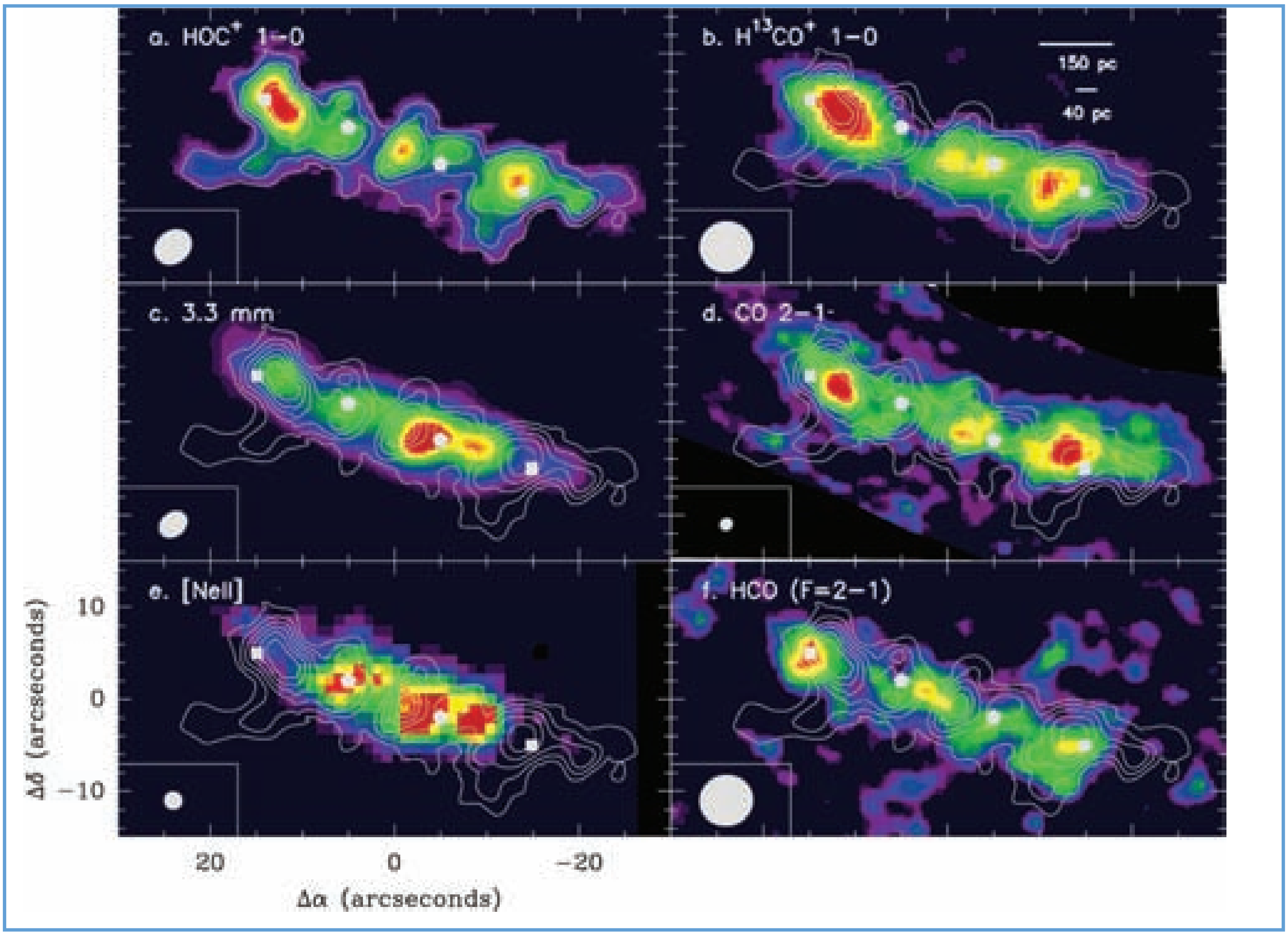
Molecular Gas in the outer filaments of NGC 1275.

CO(1-0) and (2-1) detections superposed on an Hα image (Conselice et al. 2001) of NGC 1275. The large and small circles show the 22" and 11" beams of the 30m telescope at 3mm and 1.3mm respectively. The spectra show main-beam brightness temperature in mK, vs. velocity offset from the systemic velocity of 5260 km/s, over a range of –500 to +500 km/s. The channel width is 42 km/s. Note the CO detected in the Northern filament, out to a radius of 50 kpc from the center of the galaxy (Salomé et al. 2009, A&A, 484,317).

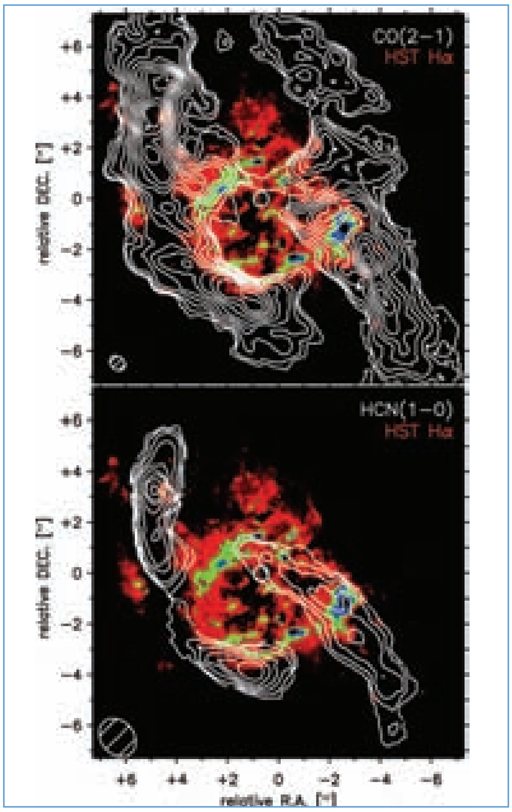
CHEMISTRY OF NUCLEAR STARBURST REGIONS

The reactive ion HOC^+ in the inner disk of M82: PDRs, not XDRs. An interferometer and single-dish study of the reactive ion HOC^+ in the inner disk of the starburst galaxy M82 (D = 3.9 Mpc, 1″= 19 pc) has produced the first high-resolution map ever obtained of this ion in an extragalactic source (Fig. 2.4). Previous detections with the 30m telescope of the reactive ions HOC^+ and CO^+ across the inner disk of M82 had suggested that this inner region is a giant photon-dominated region (PDR) of size 650 pc. Analysis of the new interferometer map shows that the HOC^+ line emission is strongest at the East and West molecular peaks in the outer, 25″-diameter ring, and is near, but not coincident with, the $H13CO^+$ and CO(2-1) line peaks. The ion HOC^+ is notably weak in the innermost ring of diameter 10″, where the X-ray emission is concentrated, and is also weak around the supernova remnant 41.95+57.5, the most intense X-ray source in M82. There is no obvious relationship between the HOC^+, HCO^+, and the diffuse, hard X-ray emission from M82's superwind outflow. All these morphological comparisons tend to exclude X-rays, or X-ray Dominated Regions (XDRs) as a major cause of the ionisation of these species, or as important agents in the molecular chemistry. Instead, the maps show that the HOC^+ line emission comes from dense, UV-Photon Dominated Regions (PDRs) embedded in the M82 nuclear disk, rather than in the inter-cloud gas or the hot wind. For these PDR regions, improved chemical models are able to explain most of the observations of HOC^+, HCO^+, CO^+, HCN, and H_3O^+, if about 87% of the molecular gas mass is in small clouds (visual extinction 5 magnitudes), with only 13% of the mass in large molecular clouds (extinction 50 mag). This suggests that only a small fraction of the molecular gas in M82 is in regions where massive star formation is still occurring, and that the previous starbursts have nearly exhausted the original reservoir of molecular gas (Fuente et al. 2008, A&A, 492, 675).

High-resolution maps of the reactive ion HOC^+ in the inner disk of the starburst galaxy M82, superposed on other tracers: a) upper left: Integrated intensity of HOC^+(1-0) mapped with the IRAM Interferometer; b) upper right: HOC^+ contours on $H^{13}CO^+$ (colors); c) middle left: HOC^+ contours on the 3.3mm continuum (colors); d) middle right: HOC^+ contours on CO(2-1) (colors, from Weiss et al. 2001); e) lower left: HOC^+ contours on [Ne II] from ionised gas (colors, from Achterman & Lacy 1995); f) lower right: HOC^+ contours on HCO (colors, from Garcia-Burillo et al. 2002). Ellipses in lower left corners show beam sizes (diagram from Fuente et al. 2008, A&A, 492, 675).



NUCLEAR STAR CLUSTERS



High-resolution HCN and CO maps of the circumnuclear region of IC 342. (Left): CO(2-1) (upper, beam 0.6") and HCN(1-0) (lower, beam 1.5") integrated intensities as mapped with the IRAM Interferometer.

The molecular-line contours are superposed on the continuum-subtracted Hα image from the Hubble Space Telescope. (Right): Model showing the position of the molecular gas arms of the nuclear mini-spiral before and after the nuclear starburst (Schinnerer et al. 2008, ApJ, 684, L21).

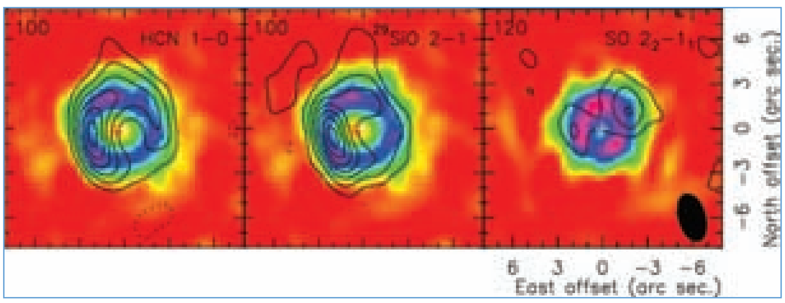
New maps of HCN and CO in the central region of the nearby galaxy IC342. A new high-resolution study with the IRAM interferometer has been made of the nuclear region of the spiral galaxy IC 342 (D = 3 Mpc, 1" = 15 pc). This is one of the nearest galaxies with a well-studied nuclear star cluster. This cluster has a stellar mass of 10^7 M_{sun} and its luminosity is dominated by hot stars formed in a recent, 4–30 Myr old, short-lived starburst. The new IRAM maps now allow a direct comparison, on spatial scales of 10 pc, of the molecular gas with the gas ionized by the young stars of this nuclear starburst. The superposition of the molecular and ionized components shows that the H II regions are on the inside of the molecular mini-spiral arms, with an indication that the normally smooth shape of these nuclear arms has been distorted by the stellar winds and supernova shocks (the "feedback") from the recent nuclear starburst. The appearance of the maps suggests that this mechanical energy has compressed and possibly pushed out, the infalling molecular gas, thereby reducing the gas supply to the central 10 pc. Because IC342 is viewed face-on, it is not possible to confirm this scenario with kinematic information, but it is consistent with data on other spiral galaxies that suggest repetitive episodes of star formation in the nuclear star clusters (Schinnerer et al. 2008, ApJ, 684, L21).

EVOLVED STARS

Structure and chemistry of the circumstellar shell around the yellow hypergiant star AFGL 2343. The rare yellow hypergiants are among the most luminous and most massive stars in the sky. They are thought to be post-red supergiants evolving rapidly toward the blue (higher-temperature) region of the HR diagram. New maps of one of these stars, AFGL 2343 (D = 6 kpc, 1" = 6000 AU) have been made with the IRAM Interferometer in the lines of HCN(1-0), ^{29}SiO(2-1), and SO($2_2 - 1_1$). The new data show a thin, dense layer of hot gas within the previously identified CO shell. This hot material could be recently shocked gas, or it could also be a part of an extremely high mass loss event. This shell appears to be responsible for all of the ^{29}SiO line emission and is a significant part of the HCN line emission. Such a dense shell rich in SiO is similar to that in IRC+10420, the only other known yellow hypergiant star that has a massive circumstellar envelope. This suggests that some of the yellow hypergiants may have episodic mass-loss events that produce high-excitation regions within their otherwise cool circumstellar shell. The estimated mass loss rate over the high-excitation region is 0.01 solar masses per year, and the time required to produce this region is only 50 years. From it's distance from the central star, the outburst in AFGL 2343 appears to have happened about 2000 years ago. (Quintana-Lacaci, Bujarrabal, & Castro-Carrizo 2008, A&A, 488, 203).

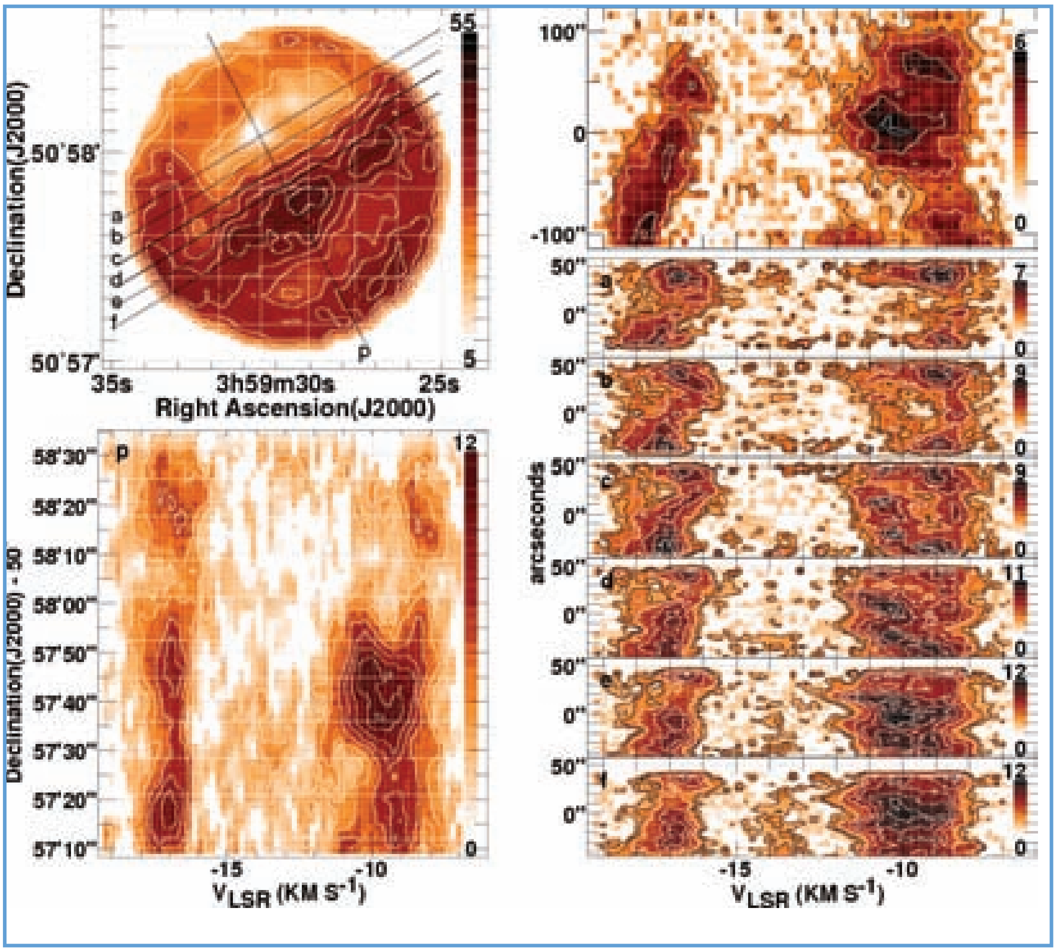
Interferometer maps of molecules in a dense layer within the circumstellar shell of the yellow hypergiant star AFGL 2343.

The black contours show maps of HCN(1-0) (left), ^{29}SiO(2-1) (middle), and in SO($2_2 - 1_1$) (right). The beam is 3.3" x 1.8" for all these maps (ellipse in lower right corner). The contour maps are superposed on the CO(2-1) maps (colors) at the same velocities (labels in upper left corners, in km/s). The yellow hypergiant star is at the center of the maps. (Quintana-Lacaci et al. 2008, A&A, 488, 203).



INTERSTELLAR MEDIUM IN OUR GALAXY

Bright, turbulent CO from diffuse gas around the line of sight to NRAO 150. The line of sight through our Galaxy toward the optically-unidentified extragalactic radio source NRAO 150 is obscured by about 5 or 6 diffuse clouds, each contributing about one magnitude of visual extinction, and also by another 6 magnitudes of extinction by low-density gas (1 atom cm^{-3}) all along the 4 to 5 kpc path through our Galaxy. The individual clouds are not dark, dense molecular clouds, but rather diffuse, nearly translucent gas which is mostly atomic hydrogen, and where only a modest fraction of the gas-phase carbon has been incorporated into CO. As previous absorption-line studies with the IRAM observatories have shown, these diffuse, mostly-atomic clouds nevertheless display a surprisingly complex molecular gas chemistry. To study these clouds further, new maps of the molecular line emission have been made with the 30m telescope and the Interferometer. The CO(1-0) and (2-1) single-dish maps cover a 220″ field, and the hybrid map (interferometer+single dish) mosaic shows CO(1-0) emission with a 5.8″ beam over a 90″ region. The (2-1)/(1-0) ratio is 0.7, so the emission is optically thick and the lines are subthermally excited. The CO previously seen toward NRAO 150 in absorption with lower optical depth (0.5) is still undetected in emission in the new maps. The position-velocity diagrams show a chaotic pattern, characteristic of turbulence. In spite of their remarkably high peak temperatures of 10 to 12 K, this diffuse gas emission probably does not trace molecular gas mass, but simply the variations in the chemistry that coverts carbon ions into CO. That is, these clouds are mostly atomic, not molecular, and most of the carbon is not in CO (Pety, Lucas, & Liszt, 2008, A&A, 489, 217).



Bright, turbulent CO surrounding the line of sight to NRAO 150.

Upper Left: Integrated intensity hybrid map (interferometer + single dish) with a 5.8″ beam, summed over the different CO(1-0) velocity features. The extragalactic point source NRAO 150 is at the center of the map. The diagonal lines correspond to the position-velocity cuts in the other diagrams.

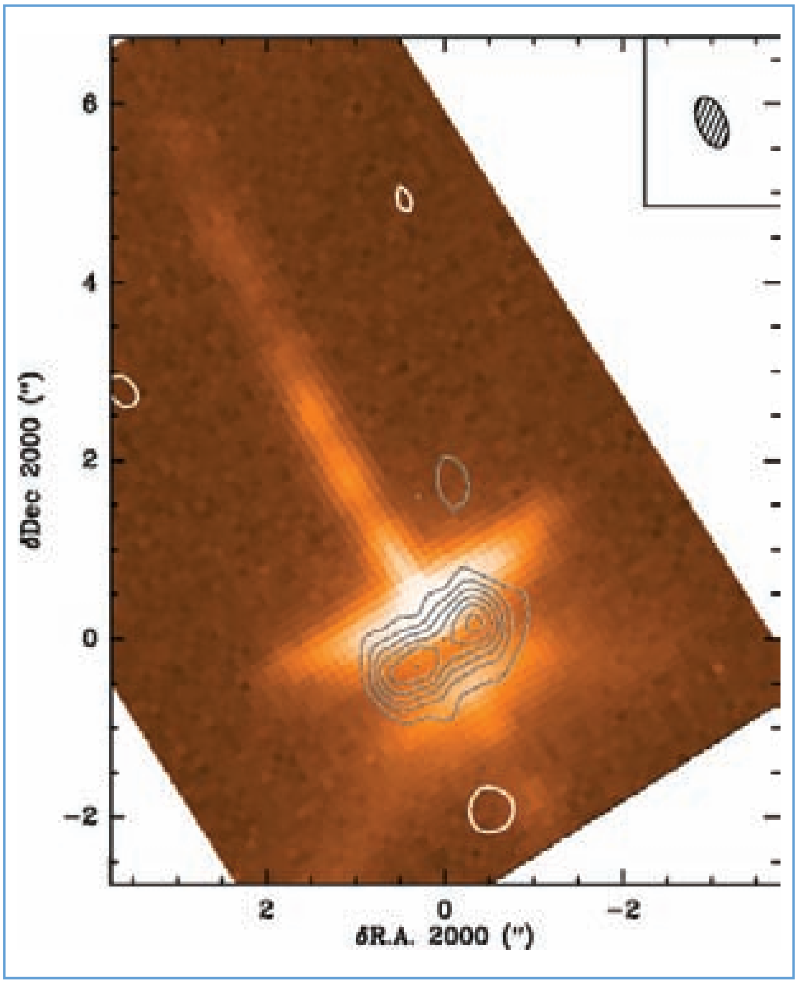
Lower Left: Position-velocity cut p, perpendicular to the elongated CO feature.

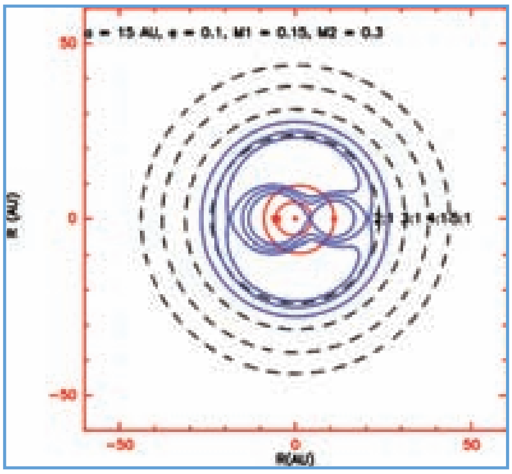
Upper Right: Long position-velocity cut along strip d, from 30m data.

Lower Right: Position-velocity strips along cuts a—f, from the hybrid map. Maximum signals (black areas) are 10 to 12 K (Pety, Lucas, & Liszt, 2008, A&A, 489, 217).

YOUNG, LOW-MASS STARS IN OUR GALAXY

Resolving the circumbinary dust disk surrounding the young star HH 30. Herbig-Haro 30 is a young stellar system in Taurus (D = 140 pc, 1″ =140 AU). Optical images from the Hubble Space Telescope show a flared, edge-on disk, and a highly-collimated optical jet. Previous IRAM interferometer observations (Pety et al. 2006, A&A, 458, 841) with a 1″ beam revealed a molecular disk in Keplerian rotation, with an outer radius of 420 AU, and a highly asymmetric molecular outflow, coming from the inner parts of the disk, seen only in the north-eastern outflow lobe. In the molecular gas, this north-eastern lobe is a cone with an opening angle of 60º. The CO outflow velocity along the wall of the cone is 12 km/s. The more highly-collimated optical jet seen by the HST lies precisely on the axis of the conical CO outflow. More recent optical observations have revealed wiggling motions in the optical jet, suggesting that the central object is a binary star (Anglada et al. 2007). The Interferometer has now been used in its most extended configuration to re-observe the 1.3mm continuum dust continuum from the disk. The new IRAM observations have a beam of 0.59″ x 0.32″ (83 x 45 AU). The minor axis of the beam is parallel to the disk, and gives a factor of 3 improvement over the previous IRAM data. The new data show a double peak in the dust disk. Because the dust is optically thin at 1.3mm, this indicates that the dust disk is truncated at an inner radius of 37 ± 4 AU. The simplest explanation for the inner hole is tidal sweeping by a binary star. The two stars must be on a low-eccentricity orbit with a semi-major axis of 15 AU. Their orbital motion causes the wiggling of the optical jet. The age of the system may be less than 2 million years, and the dust opacity index β = 0.4 indicates the presence of cm-size grains (Guilloteau et al. 2008, A&A, 478, L31).





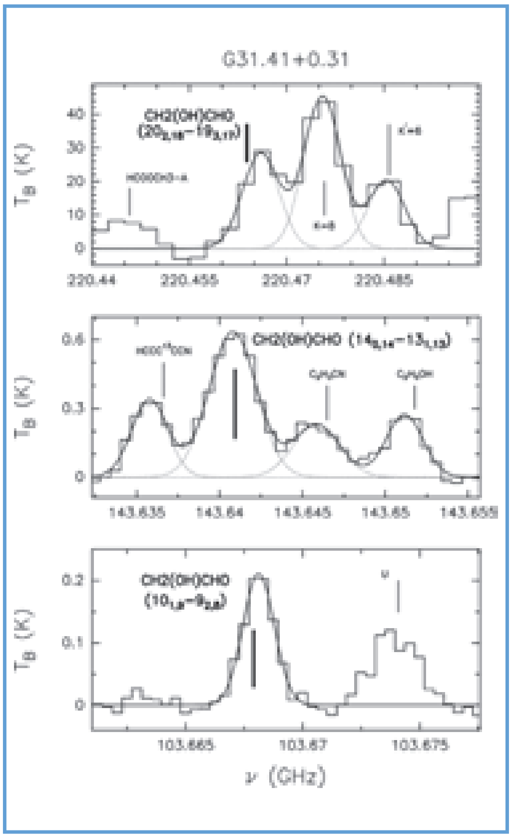
Resolving the dust disk of the young binary star HH 30.

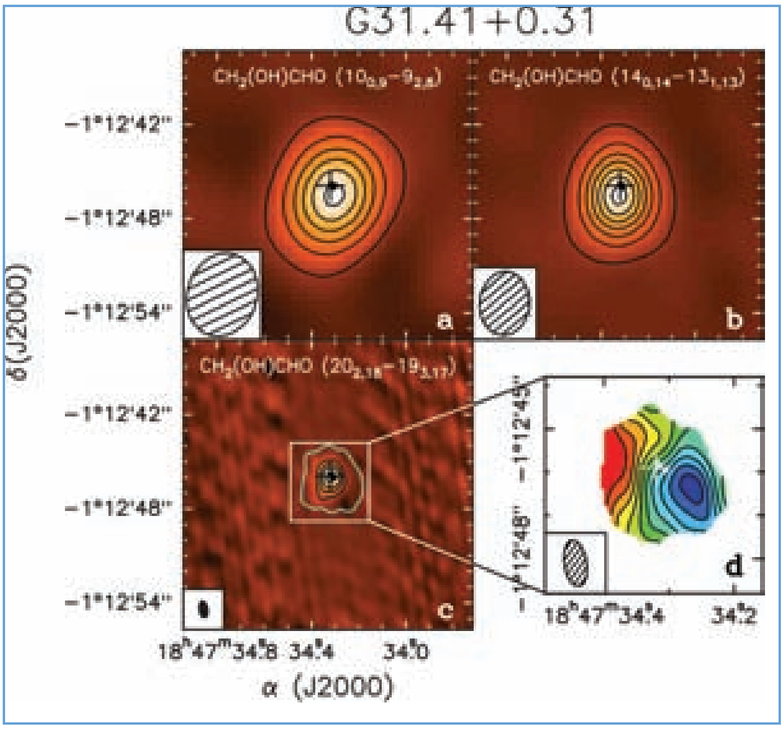
Left : 1.3mm contour map of the dust continuum, with a beam of 0.59″ x 0.32″, and an rms noise of 0.19 mJy. The peak brightness temperature is 0.5 K. The dust map is superposed on the HST optical image.

Above : Model showing Roche equipotentials (blue lines) around a binary star system with stellar masses 0.15 and 0.3 M_{sun}. Thick red ellipses show the stars' orbits, dashed black lines show the equipotentials of orbital resonances at 2, 3, 4, and 5-to-1 (Guilloteau et al. 2008, A&A, 478, L31).

YOUNG, HIGH-MASS STARS

First detection of glycoaldehyde outside the Galactic Center, in the massive young stellar object G31.41+0.31. The molecule glycoaldehyde (CH_2OHCHO) is an isomer of both methyl formate ($HCOOCH_3$) and acetic acid (CH_3COOH), both previously observed in space, and is the simplest monosaccharide sugar. It reacts with propenol to form ribose, a constituent of RNA, believed to be related to the origin of life. It was first discovered in space by Hollis et al. (2000), in the dense molecular cloud Sgr B2 in the Galactic Center. New observations with the IRAM Interferometer have now detected it in a second source, this time outside the Galactic Center, in the hot molecular core G31.41+0.31, that contains young massive stars. The three detected lines all have the same observed (beam-smoothed) brightness temperature of 30 K, indicating they are optically thick. Correcting for the measured diameter of 1.4" shows that, unlike the Galactic Center source, this spectral-line emission of glycoaldehyde comes from a very compact, hot (>300 K), dense (> 2 x 10^8 cm^{-3}) region which has a radius of 5000 AU, and probably contains the young OB star or proto-stars in G31.41. Comparison of the data with chemical models suggests an age for this hot core of a few hundred thousand years. The molecule is probably formed on the surface of dust grains, in reactions with CO, formaldehyde, HCO, and other molecules. From the dust detection at 1.4 mm, the abundance of glycoaldehyde relative to hydrogen is estimated to be 10^{-8}, so not much of the available CO is needed to form this molecule on grain surfaces (Beltrán et al. 2009, ApJ, 690, L93).

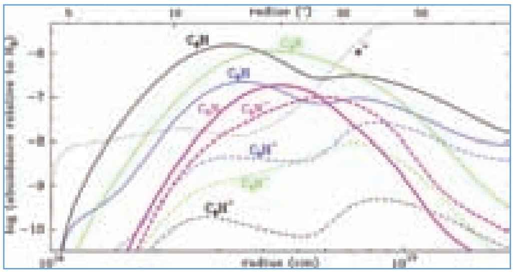


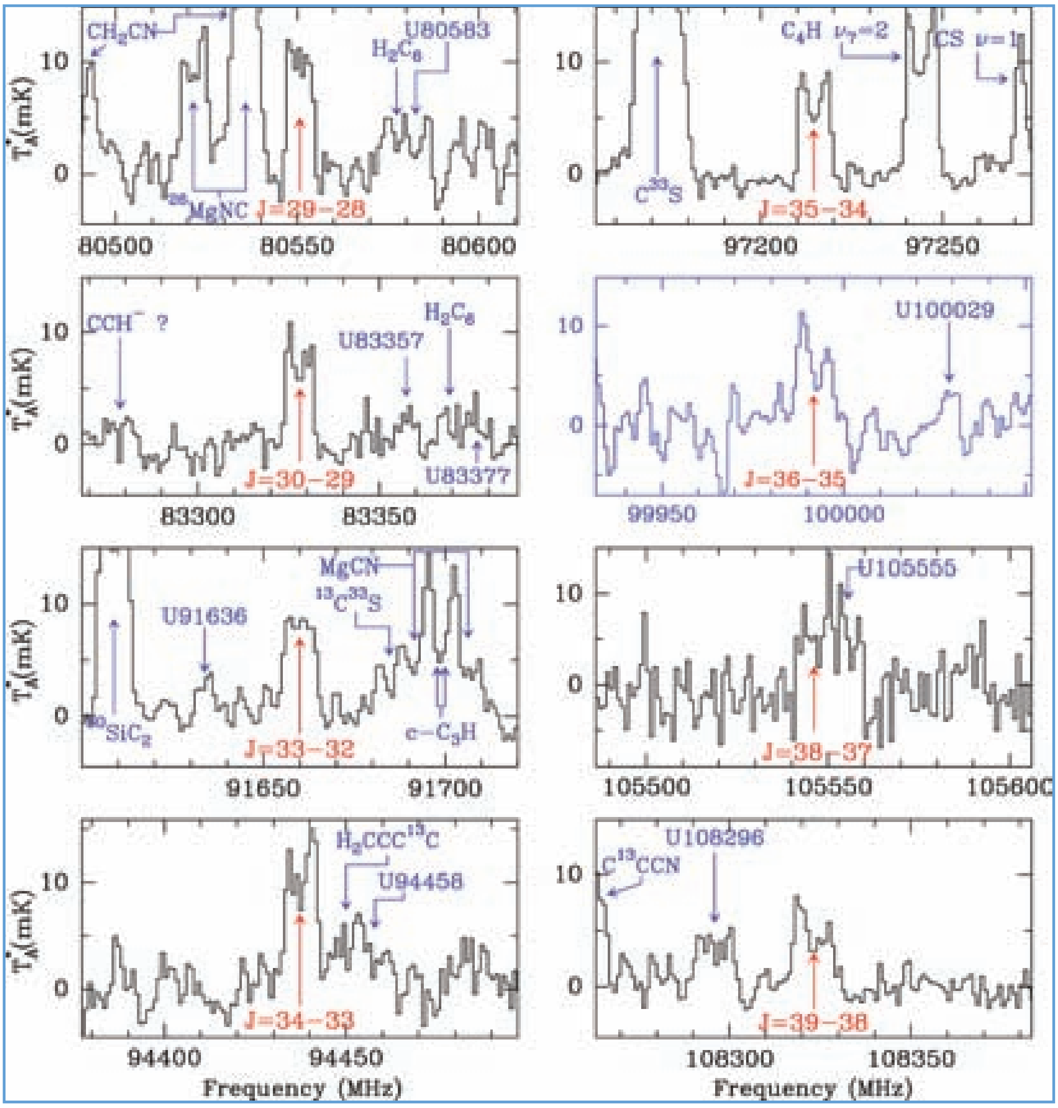


Glycoaldehyde in the massive young stellar object G31.41+0.31. Profiles (left) and maps (right) of glycoaldehyde in three different spectral lines at 1.4, 2.1, and 2.9 mm, observed with the IRAM Interferometer. The zoom in the lower right corner shows the velocity field measured at 1.4 mm, with a beam of 1.1" x 0.5" (Beltrán et al. 2009, ApJ, 690, L93).

EVOLVED STARS

Detection of the anion C_5N^- and vibrationally excited C_6H in in the circumstellar envelope of IRC +10216. The dusty envelope of the carbon star IRC+10216 (see cover illustration) is the richest source in the sky in spectral lines of negative ions. All the interstellar anions known so far, namely C_4H^-, C_6H^-, C_8H^-, and C_3N^-, have been identified in this circumstellar envelope (see Thaddeus et al. 2008, ApJ, 677, 1122, and references therein). The previously-detected presence of C_5N in IRC+10216 implied that its negative ion C_5N^- might also be present. A new search among the 1500 spectral lines in 3mm surveys of this star done at the 30m telescope between 1995 and 2008 has indeed found this anion. The data also permit the identification of vibrationally excited C_6H in this envelope. A model of the chemistry in the outer layers of the circumstellar shell gives an estimate of the abundances of these molecules and their anions as a function of radius from the star. At radii that fit in the beam of the 30m telescope at 3mm, the anion ion C_5N^- is predicted to be one-tenth to one-half as abundant as it's parent molecule C_5N, in agreement with the observations. (Cernicharo et al. 2008, ApJ, 688, L83).





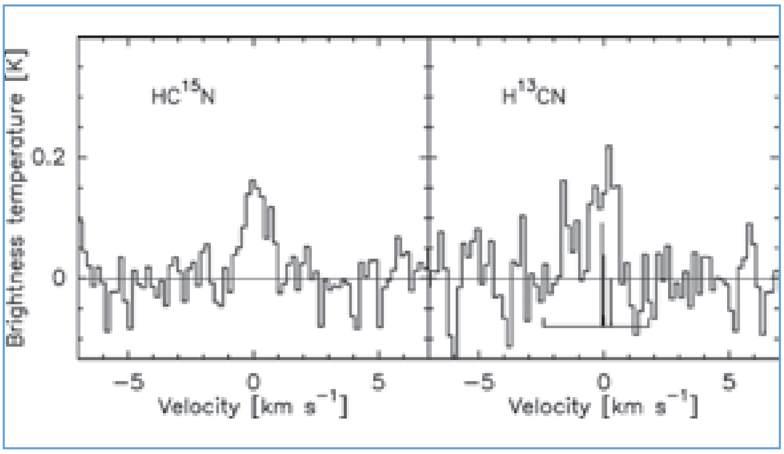
Detection of the anion C_5N^- in the carbon-rich star IRC+10216.

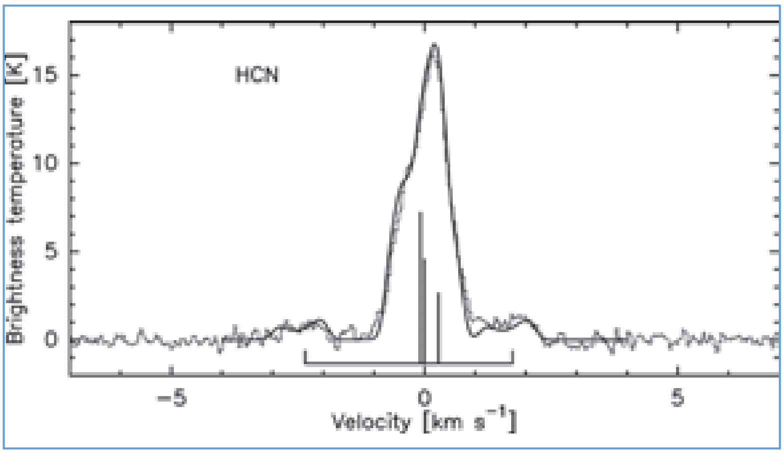
Upper: Model abundances of the neutral radicals C_nH and C_nN, and their anions as a function of radius, in the outer envelope of the star. (Cernicharo et al. 2008, ApJ, 688, L83).

Lower: Spectra of IRC+10216 observed with the 30m telescope, showing lines (marked in a red) in a harmonic sequence that can be assigned to the negative ion C_5N^-.

SOLAR SYSTEM

Large excess of heavy nitrogen in HCN and CN from comet Holmes. Comet 17/P Holmes has an orbital period of 6.9 years, and is by now world famous for its spectacular, nearly million-fold increase in brightness on 24 October, 2007. This remarkable outburst was followed by the production of a huge quantity of dust grains and gas, offering a rare opportunity to search for weak spectral lines from rare isotopes in the cometary material. Comet Holmes was observed with the 30m telescope on Oct.27 – 28 in the 260 GHz lines of HCN and its carbon-13 and nitrogen-15 isotopes. The HCN results yield a nitrogen-14 to nitrogen-15 ratio of 139 ± 26, in agreement with the same ratio in optical lines of CN, measured with the Keck and McDonald telescopes. This ratio also agrees with a re-analysis of earlier observations of the long-period comet Hale-Bopp, and a dozen other comets. What is interesting is that the nitrogen isotope ratios measured in HCN and CN in comet Holmes and other comets mean that the nitrogen-15 isotope is twice as enriched in comets as it is in the earth's atmosphere, where the ^{14}N to ^{15}N ratio is 272. Even more importantly, it is three times as enriched in comets as it is in the primitive solar nebula of 4.6 billion years ago, where the ^{14}N to ^{15}N ratio is inferred to have been 424, from the measurements of inclusions in carbonaceous chondrite meteorites and the Galileo spacecraft measurement of the atmosphere of Jupiter. This means there must have been some (still unknown) fractionation mechanism for increasing the nitrogen-15 isotope in the protosolar HCN gas, which then never again re-mixed with the main reservoir of diatomic nitrogen that formed in the later evolutionary phases of the solar system (Bockelée-Morvan et al. 2008, ApJ, 679, L49).





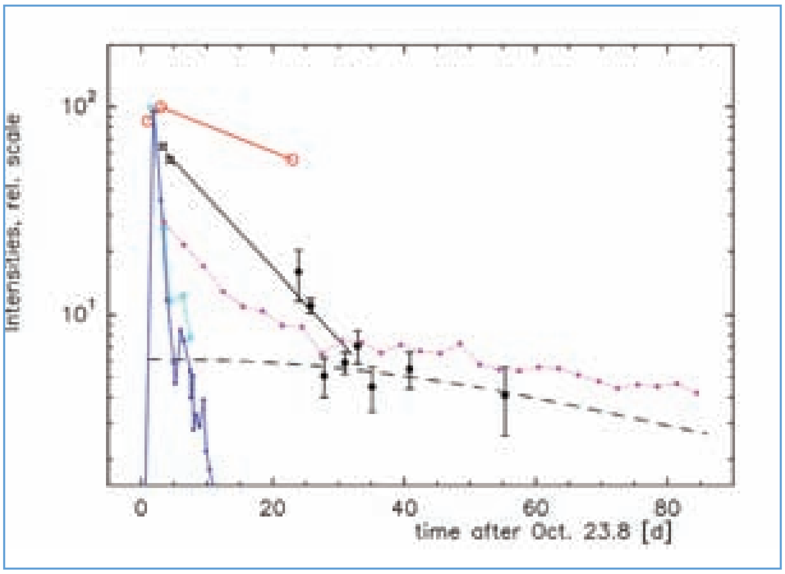
HCN, $HC^{15}N$, and $H^{13}CN$ detections in Comet Holmes.

Upper panel : Comet Holmes in early November 2007 (Astronomy Picture of the Day, apod.nasa.gov, photo by Vicent Peris and José Luis Lamadrid, astrofoto.es).

Middle panel : Spectra from the 30m telescope of the (3-2) lines of $HC^{15}N$ and $H^{13}CN$ in comet Holmes on Oct.27-28, 2007.

Lower panel : Spectrum and model fit of the $H^{12}C^{14}N$(3-2) line from the comet. The markers indicate the locations and relative intensities of the hyperfine components of the HCN line (Bockelée-Morvan et al. 2008, ApJ, 679, L49).

Why did comet Holmes burst out? A clue to the reason for the spectacular outburst of comet Holmes may be contained in the data from the Deep Impact mission to comet Tempel I. This collision revealed that the nucleus of Tempel I had a 1-m thick layer of closely-packed dust, covering a deeper layer of nearly pure, fine-grained water ice, at least 10 meters thick (Sunshine et al. 2007). It is likely that comet Holmes has a similar structure. Because comet Holmes normally only approaches the sun to a distance of 2.2 AU (the average of its last 6 apparitions), it's water ice barely approaches the limit of the temperature of sublimation, where the ice can pass directly from the solid state into vapour, without passing through a liquid phase. What was unusual about the most recent approach, was that this time, the perihelion distance was a bit closer, 2.05 AU. This closer approach may have allowed a greatly increased sublimation rate of the ice, over a surface much greater than the geometric surface of the nucleus, because of the fine-grained nature of the ice layer. The resulting water vapour spread throughout the porous nucleus, creating even more sublimation, in a sort of chain reaction, heating other molecular ices with even lower sublimation points. Two months after perihelion, the accumulated vapour pressure of all the ice species finally managed to break up the insulating dust mantle, allowing the cometary wind to escape and carry off the dust particles into the expanding cometary halo. The data show that water vapour production, as observed with the SWAN instrument on the SOHO satellite, lasted for at least a month, as did the enhanced millimeter continuum emission from the excaping dust particles, while the spectral lines of light volatile molecules like HCN, CO, and ammonia were very strong at the start, but then petered out dramatically after 3 days, possibly because the near-surface ice was relatively free of volatile molecules. Altogether, the data indicate that comet Holmes lost about 3% of its mass, corresponding to a dirty ice layer about 20 meters thick, surrounding the nucleus (Altenhoff et al. 2009, A&A, 495, 975).



Post-outburst development of Comet Holmes.

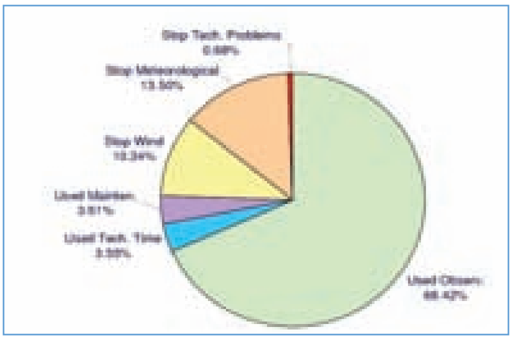
Comet Holmes' expanding spherical shell on 7 March 2008, with the HII region NGC 1499 (in red) in the background (photo copyright Takayuki Yoshida http://www.takayuki-astro.com). Compilation of outburst data: Black dots and diamonds are the 1.2 mm continuum data from the IRAM 30m and Interferometer (Boissier et al. 2008) respectively. Red circles are H_2O data from the Solar Heliospheric Observatory (SOHO; Combi et al. 2007), dark blue squares and light blue dots are HCN data from the 30m, CSO, and ARO (Biver et al. 2008; Drahus et al. 2008). The dotted magenta curve shows optical magnitudes of the nucleus, and the dashed line shows a model of the mm continuum emission of the halo (Altenhoff et al. 2009, A&A,495, 975).

Pico Veleta observatory

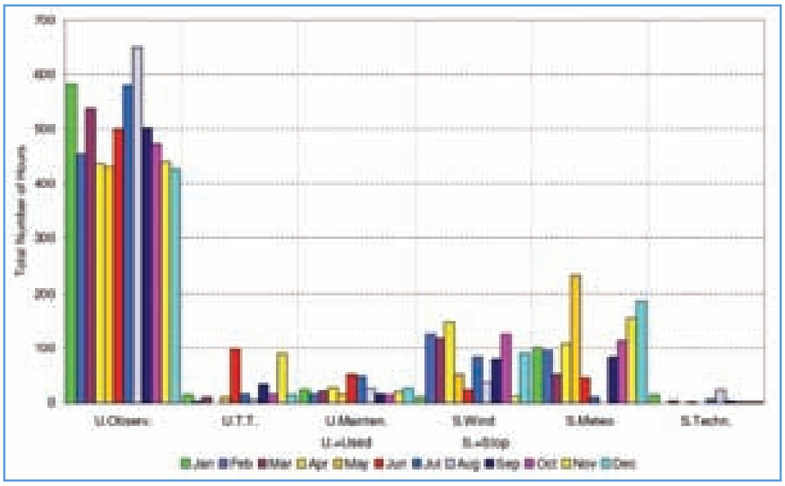
Observations with the 30m telescope at Pico Veleta were split into pooled observing weeks for the two 1mm array frontends HERA and MAMBO2, and classical observations of the Principal Investigators and their colleagues during the remaining weeks, using all instruments. Below, we briefly mention some of the science highlights achieved during 2008. During the technical periods at the telescope, the Granada staff worked on improving the "New Control System NCS", the tracking performance of the telescope, MAMBO2 observations, to name only a few of the many topics persued. Largely unnoticed by the observers, the Granada soft- and hardware groups worked hard on preparing for the new 8 mixer receiver EMIR.

The HERA pool of the winter semester 2007/2008 comprised seven weeks. Out of nine A-rated projects, eight could be finished, including ambitious undertakings like e.g. probing the formation of intermediate-mass stars in protoclusters, mapping CO gas across the galaxy-wide shock in Stephan's Quintet, or a three dimensional line survey in Orion, to cite only a few. The 2008 summer pool lasted three weeks; five out of seven highly rated projects were completed, featuring e.g. a map of the molecular gas halo of the nearby edge-on galaxy NGC891.

After two technical interventions of the MPIfR bolometer team, the MAMBO2/ABBA2 system has improved significantly, though few problems, especially with regard to ABBA2, remain to be solved. During recommissioning in November 2008, mirrors M5 to M8 were realigned and the vibration damping of the optical table was optimized. Temperature readouts were installed, which now allow to continuously monitor the temperatures of the different stages. The heat pulse needed to recycle He^{-3} is now set automatically allowing for a well controlled and reproducible recycling. The following first week of pooled observations profited from excellent weather conditions reaching below 1mm of water vapor. In total, 14 MAMBO2 projects were finished, leaving only 3 unfinished. In addition, several of the heterodyne backup projects were observed in this period. Among the science highlights of these two weeks are: the detection of a quasar at z=6, and the detections of four new disks around brown dwarfs, and observations of a very cold prestellar core in L183.



Monthly time distribution for 2008 at the 30-meter telescope showing the time used for observations (U.Observ.), for technical tests (UTT), and maintenance (U.Mainten.).



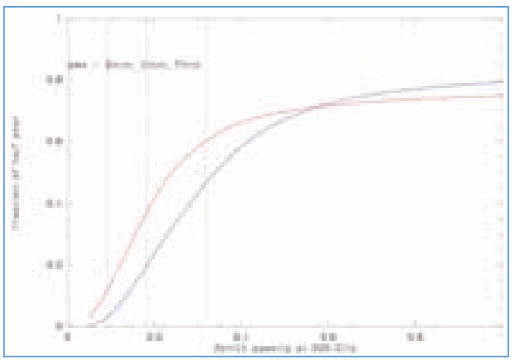
Time distribution at the 30m telescope, 2008.

While the total power flux monitoring of active galactic nuclei was continued in 2008, a new regular polarization monitoring was scheduled once per month on the average.

In October 2008, the GISMO team of the NASA Goddard Space Flight Center visited the 30m telescope a second time, after the first visit in late 2007, to test their 2mm 8x16 pixel bolometer camera. For GISMO, new observing methods were developed at IRAM Granada and tested for the first time at the 30m telescope, in particular a fast mapping mode for which the antenna scans a Lissajous pattern on the sky. An automated pipeline merges the GISMO data with the telescope data streams to create FITS files, being triggered by the IRAM messaging system. First test results are 2mm maps of the radio galaxy Cygnus-A, the supernova remnant Cassiopeia A, and the detection of the active galaxy NGC1068.

With the continued development of the control and data acquisition system NCS, we aimed to improve the quality and reliability, supported experimental work with new instruments, and started to prepare for EMIR. New equipment tested at our observatory included the "AMSTAR" 4-pixel SIS focal plane heterodyne array, which required a specially tuned version of the NCS. After the MAMBO2 pool observations in November, the tracking performance of the telescope at low speeds was improved by optimizing internal parameters of the main axis control loops. Many NCS monitoring displays were revised and error checks were added. Moreover, a new observing mode option is now available for skytips, slewing the antenna continuously, which is much faster, and potentially more precise, than the stepped skytip.

Cumulative distribution of zenith opacities at 225GHz in the Winter (red) and Summer (blue) period of 2008. The two curves refer to the Summer months April to September, and the Winter months January-March and October-December. The Pico Veleta taumeter conducts skytips every 3 minutes. Here, we only used high quality data (correlation coefficient r=0.8). Vertical lines delineate precipitable amounts of water vapor of 2mm, 4mm, and 7mm, corresponding to excellent, good, and average summer conditions.



TELESCOPE OPERATION

About 70% of the total time in 2008 was used for observations, similar as in previous years. About a quarter of the time was lost due to adverse meterological conditions including high wind velocities. About 7% of the time was used for regular maintenance and dedicated technical projects, e.g. for recommissioning MAMBO2, for tests and improvements of the telescope control loop and of the New Control System. Similar like in previous years, only about 0.68%, i.e. 60 hours, were lost due to technical problems. About 44 hours were lost due to problems with the telescope, about half of this stop time was caused by a failure of one of the elevation breaks. The remaining problems were related to computers and frontends. Minor technical problems which were resolved in less than ~1 hour are not included in this statistics, as the operators record the main status of the system every 2 hours.

The cumulative distribution of atmospheric zenith opacities obtained at 225 GHz during the year 2008 shows that about 20 days of the year exhibited weather conditions of better than 2mm of precipitable water vapor. The plot is based on taumeter data taken during the entire year, independent of the weather conditions and 30m telescope observations.

ANTENNA AND ELECTRONICS

As in previous years the main effort, was to support the daily operation of the observatory by periodical maintenance of the systems and equipments, helping with the daily problems concerning the observation and operation, and repairing broken equipment. Other specific activities in the telescope area during 2008 were:

- the replacement of the UPS batteries;
- the new batteries are now in two branches, to allow operating the telescope even if one branch of batteries fails;
- the antenna-motors gearboxes have been revised by the German company DESCH (the successors of Thyssen who constructed the gearboxes) in order to develop a strategy to repair the currently seen small vibrations;
- magnetic field and vibration measurements have been done at the place of the bolometer to evaluate a possible influence;

- a thermograph revision of the electrical installation has been performed without detecting anything unusual;
- the entrance door to the antenna tower has been replaced by a new one;
- other parts have been replaced: one of the two high voltage electrical switches, one air compressor for freezing the wobbler shakers and the humidifier for the computer/spectrometer room.

FRONTENDS

Most of the activities in the receiver area during the past year was preparatory work for the installation of the EMIR receiver. The enormous increase in IF bandwidth of the new receiver required an equivalent increase in the complexity of the IF transport scheme and consequently the modification, or new construction, of some of the associated equipment:

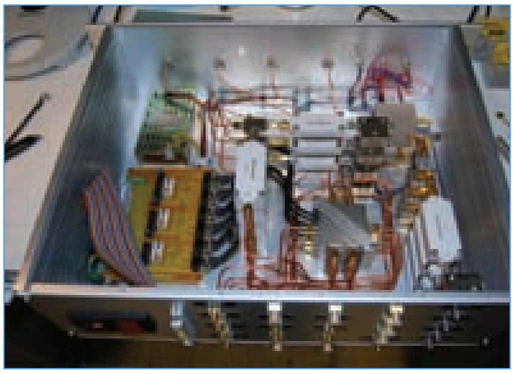
A new IF amplifier and equalizer has been designed and assembled to compensate the extra loss and slope of the new coaxial cables. The frequency compensation extends into the 2 to 10 GHz range, although only the central 4 to 8 GHz part is used.

In order to allow for a flexible band selection mechanism an IF switch box has been built. The unit permits connection of any single band, or combinations of two of them, to the four available IF lines. The rack includes a simple processor that splits the 8 GHz wide IF of band 1 (λ=3mm) in two sections of 4 GHz each, allowing the transport of the 4x4GHz through the available IF cables.

The routing of the beams to the antenna will be done with the aid of only three flat mirrors, greatly reducing the number of reflections with respect to the old optical scheme. The new external optics includes a liquid nitrogen cold load and a wire grid (polarizer), mainly devoted to calibration system for polarimetry observations.

Other EMIR related activities included the design of a new reference frequency for the phase lock circuits and a new electrical system for the helium compressor.

After one of the HERA-2 pixels showed excessive noise, a problem with the IF cable transport for the HERA-2 receiver has been identified. After testing the cables with the aid of a cable fault locator, all the cables installed in 2003 were found to show reflections, indicating cracks in the manteling at or near one position in the cable spiral. We found no indications that these failures impinged on the observations. A higher flexibility replacement cable has been bought and successfully tested. All faulty cables will be replaced in 2009, before EMIR arrives.



IF switch box and band 1 processor for the new EMIR receiver.

A complete renewal of the cryogenic system was done for the HERA multibeam receiver. Both, the cold head and the helium compressor, were replaced after more than three years of continuous operation.

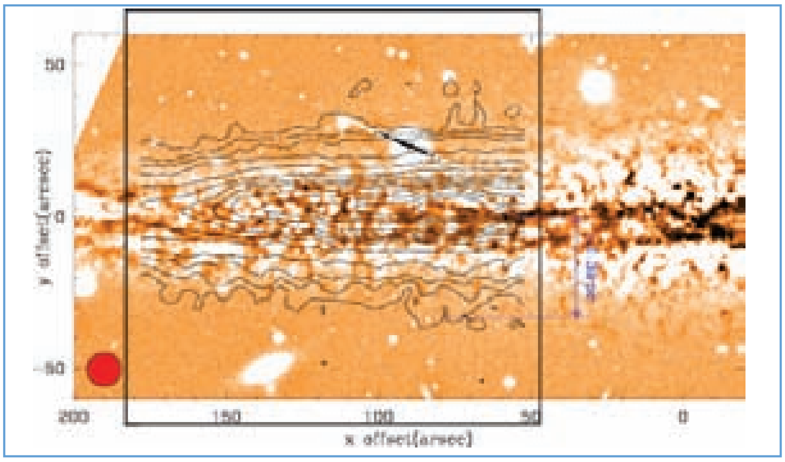
Work on the reliability and safety of the vacuum windows for the ALMA project is still going on. As a result of a change in the mould press and process used in the fabrication of these windows, a new set of tests were made in order to establish their performance. Throughout the year a total of ten overpressure tests were performed on samples of band 3 and band 4 windows, consisting of both one month three bar tests and fifty one bar cycles on each window. Mechanical window deformation with time was monitored throughout the tests and the results of which were used as part of the window mechanical performance evaluation. In order to produce reproducible pressure-time profiles for the pressure ramp up/down and pressure cycle tests an automated computer controlled test set up was constructed.

Work also continued on a new, more accurate and more reliable, tau meter for the 30m antenna, consisting of both hardware and software beyond the design phase.

BACKENDS

A new narrow band IF processor built for the VESPA autocorrelator and the 1MHz filterbank was installed in summer and tested with the AMSTAR receiver. It will be used for EMIR. Two regular VLBI 3mm global experiments were conducted in May and October. Work on the prototype 4-8GHz continuum detectors for EMIR has started for the temperature control, detector and ADC converter. It is planned to produce 16 units that will be installed in the receiver cabin.

A processor, called Wilma4x4, to adapt Wilma to the EMIR IF range has been designed and built. It splits 4 IF bands, each 4 GHz wide, into 16 1GHz bands as needed by the Wilma signal processing chain. All the RF modules have been bought or built, tested and



HERA CO (2-1) map of the northern side of the edge-on spiral galaxy NGC891 obtained by Garcia-Burillo et al. CO intensity contours are overlaid on the unsharp masked V-band image of Howk & Savage (2000).

integrated. The selection between EMIR and HERA is performed by tiny switches which are shoehorned into existing Wilma modules; this implied shutting down Wilma for a few weeks and was done while no HERA projects were scheduled. The only missing part is the final version of the interface board, which controls the switches and distributes power to the various RF modules (oscillator and mixers), fixing the problems found in the first version, mainly an overheating power supply regulator.

COMPUTERS AND SOFTWARE

The main server in Granada has been replaced. Besides improved hardware, the new system uses SATA disks, integrated into a RAID array for increased availability. Highlights of the new gra-lx1 computer are: 2 Dual-Core AMD Opteron Processors 2214, 8 GByte memory, 6x500GB disks in RAID with hardware controller, hardware compatible with the old gra-lx1 which had its SCSI backplane replaced by SAT. Now, all our main server systems in Granada and at the 30m telescope are based on the same architecture. At both sites, we have one spare system. A tape library has been purchased for the Pico Veleta observatory. It houses up to 16 LTO-4 tapes, giving a total of 16x400 GB tape space that can be written without manual intervention. This will help to handle the increased amount of data foreseen with the installation of new high resolution backends in the future.

Members of the computer group participated in the preparation and execution of tests related to: the AMSTAR receiver, the GISMO system, the installation of a new backend, ABBA2, for the MPIfR bolometer MAMBO2. They also continued to work on the improvement of the "New Control System" (NCS) for the 30m telescope and the development of the software integration of EMIR into the NCS was started.

Two additional displays at the operators' and astronomers' desks now show the tracking behavior of the telescope and subreflector and the current pointing scans. The tracking monitors show the deviation between commanded and actual position, and also the current wind conditions. The monitor routines run in the MOPSIC/GILDAS environment.

MISCELLANEOUS

End of July 2008, Rainer Mauersberger left Granada for Santiago (Chile) to work on the commissioning of ALMA. Carsten Kramer has taken over the position as Station Manager of the 30m telescope, as of August, 1st, 2008. After more than 20 years as a telescope operator at the Pico Veleta, Mariano Espinosa Burillo has left IRAM end of September 2008 to take up new challenges in his hometown Murcia. Santiago Navarro (jr.) left IRAM as well, and in August and October, Joaquín Santiago and Victor Peula started training as new telescope operators. Stephane Leon left IRAM end of 2008.

A three years grant of the Spanish Ministerio de Ciencia e Innovación on "Millimeter and Submillimeter Astronomy: the Development of Radioastronomical Archives and their Integration into the Virtual Observatory AYA2005" terminated end of 2008. This project allowed to finance conference visits of the three PhD students and the purchase of computer equipment for the TAPAS header database of all 30m data, which has been developed in close collaboration with the IAA in Granada. Its deployment is foreseen for early 2009.

IRAM/Granada has kept a close contact with the Universidad de Granada, also in support of the master and PhD thesis works of the three students.

IRAM continued negotiations with the Spanish Authorities to improve the current radioelectric protection of the observatory. A revised agreement, with more frequency bands protected, was agreed upon.

The road between Borriguiles and the 30m telescope was improved by a new support wall in the upper part, and a new water ditch. General maintenance work was conducted at the observatory building and telescope tower.

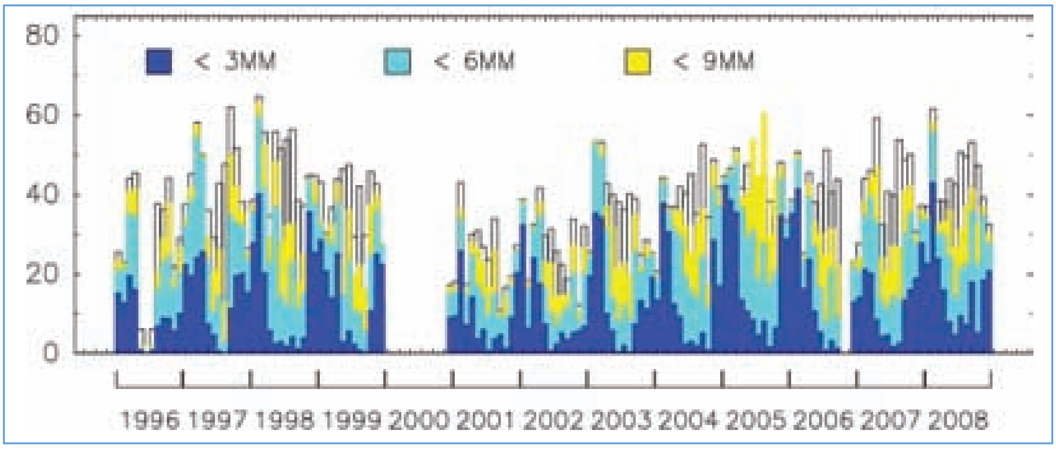
During the summer, IRAM offered guided tours and talks to a broader public. These outreach activities were done in collaboration with the Instituto de Astrofísica de Andalucía (IAA). These activities included public tours in the telescope buildings as well as talks together with the IAA.

Plateau de Bure observatory

The Plateau de Bure Interferometer performed according to expectations with almost no downtime due to equipment failure. The receivers all worked well throughout the year without significant problems. Thanks to excellent weather conditions and a careful preparation of the tracks, the change to the A configuration was accomplished on January 29, 2008. As in previous years, the scheduling of the A configuration was readjusted shortly after the beginning of the winter 2007/2008 period to optimize the scheduling of A-rated projects with respect to Sun avoidance limitations and weather constraints. As of March 9th, 56 A-configuration tracks, corresponding to 26 astronomical programs, were observed with remarkable sensitivity and successfully completed. The weather conditions were excellent in February and relatively good from spring to fall.

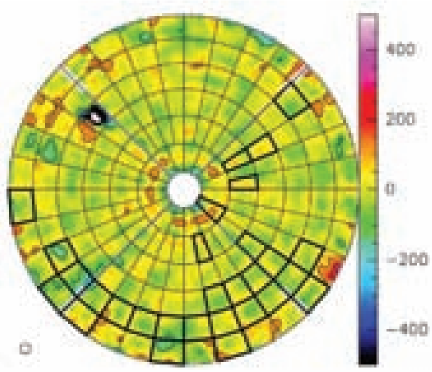
The percentage of telescope time scheduled for observing programs was on average 50% percent of the total time. Additional 10 to 15 percent have to be accounted for receiver tuning, testing equipment, surface adjustments and antenna maintenance, and finally on completing the commissioning and science verification of Band 2. As in previous years, the remaining 35 to 40% were lost due to poor weather conditions.

More than 200 different projects, which correspond to more than 130 different observing programs, including 12 proposals for Director's Discretionary time, were scheduled at the Observatory in 2008. As in previous years, the weight on young stellar objects science and extragalactic research was strong. A fairly large amount of observing time was invested in D-configuration between spring and fall in the detection of line-emission from carbon-monoxide in



Plateau de Bure atmospheric water vapor content monthly averages since January 1996. Observations in the high frequency window (200 – 271 GHz), and observations in the extended configurations are for the most part carried out in the winter months.

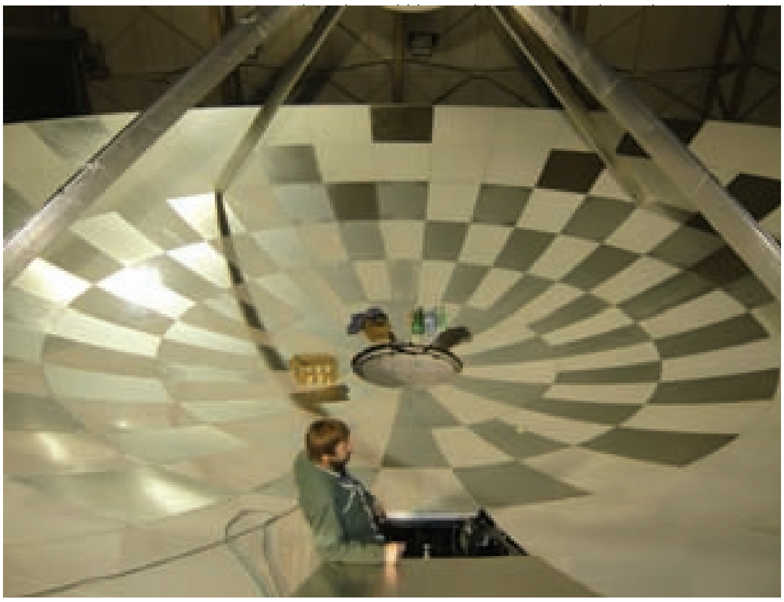
galaxies at high redshift. Appendix 7.2 details all the proposals to which time was granted in the course of the year, and largely testifies to the high scientific return of the Plateau de Bure Interferometer. The second week in May was devoted to coordinated 3mm VLBI continuum observations with several participating radio observatories in Europe and the United States.



Surface accuracy achieved on antenna 4 after six iterations. Contours are in steps of 100 microns. The ring 4 panel in the upper left quadrant could not be readjusted in 2008.

ANTENNA SURFACE IMPROVEMENTS

The loss of surface precision revealed on antennas 1, 2, 4 and 6 in 2007 was a problem of growing concern. To avoid further panel degradation and associated antenna efficiency losses, it had been decided to begin an extensive refurbishment plan to replace the carbon fiber panels with aluminum panels. The working plan was finalized to implement the replacements in three phases: a first antenna in 2008, a second in 2009 and the last two antennas in 2010. Work started on the first antenna (4) on September 21, and completed on October 17, 2008. All the carbon fibre panels were replaced with new precision-machined aluminium panels using



The surface of antenna 4, as of October 2008. The carbon fibre panels were replaced with aluminium panels using a chessboard like technique to reduce the number of iterations in the process of achieving highest surface precision.

technical improvements to counter thermal and mechanical stresses in the antenna back-structure.

Figure: the surface of antenna 4, as of October 2008. The carbon fibre panels were replaced with aluminium panels using a chessboard like technique to reduce the number of iterations in the process of achieving highest surface precision.

The surface of all six antennas was verified, and panels were readjusted when necessary. The reflectivity losses of the silver painted panels of antennas 1, 2 and 6, which were estimated in 2006 to about 10% at 230 GHz, were not verified in 2008.

WIDEX AND BAND 4

In 2008, work was progressing well to reach the next two milestones: (1) complete the construction of WideX, a broadband correlator with 4 GHz frequency coverage in each polarization and a channel spacing of 2 MHz and (2) equip the cryostats with Band 4 for operations in the 277 - 371 GHz band. Both projects are progressing well, and we are confident to complete WideX in 2009 and Band 4 in 2010.

In connection with the short-term (WideX) and long-term (NOEMA) plans to extend the receiver bandwidth and backend performance, work has been started to investigate the potential of the frequency-offset technique as an alternative to Walsh-switching to reject the unwanted image-sideband of quasi-SSB receivers (3-10dB). In view of this analysis, work was conducted to homogenize hardware and software in the LO phasing system. First performance measurements carried out in the summer 2008 qualitatively suggested promising potential of the frequency-offset technique, but the series of measurements will be continued in 2009 to better quantify the amount of sideband rejection.

SUN AVOIDANCE

For safety reasons, observations with the interferometer are currently restricted to angles larger than 45 degrees from the Sun. This restriction makes about 15% of the sky inaccessible on any given date, and many objects of the sky inaccessible for observations in the extended configurations of the array. In connection with the plan to equip all six antennas with machined aluminum panels and in the consideration that the antennas are no longer equipped with the (shiny) Hostaflon panels, measurements were performed in 2008 to investigate the possibility of relaxing the currently binding Sun avoidance constraints. Based on these investigations, we expect that projects observed in 2009 will profit from a reduced Sun avoidance circle.

DATA ARCHIVE

As in previous years, in a continuing and successful effort with the Centre de Données astronomiques de Strasbourg (CDS), data headers of observations carried out with the Plateau de Bure Interferometer are conjointly archived at the CDS, and are available for viewing via the CDS search tools. In 2008, the archive contained coordinates, on-source integration time, frequencies, observing modes, array configurations, project identification codes, etc. for observations carried out in the period from January 1990 to March 2007. To preserve the confidentiality of some information such as frequencies and coordinates, 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 is observed.

FACE -TO-FACE SUPPORT

The Plateau de Bure Science Operations Group is staffed with astronomers that regularly act as astronomers on duty to optimise the scientific return of the instrument, directly on the site or remotely from Grenoble, provide technical support and expertise on the Plateau de Bure interferometer to investigators and visiting astronomers for questions related to the calibration, pipeline-processing and archiving of Plateau de Bure data, and interact with the scientific software development group for developments related to the long-term future of the interferometer. Six astronomers were appointed to the group at the end of 2008.

The year 2008 saw 44 investigators from Europe and overseas visiting IRAM Grenoble and spending a total of 194 days to reduce data from the Plateau de Bure Interferometer, and 3 astronomers reducing data remotely from their home institutes.

Since January 2004, limited travel funds have been made available to eligible astronomers from non IRAM partner countries for expenses incurred during their stay at IRAM for reducing data from the Plateau de Bure Interferometer. These funds are made available by the European Commission in the frame of the FP6 programme. For the year 2008, the Program Committee received 22 eligible proposals and recommended 10 proposals for observations with the Plateau de Bure Interferometer. Taking into account proposals accepted in 2007 but observed in 2008, and a Director's discretionary time proposal, access time was allocated to 18 eligible proposals corresponding to a total of 334 hours of observing time; 34 hours are planned to be scheduled for early 2009. Since the beginning of RadioNet, access time was allocated to 61 eligible proposals (12 in 2004, 11 in 2005, 11 in 2006, 13 in 2007) for observations with the Plateau de Bure Interferometer, corresponding to a total of ~1400 hours (272 in 2004, 239 in 2005, 272 in 2006, 326 hours in 2007) of observing time. Time was allocated to eligible investigators from United Kingdom (percentage of total time is 56%), Italy (38%), the Netherlands (4%), Portugal (1%), Sweden (1%) and Switzerland (< 1%) with a slightly unbalanced distribution between PhD students and post-doctoral researchers (16%) and senior scientists (84%).

SIXTH SUMMER SCHOOL ON MILLIMETER INTERFEROMETRY

The Sixth IRAM Millimeter Interferometry School took place from October 6 to 10, 2008, at the IRAM headquarters in Grenoble. The school focused on both theoretical and observational aspects with special emphasis on the Plateau de Bure interferometer. Lectures were presented by in-house and invited experts. The program of the school

Participants and lecturers of the Sixth Summer School on Millimeter Interferometry was structured to provide the participants with a broad base knowledge of the Plateau de Bure Interferometer, its future upgrades and to ALMA. Participants had the opportunity to present posters on their own work, and some of them were invited to give an oral contribution on a result obtained with the Plateau de Bure Interferometer to share their knowledge and learn from each others' experience. The school attracted a total of 68 researchers from Europe and overseas: Germany (17), France (16), Netherlands (5), Spain (5), USA (5), Chile (4), Italy (4), Switzerland (4), United Kingdom (2), Australia (1), Canada (1), Finland (1), Mexico (1), Poland (1) and Portugal (1). The lectures of the 6th Interferometry School and the proceedings from previous Interferometry Schools are available on the IRAM Web.

VLBI OBSERVATIONS

The Plateau de Bure VLBI system proved its compatibility with the Bure computer upgrade in a short test between Bure and Pico Veleta on April 24, 2008. This test confirmed that the renovated EFOS-10 maser on Pico Veleta was working fine and that the timing problem at the 30-m encountered in October 2007 had been solved.

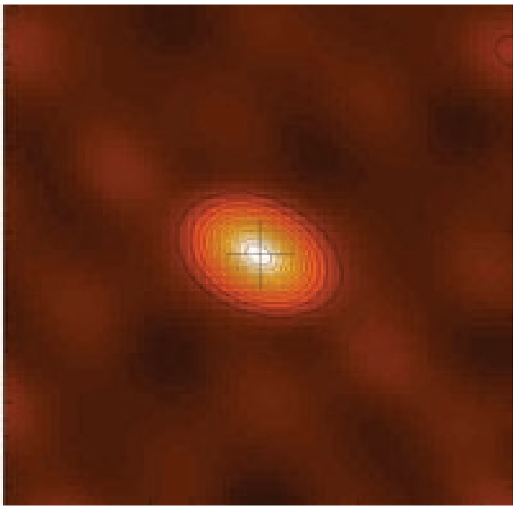
Both IRAM telescopes participated in the Global Millimeter VLBI Array (GMVA) session that took place from May 8 to 13, 2008. Plateau de Bure observed nearly 100% of the scheduled scans while Pico Veleta took a 50% loss due to adverse weather conditions (snow).

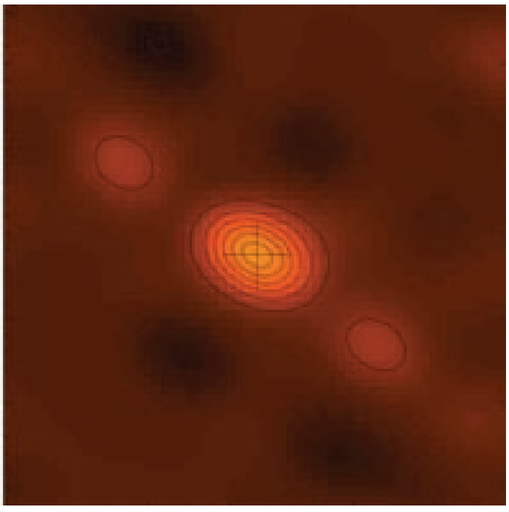
The October 9-15, 2008 Global VLBI session did not go well for the IRAM instruments. Pico Veleta suffered from bad weather so that two thirds of the scheduled scans were lost. On Plateau de Bure the special phase-stable frequency generator for VLBI (a Racal Dana 9087) developed an instability that resulted in an excessive phase noise. Fortunately this problem was detected in an early fringe test. As it became evident that the problem could not be resolved within the time frame of the session, Bure went back to local observing mode that does not use the Racal Dana (100% VLBI session loss).

In the study of the long term drift of the Plateau de Bure EFOS-38 maser vs. the GPS time signal, we have identified a tiny acceleration component that is expected due to the slow atom-by-atom erosion of the inner lining of the maser cavity. For both Global VLBI sessions in 2008, we have tried to anticipate this acceleration in our maser tunings on March 4 and August 16. The first attempt was still a bit off: our drift relative to GPS was about -1.20 nsec/day during the May VLBI session. During the period of the October session, we were on average at +0.25 nsec/day, and always below +0.4 nsec/day (or more stable than 5 x 10-15), which is close to the optimum that we can achieve.

THE 22GHZ RADIOMETRIC PHASE-CORRECTION SYSTEM

The radiometers on all six interferometer antennas performed without significant technical problems in 2008. In the post-processing software systematic interference checks have been introduced that disable the phase correction in case of satellite downlink interference. So far only two such downlinks have been detected so that only a small fraction of observations is concerned; however, one beacon perturbs the WVR channel 1 and the other channel 2. The software filter cannot reconstruct the unperturbed water vapor signal; this task would require additional radiometer channels for redundancy.





Dirty maps at ~100 GHz of the bright gravitational lens system JVAS B0218+357 (Patnaik et al. 1993). The result is based on real astronomical data and illustrates the performance improvements to expect with (left) an absolute radiometric phase correction system.

Progress has been made on the way to the absolute phase correction. In an intermediate step, software tools have been developed to extend the one-scan range (45 seconds) of the correction over more than 20 minutes, which resulted in experimental maps of improved resolution. Post processing and archive software tools now allow an automated study of a large sequence of individual project data files to test improved reduction scripts and calibration methods. For the first time, a trade-in of radiometer time resolution against improved signal-to-noise has been tried on continuum data; plans are to introduce this option into the real-time system to adapt the phase correction to the meteorological conditions.

ANTENNA MAINTENANCE

The yearly maintenance of the interferometer was carried out from May to October. During this period, each antenna was brought into the maintenance building for 3 weeks of detailed overhaul. A special effort was made this year on the renewal of the electrical case (B6) which controls the anchors and the survival pins of each antenna. The old robots (TSX17 is no longer produced) were replaced by new ones with improved capabilities that will allow to add the controls of the full lifting system of the antennas during the 2009 maintenances.

During the refurbishment process of the tracks carried out last year, it was discovered that a small portion of the tracks (2 X 30 meters in front of the maintenance building) were built on poles rather than ledger lines. These poles tend to sink in the ground when an antenna is passing and need to be repaired. Due to the location of the problem, a solution is being studied to find a way to do the job while minimizing the impact on antenna maintenances.

MAINTENANCE OF THE BUILDINGS

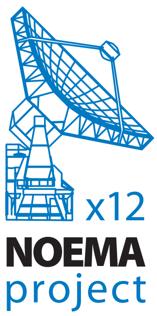
The new octagonal structure of POM2 was completed during spring after constuction had been stopped last fall due to bad weather conditions. A neutron detector was installed by the L2MP laboratory (CNRS Marseille) enabling the researchers to correlate the atmospheric neutron flux with the experiments on microelectronic chips that are located inside the building.

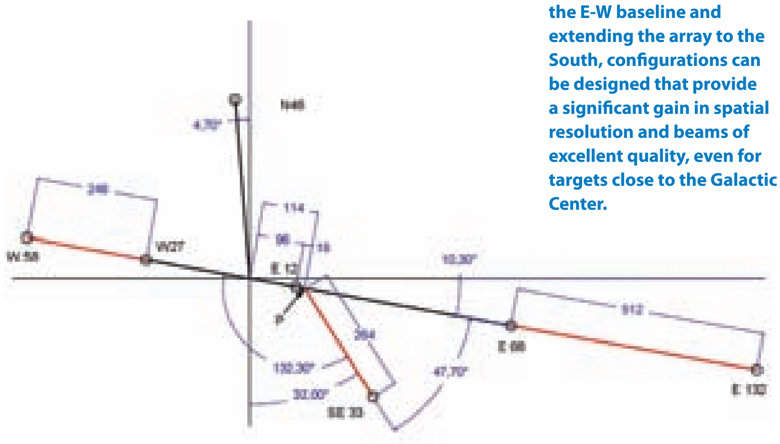
In order to try to reduce power consumption at the observatory, the company A3-Energie was mandated to carry out a full study of consumption posts. The ongoing study will result in an action plan (changing habits, investments, etc...) to streamline power consumption. Meanwhile, IRAM subscribed to a new EDF service that allows real-time monitoring of consumption and immediate intervention as soon as a peak is detected. Finally, all the doors and windows of the building were renewed during the summer.

LONG-TERM DEVELOPMENTS

In 2008, IRAM started a study of a major upgrade of the Plateau de Bure interferometer. The basic elements of the upgrade are: doubling of the number of 15-meter antennas from 6 to 12, extension of the East-West baseline from 0.8 to 1.6 km and increase of the total IF bandwidth from 8 to 32 GHz. This project named NOEMA (for NOrthern Extended Millimeter Array) will transform the current interferometer into a new and powerful facility that will give the IRAM community a unique access to the millimeter windows.

The scientific and technical studies are ongoing. They included, in 2008, an investigation of the geological and geophysical situation on the Plateau de Bure to explore the possible extensions of the baselines east and westward as well as to the south-east. The report shows that it is possible to extend the interferometer in order to obtain a 1 600 meter line base in the E-W direction and to create a new South-East track about 250 meters long.





Proposed NOEMA interferometer baseline layout - possible extensions are shown in red. By doubling the length of the E-W baseline and extending the array to the South, configurations can be designed that provide a significant gain in spatial resolution and beams of excellent quality, even for targets close to the Galactic Center.

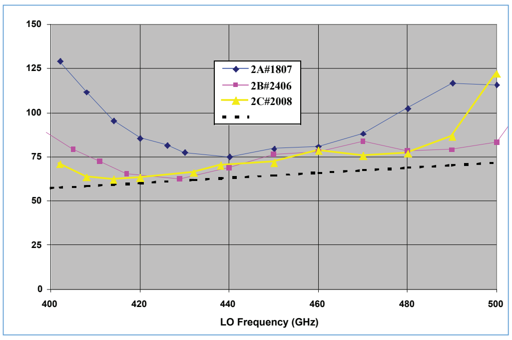
Grenoble headquarters

SIS GROUP

The IRAM SIS group continued the production of SIS junctions for various IRAM internal projects. In 2008, full speed production of the ALMA B7 junction was first reached and the original scheme for this ambitious project was shown to be valid. The project is now on schedule.

In parallel, innitial very encouraging results were also obtained at the Harvard/Smithsonian laboratory with IRAM SIS junctions for the 450 GHz range, as illustrated by receiver noise temperature shown in the graph below.

Above: Micro- and Nanostructures as defined by silicon micro machining employing micro lithography and plasma etching.



Right: Receiver noise temperature as measured with first devices for the Smithsonian Center for Astrophysics in the 400-500 GHz range as foreseen for the SMA.

Work on micro-mechanical RF systems continued with the preparation for in depth analysis of material parameter and mechanical properties of the devices (collaboration between INPG Grenoble, INSA Lyon and ENS des Mines de St Etienne, supported by the *Région Rhône-Alpes*).

A development of kinetic inductance detectors (KIDs) was started with the arrival of a PhD student (M. Rösch). Apart from investigations of the fundamental electrical and physical effects in such devices, this work will support the collaborative effort to develop continuum detector arrays for the IRAM 30m telescope (collaboration between Institut Neel, SRON and the University of Cardiff).

Silicon process development aiming for passive structures in the millimeter and submillimeter range were carried on and the ongoing collaboration with the Institut Neel on micro-squids is related to this development.

The specifications of a new and versatile high quality sputtering-machine have been worked out and negotiations with various supplierswere started. The system, that will include an electron beam evaporation set-up and open up for a large variety of new deposition parameters and materials, is planned to be installed in 2009.

FRONTEND GROUP ACTIVITIES

The IRAM frontend group had a very busy year with maintenance, upgrade and development activities for both the 30 meter telescope and the Plateau de Bure interferometer, not to mention the start of full production of the ALMA Band 7 cartridges.

PLATEAU DE BURE INTERFEROMETER MAINTENANCE

In January two repairs were performed successfully on Antenna 5: Band 3, V polarization, and Band 2, H polarization.

Following failures, two LO modules for Band 2 were replaced with spare units. The fault lay in the Gunn oscillator, that has since then been repaired by the supplier.

Following recurring problems, the modules for selection of the local oscillator and the IF channels were inspected. Several were found to have humidity-induced damage: electrolysis, crystalline outgrowths, etc. The modules have been repaired and the receiver electronics box made more or less rain proof using duct tape. No problems have been experienced since.

PLATEAU DE BURE INTERFEROMETER UPGRADE

Six optical modules (plus a prototype/spare) were fabricated and tested for Plateau de Bure Band 4. They are generally similar to other optical modules, i.e. they comprise a grid polarization diplexer and two refocusing elliptical mirrors. The horns, however, are of a new compact design, originated at Cambridge University. They combine a short horn with a parabolic mirror that corrects the phase distribution across the aperture.

PICO VELETA NEW GENERATION (A.K.A. EMIR) RECEIVER CONSTRUCTION FOR THE 30M TELESCOPE

This project was initiated and conducted to a large degree by our colleague Matthew Carter, who fought illness in good spirits until his untimely passing end of 2008.

Overview of the Eight-mixer Receiver (EMIR) system.

The receiver comprises four frequency bands. For each frequency band the optics provides diplexing into two polarization channels. Each polarization channel feeds the RF input of one mixer. Each mixer has one or two IF outputs, depending on whether it is single side band (SSB) or dual side band (2SB). The SSB mixers are identical to those developed for the PdBI. Like previous generation IRAM mixers, they achieve image rejection through the tuning of a movable backshort; unlike the previous generation, they can be tuned either USB or LSB. The band

Horn-parabola for PdBI Band 4.

1 and band 4 2SB mixers were developed in the framework, respectively, of the AMSTAR program and of the ALMA Band 7 contract: they do not belong to the presentation of the Frontend activities.

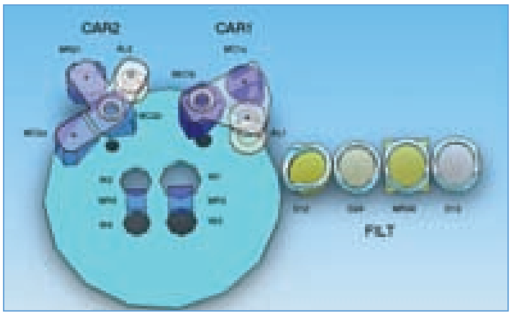
Four RF beams (one per band, dual polarization) exit the cryostat through four windows laid out side by side in the focal plane in a square array 260mm on a side, equivalent to 184.3" on the sky.

Any of the four signal beams can be re-directed to one of two internal cold calibration cold loads, via elliptical mirrors riding on two "carousels".

In basic operation, one band is active, with the pointing offsets being handled transparently by the telescope software. There are also three dual-frequency configurations, in which two signal beams are re-combined using a so-called dichroic mirror (also known as frequency selective surface). Such a "mirror" is near transparent for the lower frequency band and near-perfectly reflective for the higher frequency band. Frequency diplexing is possible for the combinations B1/B3, B2/B4, and B1/

Band #	RF coverage	Mixing scheme	IF band	Mixing scheme	IF band
		As installed		Planned expansion	
1	80-116	2SB	2x[4-12]	2SB	2x[4-12]
2	129-174	SSB (U/L)	[4-8]	2SB	2x[4-12]
3	200-267	SSB (U/L)	[4-8]	2SB	2x[4-12]
4	260-354	2SB	2x[4-8]	2SB	2x[4-12]

Initial configuration and planned mid-term upgrade of the Emir system. The RF coverage is understood to be a the center of the IF band; slightly wider coverage is achieved at the edge of the IF band. The bias harnesses, IF, cables and LO waveguides are already configured for the future upgrades, which will require a swap of verified optical modules with new mixers and an upgrade of the cryogenic IF amplifiers. These upgrades can be performed on-site.

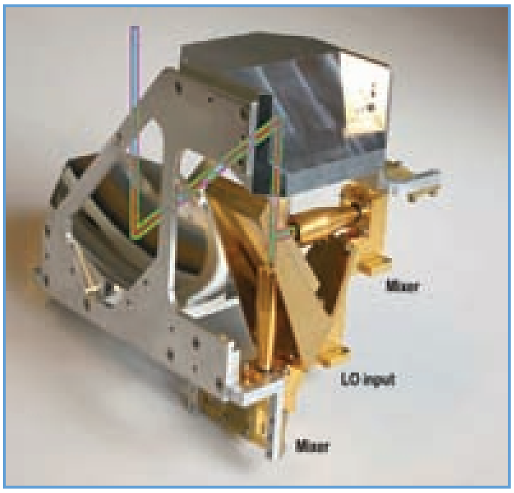


Schematic view of the room temperature optics of the receiver. Band 3 and 4 beams are always reflected off mirrors MR3 and MR4 onto the signal windows W1 and W2 respectively. In single-band mode, these beams are reflected off the solid mirror MR34, suitably positioned above the signals window W2 or W4. When the dichroic mirrors D13 or D24 are positioned, respectively, over the W1 or W2 signal windows, the diplexing modes B1/B3 or B2/B4 respectively are enabled. The B1/B2 diplexing mode operates via a reflection on MR21 (located on the #2 calibration carousel) and the D12 dichroic mirror positioned over signal window W1.

B2. Implementing the dichroic mirrors is not totally trivial, as their losses depend on the position angle of the mirror (within its plane); each of the three mirrors was carefully tested at various frequencies and position angle before defining the optimum position with minimum losses, which are typically 2%-5%.

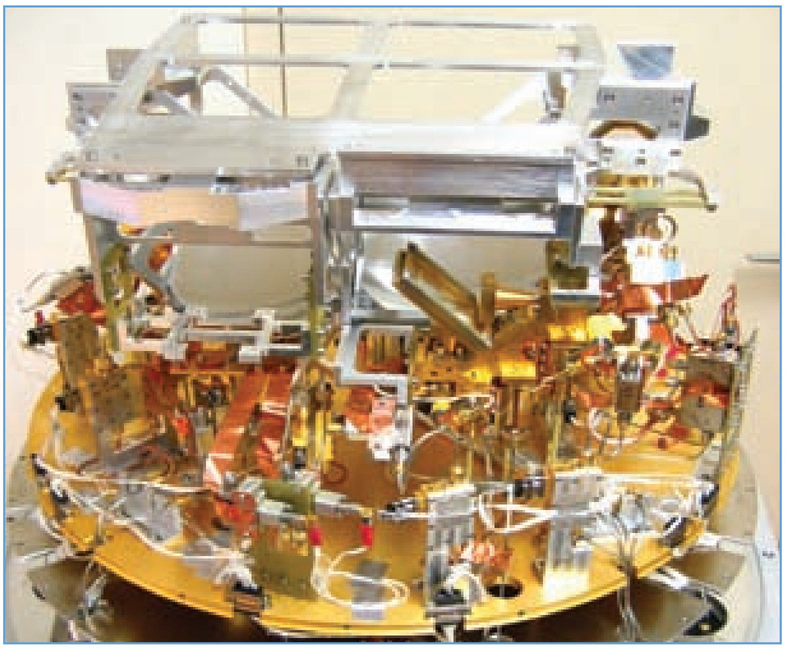
Assembly and verification activities in 2008.

The dewar and the two closed-cycle cryosystems (compressor and cold head, one operating set and one spare) were delivered in July. The cryostat (dewar augmented with all bias wiring, LO and signal paths) has been assembled. It is outfitted for 4 frequency bands, each dual polarization and dual side band (total 16 IF channels), allowing on-site upgrades in the future from a slightly more modest initial configuration.



Right: the Band 2 cold optics assembly, showing schematically the beam path.

Below: the assembled cryostat of the new Pico Veleta receiver as of November 2008.



By the end of the year, the cryostat was outfitted with three bands: Band 1, two 2SB mixers with 4-12 GHz IF, Band 2 and Band 3 with each two SSB mixers having a 4-8 GHz IF.

In parallel, the room-temperature modules of the receiver were being built or received from subcontractors: main cryostat chassis, front optics chassis, two calibration carousels, translation stage for switching in and out dichroic mirrors. Four LO boxes (one per band) were refurbished, including new CAN interface modules (from the Computer group) and new harmonic mixers. Two warm IF modules (also with CAN interface) were completed, pending delivery of parts for the rest of the 12 needed in total. The electronic modules (I2C interface) for junction bias, Josephson suppression coils and cryogenic amplifier bias and monitoring were completed, together with the corresponding power supplies.

A first cool down of the receiver took place in November and December. The mixer performance for Band 1 and Band 3 could be verified. Problems were noted with Band 2 (resolved at time of writing).

The current plan is to ship EMIR to Pico Veleta early March 2009.

MIXER DEVELOPMENT AND CONSTRUCTION

PdBI Band 4 mixers

19 sideband-separating mixers for Band 4 of the Plateau de Bure New Generation receivers have been assembled and fully characterized. The best 12 mixers will be installed at the telescope. The SSB noise temperatures of all mixers are well below 100 K and the achieved image rejection is almost always better than 10 dB.

Mixers for EMIR

Band 2 and 3 mixers are a repeat of the design implemented on Plateau de Bure. The Band 4 mixers are similar to the PdBI mixers (themselves similar to the mixers developed in the ALMA contract), except that junctions were selected for the specific band, which is shifted down by ~5%. The Band 1 mixer is a spinoff of the AMSTAR program.

LOCAL OSCILLATOR FOR PdBI BAND 4

The design, construction, and bench-top test of the validation prototype for the new Band 4 local oscillator has been reported in the 2007 Annual Report. In 2008, the following activities were completed. The prototype was integrated in a self-contained enclosure, including interface electronics, but excluding power supplies (because space is scarce in close proximity to the receiver). All electronic interfaces for 7 more local oscillators have been designed and built (by the Computer Group) and tested.

Above: local oscillator box in current use on IRAM telescopes (RF part only). Below: New LO with no moving parts (RF part only). Note the lower parts count and simpler layout.

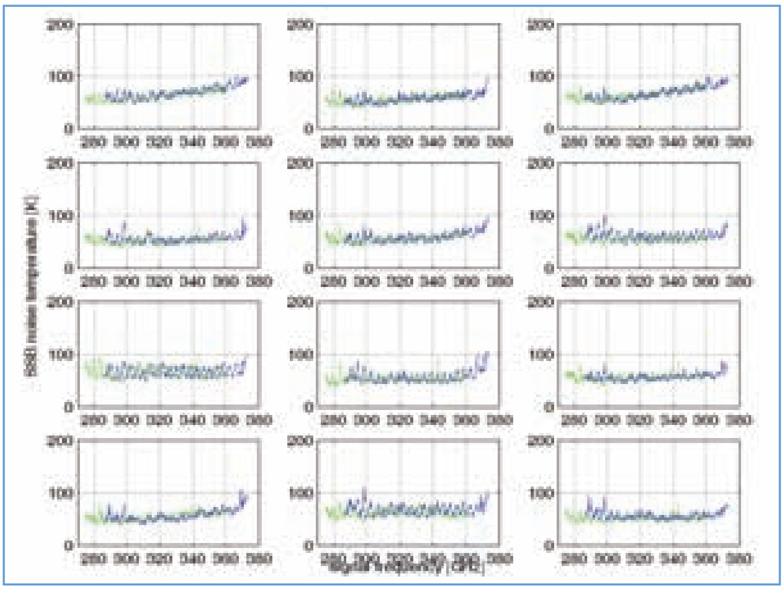
All microwave and mm-wave components (active and passive, such as filters) have also been procured, with the exception of the W-band amplifier MMIC. The LSPA-2, (InP) had become unavailable when, following prototype validation, the decision was made to proceed with the small series construction. The supplier, HRL, shifted twice the expected date for a new fabrication batch. As of end 2008, we are considering to modify the design to implement the EBPA-107C (GaAs), designed by NRAO and fabricated at the BAE foundry. Because this requires irreversible modifications of the mm-wave blocks, we wait for a full validation of NRAO's prototype or confirmed availability of the LSPA-2.

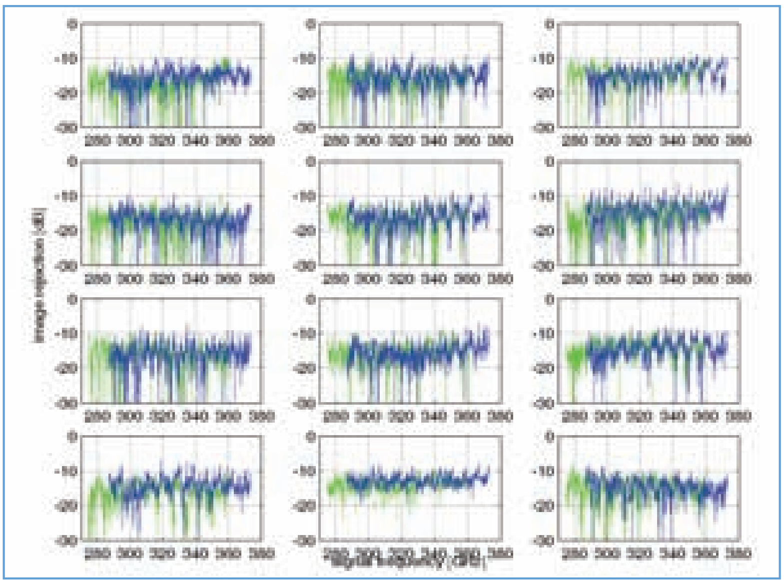
New WR10 (75-110 GHz) and WR8 (90- 140 GHz) harmonic mixers have been developed and tested. They will be used as well with the 1.875GHz and the 17 GHz future first PLL reference.

In the course of the Band 4 LO project, an automated test station was developed to characterize harmonic mixers; it has been found quite valuable for other projects as well.

Below: Noise performance of the 12 sideband separating mixers (selected out of 19 produced) for outfitting Band 4 (277-368 GHz) of the PdBI receivers. Most of these mixers were produced from a especially selected SIS junction substrate. Note that the ALMA specification for the same frequency band is 147K SSB noise, and that the typical noise shown here is half that.

Bottom: As previous: image rejection versus signal frequency; green=LSB; blue=USB.

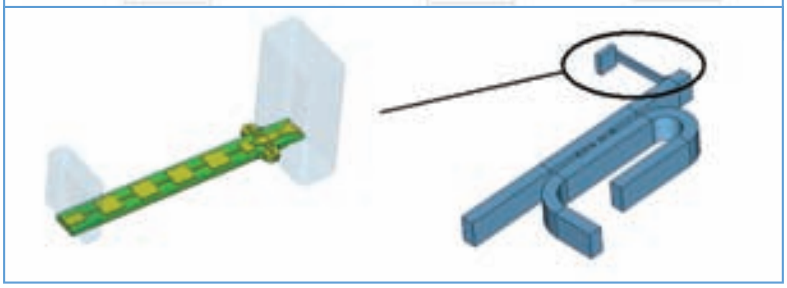




DEVELOPMENT OF A 3MM HEMT RECEIVER FOR THE 30M TELESCOPE

In the 2007 Annual Report, it was stated that MMICs from the University of Massachusetts were being tested, and that various architectures for the receiver were under consideration. In 2008, four MMICs (two stages, two polarizations) plus two spares were purchased and received from U.Mass.

The "plan B" architecture adopted for the HEMT mm-wave receiver. This gives access to a sliding window 8-GHz wide, tuneable across the 84-116 RF band.



The combination of the LO injection coupler and first mixer must handle a wide bandwidth: 67-116 GHz.

One architecture had been selected as baseline, providing full instantaneous access to the full RF bandwidth 84-116 GHz.

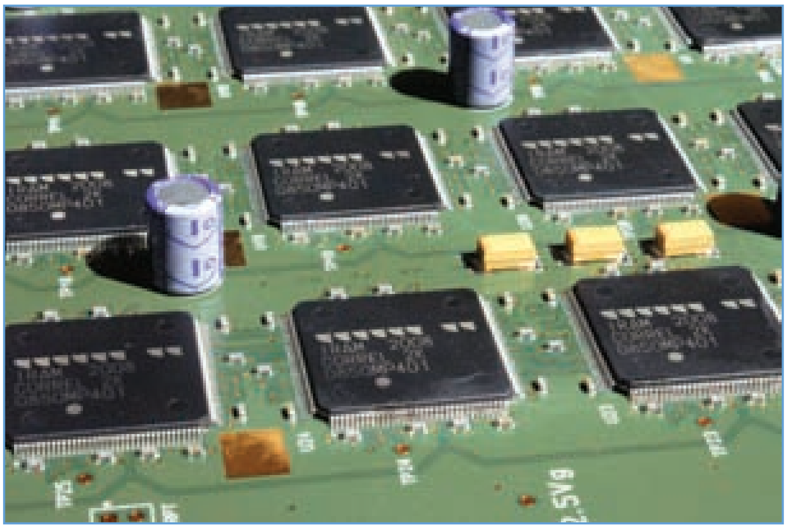
BACKEND GROUP

A large fraction of the IRAM Backend Group's activities was devoted to the building of the new large bandwidth correlator (WideX) for the Plateau de Bure interferometer.

WIDEX CORRELATOR

The correlator chip design simulation of WideX was approved and sent to the foundry . The first batch of (30) prototypes was intensively tested. They displayed excellent performance. On the correlator card, the long cascades of chips were found to be sensitive to EMI from the DC to DC converters as well as small other electrical causes. The resulting jitter could be reduced to an acceptable value by the use of low ESR decoupling capacitors and by PCB layout improvement. Thereafter the chip design was declared to be fully compliant and an order for a batch of 2300 IC's was signed off.

A few ASIC correlators.



The accumulator readout sytem, together with its broadband optical transmission system, was successfully tested together with the development software, at the nominal speed.

The FPGA code that tackles the data format conversion and integrates the geometrical delay compensation (on the internal RAM) has reached the operational level. Numerous constraints were applied on the compiler in order to achieve the functionality and to align the timings of all the 64 I/O's within a few hundreds of picoseconds. Subsequently a complete batch of Altera Stratix3 devices could be ordered.

All the boards are interconnected via an impedance and delay controlled backplane designed to serve 8 antennas. The power consumption for one 19" chassis is expected to be in the 1kW range. Four chassis will host the entire system.

LO SYSTEM III

A prototype 15 GHz YIG oscillator/divider was built and locked on 8 times the central synthesizer frequency. The phase noise is already 6dB better than the existing system, and is improved.

COMPUTER GROUP

The development of the real time WideX correlator acquisition and processing package was completed successfully. It has four purposes:

- To validate the chip in order to meet the specifications;
- To help testing and debugging the correlation cards with 28 chips each and the sampler boards;
- To provide a maintenance and diagnostic package for the final correlator chassis;
- To confirm the aptitude of the acquisition design (hardware and software) to deal with the extreme high rate of the full flow of data including all the corrections and the Fourier transforms 32 times a second with a decent solution of displaying near real time correlation functions and spectra. The later processing requirement follows the specifications compiled in our wiki created last year for this project.

The computer group was involved in the hardware of the EMIR project via the work on the CAN interfaces for the sampler 12C bus and the DC motors as well as the integration of the stepper motor CAN controllers.

The control and monitoring software was widely developed in parallel with the hardware thanks to a well detailed and exhaustive interface documentation set between the front-end and the computer group. The software written in C++ depends on QT, a cross-platform application framework largely used in the world and actively supported, sqlite, an embedded SQL database for archiving the tuning parameters, and, xml-rpc, for the communications with the software higher levels.

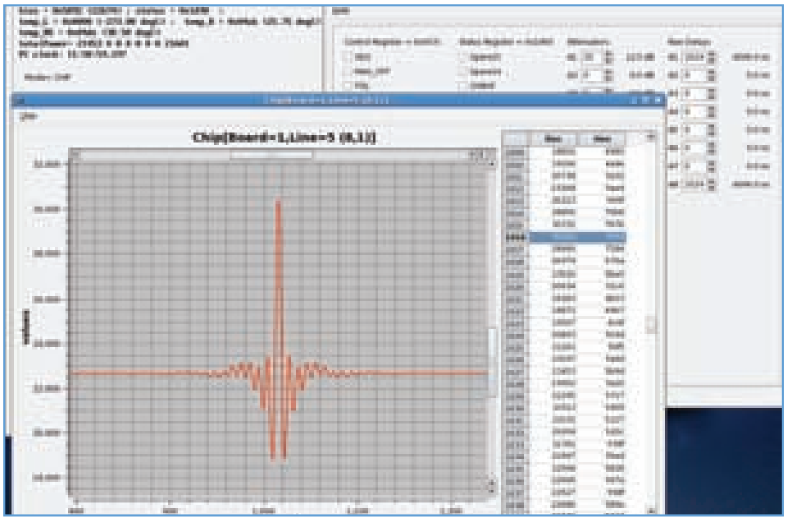
The package includes a detailed simulation layer that is very useful for debugging CAN communications, receiver monitoring and control, for testing the user interfaces and allowing parallel developments in Grenoble when the receiver was not yet available or at Pico Veleta when the receiver was still a 'paper' project.

With the experience gained last year with the implementation of diskless servers at Plateau de Bure relying on fault tolerant RAID disks of a Storage Area Network (SAN) server, a similar solution has been evaluated for the central servers at Grenoble. The purpose is always to improve the reliability of the servers and to minimize hardware failure consequences (very often disk crashes or power supply break down). The solution is based on the iSCSI protocol over IP and the creation of remote logical units located in the local (Grenoble) SAN.

The adopted solution is composed of 2 diskless servers (system disks on the SAN) running XEN, an open source industry standard hypervisor for x86 or any other CPU architecture virtualization. For better clarity the diskless servers are called xensrv1 and xensrv2.

The virtual servers hosted by xensrv1 and/or xensrv2 are for the time being netsrv1 dedicated to the network services, the mails and the account administration, and websrv1 dedicated to the web services.

In principle, the virtual servers are distributed on the 2 XEN servers for load balancing. However in case of hardware failure of one XEN server (which cannot involve file system integrity lost) or simply maintenance, the 2 virtual servers can be hosted by the single remaining XEN hypervisor. For a virtual server, its swap from one XEN host to the other



Cross-correlation of antennas 1 and 8, for an effective delay of 4096 nanoseconds on both inputs.

can be performed without shutdown and without activity lost (just a stall period may be noticed).

The XEN servers have been successfully tested for 4 months with simulated hardware failures and snapshot backups for saving given versions of the system file.

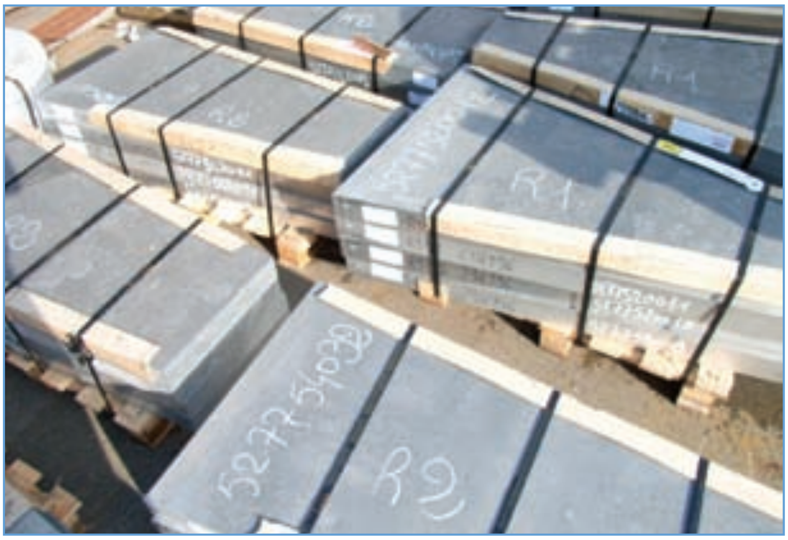
For the time being only the virtual web server websrv1 is running on any of 2 XENs. Hot swaps have been experienced and the performances are excellent.

Application and archive servers at the Plateau de Bure Observatory.

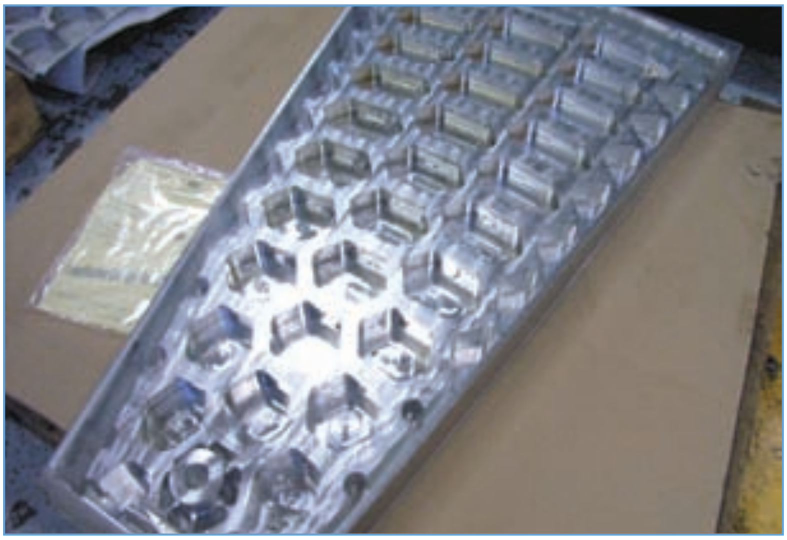
MECHANICAL GROUP

The mechanical group assures the design and supply of the IRAM developments with high quality mechanical components. The expertise covers a vast field ranging from antenna design and related upgrades to design and fabrication of high precision mechanical microwave components and optical elements. Components are either machined directly in the IRAM workshop or subcontracted to external suppliers. In the latter case the group is responsible for preparation, negotiation and follow up of the contracts.

The mechanical group, in close collaboration with technical staff from the IRAM 30m telescope and Plateau de Bure interferometer, is also involved in the maintenance and steady improvement of all IRAM antennas.



Unmachined aluminum blocks for panel fabrication.



Panel of ring 1 after coarse machining.

WORKSHOP

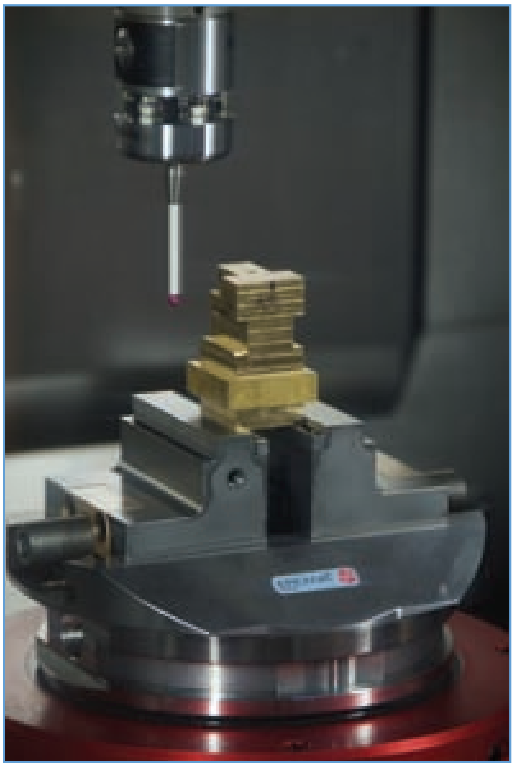
During 2008 the workshop machined a large number of high precision microwave components, mixers, couplers, horns and filters for the new IRAM instruments such as EMIR, the new wide band receiver for the 30m telescope. Another main task was to take the fabrication of ALMA Band 7 parts to full production speed, including the development of an optimum fabrication process for couplers on the new 5-axis milling machine. The process of equipment upgrade has been pursued with the arrival of a second 3-axis CNC machine.

DESIGN OFFICE

The drawing office worked on numerous mechanical designs, in close collaboration with the other groups. Among a large number of projects the main activities included:

- mechanical design for all EMIR receiver components ranging from microwave components to optics and mechanical support structure;
- design of a new type of aluminium panel and negotiation of prototyping contracts;
- design improvements for the 2nd generation aluminium subreflector of the Plateau de Bure antena (delivery date spring 2009).

Apart from the organisation of the running panel fabrication, much effort has also gone into the negotiation of the follow up contracts for the last two sets of new antenna panels for PdB. Separate contracts for material and machining were negotiated.



PUBLIC RELATIONS

In March 2008, IRAM created for the first time in its history a position for a person responsible for the institute's public outreach. The first task was to produce a brochure for the general public describing the institute, its activities, radio astronomy at millimeter wavelengths and the two IRAM observatories. Together with the graphic design agency Rebus, IRAM began to gather texts, photos and figures. Several months later, a 20 pages document was published. "To the edge of the universe", is available in English, French, Spanish and German.

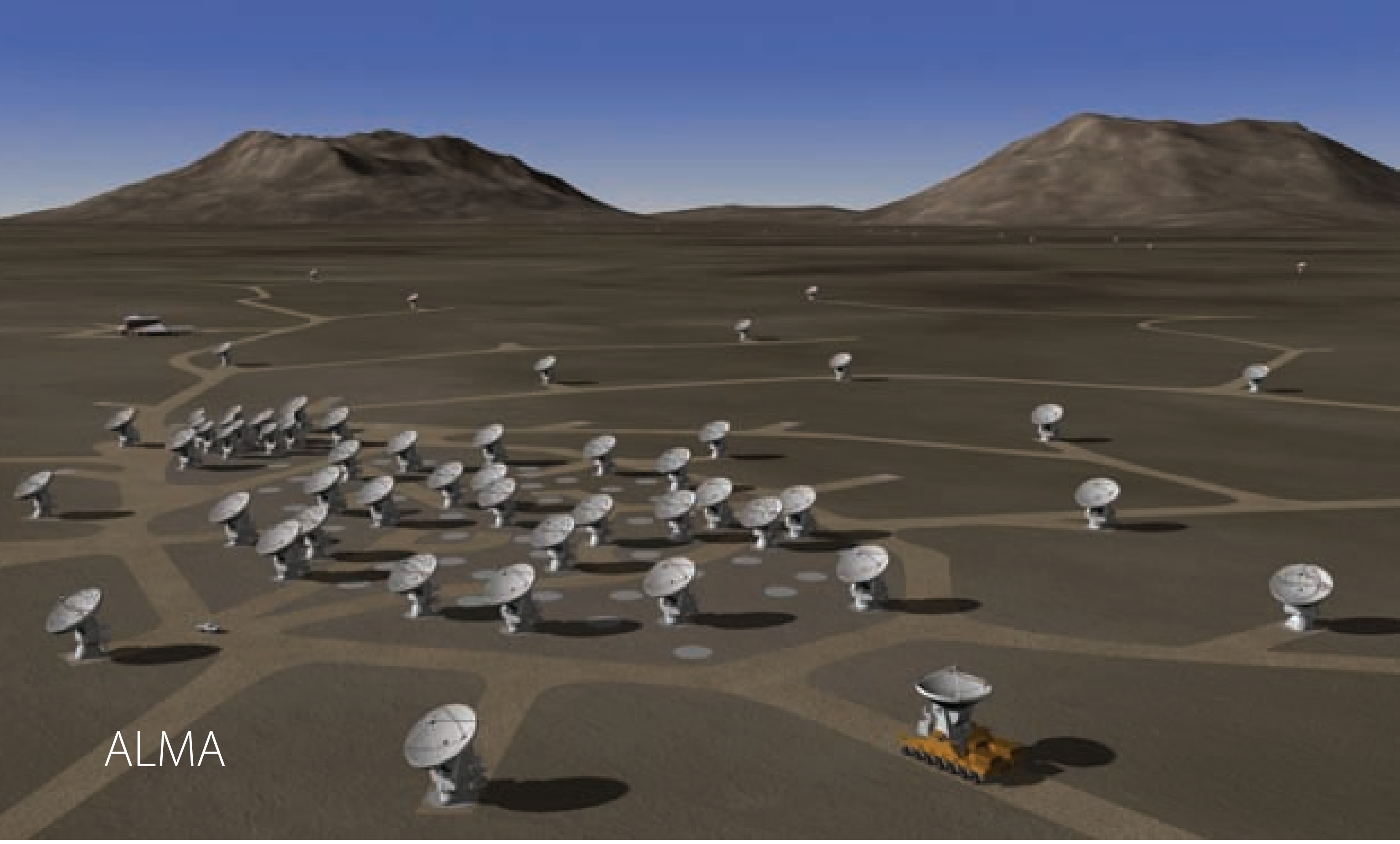
Another field of new activity concerned improving contacts with the media. Over the years, the institute did not communicated enough on its work or on its scientific results to the general public. In order to change this, IRAM started a local and regional press campaign which resulted in several articles and reports about the institute and its observatories.

Press releases on outstanding scientific results were published attracting international attention further increasing IRAM's visibility. Newspapers and periodicals with international impact such as *BBC News, Nature, Natural History, La Repubblica, Focus* and *Bild* published results based on the IRAM facilities.

An important event in 2008 was an exhibition about IRAM and the Plateau de Bure interferometer which was shown in St Etienne en Dévoluy (Hautes Alpes) where the Plateau de Bure is located. On the opening day more than 250 people came to discover the institute's activities and listened to IRAM's Director who talked about radio astronomy, the Plateau de Bure interferometer and cosmic phenomena. The exhibition will continue until April 2009.

As for 2009, the event schedule is even busier. Projects like the "100 Hours of Astronomy", outreach conferences, press campaigns, the institute's new website and, of course, IRAM's 30th anniversary are top priorities.

Exhibition "To the edge of the universe" at Saint-Etienne-en-Superdévoluy (French Alps): over 250 people came to see the stands, watch the film sequences and listen to Pierre Cox speaking about radio astronomy.



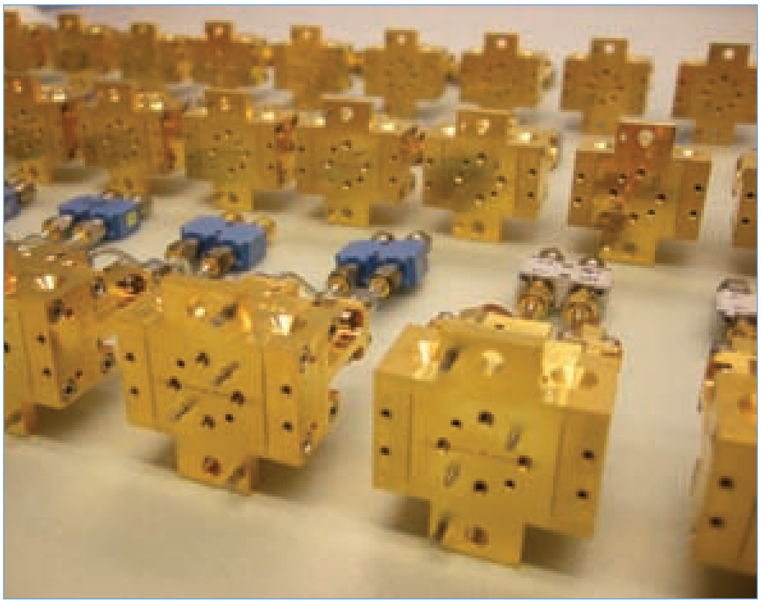
ALMA

Artist's concept of completed ALMA. Image credit: ALMA/ESO/NRAO/NAOJ.

IRAM is deeply involved in the ALMA construction, and almost all the groups within the institute are contributing (or have contributed) to this project. IRAM will also be involved in the ALMA operation phase and is currently setting up a support center for future ALMA users.

ALMA SAMPLER CLOCKS

The IRAM backend group was in charge of the design and construction of the sampler digitizer clocks and fine delay system for the ALMA backend. In 2008, this work was finalized and 68 units were delivered to ESO. The contract is now terminated, and has been realized on-schedule and on-budget.



ALMA band 7 mixer blocks.

ALMA BAND 7 CARTRIDGES

IRAM has developed the ALMA Band 7 cartridge (275-373 GHz, 8 GHZ bandwidth, two polarizations), which is one of the six frequency bands that will initially equip ALMA antennas. The first 8 units ("pre-production") were delivered to the ALMA project, and are currently integrated into the ALMA system. First light with one of the Band 7 receivers was reported on January 22th 2009 using one of the first ALMA antennas in Chile.

The contract for the production of 48 ALMA Band 7 cartridges was signed on December 3, 2007; and the option for 17 additional cartridges for the ALMA Compact Array (ACA) was signed in the summer 2008. The first year of performance of the contract was essentially devoted to the procurement of components, setting up the extra test sets, hiring extra staff, and updating the documentation, with the goal of sustaining a production rate of one cartridge every three weeks. More specifically, the activities in 2008 include:

- Procure the equipment for the second cartridge test station, including the cryostat from NAOJ; procure the equipment for five (one DSB, four 2SB) new mixer test stations;

- Assemble and validate the above mentioned test stations, including software for automated tests;
- Although not all test sets have been completed at the end of the year, already six 2SB mixers fulfilling the ALMA specifications could be produced;
- Prepare and issue the tendering documents for all the cartridge components, place the contracts and proceed with the incoming inspection of received parts;
- Hire and train two new staff, one for incoming inspection, and one for tracking orders, deliveries, and planning;
- Realize improvements in infrastructure: secure storage rooms, laminar flow hoods;
- Update the project documentation in preparation for the Pre-Production Review (passed on 12-13 Nov 2008) and the Manufacturing Readiness Review (scheduled for Feb 2009).

ALMA TELESCOPE CALIBRATION SOFTWARE

IRAM is playing a key role in the development of the real-time telescope calibration pipeline ("TelCal"). This software development involved in 2008 one astronomer and two software engineers. Incremental versions were released in April and October 2008, and are fully integrated into the ALMA software environment. In addition to the development of the 'engines' that are needed to reduce and analyse the various calibration observations (antenna pointing and focussing, atmospheric calibration, atmospheric phase correction using WVR measurements…), a significant effort was also devoted to the binding of TelCal with Python and the CASA software. This should eventually provide off-line access to the TelCal calibration routines. TelCal was heavily tested in 2008 on the ALMA Test Facility in Socorro.

Since TelCal is being tested on Plateau de Bure data, a data format filler was developed, allowing to write/read Plateau de Bure files into/from ALMA format (ASDM).

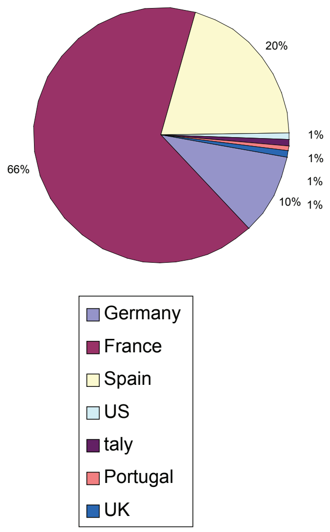
EUROPEAN ALMA REGIONAL CENTER

IRAM has established an ALMA user support center, which forms a node of the European ALMA Regional Center (ARC). The activities of this center are based on the existing support activities for the Plateau de Bure interferometer as well as on the involvement of the institute in the ALMA construction. The main tasks of the IRAM ARC node are/will be:

- User formation: the 6th IRAM millimeter interferometry school was held in Grenoble, October 2—6th 2008. About 110 applications were received, but only 68 participants could be accomodated. The school lectures covered the basics of millimetre interferometry, calibration, imaging, and a somewhat detailed presentation of the Plateau de Bure and of ALMA. 2008 marked the 10th anniversary of this successful school series (more details are given on pges 25/26). The next IRAM interferometry school will be scheduled in the fall 2010;
- User support: the main goal of the ARC node is to provide face-to-face support to the ALMA users. Procedures similar to the current Plateau de Bure support will be used: each project will be assigned a local contact, i.e. an astronomer expert in the ALMA instrument and software, who will be in charge of helping the PI reducing and analysing the data during his/her stay in Grenoble;
- Expertise center: a number of ALMA-related software and algorithmic developments are taking place at IRAM, including the development of the On-The-Fly analysis tools or the interoperability between the IRAM and ALMA data reduction software. A workshop on ALMA simulations was also organised at IRAM in September 2008.

More information is available on the IRAM ARC node web pages at http://www.iram.fr/IRAMFR/ARC.

Personnel and finances



Distribution of IRAM staff by nationality.

The IRAM administration comprises three groups covering the areas of human resources, finance, and general services.

HUMAN RESOURCES

In 2008, 105.5 positions were foreseen in the personnel plan authorised by the IRAM executive council, i.e. 77.7 for France and 27.8 for Spain.

In addition to these authorised positions, IRAM also has a number of staff recruited for specific activities such as ALMA contracts, and 2 FTE on a specific European contract as ESO subcontractor.

IRAM employed a total of 129.7 FTE in 2008.

Women represent ca 27% of the staff and are present in all sectors of activity at IRAM.

The distribution of all staff (France and Spain) per nationality is shown in the figure on the left.

In 2008, the IRAM administration decided to install a new integrated time management system to streamline both staff activities and presence. The system was selected at the end of the year and will be implemented in the course of 2009. The new system should simplify the procedures involved in recording of information on staff activities, in particular when working on externally funded contracts where reporting to funding partners is essential as well as facilitating the management of vacations, days off and absences.

FINANCES

The activity of the IRAM administration in the area of finance include budget preparation and management, annual accounts, liaison with the auditors and audit commission, report to the executive council.

IRAM's financial situation in 2008, as well as budget provisions for 2009, are summarised in the following tables.

OPERATING AND INVESTMENT BUDGETS FOR 2008

Expenditure

Budget heading	Approved	Actual
Operation / Personnel	7,803,000	7,505,071
Operation / Other items	3,791,940	3,931,521
TOTAL OPERATION	**11,594,940**	**11,436,592**
Investment (base+special)	8,808,770	3,232,173
TOTAL EXPENDITURE excl. VAT	**20,403,710**	**14,668,765**

Income

Budget heading	Approved	Actual
CNRS contributions	7,549,678	7,549,678
MPG contributions	7,389,678	7,389,678
IGN contributions	942,874	941,874
TOTAL CONTRIBUTIONS	**15,882,229**	**15,881,229**
Carry forward from previous years	3,098,361	3,098,361
IRAM's own income	1,423,120	1,514,036
TOTAL INCOME excl. VAT	**20,403,710**	**20,493,626**

OPERATING AND INVESTMENT BUDGETS FOR 2009

Expenditure

Budget heading	Approved
Operation / Personnel	8,086,700
Operation / other items	3,549,164
TOTAL OPERATION	**11,635,864**
Investment - general	11,008,134
TOTAL INVESTMENT	**11,008,134**
TOTAL EXPENDITURE	**22,643,998**

Income

Budget heading	Approved
CNRS contributions	14,052,268
MPG contributions	6,052,268
IGN contributions	772,630
TOTAL CONTRIBUTIONS	**20,877,165**
IRAM's own income	1,022,250
Carry forward from previous years	744,583
TOTAL INCOME excl. VAT	**22,643,998**

The associates have approved an increase by 3% of their contribution to the operation budget for 2009, and approved, as in 2007 and 2008, a specific contribution of 1M€ to the investment budget to allow the continuation of the change of all panels on 2 antennas of the Plateau de Bure interferometer.

The associates also approved the financing of the reconstruction of the cable car to access the Plateau de Bure observatory and first payments were made in 2008. Financing will continue over 2009 and 2010.

In 2008, the financial group within the administration was considerably strengthened by the addition of one team supervisor on the one hand, and the implementation of additional software aimed at simplifying the financial reporting on the other hand. More time and more IT support allowed a better follow-up of the major contracts currently running (e.g. ALMA Band 7 cartridge).

In order to have more detailed information on its various projects and activities, internally or externally financed, the IRAM administration had implemented in 2007 an analytical accounting, which was further developed and improved all over 2008.

One of the major tasks within the group was the full inventory of IRAM assets, which was executed with the assistance of external experts. With this inventory, IRAM could also ensure the implementation of the new rules regarding the identification of assets by components. The discussion with the insurance companies of the value for insurance as indicated by the experts is still to come.

GENERAL SERVICES

The group in charge of building and maintenance had a busy year supervising major work on and inside the building. The roof of the patio, which is the "heart" of the IRAM building in St Martin d'Hères, had to be entirely refurbished. Also, many spaces were to be rearranged in order to increase laboratory spaces or storage spaces (in liaison with the new needs arising from the IRAM participation in the ALMA project); thus, in order to free spaces, almost all of the administrative archives had to be moved to another place in Grenoble, which was a not insignificant undertaking in terms of organisation.

ANNEX I

Telescope Schedules

The next two tables show the allocations for telescope time for the 30-meter telescope and the Plateau de Bure Interferometer for the year 2008. In each table, the first column gives the project's identification, the second column the title of the investigation and the third column the names of the Principal Investigator and the co-Is.

30-meter Telescope

Ident.	Title of Investigation	Authors
119-07	Finding high-mass protostars and pre-stellar cores in Infrared Dark Clouds	Simon, Stojimirovic, Jackson, Chambers
122-07	A HERA Survey of Nearby Galaxies	Walter, Leroy, Weiss, Bigiel, Usero, Brinks, De Blok, Cannon, Kennicutt, Begum, Kramer
123-07	Search for Corannulene (C20H10) in the Red Rectangle	Giesen, Joblin, Pilleri, Mulas, Malloci, Grabow, Bruenken, Herberth, Baum, Surin, Schlemmer, Gerin
125-07	IRAM CO Observations at high Galactic latitudes	Barriault, Joncas, Martin
126-07	Protoplanetary Disk Masses in the IC 348 Cloud	Espaillat, Calvet, Bergin, Muzerolle, Hartmann
127-07	Very cold dust associated with molecular gas in M 31	Zylka, Guelin, Lis, Levine, Latter
129-07	A 2 mm line survey of the prototypical evolved starburst galaxy M82	Ocantildea Flaquer, Martin Ruiz, Mauersberger, Martin-Pintado, Henkel, Amo Baladron, Aladro
132-07	Disk mass and outer disk evolution in evolved protoplanetary disks	Sicilia-Aguilar, Henning, Merin, Patel
134-07	The angular momentum evolution of prestellar cores	Padovani, Walmsley, Galli, Caselli, Tafalla
136-07	The power source of a z=2.8 Lyman alpha "blob".	Martinez-Sansigre, Smith, Jarvis, Lacy
138-07	Confirmation of a tentative detection of TiO2 toward VY CMa	Bruenken, Mueller, Menten, Mccarthy, Thaddeus
139-07	Confirmation of the interstellar detection linebreak of thiocyanic acid (HSCN) towards SgrB2 (M)	Bruenken, Yu, Thaddeus, Belloche, Menten, Herbst
140-07	Observation of H_2CO toward IK Tau	Bruenken, Mueller, Menten
143-07	Magnetically Aligned Filaments in Taurus	Heyer, Falgarone, Hily-Blant
147-07	Molecular Gas and the Assembly of Red Sequence Galaxies: The Complete Picture	Young, Combes, Bureau, Emsellem, Cappellari, Krajnovic, Mcdermid, Crocker
148-07	Clustered Low Mass Star Formation: Using N2D+ to probe dense gas fragmentation in Ophiuchus	Friesen, di Francesco, Shirley, Andre, Belloche
151-07	The Molecular Gas Content of QSO Host Galaxies	Barthel, Evans, Tacconi, Sanders, Frayer, Surace, Vavilkin, Hines
152-07	Deep inside the Perseus cluster core - Physical conditions of the molecular gas filaments in a cooling flow -	Salome, Combes, Edge, Crawford, Erlund, Fabian, Hatch, Johnstone, Wilman
153-07	Determining the SED of 6.7 GHz methanol maser sources	Pandian, Menten, Xu, Momjian
154-07	The peculiar northern core in L183	Pagani, Bacmann
159-07	Dust thermal emission from z~5 LBGs with high star formation rates	Ohta, Yabe, Iwata, Sawicki, Yuma, Kajino, Akiyama, Tamura, Aoki
160-07	The nature of clusters of optically faint Spitzer sources at z=2	Andreani, Magliocchetti, Omont, De Zotti, Danese, Cristiani
162-07	A Complete SED Study of Spitzer ULIRGs at z~1.85	Omont, Younger, Huang, Fazio, Polletta, Fiolet, Rigopoulou
163-07	G12.22-0.12M: precursor of a hot molecular core?	Vig, Cesaroni, Codella, Moscadelli
164-07	Searching for vigorous star-formation in high-redshift obscured quasars.	Martinez-Sansigre, Omont, Cox, Rawlings, Willott, Lacy, Hill, Sajina, Schinnerer
165-07	MAMBO Observation of Four Extremely Red Spitzer 24micron Sources	Thomson, Oliver, Farrah, Lonsdale, Polletta, Shupe, Surace
166-07	The Galactic center: a large repository of complex molecules	Requena Torres, Martin-Pintado, Amo Baladron, Rodriguez-franco, Martin Ruiz, Morris
167-07	Starburst galaxies in the large-scale environments of z~6 quasar host galaxies	Wagg, Carilli, Wang, Walter, Bertoldi, Menten, Neri, Cox, Fan, Jiang, Strauss
168-07	Young Stellar Objects with observed X-ray radiation	Benz, Bruderer, Wampfler, van Dishoeck, Guedel
169-07	Mapping CO gas across the galaxy-wide shock in Stephan's Quintet	Guillard, Boulanger, Pineau des Forêts, Appleton, Falgarone, Lisenfeld, Xu, Duc, Ogle
173-07	A CN/H13CN study of a sample of high-mass YSOs	Molinari, Brand, Cesaroni, Testi, Viti, Walmsley
174-07	Determining the physical conditions of a key molecular cloud in the GC.	Amo Baladron, Martin-Pintado, Requena Torres, Martin Ruiz, Morris

Ident.	Title of Investigation	Authors
175-07	Dust emission in UV-bright lensed galaxies	Lutz, Baker, Allam, Lin, Tacconi, Genzel, Tucker
177-07	N2H+: a tool to infer chemical and physical properties of pre-stellar cores	Bacmann, Pagani
178-07	Testing the binary supermassive BH model for OJ287	Agudo, Wiesemeyer, Thum
179-07	Complex millimeter structure around the nearby M-dwarf GJ526	Lestrade, Bertoldi, Menten
181-07	Tracing AGN feedback	Lintott, Daddi, Schawinski, Silk, Maraston, Thomas, Viti
182-07	Multi-Wavelength Observations of Sgr A*	Farhad, Schuster, Wiesemeyer, Thum, Downes, Menten, Genzel, Gillessen
183-07	Testing the XDR and the PDR chemistry tracers in the nucleus of the Galaxy.	Amo Baladron, Martin-Pintado, Requena Torres, Martin Ruiz, Morris
184-07	H_2 densities in PDRs and shocked regions in external galaxies	Aladro, Mauersberger, Martin-Pintado, Torres, Martin Ruiz
185-07	Evolution of debris dust of disks around solar-type stars.	Roccatagliata, Henning, Carpenter, Wolf
186-07	Nitrogen isotopes as clues to the origin of nitrogen in comets and the solar system	Gerin, Roueff, Bockelee-Morvan, Biver, Lis, Cernicharo, Daniel
187-07	A dedicated astronomical search for vinyl acetylene (H_2C=CH-C=CH) in TMC-1	Thorwirth, Garrod, Belloche, Henkel, Menten, Bruenken
188-07	1200-micron MAMBO photometry of LABOCA sources in the ECDF-S	Greve, Walter, Smail, Ivison, Biggs, Bertoldi, Knudsen, Dannerbauer, Coppin, Weiss, Kovacs, Walter, Bell
189-07	The physical properties in the GC molecular clouds: the methanol approach	Requena Torres, Leurini, Martin-Pintado, Menten, Martin Ruiz
190-07	The Galactic Center Ridges, studying the chemistry in SNR	Requena Torres, Martin-Pintado, Jones, Burton, Menten, Amo Baladron, Martin Ruiz, Cunningham, Schilke, Leurini, Belloche
191-07	A search for propane and propene derivatives in TMC-1	Marcelino, Cernicharo, Agundez, Viti
192-07	Molecules in disks around the remarkably dusty, nearby field stars BP Psc and Tyc 4144 329 2	Kastner, Forveille, Zuckerman, Melis, Wilner, Meier
193-07	Tracing the signature of cluster shocks in Cygnus OB2	Schneider, Butt, Dame, Thum, Montmerle
195-07	Exploring the evolution of debris dust belts around F-type stars.	Moor, Ábraham, Kiss, Kospal, Csengeri, Apai, Henning, Mosoni, Grady
197-07	Benchmarking chemical models against the Horsehead edge: V. Gas phase versus grain surface chemistry	Pety, Goicoechea, Gerin, Hily-Blant, Cernicharo, Roueff
198-07	A new population of massive high extinction clouds: A HERA view of their evolutionary stages	Rygl, Wyrowski, Schuller, Menten
199-07	Search for molecular gas in the H i condensation near M 81	Boone, Brouillet, Braine
203-07	UNVEILING THE NATURE OF THE SOMBRERO GALAXY'S AGN	Vlahakis, Baes, Bendo, Bertoldi, Falony, Hirota, Kuno, Lundgren, Minchin
204-07	Lifetime of massive young stellar objects in W48	Motte, Schneider, Bontemps
206-07	Connecting the ice and gas phase chemistry around low mass young stellar objects	Oeberg, Bottinelli, Visser, van Dishoeck
208-07	Tracking ice evaporation in the Orion Bar PDR	Parise, Garrod, Leurini, Schilke
209-07	Propylene (CH_2CHCH_3) in Dense Cores in Taurus	Marcelino, Cernicharo, Agundez, Roueff
210-07	CN and HCN in starless cores	Hily-Blant, Pineau des Forêts, Walmsley, Flower
211-07	Molecular gas properties of intermediate redshift ULIRGs	Boone, Lim, Gerin, Bayet, Papadopoulos, Leon, Trung, Matsushita
212-07	Search for C3N- in the interstellar medium	Agundez, Cernicharo, Guelin, Gottlieb, Mccarthy, Thaddeus
214-07	Studying the mass-loss history of high-mass AGB stars	Jimenez-Esteban, Bujarrabal, Alcolea, Quintana-Lacaci
215-07	Phosphorus chemistry in circumstellar envelopes	Agundez, Cernicharo, Guelin
216-07	Probing Hot Bottom Burning by observations of N-bearing molecules in CSEs	Alcolea, Bujarrabal, Menten, Desmurs, Jimenez-Esteban, Quintana-Lacaci
217-07	A MAMBO survey of the 1046+59 VLA ultradeep field	Baker, Omont, Lonsdale, Owen, Beelen, Bertoldi, Dole, Harris, Lutz, Polletta, Fiolet
218-07	Is there a Lfir-Lhcn correlation for low Lfir isolated galaxies?	Ocantildea Flaquer, Espada, Leon, Lisenfeld, Ruiz, Sabater Montes, Verdes-Montenegro, Verley
219-07	Turbulence in molecular clouds: is it long-lived ?	Hily-Blant, Falgarone, Pety, Hennebelle., Goddard., Pineau des Forêts
220-07	Molecules from below the surface of Enceladus	Greaves, Fraser, Thi, Dent, Ramsay
221-07	The physical structure of the supersonically contracting core ahead of HH80N	Girart, Masque, Estalella
222-07	Dust Properties in Nearby Galaxies: the SINGS Sample	Albrecht, Bertoldi, Draine, Walter, Weiss
224-07	The Excitation Mechanism of Molecular Gas in Galaxy Nuclei	Israel, Meijerink
229-07	Supporting observations for the outflow WISH survey	Tafalla, Santiago-Garcia, Nisini, Liseau, van Dishoeck
230-07	Search for C4H- and C2H- in the Low-Mass Star Forming Region L1527	Sakai, Sakai, Yamamoto
231-07	Physical and Chemical Properties of Massive Starless Clumps within Infrared Dark Clouds	Gomez, Wyrowski, Menten, Pillai

Ident.	Title of Investigation	Authors
232-07	On the origin of the SiO narrow emission detected toward Massive IRDCs	Jimenez-Serra, Martin-Pintado, Rodriguez-franco
233-07	Molecular excitation in icy silicate-break galaxies -- searching for overluminous HNC and HC3N.	Aalto, Costagiola, Monje, Spaans, Perez-Beaupuits, Conway
234-07	CCS and CCCS Formation Mechanisms in Dark Clouds and Evolved Stars	Sakai, Cernicharo, Yamamoto, Agundez
235-07	What happens to the outer disks when planets form in the inner disks?	Bottinelli, Merin, Augereau, F. Van Dishoeck, Oliveira, Brown, Blake, Pontoppidan
236-07	CO(2-1) Observations in the outer regions of NGC 4258	Dessauges, Salome, Krips, Combes, Downes
237-07	Unveiling the chemical structure of Orion : A 2-D line survey using HERA	Cernicharo, Marcelino, Pardo, Tercero, Mauersberger, Guelin
238-07	Deuterium Fractionation in Warm Carbon-Chain Chemistry	Yamamoto, Sakai, Sakai, Shiba, Hirota
240-07	Probing the Formation of Intermediate-Mass Stars in Protoclusters	Andre, Maury, Peretto, Motte, Bontemps, Schneider, Hennebelle, Menshchikov
241-07	Coordinated cm to mm-monitoring of variability and spectral shape evolution of a selected GLAST blazar sample	Fuhrmann, Zensus, Krichbaum, Readhead, Angelakis, Marchili, Ungerechts, Agudo
242-07	Probing star formation laws across the galaxy disk of NGC 6946	Usero, Leroy, Brinks, Walter, De Blok, Bigiel
243-07	Composition of Halley family comet 8P/Tuttle	Biver, Bockelee-Morvan, Boissier, Crovisier, Colom, Moreno, Paubert, Lis, Weaver, Russo
244-07	Molecular emission from the inner shells of symbiotic stars	Bujarrabal, Ajewska, Alcolea
246-07	A HERA survey of the circumstellar gas around LBV stars	Rizzo, Henkel, Usero
D09-07	Confirmation of the SMG cadidate Vd-6364	Schinnerer, Carilli
D10-07	CO in CUDSS10B	Vlahakis, Dunne, Eales, Minchin
D12-07	Confirmation of 15NH2D	Gerin, Roueff, Bockelee-Morvan, Lis, Biver, Marcelino, Cernicharo
D13-07	CO(1-0) in Stephan's Quintet	Guillard, Boulanger, Falgarone, Lisenfeld, Appleton, Pineau des Forêts
D14-07	Hypernova SN2008D	Agudo
D15-07	GRB080129	Bertoldi, Greiner
D16-07	Molecules in V4046 Sgr	Kastner
001-08	A dedicated astronomical search for vinyl acetylene (H_2C=CH-C=CH) in TMC-1	Thorwirth, Garrod, Belloche, Henkel, Menten, Wyrowski, Schilke, Bruenken
003-08	Radiography of the intermediate mass protostars OMC2 FIR3, 4 and 5	Crimier, Ceccarelli, Cernicharo, Lefloch, Fuente, Alonso-Albi, Caselli, Johnstone, Caux, Dominik
004-08	Probing the chemical evolutionary stage of the cores of the Pipe Nebula	Frau, Beltran, Morata, Girart, Alves, Busquet, Estalella, Franco, Masque, Sanchez-Monge
005-08	The abundance of CN, HCN, and HNC in prestellar cores	Padovani, Walmsley, Tafalla, Hily-Blant, Pineau des Forêts
006-08	Assessing the drivers of galaxy evolution in clusters	Usero, Scott, Brinks, Bravo-Alfaro
007-08	Tracing the dense gas component in the Antennae galaxies	Bayet, Viti, Lintott, Martin-Pintado, Martin Ruiz
009-08	The peculiar northern core in L183	Pagani, Bacmann, Fich, Steinacker
010-08	Investigating grain chemistry in the GC molecular clouds: the deuterium approach.	Requena Torres, Parise, Martin-Pintado, Rodriguez-franco, Martin Ruiz
011-08	SiO maser emission in red supergiant stars.	Verheyen, Messineo, Menten
012-08	HCO2+ Survey in Low-Mass Star-Forming Regions	Sakai, Sakai, Aikawa, Yamamoto
013-08	Are low luminosity Class 0 sources very young objects?	Vastel, Ceccarelli, Caselli, Caux, Andre, Bacman, Pagani
014-08	Dust Properties in Nearby Galaxies: the SINGS Sample	Albrecht, Bertoldi, Draine, Walter, Weiss
015-08	The Formation of IRDCs: Testing Dynamic Versus Quiescent Theories	Caselli, Tan, Hernandez, Loo, Jimenez-Serra, Fontani, Ceccarelli
018-08	The role of X-rays and shocks in the Galactic starburst template W49A	Peng, Wyrowski, van der Tak, Walmsley, Menten, Weiss
019-08	Survey of CN in IRDCs for Future Zeeman Observations	Falgarone, Crutcher, Troland, Hily-Blant
020-08	The primordial conditions to cluster formation	Roman-Zuniga, Alves, Anglada, Gomez
021-08	Molecular Gas in infrared ultraluminous QSOs	Leon, Xia, Gao, Omont, Cox, Qinghua, Mao, Flaquer
022-08	Diffuse gas: where turbulent dissipation meets chemistry.	Hily-Blant, Falgarone, Godard, Pineau des Forêts
023-08	CO observation of VIRGOHI21, a tail extending from NGC 4254	Jachym, Combes
027-08	Regeneration of CCS in Low-Mass Star-Forming Regions	Sakai, Caux, Ceccarelli, Sakai, Yamamoto
028-08	A CO survey in very young Planetary Nebulae	Buemi, Cerrigone, Leto, Trigilio, Umana
029-08	A MAMBO survey of the 1046+59 VLA ultradeep field	Omont, Baker, Lonsdale, Owen, Beelen, Bertoldi, Dole, Harris, Lutz, Polletta, Fiolet
030-08	A 2 mm line survey of the prototypical evolved starburst galaxy M82	Aladro, Martin Ruiz, Mauersberger, Martin-Pintado, Ocantildea Flaquer, Henkel, Amo Baladron

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031-08	A complete and deep HERA map of M33	Braine, Schuster, Sievers, Rodriguez, Brouillet, Gratier, Herpin, Bontemps, Israel, Tabatabaei, Mookerjea, Koribalski, Combes, Wiedner, Van Der Werf, van der Tak, Henkel, Kramer, Roellig, Corbelli, Aalto, Garcia-Burillo, Calzetti, Wiklind, Xilouris
033-08	HCN(1-0) mapping in isolated galaxies	Ocantildea Flaquer, Leon, Espada, Lisenfeld, Ruiz, Sabater Montes, Verdes-Montenegro, Verley
034-08	A HERA Map of M 101	Leroy, Gordon, Walter, Weiss, Kennicutt
035-08	Exploring the Chemistry of the EHV Gas in Outflows	Tafalla, Santiago-Garcia, Bachiller
036-08	Molecules in low-metallicity star formation	Hunt, Garcia-Burillo, Casasola, Combes, Guesten, Maiolino, Menten, Testi
038-08	Magnetic reconnection as the origin of the NTFs in the GC?	Amo Baladron, Martin-Pintado, Morris, Requena Torres, Martin Ruiz, Riquelme, Burton, Jones, Cunningham
039-08	Searching for dense molecular gas in four gas-rich lenticular galaxies from the SAURON sample	Krips, Bureau, Combes, Crocker, Young
040-08	Physical and Chemical Properties of Massive Starless Clumps within Infrared Dark Clouds.	Gomez, Wyrowski, Menten, Pillai
041-08	Deuteration in warm conditions : Search for CH2D+	Gerin, Lis, Wootten, Roueff
042-08	Molecular gas in intermediate redshift ULIRGs. III. CO(1-0) at low frequency	Boone, Lim, Gerin, Bayet, Papadopoulos, Leon, Trung, Matsushita
045-08	Survey of 15NH2D in dense cores	Gerin, Lis, Bockelee-Morvan, Biver, Roueff, Coudert, Marcelino, Cernicharo
046-08	Complex Molecules in Protostellar Outflows	Arce, Jorgensen, Santiago, Tafalla, Bachiller
047-08	A quest for a complete understanding of the effect of AGN on galaxy formation: dust emission at z ~ 1	Jarvis, Omont, Fiolet, Beelen, Schinnerer, Martinez-Sansigre, Zylka, Cox, Stevens, Perez-Fournon, Page, Mclure
048-08	The Impact of Protostellar Outflows in Clusters	Arce, Foster, Pineda, Kauffmann, Frank
051-08	Probing the latest high-mass star formation models	Lopez-Sepulcre, Cesaroni, Walmsley
054-08	Extragalactic star-forming regions properties : the hunt for sulfur-bearing species	Bayet, Viti, Lintott, Martin-Pintado, Martin Ruiz
055-08	The Nucleus of NGC 1068: Depletion, XDR or Just Warm Gas?	Muehle, Henkel, Aalto
058-08	HERA Maps To Complement the KINGFISH Herschel Key Program	Walter, Leroy, Schinnerer, Rix, Weiss, Kennicutt, Calzetti, Schuster, Wiesemeyer
061-08	New light on the physical nature of MWC 349	Thum, Wiesemeyer, Hora
062-08	A CO survey of high-z obscured quasars	Martinez-Sansigre, Omont, Cox, Lacy, Rawlings, Willott, Smith, Brand, Kloeckner, Jarvis, Petric
063-08	Dust and CO contents of the CORALZ sample	Mack, Snellen, Schilizzi
064-08	A comparative study between L1527 and TMC-1	Marcelino, Agundez, Cernicharo
065-08	Measuring the H_2 ortho-to-para ratio in pre-stellar cores	Bacmann, Pagani, Vastel, Ceccarelli
066-08	MAMBO photometry of circumstellar disks in the Herschel/GASPS sample	Menard, Grob, Duvert, Augereau, Duchene, Williams, Matthews, Dent, Thi, Pinte, Padgett, Fukagawa, Bouy, Audard, Baldovin
067-08	What drives star formation in bars of galaxies?	Lisenfeld, Zurita, Perez, Verdes-Montenegro, Martinez, Espada, Verley, Combes, Leon, Garcia-Burillo
068-08	H_2 densities in two nearby starburst galaxies	Aladro, Mauersberger, Martin-Pintado, Requena Torres, Martin Ruiz
069-08	Deep HERA mapping of very nearby low metallicity spiral galaxies: NGC6822	Gratier, Schuster, Sievers, Braine, Brouillet, Gardan
073-08	Physical conditions of an unbiased sample of Galactic massive star forming clumps	Schuller, Bontemps, Herpin, Gomez, Morales, Menten, Schilke, Wyrowski, Beuther, Henning, Linz, Bronfman, Walmsley
074-08	Probing the Formation of Intermediate-Mass Stars in Protoclusters	Andre, Maury, Peretto, Motte, Bontemps, Schneider, Hennebelle, Menshchikov
078-08	Are there massive prestellar cores?	Gomez, Wyrowski, Menten, Rygl
079-08	Continuum observations of YSO candidates in Taurus	Baldovin Saavedra, Audard, Carmona, Padgett, Rebull, Stapelfeldt, Terebey, Hillenbrand, Guedel, Glauser, Menard, Evans
083-08	Black hole-spheroid relation in bright z~2 BAL QSOs	Omont, Bergeron, Fiolet, Lehnert, Nesvadba, Beelen, Cox
084-08	The chemistry of the Galatic dustlanes	Rodriguez-Fernandez, Requena Torres, Combes, Liszt
085-08	Coordinated cm to mm-monitoring of variability and spectral shape evolution of a selected GLAST blazar sample	Fuhrmann, Zensus, Krichbaum, Readhead, Angelakis, Marchili, Ungerechts
086-08	Understanding the Formation of the Brightest Taurus Filament	Hacar, Tafalla
087-08	Vibrationally excited HC3N in HNC-rich Galaxies	Costagliola, Aalto, Monje, Spaans, Perez-Beaupuits, Martin Ruiz, Martin-Pintado
089-08	Probing the contracting history of the dense core ahead of HH 80N using molecular tracers	Masque, Girart, Estalella, Beltran
090-08	A Comparison of Gas and Solid Phase CO Distribution in Molecular Cores	Fraser, Craigon, Thi, Dent
092-08	The role of the magnetic field in the Pipe Nebula.	Alves, Girart, Franco, Beltran, Estalella, Morata, Frau, Busquet, Sanchez-Monge, Masque

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097-08	Probing the molecular gas halo of NGC 891	Garcia-Burillo, Guelin, Usero, Fernandez-Garcia, Fuente, Gracia-Carpio, Zylka
098-08	Imaging turbulent flows and turbulent chemistry in diffuse gas	Liszt, Pety
099-08	Molecular line probes of dense gas in LIRGs	Garcia-Burillo, Alonso-Herrero, Gracia-Carpio, Colina, Planesas, Arribas
100-08	Non LTE effects in C2H	Padovani, Walmsley, Tafalla
102-08	Infall and Chemistry of the Starless Core TMC-1C	Schnee, Caselli, Sargent
103-08	Comparison of CO and N2 depletion in a prestellar core	Pagani, Bacmann, Ceccarelli, Vastel
104-08	The Chemical Signature of a Molecular Bow Shock and its Mach Disk	Lefloch, Schuster, Cabrit, Pineau des Forêts, Hily-Blant, Cecarelli
105-08	Star Formation Efficiency and K+A Galaxies	Helmboldt
107-08	SiO maser emission from red supergiants in the RSG3 open cluster.	Messineo, Menten, Davies, Figer, Clark, Negueruela, Verheyen
108-08	Probing the 15N/14N ratio in cold quiescent clouds: search for 15NNH+ and N15NH+ in L1544.	Bizzocchi, Caselli, Dore
109-08	Dust Emission in the Most Distant Quasars	Wang, Carilli, Wagg, Bertoldi, Walter, Menten, Cox, Omont, Strauss, Fan, Jiang
113-08	The Molecular Gas Content of QSO Host Galaxies	Barthel, Evans, Tacconi, Sanders, Frayer, Surace, Vavilkin, Hines
114-08	Mass-loss from dust-rich evolved stars in the globular cluster M15	Muller, Campbell, Dinh-v-Trung, Lim
116-08	Exploring starbursts down the z=6 QSO LF	Omont, Willott, Bergeron, Delorme, Forveille, Delfosse, Cox, Beelen, Fiolet
118-08	Formaldehyde in the Gravitational Lens PKS 1830-211	Darling, Zeiger, Wiklind
119-08	Hot and cold gas-grain chemistry in star-forming regions: formic acid and formaldehyde.	Garrod, Parise, Zapata, Thorwirth, Bisschop, Schilke
122-08	Revealing the nature of the outflow "bullets"	Tafalla, Santiago-Garcia, Bachiller
123-08	Imaging infall in a high-mass star forming region	Lopez-Sepulcre, Cesaroni, Walmsley, Neri
D01-08	Dust emission from a luminous LBG at z~9	Boone, Combes, Schaerer, Pello, Dessauges-Zavadsky
D02-08	Completion of Taurus CO(2-1) map	Schuster
D03-08	Completion of the UC HII-region survey	Churchwell, Sievers, Thum
D04-08	Completion of Orion A Map	Cernicharo, Marcelino
D05-08	Coordinated observations of Blazars	Agudo, Marscher, Jorstad, Gomez, Roca-Sogorb, Wiesemeyer
D07-08	ToO for SGR0501+4516	Rea
D08-08	GRB080913 Host Galaxy	Riechers, Walter, Bertoldi, Carilli, Cox
D09-08	Outburst of V1647 Ori	Audard
D11-08	Makeup for 042-08	Boone

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O046	Properties and evolution of disks in high-mass YSO	Cesaroni, Beltrán, Furuya, Neri, Olmi, Testi, Codella
P017	Deep study of the circumstellar envelopes of AGB & early post-AGB stars	Castro-Carrizo, Bujarrabal, Grewing, Lindqvist, Lucas, Neri, Olofsson, Quintana-Lacaci, Schöier, Winters
P043	Ultra-Low-Mass Cores in the _-Ophiuchi Protocluster	André, Greaves, Motte, Ward-Thompson
Q008	Binary fragmentation in prestellar cores	Ward-Thompson, André, Belloche, Kirk
Q012	Deep study of the circumstellar envelopes of AGB & early post-AGB stars	Castro-Carrizo, Bujarrabal, Grewing, Lindqvist, Lucas, Neri, Olofsson, Quintana-Lacaci, Schöier, Winters
Q046	GG Tau: back to the ringworld	Huré, Dutrey, Guilloteau, Simon, Pierens
Q048	Search for planetary cavities in circumstellar disks: 1. Standard proposal	Piétu, Pety, Gueth, Guilloteau, Dutrey
Q052	Deep study of the circumstellar envelopes of AGB & early post-AGB stars	Castro-Carrizo, Bujarrabal, Grewing, Lindqvist, Lucas, Neri, Olofsson, Quintana-Lacaci, Schöier, Winters
Q061	Origin of molecular gas in E/S0 galaxies: NGC 3156 and NGC 3489	Schinnerer, Emsellen, Haan, Mundell Dumes, Böker
Q064	Molecular gas chemistry in the circumnuclear disk of NGC 1068	Usero, García-Burillo, Fuente, Boone, Tacconi, Gracía-Carpio, Neri, Krips
Q079	High resolution mm-interferometry of submm galaxies: Galaxy formation by major mergers?	Genzel, Neri, Tacconi, Smail, Omont, Ivison, Greve, Cox, Chapman, Blain, Bertoldi
Q082	A better lensing model from high-resolution observations of APM 08279	Neri, Wagg, Downes, Weiss, Wilner
R003	Benchmarking chemical models against the Horsehead edge: III.1 CN/HCN/HNC as a tracer of the photodissociation fronts	Pety, Goicoechea, Gerin, Teyssier, Hily-Blant, Roueff
R004	Absorption line study of the interstellar medium chemistry	Gerin, Black, Falgarone, Giesen, Goicoechea, Gry, Krelowski, Lis, Neufeld, Vastel, Hily-Blant, Pety, Menten, Wyrowski

Ident.	Title of Investigation	Author
R006	The initial conditions of massive star formation	Beuther, Henning
R00B	Origin of Extremely Rich Carbon-Chain Molecules in L1527	Nami, Sakai, Hirota, Yamamoto
R00D	Probing the disk and inner chemical structure of the Class 0 protostar IRAM 04191	Belloche, Parise, André
R00E	Acetonitrile in Hot Corinos: the origin of complex organic molecules	Ceccarelli, Bottinelli, Neri
R010	Kinematic study of Class 0 protostellar cluster L1448	Chen, Launhardt, Henning
R014	Testing the "unified" model of bipolar outflows	Santiago-Garcia, Tafalla, Bachiller
R024	CN(2-1)/CN(1-0) ratio as an excitation condition tracer in proto-planetary disks	Chapillon, Dutrey, Guilloteau, Henning, Pavlyuchenkov, Pety, Piétu, Semenov
R029	A Debris Disk around the central star of the Helix nebula	Huggins, Cox, Bachiller
R02A	H Recombination Lines as Star-Formation Indicator	Basu, Menten, Wyrowski, Bertoldi
R02E	Phase transitions in the neutral ISM: probing GMC complexes in Nearby Galaxies	Usero, Brinks, Walter, Leroy, deBlok
R048	Molecular Gas Masses and Dynamics in High-z	Nesvadba, deBreuck, Lehnert, Walter, Downes, Omont, Neri
R056	Search for molecular gas in the most distant quasars	Wang, Carilli, Walter, Bertoldi, Menten, Cox, Fan, Strauss, Neri, Omont, Wagg, Jiang, Beelen
R05B	The nucleus of comet 8P/Tuttle	Boissier, Bockelée-Morvan, Biver, Colom, Crovisier, Moreno, Groussin, Jorda, Lamy
R064	The origin of molecular jets: new clues from CO in HH212	Codella, Cabrit, Gueth, Gusdorf, Panoglou, Pineau des Forêts
R068	Probing the formation of binary stars: A survey of Class 0 objects	André, Maury, Hennebelle, Duchêne, Bouvier, Bate, Bonnell, Patience, Goodwin, Tafalla, Belloche, Ohashi, Bontemps, Motte
R06D	Dynamical disk perturbations in high accretion T Tauri stars	Cabrit, Pety, Dougados, Beust
R06F	Weak-Lined T Tauri Disk Dissipation Dynamics and Timescale: Follow-up of the Spitzer survey. I - The Taurus Cloud	Duvert, Augereau, Cieza, Duchêne, Ménard, Olofsson, Pinte
R073	Disk Masses of the _-Oph Brown Dwarfs	Natta, Testi, Neri
R076	Probing clustered star formation towards IC 1396N	Fuente, Alonso-Albi, Beltran, Castro-Carrizo, Ceccarelli, Neri
R077	Occurrence and lifetimes of disks around Herbig Ae/Be (HAEBE) stars	Alonso-Albi, Fuente, Bachiller, Neri, Olivier, Planesas
R081	Dissecting the circumstellar disk around the high-mass protostarIRAS 20126+4104	Cesaroni, Galli, Neri, Walmsley
R08B	Unveiling the main heating source in the Cepheus A HW2 star cluster	Jiménez-Serra, Martín-Pintado, Rodríguez-Franco, Chandler
R08E	The birth and death of organic molecules in protoplanetary disks	Semenov, Guilloteau, Henning, Dutrey, Chapillon, Gueth, Hersant, Launhardt, Pavlyuchenkov, Piétu, Schreyer, Wakelam
R08F	Turbulence in Protoplanetary Disks: CS Spectroscopy in DM Tau	Guilloteau, Henning, Semenov, Pavlyuchenkov, Launhardt, Dutrey, Chapillon, Piétu, Pety, Gueth
R091	Characterizing radial variations of grain growth inprotoplanetary disks	Piétu, Pety, Gueth, Guilloteau, Dutrey
R096	The Jets and Torus of the Proto-PN CRL 618	Cox, Huggins, Neri, Bachiller, Lucas, Forveille, Castro-Carrizo, Winters, Bremer, Guélin, Cernicharo, García-Burillo
R097	Searching the engine of the shaping of bipolar proto-PNe; thecase of M 2-9	Castro-Carrizo, Chesneau, Neri, Bujarrabal, Bachiller
R09A	The remarkable envelope chemistry of VY Canis Majoris	Menten, Verheyen, Winters, Alcolea
R09F	Feeding the Nuclear Starburst in NGC 6946: III. Chemical Tracers at 3mm	Schinnerer, Meier, Emsellem, Böker, Downes
R0A6	The optically thick-thin turnover frequency in M81*	Schödel, Eckart, Krips, Markoff
R0A8	Probing the XDR/PDR chemistry in the nucleus of M82	Fuente, Garcia-Burillo, Usero, Rizzo, Gerin, Krips, Neri
R0AB	Fuelling and Feedback in the Nucleus of NGC1068	Davies, Tacconi, Combes, Baker, Schinnerer, Hicks, Genzel, Sanchez
R0AF	Deriving abundance ratios in Luminous Infrared Galaxies	Graciá-Carpio, García-Burillo, Planesas, Tacconi, Lutz, Neri, Fuente, Usero
R0B0	HCN and HCO+ in Ultraluminous Galaxies	Downes, Solomon
R0B6	High-Resolution CO Imaging of z<0.1 QSO Host Galaxies	Riechers, Walter, Bertoldi, Cox, Carilli, Fan, Vestergaard
R0B7	Imaging CO emission from the H2 luminous galaxy 3C 326 N	Boulanger, Appleton, Falgarone, Guillard, Ogle, Pineau des Forêts, Salomé
R0B9	Resolving the Schmidt law in the local analogs of Lyman break galaxies	Baker, Tacconi, Lutz, Genzel, Heckman, Hoopes, Martin, Small, Wyder
R0BA	Molecular absorption and isotopic ratios at redshifts 0.25 - 0.68	Muller, Guélin
R0BF	A Survey of CO in Optically Faint Radio Galaxies	Bertoldi, Chapman, Trethewey, Greve, Genzel, Neri, Omont, Cox, Smail, Swinbank, Ivison, Blain
R0C3	Molecular Gas Masses and Dynamics in High-z Radio Galaxies	Nesvadba, deBreuck, Walter, Downes, Omont, Neri

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R0C4	CO Observations of Spitzer Selected z~2 ULIRGs	Tacconi, Yan, Lutz, Steffen, Omont, Frayer, Cox
R0C7	Probing massive galaxy formation at z=2 from molecular gas physics	Daddi, Dannerbauer, Elbaz, Dickinson, Morrison
R0CA	Resolving the Merger in SMM J16359+6612 at z=2.5	Riechers, Walter, Weiss, Cox, Carilli, Neri, Bertoldi, Brewer, Lewis, Kneib, Smail
R0CF	The Structure of SMGs as a Function of Redshift	Genzel, Neri, Tacconi, Smail, Omont, Ivison, Greve, Cox, Chapman, Blain, Bertoldi
R0DD	A CO survey of redshift 4-5 QSOs	Bertoldi, Walter, Carilli, Riechers, Cox, Omont, Wang, Greve, Weiss
R0E1	Detecting CO(5-4) in a Massive Star-Forming System at z=4.52	Schinnerer, Capak, Carilli, Martinez-Sansigre, Yun
R0E2	Probing for highest redshift submm galaxies	Lutz, Tacconi, Garcia-Carpio, Dannerbauer
R0E5	Search for molecular gas in the most distant quasars	Wang, Carilli, Wagg, Walter, Cox, Neri, Bertoldi, Menten, Strauss, Omont, Fan, Jiang
R0E6	CO emission from the Highest Redshift Radio Loud Quasar Known	Lehnert, Becker, Walter, Lutz, Tacconi, Narayanan
R0E7	Ionized Carbon in High-Redshift QSOs	Bertoldi, Walter, Kurk, Carilli, Wagg, Aravena, Maiolino, Cox, Neri, Omont, Menten, Weiss
R0E9	Constraining the Kinematics of a QSO host galaxy at z=6.4	Walter, Bertoldi, Carilli, Maiolino, Cox, Neri, Menten, Weiss, Riechers
R0EB	Millimetre observations of GRB afterglows in the it Swift era (ToO)	Castro-Tirado, Bremer, Winters, Bhattacharya, Gorosabel, Guziy, De Ugarte Postigo, Jelinek, Kubánek
R--C	Radio contamination in the first SZ-selected cluster	Bertoldi, Basu, Pacaud, Menten, Kneissl, Lee
R--F	1mm commissioning: 267GHz	Piétu
R--G	Understanding the chemical differentiation in IC 342	Rodriguez-Fernandez, Salomé, Downes
R--I	High-resolution CO76 map of the Cloverleaf	Cox
R--J	Ionized Carbon in High-Redshift QSOs	Bertoldi, Walter, Kurk, Carilli, Wag, Aravena, Maiolino, Cox, Neri, Omont, Menten, Weiss
S--1	Tracing disk and jet emission in LkH_233	Boissier, Fuente, Alonso-Albi, Neri
S--2	Confirmation of vibrationally excited CO towards IRC+10216	Menten, Patel, Brünken, Young, Winters
S--3	Submillimter observations of V1647 Ori in outburst	Audard, Carmona, Baldovin-Saavedra, Fontani, Stringfellow, Skinner, Walter, Güdel, Gueth
S--4	Search for changes in the HCO+(2-1) absorption profile in front of PKS 1830-211	Muller, Guélin
S003	On the intriguing behavior of the NH_3/N2H+ ratio	Busquet, Palau, Estalella, Viti
S004	Hot and cold gas-grain chemistry in star-forming regions: formic acid and formaldehyde.	Garrod, Parise, Zapata, Thorwirth, Bisschop, Schilke
S006	Unveiling the collapsing envelope and disk aroundIRAS 22129 peculiar protostar	Goicoechea, Pety, Gerin, Berné, Hennebelle, Joblin
S007	Physical conditions of the shocked gas in L1157-B1	Benedettini, Codella, Gueth, Viti, Beltran, Bachiller, Tafalla
S008	Revealing the nature of the outflow "bullets"	Tafalla, Santiago-García, Bachiller
S00B	Is Methanol Tracing the Precursor of MHD shocks in Cep E ?	Lefloch, Cabrit, Pineau des Forêts, Gueth, Cernicharo, Ceccarelli
S00C	Imaging infall in a high-mass star forming region	Lopez Sepulcre, Cesaroni, Walmsley, Neri
S00D	The link between clump dynamics and high-mass star formation	Bontemps, Csengeri, Motte, Schneider, André, Hennebelle, Gueth
S00E	The possible detection of glycolaldehyde in massive protostars	Beltrán, Cesaroni, Codella, Neri, Viti
S011	IRAS 22198+6336: a precursor of an O-type star?	Sánchez-Monge, Palau, Estalella, Shepherd, Zhang, Di Francesco
S012	Episodic accretion in Very Low Luminosity Objects?	Maret, Lee, Bergin, Lefloch
S013	Searching for cold gas emission in disks around young brown dwarfs	Carmona, Meeus, Pavlyuchenkov, Semenov, Wiebe, Audard
S01A	Chemical study of the disk around the massive star R Mon	Fuente, Alonso-Albi, Bachiller, Neri, Testi, Planesas
S01B	Mapping cold gas in transitional disks	Brown, Dishoeck, Blake, Salyk
S01C	Chemistry in Proto-Planetary Disks (CID): the youngest source CB 26	Launhardt, Gueth, Dutrey, Henning, Guilloteau, Chapillon, Hersant, Pavlyuchenkov, Pety, Piétu, Schreyer, Semenov
S01D	Photoprocesses and grain destruction in protoplanetary disks as traced by C2H	Henning, Dutrey, Chapillon, Semenov, Gueth, Guilloteau, Launhardt, Pavlyuchenkov, Piétu, Schreyer, Wakelam
S021	High-resolution observations of molecular clouds in the outer disk of M33	Braine, Gratier, Bontemps, Brouillet, Jacq, Schuster
S024	High resolution mapping of cooling filaments around NGC 1275	Salomé, Combes, Revaz, Downes, Edge, Fabian, Johnstone
S02A	Formaldehyde and the evolution of dust chemistry in nearby starburst galaxies	Schinnerer, Meier, Petitpas
S031	C, N, O and S isotopic ratios at z=0.68 vs 0.89	Muller, Guélin

Ident.	Title of Investigation	Author
S032	CO emission with exceptional velocity width in 3C 326 N?	Boulanger, Salomé, Ogle, Antonucci, Appleton, Guillard, Langer, Lehnert, Nesvadba, Pineau des Forêts
S033	Molecular gas in H_2 luminous radio galaxies	Boulanger, Ogle, Salomé, Antonucci, Appleton, Guillard, Langer, Lehnert, Nesvadba, Pineau des Forêts
S035	Explaining the origin of distant cluster starburst galaxies	Geach, Smail, Edge, Wardlow, Moran, Treu, Ellis
S038	Low excitation molecular gas in typical massive z~1.5 galaxies?	Dannerbauer, Daddi, Dickinson, Elbaz, Morrison, Stern, Walter
S039	Gas Fractions and Star Forming Histories of Galaxies at z=1-1.5	Genzel, Tacconi, Davis, Cooper, Schreiber, Shapiro, Bolatto, Weiner, Lutz, Gracia-Carpio, Comerford
S03A	Searching for CO in a starbursting ULIRG at z=1.25	Schinnerer, Smolcic, Sargent, Martinez-Sansigre, Carilli, Bertoldi, Kartaltepe, Sanders, Frayer
S03B	Towards a 0.3" matched-beam radio/CO study of SMGs	Tacconi, Chapman, Genzel, Greve, Bertoldi, Neri, Omont, Cox, Smail, Ivison, Biggs, Blain, Casey, Muxlow, Beswick
S03D	Probing the gas properties of star-forming galaxies at high-z through lensing clusters	Swinbank, Coppin, Cox, Edge, Ellis, Neri, Richard, Smail, Stark
S03E	CO Observations of Spitzer Selected z~2 ULIRGs	Fiolet, Yan, Omont, Tacconi, Lutz, Sajina, Steffen, Frayer, Cox, Nesvadba
S03F	Low Excitation of the Dense Molecular Gas in IRAS F10214+4724 at z=2.3	Riechers, Walter, Weiss, Downes, Carilli, Neri, Cox
S040	Molecular gas in a bright lensed LBG/AGN host	Baker, Lutz, Tacconi, Lin, Allam, Genzel, Tucker, Shapley
S044	Delayed Nucleosynthesis in the Early Universe: Toward a Nuclear Chronometer	Henkel, Weiss, Riechers, Downes, Walter
S045	Atomic carbon in high-redshift quasars and starbursts	Kraiberg-Knudsen, Bertoldi, Walter, Cox, Omont, Fiolet, Carilli
S046	Atomic Carbon in High Redshift SMGs	Walter, Weiss, Downes, Henkel
S047	The CO line SED in high redshift SMGs	Weiss, Walter, Downes, Henkel
S048	Molecular Gas Masses and Dynamics in High-z radio Galaxies	Nesvadba, De Breuck, Omont, Lehnert, Walter, Boulanger, Neri, Downes
S050	A CO survey of redshift 4-5 QSOs	Bertoldi, Walter, Carilli, Kraiberg-Knudsen, Riechers, Cox, Omont, Wang, Greve, Weiss
S051	Search for molecular gas in the most distant quasars	Wang, Carilli, Wagg, Walter, Cox, Neri, Bertoldi, Riechers, Menten, Strauss, Omont, Fan
S052	Molecular Gas Excitation in z=5.0-6.4 Quasar Host Galaxies	Riechers, Carilli, Wang, Walter, Neri, Cox, Weiss, Bertoldi, Maiolino
S053	[CII] line emission from HCM 6A: a lensed Lyman-a emitter at z=6.56	Kanekar, Wagg, Carilli, Walter
S054	Millimetre observations of GRB afterglows in the Swift era (ToO)	Castro-Tirado, Bremer, Winters, Bhattacharya, Gorosabel, Guziy, De Ugarte Postigo, Jelinek, Kubánek
S--6	v=2 vibrationally excited CO toward IRC+10216	Menten, Winters
S--7	CO(6-5) in J1623	Bertoldi, Walter, Kurk, Carilli, Vestergaard, Aravena, Maiolino, Cox, Neri, Omont, Menten, Weiss
S--8	V=2 vibrationally excited CO toward Orion BN	Menten, Winters
S05A	The Molecular Bow Shock TMC1-B1 and its Mach Disk	Lefloch, Schuster, Cabrit, Gueth, Ceccarelli, Pineau Des Forets
S05B	The kinematic signature of a high-mass star forming clump	Schneider, Csengeri, Motte, André, Bontemps, Hennebelle, Gueth
S06A	Origin of Water in Low-Mass Protostars	Van Dishoeck, Jorgensen
S076	Millimeter Flaring in the DQ Tau Binary: Probing Magnetospheric Interactions	Salter, Hogerheijde, Blake
S07B	Tracing ionization structure of protoplanetary disks	Semenov, Guilloteau, Henning, Dutrey, Chapillon, Gueth, Hersant, Launhardt, Pavlyuchenkov, Piétu, Schreyer, Wakelam
S07C	CN and HCN in proto-planetary disks: the very low mid-plane temperature	Dutrey, Chapillon, Henning, Semenov, Pavlyuchenkov, Guilloteau, Wakelam, Piétu, Gueth, Schreyer
S080	Search for massive disks in Herbig Ae/Be (HAeBe) stars	Fuente, Alonso-Albi, Bachiller, Neri, Boissier
S097	Is there a warped molecular gas disk in the Seyfert 1 NGC4151?	Dumas, Schinnerer, Mundell, Tacconi
S0A7	Probing the Molecular Gas Properties of Galaxies at Half the Age of the Universe	Schinnerer, Karim, Sargent, Martinez-Sansigre, Martinez-Sansigre, Kaltarpepe, Smolcic
S0AB	Low-excitation galaxy-wide gas reservoirs inside typical high-z galaxies	Daddi, Dannerbauer, Dickinson, Elbaz, Krips, Morrison, Stern, Walter, Carilli, Riechers, Onodera
S0B3	Atomic Carbon in High Redshift SMGs	Walter, Weiss, Downes, Henkel
S0C0	Unveiling a population of massive dust-enshrouded galaxies at z»3	Cirasuolo, Dannerbauer, Ivison, Greve, Dunlop
S0C2	Confirmation of a z=4.042 CO redshift for GN10	Daddi, Dannerbauer, Dickinson, Elbaz, Krips, Morrison, Walter
S0D2	[CII] Emission in Actively Starforming Galaxies at Redshifts ~6.5-7.0	Walter, Carilli, Riechers, Bertoldi, Cox, Neri, Weiss, Wagg, Ouchi, Egami, Iono, Nakanishi
S0D7	Star Forming Histories and Gas Fractions of Galaxies from z=1-3	Genzel, Tacconi, Davis, Bolatto, Bournaud, Burkert, Combes, Cooper, Cox, Schreiber, Garcia-Burillo, Gracia-Carpio, Lutz, Naab, Neri, Omont, Shapiro, Shapley, Sternberg, Weiner
GC068	Global millimeter VLBI array observations of Markarian 501	Giroletti, Giovannini, Perez Torres, Cotton, Chiaberge, Feretti

Ident.	Title of Investigation	Author
GC027C	Structural Variation in the core of BL LAC	Cawthorbe, Sokolov, Marscher, Jorstad, Krichbaum
GK036C	0716+714 – An accelerating and precessing jet?	Krichbaum, Bach, Agudo, Dodson, Bremer
GK037D	Rotating jet from a binary black hole?	Kudryavtseva, Britzen, Krichbaum, Witzel, Zensus, Larionov, Hagen-Thorn

ANNEX II

Publications

The list of refereed publications, conferences and workshop papers as well as thesis based upon data obtained using the IRAM instruments which appeared in 2008 are provided in the following two tables: the first table gives the publications with IRAM staff members as (co)-author (including technical publications by the IRAM staff) and the second table those with results from the user's community.

The running number is the cumulative number since the first annual report was published for the year 1987.

Publications with IRAM staff members as (co-) authors

1254.	FORMATION OF COLD FILAMENTS IN COOLING FLOW CLUSTERS	Y. Revaz, F. Combes, P. Salomé 2008, A&A 477, L33
1255.	SEARCH FOR ANIONS IN MOLECULAR SOURCES: C4H$^-$ DETECTION IN L1527	M. Agúndez, J. Cernicharo, M. Guélin, M. Gerin, M.C. McCarthy, P. Thaddeus, 2008, A&A 478, L19
1256.	RESOLVING THE CIRCUMBINARY DUST DISK SURROUNDING HH30	S. Guilloteau, A. Dutrey, J. Pety, F. Gueth, 2008, A&A 478, L31
1257.	MOLECULAR GAS IN NUclei OF GAlaxies (NUGA), VII. The Seyfert 2 NGC 6574	E. Lindt-Krieg, A. Eckart, R. Neri, M. Krips, J.-U. Pott, S. García-Burillo, F. Combes, 2008, A&A 479, 377
1258.	DETECTION OF CIRCUMSTELLAR CH$_2$CHCN, CH$_2$CN, CH3CCH, AND H$_2$CS	M. Agúndez, J.P. Fonfría, J. Cernicharo, J.R. Pardo, M. Guélin, 2008, A&A 479, 493
1259.	EXTRASOLAR PLANET DETECTION BY BINARY STELLAR ECLIPSE TIMING:. EVIDENCE FOR A THIRD BODY AROUND CM DRACONIS	H.J. Deeg, B. Ocaña, V.P. Kozhevnikov, D. Charbonneau, F.T. O'Donovan, L.R. Doyle, 2008, A&A 480, 563
1260.	CN IN PRESTELLAR CORES	P. Hily-Blant, M. Walmsley, G. Pineau des Forêts, D. Flower, 2008, A&A 480, L5
1261.	DISSIPATIVE STRUCTURES OF DIFFUSE MOLECULAR GAS. III. Small-scale intermittency of intense velocity-shears	P. Hily-Blant, E. Falgarone, J. Pety, 2008, A&A 481, 367
1262.	MOLECULAR GAS IN NUclei OF GAlaxies (NUGA). IX. The decoupled bars and gas inflow in NGC 2782	L.K. Hunt, F. Combes, S. García-Burillo, E. Schinnerer, M. Krips, A.J. Baker, F. Boone, A. Eckart, S. Léon, R. Neri, L.J. Tacconi, 2008, A&A 482, 133
1263.	LONG-TERM OBSERVATIONS OF URANUS AND NEPTUNE AT 90 GHz WITH IRAM 30 M TELESCOPE (1985-2005)	C. Kramer, R. Moreno, A. Greve, 2008, A&A 482, 359
1264.	OBSERVATIONS OF CO IN THE EASTERN FILAMENTS OF NGC 1275	P. Salomé, Y. Revaz, F. Combes, J. Pety, D. Downes, A.C. Edge, A.C. Fabian, 2008, A&A 483, 793
1265.	COLD GAS IN THE PERSEUS CLUSTER CORE: EXCITATION OF MOLECULAR GAS IN FILAMENTS	P. Salomé, F. Combes, Y. Revaz, A.C. Edge, N.A. Hatch, A.C. Fabian, R.M. Johnstone, 2008, A&A 484, 317
1266.	THE HIGH ACTIVITY OF 3C 454.3 IN AUTUMN 2007. Monitoring by the WEBT during the AGILE detection	C.M. Raiteri, C. Thum, H. Wiesemeyer et al., 2008, A&A 485, L17
1267.	THE AMIGA SAMPLE OF ISOLATED GALAXIES. VI. Radio continuum properties of isolated galaxies: a very radio-quiet sample	S. Leon, L. Verdes-Montenegro, J. Sabater, D. Espada, U. Lisenfeld, A. Ballu, J. Sulentic, S. Verley, G. Bergond, E. García, 2008, A&A 485, 475
1268.	THE AMIGA SAMPLE OF ISOLATED GALAXIES, VII. Far-infrared and radio continuum study of nuclear activity	J. Sabater, S. Leon, L. Verdes-Montenegro, U. Lisenfeld, J. Sulentic, S. Verley, 2008, A&A 486, 73
1269.	LIMITS ON CHEMICAL COMPLEXITY IN DIFFUSE CLOUDS : Search for CH3 and HC5N absorption	H.S. Liszt, J. Pety, R. Lucas, 2008, A&A 486, 493
1270.	DUST-DRIVEN WINDS AND MASS LOSS OF C-RICH AGB STARS WITH SUBSOLAR METALLICITIES	A.Wachter, J.M. Winters, K.-P. Schröder, E. Sedlmayer, 2008, A&A 486, 497
1271.	THE STRUCTURE AND CHEMISTRY OF THE MASSIVE SHELL AROUND AFGL 2343: 29SiO AND HCN AS TRACERS OF HIGH-EXCITATION REGIONS	G. Quintana-Lacaci, V. Bujarrabal, A. Castro-Carrizo, 2008, A&A 488, 203
1272.	DISKS AROUND CQ TAURI AND MWC 758: DENSE PDR OR GAS DISPERSAL?	E. Chapillon, S. Guilloteau, A. Dutrey, V. Piétu, 2008, A&A 488, 565
1273.	SEARCH FOR COLD GAS ALONG RADIO LOBES IN THE COOLING CORE GALAXIES MS0735.6+7421 AND M87	P. Salomé, F. Combes, 2008, A&A 489,101

1274.	GAS FLOW MODELS IN THE MILKY WAY EMBEDDED BARS	N.J. Rodriguez-Fernandez, F. Combes, 2008, A&A 489, 115
1275.	IMAGING GALACTIC DIFFUSE GAS : BRIGHT, TURBULENT CO SURROUNDING THE LINE OF SIGHT TO NRAO150	J. Pety, R. Lucas, H.S. Liszt, 2008, A&A 489, 217
1276.	CAVITIES IN INNER DISKS: THE GM AURIGAE CASE	A. Dutrey, S. Guilloteau, V. Piétu, E. Chapillon, F. Gueth, T. Henning, R. Launhardt, Y. Pavlyuchenkov, K. Schreyer, D. Semenov, 2008, A&A 490, L15
1277.	TESTING THE INVERSE-COMPTON CATASTROPHE SCENARIO IN THE INTRA-DAY VARIABLE BLAZAR S50716+71. III. Rapid and correlated flux density variability from radio to sub-mm bands	L. Fuhrmann, H. Ungerechts et al., 2008, A&A 490, 1019
1278.	RAM-PRESSURE STRIPPED MOLECULAR GAS IN THE VIRGO SPIRAL GALAXY NGC 4522	B. Vollmer, J. Braine, C. Pappalardo, P. Hily-Blant, 2008, A&A 491, 455
1279.	HCN(1-0) ENHANCEMENT IN THE BAR OF NGC 2903	S. Leon, S. Jeyakumar, D. Pérez-Ramírez, L. Verdes-Montenegro, S.W. Lee, B. Ocaña Flaquer, 2008, A&A 491, 703
1280.	DRASTIC CHANGES IN THE MOLECULAR ABSORPTION AT REDSHIFT z=0.89 TOWARD THE QUASAR PKS 1830-211	S. Muller, M. Guélin, 2008, A&A 491, 739
1281.	THE CO LINE SED AND ATOMIC CARBON IN IRAS F10214+4724	Y. Ao, A. Weiss, D. Downes, F. Walter, C. Henkel, K.M. Menten, 2008, A&A 491, 747
1282.	A PHOTOMETRIC REDSHIFT z = 1.8+0.4 FOR THE AGILE GRB 080514B	A. Rossi, M. Bremer et al., 2008, A&A 491, L29
1283.	A NEW ACTIVITY PHASE OF THE BLAZAR 3C 454.3 MULTIFREQUENCY OBSERVATIONS BY THE WEBT AND XMM-NEWTON IN 2007-2008	C.M. Raiteri, H. Wiesemeyer et al., 2008, A&A 491, 755
1284.	HI AND CO IN THE CIRCUMSTELLAR ENVIRONMENT OF THE OXYGEN-RICH AGB STAR RX LEPORIS	Y. Libert, T. Le Bertre, E. Gérard, J.M. Winters, 2008, A&A 491, 789
1285.	CHEMISTRY IN DISKS. II. Poor molecular content of the AB Aurigae disk	K. Schreyer, S. Guilloteau, D. Semenov, A. Bacmann, E. Chapillon, A. Dutrey, F. Gueth, T. Henning, F. Hersant, R. Launhardt, J. Pety, V. Piétu, 2008, A&A 491, 821
1286.	SIMULTANEOUS NIR/SUB-MM OBSERVATION OF FLARE EMISSION FROM SAGITTARIOUS A	A. Eckart, M. Krips, K.F. Schuster, C. Thum, H. Wiesemeyer, et al., 2008, A&A 492, 337
1287.	RESULTS OF WEBT, VLBA AND RXTE MONITORING OF 3C279 DURING 2006-2007	V.M. Larionov, H. Ungerechts et al., 2008, A&A 492, 389
1288.	ON THE CHEMISTRY AND DISTRIBUTION OF HOC+ IN M82. More evidence for extensive PDRs	A. Fuente, S. García-Burillo, A. Usero, M. Gerin, R. Neri, A. Faure, J. Le Bourlot, M. González-García, J.R. Rizzo, T. Alonso-Albi, J. Tennyson, 2008, A&A 492, 675
1289.	OBSERVATIONS OF THE GOLDREICH-KYLAFIS EFFECT IN STAR-FORMING REGIONS WITH XPOL AT THE IRAM 30 M TELESCOPE	J. Forbrich, H. Wiesemeyer, C. Thum, A. Belloche, K.M. Menten, 2008, A&A 492, 757
1290.	MASSIVE EXPANDING TORUS AND FAST OUTFLOW IN PLANETARY NEBULA NGC 6302	Dinh-V-Trung, V. Bujarrabal, A. Castro-Carrizo, J. Lim, S. Kwok, 2008, ApJ 673, 934
1291.	A MULTI-TRANSITION HCN AND HCO+ STUDY OF 12 NEARBY ACTIVE GALAXIES: ACTIVE GALACTIC NUCLEUS VERSUS STARBURST ENVIRONMENTS	M. Krips, R. Neri, S. García-Burillo, S. Martín, F. Combes, J. García-Carpio, A. Eckart, 2008, ApJ 677, 262
1292.	LABORATORY AND ASTRONOMICAL DETECTION OF THE NEGATIVE MOLECULAR ION $C3N^-$	P. Thaddeus, C.A. Gottlieb, H. Gupta, S. Brünken, M.C. McCarthy, M. Agúndez, M. Guélin, J. Cernicharo, 2008, ApJ 677, 1132
1293.	TRACING SHOCKS AND PHOTODISSOCIATION IN THE GALACTIC CENTER REGION	S. Martín, M.A. Requena-Torres, J. Martín-Pintado, R. Mauersberger, 2008, ApJ 678, 245
1294.	LARGE EXCESS OF HEAVY NITROGEN IN BOTH HYDROGEN CYANIDE AND CYANOGEN FROM COMET 17P/HOLMES	D. Bockelée-Morvan, N. Biver, E. Jehin, A.L. Cochran, H. Wiesemeyer, J. Manfroid, D. Hutsemékers, C. Arpigny, J. Boissier, W. Cochran, P. Colom, J. Crovisier, N. Milutinovic, R. Moreno, J.X. Prochaska, I. Ramirez, R. Schulz, J.-M. Zucconi, 2008, ApJ 679, L49
1295.	SUBMILLIMETER GALAXIES AT z ~ 2: EVIDENCE FOR MAJOR MERGERS AND CONSTRAINTS ON LIFETIMES, IMF, AND CO-H_2 CONVERSION FACTOR	L.J. Tacconi, R. Genzel, I. Smail, R. Neri, S.C. Chapman, R.J. Ivison A. Blain, P. Cox et al., 2008, ApJ 680, 246
1296.	THE DUSTY DISK AROUND VV SERPENS	T. Alonso-Albi, A. Fuente, R. Bachiller, R. Neri, P. Planesas, L. Testi, 2008, ApJ 680, 1289
1297.	A MOLECULAR EINSTEIN RING AT z = 4.12: IMAGING THE DYNAMICS OF A QUASAR HOST GALAXY THROUGH A COSMIC LENS	D.A. Riechers, F. Walter, B.J. Brewer, C.L. Carilli, G.F. Lewis, F. Bertoldi, P. Cox, 2008, ApJ 686, 851
1298.	THERMAL EMISSION FROM WARM DUST IN THE MOST DISTANT QUASARS	R. Wang, C.L. Carilli, J. Wagg, F. Bertoldi, F. Walter, K.M. Menten, A. Omont, P. Cox, M.A. Strauss, X. Fan, L. Jiang, D.P. Schneider, 2008, ApJ 687, 848
1299.	DETECTION OF $C5N^-$ AND VIBRATIONALLY EXCITED C6H IN IRC +10216	J. Cernicharo, M. Guélin, M. Agúndez, M.C. McCarthy, P. Thaddeus, 2008, ApJ 688, L83
1300.	INTERFEROMETRIC CO OBSERVATIONS OF SUBMILLIMETER-FAINT RADIO-SELECTED STARBURST GALAXIES AT z ~ 2	S.C. Chapman, R. Neri et al., 2008, ApJ 689, 889
1301.	SHARC-II 350 μm OBSERVATIONS OF THERMAL EMISSION FROM WARM DUST IN z > 5 QUASARS	R. Wang, P. Cox et al., 2008, Astron. J., 135, 1201
1302.	A GLOBAL 86 GHz VLBI SURVEY OF COMPACT RADIO SOURCES	Sang-Sung Lee, A.P. Lobanov, T.P. Krichbaum, A. Witzel, A. Zensus, M. Bremer, et al., 2008, Astron. J., 136,159

1303.	TESTING THE EVOLUTIONARY LINK BETWEEN SUBMILLIMETRE GALAXIES AND QUASARS: CO OBSERVATIONS OF QSOs AT z ~ 2	K.E.K. Coppin, R. Neri et al., 2008, Mon. Not. R. Astron. Soc. 389, 45
1304.	XPOL- THE CORRELATION POLARIMETER AT THE IRAM 30-M TELESCOPE	B. Thum, H. Wiesemeyer, G. Paubert, S. Navarro, D. Morris, 2008, Pub. Astron. Soc. Pacific, 120, 777
1305.	UNVEILING THE CHEMISTRY OF HOT PROTOSTELLAR CORES WITH ALMA	M. Guélin, N. Brouillet, J. Cernicharo, F. Combes, A. Wooten, 2008, Astrophys. & Space Sci., 313, 45
1306.	UNDERSTANDING THE CHEMICAL COMPLEXITY IN CIRCUMSTELLAR ENVELOPES OF C-RICH AGB STARS: THE CASE OF IRC +10216	M. Agúndez, J. Cernicharo, J.R. Pardo, J.P. Fonfría Expósito, M. Guélin, E.D. Tenenbaum, L.M. Ziurys, A.J. Apponi, 2008, Astrophys. & Space Sci., 313, 229
1307.	PROBING THE FEEDING AND FEEDBACK OF ACTIVITY NEAR AND FAR	S. García-Burillo, F. Combes, J. Gracía-Carpio, A. Usero, M. Guélin, 2008, Astrophys. & Space Sci., 313, 261
1308.	MOLECULAR GAS IN THE ANDROMEDA GALAXY : PROPERTIES OF THE MOLECULAR CLOUDS	S. Muller, M. Guélin, H. Ungerechts, L. Loinard, R. Lucas, R. Wielebinski, 2008, in Mapping the Galaxy and nearby Galaxies, Astrophys. and Space Sci. Proceedings, Springer Verlag, 200
1309.	BROADBAND OBSERVATIONS OF THE NAKED-EYE GAMMA-RAY BURST GRB 080319B	J.L. Racusin, J.M. Winters et al., 2008, Nature 455, 183
1310.	FLARES FROM A CANDIDATE GALACTIC MAGNETAR SUGGEST A MISSING LINK TO DIM ISOLATED NEUTRON STARS	A.J. Castro-Tirado, M. Bremer, J.M. Winters et al., 2008, Nature 455, 506
1311.	MONITORING VENUS' MESOPHERIC WINDS IN SUPPORT OF VENUS EXPRESS: IRAM 30-M AND APEX OBSERVATIONS	E. Lellouch, G. Paubert, R. Moreno, A. Moullet, 2008, Planetary and Space Science 56, 1355
1312.	UNVEILING THE CHEMISTRY OF HOT PROTOSTELLAR CORES WITH ALMA	M. Guélin, N. Brouillet, J. Cernicharo, F. Combes, A. Wooten, 2008, in Science with the Atacama Large Millimeter Array, eds. R. Bachiller, J. Cernicharo, Springer Verlag, 45
1313.	UNDERSTANDING THE CHEMICAL COMPLEXITY IN CIRCUMSTELLAR ENVELOPES OF C-RICH AGB STARS: THE CASE OF IRC 10216	M. Agúndez, J. Cernicharo, J.R. Pardo, J.P. Fonfría Expósito, M. Guélin, E.D. Tenenbaum,, L.M. Ziurys, A.J. Apponi, 2008, in Science with the Atacama Large Millimeter Array, eds. R. Bachiller, J. Cernicharo, Springer Verlag, 229
1314.	NEW PLATEAU DE BURE OBSERVATIONS OF M1-92; UNVEILING THE CORE	J. Alcolea, V. Bujarrabal, R. Neri, 2008, in Science with the Atacama Large Millimeter Array, eds. R. Bachiller, J. Cernicharo, Springer Verlag, 235
1315.	PROBING THE FEEDING AND FEEDBACK OF ACTIVITY NEAR AND FAR	S. García-Burillo, F. Combes, J. García-Carpio, A. Usero, M. Guélin, 2008, in Science with the Atacama Large Millimeter Array, eds. R. Bachiller, J. Cernicharo, Springer Verlag, 261
1316.	THE GALACTIC CENTER AS NEARBY EXTRAGALACTIC CHEMICAL LABORATORY	S. Martín, M.A. Requena-Torres, J. Martín-Pintado, R. Mauersberger, 2008, in Science with the Atacama Large Millimeter Array, eds. R. Bachiller, J. Cernicharo, Springer Verlag, 303
1317.	STUDYING THE FIRST GALAXIES WITH ALMA	C.L. Carilli, F. Walter, R. Wang, A. Wooten, K. Menten, F. Bertoldi, E. Schinnerer, P. Cox,, A. Beelen, A. Omont, 2008, in Science with the Atacama Large Millimeter Array, eds. R. Bachiller, J. Cernicharo, Springer Verlag, 307
1318.	TWO PROTOTYPICAL GALACTIC PDRS: THE ORION BAR AND THE HORSEHEAD MANE	J. Pety, J.R. Goicoechea, M. Gerin, 2008, in Far-Infrared Workshop 2007, eds. C. Kramer, S. Aalto, R. Simon, EAS Pub. Series, 31, 35
1319.	LARGE-SCALE MOLECULAR SHOCKS IN STARBURST AND ACTIVE GALAXIES	A. Usero, S. García-Burillo, Martín-Pintado, A. Fuente, R. Neri, 2008, in Far-Infrared Workshop 2007, eds. C. Kramer, S. Aalto, R. Simon, EAS Pub. Series, 31, 117
1320.	MECHANICAL MEASUREMENTS OF THE ALMA PROTOTYPE ANTENNAS	A. Greve, J.G. Mangum, 2008, IEEE Trans. Ant. & Prop. Mag., 50, No. 2, p. 66

Publications with results from the users' community

1324.	HIGHLY DEUTERATED PRE-STELLAR CORES IN A HIGH-MASS STAR FORMATION REGION	F. Fontani, P. Caselli, T.L. Bourke, R. Cesaroni, J. Brand, 2008, A&A 477, L45
1325.	DENSE GAS IN LUMINOUS INFRARED GALAXIES	W.A. Baan, C. Henkel, A.F. Loenen, A. Baudry, T. Wiklind, 2008, A&A 477, 747
1326.	CO INVESTIGATION OF z = 0.4-1.5 GALAXIES	A.-L. Melchior, F. Combes, 2008, A&A 477, 775
1327.	EVIDENCE OF ENHANCED STAR FORMATION EFFICIENCY IN LUMINOUS AND ULTRALUMINOUS INFRARED GALAXIES	J. Gracía-Carpio, S. García-Burillo, P. Planesas, A. Fuente, A. Usero, 2008, A&A 479, 703
1328.	DETECTION OF AMINO ACETONITRILE IN SGR B2(N)	A. Belloche, K.M. Menten, C. Comito, H.S.P. Müller, P. Schilke, J. Ott, S. Thorwirth, C. Hieret, 2008, A&A 482, 179
1329.	FIRST DISK-RESOLVED MILLIMETER OBSERVATIONS OF IO'S SURFACE AND SO2 ATMOSPHERE	A. Moullet, E. Lellouch, R. Moreno, M.A. Gurwell, C. Moore, 2008, A&A 482, 279
1330.	TRIGGERED MASSIVE-STAR FORMATION ON THE BORDERS OF GALACTIC HII REGIONS. IV. Star formation at the periphery of Sh2-212	L. Deharveng, B. Lefloch, S. Kurtz, D. Nadeau, M. Pomarès, J. Caplan, A. Zavagno, 2008, A&A 482, 585
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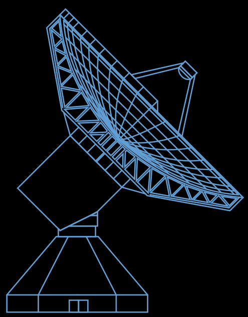
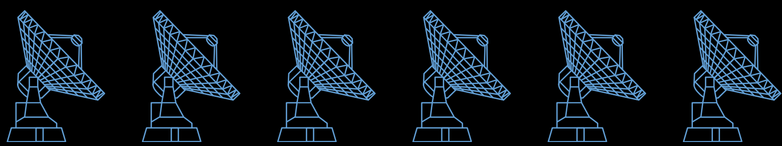


30-meter diameter telescope, Pico Veleta



6 x 15-meter interferometer, Plateau de Bure

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