IRAM Annual Report 2007

iram
Institut de
Radioastronomie
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IRAM Annual Report 2007

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Front Cover
A ring of dust around a young binary system in the nearby Taurus-Auriga star forming region.

The shape of the circumbinary disk is a consequence of a dynamical sculpting by the inner orbital motion of the two stars traced in the dust continuum emission at 265 GHz using the Plateau de Bure interferometer.

(From Pietu et al. 2008)

Contents

Introduction

The year 2007 was another successful year for IRAM, with many achievements and milestones.

Major changes occurred at the Plateau de Bure Interferometer. The New Generation Receivers operating at 2 mm were installed successfully at the end of 2007. The performances of these dual polarization 4 GHz bandwidth receivers are excellent with SBB receiver temperatures of 30 to 40 K over most of the frequency range (covering 129 to 174 GHz). This opens the Plateau de Bure Interferometer to a new frequency window, allowing observations at high spatial resolution in the 2 mm band and opening for the first time the 153 to 174 GHz frequency range for interferometric studies. In addition, the 1 mm receivers were upgraded with new triplers that extend the high frequency range to 267 GHz. The image of the dust continuum of the circumstellar disk around a double star in the Taurus region (shown on the cover of this Annual Report) is a remarkable example of what can be achieved with these upgraded receivers.

To prepare the next upgrades, both for the Plateau de Bure interferometer and the 30-meter telescope, the technical groups at IRAM were very busy during 2007 designing, developing and building new receivers and correlators.

For the Plateau de Bure Interferometer, the next steps will be to equip all the antennas of the interferometer with 350 GHz receivers and install a new broadband correlator (WIDEX); both will be available in 2009. Together with the on-going replacement of the carbon fiber panels with aluminum panels allowing for more robust antennas with better performances, the Plateau de Bure Interferometer will remain the world-leading facility of its kind for the years to come enabling new type of science and survey type observations to be conducted.

The 30-meter telescope is also ready for significant upgrades, which are planned for the end of 2008. New dual polarization 4 GHz bandwidth receivers will be installed that will operate at 3, 2, 1 and 0.8 mm. The installation of these new receivers will provide a significant increase both in sensitivity and observing capabilities that will open a new era for the 30-meter telescope.

The 1.3 mm heterodyne instrument (HERA) at the 30-meter telescope is highly requested by the community producing numerous maps of nearby star-forming regions and nearby galaxies, mainly in the CO(2-1) emission line. The bolometer camera (MAMBO), operating at 1.3 mm, has enabled further studies (mainly in the area of observational cosmology).

IRAM is currently exploring ways to install a new generation bolometer camera at the 30-meter telescope. A first step in this direction was the first successful test observations of the Goddard-IRAM Super-conducting 2-Millimeter Observer (GISMO) in late 2007, a prototype camera that employs a large-format, fast and efficient detector array developed at NASA Goddard Space Flight Center.

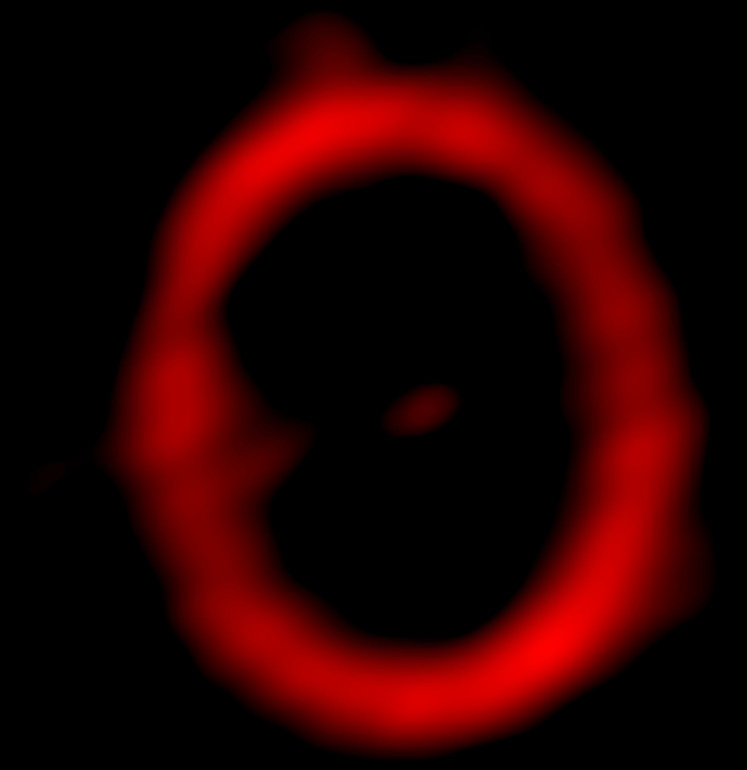
In 2007, there were 157 publications based upon data obtained using the IRAM instruments with about half of them using the Plateau de Bure interferometer. The papers range from solar system studies to star formation processes, astrochemistry to circumstellar disks, evolved starts to pulsars, and detailed observations of nearby galaxies to studies of the physical (and chemical) conditions in galaxies and quasars at the end of the reionization epoch. Highlights are described in the annual report.

In addition to the technical work required to maintain and upgrade the interferometer and the 30-meter telescope, IRAM continued in 2007 to be involved in the technical research, the development and the assembly of new receivers in the frame of the European Framework Programs and for the ALMA project. These external contracts were very beneficial to IRAM. They enabled the exploration of new techniques, fostered synergies and strengthened the management of large projects. In particular, the AMSTAR program has allowed the achievement of remarkable results for an IF 8 GHz sideband-separating mixer operating at 100 GHz providing the technical basis for future receivers.

On December 3rd, 2007, ESO and IRAM signed the Band 7 Cartridge production contract for 48 units. This is an important milestone for the overall ALMA project. During the pre-production contract, IRAM already delivered eight receivers with outstanding performances. The production contract includes the fabrication, assembly, test, and delivery of 48 field-replaceable front-end modules for the ALMA Band 7, covering the frequency range from 275 to 373 GHz. The production team at IRAM, together with the ALMA Front End IPT, will do its best for this ambitious and challenging undertaking. Two further ALMA contracts were signed in 2007: one for the software and one for the back-end digitizer clocks.

Among the events that occurred in 2007, the visit of the President of the Max-Planck-Gesellschaft, Prof. Dr. Peter Gruss, was a particularly notable one. Accompanied by staff from both the MPG and the CNRS, this visit, which occurred on a splendid day in May, enabled us to present and discuss in detail the work that is done at the Plateau de Bure, the recent upgrades, the future plans for development and the successes and problems of this outstanding site.

The visit of the President of the Max-Planck-Gesellschaft, Prof. Dr. Peter Gruss, on the Plateau de Bure on may 30th, 2007. From right to left: S. Zimmermann, M. Zimmermann, D. Bougeard, I. Abram, P. Gruss, R. Genzel, A.-M. Brass, U. Mahr, D. LeQuéau, P. Cox, J.-M. Hameury, K.-F. Schuster.



Highlights of research with the IRAM telescopes in 2007

Among projects at the IRAM telescopes, done or published in 2007, a few highlights were:

High-redshift quasars. The interferometer has detected CO at redshift $z = 5.77$ in the quasar SDSS J0927+20.

Jets from quasar nuclei. VLBI maps show fast rotation in NRAO 150's inner jet.

Interacting galaxies. Sub-arcsecond CO observations of IRAS 10190+1322 show two interacting components separated by 6 kpc.

Circumnuclear disks in ULIRGS: High-resolution CO and dust maps of Arp 220 show a compact, high-brightness source in the West nucleus that is opaque at 1mm.

Central cluster galaxies. Interferometer observations detect CO clumps in the filament system surrounding NGC 1275.

High-Mass star formation in our Galaxy. A bolometer survey of dust in the Cygnus-X region reveals the sites of massive protostars.

Intermediate-mass protostars. The IC1396N proto-star cluster has been mapped at a scale of 250 AU.

Interstellar Chemistry: negative ions. Observations with the 30m telescope of CH_4^- and CH_6^- in IRC+10216 show that carbon-chain anions can be abundant in space.

New Molecules. New detections have been made with the 30m telescope of the molecules phosphaethyne (HCP) in IRC+10216 and Propylene (CH_2CHCH_3) in the dark cloud TMC-1.

Evolved Stars. A new high-resolution interferometer study has been made of the nebula around the post-AGB, binary star 89 Herculis.

Pulsars. The magnetar XTE J1810–197, with a pulse period of 5.54 sec, was observed with the 30m telescope at 88 and 144 GHz, the highest frequency at which a pulsar has been detected. The pulsar is seen *in single pulses*, and is highly polarized at millimetre wavelengths.

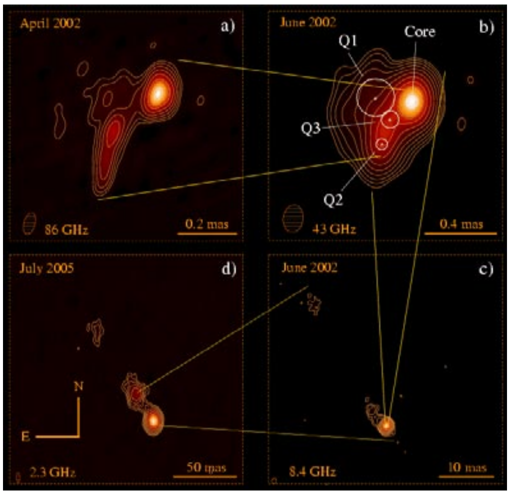
Solar system. An Interferometer study of sulfur-bearing molecules in comet Hale-Bopp gives information on their origin and their photodissociation rates.

HIGH-REDSHIFT QUASARS

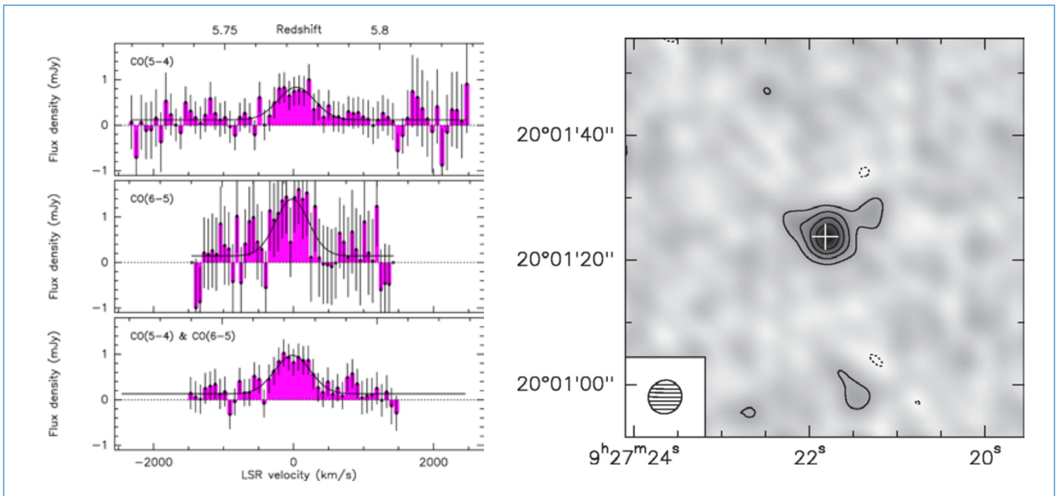
Detection of CO at redshift z = 5.77 in the quasar SDSS J0927+20. The IRAM Interferometer has been used to detect the CO(5-4) and (6-5) lines, redshifted to 84.9 and 102.1 GHz, in the host galaxy of the quasar SDSS J0927+20. The mean peak line flux density is about 0.9 mJy, the linewidth is 610 km/s and the implied molecular gas mass is 1.6 x 10^{10} M_{sun}. The 3mm continuum is also detected, consistent with a 47 K dust spectrum extrapolated from higher frequencies. This source is the second-highest redshift object (after J1148+52 at $z = 6.42$) in which CO has been detected. The observations suggest that the formation of the massive black hole (the quasar), the early massive starburst (from the molecular gas and the creation of dust), and the formation of the stellar host spheroid are all proceeding at the same time, close to the end of the re-ionization of the universe, which probably occurred over the interval $z = 15$ to 5 (Carilli et al. 2007, ApJ, 666, L9).

VLBI OBSERVATIONS OF JETS FROM QUASARS

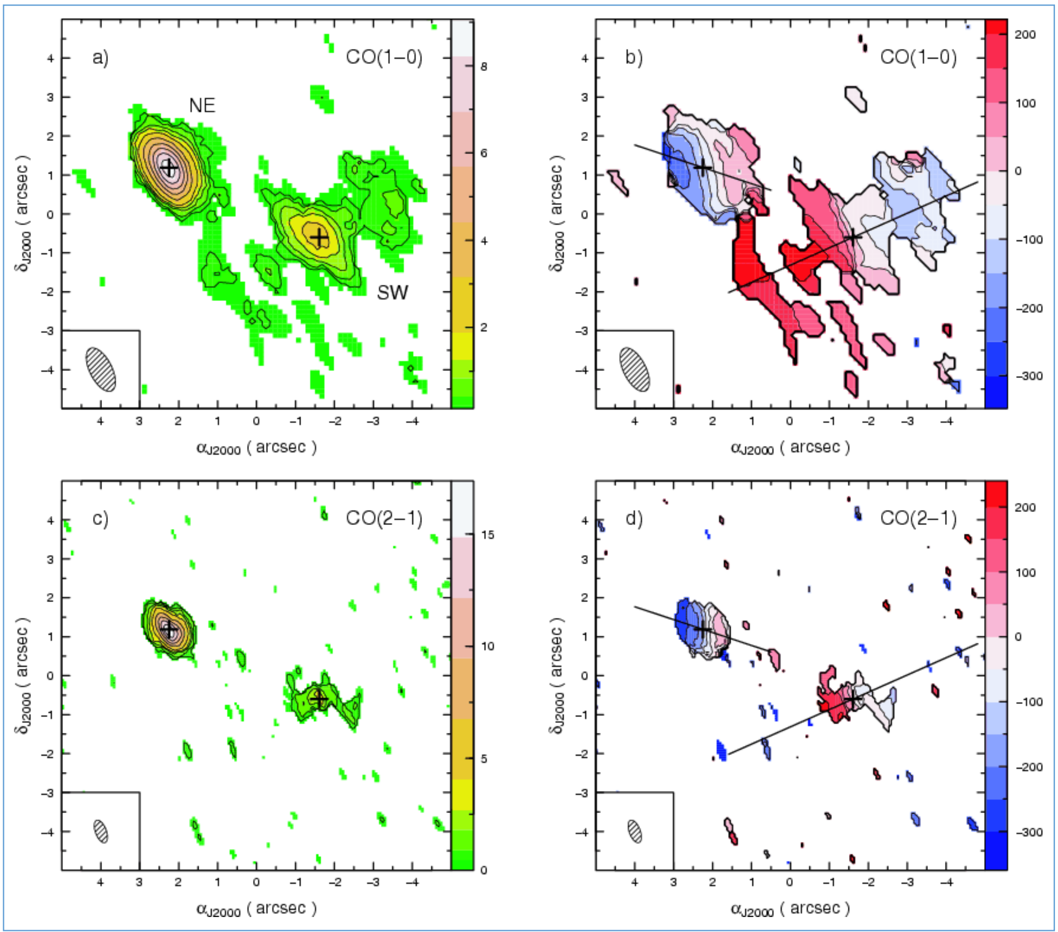
Extremely fast jet rotation in the quasar NRAO 150. Both of the IRAM observatories were used at 86 GHz in VLBI observations during 2001 to 2004 of the quasar NRAO 150 with the Global mm VLBI Array (Pico Veleta, Plateau de Bure, Effelsberg 100m, the NRAO VLBA, the Onsala 20m, and the Metsähovi 14m telescopes). An analysis of these data has now been published and shows several astonishing features: 1) The inner jet extending from 0.5 to 1 milli-arcsec (mas) from the core source is misaligned by > 100° from the "large-scale" (≥ 80 mas) one-sided straight jet seen on lower-frequency maps. 2) This inner jet has an extremely fast rotation on the plane of the sky, of about 10 degrees per year! *3)* The jet appears to move outward from the core at about three times the speed of light. *4)* The transverse (non-radial) speed of clumps in the jet is also superluminal, at about twice the speed of light. *5)* The apparent rotation of the position vector of the clumps by 10° per year is an extreme example of this type of motion, about 10 times faster than the similar motion in 3C345; the apparent superluminal bending of the clump trajectories suggests that magnetic fields may be curving the path of the relativistic outflow. *6)* The core's flux (2.6 Jy), size (0.10 mas), spectral index (–0.5), and X-ray flux lead to estimates of a Lorentz factor of 4 for the bulk relativistic motion, a magnetic field strength of ~1 Gauss in the core, and an inclination to our line of sight of 8°. For this inclination, the deprojected length of the 0.5 mas inner jet would be 31 pc (Agudo et al. 2007, A&A, 476, L17).



VLBI images of NRAO 150 at 86, 43, 8.4 and 2.3 GHz. The 86 GHz image (upper left) was made with the participation of the IRAM telescopes and has a beam (lower left corner) of 0.04 x 0.1 mas. It shows that the innermost jet is nearly perpendicular to the large-scale jet that is shown on the 2.3 GHz map (lower left; beam 2.6 x 7.4 mas). Labels on the 43 GHz map (upper right) indicate the quasar core and various components of the inner jet.



Detection of CO at redshift $z = 5.77$ in the quasar SDSS J0927+20.
Left Panel: Spectra of CO(5-4), (6-5), and their average. The r.m.s. moise in the combined spectrum is 0.3 mJy/beam. *Right Panel:* Image of the velocity-integrated average of the CO(5-4) and (6-5) lines. Contour steps are 0.14 Jy km/s (2 σ) in the 5" beam (lower left). The cross marks the position of the optical quasar.



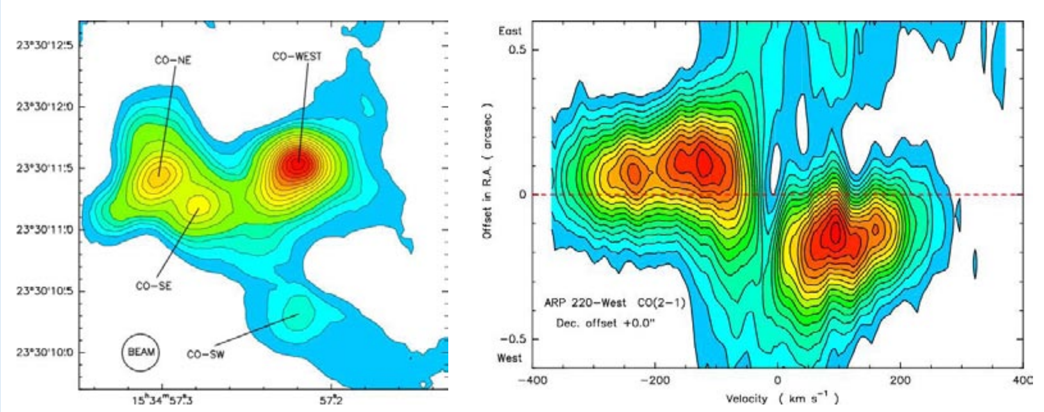
High-resolution CO maps of the ultraluminous infrared galaxy IRAS 10190+1322. The diagrams show integrated intensity (left) and iso-velocity contours (right) in CO(1-0) *(upper panels)* and CO(2-1) *(lower panels)* mapped with the IRAM Interferometer. The beams (lower left corners) are 1.22" x 0.57" for CO(1-0) and 0.61" x 0.28" for CO(2-1). The straight lines in the right panels indicate the direction of the kinematic major axes of the two rotating disks.

INTERACTING GALAXIES

Sub-arcsecond CO observations of IRAS 10190+1322. An interferometer study with the new extended baseline configuration has been made of CO in IRAS 10190+1322 (redshift z = 0.07656, D_L = 340 Mpc, 1" = 1.4 kpc). This object is an ultraluminous infrared galaxy (ULIRG) with an infrared luminosity ≥ 10^{12} L_{sun}, with two interacting components at a projected nuclear separation of 4" (6 kpc). The southwest nucleus is brighter in the optical, but the northeast nucleus is brighter in the near infrared, meaning that it is mainly the NE nucleus that is in the ultraluminous infrared phase. The new data show that the two nuclei have similar CO luminosities, and probably similar gas masses. The CO maps show that their main difference is that the NE circumnuclear disk is more compact (diameter 1.7 kpc), possibly due to the initial configuration of the two-galaxy encounter. The mass of molecular gas in the NE component is estimated to be 10^9 M_{sun}, about 11% of the dynamical mass in the same region, estimated from the measured CO position-velocity diagram. The total infrared luminosity from both objects corresponds to a star formation rate of 200 M_{sun}/year, which implies that all the molecular gas in the NE component, where most of the star formation occurs, will be consumed in 20 million years. This is shorter than the time needed for the coalescence of both disks, or for a second close passage, which is about 50 million years. Because the gas is more extended in the SW disk (diameter 7.4 kpc), it is likely to survive until a future passage, when it will have its own turn to become the centre of ULIRG activity (Graciá-Carpio, Planesas & Colina, 2007, A&A, 468, L67).

CIRCUMNUCLEAR DISKS

Sub-arcsecond maps of CO and dust in the West nucleus of Arp 220. An interferometer study with the longest-baseline configuration has been made of Arp 220 (redshift z = 0.018, D_L = 78 Mpc, 1" = 360 pc). This well-known ultraluminous infrared galaxy (ULIRG) with an infrared luminosity 1.2 x 10^{12} L_{sun}, has two nuclei separated by 1". The new IRAM maps show a compact dust source in the West nucleus, with a size of 0.19" x 0.13", which implies a 1.3 mm brightness temperature of 90 K and a dust opacity of unity near 1 mm. This compact dust core is surrounded by the 0.5" circumnuclear disk of molecular gas, with strong absorption at the centre of the CO(2-1) line. Radiative transfer modelling indicates this is mainly CO self-absorption of the warm inner gas by cooler outer gas. The CO lines



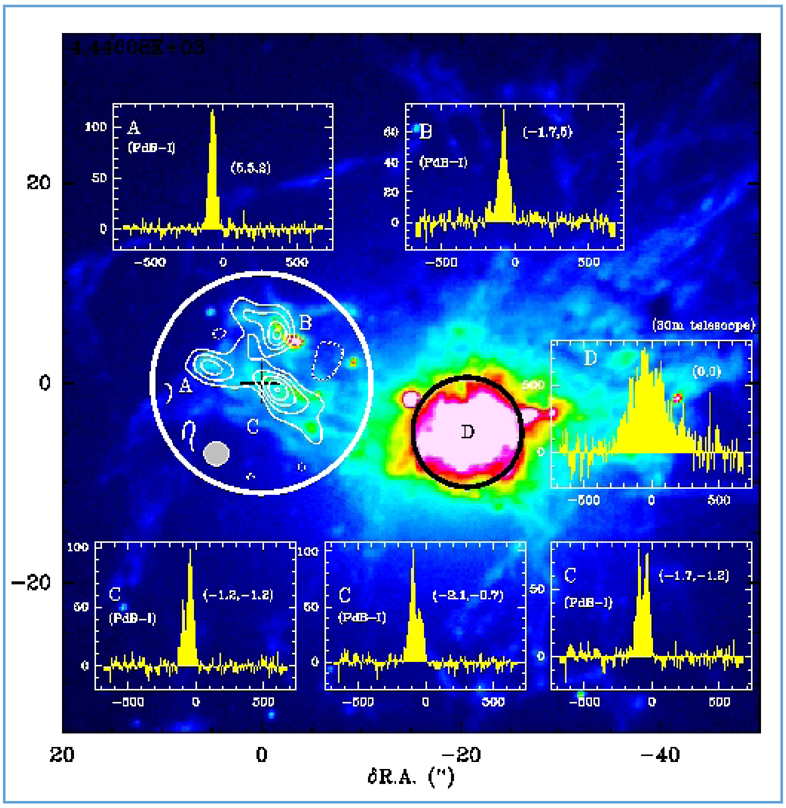
High-resolution CO maps of the nuclear disks of Arp 220. The diagrams show the CO(2-1) integrated intensity (left) and a position-velocity cut (right) east-west, through the West nucleus, as mapped with the IRAM Interferometer. The beam (lower left corner) is 0.30". In this beam, the CO-West peak is 57 Jy km/s. Note the strong CO self-absorption in the position-velocity diagram, over the central part of the line.

show that the molecular disk is rotating around the compact, hot dust core with a velocity of 370 km/s. The measured size of the dust core source corresponds to a radius of 35 pc, and the true dust temperature could be as high as 170 K. This small, high-brightness dust source accounts for up to 75% of the infrared luminosity of Arp 220. Its surface brightness is to $5x10^{14} L_{sun}$ / kpc^2 which suggests that the power source may not be a starburst, but rather a heavily-obscured, black hole accretion disk (Downes & Eckart, 2007, A&A, 468, L57).

CENTRAL CLUSTER GALAXIES

Cold Molecular Gas in the filaments around NGC 1275. Last year's annual report showed results from the 30m telescope that revealed CO in the network of ionised filaments surrounding the central galaxy at the core of the Perseus cluster, NGC 1275, which contains the strong radio source 3C84 (D = 75 Mpc, 1" = 350 pc). Follow-up observations have now been made in 2007 with the IRAM Interferometer of the eastern filaments, at about 8 kpc from the centre of the galaxy. The Interferometer detects the CO(2-1) line over an extent of 15", or a projected length of 5 kpc. The main CO filament is mostly unresolved along its minor axis, in the 2.5" beam, which corresponds to an extent of 700 pc. Along the filaments, there are multiple CO clumps with narrow (30 km/s) line widths. The low apparent brightness temperatures (typically 0.4 K) of these clumps suggest that there are further unresolved structures within the beam that may be associations of giant molecular clouds. It is thought that the optical Hα-line filaments are at the boundaries of expanding bubbles of hot, ionised gas surrounding the relativistic jets emanating from 3C84, the super massive black hole in the core of the giant galaxy NGC 1275. As the hot (ten million-degree) 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 onto the large galaxy where it originated. Evidently, the colder (<100 K) component of this gas is in molecular form, and can be detected in CO lines. The high signal-to-noise ratios of the new observations are due to the new-generation receivers at Plateau de Bure, which allow fine spectral structure to be seen in these very unusual, 0.4 K CO lines at a distance of 75 Mpc (Salomé et al. 2008, A&A, in press).

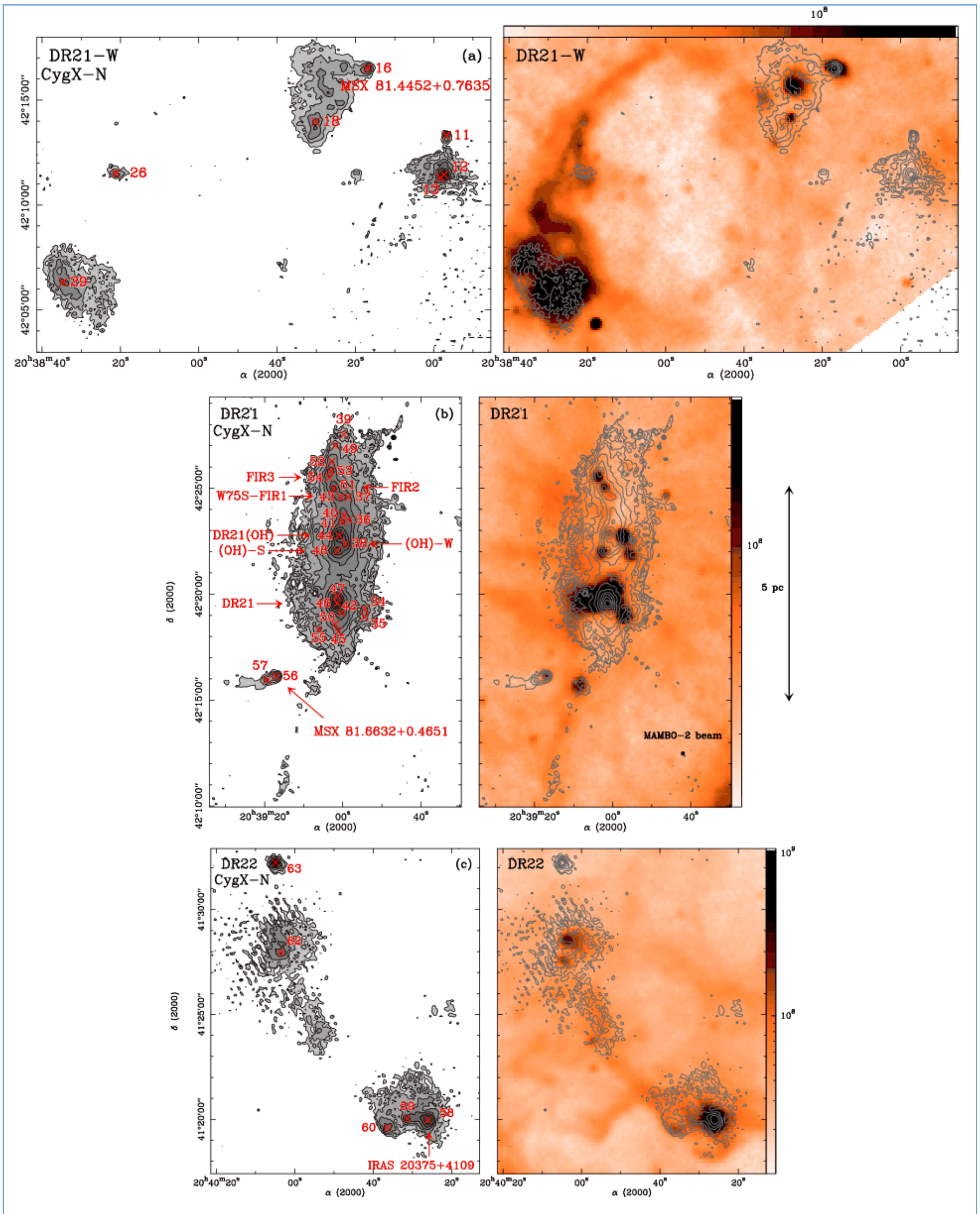
Cold Molecular Gas in the eastern filaments of NGC 1275.
CO(2-1) intensity (white contours) superposed on an Hα image (Conselice et al. 2001) of NGC 1275. The CO is integrated over 175 km/s, and the contour step is 1.6 Jy km/s/beam. The white circle is the interferometer primary beam, and the grey ellipse (lower left of this circle) is the 2.6" synthesized beam for merged interferometer and 30m telescope data. The spectra (insets) are from single pixels in regions A, B, and C on the CO map. The CO(2-1) spectrum of region D is from the 30m telescope only, and shows the much wider and much stronger CO line (intensity scale 10 times greater) from the centre of the galaxy. The black circle around region D is the 11" beam of the 30-meter telescope. The velocity scale on the spectra is relative to a systemic velocity of 5260 km/s.



HIGH-MASS STAR FORMATION IN OUR GALAXY

A millimeter continuum survey of the Cygnus-X region. A new survey of 1.2 mm continuum radiation from dust has been made with the MAMBO 117-pixel bolometer array at the 30m telescope in a 3-square-degree area of the Cygnus-X region (*D* = 1.7 kpc, 1″ = 0.008 pc). This survey reveals the sites of recently formed massive stars, in numerous large-scale (0.7 pc) clumps and in 129 compact (0.1 pc) cores. The figure shows a few examples. The dense cores have masses ranging from 4 to 950 M_{sun}, densities of 10^5 H_2 molecules per cm^3, and are probably the precursors of high-mass stars.

Interestingly, a comparison with maps from the *Midcourse Space Experiment (MSX)* satellite shows that out of 33 dense cores more massive than 40 M_{sun}, i.e., the best candidate precursors of high-mass stars, 17, or about half of them, are not strong sources in the infrared. The ratio of high-mass protostars to observed OB stars in Cygnus X suggests that the lifetime of the high mass protostars is 30,000 years. This agrees with the free-fall time estimated for the dense cores in Cygnus X, and is about ten times shorter than the lifetimes estimated for low-mass protostars, for example, in the rho Ophiucus and Taurus regions (Motte et al. 2007, A&A, 476, 1243).

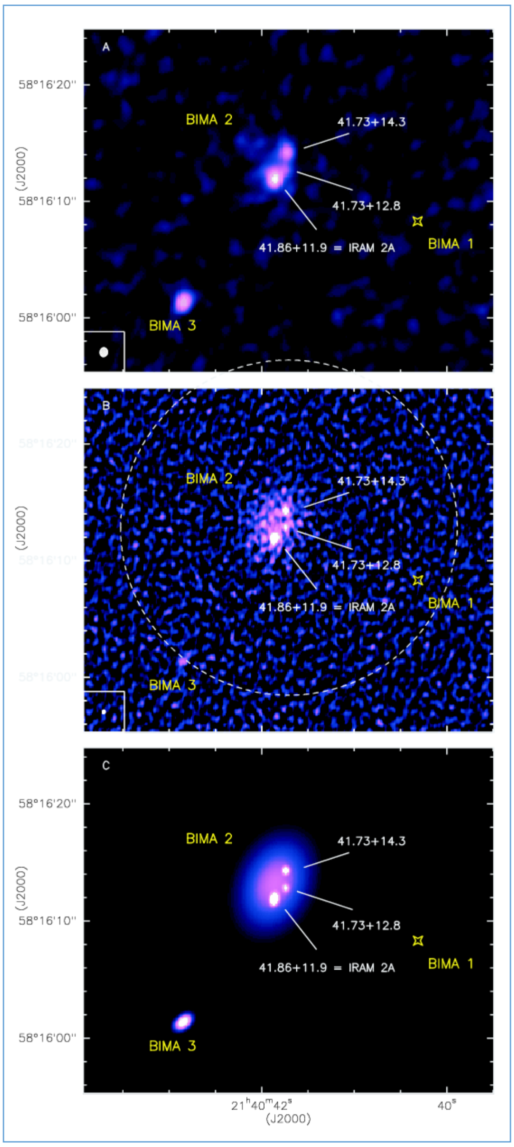


MAMBO maps of sources in the northeast part of Cygnus-X. *Upper Left Panel:* The region west of the radio source DR21. *Middle Left Panel:* The region around the sources DR21 and DR21-OH. *Lower Left Panel:* The region around the source DR22. In all three diagrams, the 1.2mm continuum contours are logarithmic and run from 40 to 800 mJy/beam in (a) and (c) and from 40 to 4800 mJy/beam in (b). The beam of the MAMBO observations is 11″. The right panels show the 1.2mm contours superposed on the near-infrared 8-micron images from the *MSX* satellite, with a beam of 20″. The numbers indicate compact clouds on the MAMBO images.

INTERMEDIATE-MASS PROTOSTARS IN OUR GALAXY

The IC1396N proto-star cluster at a scale of 250 AU. The IRAM Interferometer has been used in its most extended configuration to observe the 3 and 1.3 mm continuum and the molecule methyl cyanide (CH_3CN) in the intermediate-mass protostar IC1396N (D = 750 pc, 1″=750 AU).

The 1.3 mm observations have a beam of 0.45″ x 0.37″ (340 x 280 AU). The continuum data reveal the existence of a cluster of molecular-cloud cores that are likely to be the precursors of low and intermediate mass stars. The spectral indices of the compact cores ranges from 1.4 to 1.9, suggesting that the millimeter continuum may be a mixture of free-free and dust emissions. The main core in the 1.3 mm continuum has a size of 300 x 150 AU, and may be a disk surrounding the protostellar source of the molecular outflows previously observed in this source by Beltrán et al. (2002). The methyl cyanide emission is slightly more extended than the associated continuum, and may be coming from a region heated by the molecular outflow (Neri et al. 2007, A&A, 468, L33).

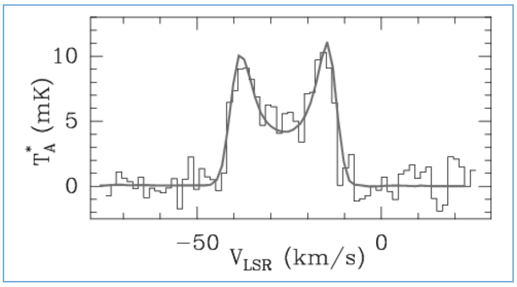


Interferometer continuum maps of the proto-star cluster IC1396N.
Maps of the continuum emission obtained with the Plateau de Bure Interferometer at 3.3 mm with a beam of 1.2″ x 1.0″ (*Upper Panel*) with a rms noise of 0.12 mJy (0.02 K) and at 1.3 mm (*Middle Pane*) with a beam of 0.45″ x 0.37″ and a rms noise of 0.43 mJy (0.06 K). The dashed circle in the middle diagram shows the primary beam of the 15-meter antennas at 1.3mm. *Lower Panel*: The model of the emission, including an extended dust cocoon in which three compact cores are embedded, plus a fourth compact source (BIMA 3) to the southeast.

INTERSTELLAR CHEMISTRY: NEGATIVE IONS

Astronomical detection of the second interstellar anion C_4H^-. Following the recent detection of the negative ion C_6H^- in the laboratory and in space by McCarthy et al. (2006), the first detection in space has been made of the negative ion C_4H^- with the 30-meter telescope. Five lines were detected in the envelope of the carbon star IRC+10216, from the J=9-8, 11-10, 12-11, 14-13, and 15-14 rotational transitions of C_4H^-. The lines have the well-known cusped shape characteristic of the outer part of the envelope of IRC+10216, indicating that this ion is formed in the same region as its neutral counterpart, C_4H. The detection confirms earlier theoretical predictions that carbon-chain anions can be abundant in space (Cernicharo et al. 2007, A&A, 467, L37). Follow-up observations have succeeded in detecting the 9-8 and 10-9 lines of C_4H^- in the low-mass star-forming cloud L1527, confirming a previous tentative detection in this source (Agúndez et al. 2008, A&A, 478, L19).

Further observations of the negative ion C_6H^- in IRC+10216. After the identification of the negative ion C_6H^- in the laboratory and in space by McCarthy et al. (2006), a new detection has been made with the 30-meter telescope by Kasai et al. in the circumstellar envelope of IRC+10216, and analysed in combination with previous data below 50 GHz, taken with the Nobeyama 45m telescope by Kawaguchi et al. (1995). The combined data from the IRAM and Nobeyama telescopes yield a column density of this ion of about 7x10^{12} cm^{-2} and an excitation temperature of 32 K (for an assumed source size of 30″). The abundance of C_6H^- was estimated to be 8.6% of the neutral counterpart C_6H (Kasai et al. 2007, ApJ, 661, L61).



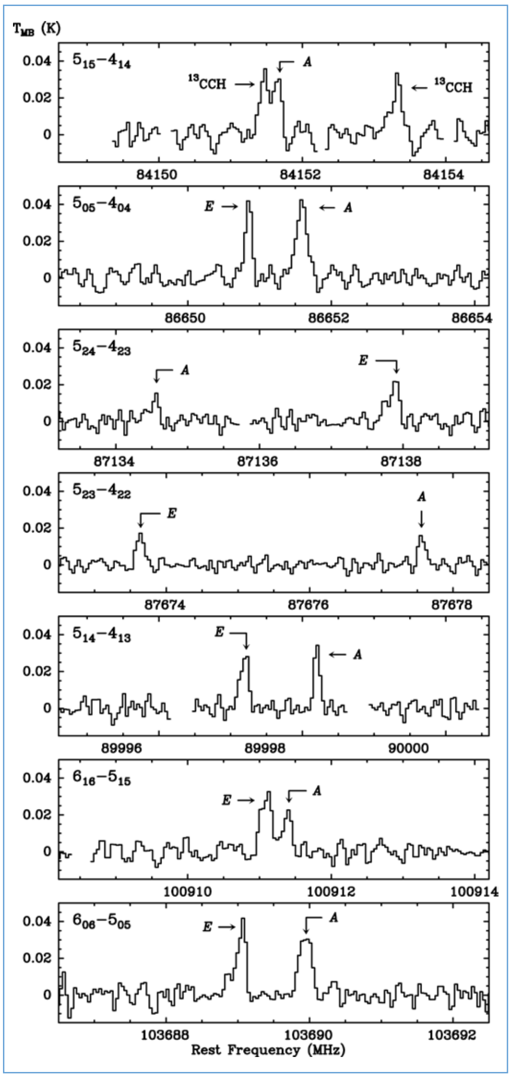
Detection of the second interstellar anion C_4H^- in IRC+10216.
Average spectrum of the J=9-8, 11-10, 12-11, 14-13, and 15-14 lines of C_4H^- (shown as an histogram, after subtraction of lines of other molecules blended with those of C_4H^-). For comparison, the thick continuous line shows the average of the same lines of the neutral counterpart C_4H, scaled down by a factor of 100.

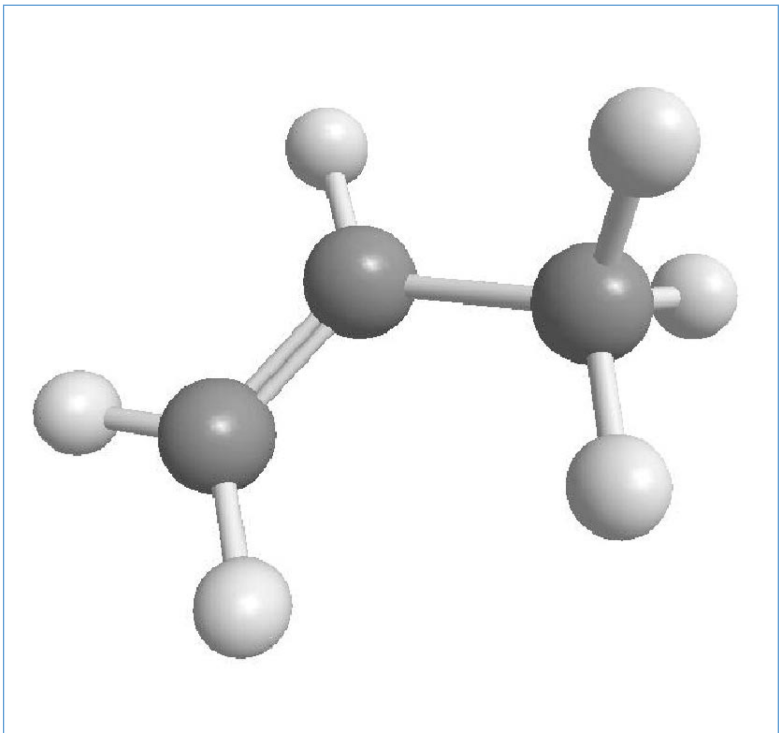
NEW MOLECULES: PHOSPHAETHYNE, PROPYLENE, AMINO ACETONITRILE.

Phosphaethyne (HCP) in IRC+10216. The 30-meter telescope was used to make the first detection in space of phosphaethyne, the phosphorus analog of HCN. Four rotational lines of HCP were detected in IRC+10216. HCP is the third phosphorus-bearing molecule identified in space, after the molecules PN and CP. The data indicate that HCP takes up 3% of the phosphorus present in the expanding circumstellar envelope, with the remainder probably being condensed out on dust grains (Agúndez et al. 2007, ApJ, 662, L91).

Interstellar Propylene (CH_2CHCH_3) in the dark cloud TMC-1. The molecule propylene (also called propene) has been discovered in space with the 30-meter telescope. This molecule is the most saturated hydrocarbon ever detected in space by radioastronomy. Despite the weak molecular dipole moment, 7 lines stronger than 20 mK have been detected. The derived column density of propylene is $4x10^{13}$ cm^{-2}, and its abundance relative to H_2 is $4x10^{-9}$, comparable with that of other hydrocarbons in the dark cloud TMC-1. This isomer of C_3H_6 has been ignored in previous chemical models of dark clouds because there seems to be no obvious way to form it in the gas phase. This discovery, however, indicates that it could play an important role in interstellar chemistry (Marcelino et al. 2007, ApJ, 665, L127).

Amino Acetonitrile (NH_2CH_2CN) in Sgr B2 (N). Surveys with the 30-meter telescope at 3, 2 and 1.3 mm have revealed 51 line features of the molecule amino acetonitrile toward the source Sgr B2(N), near the Galactic Center. Nine of these were mapped with the IRAM and ATCA Interferometers, which measured a source size of 2". This molecule may be a chemical precursor of the simplest amino acid, glycine (Belloche et al. 2008, A&A, 482, 179).

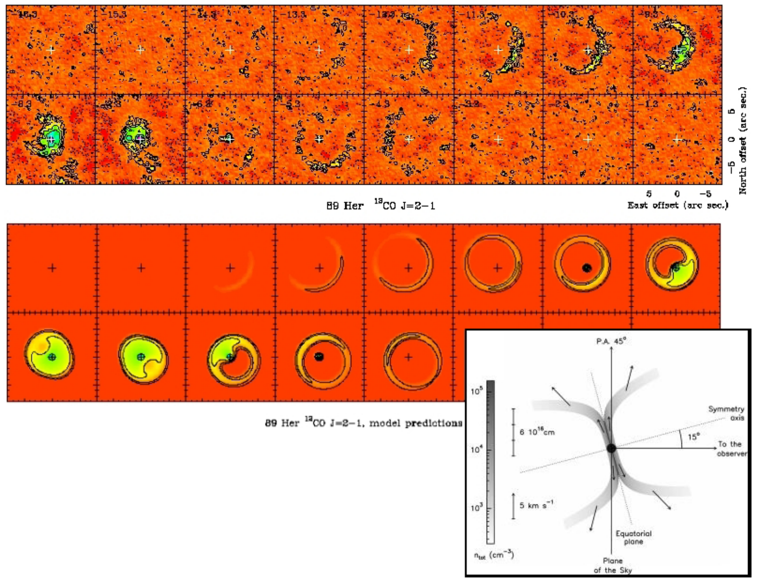




Detection of interstellar propylene with the 30m telescope.
Right Panel: Lines of the *A* and *E* species of CH_2CHCH_3 observed in the Taurus dark cloud TMC-1. The scale is main-beam brightness temperature. *Bottom Panel:* Model showing the molecular structure of propylene. Dark grey spheres are carbon, light grey spheres are hydrogen (Marcelino et al. 2007, ApJ, 665, L127).

EVOLVED STARS

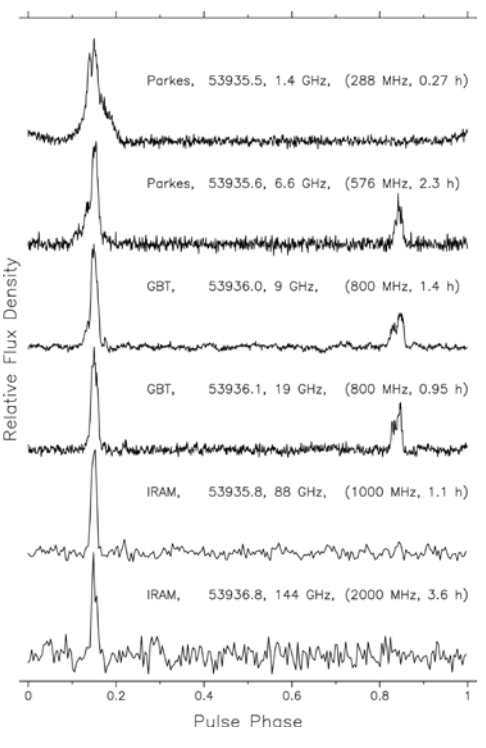
The proto-planetary nebula around the post-AGB, binary star 89 Herculis. The star 89 Herculis (D=1 kpc, 1″= 970 AU) is a well known evolved star that has left the Asymptotic Giant Branch (AGB) phase of its evolution, and is now surrounded by a (proto-) planetary nebula that may contain an inner, rotating disk. Such disks may explain the ejection of collimated energetic jets that are often observed from post-AGB stars. Up to now, a high-resolution study of the rotation of such a disk has been made for only one post-AGB object (the Red Rectangle). The new maps of 89 Herculis obtained with the Plateau de Bure Interferometer show two CO components: (1) an extended hourglass-like bipolar outflow at a velocity of 7 km/s, and (2) an unresolved compact component, smaller than 0.4″ (< 390 AU), with a total velocity range of 5 km/s. This velocity dispersion can hardly be due to expansion, because this would imply an ejection of mass too sudden and too recent to be compatible with other observations. If the compact CO component is a rotating disk, then its size and temperature are consistent with values estimated from near-infrared observations at 12 microns made with the Very Large Telescope Interferometer (VLTI) (Bujarrabal, Neri, Castro-Carrizo, et al. 2007, A&A, in 468, L45).



Interferometer maps of CO in the hourglass-like nebula around the post-AGB binary star 89 Herculis.
Upper Panels: Channel velocity maps in CO(2-1) obtained using the Plateau de Bure Interferometer with a beam of 0.64″ - the labels in the upper left corners indicate the velocities in km/s. The crosses mark the position of the star 89 Herculis. The extended arcs trace the edges of an hourglass-like structure. The compact structure seen in the channels corresponding to the systemic velocity may be a disk around the star. *Lower Panels*: Model predictions of the CO(2-1) emission in 89 Herculis based on the geometry, density, and velocities shown in the sketch. The black circle represents the unresolved compact component.

PULSARS

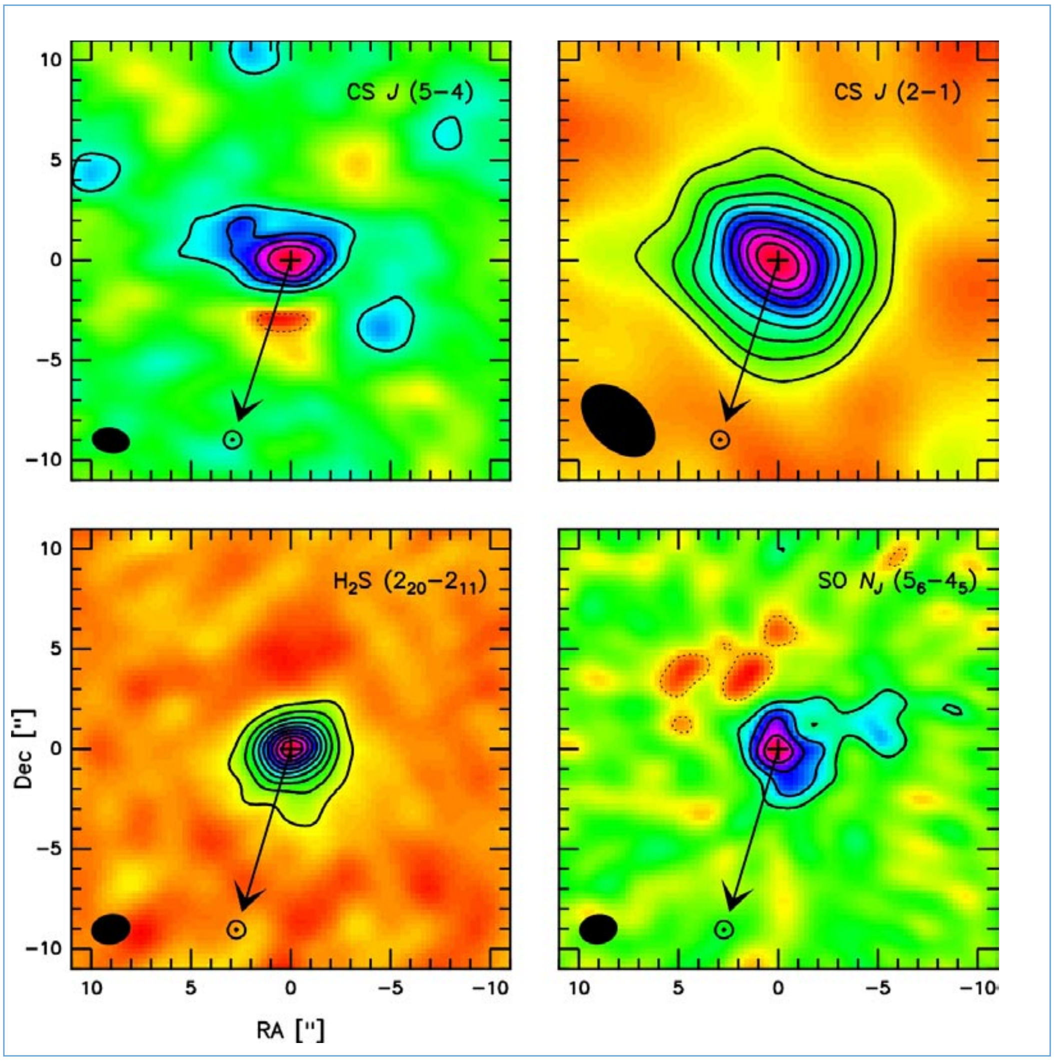
Strong pulses at millimetre wavelengths from a magnetar. Anomalous X-ray Pulsars are neutron stars with long spin periods and ultra-strong magnetic fields at their surface. The decay of these extremely strong magnetic fields is responsible for their X-ray emission. Such neutron stars are called *magnetars,* and about a dozen such objects have been identified. The magnetar XTE J1810-197, with a pulse period of 5.54 sec, was first detected in 2003, when its X-ray flux increased by a factor of about 100. It is the only magnetar known to emit radio waves, which are in phase with the X-ray pulses. Unlike ordinary radio pulsars, however, this object has a flat radio spectrum over most of the radio range, although the spectral index may vary from 0.0 to -1.0, with time. This source has now been observed with the IRAM 30m telescope at 88 and at 144 GHz, the highest frequency at which a pulsar has ever been detected. The flux density in July 2006 was so high that numerous individual pulses were detected at 88 GHz, with the largest pulses peaking at an astonishing flux density of 45 Jy! As at longer wavelengths, this pulsar is highly polarized at millimetre wavelengths. The millimetre flux varies by a factor of a few, due to interstellar scintillation, but much less than it does at longer wavelengths, so the transition between the strong and weak scattering regimes appears to be at about 50 GHz (Camilo, Peñalver, Karastergiou, Thum, et al. 2007, ApJ, 669, 561).



Strong pulses from a magnetar.
Average pulse profiles of the magnetar XTE J1810-197 at frequencies from 1.4 to 144 GHz with the Parkes, Green Bank, and IRAM-30m telescopes. The labels give the telescope, Julian day, centre frequency, bandwidth, and integration time. The main pulse appears near phase 0.15, and a precursor pulse appears at phase 0.85 at frequencies near 1 GHz. The pulse widths observed at IRAM are only 1.3% of the pulse period, and the peak fluxes at 88 and 144 GHz are about 1 Jy.

SOLAR SYSTEM

Interferometer study of sulfur-bearing molecules in comet Hale-Bopp. An analysis has been made of the H_2S, SO, and CS lines observed with the IRAM Interferometer during the 1997 approach of comet Hale-Bopp. The interferometer maps provide information on the spatial extent and velocity distribution of these molecules, and constrain their photodissociation rate and their origin in the coma or the comet's nucleus. The line spectra taken with the Interferometer show evidence for a day-night asymmetry in the outgassing. The interferometer maps of SO and CS show a jet-like structure that may be the gaseous counterpart of the dust jet seen in optical images. A second, rotating, jet is also observed in CS. On the molecule maps, the exact position of the comet's nucleus can be well localized, thanks to the interferometer maps of its thermal radio continuum, which were obtained simultaneously with the molecule observations. Thanks to the comparisons of the radio continuum with the molecules, one may draw the following conclusions: H_2S molecule: The radial extent of H_2S is consistent with direct release of this molecule from the nucleus. SO molecule: The SO has an extended distribution, radially outward from the nucleus. If SO is produced by photodissociation of sulfur dioxide, SO_2, then its production rate at 1 AU from the Sun would be 1.5×10^{-4}/sec. This is lower than most estimates based on laboratory data, and suggests that there may be other ways to produce SO than SO_2 photolysis. CS molecule: The CS is probably produced by photodissociation of CS_2. For CS, the interferometer beam radius, at the 1 AU distance of the comet, corresponded to 750 km in the CS(5-4) line at 245 GHz, and 2000 km in the CS(2-1) line at 98 GHz. Comparison of the fluxes of these two lines as a function of their observed extents indicates a CS photodissociation rate of 1-5 x 10^{-4}/sec (Boissier et al. 2007, A&A, 475, 1131).



Interferometer maps of sulfur-bearing molecules in Comet Hale-Bopp. *Upper Left Panel:* CS 5-4 (245 GHz) in a 4 km/s band. The line peak flux is 5 Jy km/s, and the observed line peak brightness temperature, T_b, is 12 K in a 2″ x 1″ beam. *Upper Right Panel:* CS 2-1 (98 GHz) in a 4 km/s band. The peak flux is 1.5 Jy km/s, and the peak T_b = 4 K in a 4″ x 3″ beam. *Lower Left Panel:* H_2S $2_{20} - 2_{21}$ (217 GHz) in 3 km/s. The peak flux is 3.5 Jy km/s, and the peak T_b = 11 K in a 2″ x 1.5″ beam. *Lower Right Panel:* SO $5_6 - 4_5$ (220 GHz) in 3 km/s. Peak flux = 0.4 Jy km/s, peak T_b = 1 K in a 2″ x 1.5″ beam. In each panel, the ellipse at lower left is the synthesized beam, and the arrow shows the direction to the Sun.

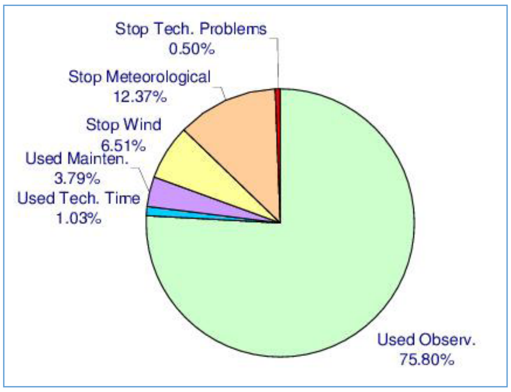
Pico Veleta observatory

TELESCOPE OPERATION

As a result of the excellent weather conditions and a smooth operation of the antenna and the control system, about 75% of the total time could be used for astronomical observations. The distribution of the telescope time lost and used for observations and technical work along the year is displayed in the graph. As in previous years, a large fraction of the projects participating in the two observing pools, concentrating on the MAMBO bolometers and the HERA multibeam receivers could be completed.

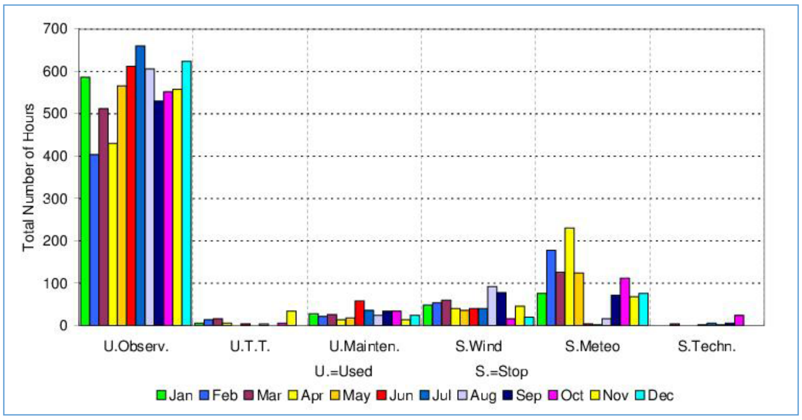
The improved instrumentation and the increased observing efficiencies due to the pools is reflected in a steady increase of the publication rate resulting from observations with the 30-meter telescope. In 2007, the number of refereed publications resulting from 30-meter observations reached an historic maximum of 78.

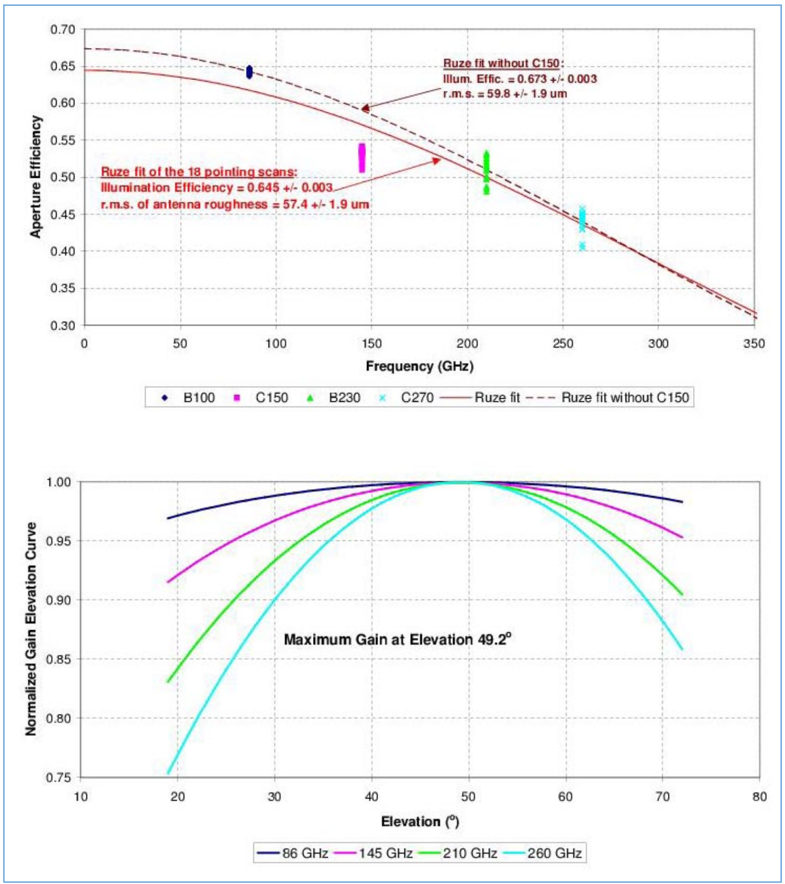
Remote observing with the 30-meter telescope is now also possible for experienced observers from the OAN Madrid, besides the existing remote stations at IRAM Granada, the Grenoble Office, and the Max-Planck-Institute for Radioastronomy (Bonn). Remote observing with the NCS is based on the concept and implementation of 'Virtual Network Computing'. This makes using remote observing easier than in the old control system. Monitoring of observation is provided in the Granada entry and the observatory's dining room.



Time distribution at the IRAM 30-meter telescope in 2007

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





(Upper Panel) Aperture Efficiency of the 30-meter telescope (Lower Panel) Gain elevation curve of the 30-meter telescope extracted from the antenna rms. Both sets of data were obtained on August 31st, 2007 in the elevation range 30 to 60º.

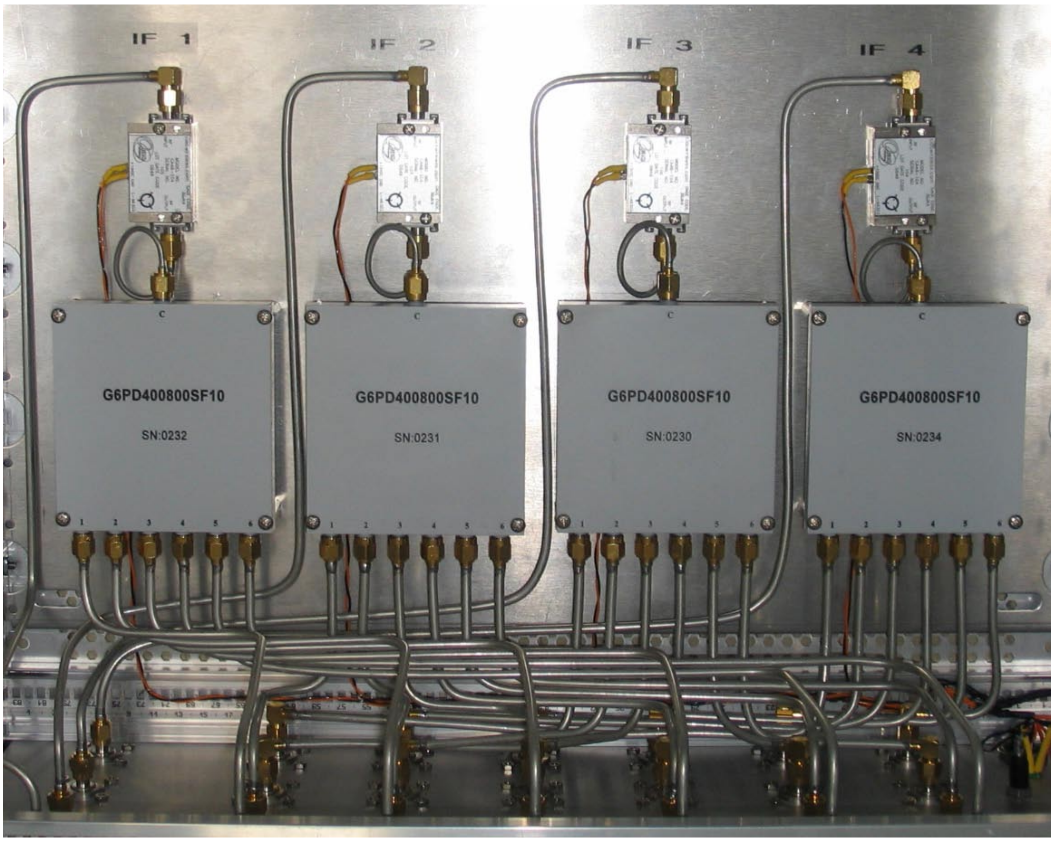
ANTENNA AND ELECTRONICS

As in previous years the main effort of the group members was the support of the day-to-day operation of the observatory, i.e. the periodical maintenance of the systems and equipments, problem solving and the repair of broken equipment.

The computer-backend room has been equipped with an automatic system for fire extinction. The lifting platform to access the antenna prime focus has been revised. The Spanish company Predycsa has performed vibration measurements of the antenna gearboxes. Conclusions are that one of the six gearboxes has an excess of vibration and must be corrected (in progress). Acceleration measurements of the antenna to identify the eigen frequencies were performed too. Observations with the custom design backend for pulsar detection continued during the beginning of the year.

Antenna efficiency measurements were performed, together with the gain elevation curve indicating a total r.m.s. of 60 microns.

Improvements of the wobbler control at the mechanical level (adjustment of the anti-back slash springs) and modifying the control algorithm too have been carried out to improve its performance



A (4-8) GHz Distribution Box, which makes copies of the 4 IF's and distributes them to the six Backend outputs, leaving two of them free for future spectrometer. This box is finished and ready to be used.

in fast wobbling switching observations as with the bolometer.

Temperature sensors have been installed in the servo room steel walls to identify temperature gradients, which might affect the antenna pointing.

Activities to accompany the work on the New Control System (NCS) included, among others, the characterization of the antenna friction compensation, and an increase of the rotation range of the subreflector to +/- 65 degrees. The antenna servo loop implemented in the NCS was compared with respect to the results from the old system. The antenna vibrations were studied as a function of different acceleration parameters and the threshold for switching speeds. An accompanying measure was the measurement of vibrations in the bolometer platform.

After more than 20 years, the 100kHz filter bank has been decommissioned.

Work on backend processors for the new IF's (4-8) GHz required for new generation receivers was one priority in the electronics area:

- The processor for Vespa, 1MHz filter bank, VLBI and Continuum detectors has been finished and tested.
- The processor for the 4MHz filter banks consists of two chains of 4x1GHz covering each one the 4 GHz of the new IF bandwidth. The two set of banks can be connected to any of the 4 IF inputs.
- Development of the processor for the WILMA Correlator allowing processing four bands of four GHz each is nearing completion.

RECEIVERS

The main activities of the receiver group during the year were mostly oriented toward the installation of the future New Generation Pico Veleta Receiver. The construction of a four-channel wideband IF system, including the necessary equalization of the coaxial cables, was started together with a new version of the continuum detectors. The design of an IF selector unit with sixteen input ports was also designed. This unit offers sufficient flexibility to enable the selection of the planed receiver combinations to be sent to the current four IF coaxial outputs. In the case of the double sideband B mixers, with up to four IF outputs per band, an extension to eight outputs has been also considered.

The Goddard-IRAM Super-conducting 2-Millimeter Observer (GISMO) bolometer was successfully installed and tested by the receiver and computer group during the beginning of the winter 2006/2007. A second test period is already scheduled foreseen.

An improved version of the existing tau-meter receiver has been initiated. Work for ALMA project, although mostly finished, still required time for measurements and test of window materials.

COMPUTERS AND SOFTWARE

Work on the New Control System continued with the aim to improve the reliability of many subsystems, additional error checks at all levels, and more warnings and alarms with explanations during the execution of observations. The most visible improvement guarantees the execution of the complete requested time and position range by a modified implementation of the start of track and on-the-fly sub-scans. Other revisions include the handling of interrupts in the real-time systems running Linux, and of the Wobbler switching throw. Special features for tests, bolometer pools, or VLBI sessions are now protected by user privileges. Examples are the option to limit the acceleration during position changes, and an override of the limits on frequency ranges. Preparations continue for new observing modes like on-the-fly antenna tips and flexible sequences of sub-scans. Information about the NCS, including the user manual, is on the www; wiki pages with up-to-date news and notes about the NCS are available to visitors at the observatory.

The main computers at the observatory were modified and reorganized. The main servers mrt-lx1 (used for antenna control) and mrt-lx3 (used for offline data analysis) are now equipped with the same ARECA SATA II Raid controller. The mrt-lx2 system is configured identically to serve as a hardware replacement in case of a failure of mrt-lx1 or mrt-lx3. There are also hardware backup solutions for other computers used for the telescope control. Spare equipment is also available for network devices and the telescope group maintains spare VME controllers. In 2007, a server with a ppc processor replaced the boot and file server for the VME systems. The server disk is mirrored by software RAID and a second server is available as a hardware backup.

For the communication between the observatory, Granada office, and the Internet link at the University of Granada, there are three radio links. New network switches were installed that allow an automatic configuration change, based on the spanning-tree technology, in case of a failure of one of the links. Limited access is also possible via ADSL.

MAINTENANCE AND SAFETY

After 20 years, the entire telescope tower has been repainted. A new control desk in the control room has been partially installed, and also the remote observing station in Granada has been equipped with new furniture.

A sensor of the oxygen level has been installed in the receiver cabin with the goal to identify hazardous situations in case of possible helium leaks.

MISCELLANEOUS

25 years ago, in 1982 IRAM started its activities with a small group in Granada to plan and construct Pico Veleta observatory. From the personnel hired at that time, Gloria España, Gregorio Galvez, José García and Francisco Urbano are still working at our institute. From the international staff at IRAM Spain, Walter Brunswig and Miguel Muñoz have been working at IRAM for 25 years or longer.

Nuria Marcelino successfully defended her PhD work on 'Chemistry in dark clouds' at the University of Granada. Her thesis work was conducted at Pico Veleta observatory making use of the VESPA correlator in order to obtain unbiased 3mm surveys of several dark clouds. She left IRAM in March 2007. Rebeca Aladro (since June 2007) and Denise Riquelme (since October 2007) started their PhD thesis work at IRAM Granada. Since Feb. 1st 2007, Ignacio Ruiz Peralta is working in the antenna group and telescope operation.

The fourth IRAM Observing School in Granada, which was held between September 28th and October 5th 2007 in Pradollano broke an IRAM internal record in national diversity: The 45 participants of this event came from 21 different nationalities. This shows the increasing awareness of the community in the millimeter radioastronomy, which is due to the scientific capabilities of present instruments but also future observatories such as ALMA. The students of the school participated in a series of lectures on millimeter astronomy and its synergy with FIR astronomy, in tutorials and in observing small projects with the 30-m telescope. Highlight talks about the HERSCHEL observatory and ALMA were presented by Jesús Martín-Pintado from the IEM/CSIC (Madrid) and by Alison Peck, ALMA deputy project scientist, who had been a student at the first Observing School in Spain in 2001. The IRAM Computer group provided computer and Internet access.

Participants and lecturers of the fourth IRAM Observing School in Granada.

Plateau de Bure observatory

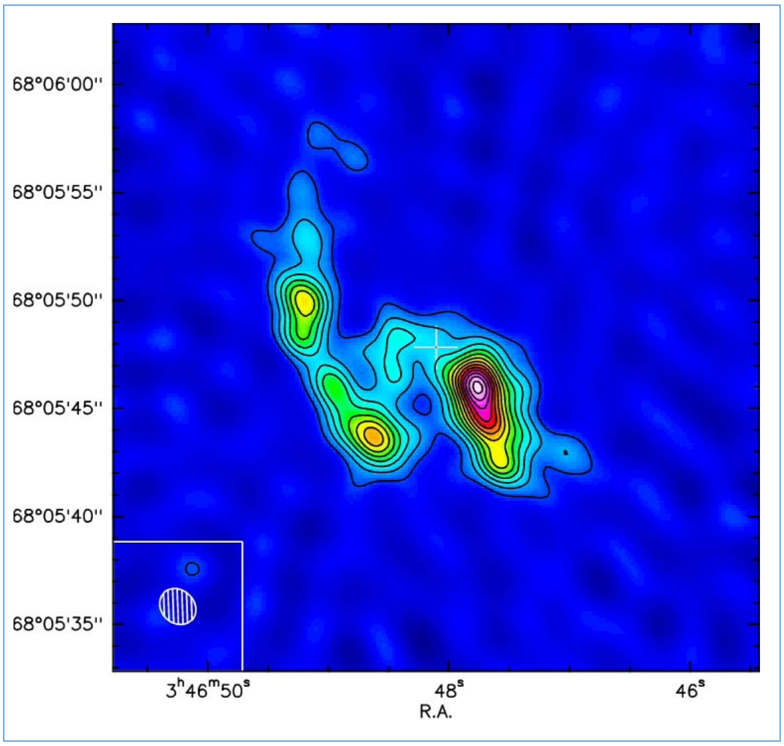
Several important events have marked the Plateau de Bure Observatory in 2007: first observations in the extended baseline configurations of the interferometer with the sensitivity of the newly installed receivers, first light in two new frequency ranges 129 - 174 GHz (Band 2) and 250 – 267 GHz (Band 3), and a major refurbishment of the computer infrastructure at the Observatory.

The beginning of 2007 was marked by the Plateau de Bure Interferometer's move to the most extended baselines configuration. Thanks to good weather conditions and a careful preparation of the tracks, the change to the new configuration was accomplished on January 28, 2007. As of March 17, 85 A-configuration tracks, corresponding to 37 astronomical projects were observed with unprecedented sensitivity and successfully completed.

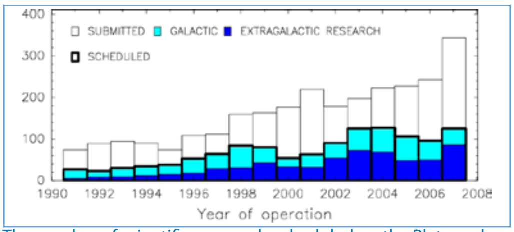
Another milestone was reached at the end of 2007 with the successful installation of the Band 2 (129 – 174 GHz) new generation receivers. To undertake preparatory work, the receiver of antenna 3 was already equipped with a Band 2 input in July. The successful outcome of a comprehensive series of tests led to the decision to equip a second antenna with Band 2 and finally to the detection of fringes on Sep 13. By Dec 13 all six receivers were equipped with Band 2, and by Dec 15, stable fringes were observed with the six-element array towards the high mass star forming region W3(OH). First images from the commissioning and science verification phase of Band 2 revealed the power of the new instrument and allowed us to identify areas where work had to be done to improve operational reliability. By opening Band 2 to astronomical research, the interferometer provides for the first time the opportunity to observe with high spatial resolution in the 153 – 174 GHz frequency window, and this with excellent sensitivity, as apparent from the noise performance of Band 2.

By the end of 2007, another highlight was fast approaching: the extension of Band 3 to the high frequency range (250 – 267 GHz). On January 7^{th}, 2008, the Plateau de Bure interferometer detected first fringes at 267 GHz on the circum-binary ring in the well-known T Tauri star GG Tau (see front cover of the Annual Report). The excellent performance of Band 3 and the extended frequency coverage result from two major modifications: an improved noise performance of the IF amplifier circuitry and the transition to a new generation of frequency multipliers in the LO system. The enhanced capabilities of Band 3 are particularly gratifying as they are likely to trigger a flood of exciting observations, e.g. in the line transitions of HCO^+(3-2) and HCN(3-2), in the Milky Way and in nearby galaxies.

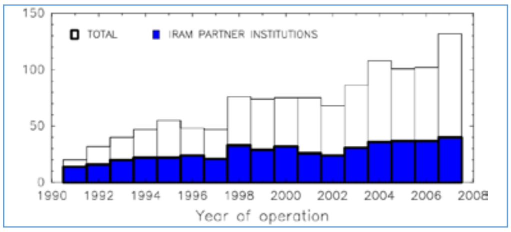
In 2007, work was also underway to reach the next two milestones: (1) complete the construction of WideX, a broadband correlator with 4 GHz frequency coverage in each polarization and a channel spacing of 2 MHz and (2) equip the cryostats with Band 4 for operations in the 277 - 371 GHz band. Both projects are progressing well, and we are confident to complete them in 2009.



PdBI first light observations in the continuum at 145 GHz (Band 2) towards the center of IC342. The map at 2mm shows the free-free radiation from ionized gas and dust emission in the mini-spiral at the center of this galaxy. Located at 1.8 Mpc, IC342 is a nearby galaxy of the northern sky and can be studied in great detail with an instrument such as the PdBI. The inset at the lower left shows the synthesized beam (~1.7″).



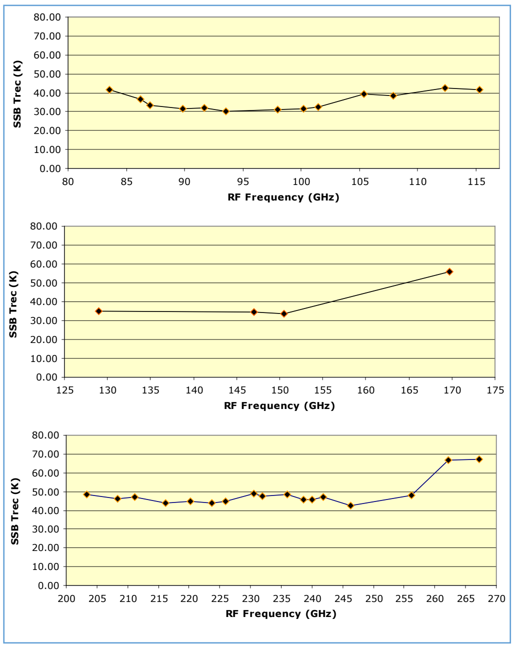
The number of scientific proposals scheduled on the Plateau de Bure Interferometer from May 1990 to May 2007. The average pressure factor was 2.7 in 2007 (2.4 in 2006).



The number of institutions represented annually by users having submitted a proposal for observations with the Plateau de Bure Interferometer.

OBSERVATIONS

The Plateau de Bure Interferometer performed according to expectations in 2007 with almost no downtime due to equipment failure during the scheduled observations. The instruments were used throughout the year without significant problems, but regular observations had to be (1) stopped from Nov 20 to Nov 25, 2007 because of the new computer system: work was necessary to adapt the data acquisition and data reduction software to the requirements of the new operating systems and to make the move to the new computer system, and (2) suspended for several days at the end of 2007 and at the beginning of 2008 to complete the technical commissioning and science verification of Band 2 and the extended Band 3. The winter 2006/2007 weather conditions have been good at the Plateau de Bure with almost no snow and with long periods of excellent phase stability and low atmospheric opacity, but the overall conditions were not as good as in 2006. More specifically, the weather conditions on the site were moderate to good from January to April, relatively good from spring to fall, and fairly good to excellent from September to the end of December. The percentage of telescope time invested on regular observing programs was on average 45% of the total time (up to 60% in April).



Median noise performance for the 12 mixers (six antennas, dual polarization) of Band 1 (*Upper Panel*), the recently installed 2mm band (*Middle Panel*) – data of January and February 2008 - and Band3 (*Lower Panel*). The on-telescope receiver noise data (diamonds) are plotted as function of frequency.

Additional 20 to 25 percent were spent on receiver tuning, surface adjustments, antenna reconfiguration, VLBI observations and finally on the commissioning and science verification of Band 2 and Band 3; the remaining 30 to 35% were lost because of poor weather conditions.

The strong pressure for getting observing time at Plateau de Bure has resulted in the scheduling of many excellent programs. More than 200 different projects, including 16 proposals for Director's Discretionary Time, which correspond to more than 120 accepted programs, were scheduled at the Observatory in 2007, with strong weights on young stellar objects science and extragalactic research, and with a steadily progressing pressure on high redshift galaxies. Annex I details all the proposals for which time was granted in the course of the year, and largely testifies to the high scientific return of the Plateau de Bure Interferometer.

Despite our limited ability to carry out configuration changes in winter conditions, we have successfully scheduled all four (ABCD) configurations of the interferometer in 2007. As in previous years, the scheduling of the A and B configurations was readjusted shortly after the beginning of the winter 2006/2007 period to optimize the observing of A-rated projects with respect to Sun avoidance limitations and weather constraints. A large amount of observing time was invested in the D configuration between spring and fall in the detection of line emission of carbon monoxide and other molecules in high-redshift galaxies.

ANTENNA SURFACE IMPROVEMENTS

The loss of surface reflectivity revealed on antennas 1, 2 and 4, initially in the fall of 2004, and on antenna 6, in 2006 is a problem of growing concern. To avoid further panel degradation, it was decided to refurbish the remaining Hostaflon panels with a reflective layer of silver paint and to protect them with white cover paint. Since October 2006, antennas 1, 2, 6 were entirely painted, antenna 4 has 168 painted panels and 18 electroformed Nickel technology panels developed by the Italian company MediaLario. The loss of reflectivity in the silver panels of antenna 6 (painted in 2001), which were estimated to ~10% at 230 GHz in 2006, remained the same in 2007; no losses of reflectivity were detected on antennas 1, 2 and 4.

Owing to the installation and commissioning of the new generation receivers, the surface of the six antennas could not be readjusted in 2006, but the readjustments were done in the maintenance period of 2007. A sensitive surface adjustment by means of holographic measurements was made that yielded surface accuracies (weighted by illumination) of 44 microns for antenna 5 and 62 microns for antenna 6. The surface accuracy of the inner four rings is about 10 to 20 microns better. In connection with the plans to improve the surface efficiency of the antennas for operation at frequencies above 300 GHz (Band 4), the long-term stability of the surface adjustments made in 2004 on antenna 5 were evaluated again. The new results confirm that the surface quality remains relatively stable over periods of 3 years, and that antenna efficiencies of 30 Jy/K can be achieved at a frequency of 300 GHz.

OPERATOR WORKSHOP

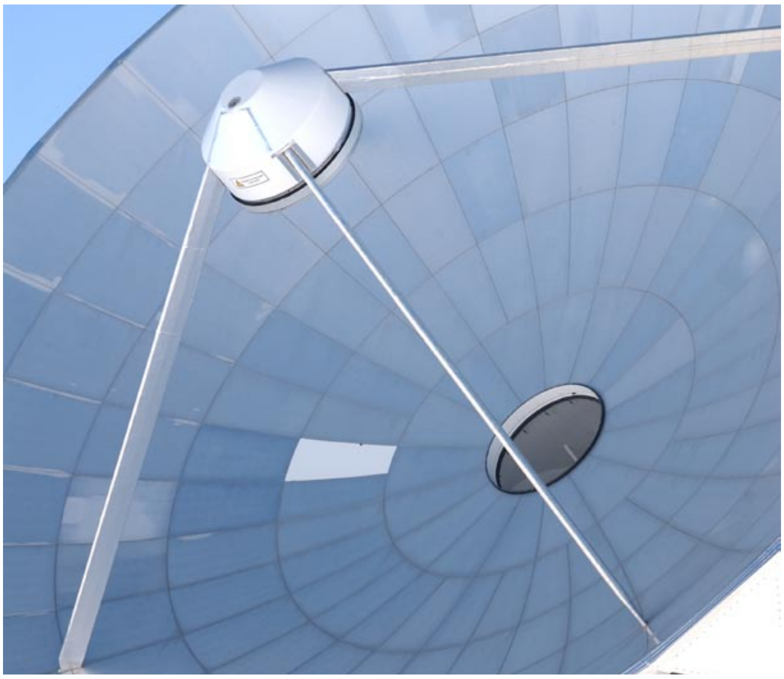
The Plateau de Bure Science Operations Group (SOG) organized a half-day workshop for the operators and technicians, on October 16, 2007. The aim of the workshop was to share practical and technical insights among the participants by means of presentations on the pointing of the Plateau de Bure antennas.

DATA ARCHIVE

As in previous years, in a continuing effort with the Centre des 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. The archive contains 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 September 2006. To preserve the confidentiality of some pieces of 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 was observed.

FACE-TO-FACE SUPPORT

The Plateau de Bure Science Operations Group is staffed with astronomers that regularly act as



The snow cats PB300 (left) and PB600 (right) that are used to clear the snow from the interferometer tracks.

astronomers on duty to optimise the scientific return of the instrument, directly on the site or remotely from Grenoble. Their role is to 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. They also interact with the scientific software development group for developments related to the long-term future of the interferometer. Four astronomers were appointed to the group in 2007, but only three astronomers were available from July to September.

The year 2007 saw 41 investigators (~50% more than in 2006) from Europe and overseas visiting IRAM Grenoble and spending a total of 211 days to reduce data from the Plateau de Bure Interferometer, and 4 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 through the European FP6 Program. For the year 2007, the Program Committee recommended 14 eligible proposals (as in 2006) for observations with the Plateau de Bure Interferometer. Access time was allocated to 13 eligible proposals corresponding to a total of 326 hours of observing time; 64 hours will be scheduled for early 2008. Since the beginning of RadioNet, access time was allocated to 47 eligible proposals (12 in 2004, 11 in 2005, 11 in 2006) for observations with the Plateau de Bure Interferometer, corresponding to a total of ~1100 hours (272 in 2004, 239 in 2005, 272 in 2006) of observing time. Time was allocated to eligible investigators from United Kingdom (percentage of total time is 53%), Italy (41%), the Netherlands (4%), Portugal (1%) and Sweden (1%) with a balanced distribution between PhD students and post-doctoral researchers (32%) and senior scientists (68%).

COMPUTERS

In connection with the plans to equip all six antennas with the same computers as for the receiver control, work was started in 2006 to replace the VME racks for the control of the azimuth and elevation drives with VMIVME boards running a diskless, real-time Linux operating system. This work was completed in summer 2007.

Coupled to the development of the WIDEX 4 GHz correlator (2009) and so to the need to handle an increased volume of data, work was also done to increase the bandwidth communication, expand the data storage capacity and renew the existing computer facilities. The move to the new computer infrastructure was successfully completed on November 25, 2007.

VLBI OBSERVATIONS

Plateau de Bure achieved first VLBI light with the new receivers, the new LO system, and the Swiss EFOS-38 maser. This required a number of changes in the preparation of the observations, system software, the observing itself, and data reduction scripts. A series of short tests in early 2007 indicated a phase stability problem. The cause of this problem was a partly broken cable in the 5 MHz master frequency distribution, which was subsequently repaired. But it remained uncertain if the main cause of the instability had been identified, so that a fringe test at the beginning of the Global May session was included. Due to a technical problem at the MPIfR correlator the test data reduction was delayed, so that after the initial 19 hours of observations, it was decided to switch back to local projects to avoid a possible loss of observing time.

Finally, the MPIfR bypassed the technical problems by conducting the fringe search on the supercomputer software correlator in Swinbourne (Australia). Confirmation of the full dual polarization, six antenna phased array VLBI capability of the new Bure system was received in time to step back into the Global session. Compared with the old system, an improvement in S/N of a factor 4 has been achieved. In the end, however, only 3.5 out of 9 projects had been observed. The 30-m telescope observed successfully for nearly 100% of the time.

In the Global VLBI October session, the Plateau de Bure Interferometer participated successfully under good conditions for nearly 100% of the time (7 projects). The 30-meter telescope observed too, but due to a technical problem, no useful fringes were recorded. Extensive data rescue efforts by MPIfR were not successful. Tests are foreseen before the next Global session to confirm that the problem has been understood and corrected.

With the VLBI recording upgrade to Mark5A in 2004, the Mark4B tape recorder on Plateau de Bure had become obsolete. As the machine was still in perfect working condition and one of the fastest tape recorders ever built, we donated it to the Deutsche Museum in Munich, Germany, where it has joined the exposition on telecommunication.

THE 22GHZ RADIOMETRIC PHASE-CORRECTION SYSTEM

Work in 2007 led to an improvement in the overall Water Vapour Radiometric (WVR) calibration. Gain corrections are determined with improved precision and provide good (i.e. better than 0.2 mm zenith precipitable water) consistency in the water vapor measurements of different antennas. This is one crucial step towards implementing an absolute phase correction. The development of a web-based monitoring of the system performance enables a closer supervision of the phase correction and a better reporting of technical problems to allow timely interventions. The calculation of the triple-channel derived water vapor content shows that the radiometers provide an excellent suppression of cloud emission. Interference from a geostationary satellite beacon was noticed in the low-frequency WVR channel, but the occurrence of this perturbation was found in less than 0.5% of the observing data. A new algorithm was implemented that automatically deactivates the radiometric phase correction when interferences and other disturbances are detected.

MAINTENANCE

The maintenance of the interferometer was carried out from May to October. During this period, each antenna of the array was brought into the maintenance building for three weeks for a detailed overhaul. In particular, the deicing controllers for the antennas were successfully refurbished and the wirings of the panels' heaters rearranged to guarantee a better balance between the voltage phases. In order to improve the pointing performance of the antennas, the mechanical parts of the subreflector (bearings and actuators) were inspected and some of the malfunctioning parts replaced.

Following a routine inspection of the interferometer tracks, it appeared that some rails had moved significantly, threatening to disrupt the movement of the antennas during configuration changes. A subsequent control showed that a relatively large number of the fasteners that keep the tracks tighten had loosened over time. An overall inspection of all the tracks (except for the recent extensions) was done, during which each screws was tested individually. During this operation, the alignment of the tracks was also reviewed. Finally, 80% of the bolts had to be tightened, and additional wedges had to be added on the track of the hall to compensate for the collapse of certain parts of the ground. The next step is to bury again the bolts to protect them from possible shocks.

Other maintenance activities involved a complete upgrade of the electrical systems on the Plateau de Bure to remain compliant with the new standards. In addition, the doors and windows of the Observatory are or will be renovated as the harsh winter conditions have impacted them heavily.

The new doors and windows have an improved thermal and acoustic insulation, which will help the energy savings and provide a greater comfort

The EFOS-38 hydrogen maser in its temperature controlled rack, which also houses the Racal Dana frequency generator. The rack improves the stability of the internal regulation of the maser, which is monitored over 42 of its vital operating parameters. This allows to optimize the maser performance, and to fully exploit the capacities of this frequency standard, which was designed to allow VLBI observations up to 350 GHz.

to the personnel working on the Plateau. Finally, a new snow cat (Pisten Bully PB600, Kässbohrer) was bought at the end of 2007, replacing the old and now unreliable PB320 machine. The new and powerful machine will be particularly helpful to the snow of the outer tracks when changing into the extended configuration during the winter.

In order to install new experiments lead by the laboratory L2MP (Marseille), the old building of the Petit Observatoire Millimétrique (POM2), which wasn't used since many years, was entirely restructured. The dome and the small, unused antenna were dismounted. They were replaced by an octagonal watertight structure that will soon accommodate an atmospheric neutron detector. The building will offer new lab and office space to perform experiments on Single Event Effect testing on electronic components.

The dismounting of the dome of POM2 on the Plateau de Bure

Grenoble headquarters

SIS GROUP ACTIVITIES

The IRAM SIS group had a very busy year with numerous important projects done in parallel under a tight schedule. A major effort went into the improvement of the fabrication of multiple junction circuits for the IRAM large bandwidth 100 GHz 2SB mixer design. Alternative designs for SSB mixers at 150 GHz and supplementary devices for the 230 GHz band were also produced.

The fabrication of a large number of SIS junctions for the ALMA Band-7 project has been prepared following an in-depth yield analysis. Within the ALMA Band-7 cartridge contract it is foreseen to produce 28 substrates to specifications within the next 3 years.

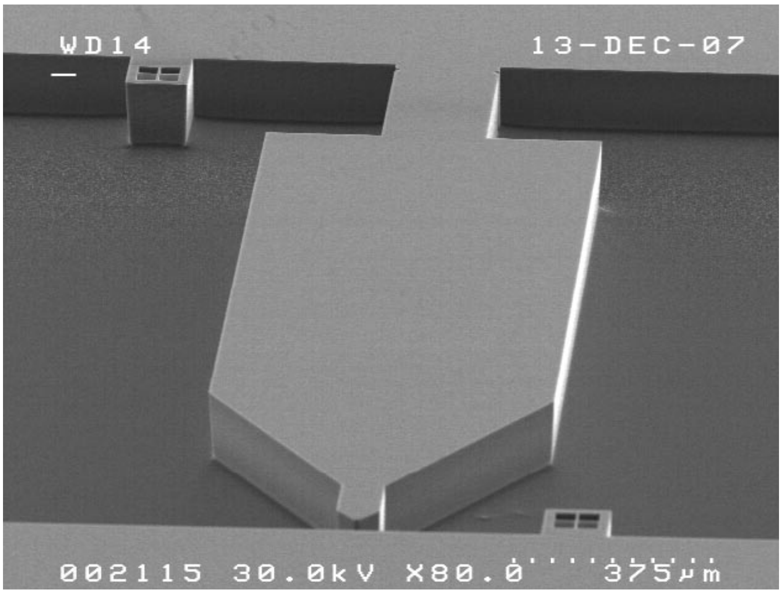
IRAM has started production of 490 GHz mixer devices for the Smithsonian Sub-millimeter Array (SMA) Observatory. The design of these devices includes junctions down to a size of 0.8 μm^2.

The work on ultra-thin NbN films for Hot Electron Bolometer was continued with modeling of optical spectra as a function of free carrier densities. An independent experimental approach to determine these densities was achieved by the implementation of a Hall measurement set-up.

IRAM is also collaborating with the Institute Louis Neel in Grenoble on the subject of µ-SQUID systems. Such systems will allow probing magnetic environment of super-conducting devices with high spatial resolution. The current effort is focused on the Silicon micro machining of cantilevers for the µ-SQUIDs.

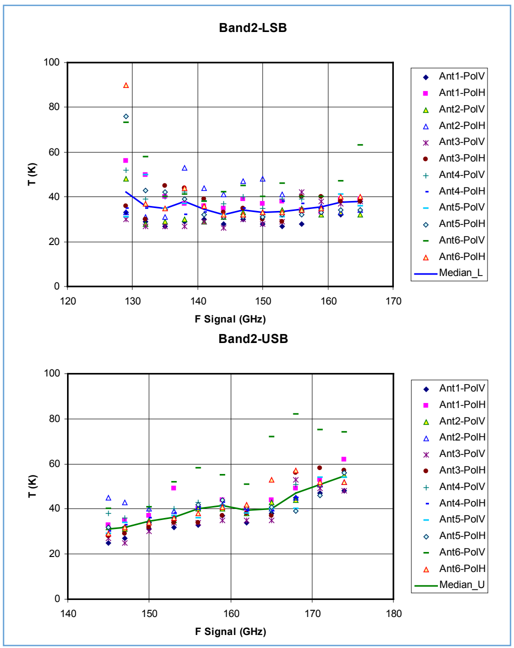
Finally, the development of cryogenic super-conducting micro electromechanical systems (SUPRAMEMS) is pursued in collaboration with the Institute National Polytechnique of Grenoble, the INSA of Lyon and the ENS des Mines of St-Etienne. This research has been awarded funding through the French region Rhône-Alpes.

Micro machined Silicon cantilever for µ-SQUID probes. The structure was created using inductively coupled plasma etching and the so-called BOSCH process.



RECEIVER GROUP

PLATEAU DE BURE INTERFEROMETER



The SSB receiver noise of the six dual-polarization modules installed on the Plateau de Bure Interferometer in the summer and fall of 2007. (*Upper Panel*) Values corresponding to the Lower Sideband operation. The line shows the median value at each signal frequency, arguably an objective measure of the "typical" performance. The median value stays below 40K SSB over the range 130-165 GHz. (*Lower Panel*) Same as above, for the Upper Sideband operation.

The 2mm New Generation Receiver - Band 2 (129-174 GHz)

Fourteen SSB mixers (and four more for the upcoming 30-m new receiver, as well as some second-tier spares) were assembled and characterized (wet dewar, 4.2K) by the mixer team. Seven optical modules, including each two off-axis mirrors, a polarization diplexing grid, two corrugated horns, and a local oscillator injection coupler, were put together and verified by the optics team. The construction team integrated the mixers into the optical modules and characterized them (spare PdBI cryostat, 3K) for noise, stability, and optical alignment. After six of these dual-polarization modules were incorporated into the receivers on-site on the Plateau de Bure, the PdBI scientists and operators commission successfully the 2 mm New Generation Receiver, which covers the frequency range from 129 to 174 GHz. As can be seen in the figure, the performances of the receivers are excellent, matching the expectations from the laboratory measurements with SSB receiver noise temperatures below 40 K over most of the frequency range.

Other Improvements to the Plateau de Bure Interferometer

Several other improvements were made to the Plateau de Bure Interferometer receivers between July and December 2007. On antennas 1 to 3, the IF isolators were thermalized to the 4K stage (instead of the 15K stage), as on antennas 4 to 6; this thermalization results in a small but significant improvement of the noise performance. All cryogenic amplifiers were overhauled to address a potential reliability problem. The Millitech triplers — that had been in operation for over 10 years— were replaced with Virginia Diodes triplers, extending the upper end of the Band 3 RF range to the design value of 267 GHz. This is the highest frequency observable today with the interferometer and will enable astronomers to observe the 3–2 rotational transitions of the molecules HCO^+ and HCN.

Full Electronic Local Oscillator for the Band 4

This development was driven by three motives: a) need of a first LO system for the Plateau de Bure Interferometer Band 4, which was previously not implemented; b) increasing difficulties in procuring Gunn oscillators, a key component of IRAM local oscillators for more than 15 years; c) potentially more reliable and faster tuning due to the absence of moving parts. If successfully implemented, it will pave the way for similar local oscillators for both of IRAM's telescopes.

The full electronically tuned LO Band 4 prototype has been built, consisting of a YIG oscillator (15.7–20.3 GHz) followed by a multiplicative chain (AMC 94.33–121.6 GHz), a power module (PA), a 3 dB coupler, a frequency tripler (283–365 GHz) and cutoff high-pass filter. All millimeter MMIC devices doubler, amplifiers, except the 300 GHz tripler, have been integrated in house using ultrasonic bonding and a millimeter (40 GHz) prober station. The millimeter PLL has been built taking account of the 1.875 GHz first references and the 100 MHz IF used at the Plateau de Bure interferometer.

A remote control box associated to a Labview program has been built to drive automatically the MMIC bias and the full locking process.
The LO power is between 6 and 15 dBm at the 94.33–121.6 GHz 3 dB coupler output and between 60 and 840 µW in the 283–365 GHz band. The phase noise measured is –75 dBc / Hz at 121.6 GHz at 10 kHz from carrier. Finally, the LO has been tested with a 2SB separating band SIS mixer.

THE 30-METER TELESCOPE

30-m telescope new four-band dual polarization receiver

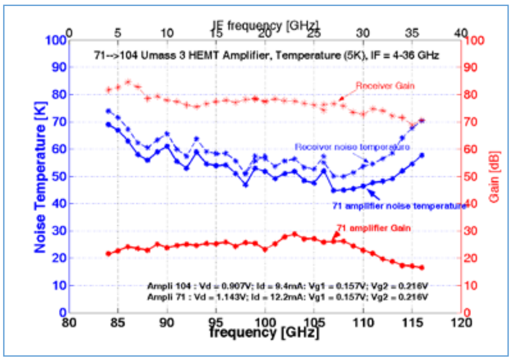
The new receiver being designed for the 30-meter telescope builds upon the successful design of the new Plateau de Bure Interferometer receiver, with modifications as needed, such as those induced by the different focal ratio, 9.7 instead of 5.

The design of the cryostat was completed, apart from a verification of the flexure of the front plate, which still remains to be done. All the wiring will be adequate for future 2SB mixers. The cryo-cooler and a spare were ordered once the evolution of the design at Sumitomo could be properly documented. Mirrors, grid, horns, and LO injection couplers have been designed for Bands 1, 2, and 3, with Band 4 still pending.

The decision was taken to use for Band 4 (covering the 0.8 mm window) a slightly modified version of the ALMA Band 7 2SB mixer, and for Band 1 (covering the 3mm window) the wide IF (4-12 GHz) mixer developed in the framework of AMSTAR.

30-m telescope dual polarization HEMT receiver

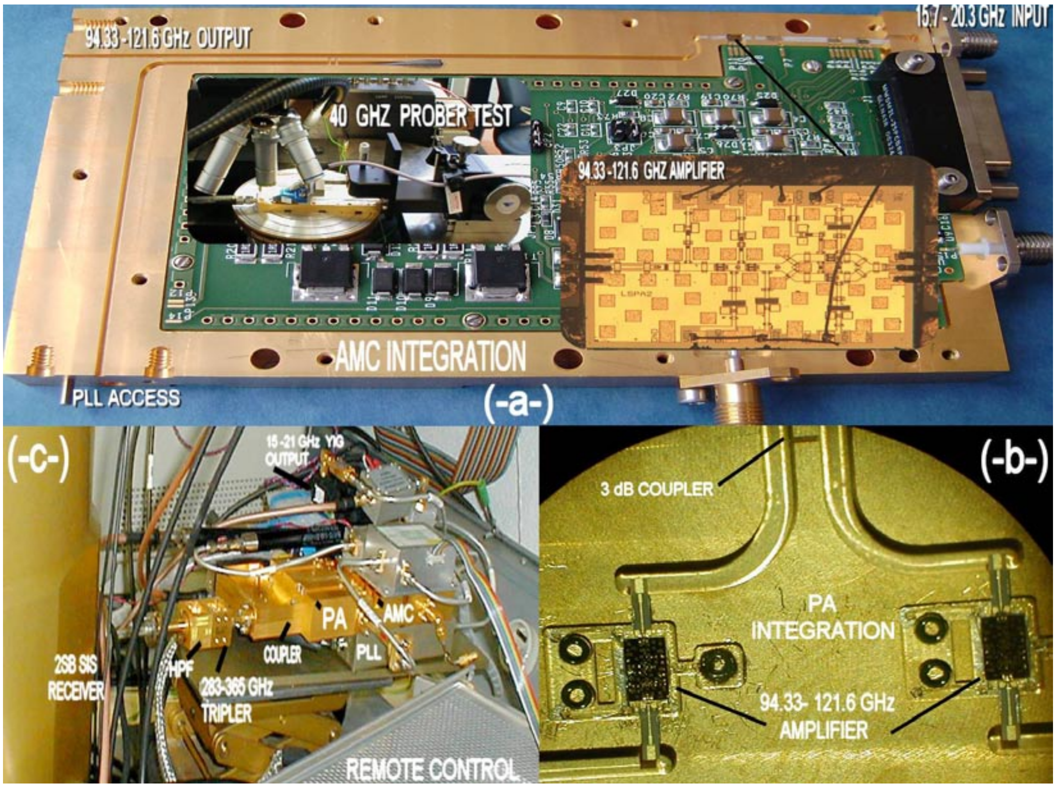
This is an ongoing project to design a dual-polarization 3-mm band receiver based on mm-wave HEMT MMIC. The goals are: a) to design and build a dual-polarization receiver with a very wide instantaneous bandwidth, implementing state-of-art components; b) to provide a backup in the 3-mm band for the four-band receiver; c) to gain experience with the implementation of mm-wave HEMTs in the perspective of a possible future multibeam receiver. It was decided to implement this receiver over the design RF band of 84–116 GHz,



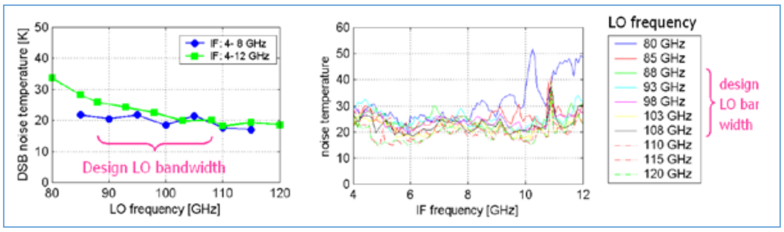
Receiver and amplifier gain and noise of the MMICs, which are currently being evaluated at IRAM.

with the cryostat designed to allow, in a second step, the inclusion of a lower frequency pixel starting around 70 GHz.

Two MMICs have been obtained on loan from Pr. Neal Erickson of University of Massachusetts. They have been evaluated, first at room temperature, then at 4K, separately and cascaded. The results are quite encouraging as shown in the figure. In parallel, various options are being explored (including component availability and budget) for the processing of the 32 GHz bandwidth into chunks compatible with the IRAM IF transport and spectrometers, either existing or foreseeable.



The local oscillator for the Plateau de Bure Band 4. (a) The AMC integration; (b) The PA integration and (c) The full LO Band 4 prototype in test with a 2 SB band separating SIS mixer.



(*Left Panel*) Diagram showing the noise temperature for the DSB mixer tests (using junction 08-10-03) for an IF of 4-8 GHz (blue curve) and 4-12 GHz (green curve). (*Right Panel*) Noise measured in the IF band for different LO frequencies.

AMSTAR DEVELOPMENT WORK

Wide IF sideband separating mixer (WP 211)

The goal of this project is the development of a sideband separating mixer for the RF frequency range of 80 to 116 GHz with a 4 to 12 GHz IF band. In 2007, first good junctions could be fabricated. DSB mixer tests have been carried out allowing a validation of the RF mixer design.

These measurements show that this mixer design covers, as intended, the IF frequencies from 4 to 12 GHz and that its RF frequency range is even larger than foreseen in the design. The assembling and testing of a sideband separating mixer is planned in 2008.

Focal Plane Heterodyne Array (WP 241)

The design and construction of the 2mm Amstar Focal Plane Heterodyne Array Receiver is now completed. The 4-pixel array optics was designed and constructed, and the full system tested in the laboratory with a 'traditional' doubled gunn local oscillator. Further measurements of the receiver were also made using a cryogenic photonic local oscillator provided by the Rutherford Appleton Laboratory.

The double side band noise temperature performance of the receiver array pumped by a doubled Gunn local oscillator stays within 30-35 K in a large part of the frequency range, and remains below 50 K in the 133-177 GHz LO frequency range, corresponding to the 127-183 GHz signal range. The receiver sensitivity is slightly degraded when using the cryogenic photonic local oscillator (DSB noise temperatures around 40 K) due lo the lack of photonic LO output power, which imposes a more important coupling ratio, i.e. 12dB instead of 17dB.

ALMA CONTRACTS

Optics

IRAM was the prime coordinator for the optical design of the ALMA front-end. The Optics Critical Design Review, which was held in May 2007, concluded this activity.

Band 7 Cartridge

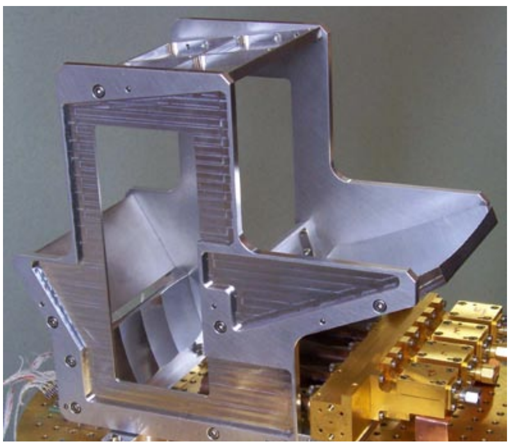
Following the test and delivery of two Band 7 cartridges in 2006, IRAM assembled, tested and passed the preliminary acceptance of six additional Band 7 cartridges in 2007 (the dates are given in the Table below). The Band 7 team at IRAM was the first of the cartridge groups to achieve Preliminary In-House Acceptance of all 8 pre-production cartridges.

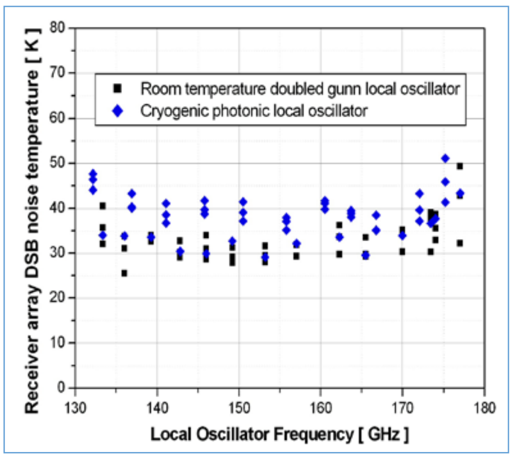
ALMA Band 7 Cartridges Status

Cartridge delivery order	Cartridge N°	Preliminary acceptance in house date
3	4	30 January 2007
4	7	5 March 2007
5	5	9 May 2007
6	3	3 July 2007
7	6	3 July 2007
8	8	17 September 2007

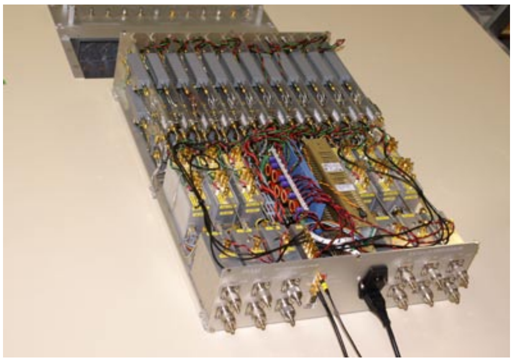
Amongst these cartridges, two were delivered to the North American Integration center. Four are still at IRAM, waiting the green light from ESO to be delivered to the European Integration Center at RAL (UK). The ALMA team has spent the rest of the year 2007, working on the test setup development for the forthcoming production.

(*Left Panel*) Picture showing the 2mm 4-pixel Amstar Focal Plane Heterodyne Array and its cold optics integrated into the demonstration cryostat. (*Right Panel*) DSB receiver noise temperatures measured (for each of the four pixels) with a traditional room temperature doubled gunn local oscillator (black squares) and with a cryogenic photonic local oscillator (blue diamonds).





Finally, after detailed negotiations, a contract was signed on December 3rd, 2007 between IRAM and ESO to produce 48 ALMA Band 7 receivers over the next 4 to 5 years with an option for 17 extra receivers for Japanese antennas.



View of the IF Processor and Optic Fiber terminal units

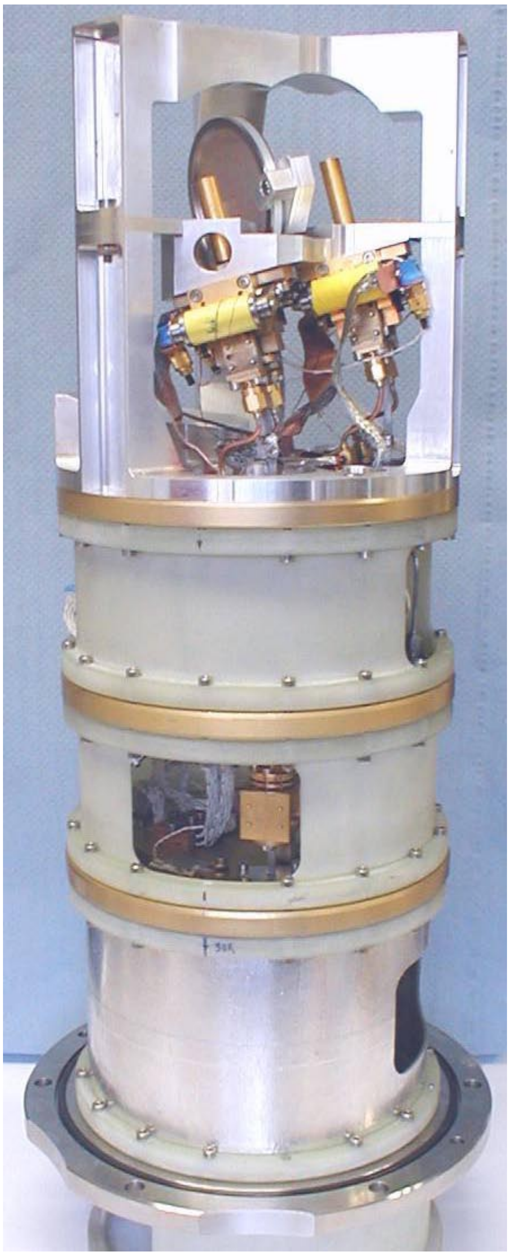
BACK-END DEVELOPMENT

Construction of 7 Laser Transmitter Racks

A dual laser IF transmitter was built for each antenna. It converts the two 4-8 GHz IF's into modulated light, which is sent to the building over the mono-mode FO network. All the operating parameters (temperature, current, etc) of the lasers are locally recorded and can be remotely monitored, in order to provide early aging detection.

Construction of the Optical Fiber Receiver Unit

In the correlator room, this unit converts the twelve FO signals into electrical signals for the IF Processor. These can be switched to a central noise source to allow quick bandpass calibration of the IF processor and correlators. The unit incorporates a light power monitor interface that helps tracing the attenuation of the FO network.



Pierre Cox signing the Band 7 Production Contract

Completion of the IF Processor

This unit implements the new IF frequency plan. For each of the six antennas the two 4 GHz IF bands are split:

- into two halves of 2GHz that will feed the wideband correlator inputs.
- again into Quarters of 1 GHz that feed the existing correlator.

The dual LO2's are phase-steerable and have a frequency resolution of 1.5 milliHertz. All LO's used for this processing are phase-coherent with the Maser to preserve VLBI phased array operation.

Preliminary Design of the Digital Section of the Wideband Correlator

A feasibility study for the correlator chip was subcontracted and delivered. The chip channel number, that determines both spectral resolution and power dissipation, has been intensively discussed.

COMPUTER GROUP

In 2007, the main goal of the computer group was the upgrade of the computing facilities at the Plateau de Bure. The architecture and the decisions were taken in 2006 and, as soon as the new machines were received in early 2007, a complete prototype was built and tested in Grenoble. The adopted solution relies on the combination of a Network Attached Storage (NAS) server and a Storage Area Network (SAN) server, themselves based on an extremely reliable and redundant hardware that includes fault tolerant RAID disks, redundant control units, redundant power supplies and many other solutions which improve the overall efficiency and reliability.

The computing services and the center functions of the interferometer are hosted on two different robust computers. For reliability reasons, these computers do not use local hard disks for their operating system (non redundant hard disks are weak points in a computer). It is the SAN server that provides the system disks through the network and the protocole iSCSI. Furthermore, each computer has its own spare unit.

The computing services include the management of the host names and the accounts, the time distribution and the methods for booting the different Single Board Computers (micros) installed in the antennas for the drives and the receivers or managing the different elements of the backend. The center interferometer computer synchronizes all the operations of control, monitoring and acquisition.

The Plateau de Bure interferometer is operated through a series of 3 PCs and 6 displays. In normal observations, the operator needs 2 PCs and 4 displays for driving the observations, looking at the first results and archiving data. The last PC may be assumed as a spare unit or a workstation available for a scientist present at Bure.

The introduction of console servers (KVM and serial consoles) with access over IP enabled to increase the remote maintenance capability. The local system console and the serial terminal can be linked on demand to many computing units by the local staff. However, the great interest of those servers is that the remote access may be used to provide assistance and expertise.

The computers are built around 64 bit processors and a new version of Linux RedHat Fedora had to be installed (FC6) to overcome some technical difficulties. The Gigabit network is built around 2 switches linked together at 10Gbits/s. In the case of failure, all port connections may be moved to a single switch. The prototype was delivered for further integration of the scientific software at the beginning of July and by the end of the summer, the complete solution was successfully installed and tested on the Plateau de Bure. Until the end of the year, although the new computing system with the newest GILDAS version was used, the old solution

was present and it has been always possible to switch from one solution to the other quickly.

Tests were carried out on the new wide band correlator acquisition scheme. The system is based on a fiber optic acquisition board from CERN and for simulating data transfer, both ways, a test board was built around a FPGA and the CERN Front End adaptor. This simulation is important for developing the key elements of the control and acquisition software. The software, which is written in C++ and runs in user mode in a real-time environment, has different goals. First, it should be used to validate the new correlator hardware and, in particular, the correlator chips. Once the correlator units are built and operating, the software will provide maintenance and diagnostic tools. Finally, its task will be to control, monitor and collect correlation data. After this preliminary development, the tests with a first version of the correlator interface provided this time by the back-end team has so far been successful. More features and more tests are foreseen.

For the first LO of the new coming receiver Band 4 developed for the Plateau de Bure interferometer, a control and monitoring CAN interface was designed and built. We used Labview for the interface validation and for the receiver integration tests in the laboratory. Later for the operations, the current control and monitoring software at the Plateau de Bure will be upgraded to include these new receivers in the antenna cabins.

Besides these main hard and soft (system and application) developments, a large part of the computer group's efforts is dedicated to prospective studies, maintenance, upgrades and smaller tasks, which include: a new Internet ADSL connection at Montmaur to interface a monitoring video camera that is used weekly for the staff shifts with the helicopter; an evaluation of the Xen hypervisor, the open source standard for virtualization, with FedoraCore 4 or 6 and iSCSI unit connections, which is a candidate for future system architecture development at Grenoble; an adaptation of Linux OpenVpn to keep the certificates buried in the system and to avoid ill-disposed recovery; an upgrade of IRAM's computer fleet inventory management package GLPI with its associated configuration-tracking tool; and, finally, an upgrade of the current receiver control and monitoring software to generalize the usage of C++ within the QT development framework.

SCIENTIFIC SOFTWARE

The first goal of the science software activities at IRAM is to support the reduction of the data acquired by the 30-meter and the Plateau de Bure interferometer. This includes the delivery of software to the IRAM staff for use in the online acquisition system and of offline software to end users for final reduction of their data. The GILDAS suite of software is freely available to and used by other radio telescopes.

At the 30-meter telescope, MOPSIC is used to support the bolometer observations while MIRA and CLASS are used to support the heterodyne observations. In 2007, MOPSIC was further developed to enhance its monitoring capabilities (check of possible signal instabilities, large tracking errors, etc). Among the new features of MIRA were the calibration of the receiver phase for polarimetry, an easy recalibration of the large data sets occurring in the HERA pool, the possibility to take into account the variations of the image gains with frequency at the lower edge of the 3mm window and the calibration of data coming from a fast Fourier transform spectrometer. Work started in CLASS to remove current limitations in the frequency to velocity conversion.

For the Plateau de Bure interferometer, the CLIC monitoring and calibration procedures, including the pipeline, were thoroughly adapted to cope with the possibilities of the new dual polarization receivers at 3 and 1 mm installed at the end of 2006. In addition, more technical parameters are now monitored in these procedures to enable a better monitoring of the instrument by the Science Operation Group. The installation of the 2 mm receivers at the end of 2007 also implied adaptations in ASTRO, the tool to prepare the observations, in CLIC, the on-line and off-line calibration software and in OBS, the operator interface. The change of the on-line computer operating system from HPUX to Linux triggered the design and implementation of new software practices, with a clearer separation between 1) the development and standard versions of the software, 2) the on-line and off-line versions, and 3) the roles of the different actors, i.e. developers, operators and astronomers on duty. Finally, the MAPPING interface was fully rewritten to enable the imaging and de-convolution of both single-field and multi-field mosaic observation with exactly the same commands.

All these developments are based on the common GILDAS services, e.g., the versioning of the source code and the make-file system. In 2007, MOPSIC and the on-line software at Plateau de Bure interferometer (OBS, RDI, correl) joined these services. After five years of effort, almost all the on and off-line acquisition softwares at IRAM use the same centralized services. The development of the binding of GILDAS to python, the scripting language used in the future ALMA software, was continued in collaboration with the Observatory of Bordeaux. This triggered a major modernization of the GILDAS infrastructure, like the use of FORTRAN modules or the implementation of new standard ways to initialize the GILDAS software. Although this effort is not much visible, it is extremely important for the medium term life of the IRAM data reduction software. In the area of user support, the scientific software group answered about 400 different electronic mail requests since the end of 2004. The median time between the request and the first answer is 11 hours and 32 hours the final answer.

The expertise of IRAM in the science software area has been also used by the ALMA project. First, IRAM leads the research and development activities around the interferometric On-The-Fly (OTF) observing mode in the framework of the European FP6 program 'ALMA Enhancement'. In 2007, three different activities were started: 1) an in-depth review of the short-spacing processing; 2) the development of an interferometric OTF simulator; 3) the evaluation of possible algorithms to image and de-convolve interferometric OTF data. Second, IRAM has been in charge of key aspects of the ALMA computing activities:

- An IRAM astronomer chairs the Science Software Requirements Committee (SSR) and two other IRAM astronomers actively participate. After an intense period of activity in the past years to determine the software requirements, the SSR has been coordinating the science testing of individual software parts (e.g. the Observing Tool that will be used by Principal Investigators to define and then to setup their proposition of observations) as well as the integration of on-line software at the Alma Test Facility on the VLA site in New Mexico (USA). In addition, IRAM is leading the SSR task of developing the scripts, which implement the different observing modes.

- The on-line calibration subsystem (TELCAL) is designed and implemented at IRAM by one IRAM astronomer and two software engineers. In 2007, developments included the bandpass and sideband ratio calibration engines. Discussions on the design of the Water Vapor Radiometer calibration engines and on the handling of sub-arrays have started. A python binding of the C++ calibration software has been started. The goal is first to enable easy off-line operation of the online engines for the ALMA staff astronomers and operators and second to enable a later, use in the standard off-line data reduction package (CASA). Integrated tests have been routinely conducted in Simulated Test Environments using a simulator developed at IRAM.

- IRAM also led the development of an improved version of the ALMA Science Data Model (ASDM) that was delivered with the ALMA software release R5 in October 2007. This version featured a simpler version of the Main table, and binary files for both the correlator and total power backends. Finally, the GILDAS holography package was updated for use on the first ALMA production antennas. The first ALMA-J MELCO antenna surface has been successfully tuned at the Operation Support Facility in San Pedro de Atacama using this software.

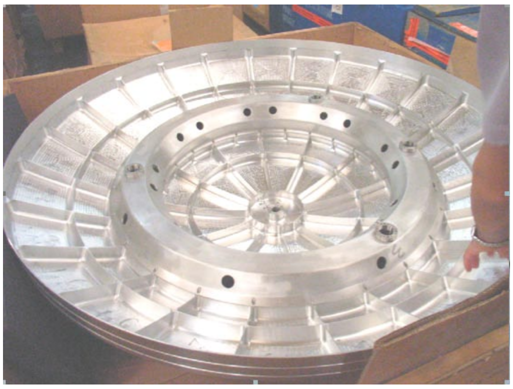
MECHANICAL GROUP

In 2007, the staff in the mechanical group dealt with a total of 146 requests for mechanical components - 109 of the requests were handled internally, and 37 subcontracted to external companies. In addition, the mechanical group worked in close collaboration with the technical staff on the Plateau de Bure for the antenna maintenance

In 2007, the workshop produced a large number of microwave components, mixers, couplers, and horns for the New Generation Receivers of the Plateau de Bure interferometer and the 30-meter telescope, as well as for the ALMA Band 7 receivers. The drawing office worked on numerous projects, in close collaboration with the other groups, including the design of all the microwave components for the New Generation Receivers of the Plateau de Bure interferometer, and the receivers for ALMA (Band 7) and AMSTAR.

A major effort concerned the work related to the new subreflector and the aluminium panels that will replace the carbon fibre panels on the antennas of the Plateau de Bure interferometer. A new and simplified design was developed for the aluminium cast panels with the goal to reduce machining costs by as much as 20%. The technical group organized the supply of 130 tons of aluminium (from the company Apollo Metal) for two antennas, of which only 2.6 tons of aluminium per antenna will be left after the machining. The first antenna (antenna 4) will be refurbished in the summer of 2008, the second one (antenna 6) in the summer of 2009.

Finally, an upgrade of the workshop was done in view of the new 5-axis machine that is planned to be delivered in 2008 and will be used for the ALMA Band 7 project.



New sub-reflector for the Plateau de Bure 15-meter antenna.

Personnel and finances

HUMAN RESOURCES

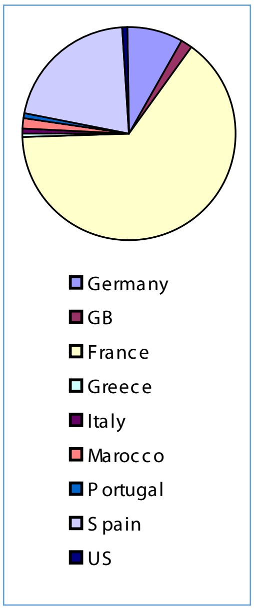
In 2007, 105.5 positions were foreseen in the Personnel Plan authorised by the IRAM Executive Council, i.e. 77.7 for France and 27.8 for Spain.

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 120.66 FTE in 2007.

The distribution of all staff (France and Spain) by nationality is shown in the figure:

Distribution of the IRAM staff per nationality



FINANCE

The activity of the IRAM Administration in the area of finance includes the budget preparation and management, annual accounts, liaison with the Auditors and Audit Commission, report to the Executive Council.

In order to have more detailed information, the IRAM Administration implemented in 2007 an analytical accounting.

The IRAM's financial situation in 2007, as well as budget provisions for 2008, are summarised in the Table hereafter.

The Associates have approved an increase by 2% of their contribution to the Operation budget, and approved, as in 2007, a specific contribution of 1M€ to the Investment budget to allow the change from carbon fibre to aluminium panels on 2 antennas of the Plateau de Bure interferometer.

BUILDING AND SITE MAINTENANCE

In addition to ensuring that the buildings (Grenoble, Plateau de Bure and Granada) are in good state, the group in charge of building and maintenance supervised two main projects. First, the extension of the Front-End laboratory and office space. Second, the reinforcement of the ground of the mechanical workshop, which was needed in order to accommodate the new and heavy 5-axes milling machine recently purchased for the ALMA Band 7 production work.

OPERATING AND INVESTMENT BUDGETS FOR 2007

Expenditure

Budget heading	Approved	Actual
Operation / Personnel	7,548,400	7,323,500
Operation / Other items	3,320,900	3,693,490
TOTAL OPERATION	**10,869,300**	**11,016,990**
Investment (base+special)	3,163,835	1,657,054
TOTAL EXPENDITURE excl. VAT	**14,033,135**	**12,674,044**
VAT	897,341	897,341
TOTAL EXPENDITURE incl. VAT	**14,930,476**	**13,571,385**

Income

Budget heading	Approved	Actual
CNRS contributions	5,798,112	5,798,112
MPG contributions	5,798,112	5,798,112
IGN contributions	740,185	740,185
TOTAL CONTRIBUTIONS	**12,336,409**	**12,336,409**
Carry forward from previous years	989,226	989,227
IRAM's own income	707,500	2,469,120
TOTAL INCOME excl. VAT	**14,033,135**	**15,794,756**
CNRS contribution for VAT (19,6%) *	897,341	897,341
TOTAL INCOME incl. VAT	**14,930,476**	**16,692,097**

OPERATING AND INVESTMENT BUDGETS FOR 2008

Expenditure

Budget heading	Approved
Operation / Personnel	7,643,600
Operation / other items	3,106,400
TOTAL OPERATION	**10,750,000**
Investment (base+special)	2,725,409
TOTAL INVESTMENT	**2,725,409**
TOTAL EXPENDITURE	**13,475,409**
VAT (19,6%)	915,288
TOTAL EXPENDITURE incl. VAT	**14,390,697**

Income

Budget heading	Approved
CNRS contributions	5,889,678
MPG contributions	5,889,678
IGN contributions	751,874
TOTAL CONTRIBUTIONS	**12,531,229**
IRAM's own income	488,180
Carry forward from previous years	456,000
TOTAL INCOME excl. VAT	**13,475,409**
CNRS contribution for VAT *	915,288
TOTAL INCOME incl. VAT	**14,390,697**

* = 19.6% on CNRS contribution to operation budget

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 2007. 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	Author(s)
103-05	A 3-mm Line Survey of the Simplest Star Forming Regions	Marcelino, Mauersberger, Pintado, Thum, Tafalla, Paubert, Cernicharo, Fonfria, Roueff, Gerin
012-06	HNCO and CH3OH in external galaxies. New tracers of the nuclear activity	Martin-Pintado, Requena-Torres, Martin, Mauersberger
020-06	Barnard 1: a Dense Core with Low-Mass Star Formation Activity	Marcelino, Cernicharo, Gerin, Roueff, Mauersberger
026-06	Deep HERA mapping of very nearby low metallicity spiral galaxies	Gardan, Schuster, Sievers, Brouillet, Braine
049-06	Mm Lighthouses from SWIRE: II. HLIRG obscured QSOs	Omont, Lonsdale, Polletta, Smith, Zylka, Cox, Bavouzet, Dole, Lagache, Bergeron, Peiyu, Mccracken, Bertoldi, Beelen, Lutz, Tacconi, Le Brun, De Breuck, Farrah, Frayer, Shupe, Sriana, Surace, Seymour, Rowan-Robinson, Clements, Perez-Fournon, Franceschini, Owen
060-06	The CORALZ sample at 250 GHz	Mack, Snellen, Schilizzi
065-06	A population of massive high extinction clouds	Wyrowski, Pillai, Schuller, Menten
089-06	CO isotopic measurements of galaxy nuclei	Israel
104-06	A deep survey of the most powerful radio galaxies, the nearby B2 galaxies	Leon, Flaquer, Lim, Combes, Mauersberger
119-06	The nature of massive protostars detected by Spitzer	Hennemann, Birkmann, Krause, Lemke
121-06	A 2 mm line survey of the prototypical evolved starburst galaxy M82	Martin, Ruiz, Ocantildea, Flaquer, Mauersberger, Martin-Pintado, Henkel, Amo
125-06	A survey of sulfur-bearing species in starbursts: a stepping stone from the Milky Way to high redshift:	Bayet, Viti, Lintott, Martin-Pintado, Martin
126-06	A quest for a complete understanding of AGN: dust emission at $z \sim 1$	Omont, Jarvis, Beelen, Schinnerer, Martinez-Sansigre, Polletta, Zylka, Cox, Stevens, Perez-Fournon, Page, Rawlings
129-06	Albedo and size determination of Centaur object 1999 TZ1	Doressoundiram, Lellouch, Moullet, Moreno
131-06	Molecular Clouds in the Outer Milky Way	Braine, Schuster, Combes, Brouillet, Gardan, Soubiran
132-06	Completing the study: CO content in the hosts of nearby QSOs	Bertram, Eckart, Fischer, Zuther, Krips, Straubmeier
133-06	Neutral Carbon lines in dusty Quasars and Starbursts at high redshifts	Weiss, Downes, Walter, Henkel
134-06	A search for CO emission in high-z QSOs and submm galaxies in the 2mm band	Weiss, Walter, Downes, Henkel
136-06	CN Zeeman Observations	Falgarone, Crutcher, Troland, Paubert, Hily-Blant
137-06	Studying the transient radio-magnetar XTE J1810-197	Camilo, Cognard, Halpern, Helfand, Karastergiou, Pentildealver, Ransom, Reynolds, Thum
139-06	Deuterated Molecules in Barnard 1: The Formation of Methanol	Marcelino, Cernicharo, Gerin, Roueff, Mauersberger
141-06	Study of the dust distribution in the CS core of L673	Morata, Girart, Garrod
142-06	Tracing the outer disk in planet-forming evolved systems	Sicilia-Aguilar, Merin, Henning, Patel, Hartmann
144-06	Average star formation in high-z SWIRE ULIRGs	Lonsdale, Omont, Polletta, Smith, Zylka, Cox, Bavouzet, Beelen, Dole, Lagache, Bertoldi, Lutz, Tacconi, De Breuck, Farrah, Shupe, Rowan-Robinson, Perez-Fournon, Franceschini, Owen
145-06	What supresses star formation in Hickson Compact Groups?	Lisenfeld, Verdes-Montenegro, Martinez, Leon, Espada, Sulentic, Yun, Garci, Burillo

Ident.	Title of Investigation	Author(s)
147-06	CN in prestellar cores	Hily-Blant, Walmsley, Pineau des Forets, Flower, Akylimaz
148-06	PDR Structure of the Molecular Gas in the Sgr A* Environment	Stankovic, Seaquist, Muehle
149-06	M 82 - a large scale CO survey	Dessauges-Zavadsky, Weiss, Walter, Ott, Greve
150-06	The Molecular Gas Content of QSO Host Galaxies	Barthel, Evans, Tacconi, Sanders, Frayer, Surace, Vavilkin, Hines
151-06	Clustered Low Mass Star Formation: Using N2D+ to probe dense gas fragmentation in Ophiuchus	Friesen, di Francesco, Shirley, Andre, Belloche
157-06	Deuterium fractionation in the nearest cluster-forming region	Caselli, Andre, Belloche, Bourke, di Francesco, Friesen, Rgensen, Myers, Plume
158-06	Testing the Schmidt Law at the End of the Hubble Sequence	Martini, Schinnerer, Lisenfeld, Boeker
159-06	13CO(2-1) and HCN(1-0) in a spiral arm of M51	Hitschfeld, Kramer, Garcia-Burillo, Stutzki, Mookerjea, Schuster
164-06	MAMBO observations of the most active BzK-selected z=2 starburst galaxies	Dannerbauer, Daddi, Brusa, Cimatti, Dickinson, Kurk, Lehnert, Morrison, Roettgering, Renzini
165-06	MAMBO observations of a complete color selected sample of Spitzer FLS galaxies	Lutz, Yan, Dasyra, Frayer, Tacconi, Genzel, Omont, Cox, Baker
167-06	Searching for gas motion in the Snake filament	Hily-Blant, Teyssier, Risacher
168-06	Deep inside the Perseus cluster core II- Mapping the extended continuum emission	Salome, Combes, Leon
169-06	A Wide-Field CO Imaging Survey of Nearby Galaxies	Walter, Weiss, Leroy, Brinks, De Blok, Bigiel, Cannon, Kennicutt, Begum, Kramer, Usero
172-06	A MAMBO/HERA survey of the densest portion of the Aquila Rift complex	Andre, Maury, Bontemps, Motte, Menshchikov
178-06	The spatial distribution of complex organic molecules in Orion KL	Tercero, Martinez, Cernicharo, Pardo, Guelin, Brouillet, Goicoechea, Daniel
179-06	A search for 183 GHz water vapor megamasers	Cernicharo, Pardo, Garcia-Burillo, Diaz-Beltran
180-06	A MAMBO survey of the 1046+59 VLA ultra-deep field	Baker, Omont, Lonsdale, Owen, Beelen, Bertoldi, Dole, Harris, Lutz, Polletta
181-06	Benchmarking PDR models against the Horsehead edge - III.2 CN/HCN/HNC as a tracer of the photodissociation fronts	Pety, Goicoechea, Gerin, Teyssier, Hily-Blant, Roueff
187-06	The chemical age and magnetic support of the massive prestellar core Ori B9	Harju, Miettinen, Juvela, Thum
188-06	Very cold dust associated with molecular gas in M 31	Zylka, Guelin, Lis, Levine, Latter
190-06	Cold debris disks around nearby M-dwarfs and epsilon Eri	Lestrade, Bertoldi, Menten
196-06	A search for Sylil cyanide, SiH3CN, in IRC+10216	Cernicharo, Agundez, Pardo Guelin
198-06	Testing the binary supermassive BH model for OJ287	Agudo, Wiesemeyer, Thum, Krichbaum, Ungerechts
202-06	Mapping Molecular Gas in the Disks of Low Surface Brightness Galaxies	Das, Boone, Viallefond, O'Neil
203-06	HNCO and CH3OH in external galaxies. New tracers of the nuclear activity	Martin-Pintado, Martin, Requena-Torres, Martin, Mauersberger
204-06	A Search for SO in IRC +10216	Agundez, Cernicharo
207-06	The dust and gas content of the most luminous starburst galaxies at intermediate redshifts	Greve, Yang, Dowell, Kovacs
208-06	A chemical study of the PDR interface in Rosette	Simon, Schneider, Ossenkopf, Kramer, Stutzki, Roellig, Mueller
209-06	The formation of massive prestellar clumps and the triggering of massive star formation	Peretto, Fuller
210-06	Search for CO emission in yellow hypergiant stars	Quintana-Lacaci, Bujarrabal, Castro-Carrizo, Alcolea
213-06	The COSMOS deep field: constraining dust-obscured galaxy formation	Bertoldi, Schinnerer, Carilli, Scoville, Blain, Menten, Aravena, Smolvcic, Vlahakis, Hasinger, Lutz, Omont
218-06	Molecular gas in Low Power Compact radio galaxies	Giroletti, Perez, Torres, Giovannini
219-06	Search for molecular gas in the two H i condensations near M 81	Boone, Brouillet, Braine
220-06	A quantitative search for large disks around new young brown dwarfs in the Taurus cloud	Monin, Guieu, Pinte, Menard
221-06	The origin of methanol and formaldehyde in PDRs	Leurini, Parise, Schilke, Pineau des Forets, Thorwirth
226-06	The circumstellar chemistry of AGB S-stars	Ramsted, Olofsson, Schoeier
228-06	Unveiling the nature of the Sombrero galaxy's AGN	Vlahakis, Baes, Bertoldi, Falony, Hirota, Kuno, Lundgren, Minchin
231-06	Ionized Carbon in High-Redshift QSOs	Bertoldi, Walter, Kurk, Carilli, Maiolino, Cox, Beelen, Menten, Omont, Weiss, Walmsley, Caselli, Nagao, Neri
234-06	Searching for CO in a star-bursting QSO at z=1.83 in the COSMOS Field	Aravena, Bertoldi, Schinnerer, Carilli, Menten, Smolvcic, Aussel, Brusa, Hasinger, Impey, Lilly, Sanders, Scodeggio, Trump

Ident.	Title of Investigation	Author(s)
237-06	What happens to the outer disks when planets form in the inner disks?	Merin, Martin, Augereau, van Dishoeck, Oliveira, Brown, Blake, Pontoppidan
238-06	Are low luminosity Class 0 sources very young objects?	Vastel, Ceccarelli, Caselli, Caux, Andre
239-06	Testing quasar feedback at z=2 with the COSMOS survey	Martinez-Sansigre, Schinnerer, Bertoldi, Smolcic, Jahnke, Sanders
240-06	A Multi-wavelength Observing Campaign to study SgrA*	Yusef-Zadeh, Wiesemeyer, Thum, Schuster, Downes
241-06	N2D+ and DCO+ as tracers of deuteration in star forming regions	Roberts
242-06	MAMBO observations of zSZgt5 quasars	Wang, Carilli, Bertoldi, Walter, Menten, Beelen, Cox, Omont, Strauss, Fan, Jiang
245-06	Exploring starbursts down the z=6 QSO luminosity function with CFHQS QSOs	Omont, Willott, Bergeron, Forveille, Delfosse, Cox, Beelen
246-06	A Search for Cold Dust Around Giant Planet Host Stars	Sozzetti, Teixeira
D17-06	Confirmation of CH2D+	Parise
D19-06	Short spacings for SMA observation of IRAS18223-3	Beuther
D20-06	Brightest Lyman break galaxy	Lutz
D21-06	Two new CFHT z=6 QSOs	Omont
D22-06	IRAS19312 molecular cloud	Schuller
D23-06	Confirmation of a giant loop in M33	Schuster
D25-06	Comet C/2006/ P1 (McNaught)	Biver
D26-06	Confining the accretion process for SgrA*	Eckart
D28-06	Extension for 242_06	Wang
D29-06	Gamma Ray Burst 070125	Bertoldi
D30-06	Coordinated Monitoring of SgrA*	Eckart
D31-06	Zero-spacings for 13CO and C18O observations	Nissen
004-07	A search for kinematic proof of the triggering of massive star formation	Hoare, Mundy, Urquhart, Lumsden, Oudmaijer, Loo, Hartquist
005-07	Carbon Isotopes in Stars of Type S	Wallerstein, Alcolea, Balick, Bajurrabal, Vanture
006-07	A 2 mm line survey of the prototypical evolved starburst galaxy M82	Ocantildea, Flaquer, Martin, Mauersberger, Martin-Pintado, Henkel, Amo
008-07	SiO detection experiment towards the massive protostar G24.78+0.08 A1	Codella, Cesaroni, Beltran, Moscadelli
009-07	HI: the precursor and the product of star formation in the spiral arms of M31	Rodriguez, Fernandez, Brouillet, Braine, Fuente
012-07	AGN versus SB environments: Assessing the importance of non-collisional excitation, shocks and evolutionary stage	Krips, Neri, Martin, Combes, Garcia-Burillo
013-07	Linking Local Star Formation to Global Star Formation Laws	Rosolowsky, Gao
014-07	Extragalactic activity molecular diagnostics revisited. The need of isotopomers	Martin-Pintado, Martin, Krips, Mauersberger
019-07	86GHz SiO maser emission survey of young, O-rich pre-planetary nebulae	Sanchez, Contreras, Bujarrabal, Alcolea, Desmurs, Sahai, Cernicharo
022-07	CO observations of a complete sample of young radio galaxies	Mack, Snellen, Schilizzi
024-07	The CO Luminosity of Galaxies Within 5 Mpc	Leroy, Walter, West, Lee, Bolatto
026-07	Confirmation of NCCP in IRC +10216	Agundez, Cernicharo, Guelin
027-07	The first unbiased, volume-limited survey of CO in elliptical galaxies	Sage, Welch, Young
029-07	Search for molecular anions in photon-dominated regions and dark clouds	Agundez, Cernicharo, Guelin, Gerin, Teyssier, McCarthy, Thaddeus
030-07	Stellar wind bubble in Ultra-compact HII regions	Roshi, Wyrowski, Menten, Jeyakumar
032-07	Diffuse Clouds: Hotspots, signatures of turbulence and the minimum size scale in CO emission	Pety, Liszt, Lucas
033-07	Wind measurements in Venus' mesosphere in support of Venus Express: a joint 30-m / PdBI proposal	Lellouch, Moreno, Moullet, Paubert
034-07	Mapping CO in the outer parts of XUV disks	Dessauges-Zavadsky, Combes, Pfenniger
035-07	Benchmarking chemical models against the Horsehead edge: IV. Tracing the gas depletion in the shielded regions of the Horsehead	Goicoechea, Gerin, Pety, Hily-Blant, Teyssier, Roueff
036-07	Star formation sites in the extended disk of M33	Corbelli, Giovanardi, Verley
037-07	Testing the binary supermassive BH model for OJ287	Agudo, Wiesemeyer, Thum, Krichbaum, Ungerechts
038-07	A new population of massive high extinction clouds: molecular line follow-ups	Rygl, Wyrowski, Schuller, Menten

Ident.	Title of Investigation	Author(s)
040-07	How prototypical is NGC1068? A search for 'NGC 1068-like' galaxies through HCN, 13CO and 12CO	Krips, Neri, Martin
043-07	Investigating grain chemistry in the GC molecular clouds: the deuterium approach	Requena, Torres, Parise, Martin-Pintado, Rodriguez-Franco, Martin
047-07	Search for 12CO(J=1-0) emission in the dark galaxy DDO154	Komugi, Kobayashi, Yasui, Kohno, Sofue
049-07	The Galactic center: a large repository of complex molecules	Requena, Torres, Martin-Pintado, Amo-Baladron, Rodriguez-Franco, Martin, Morris
054-07	Exploring Production Pathways of CCS and CCH	Sakai, Sakai, Takano, Yamamoto
058-07	H2S emission in nearby starburst galaxies	Muller, Liu, Minh
061-07	The nature of the Extremely High Velocity emission in outflows	Santiago-Garcia, Tafalla, Bachiller
063-07	Molecular Gas and the Assembly of Red Sequence Galaxies: the Complete Picture	Young, Combes, Bureau, Emsellem, Cappellari, Krajnovic, McDermid, Crocker
066-07	N2H+: a tool to infer chemical and physical properties of pre-stellar cores	Bacmann, Pagani
068-07	Coordinated cm- to mm-monitoring of variability and spectral shape evolution of a selected GLAST blazar sample	Fuhrmann, Zensus, Krichbaum, Readhead, Angelakis, Ungerechts, Agudo
069-07	Gas properties of low redshift QSO absorption line host galaxies	Zwaan, Murphy, Zych, Curran, Peroux, Liske, Bouche
070-07	Probing turbulence over the parsec scale	Hily-Blant
071-07	The IR-HCN Correlation over Ten Orders of Magnitude	Gao, Solomon
073-07	Molecular gas properties of intermediate redshift ULIRGs	Boone, Lim, Gerin, Trung, Bayet, Papadopoulos
074-07	The deuteration and exceptional kinematics of the DR21 ridge	Schneider, Motte, Bontemps, Marseille, Hennebelle, Simon
077-07	CN in prestellar cores	Hily-Blant, Walmsley, Pineau des Foret, Flower, Akylimaz
078-07	Dense Gas Tracers Across the Star-Forming Disk of NGC 3627	Leroy, Bolatto, Weiss, Bigiel
080-07	Are Complex Organic Molecules Found in Chemically Active Outflows?	Arce, Jorgensen, Santiago, Tafalla, Bachiller, Bourke
081-07	On the heating of ULIRGs by a proto-starburst. Catching the formation of superclusters in galaxies	Martin-Pintado, Martin, Krips, Mauersberger
082-07	Exploring the chemistry of the FIR-excess galaxies NGC 4418 and NGC 1377	Monje, Aalto, Martin-Pintado, Spaans, Martin
085-07	Deuterium fractionation and degree of ionization in the central region of starless core B68	Nakazato, Guelin
087-07	Is HNCO a good shock tracer?	Rodriguez-Fernandez, Gueth, Tafalla, Bachiller
089-07	Tracing AGN feedback	Lintott, Daddi, Schawinski, Silk, Maraston, Thomas, Viti
090-07	Triggered Star Formation in HII region Sh2-241	Lefloch, Pomares, Deharveng, Zavagno
094-07	Large scale velocity field and physical conditions in L183	Pagani, Bacmann, Hennebelle, Lesaffre
096-07	The temperature and turbulence in dense cores	Padovani, Galli, Walmsley, Caselli
98-07	Study of bipolar outflow driven by massive YSO	Kalenskii, Slysh, Alakoz
100-07	The molecular jet counterpart in T-Tauri stars: the case of DG Tau	Codella, Cabrit, Bacciotti, Cesaroni, Gueth, Lefloch
103-07	Molecular gas in infrared ultraluminous QSOs	Xia, Leon, Gao, Omont, Wu, Cao, Mao
107-07	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
109-07	Probing the disk and inner chemical structure of the Class 0 protostar IRAM 04191	Belloche, Parise, Andre
112-07	Testing the 'unified' model of bipolar outflows	Santiago-Garcia, Tafalla, Bachiller
178-07	Testing the binary supermassive BH model for OJ287	Agudo, Wiesemeyer, Thum
181-07	Tracing AGN feedback	Lintott, Daddi, Schawinski, Silk, Maraston, Thomas, Viti
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
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
203-07	Unveiling the nature of the Sombrero galaxy's AGN	Vlahakis, Baes, Bendo, Bertoldi, Falony, Hirota, Kuno, Lundgren, Minchin
233-07	Molecular excitation in icy silicate-break galaxies: searching for over-luminous HNC and HC3N	Aalto, Costagiola, Monje, Spaans, Perez-Beaupuits, Conway
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

Ident.	Title of Investigation	Author(s)
D01-07	Search for propane in TMC-1	Cernicharo
D03-07	Polarization map of Crab Nebula	Puget
D04-07	Outburst of 3C454.3	Agudo
D05-07	Confirmation of CN3-	Guelin

Plateau de Bure Interferometer

Ident.	Title of investigation	Authors
O04E	Deep study of the circumstellar envelopes of AGB & early post-AGB stars	Castro-Carrizo, Alcolea, Bujarrabal, Grewing, Lucas, Neri, Oloffson, Schoeier, Winters, Lindqvist
O066	Neutral Carbon CI($^3P_2$-$^3P_1$) and ^{13}CO in high-z Quasars and Starbursts	Weiss, Downes, Henkel, Walter
P017	Deep study of the circumstellar envelopes of AGB and early post-AGB stars	Castro-Carrizo, Alcolea, Bujarrabal, Grewing, Lindqvist, Lucas, Neri, Olofsson, Quintana-Lacaci, Schoeier, Winters
P043	Ultra-Low-Mass Cores in the Rho Ophiuchi Proto-cluster	Andre, Greaves, Motte, Ward-Thompson
P047	Benchmarking PDR models against the Horsehead edge: II.2 Fractional ionization	Pety, Goicochea, Gerin, Roueff, Teyssier, Hily-Blant, Aber, Habart, Joblin
P04A	AFGL 2591: A massive circumstellar disk	VanderTak, Walmsley, Herpin, Ceccarelli
P065	Disk Formation in Early-Type Galaxies	Combes, Bureau, Young
P06F	The extended gas distribution in the advanced merger NGC4441	Manthey, Huettemeister, Aalto
P075	The Counter-Rotating Nuclear Disks in Arp 220	Downes, Eckart
P07A	High-resolution CO imaging of z<0.1 QSO host galaxies	Riechers, Walter, Bertoldi, Knudsen, Kurk, Carilli, Fan, Vestergaard
P08A	The highest redshifts: Pinpointing mm sources without radio counterpart	Voss, Bertoldi, Lutz, Blain, Carilli, Schinnerer
Q004	The small scale structure of infrared dark cloud cores	Simon, Rathborne, Jackson, Chambers
Q005	The onset of massive star formation: Outflow/dense core emission	Beuther, Sridharan, Zhang
Q006	The G25.82 infrared dark cloud: Global infall or individual collapse of protostellar cores?	Peretto, Minier, Fuller, Andre, Motte, Hill, Purcell
Q007	Are there massive pre-stellar cores in IRAS05345+3157?	Fontani, Caselli, Crapsi, Cesaroni, Brand
Q008	Binary fragmentation in pre-stellar cores	Ward-Thompson, Andre, Belloche, Kirk
Q00A	The nature of massive protostars detected by Spitzer	Hennemann, Birkmann, Krause, Lemke
Q00D	In search of proto brown dwarfs Distribution of angular momentum in binary	Scholz, Jayawardhana
Q00F	Chemistry in Proto-Planetary Disks (CID) - Part III-IV	Dutrey, Henning, Bacmann, Dartois, Gueth, Guilloteau, Hily-Blant, Launhardt, Pety, Pietu
Q010	Rotation in T Tauri disks: a crucial test of jet launching models	Dougados, Cabrit, Pety, Agra-Amboage, Bacciotti, Coffei, Testi, Natta
Q011	Unveiling the structure of two far-outer star forming regions	Brand, Wouterloot, Fontani, Moscadelli
Q012	Deep study of the circumstellar envelopes of AGB and early post-AGB stars	Castro-Carrizo, Alcolea, Bujarrabal, Grewing, Lindqvist, Lucas, Neri, Olofsson, Quintana-Lacaci, Schoeier, Winters
Q02F	A search for CO(2-1) emission from the host galaxies of GRB000418 and GRB010222	Hatsukade, Kohno, Tosaki, Ohta, Kawai, Endo, Sameshima
Q032	Benchmarking PDR models against the Horsehead edge: III.1 CN/HCN/HNC as a tracer of the photodissociation fronts	Pety, Goicoechea, Gerin, Teyssier, Hily-Blant, Roueff
Q046	GG Tau: back to the ring world	Hure, Dutrey, Guilloteau, Simon, Pierens
Q048	Search for planetary cavities in circumstellar disks	Pietu, Pety, Gueth, Guilloteau, Dutrey
Q04C	High-angular resolution mapping of the young disk around Z Cma	Alonso-Albi, Fuente, Bachiller, Testi, Neri, Planesas
Q051	Accretion in the Mira binary system	Huggins, Bachiller, Planesas, Josselin
Q052	Deep study of the circumstellar envelopes of AGB and early post-AGB stars	Castro-Carrizo, Alcolea, Bujarrabal, Grewing, Lindqvist, Lucas, Neri, Olofsson, Quintana-Lacaci, Schoeier, Winters
Q055	Molecular line mapping of hyper-giant stars	Quintana-Lacaci, Bujarrabal, Castro-Carrizo
Q059	Feeding the nuclear starburst in NGC 6946: III. Chemical probes at 3mm	Schinnerer, Meier, Emsellem, Boeker
Q05A	Coordinated multi-wavelength observations of M81, NGC 4258, and M104	Schoedel, Eckart, Zuther, Bendo, Krips, Peck, Markoff, Greenhill, Zensus
Q05D	HCN and HCO^+ in active galaxies: I. Mapping the prototypical starburst galaxy M82	Krips, Neri, Garcia-Burillo, Martin, Combes, Eckart, Fuente, Usero

Ident.	Title of investigation	Authors
Q061	Origin of molecular gas in E/S0 galaxies: NGC 3156 and NGC 3489	Combes, Bureau, Crocker, Young
Q064	Molecular gas chemistry in the circumnuclear disk of NGC 1068	Usero, Garcia-Burillo, Fuente, Boone, Tacconi, Gracia-Carpio, Neri, Krips
Q06C	Gas dynamics in the prototypical merger NGC6240	Sturm, Tacconi, Baker, Tecza, Lutz, Davies, Genzel
Q070	Deriving molecular abundance ratios in Arp220: $H^{13}CN$ and $H^{13}CO^+$ isotopes	Gracia-Carpio, Planesas, Garcia-Burillo, Neri
Q072	The path of the ULIRG phase: close interacting pairs	Gracia-Carpio, Planesas, Colina
Q073	Molecular gas in the local analogs of LBGs	Baker, Tacconi, Hoopes, Lutz, Heckman, Genzel, Martin, Lehnert, Small
Q075	Constraining the size of the CO emission in a gravitationally lensed BAL QSO at z=1.8523	Krips, Neri, Barvainis, Beelen, Peck
Q076	High duty cycle for ULIRGs in massive z=2 galaxies?	Daddi, Dannerbauer, Elbaz, Dickinson, Morrison
Q077	Completion of a PdB pilot survey of CO in QSOs at z=2	Cox, Smail, Omont, Neri, Beelen, Knudsen, Bertoldi, Alexander, Swinbank, Coppin, Stevens, Ivison, Page
Q078	Pilot survey of CO in 24μm-luminous, optically faint radio galaxies	Bertoldi, Chapman, Genzel, Neri, Omont, Cox, Smail, Ivison, Blain, Greve
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
Q085	High resolution map of a luminous QSO at z=5	Maiolino, Neri, Bertoldi, Carilli, Caselli, Cox, Beelen, Menten, Omont, Nagao, Walmsley, Walter
Q086	Molecular gas in the most distant QSO host galaxies	Carilli, Wang, Walter, Bertoldi, Menten, Cox, Fan, Strauss, Maiolino, Neri, Omont
Q089	Millimetre observations of GRB afterglows in the SWIFT era (ToO)	Castro-Tirado, Bremer, Bhattacharya, Gorosabel, Guziy, Ugarte-Postigo, Jelinek
Q08B	Chemical pathways to HCO^+ in diffuse clouds	Liszt, Pety, Lucas
Q090	Searching for Keplerian rotation about a 20 M_{sun} young star	Beltran, Cesaroni, Codella, Neri, Moscadelli
Q092	The Origin of the HH30 Outflow: Disk Wind or Jet Entrainment	Guilloteau, Pety, Dutrey, Gueth
Q094	Deuterium and ionization fraction in proto-planetary disks: imaging the DCO^+/HCO^+ ratio	Guilloteau, Dutrey, Guelin, Bacmann, Chapillon, Semenov, Pavlyuchenkov, Henning, Schreyer
Q096	Disk Masses of the Rho-Oph Brown Dwarfs	Testi, Natta, Neri
Q098	High-Resolution observation of 1mm Lines in ultra-luminous Galaxies	Downes, Solomon
Q09A	Probing isotopic ratios at z = 0.68 - 0.89	Muller, Guelin, Lucas, Combes, Wiklind
Q09C	The molecular gas around the gravitationally lensed quasar RXJ091	Boone, Henkel, Beelen, Weiss
Q09E	Spatially resolved dust and gas emission in a z=4.12 QSO	Beelen, Hudelot, Bertoldi, Krips, Pety, Cox, Weiss, Kovacs, Riechers, Walter, Carilli
Q0A0	BRI1202-0725: Zooming on a merger at z=4.7	Guelin, Salome, Riechers, Neri, Winters, Pety, Bremer, Zylka, Cox, Downes, Walter, Guilloteau
Q0A1	CO, CI, [CII] and dust imaging of the z=6.42 QSO J1148+5251	Walter, Bertoldi, Carilli, Maiolino, Cox, Neri, Menten, Weiss, Riechers
Q-2	Determination of the molecular gas mass in BzK-5882	Genzel, Tacconi, Eisenhauer, Foerster, Schreiber, Cox, Cimatti
Q-7	Dust and cold gas in the (new!) brightest known Lyman Break Galaxy	Lutz, Baker, Allam, Tacconi,Genzel, Tucker, Lin
R001	Wind measurements in Venus' mesosphere	Moreno, Lellouch, Moullet, Sagawa
R002	Mapping the D/H ratio in the Martian atmosphere	Fouchet, Moreno, Montmessin, Lellouch
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
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, Andre
R00E	Acetonitrile in Hot Corinos: the origin of complex organic molecules	Ceccarelli, Bottinelli, Neri
R00F	The grain mantle composition in the dark clouds and the hot corino of L1448-mm	Jimenez-Serra, Ceccarelli, Requena-Torres, Martin-Pintado, Bottinelli, Winters

Ident.	Title of investigation	Authors
R010	Kinematic study of Class 0 protostellar cluster L1448	Chen, Launhardt, Henning
R013	The physical state of the disk-like structure around the high-mass protostar NGC 7538S	Parise, Comito, Schilke, Zapata
R014	Testing the "unified" model of bipolar outflows	Santiago-Garcia, Tafalla, Bachiller
R019	Densities and flow in hypercompact HII regions	Keto, Kurtz, Zhang
R01A	Weak-Lined T Tauri Disk Dissipation Dynamics and Timescale: Follow-up of the Spitzer survey. (I) The Taurus Cloud	Duvert, Augereau, Cieza, Duchene, Olofsson, Pinte
R01C	A 3-mm survey of classical T Tauri stars in Taurus	Natta, Neri, Cabrit, Testi
R01E	On the kinematics of the ionized jet in HW2	Martin-Pintado, Jimenez-Serra, Thum
R020	Chemical study of the massive flat disk around R Mon	Alonso-Albi, Fuente, Bachiller, Neri, Testi, Planesas
R022	Unveiling the youngest phase of proto-planetary disks	Wakelam, Dutrey, Guilloteau, Bottinelli, Pietu
R023	Chemistry in the proto-planetary disk of HD163296	Dutrey, Henning, Bacmann, Gueth, Guilloteau, Hersant, Launhardt, Pavluychenkov, Pety
R024	CN(2-1)/CN(1-0) ratio as an excitation condition tracer in proto-planetary disks	Chapillon, Dutrey, Guilloteau, Henning Pavluychenkov, Pety, Pietu, Semenov
R028	Negative ion chemistry: the test of IRC+10216	Guelin, Cernicharo, Agundez, Winters
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
R02C	Feeding the Nuclear Starburst in NGC 6946: III. Chemical tracers at 3mm	Schinnerer, Meier, Emsellem, Boeker
R02E	Phase transitions in the neutral ISM: probing GMC complexes in Nearby Galaxies	Usero, Brinks, Walter, Leroy, deBlok
R030	Origin of molecular gas in E/SO galaxies: NGC 4550 and NGC 7457	Combes, Crocker, Bureau, Young
R033	Is there chemical differentiation in a barred galaxies?	Rodriguez-Fernandez, Downes
R034	Hydrogen Recombination Lines in Arp220: Is there a warped molecular gas disk?	Downes, Thum
R03A	High resolution mapping of cooling filaments around NGC 1275	Salome, Combes, Revaz, Edge, Fabian
R03C	Radio Source Contamination in SZ Surveys	Nord, Salome, Basu, Bertoldi, Menten, Carilli, Boehringer
R03E	Imaging of the kpc-scale Jet in Quasar 3C273	Asada, Uchiyama, Sawada-Satoh, Rao, Vir, Urry
R03F	Molecular gas in highly dust-obscured type-2 quasars: Maximum of mass build up-caught in the act?	Krips, Neri, Cox
R040	Molecular absorption lines in front of B0218+357 and PKS1830-211	Muller, Guelin, Combes
R041	Characterizing the molecular content of absorption-selected starbursts	Bouche, Tacconi, Lutz, Genzel, Zwaan, Murphy, Peroux
R044	Molecular gas in bright lensed LBGs: The SDSS J1206+5142 arc	Lutz, Baker, Lin, Tacconi, Genzel, Allam, Tucker
R045	Excitation of the Dense Molecular Gas in IRAS F10214+4724 at z=2.3	Riechers, Walter, Weiss, Downes, Carilli, Neri, Cox
R047	CO Observations of a Spitzer z~2 ULIRG with Strong PAH Emission	Tacconi, Yan, Lutz, Omont, Frayer, Cox
R048	Molecular Gas Masses and Dynamics in High-z Radio Galaxies	Nesvadba, deBreuck, Lehnert, Walter, Downes, Omont, Neri
R04A	Search for HNC in the Cloverleaf: the role of radiative excitation	Garcia-Burillo, Gracia-Carpio, Planesas, Salome, Guelin, Neri, Cox, Tacconi
R04D	HCN(4-3) observations of submillimetre galaxies	Kraiberg, Knudsen, Greve, Walter
R04F	Imaging the molecular gas reservoirs in massive radio galaxies at high redshift	Greve, Ivison, Smail, Bertoldi
R050	Search for Formaldehyde and Water in APM08279+5255 (z= 3.9)	Salome, Guelin, Garcia-Burillo, Gracia-Carpio, Planesas, Neri, Cox
R053	CO search in an obscured quasar at redshift 4.169	Martinez-Sansigre, Omont, Cox, Rawlings, Willot, Kloeckner
R056	Search for molecular gas in the most distant quasars	Wang, Carilli, Walter, Bertoldi, Menten, Cox, Fan, Strauss, Neri, Omont, Wagg, Jiang, Beelen
R058	Searching for C^+ in the host galaxy of the z=6.43 quasar CFHQS2329	Omont, Willott, Forveille, Beelen, Cox, Neri, Bergeron, Delfosse
R05A	Millimetre observations of GRB afterglows in the SWIFT era (ToO)	Castro-Tirado, Bremer, Bhattacharya Gorosabel, Guziy, Ugarte-Postigo, Jelinek
R05B	The nucleus of 8P/Tuttle	Boissier, Bockelee-Morvan, Biver, Colom, Crovisier, Moreno, Groussin, Jorda, Lamy
R0A6	The optically thick-thin turnover frequency in M81*	Schoedel, Eckart, Krips, Markoff

Ident.	Title of investigation	Authors
R0A8	Probing the XDR/PDR chemistry in the nucleus of M82	Fuente, Garcia-Burillo, Usero, Rizzo, Gerin, Krips, Neri
R0B6	High-Resolution CO Imaging of z<0.1 QSO Host Galaxies	Riechers, Walter, Bertoldi, Cox, Carilli, Fan, Vestergaard
R0BA	Molecular absorption and isotopic ratios at redshifts 0.25 - 0.68	Muller, Guelin
R0E0	The shape of the CO SED beyond its turnover - gas excitation in z>4 QSOs	Weiss, Walter, Downes, Henkel
R-1	Molecular gas in the most distant QSO host galaxies	Carilli, Wang, Walter, Bertoldi, Menten, Cox, Fan, Strauss, Maiolino, Neri, Omont
R-2	Confirming the 2.6mm detection of the circumstellar disk around VV Ser	Alonso-Alibi, Fuente, Neri
R-3	CO(3-2) emission in a lensed UV-selected galaxy with strong Lyα emission	Baker, Lutz, Lin, Tacconi, Genzel, Shapley, Allam, Tucker
R-4	Confirming a candidate z>7 galaxy detected with PdBI 3mm continuum imaging	Daddi, Dannerbauer, Elbaz, Dickinson, Morrison
R-5	Dust and cold gas in the brightest known Lyman Break Galaxy (follow-up)	Lutz, Baker, Allam, Tacconi, Genzel, Tucker, Lin
R-6	Vega	Pietu, Guth
R-7	Is HCO^+ formed through H_2 + CO^+ – HCO^+ + H in diffuse clouds?	Liszt, Pety, Lucas
R-8	Coordinated multi-wavelength observations	Krips, Markoff, Nowak, Schoedel, Eckart
R-9	Comet 17/P Holmes: HCN	Boissier, Bockelee-Morvan, Biver, Crovisier, Colom, Lellouch, Moreno
R-A	Comet 17/P Holmes: HNC	Boissier, Bockelee-Morvan, Biver, Crovisier, Colom, Lellouch, Moreno
R-B	Neutral Carbon CI(2-1) Line at 1mm in 10214+4724	Weiss, Downes, Henkel, Walter
R-D	2mm commissioning: H_2S and H_2CO	Lucas, Pety, Liszt
R-G	Understanding the chemical differentiation in IC342	Rodriguez-Fernandez, Salome, Downes
R-H	2mm-interferometry of a highly magnified Lyman break Galaxy at z=3.07	Neri, Coppin, Smail, Swinbank, Edge, Cox, Ellis

ANNEX II

Publications in 2007

The list of refereed publications, conferences and workshop papers as well as thesis based upon data obtained using the IRAM instruments 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

N°	Title	Authors	Published
1172.	A COMPLETE ^{12}CO 2-1 MAP OF M51 WITH HERA I. Radial averages of CO, HI, and radio continuum	K.F. Schuster, C. Kramer, M. Hitschfeld, S. García-Burillo, B. Mookjerjea	2007, A&A 461, 143
1173.	BAR-DRIVEN MASS BUILD-UP WITHIN THE CENTRAL 50 PC OF NGC 6946	E. Schinnerer, T. Böker, E. Emsellem, D. Downes	2007, A&A 462, L27
1174.	DETECTION OF HNC AND TENTATIVE DETECTION OF CN AT z = 3.9	M. Guélin, P. Salomé, R. Neri, S. García-Burillo, J. Gracía-Carpio, J. Cernicharo, P. Cox, P. Planesas, P.M. Solomon, L.J. Tacconi, P. Vanden Bout	2007, A&A 462, L45
1175.	A HIGHLY COLLIMATED SiO JET IN THE HH212 PROTOSTELLAR OUTFLOW	C. Codella, S. Cabrit, F. Gueth, R. Cesaroni, F. Bacciotti, B. Lefloch, M.J. McCaughrean	2007, A&A 462, L53
1176.	EXTENSIVE MULTIBAND STUDY OF THE X-RAY RICH GRB 050408 A likely off-axis event with an intensive energy injection	A. de Ugarte Postigo, M. Bremer et al.	2007, A&A 462, L57
1177.	THE DEPLETION OF NO IN PRE-PROTOSTELLAR CORES	M. Akyilmaz, D.R. Flower, P. Hily-Blant, G. Pineau des Forêts, C.M. Walmsley	2007, A&A 462, 221
1178.	SIMULTANEOUS SINGLE-PULSE OBSERVATIONS OF RADIO PULSARS V. On the broadband nature of the pulse nulling phenomenon in PSR B1133+16	N.D.R. Bhat, Y. Gupta, M. Kramer, A. Karastergiou, A.G. Lyne, S. Johnston	2007, A&A 462, 257
1179.	THE AMIGA SAMPLE OF ISOLATED GALAXIES: III. IRAS data and infrared diagnostics	U. Lisenfeld, S. Leon et al.	2007, A&A 462, 507
1180.	THE MILLIMETRE VARIABILITY OF M81 Multi-epoch dual frequency mm-observations of the nucleus of M81	R. Schödel, M. Krips, S. Markoff, R. Neri, A. Eckart	2007, A&A 463, 551
1181.	BARRED CO EMISSION IN HE 1029-1831	M. Krips, A. Eckart, R. Neri, T. Bertram, C. Straubmeier, S. Fischer, J.G. Staguhn, S.N. Vogel	2007, A&A 464, 187
1182.	NUclei of GAlaxie V. Radio emission in 7 NUGA sources	M. Krips, A. Eckart, T.P. Krichbaum, J.-U. Pott, S. Leon, R. Neri, S. García-Burillo, F. Combes, F. Boone, A.J. Baker, L.J. Tacconi, E. Schinnerer, L.K. Hunt	2007, A&A 464, 553
1183.	CHEMISTRY IN DISKS I. Deep search for N_2H^+ in the protoplanetary disks around LkCa 15, MWC 480, and DM Tauri	A. Dutrey, T. Henning, S. Guilloteau, D. Semenov, V. Piétu, K. Schreyer, A. Bacmann, R. Launhardt, J. Pety, F. Gueth	2007, A&A 464, 615
1184.	GLOBULAR CLUSTERS AND DWARF GALAXIES IN FORNAX I. Kinematics in the cluster core from multi-object spectroscopy	G. Bergond, E. Athanassoula, S. Leon et al.	2007, A&A 464, L21
1185.	DEUTERIUM FRACTIONATION IN THE HORSEHEAD EDGE	J. Pety, J.R. Goicoechea, P. Hily-Blant, M. Gerin, D. Teyssier	2007, A&A 464, L41

N°	Title	Authors	Published
1186.	ARCSECOND-RESOLUTION ^{12}CO MAPPING OF THE YELLOW HYPERGIANTS IRC+10420 AND AFGL 2343	A. Castro-Carrizo, G. Quintana-Lacaci, V. Bujarrabal, R. Neri, J. Alcolea	2007, A&A 465, 457
1187.	THE INTERACTION OF YOUNG MASSIVE STARS WITH THEIR ENVIRONMENT A millimetre and sub-millimetre line study of NGC 6334 FIR II	J.S. Zhang, C. Henkel, R. Mauersberger, Y.-N. Chin, K.M. Menten, A.R. Tieftrunk, A. Belloche	2007, A&A 465, 887
1188.	THE INTERSTELLAR MEDIUM OF THE ANTENNAE GALAXIES	A. Schulz, C. Henkel, D. Muders, R.Q. Mao, M. Röllig, R. Mauersberger	2007, A&A 466, 467
1189.	PROBING THE STRUCTURE OF PROTOPLANETARY DISKS: A comparative study of DM Tau, LkCa 15, and MWC 480	V. Piétu, A. Dutrey, S. Guilloteau	2007, A&A 467, 163
1190.	ASTRONOMICAL DETECTION OF C_4H^- THE SECOND INTERSTELLAR ANION	J. Cernicharo, M. Guélin, M. Agúndez, K. Kawaguchi, M. McCarthey, P. Thaddeus	2007, A&A 467, L37
1191.	HIGHLY-EXCITED CO EMISSION IN APM 08279+5255 AT z = 3.9	A. Weiss, D. Downes, R. Neri, F. Walter, C. Henkel, D.J. Wilner, J. Wagg, T. Wiklind	2007, A&A 467, 955
1192.	MAGNETIC INTERACTION OF JETS AND MOLECULAR CLOUDS IN NGC 4258	M. Krause, C. Fendt, N. Neininger	2007, A&A 467, 1037
1193.	PdBI SUB-ARCSECOND STUDY OF THE SiO MICROJET IN HH212 Origin and collimation of class 0 jets	S. Cabrit, C. Codella, F. Gueth, B. Nisini, A. Gusdorf, C. Dougados, F. Bacciotti	2007, A&A 468, L29
1194.	THE IC1396N PROTO-CLUSTER AT A SCALE OF ~250 AU	R. Neri, A. Fuente, C. Ceccarelli, P. Caselli, D. Johnstone, E.F. van Dishoeck, F. Wyrowski, M. Tafalla, B. Lefloch, R. Plume	2007, A&A 468, L33
1195.	PROTOSTELLAR CLUSTERS IN INTERMEDIATE MASS (IM) STAR FORMING REGIONS	A. Fuente, C. Ceccarelli, R. Neri, T. Alonso-Albi, P. Caselli, D. Johnstone, E.F. van Dishoeck, F. Wyrowski	2007, A&A 468, L37
1196.	MINKOWSKI'S FOOTPRINT REVISITED Planetary nebula formation from a single sudden event?	J. Alcolea, R. Neri, V. Bujarrabal	2007, A&A 468, L41
1197.	THE NEBULA AROUND THE POST-ABG STAR 89 HERCULIS	V. Bujarrabal, H. Van Winckel, R. Neri, J. Alcolea, A. Castro-Carrizo, P. Deroo	2007, A&A 468, L45
1198.	DISTRIBUTION OF THE MOLECULAR ABSORPTION IN FRONT OF THE QUASAR B0218+357	S. Muller, M. Guélin, F. Combes, T. Wiklind	2007, A&A 468, L53
1199.	BLACK HOLE IN THE WEST NUCLEUS OF ARP 220	D. Downes, A. Eckart	2007, A&A 468, L57
1200.	MOLECULAR GAS IN NUclei OF GAlaxies (NUGA): VI. DETECTION OF A MOLECULAR GAS DISK/TORUS VIA HCN IN THE SEYFERT 2 GALAXY NGC 6951?	M. Krips, R. Neri, S. García-Burillo, F. Combes, E. Schinnerer, A.J. Baker, A. Eckart, F. Boone, L. Hunt, S. Leon, L.J. Tacconi	2007, A&A 468, L63
1201.	FUELLING THE CENTRAL ENGINE OF RADIO GALAXIES I. The molecular/dusty disk of 4C 31.04	S. García-Burillo, F. Combes, R. Neri, A. Fuente, A. Usero, S. Leon, J. Lim	2007, A&A 468, L71
1202.	DISSIPATIVE STRUCTURES OF DIFFUSE MOLECULAR GAS II. The translucent environment of a dense core	P. Hily-Blant, E. Falgarone	2007, A&A 469, 173
1203.	MILLIMETER IMAGING OF HD 163296: PROBING THE DISK STRUCTURE AND KINEMATICS	A. Isella, L. Testi, A. Natta, R. Neri, D. Wilner, C. Qi	2007, A&A 469, 213
1204.	DUST AND MOLECULAR CONTENT OF THE LENSED QUASAR, MG0751+2716, AT z=3.2	D. Alloin, J.-P. Kneib, S. Guilloteau, M. Bremer	2007, A&A 470, 53
1205.	THE AMIGA SAMPLE OF ISOLATED GALAXIES IV. A catalogue of neighbours around isolated galaxies	S. Verley, S. Leon et al.	2007, A&A 470, 505
1206.	MOLECULAR GAS IN NUclei Galaxies (NUGA) VII. NGC 4569, a large scale bar funnelling gas into nuclear region	F. Boone, A.J. Baker, E. Schinnerer, F. Combes, S. García-Burillo, R. Neri, L.K. Hunt, S. Léon, M. Krips, L.J. Tacconi, E. Eckart	2007, A&A 471, 113
1207.	THE CHEMICAL COMPOSITION OF THE CIRCUMSTELLAR ENVELOPES AROUND YELLOW HYPERGIANT STARS	G. Quintana-Lacaci, V. Bujarrabal, A. Castro-Carrizo, J. Alcolea	2007, A&A 471, 551
1208.	THE AMIGA SAMPLE OF ISOLATED GALAXIES. V. Quantification of the isolation	S. Verley, S. Leon et al.	2007, A&A 472,121
1209.	MOLECULAR GAS IN QSO HOST GALAXIES AT z>5	R. Maiolino, R. Neri, A. Beelen, F. Bertoldi, C.L. Carilli, P. Caselli, P. Cox, K.M. Menten, T.Nagao, A.Omont, C.M. Walmsley, F. Walter, A. Weiss	2007, A&A 472, L33
1210.	PARTICULARLY EFFICIENT STAR FORMATION IN M33	E. Gardan, J. Braine, K.F. Schuster, N. Brouillet, A. Sievers	2007, A&A 473, 91

N°	Title	Authors	Published
1211.	NUCLEAR STARBURST-DRIVEN EVOLUTION OF THE CENTRAL REGION IN NGC 6764	S. Leon, A. Eckart, S. Laine, J.K. Kotilainen, E. Schinnerer, S.-W. Lee, M. Krips, J. Reunanen, J. Scharwächter	2007, A&A 473, 747
1212.	STAR FORMATION IN ISOLATED AMIGA GALAXIES: DYNAMICAL INFLUENCE OF BARS	S. Verley, F. Combes, L. Verdes-Montenegro, G. Bergond, S. Leon	2007, A&A 474,43
1213.	THE DARK NATURE OF GRB 051022 AND ITS HOST GALAXY	A.J. Castro-Tirado, M. Bremer, R. Neri et al.	2007, A&A 475, 101
1214.	PHYSICAL CHARACTERISTICS OF A DARK CLOUD IN AN EARLY STAGE OF STAR FORMATION TOWARD NGC 7538. An outer Galaxy infrared dark cloud?	Frieswijk, W.W.F., Spaans, M., Shipman, R.F., Teyssier, D., Hily-Blant, P.	2007, A&A 475, 263
1215.	THE INNERMOST REGION OF THE WATER MEGAMASER RADIO GALAXY 3C 403	A. Tarchi, A. Brunthaler, C. Henkel, K.M. Menten, J. Braatz, A. Weiss	2007, A&A 475, 497
1216.	MASS LOSS FROM DUSTY, LOW OUTFLOW-VELOCITY AGB STARS II. The multiple wind of EP Aquarii	J.M. Winters, T. Le Bertre, J. Pety, R. Neri	2007, A&A 475, 559
1217.	SUPERLUMINAL NON-BALLISTIC JET SWING IN THE QUASAR NRAO 150 REVEALED BY MM-VLBI	I. Agudo, M. Bremer et al.	2007, A&A 476, L17
1218.	THE EARLIEST PHASES OF HIGH-MASS STAR FORMATION: A 3 SQUARE DEGREE MILLIMETER CONTINUUM MAPPING OF CYGNUS X	F. Motte, S. Bontemps, P. Schilke, N. Schneider, K.M. Menten, D. Broguière	2007, A&A 476, 1243
1219.	ORGANIC CHEMISTRY IN THE DARK CLOUDS L1448 AND L183: A UNIQUE GRAIN MANTLE COMPOSITION	M.A. Requena-Torres, N. Marcelino, J. Jiménez-Serra, J. Martín-Pintado, S. Martín, R. Mauersberger	2007, ApJ 655, L37
1220.	ANATOMY OF HH 111 FROM CO OBSERVATIONS: A BOW-SHOCK-DRIVEN MOLECULAR OUTFLOW	A. Lefloch, J. Cernicharo, B. Reipurth, J. Ramon Pardo, R. Neri	2007, ApJ 658, 498
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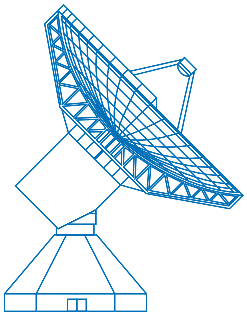
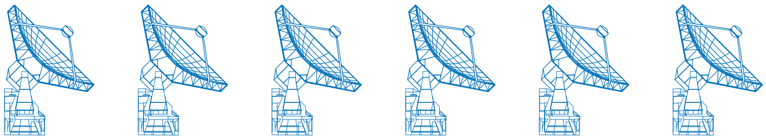


30-meter diameter telescope, Pico Veleta



6 x 15 metre interferometer, Plateau de Bure

The Institut de Radioastronomie Millimétrique (IRAM) is a multi-national scientific institute covering all aspects of radio astronomy at millimeter wavelengths: the operation of two high-altitude observatories – a 30-meter diameter telescope on Pico Veleta in the Sierra Nevada (southern Spain), and an interferometer of six 15 meter diameter telescopes on the Plateau de Bure in the French Alps – the development of telescopes and instrumentation, radio astronomical observations and their interpretation.

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