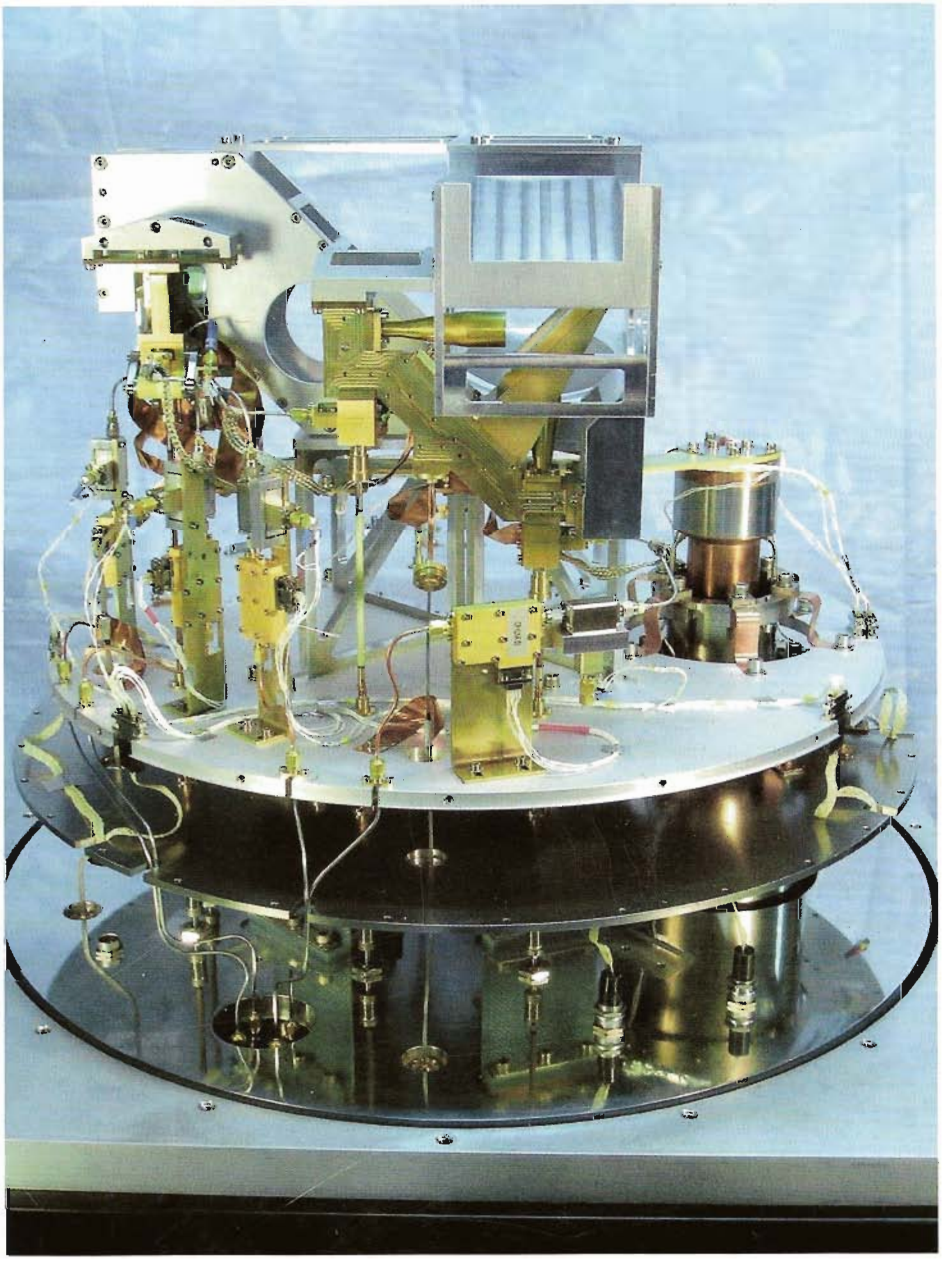
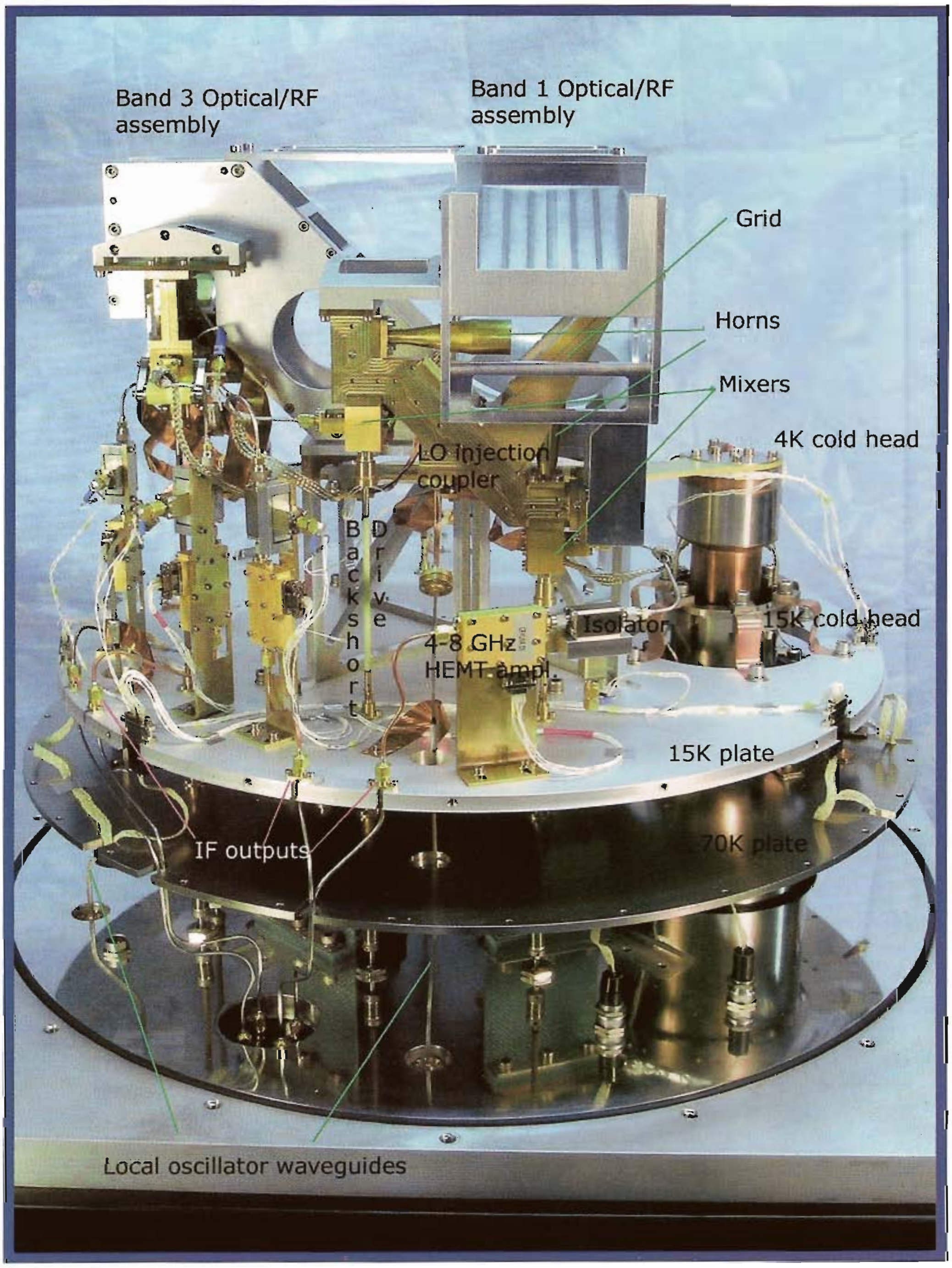
IRAM 2004



ANNUAL REPORT



Front Cover: The first unit of the next generation Plateau de Bure receivers which will contain 4 bands in dual polarization. The present unit is equipped with band 1 (3 mm) and band 3 (1.3 mm) receivers. Cooling to 4 K is achieved by a Sumitomo closed-cycle cryocooler.

ANNUAL REPORT

2004

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1. INTRODUCTION

In 2003, the IRAM Executive Council had decided to appoint an external Visiting Committee to evaluate IRAM's current achievements and the longer-term perspectives for its two observatories, the 30m-telescope on Pico Veleta, and the 6-element Interferometer on the Plateau de Bure, especially in the ALMA era. In preparation for this evaluation, a workshop had been held in December 2003 with members from the scientific community, and a White Paper was written by the IRAM Management early in 2004, in which the current scientific and technical activities were summarised and possible future developments, both scientific and technical ones, identified.

The Visiting Committee met at the IRAM Headquarters in Grenoble in the spring of 2004. C. Carilli, R. Hills, M. Longair, and P. Vanden Bout (Chairman) were able to attend, R. Ekers kindly agreed to participate in the preparation of the report on the basis of the written material that has been distributed and on the basis of the discussions with the other committee members. The findings and recommendations were delivered to the Executive Council at its annual meeting in June 2004 by Paul Vanden Bout. Basically, the Visiting Committee confirmed that IRAM's current activities meet international standards, and that IRAM has an important role to play as a leading institute in millimetre wavelength radio astronomy at least until 2014, and probably well beyond this date.

IRAM hopes that the results of this evaluation will allow the IRAM partners to extend already in 2005 the contract which has first been signed between the CNRS and the MPG for a 30 years period in 1979, and re-signed in 1990 when the IGN joined as 3rd partner, beyond its current limit date of 2009 to at least 2014.

As part of this "preparing the future" activity, the Executive Council has taken a number of important personnel decisions at its June 2004 meeting: Michel Guelin's appointment as Deputy Director, which would have ended in September 2004, was extended until the end of 2004, and Pierre Cox was appointed as the new Deputy Director for 2005. In 2006, Pierre Cox will become the new IRAM Director, succeeding Michael Grewing whose mandate was extended by one year until the end of 2005.

Concerning IRAM's activities in 2004, this Annual Report gives an account of the scientific highlights, and of the technical achievements and developments underway.

On the scientific side, extragalactic studies of dust and molecules in distant sources continues to produce spectacular results, and it is safe to predict that with the next generation of Plateau de Bure receivers (see cover page), which offer significantly enhanced performance, the hunt for more detail in distant objects will continue for years to come. The way in which use is made of the mapping capabilities of the 30m-telescope with its bolometric and heterodyne array receivers on the one side, and the possibilities of very sensitive follow-up observations with the PdB interferometer, is a unique asset to the users of the IRAM telescopes, and a model for future observing strategies.

Concerning access to the IRAM telescopes, there has been a new development in 2004: as part of the activities within the EU-funded RadioNet project, transnational access to existing facilities is now officially supported, and both the 30m-telescope and the PdBI participate in this program at the 5% level. Given the fact that access had been granted already in the past, purely on a scientific merit basis, the possibility to have at least some financial compensation is highly welcome.

As far as technical developments are concerned, we can report a lot of progress on frontends, backends and on the software developments, and, as explained in Chapter 5, this holds not only for IRAM's own projects but also for development work done under contract for ALMA, for ESA's Herschel mission (HIFI), and the EU-funded AMSTAR project. Special mention must be made of the successful completion of the ALMA band 7 prototype receiver which not only meets but substantially exceeds the required specifications.

A concern remains for IRAM the absence of a reliable access to the Plateau de Bure observatory. Last year we had reported that a tunnel plus elevator project had been chosen as baseline solution, and indeed everything was ready in the summer of 2004 to execute this project except the final "go ahead" from the environmental office. Several considerations then led to the cancellation of this plan, and IRAM, together with the CNRS-INSU, started to look at a private, small road solution as an alternative. This is the current new baseline solution.

IRAM has continued its series of Summer School by organising the 4th school on Millimeter Interferometry. It took place from November 22nd to 27th, 2004, and was attended by 55 young scientists from 10 different countries despite the fact that only very limited financial support could be provided. IRAM intends to continue this series of schools as part of the activities in radio astronomy at European level, and hopefully with funding from the EU in the future.

2. HIGHLIGHTS OF RESEARCH WITH THE IRAM TELESCOPES IN 2004

2.1 SUMMARY

Among the projects at the IRAM telescopes done or published in 2004, a few highlights were:

- **An extraordinary gravitational lens**: CO lines and dust in three widely-separated images of the galaxy SMM J16359+66 at $z = 2.5$, behind the galaxy cluster Abell 2218.
- **Neutral carbon in high-redshift sources**: After the redshifted 809-micron line detected in 2003, the redshifted 610-micron line has now been detected in the lensed quasars H1413+117, IRAS F10214+4224, PSS 2322+1944, and in the lensed starburst galaxy SMM J14011+0252.
- **High-z radio galaxies:** Detection of two massive CO systems in 4C 41.17 at $z = 3.8$.
- **Interacting galaxies:** Molecular gas in the tidal tail in Stephan's Quintet.
- **Gamma Ray Bursts:** Millimeter light curve of the GRB030329 afterglow.
- **Galactic molecular clouds:** Small hydrocarbon molecules mapped in the photo-dissociation region in the Horsehead nebula.
- **Young stars:** Discovery of a highly collimated, high-velocity outflow from a low-luminosity star in the Taurus molecular cloud.
- **Polarization of Molecular Lines:** New measurements of the polarization of millimeter-wavelength methanol masers.
- **Disks around young massive stars:** High resolution studies of gas and dust in four disks around young, massive stars in G24.8+0.1 and G31.4+0.3.
- **Protoplanetary nebulae:** The unusual structure of the Frosty Leo protoplanetary nebula.
- **Solar system:** More size estimates of optically bright Kuiper Belt Objects based on mm-wavelength data.

2.2 EXTRAGALACTIC RESEARCH

An extraordinary gravitational lens.

One of the most exciting millimeter results of 2004 was the detection of CO(3-2) in all three images of the lensed submillimeter galaxy SMM J16359+6612, at a redshift of 2.5168. This object lies in a rare high-magnification configuration behind the massive galaxy cluster Abell 2218 at $z = 0.175$, that strongly amplifies the emission from the otherwise faint background galaxy into three images. The three images are magnified by factors of 22, 14, and 9, and the maximum image separation is 41 arcsec, much larger than any other lens system detected at radio wavelengths. The discovery is explained by Kneib et al. 2004, MNRAS, 349, 1211. The galaxy was originally found as three submillimeter sources in maps made with the SCUBA array on the JCMT in 1998 and 2000. Optical images taken with the HST in 2000 showed faint sources that could be identified with the submillimeter sources. The optical sources were then observed at the Keck telescope in 2003, to obtain Hα redshifts of 2.516. The CO(3-2) lines were then detected with the OVRO array by Sheth et al. 2004, ApJ, 714, L5 , and with the IRAM Interferometer by Kneib et al. 2005, A&A 434, 819. The IRAM observations also detected the CO(7-6) line and the 1.3mm continuum for the brightest of the three images. Synchrotron radio emission has also been found at 1.4 GHz (WSRT) and 8.2 GHz (VLA) by Garrett et al., 2005, A&A, 431, L21. This is the first time that cm-radio emission has been detected in a *multiply*-imaged submm galaxy lensed by a foreground cluster.

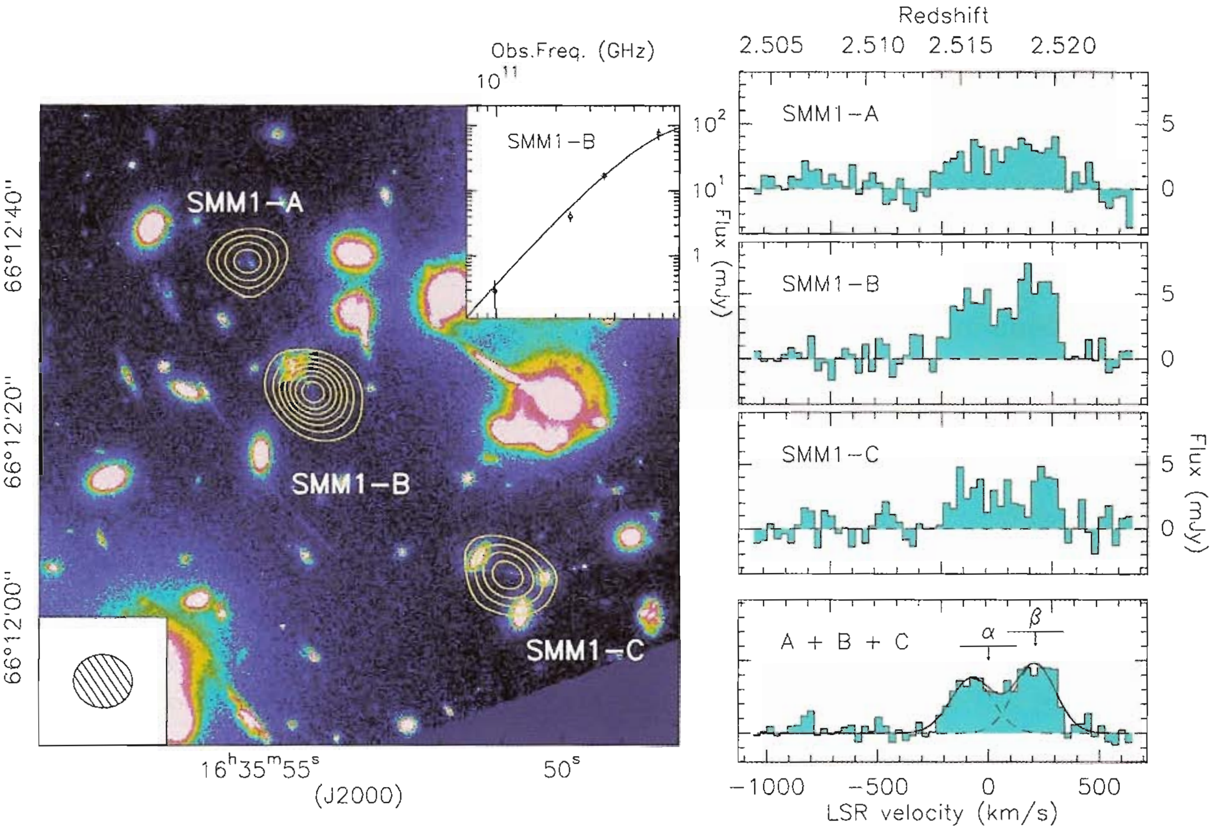


Fig. 2.1: IRAM CO detection toward the multiply-imaged z=2.5 galaxy SMM J16359+6612. *Left:* IRAM Interferometer CO(3-2) contours from the three images of the same galaxy, superposed on a Hubble Space telescope optical image of a 1 x 1 arcmin field within the Abell 2218 cluster of galaxies.. Most of the overexposed white objects in the optical image are galaxies in the foreground cluster. The long colored arcs are lensed images of other galaxies behind the cluster. The *middle inset* shows the millimetre continuum spectrum of the dust emission. The *right panels* show the IRAM CO(3-2) spectra, with the *lowest spectrum* being the mean of the CO spectra from all three images (Kneib et al. 2005, A&A 434, 819).

Correcting for the total magnification of 45 means that the true flux densities of this galaxy would be only 0.1 mJy at the peak of the CO(3-2) line and only 0.8 and 0.2 mJy in the dust continuum at 850μm and 1.2mm, respectively. These are values expected from typical high-redshift galaxies (Lyman break galaxies), but are below the detection limits of most current surveys. The gravitational lens thus provides a rare opportunity to study a typical, faint, high-redshift galaxy. The IRAM observations reproduced above show that the CO(3-2) line has two velocity components, each 220 km/s wide, and 280 km/s apart. The two velocity components are separated by 1 arcsec, which is 3 kpc, after correction for lensing. The molecular gas mass is about 3×10^9 Msun. The IRAM observers conclude that the source may be a compact merger of two Lyman-break galaxies, with the two nuclei separated by 3 kpc.

New detections of neutral carbon from high-redshift quasars and galaxies.

In 2003, the *upper* fine structure line of neutral carbon, CI($^3P_2$ -- $^3P_1$), normally at an emitted wavelength of 370 microns, was detected with the IRAM interferometer, redshifted to 1.3mm, in the Cloverleaf quasar (2003, Weiss et al. A&A, 409, L41). In 2004, new detections have been made of the *lower* fine structure line of neutral carbon, CI($^3P_1$ -- $^3P_0$), normally at an emitted wavelength of 610 microns, in several sources (**Fig. 2.2**). Weiss et al. (2005, A&A, 429, L25) used the 30m telescope, to detect this carbon line redshifted to 2mm in the type 2 quasar IRAS F10214+4724 (z= 2.3), in the submillimeter starburst galaxy SMM J14011+0252 (z = 2.57), and again in the Cloverleaf quasar (z = 2.56; the new, high signal-to-noise detection in the Cloverleaf confirms the earlier result at the 30m telescope by Barvainis et al. 1997). Another new detection was made by Pety et al. (2004, A&A, 428, L21) who used the IRAM Interferometer to observe this same carbon line in the quasar PSS 2322+1944 at z =4.12, this time with the 610 micron line redshifted to 3mm. The conclusions from analysing these lines are as follows. Line ratios are consistent with an excitation temperature of ~30 K for the carbon atoms, so the line obviously comes from a relatively cool region several hundred parsecs away from the quasar, and in regions of dense molecular gas typical of starburst regions. The carbon and CO linewidths are the same, implying that both lines trace similar circumnuclear regions of molecular gas. The derived carbon masses are of the order of a few times 10^7 Msun in all four objects, and the luminosity ratio of the CI-610-micron line to the CO(3-2) line is 0.2, similar to the values found in nearby galaxies. The implied abundance of *neutral, atomic* carbon is 5×10^{-5}, i.e., the same as in the interstellar medium of the Milky Way, which implies significant metal enrichment of the cold molecular gas in these four high-redshift objects. The cooling of the molecular interstellar medium due to the neutral carbon lines is about 6 times smaller than that due to the lines in the CO ladder, which is in turn about 10^{-4} times the power radiated by the dust in the far-infrared continuum.

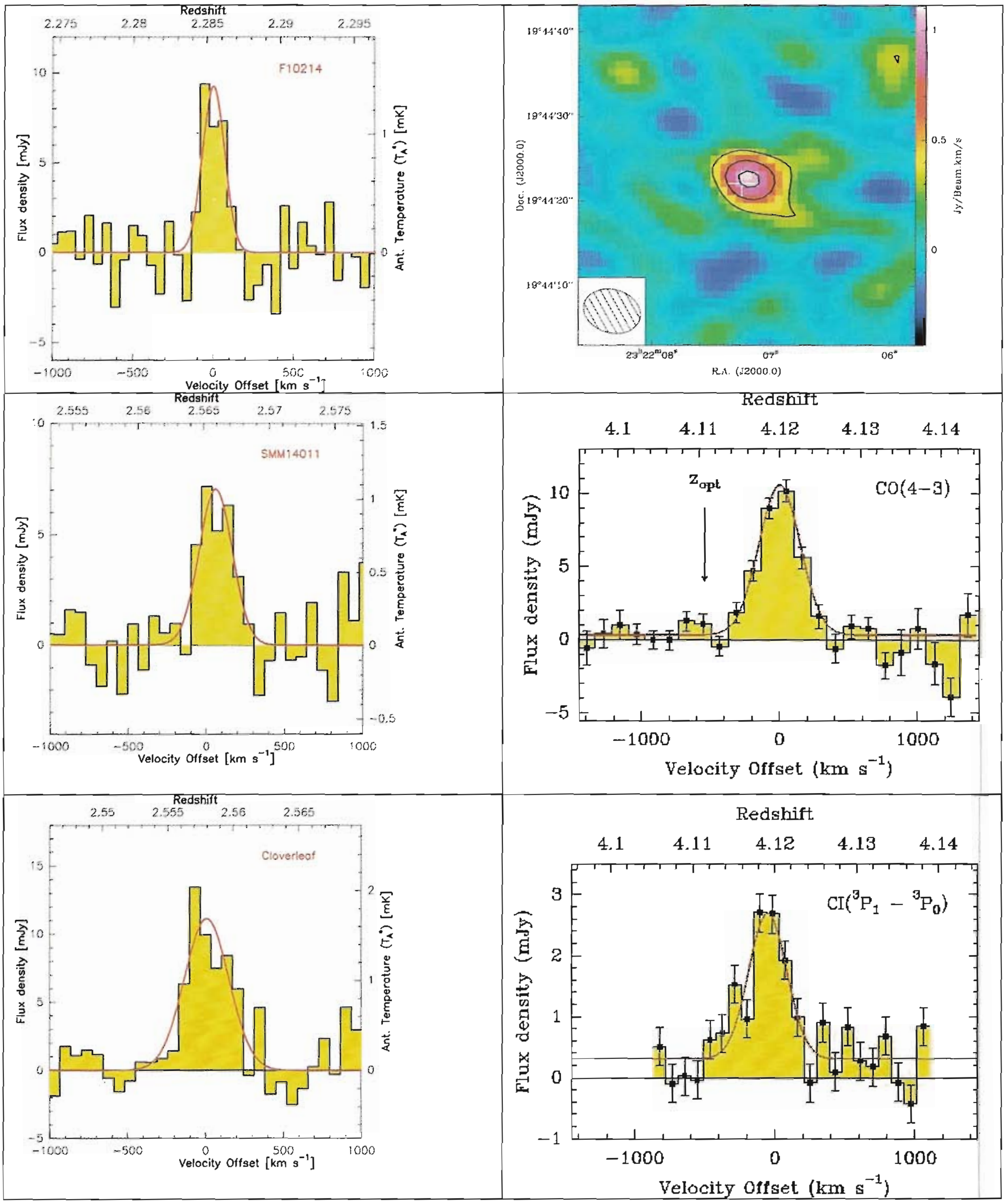


Fig. 2.2: New detections of neutral carbon from high-redshift quasars and galaxies.
Left column: The neutral carbon $^3P_1$-$^3P_0$ fine structure line at 492 GHz, redshifted to 149 GHz in the quasar IRAS F10214, to 138.0 GHz in the starburst galaxy SMM J14011, and to 138.3 GHz in the Cloverleaf quasar, all detected at the IRAM 30m telescope (Weiss et al. 2005, A&A, 429, L25).
Right column: The same line, detected with the IRAM Interferometer, in the quasar PSS 2322. Top: the carbon-line appears as a point source in the interferometer's 6″ beam. Middle: spectrum of the CO(4-3) line in PSS 2322, redshifted to 90 GHz. Bottom: spectrum of the carbon-line, redshifted to 96.1 GHz (Pety et al. 2004, A&A, 428, L21).

High-redshift radio galaxies: Detection of two massive CO systems in 4C 41.17 at z = 3.8. Because of its high luminosity and large angular extent, 4C 41.17 is the most-studied radio galaxy at high redshift (Fig. 2.3).

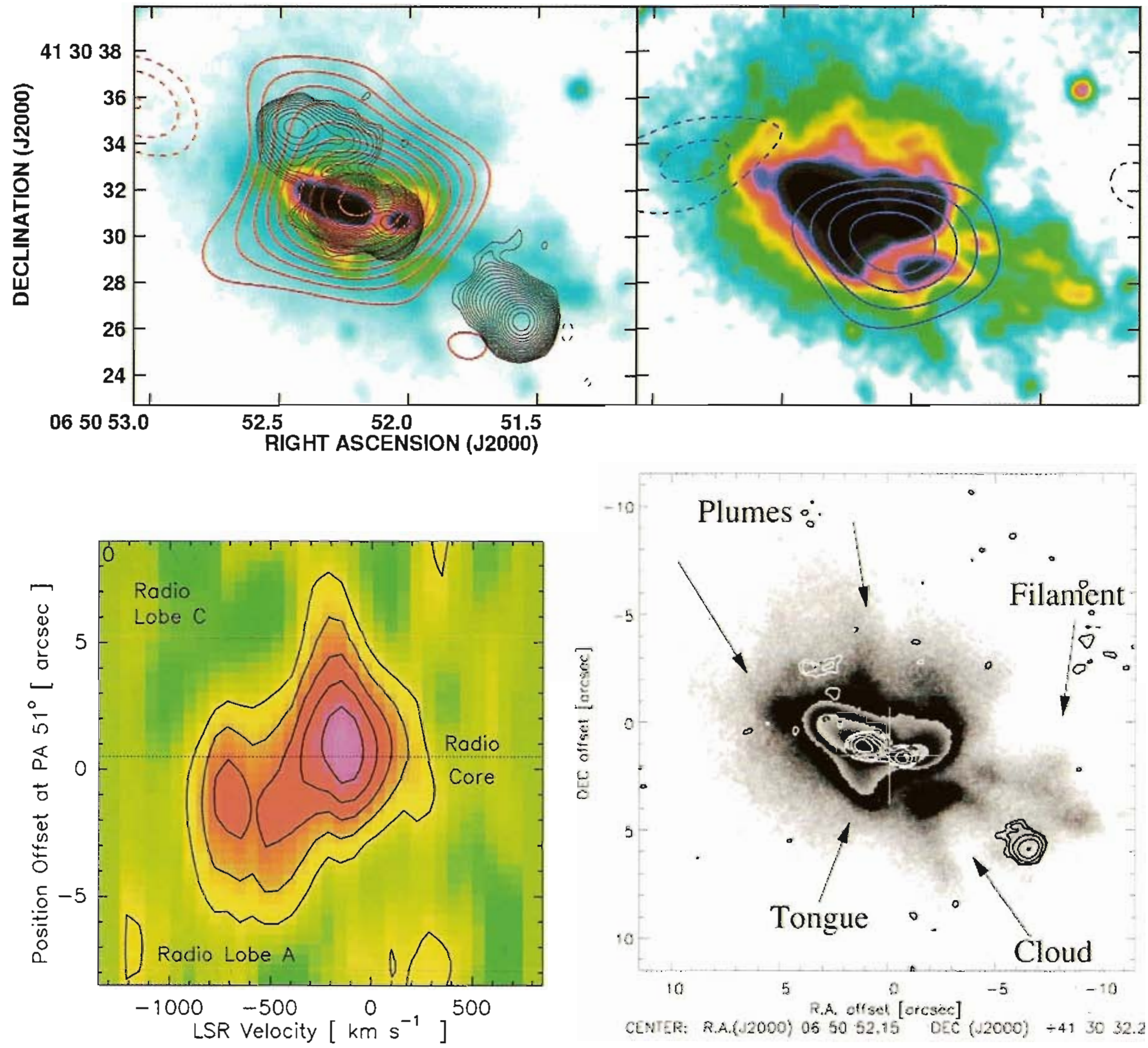


Fig. 2.3: Molecular gas in the powerful High-redshift galaxy 4C41.17 at z = 3.8. *Upper left:* CO(4-3) detected with the IRAM Interferometer (De Breuck et al. 2005, A&A, 430, L1), shown in red contours for the molecular gas surrounding the center of the radio galaxy, superposed on the 20-cm radio jet contours (black; from Carilli et al. 1994) and the Lyman alpha image (green-blue at low intensity, yellow-red-black at high intensity; from Reuland et al. 1993). *Upper right:* A similar superposition, for the second, blueshifted, CO component (shown in white/blue contours), coincident with the trough in the optical image. *Lower left:* Position-velocity diagram for the CO(4-3) line along the major axis of the radio source; contour steps are 0.4 mJy in the 6″ beam. *Lower right:* Details of the Lyman alpha image, with the 6-cm radio jet contours superposed (Reuland et al. 2003, ApJ, 592, 755).

On visible and near-IR images, the forming "galaxy" is actually a dozen starburst clumps that are clustered around the central proto-galaxy containing the radio source, generated by a massive black hole. In time, all of these clumps will probably merge with the proto-galaxy at the center, to evolve into a massive elliptical galaxy. The highly active formation phase is indicated by the UV continuum emission that extends over 70 kpc around this system, an even larger Lyman-alpha halo, and an extended X-ray halo. Although thermal emission from cold dust was detected from this radio galaxy 10 years ago (Dunlop et al. 1994), searches for molecules have been unsuccessful. The first detection has now been made with the IRAM Interferometer by De Breuck et al. (2005, A&A, 430, L1), who observed the CO(4-3) line. The CO appears to be in two massive (6 x 10^{10} Msun) objects separated by 13 kpc and by 400 km/s in velocity. These proto-galactic objects coincide with two different dark lanes in deep Lyman-alpha images.

The main CO component coincides with the cm-radio core of the radio galaxy. The second CO component is near the base of an optical cone-shaped region southwest of the radio nucleus, that resembles the emission-line cones seen in nearby AGNs and starburst galaxies. The properties of the CO and the mm dust continuum are similar to those in nearby ultraluminous IR galaxies and in some other high-redshift radio galaxies and quasars. The fact that 4C41.17 contains two CO systems is further evidence for the role of mergers in the evolution of galaxies at high redshifts.

Interacting galaxies: Molecular gas in the tidal tail from NGC 7319 in Stephan's Quintet.
New observations have been made with both the IRAM Interferometer and the 30m telescope, of the CO emission toward *intergalactic* star forming regions in the tidal tail from the galaxy NGC 7319 in the compact group of galaxies known as Stephan's Quintet. Because the 30m telescope detects twice as much flux as the interferometer, about half of the molecular gas must be on scales of ~15 arcsec (6 kpc) to which the interferometer is not sensitive. There is an elongated CO source near the dense region labeled Stephan's Quintet-B (SQ-B), that may evolve to become a tidal dwarf galaxy. There is also a second, unresolved CO source at the tip of the optical tidal tail (**Fig. 2.4, lower**). Both CO sources coincide with dust lanes on HST images, and the CO peak also lies on the Hα line peak. The CO velocities and linewidths agree with those of HI and Hα, so the molecular gas must be associated with the optical tidal tail. The similarities of the line profiles suggest that both the *molecular* and the *atomic* gas have been expelled from NGC 7319 into the intergalactic space that separates the group members. New optical spectra taken with the Calar Alto 3.5m telescope show that the oxygen abundance in these intergalactic regions is relatively high, about solar abundance, implying that the gas feeding the star formation in the tidal tail must have originated in the metal-rich inner regions of the parent galaxy rather than in its lower-metallicity outer disk. The star

formation rate within the molecular region SQ B is 0.5 Msun/yr, one of the highest values so far measured *outside of* galaxies. The 12CO/13CO ratio is 25, much higher than typical values in molecular clouds in galaxy disks, so the 12CO must have a relatively modest opacity. (Lisenfeld et al. 2004, A&A, 426, 471).

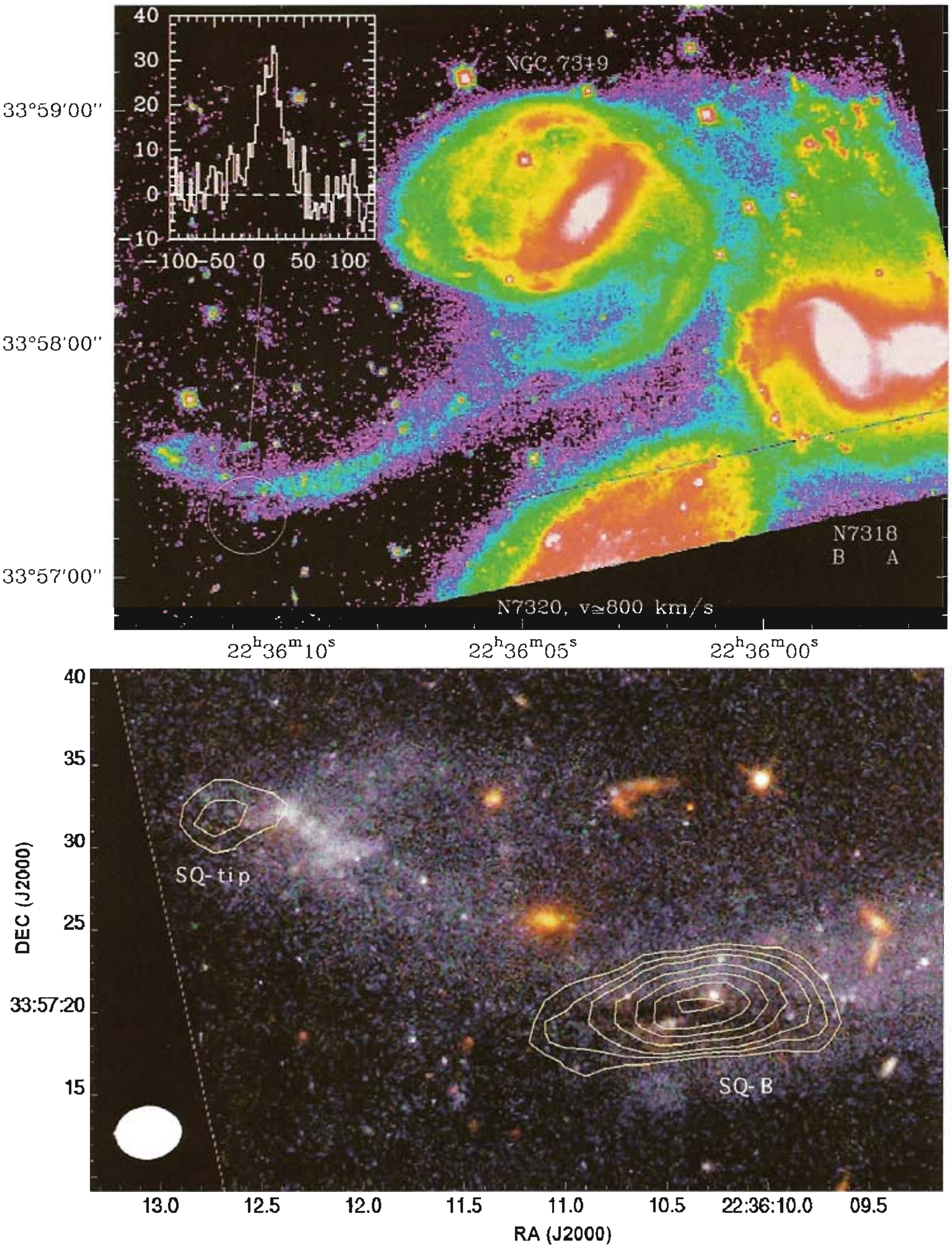


Fig. 2.4: Molecular and ionized gas in the tidal tail in Stephan's Quintet.
Upper: Stephan's quintet, in the Hubble Space Telescope (HST) V-band false-color mosaic, showing the tidal tail that extends from the galaxy NGC7319. The inset shows the tidal tail's CO(1-0) emission that was discovered several years ago at the 30m telescope (Braine et al. 2001, A&A, 378, 51). *Lower:* The same CO emission, observed in follow-up observations with the IRAM Interferometer (Lisenfeld et al. 2004, A&A, 426, 471). The CO contours are superposed on an HST image from Gallagher et al. 2001, AJ, 122, 163.

2.3 GAMMA-RAY BURSTS

Millimeter Light Curve of the GRB030329 Afterglow

During the past seven years, there has been increasing evidence that long-duration (>2sec) gamma-ray bursts (GRBs) arise in the core collapse of massive stars and the birth of a black hole. These bursts are the most brilliant of all astronomical explosions, and can be seen all across the universe. The gamma-ray burst of 29 March 2003 was a unique event, because the spectral signature of an unusual class of supernovae, a Type Ic supernova (SN2003dh) appeared in the optical transient a few days after the burst (Stanek et al. 2003, ApJ, 591, L17; Hjorth et al. 2003, Nature, 423, 847) and thus provided the first unambiguous evidence of the long-suspected association between GRBs and supernovae. The burst was also spectacular, because at a redshift of 0.1685 (distance 870 Mpc), it was the second-nearest GRB for which an afterglow has been observed, and the optical and radio afterglow of this burst was one of the brightest detected so far.

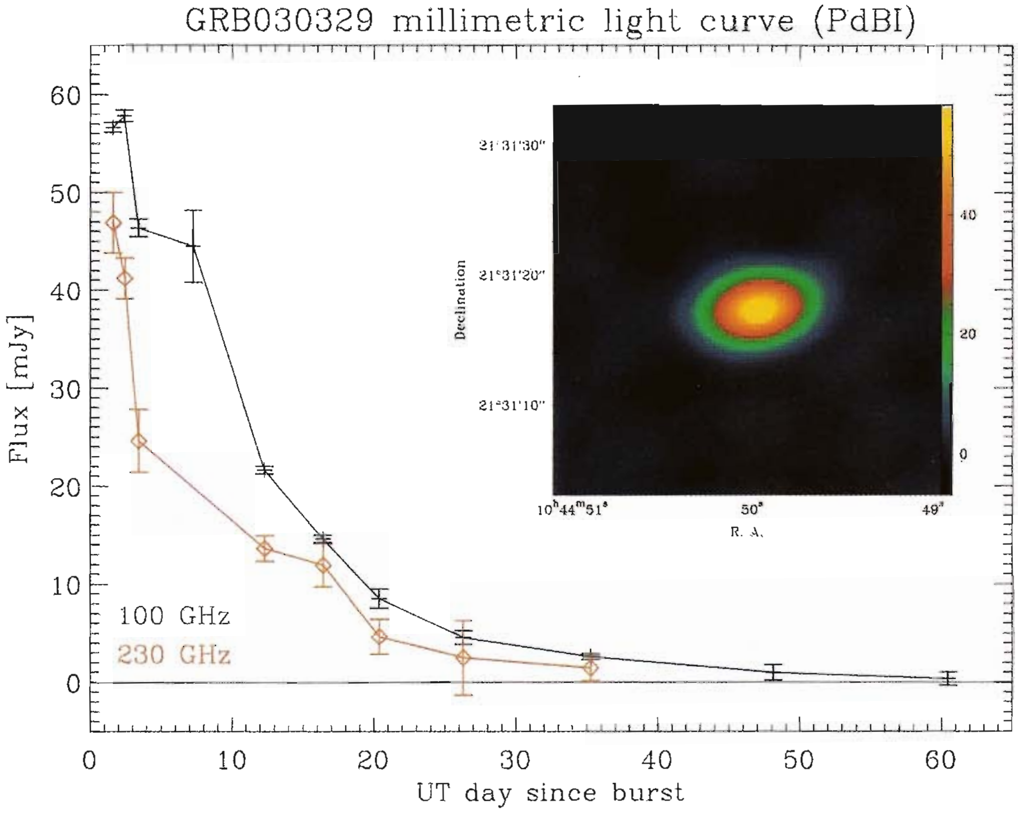


Fig. 2.5: Light curve of the millimeter afterglow of the Gamma Ray Burst 030329. The data are from the IRAM Interferometer at 3mm (blue curve) and from the interferometer and the IRAM 30m telescope at 1.3mm (orange curve; the 30m data are from Sheth et al. 2003, ApJ, 595, L33). The inset shows the 3mm interferometer map made near the peak of the burst. Composite diagram provided by M. Bremer.

Recent analyses of the data collected after the burst have provided the best millimetre light curves for the afterglow of a gamma ray burst so far. Observations at 3mm and 1.3 mm with the IRAM Interferometer and at 1.2 mm with the IRAM 30m telescope followed the burst for a month after its occurrence (Fig. 2.5).

The above figure shows that at 3mm, the afterglow reached a peak flux density of 60 mJy, about 10 times greater than most of the other gamma-ray burst sources detected so far at millimetre wavelengths. The gamma-ray burst itself is known to be highly beamed, and the millimetre observations also support a (double) jet model for the afterglow (Resmi, Bremer et al. 2005, A&A, in press).

2.4 MOLECULAR CLOUDS IN OUR GALAXY

Maps of small hydrocarbons the photo-dissociation region in the Horsehead nebula.

The Horsehead nebula in Orion was mapped with the IRAM Interferometer, in the 3mm lines of the molecules CCH, c-C_3H_2, C_4H, ^{12}CO, and $C^{18}O$. The edge of the nebula is a Photo-Dissociation Region (PDR) viewed edge-on. Comparison of the CO, H_2, and 7.7μm emission shows that the gas pressure is constant (at $P = 4.10^6$ Kkm/s) across the PDR from the illuminated side to the dark side (Habert et al. 2005, A&A, in press). A very intriguing result is that CCH, c-C_3H_2, and C_4H are all seen in the UV-irradiated gas, with abundances that are nearly as high as those in dense molecular cores that are well-shielded against UV radiation. Models based on purely gas-phase chemistry have underestimated the abundances of the small hydrocarbons like CCH and c-C_3H_2. The new maps show that the small hydrocarbons mapped with the interferometer are well correlated with the polycyclic aromatic hydrocarbons (PAHs) mapped at 7.7μm by the *ISO* satellite **(Fig. 2.6)**. It is thus likely that the intense far-UV radiation from the star σ Ori is breaking up the PAHs into small hydrocarbons. (Pety et al., 2005, A&A, in press).

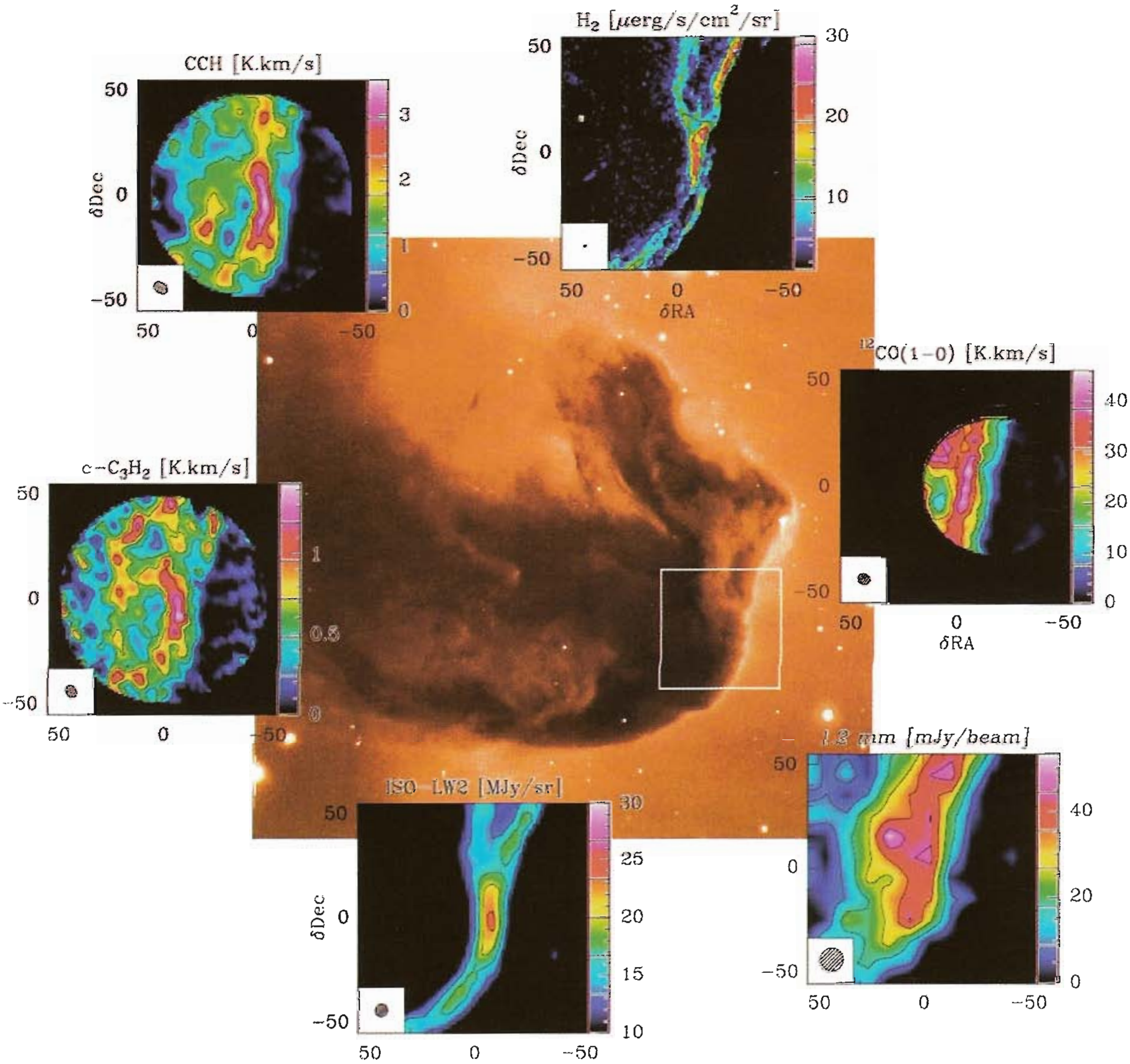


Fig. 2.6: Molecules and dust in the Photo-Dissociation Region at the edge of the Horsehead nebula. The central picture is an optical composite image, in the *B, V,* and *R* bands, of the Horsehead nebula, taken at the ESO VLT. The white box in the central image shows the region mapped in CCH, c-C_3H_2, C_4H, ^{12}CO, and $C^{18}O$ with the IRAM Interferometer (Pety et al. 2005, A&A, in press), as well as the 1.2mm dust continuum mapped at the 30m telescope (Teyssier et al. A&A, 417, 135), the H_2 v=1-0 S(1) line mapped at the ESO NTT (Habart et al. 2004, 2005), and the PAH emission at 7.7 μm mapped with the ISO-LW2 instrument (Abergel et al. 2003 A&A, 410, 577). Coordinate offsets in the individual maps are in arcsec.

2.5 YOUNG STARS

A highly collimated, high-velocity outflow in Taurus.

New CO(2-1) observations with the 30m-telescope and the HERA multibeam receiver array have revealed a highly-collimated, high-velocity outflow from the low-luminosity (0.4 Lsun) source IRAS 04166+2706 in the Taurus molecular cloud. The flow contains gas that has been accelerated to at least 50 km/s relative to the ambient cloud, in both the red and blue-shifted components of the flow, making this the first high-velocity flow found in the Taurus cloud. At the highest velocities, the innermost connected region of the flow is 220″ long, and its width is unresolved by the 11″ beam, so the collimation factor (length-to-width) is greater than 20, making this one of the most collimated outflows known. The fast-moving gas has multiple intensity maxima, and is probably due to the acceleration of the ambient molecular gas by a time-variable, jet-like stellar wind. The mechanical power in the outflow is greater than 15% of the power radiated by the star, and when scaled for luminosity, the outflow parameters are comparable to those of other high-velocity outflows like L1448. All this shows that even the very quiescent star-forming mode characteristic of the Taurus cloud can nevertheless produce objects powering very high energy flows. (Tafalla et al. 2004, A&A, 423, L21).

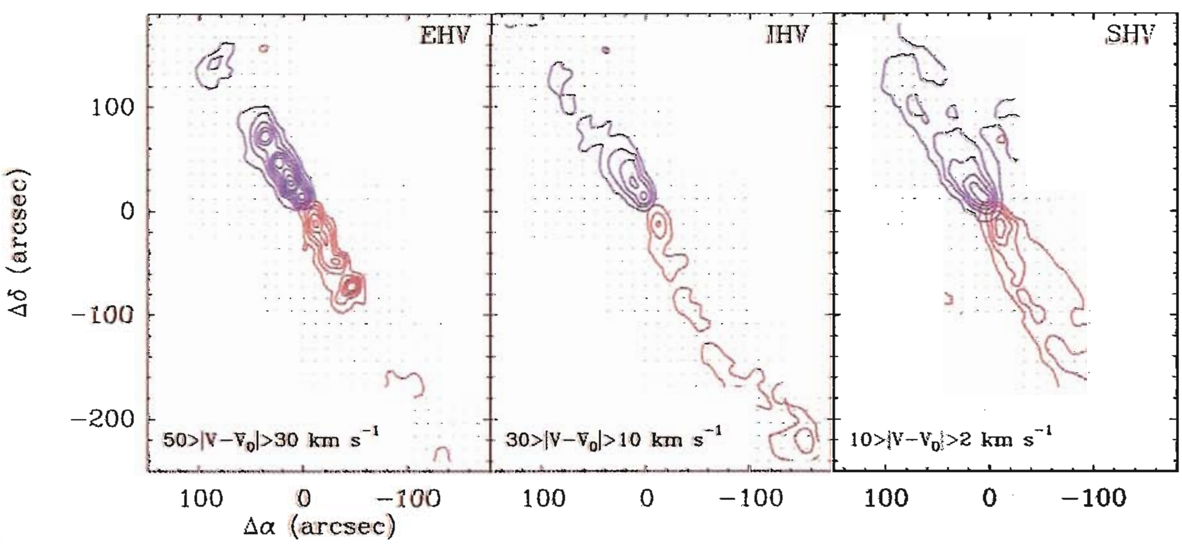


Fig. 2.7a: CO in outflow from the highly-collimated, high-velocity outflow from IRAS 04166 in Taurus. CO(2-1) intensity in the velocity ranges indicated in the bottom left of each box, for the extreme high velocities (EHV, left panel), intermediate high velocities (IHV middle panel) and standard high velocities (SHV, right panel) with contours every 1 K km/s for the EHV and IHV, and every 3 K km/s for the SHV.

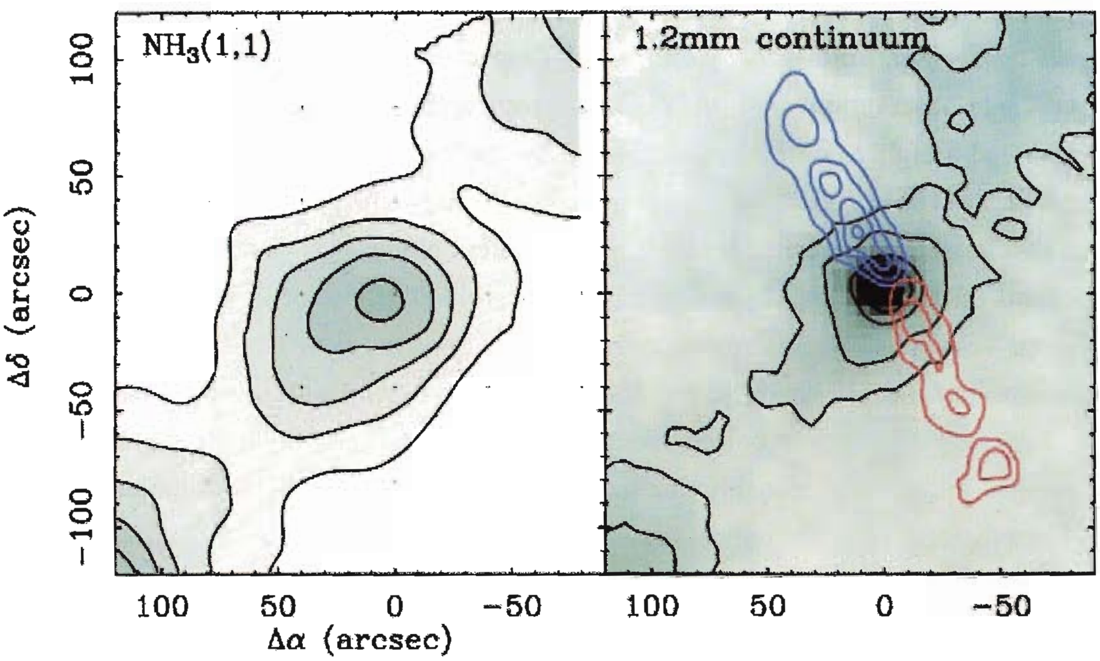


Fig. 2.7b: CO in outflow from the highly-collimated, high-velocity outflow from IRAS 04166 in Taurus. Comparison of the ammonia (1,1) map made with the Effelsberg 100m telescope, showing the ridge and the dense core, with the dust continuum emission at 1.2mm mapped at the 30m telescope, with the EHV CO outflow superposed. (Tafalla et al. 2004, A&A, 423, L21).

2.6 INTERSTELLAR MOLECULES

Polarization of millimeter-wavelength methanol masers

The 30m telescope has been used to measure the polarization of mm-wavelength methanol (CH_3OH) masers in several lines from 84 to 157 GHz. This survey was made possible by a new polarimeter at the 30m telescope that has greatly improved polarization sensitivity and is able to measure all four Stokes parameters simultaneously. Methanol masers of Class I are near ultra-compact H II regions and high-velocity outflows, where collisional pumping is important. Class II methanol masers often coincide with OH masers and are thought to be pumped by IR radiation. Linear polarization was found in more than half the observed objects and circular polarization was tentatively detected in two sources. The highest linear polarizations were found in the class I maser at 133 GHz in L379 (40% polarized), and in the class II maser at 157 GHz in G9.6+0.2 (37% polarized). In interesting result for NGC 7538 is that for both maser classes, there is a good agreement between the polarization angles measured for the methanol masers and those measured for the submillimeter dust continuum.

Because the polarization angles of the methanol masers can depend on the direction of propagation relative to the magnetic field, this result is further evidence that the dust grains near NGC 7538 are aligned by magnetic fields (**Fig. 2.8**). (Wiesemeyer, Thum, & Walmsley 2004, A&A, 428, 478).

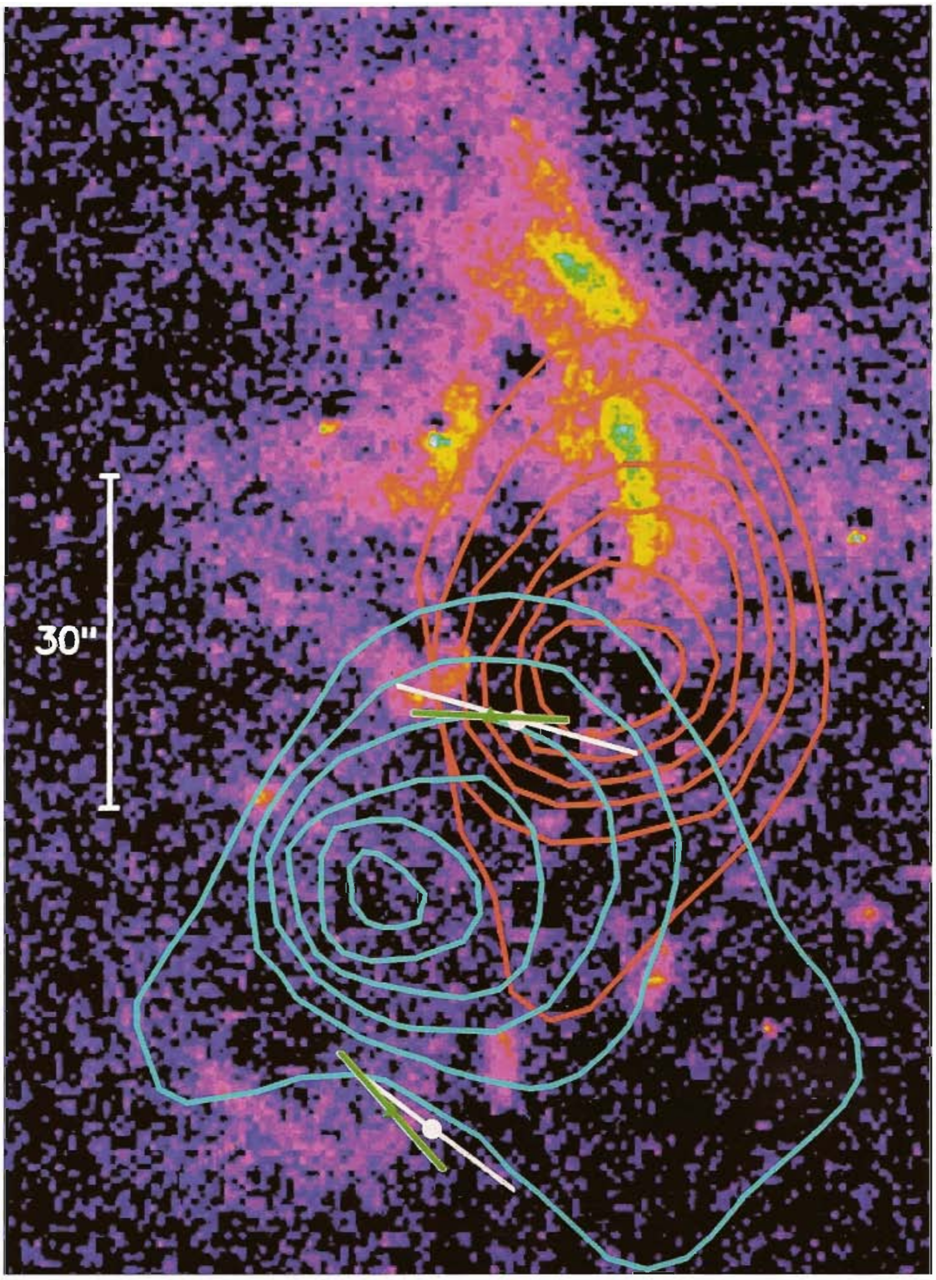


Fig. 2.8: Polarization of methanol masers near the ultracompact H II regions and IR sources in NGC 7538. The polarization angles of the 107 and 133 GHz methanol masers are indicated by the white bars at the IRS1 maser (center) and at a second maser to the south. These maser polarization angles agree well with the 870μm dust polarization angles (green bars Momose et al. 2001, ApJ, 555, 855). The contours show the extent of the red- and blue-shifted CO outflows (Kameya et al. 1989, ApJ, 339,22), and the background color image shows the 2.2μm emission of molecular hydrogen, a tracer of shocked gas (Davis et al. 1998, AJ, 115, 1118). This composite diagram is from Wiesemeyer et al. 2004, A&A, 428, 479.

Rotating disks around high-mass young stellar objects**.**

How do high mass stars form? Unlike low-mass stars, the high-mass objects should reach the zero-age main sequence while they are still deep inside their dust cocoons. Ignition of thermonuclear reactions should then inhibit further accretion by radiation pressure and strong stellar winds. This means the massive stars cannot continue accreting isotropically, but must be doing so only in the plane of a massive accretion disk. A new search with the IRAM Interferometer in the 1.4 mm line of methal cynanide (CH_3CN (12-11)) has revealed four rotating massive disks in two regions of high-mass star formation, G24.8+0.1 and G31.4+0.3. The disks are perpendicular to the previously-known bipolar outflows from these objects. The derived values of the gas mass in the disks is larger than the dynamical mass obtained from the observed radii and velocities, suggesting that these disks may not be stable objects. The estimated accretion rates onto the embedded protostars are estimated to be about 10^{-2} Msun /yr. (Beltran et al., 2004, ApJ, 601, L187).

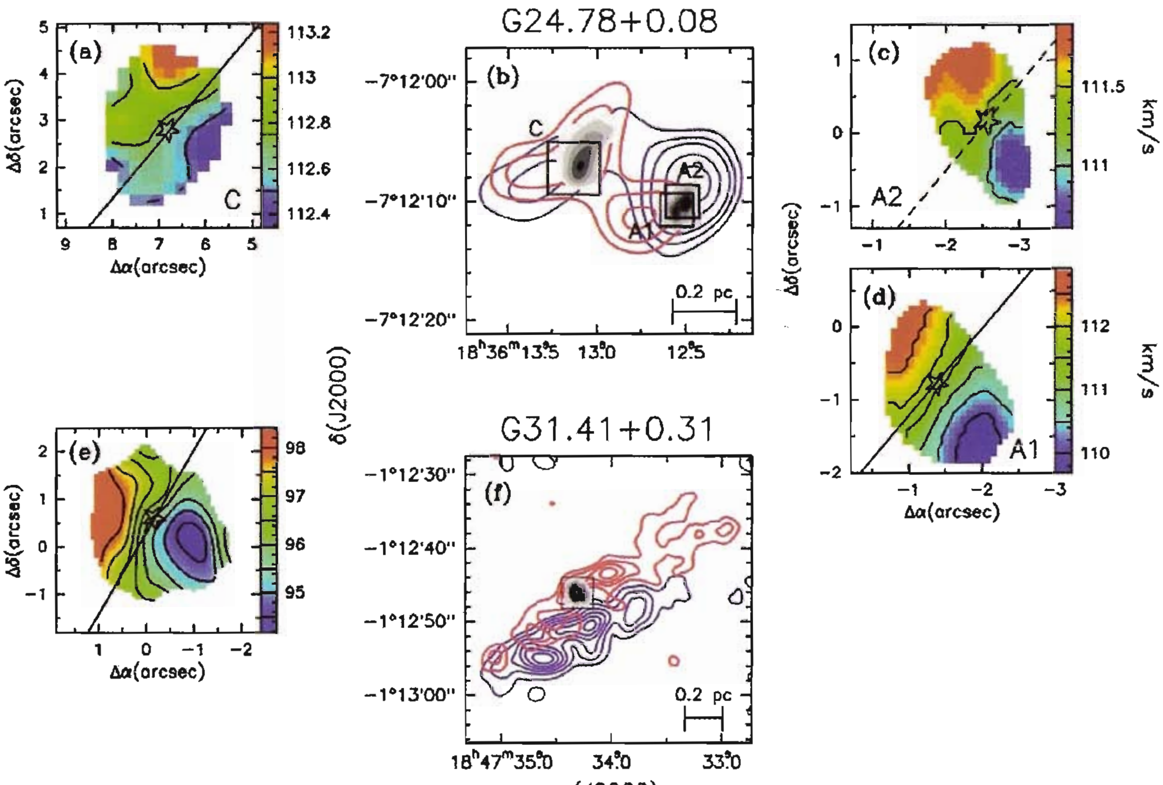


Fig. 2.9: Rotating disks around high-mass young stellar objects. ***(a)*** Velocity contours of the CS(3-2) line from G24C; the velocity scale, in km/s, is shown in the wedge on the right of the panel. The star symbol marks the mm continuum peak, and the straight line shows the outflow axis. ***(b)*** Comparison of the CO(1-0) bipolar outflow (blue and red contours, Furuya et al. 2002), the CH_3CN (12-11) line emission from G24A1 and A2 (grey scale, from the IRAM Interferometer), and the CS(3-2) emission from G24C (grey scale, Furuya et al. 2002). ***(c, d, e)*** Velocity contours of the CH_3CN (12-11) line toward G24A2, A1, and C, respectively. ***(f)*** Comparison of the ^{13}CO(1-0) outflow from G31.4+0.3 observed by Olmi et al. (1996) with the CH_3CN (12-11) emission mapped with the IRAM Interferometer. This composite diagram is from Beltran et al. 2004, ApJ, 601, L187.

2.7 PROTOPLANETARY NEBULAE

The unusual structure of the Frosty Leo protoplanetary nebula.

When evolved stars end their giant phase, their circumstellar evelopes will eventually become planetary nebulae, ionised by the hot stellar remnant. On the way to this state, the former circumstellar envelopes become "protoplanetary nebulae" for a few thousand years. Because of this short lifetime, only a few such objects are known. Those few objects that have been well-studied appear to have a central molecular disk, perpendicular to the symmetry axis of the optical nebula, which is formed by bi-conical outflows from stars in this phase of their evolution. These outflows produce the protoplanetary nebula, whose shape may be preserved later on, when the star becomes much hotter, and ionises its surroundings to form a planetary nebula. The usual interpretation is that the disk is the remnant of the giant star's circumstellar envelope that has not been accelerated by the star's outflows, that occurred preferentially in the polar directions, normal to the remnant disk. At first glance this scenario might be thought to describe the protoplanetary nebula known as Frosty Leo (the infrared source IRAS 09371+12). New evidence from the IRAM Interferometer however, shows that this object is quite unusual. Neither its compact molecular disk nor its high-speed molecular outflows seem to be related to the main symmetry axis of the optical bipolar nebula **(Fig. 2.10).**

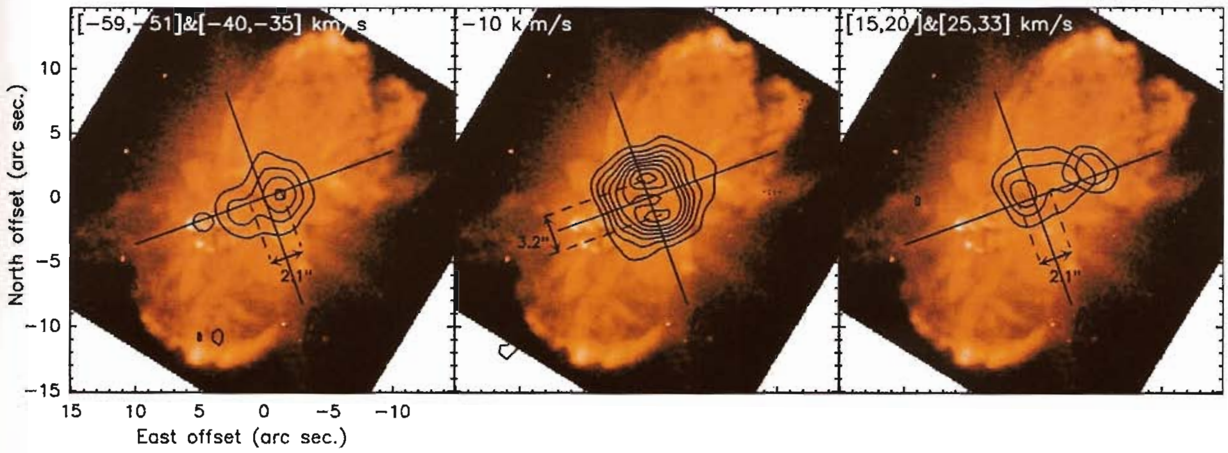


Fig. 2.10: Evidence for a rotating disk in the Frosty Leo protoplanetary nebula. The diagrams show contours of CO(2-1) intensity integrated over the velocity ranges indicated, in the blue-shifted outflow *(left)*, in the central ring *(middle)*, and the red-shifted outflow *(right)*. The straight lines show the symmetry axes of the central ring, projected on the sky. The CO contours are superposed on the HST image (from Sahai et al. 2000). Note that the molecular gas is concentrated in the central 6″, while the optical bipolar nebula has a size of 27″. The IRAM interferometer maps of CO(2-1) were made with a 2.0″ x 1.7″ beam. (Castro-Carrizo et al. 2004, A&A, 431, 979).

The observers propose the following interpretation: The initial bipolar ejection occurred 2500 to 3500 years ago, creating the optical bipolar nebula, with a size of 27". These large-scale optical lobes no longer contain CO molecules because the CO has been by now photodissociated by interstellar photons. The central molecular ring is indeed the remant of the giant star's circumstellar envelope, that was mostly unaffected by the initial bipolar ejection, but which has since been modified by subsequent ejections, in the form of jets, in unusual directions. The more recent ejections may be the two jets detected in CO, with velocities up to 70 km/s. As a result of these molecular jets, and other jets seen in the optical, the disk itself has acquired an expansion velocity of 30 km/s, and is now oriented at 40° relative to the direction of the original bipolar ejection. The distance of this object is not well-known (estimates range from 1 to 4 kpc), but a distance-independent quantity is the ratio of mechanical pressure in the winds to the radiation pressure of the star. For the Frosty Leo object, this ratio is $2x10^5$, one of the highest ever observed in a protoplanetary nebula. Surprisingly, most of this excess of the mechanical wind pressure is in the central ring, rather than in the molecular jets, unlike most other protoplanetary nebulae (Castro-Carrizo et al. 2004, A&A, 431, 979).

2.8 SOLAR SYSTEM

More millimeter size estimates of optically bright Kuiper Belt Objects.

It is currently thought that about 100,000 objects larger than 100 km are orbiting the sun beyond the planet Neptune in a region known as the Edgeworth-Kuiper Belt. These objects do not have the same reflection spectra as the asteroids in the main inner belt between Mars and Jupiter, and their composition may be unchanged since the formation of the solar system. Their total mass is about 100 times the mass of the earth. Some of these objects (the "Centaurs") probably interacted with Neptune and got pushed from the outer Kuiper-belt region into the zone between Jupiter and Neptune's orbits. For the brightest of these objects, with known orbits, one may use the blackbody formula and measured millimetre fluxes to estimate sizes. The first Centaur to be observed with the 30 m telescope was Chiron, which was shown to have a diameter of 168 ± 20 km (Altenhoff & Stumpff, 1995, A&A, 293, L41). A second object, Chariklo, found with the optical Spacewatch telescope in 1997, was observed with the MPIfR 37-channel bolometer array on the 30 m telescope and was shown to have a diameter of 268 ± 19 km (Altenhoff, Menten, & Bertoldi, 2001, A&A, 306, L9).

In the past three years, observations at the 30 m telescope with the MPIfR 117-channel bolometer array have yielded size measurements or size upper limits for some more of the largest Kuiper Belt objects (Altenhoff et al. 2004, A&A, 415, 771). These include:

Name	Distance from Sun	Diameter	Measured with
Chiron	8.3 AU	168 ± 20 km	IRAM 30 m, HST
Chariklo	12.6 AU	268 ± 19 km	IRAM 30 m
Huya	29.6 AU	< 540 km	IRAM 30 m
1999 TC36	31.6 AU	609 ± 100 km	IRAM 30 m
1995 SM55	39.4 AU	< 701 km	IRAM 30 m
Chaos	41.9 AU	< 742 km	IRAM 30 m
Ixion	42.2 AU	< 804 km	IRAM 30 m
Quaoar	42.6 AU	1200 ± 200 km	IRAM 30 m, HST
1966 TO66	46.5 AU	< 897 km	IRAM 30 m
2002 TC302	48.5 AU	< 1200 km	IRAM 30 m
Sedna	90 AU	< 2000 km	IRAM 30 m

Among the more recent observations, the most striking result was the detection of the binary Kuiper Belt object 1999 TC36. This remarkable object **(Fig. 2.11)** was recognized by Trujillo and Brown in 2002 to be an optical binary, with a brightness difference of about 2 magnitudes. If the mean geometric albedo of 0.05 is the same for both members of the binary, then the 1.2mm detection at the 30m telescope implies component diameters of 566 and 225 km (Altenhoff et al. 2004, A&A, 415, 771).

For extensive information on the Edgeworth-Kuiper Belt Objects, see the website of D. Jewitt at http://www.ifa.hawaii.edu/faculty/jewitt/kb.html and the website of Mike Brown at http://www.gps.caltech.edu/~mbrown.

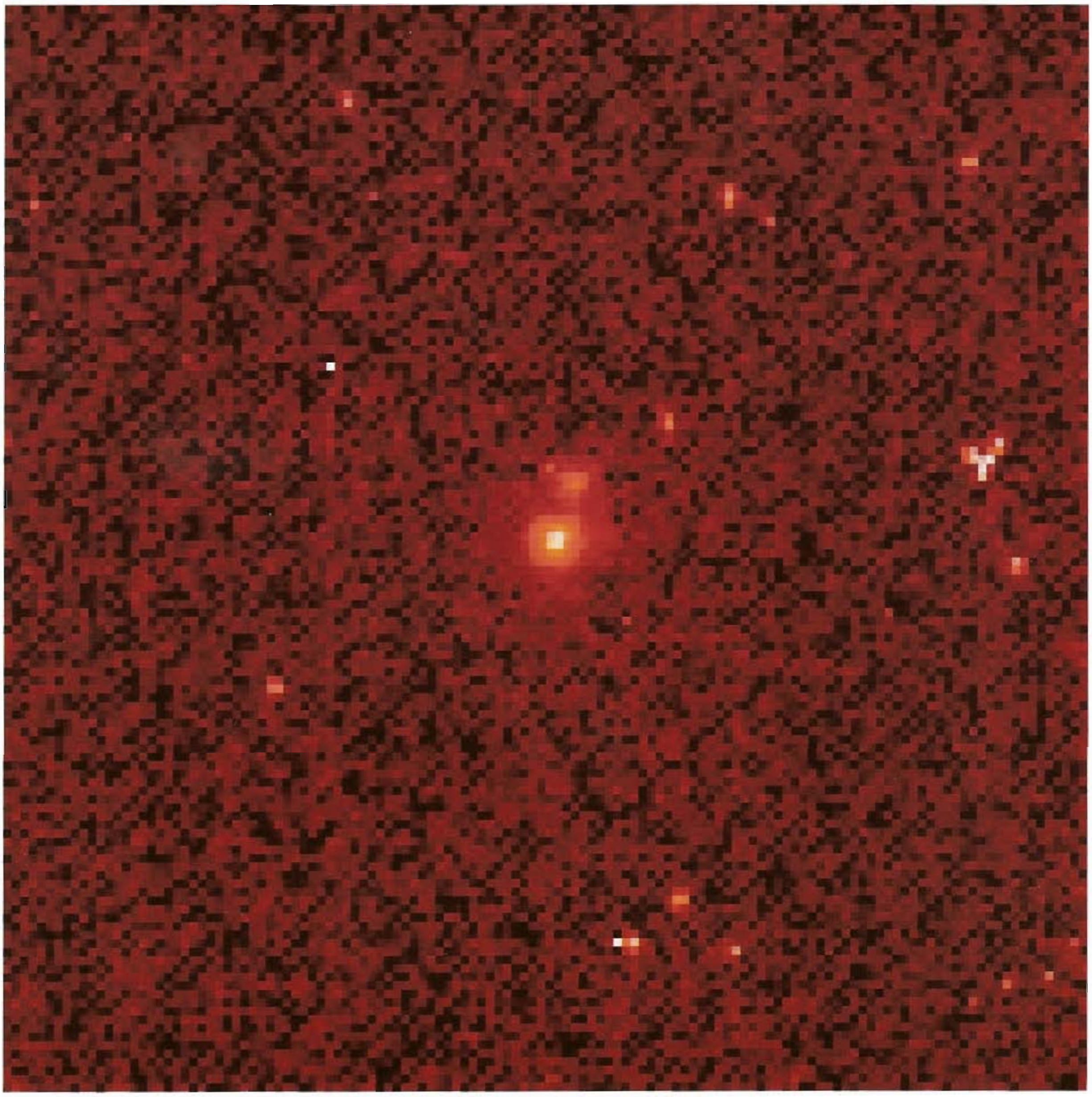


Fig. 2.11: Hubble Space Telescope image of the trans-Neptunian object 1999 TC36. This is a raw image, including cosmic-ray hits and CCD defects (white pixels), taken on 8 December 2001. The object TC36 is in the center, with its fainter companion toward the upper right. The separation between the main object and its companion is about 0.4 arcsec. North is 19 degrees clockwise from vertical. (*image:* C. Trujillo, Cal Tech).

3. PICO VELETA OBSERVATORY

3.1. Staff Changes

Jean-Francois Desmurs from the IRAM Granada Astronomy Group left the Institute on 15.2.2004 to work at the OAN in Madrid. Ramon y Cajal fellow Miguel Ángel Pérez Torres has left IRAM on 1.4.2004. In July 2005 Víctor Espigares was hired as a junior software engineer.

3.2. 30-m Telescope Operation

Operation in 2004 went generally smoothly with about 2/3 of the total time available for observations.

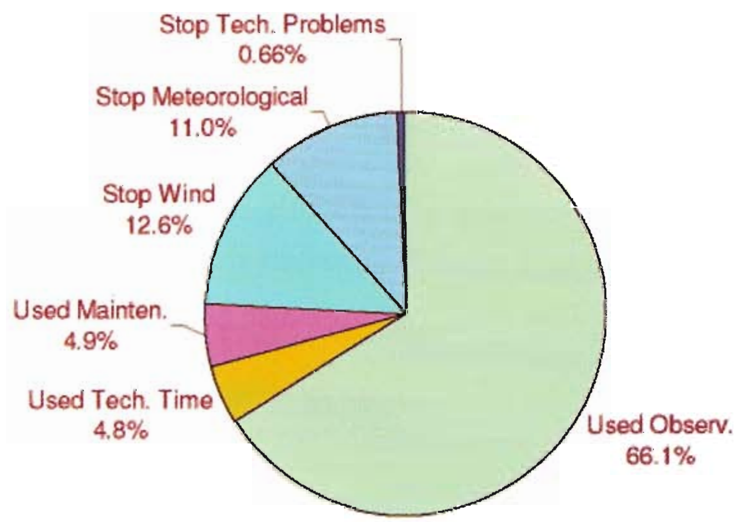


Fig. 3.1: Time distribution at the IRAM 30-m telescope in 2004

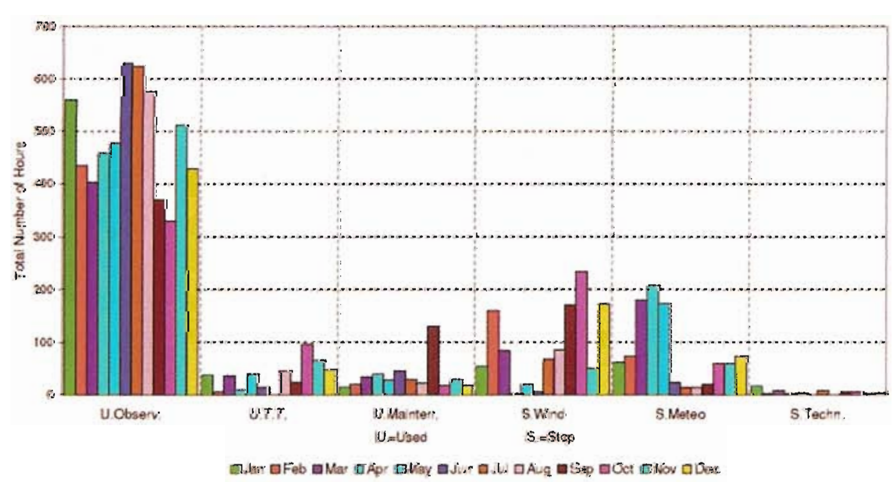


Fig. 3.2: Monthly time distribution at the IRAM 30m telescope (U.Observ.=used for observations, UTT=used for technical tests, U.Mainten.=maintenance time).

As in the previous two years, IRAM offered both during the winter 2003/4 (Dec 2003 till April 2004), and during the fall of 2004 (mid October till mid November) pooled observations at the 30m telescope. Participation in the observing pool is still voluntary, but the demand is increasing because of the obvious advantages for projects that require excellent weather conditions, such as bolometer observations. These are mixed in the pool with suitable heterodyne backup projects that can be observed in less than optimum atmospheric conditions.

In total, almost a third of the yearly observing time was allocated for the pooled observations (16.5 weeks). 77 projects participated in the pool (48 in the winter, 29 in the summer) out of which 36 had been rated "A" by the program committee, and the remainder "B".

Almost 60% of the scheduled pool time was actually used for astronomical observations. Slightly more than 40% of the allocated time was lost, mainly due to bad weather conditions. This number is similar to that of the previous year. About 60% of the useful observing time was dedicated to bolometer observation, and about 40% to heterodyne backup projects. The detailed distribution of pool observing time is shown in Fig. 3.3.

Within the pool, the average success rate of A rated projects requiring good weather conditions was ~90% during the winter pool and almost 100% in the summer session. The completeness of programs achieved within both pools is show in Fig. 4.

This needs to be compared to roughly 25% of good weather periods during the pool sessions, which demonstrates the advantages of flexible scheduling.

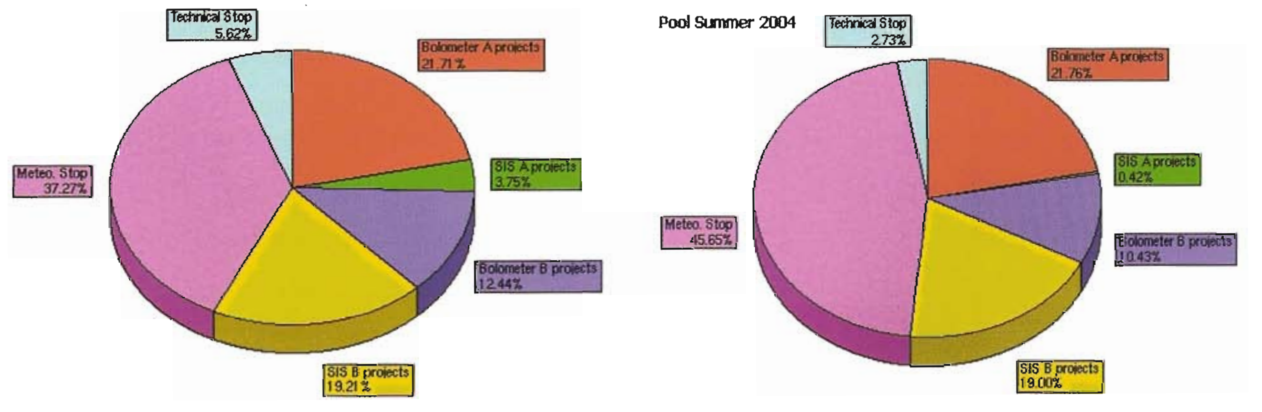


Fig. 3.3: Observing time distribution within the winter (left) and summer (right) pool observations 2004.

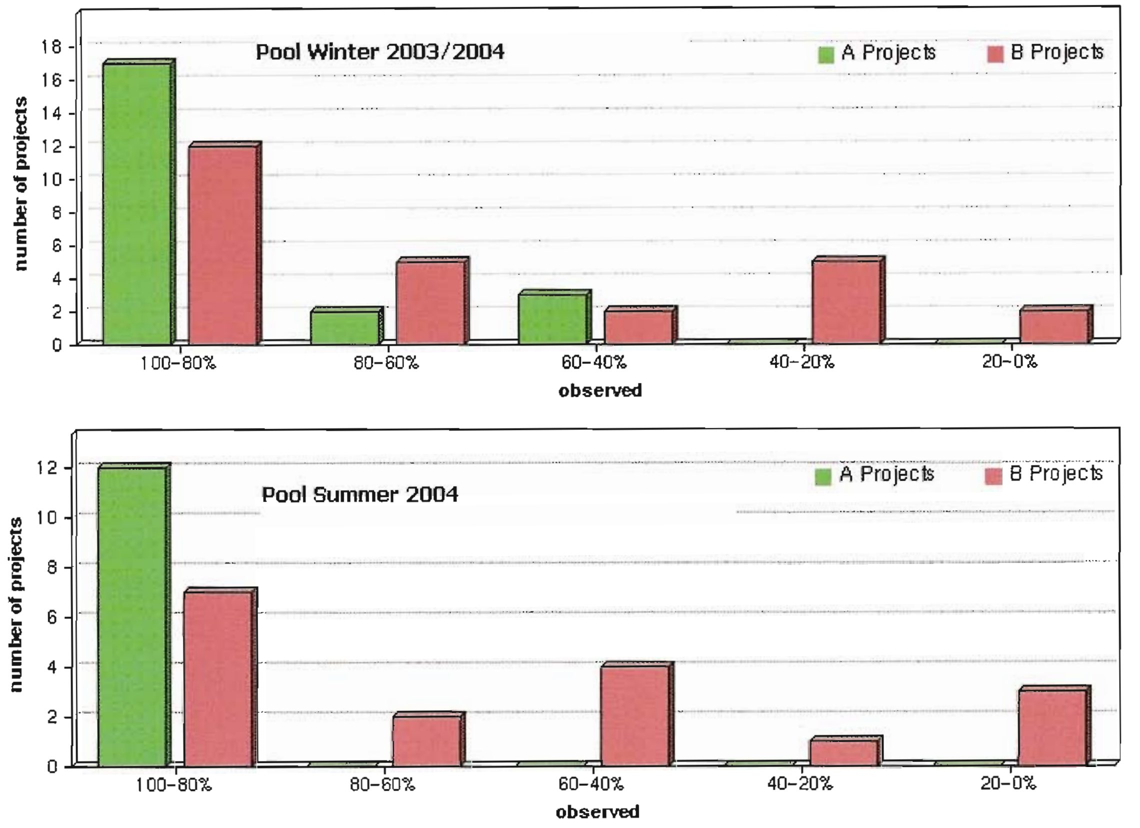


Fig. 3.4: Completeness of A (green) and B (red) projects within the winter (*top*) and summer (*bottom*) pool observations 2004.

3.3. Antenna and Electronics

The main task of the antenna group was to prepare the telescope and its electronics for the new control system (NCS). Particular tasks were:

a) Monitoring the behavior of the new hardware installed in the antenna during the Technical Time periods granted to the NCS.
b) Making new versions of the programs to control the Servo Control Unit (SCU), and the subreflector spindles, with additional features according to the requirements of the NCS.
c) Developing the program to control the subreflector rotation under VME.
d) Studying the antenna pointing in the old control system to facilitate its future implementation in the NCS.

The wobbler control is now running under VME/Linux. The newly designed VME/Linux control has the following advantages:

a) IRAM staff does not depend on the black box control implemented by MAN in CAMAC where many stops were produced during normal operation without any clear reason.
b) The actual servo loop is optimized to work with the subreflector more smoothly than the previous one, thereby avoiding vibrations of the subreflector during the tracking.
c) Many new alarms are implemented as a protection against wrong and dangerous wobbler modes. For example, an alarm goes off if the two position sensors give contradictory readings, if the two servoamplifier currents are different, and if the beating time is too long.
d) The pointing error, due to offset and gain errors, of the position encoders can be corrected by software now. Previously, with the CAMAC control, all those adjustments had to be done mechanically and were quite cumbersome.
e) In case of a failure of the new control, the operation of the last five seconds is kept on a log file and can be used for troubleshooting.

A total of 4.5 millions wobbler throws have already been counted with the new control until the beginning of March 2005.

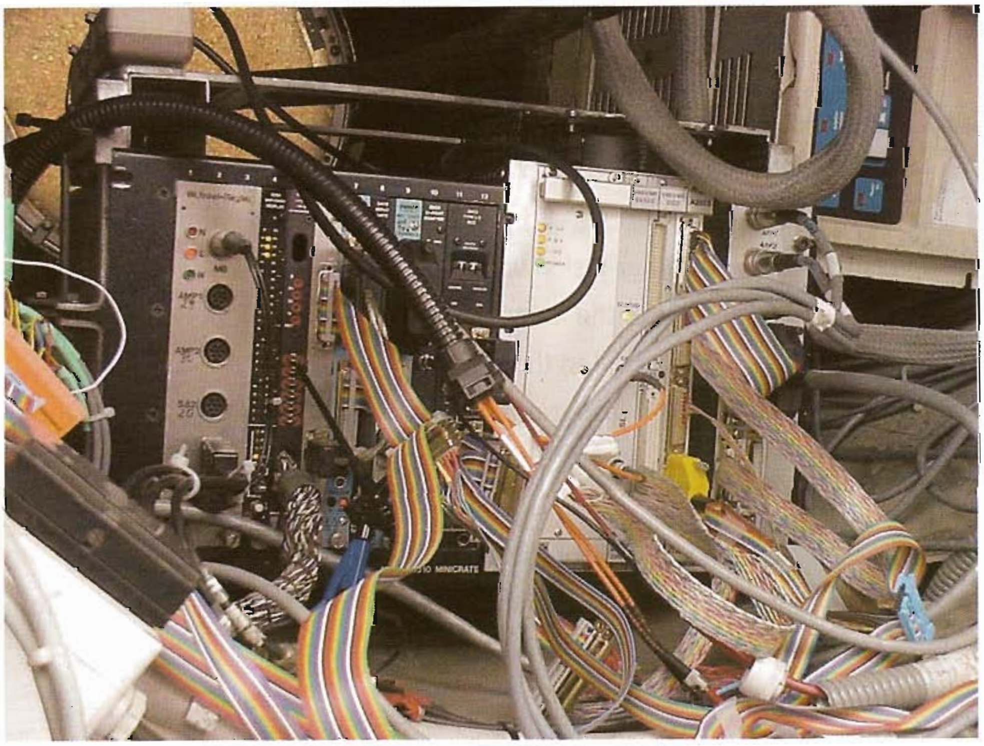


Fig. 3.5: VME crate for the wobbler control (unit on the right side of the crate). Also visible are the control units for the subreflector spindles and for the rotation of the subreflector.

A *New Antenna Temperature Control Module* has been installed replacing the initial one installed by Sulzer. The previous control module was an old design that is no longer available on the market. The antenna temperature control system has been modified to permit the use of new technology modules that incorporate a wide variety of programming features, which optimize the control of the antenna temperature system.

A damaged metallic plate has been replaced at the top of the backstructure using an external crane (Fig. 3.6). The reason of the damage is presumably due to vibrations produced by high winds. A special effort has been made to reinforce the fixation points.

Fig. 3.6: Repairing the backstructure of the 30m telescope

The 100 kHz and 1 MHz filterbanks have been prepared to be read with the new VME module latch-scalers. This work could be carried out while the normal operation with CAMAC continued. The VME module chosen was the model VS-64, with 64 channels, from Joerger. Two VME crates have been prepared and adapted to optimise the synchronization. All CAMAC units will be replaced by VME systems as part of the commissioning of the NCS.

The original power supply unit for the VESPA correlator was replaced by a new, more reliable system.

The necessary software for the data acquisition of the broadband WILMA correlators has been developed and the hardware has progressively been debugged. At present, WILMA is fully operational and can be used together with HERA. In addition, software tools have been developed that facilitate the multibeam receiver tuning, using WILMA as a Virtual Spectrum Analyser.

A computer control of the new IF distribution for HERA has been developed and implemented.

A new system of processing and distributing the synchronization signals for the backends has been developed. The new system includes copies for the new backends.

3.4. Receivers

The upgrade from 9 to 18 channels of the multibeam receiver (HERA) was one of the most important activities in 2004. The considerable complexity of this instrument presented numerous challenges, not only during the commissioning phase, but also in the day-to-day operation. Soon after the installation, in March 2004, problems on one of the new pixels and a small leak on the 300K shielding were found that required a second intervention on the cryostat. Yearly maintenance of the cryogenic equipment, even when done by experts from an external company, turned out to be a critical and risky operation. A complete replacement of the Daikin cold head was necessary after such an intervention. The fact that the helium compressor uses water-cooling turned out to be one of the weak points in the chain and, due to the altitude of the site, necessitated considerable modifications of the system in the course of the year.

Some other activities associated with the installation included:

- The synthesizer distribution box was modified so as to allow the automatic switching of all receivers, including the two parts of HERA, in order to give the possibility of observing at two different frequencies in the two different polarization chanels.
- A pair of remotely controlled synthesizers has been connected to HERA in order to help test and tune the system for new frequencies, and for calibrating every pixel of the array in SSB mode. For this operation, WILMA was used as a spectrum analyzer.

- In preparation for a future extension of the IF bandwidth, a second set of 10 high frequency coaxial cables was installed in the tower.

The installation of the additional 9 channels in the 230 GHz multibeam receiver has considerably increased the observing power of the telescope by doubling the available number of pixels in a frequency band where the 30m-telescope is still the leading instrument.

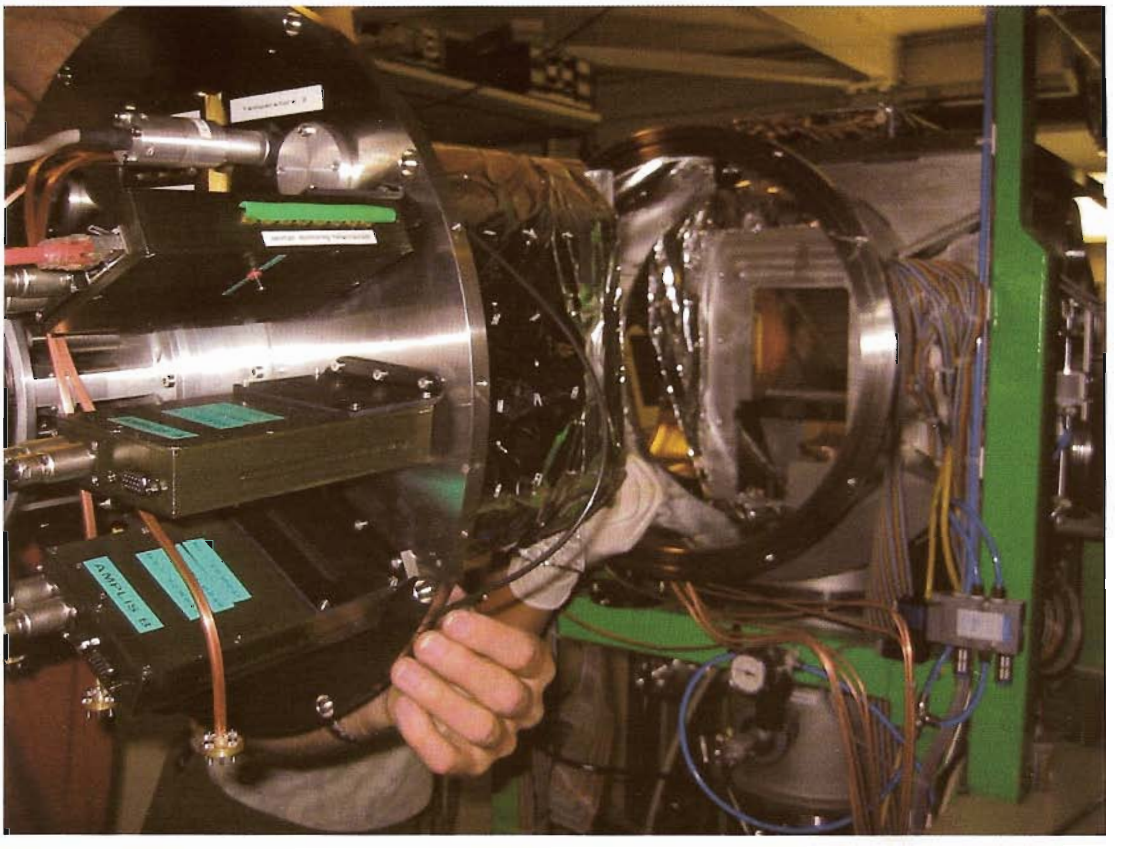


Fig. 3.7. Installation of the second half of HERA.

With the exception of the HERA VME crate, all the other systems associated with receiver control still use the OS/9 operating system. It is necessary to replace this software which is obsolete now and runs on microprocessor boards which are no longer produced. With the help of a student, the receiver calibration and frequency control system has already been changed to a Linux system.

The operating frequency range of the 3mm band receivers, in the so-called Low Frequency (LF) mode, has been extendable down to 72 GHz. The installation of waveguide switches has made the change between this mode and the standard one an easy and fast operation. This will make it possible to include the new LF operation mode into future flexible observing schedules.

A new electrical distribution rack, offering greater security, for the helium compressors has been installed and connected to the UPS system. The long-standing electrical problems associated with power-up of the helium compressor should now hopefully be solved.

Work on the ALMA project continued throughout the year. Measurements of the mechanical properties of windows for the ALMA receivers had been carried out and showed that some fractures and cracks occur in the plastic material when exposed to moderate pressures. In some cases this means that the vacuum is lost. The occurrence of the cracks seems to be linked to the fabrication process. Lenses fabricated by an injection process show the cracks, while lenses made by the traditional groove cutting process seem to be stable. More detailed investigations are under way to understand better why the injection process has a negative effect on the mechanical properties of the lenses/windows. This work is mainly conducted in IRAM-Grenoble with the final material testing done in IRAM-Granada. The interest in the injection process for lens/window fabrication is mainly one of cost- for very large numbers of lenses the possible cost saving with respect to the traditional fabrication methods could be significant.

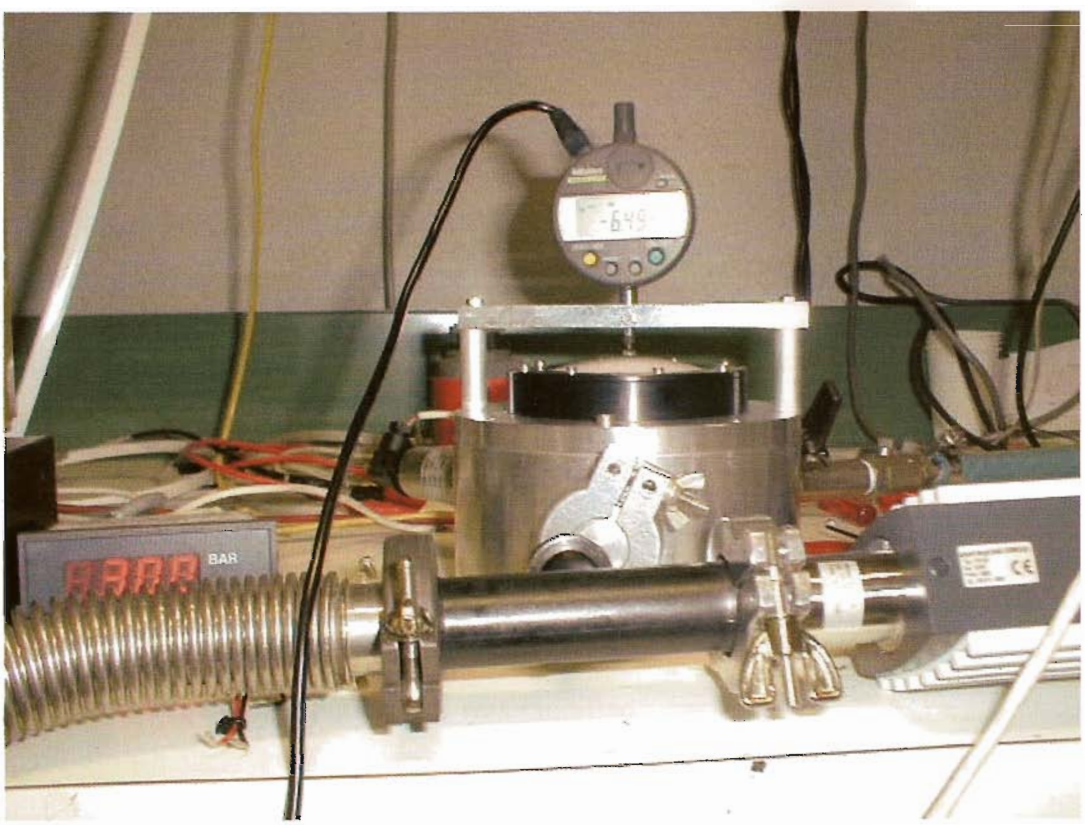


Fig. 3.8. Lens/window showing centre deformation of 6.45mm. Test conducted at overpressure of 3 Bars.

During 2004, a total of four complete sets of infrared filters for all the 10 ALMA bands were also delivered to the Rutherford Appleton Laboratory (RAL) England, for final mounting.

To avoid damages of the compressors of the receivers during power failures, they were connected to the UPS with a new electrical switching box that connects the compressors' load progressively. The UPS is working now at 85% of its maximum capacity; a new system with more power capacity should replace the current one in the near future.

3.5. VLBI

Two global VLBI sessions of five days duration each have been carried out at 3 mm during the months of April and October. The new data recorder Mark-5 operated flawlessly.

3.6. Computers and Software

In November 2004 a preliminary version of the New Control System (NCS) for the 30m telescope was successfully tested for bolometer observing modes: pointing, focus, tip, on-off and on-the-fly maps, as well as for pointing and focus with the single-pixel heterodyne receivers. For these tests, several major new subsystems were integrated into a functioning prototype of the NCS. These subsystems had previously been tested individually. It is now confirmed that they also work together as planned. Several details for bolometer observations remain to be investigated, debugged, and optimized, e.g., questions related to the pointing model and the timing.

This progress has been possible because of the intensive development and testing of the control subsystems based on VME and Linux for the main axes, the subreflector, the coordinator subsystem and the observer's user interface throughout the summer. Software tools were written for the exchange of messages and for the monitoring of the NCS, as well as for its subsystems. Moreover, the data acquisition system, data files, and data processing software were developed or adapted to support the new standards for the NCS, i.e., VOTable XML and (IMB)FITS files. Finally, in December the new subsystem for the control for the Wobbler was tested and it is ready to be used from January 2005 onwards, together with the old control system. As a result of the work for the New Control System, most of the telescope monitoring can now be viewed remotely via web browsers.

Several of the general use computer systems were replaced, including our web server. New Linux installations are all based on the Debian distribution and most of the existing systems have also been changed to Debian. In Granada, wireless networking is offered whereas at the observatory wireless equipment shall not be used to avoid interference with the backends.

The observers workplace has been changed to allow two astronomers to work more comfortably. The observer has two computers with two screens each plus several monitoring displays.

3.7. Infrastructure

Three high voltage terminals with contacts in hexa-fluorine chambers have been installed in the observatory, replacing the old units. Two cabinets receive the two high voltage lines to give power to the observatory, while the third one is a general protection of our electrical installation. The new terminals are easier to operate, and offer a higher reliability.

Humidity and temperature sensors of the weather station have been installed in a more convenient place to protect them from the daily sun radiation in order to provide more exact weather data. The VME weather program has been modified to deliver the weather data in a format that is suitable for a web page with graphics and statistics.

A new electrical protection box has been installed on the second floor of the observatory building. With the new electrical box, all the loads have individual magnetothermic and differential protections.

The thermal insulation of the outside walls of the building and the lower part of the radiotele-scope, had to be renewed after about 20 years of operation.

A new Renault Kangoo 1.9 station wagon has been purchased. For safety reasons, all our cars are now equipped with four wheel drives.

3.8. Safety

Two new fire hoses have been installed on the periphery of the observatory to improve the fire fighting resources. Eight new fire detectors have been installed in the kitchen storage rooms, and in the living room areas, as recommended by IRAM's insurance company ACE during a safety inspection.

We have acquired a finger oximeter in order to detect more easily human hypoxia caused by the altitude of the site. We have elaborated a safety plan together with an external consultancy firm.

The antenna emergency limit switches in azimuth and elevation have been tested with extreme care by bypassing the software limit switches to confirm their correct operation.

3.9. Miscellaneous

We have continued the negotiations with the Spanish Ministry of Industry and Commerce in order to obtain the best possible radioelectric protection for the observatory in accordance with the Spanish telecommunications laws. Finally, in December 2004, we received the definitive text, which was officially published a few days later.

IRAM Spain offered several guided tours at the observatory to schools and other groups, and participated with a poster presentation in the exhibition “Destination Mars” in the Granada Science Park.

4. PLATEAU DE BURE OBSERVATORY

4.1 Observations

The Plateau de Bure Interferometer was performing according to expectations with almost no downtime due to equipment failure during scheduled observations. The receivers all performed well throughout the year without significant problems. The weather conditions on the site were excellent in February, March, November and December, conditions were relatively good from spring to fall, and rather poor in January. The percentage of telescope time scheduled for observing programs was on average 50% percent of the total time. Additional 10 to 15 percent have to be accounted for receiver tuning, testing equipment, surface adjustments and antenna maintenance; the remaining 35 to 40% were lost because of poor weather conditions.

More than 140 different observing projects corresponding to 104 submitted programs were scheduled at the Observatory in 2004, with similar weight on galactic and extragalactic science. Chapter 7.2 details all the proposals to which time was granted in the course of the year, and largely testifies to the high scientific return of the Plateau de Bure Interferometer. The third week in October was devoted to coordinated 3mm VLBI continuum observations with several participating radio observatories in Europe and the United States.

Despite the large quantities of snow and our limited ability to carry out configuration changes in difficult winter conditions, we have been able to schedule all four (ABCD) configurations of the interferometer in 2004. As in previous years, a large amount of observing time was invested between spring and fall in the detection of line-emission from carbon-monoxide in high-redshift galaxies using the D configuration.

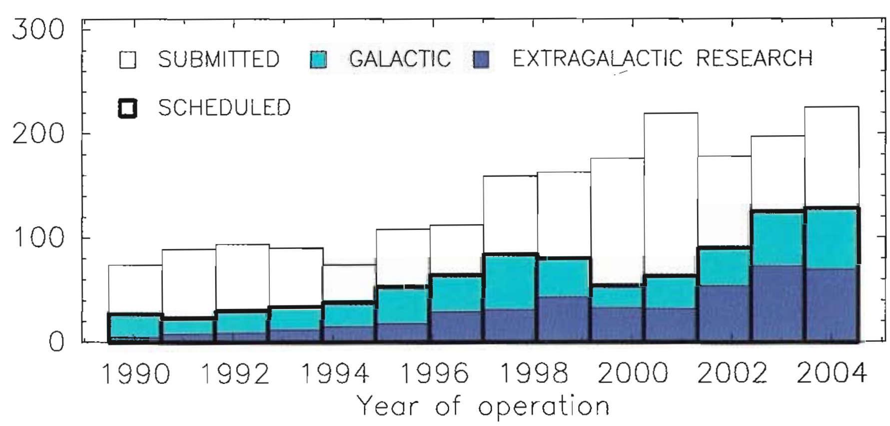
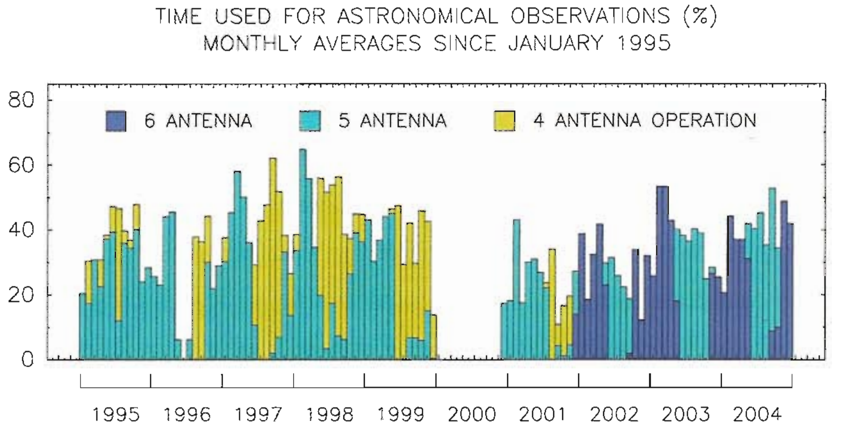


Fig. 4.1: Fifteen years of science at the Plateau de Bure Interferometer. From May 1990 and up to May 2004, the average pressure factor is higher than two. Note the steadily increasing interest for extragalactic science.



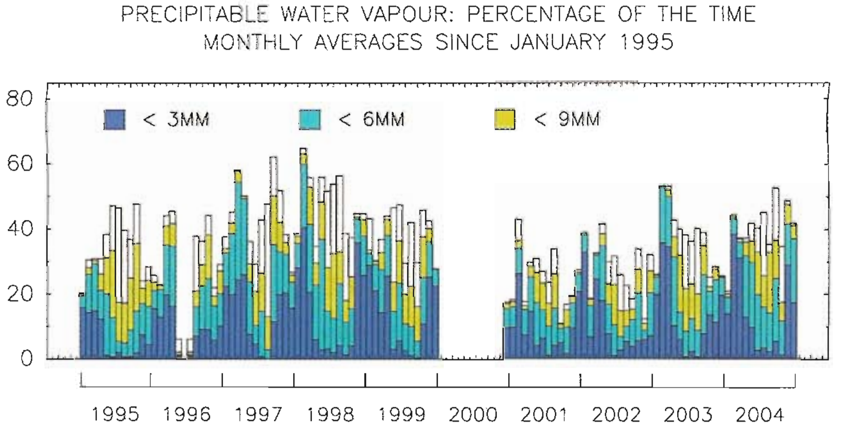


Fig. 4.2: (*Top*) Percentage of net-integration-time invested on astronomical observations in the last ten years. In the May to October period, which coincides with the annual maintenance period, observations are in general made with a subset of the six-element array. Antenna 5 became operational in the summer 1996, Antenna 6 at the end of 2001. As a consequence of the accidents, observations had been stopped from December 15, 1999 to December 1, 2000. (*Bottom*) The atmospheric water vapour content recorded on the Plateau de Bure since August 1994.

4.2 Antenna maintenance

As in previous years, the maintenance of the interferometer was carried out during the summer. This year again, a particular effort has been made to improve the water-tightness of the antennas. A period of 2 weeks had been foreseen for the maintenance of each antenna. The logistical support group located at the Grenoble headquarters, coordinated activities related to the maintenance, organized the training and working schedule of personnel recruited on fixed-term contracts (3 mechanics were hired during this period), scheduled transports by helicopter or transports on ground, provided assistance to the Observatory staff when needed, and coordinated technical activities.

In order to ensure an optimum operation and evolution of the interferometer, it has been decided in 2004 to establish the Science Operations Group (SOG). The SOG is staffed with astronomers that regularly act as astronomers on duty for the PdBI with the aim to optimise the scientific return of the instrument. They work directly on the site or remotely from Grenoble, provide technical support and expertise to investigators and visiting astronomers for questions related to the calibration, pipeline-processing and archiving of Plateau de Bure data, and interact with the scientific software development group for developments related to the long-term future of the interferometer. Four astronomers were appointed to the group in 2004.

The SOG organized two workshops for the operators, in April and in December 2004. The aim of the workshops was to discuss and share practical and technical experience amongst the participants, evaluate and identify actions that need to be taken to ensure a regular and smooth operation of the interferometer, and to increase the general knowledge and understanding through lectures given by in-house experts.

4.3 Antenna surface improvements

As part of the preparation for the installation of the new generation receivers, a campaign of surface adjustments was started on antenna 5 to investigate the precision to which the surfaces of the 15m antennas can be adjusted for operation at frequencies above 300 GHz. To speed up the surface adjustments, the aluminium surface panels of antenna 5 were all equipped with motors during periods of poor weather conditions in January 2004 in order to minimize antenna downtime. Series of holographic measurements were made subsequently to assess the panel corrections, evaluate the performance of the antenna at frequencies above 300 GHz, and monitor the stability of the surface end-adjustments over time. At the end of the maintenance period, the surface of antenna 5 had been adjusted to a precision of 35 microns, i.e. 20-40 microns in the inner four rings, and 10 to 30 microns higher on the external two rings. Such a precision should lead to antenna efficiencies better than 30 Jy/K above 300 GHz. No significant change in the surface accuracy of this antenna has been detected up to the end of 2004.

The reflecting Hostaflon film that covers large parts of the surface of antennas 1, 2 and 4 has carefully been inspected at the beginning of the maintenance period. It was decided to remove the Hostaflon layer from carbon fibre panels when reflectivity losses were expected, or when it was feared that the underlying carbon fibre layers could delaminate. As a result of these investigations, the Hostaflon layer was removed from 134 panels: 54 panels on antenna 1, 35 panels on antenna 2 and 45 panels on antenna 4. These panels were then dismounted and painted with a conductive layer of silver emulsion paint, protected with a cover of white paint. To readjust the surfaces of the antennas after remounting the panels, holographic measurements were made. Unfortunately, they revealed losses of reflectivity on a large number of the refurbished panels. This effect was noticed in particular on antennas 1 and 4, and was still under investigation by the end of 2004. By contrast, no signs of degradation or losses of reflectivity were detected for the panels of antenna 6 which were painted in the summer of 2001.

The surface of all antennas was readjusted in the fall and verified with holographic measurements. According to the final analysis, the surface accuracy of antennas 1, 2, 3, 4 and 6 was found to be in the 50 to 60 micron range on the inner four rings, and 10 to 30 micron higher on the external two rings.

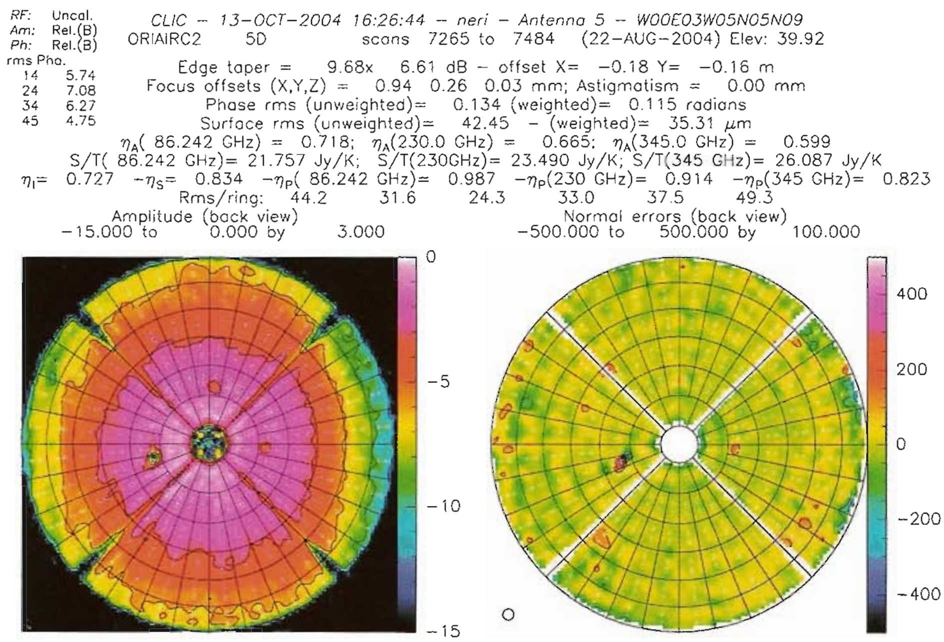


Fig. 4.3: Illumination pattern (left) and surface accuracy (right) of Antenna 5 as of October 13, 2004. A surface accuracy of 35μm (RMS) was achieved after five holography iterations.

In view of the risk that in the future more and more panels may need refurbishment, and eventually may have to be replaced, IRAM had started together with the company MediaLario a development program for a new type of panels, based on a replica technique. The basic concept is similar to that adopted by the ALMA project for the panels for the European prototype antenna, except that the PdB panels have to be equipped with a heating system. During the summer of 2004, 20 MediaLario panels have been delivered, and, after minor modifications (design of the electrical outputs, stiffness of the new feet), it has been decided to mount them on antenna 4, on the lower part of the parabola. Unfortunately, it quickly became evident that the new panels lost their initial surface stiffness and became very soft. They had to be sent back to MediaLario, where the analysis showed that the adherence of the inner honeycomb structure to the back surface was insufficient due to a bonding problem. The panels will be re-worked and the test continued in 2005.

Fig. 4.4: Back skin of one of the MediaLario panels. The glue (violet colour) can be seen between the inner structure and the back skin surface.

4.4 New Technical Installations

The 22GHz radiometric phase-correction system and related changes in CLIC

In June 2004 the observing software on Plateau de Bure was adapted to make use of the 22GHz atmospheric monitoring for real time de-correlation corrections of the astronomical spectral line data. The previous phase correction system, based on total power measurements in the 1mm band, is still available for correction of continuum data, and as a backup for correction of spectral line data. Along with this change, the data calibration software CLIC was upgraded to deal with this new situation and to pass the information to the observer on which correction method actually has been used during the observation. In principle it is now possible to choose the method of real time phase correction (1mm total power or 22GHz measurements) for each antenna and each correlator unit independently. However, the mixed system still requires significant changes in the CLIC software. We therefore apply only one method at a time for the complete correlator configuration, Since August, the 22GHz system is the default option for the correction of spectral line data.

The software upgrade includes a simulation of the basic effects of the new atmospheric model ATM (Pardo et al. 2002) on the determination of the emission temperature to path-length conversion factor. This factor turns out to be larger in the new atmospheric model which is available in Grenoble but not yet implemented in the real time system nor in the standard offline software packages. The relation between the conversion factors resulting from both models is described by a linear function in the amount of the precipitable water vapor.

Three astronomical projects were modified to include a third calibrator close to the astronomical source for testing the capabilities of the 22GHz system for absolute phase correction. These projects were given more observing time than requested by the PIs to make up for the extra time spent on the additional calibration source. An analysis of the data in terms of absolute phase correction is presently under way. It is, however, already clear that some major software development will have to be done in 2005 to develop a reliable scheme for absolute phase correction.

Fibre optic cables

The need for a replacement of the LO signal transport system, capable of wider-band and more reliable performance, led IRAM to explore a fibre optic cable based solution. The new generation receivers, which will deliver signals sampled at 4 GHz RF bandwidth, will have to be interfaced over distances of several hundred meters. The goal for 2004 was to resume the tests started in 2003 in order to on assess the performance of the prototype electronic systems that were installed in two antennas, and to equip all the stations on the northern, western and eastern tracks with fibre optic cables.

VLBI Terminal

In early 2004, IRAM received the two Mark5A recorders ordered at the end of 2003. Both systems were pre-tested in Grenoble and then sent to Pico Veleta and Plateau de Bure. Compared with the previous recording technology, these recorders allow data rates twice as high (up to 1 Gbit/sec, i.e. observing bandwidths of up to 512 MHz). Plateau de Bure received a new field system computer from the Max-Planck Institut fuer Radioastronomie (MPIfR) Bonn, the old one is being kept as a spare.

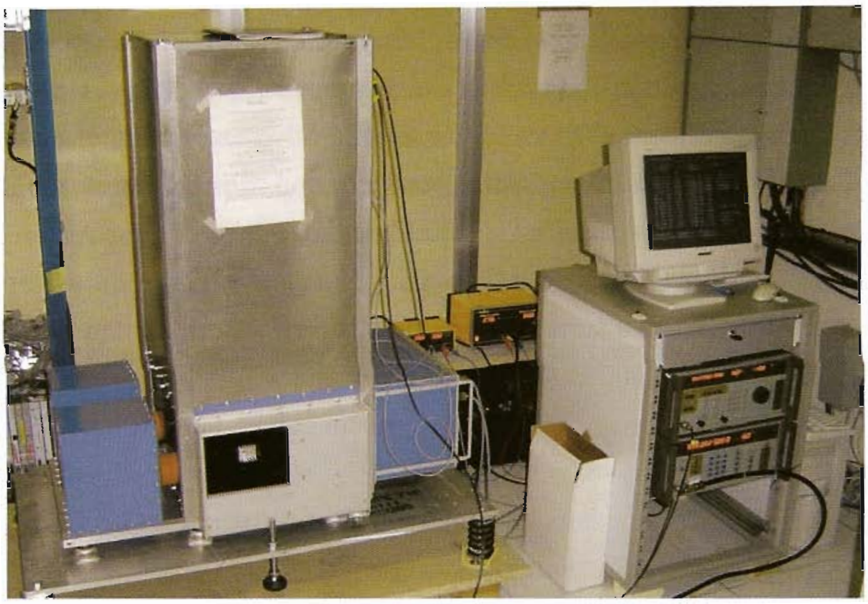


Fig. 4.5: EFOS-1 in the Plateau de Bure correlator room. In the background its power supply and backup batteries can be seen. To the right, the computer monitoring the maser parameters is situated, together with the two Racal Dana frequency multipliers for the VLBI LO system.

A series of VLBI test sessions was planned for the summer of 2004 with the aim to uncover the reason for the parasitic phase noise which had slightly reduced the efficiency of the Plateau de Bure phased array at 3mm wavelengths, but which resulted in a strong loss for VLBI observations at 1mm. Several modifications were introduced into the LO chain to remove possible sources for instabilities.
The April 2004 Global 3mm session went fine at Pico Veleta, but Plateau de Bure encountered multiple problems, including a maser breakdown ten hours before the session should start, and adverse meteorological conditions. While Pico Veleta was almost 100% successful, no observations were possible at the Plateau de Bure. After the session, the Plateau de Bure maser problems were carefully analysed by the OCA (Observatoire de la Cote d'Azur). A hardware component had failed, and needed replacement. The time required for the repair was evaluated to be later than October 2004. Without the maser frequency standard for the local oscillator system, mm-VLBI is not possible. Fortunately the Fundamentalstation Wettzell, which is a geodetic station situated in Wettzell, Germany, was willing to lend to IRAM one of its high-quality masers until 2005. This maser turned out to be EFOS-1, the very first of the EFOS maser series constructed and maintained by the Observatoire de Neuchatel, Switzerland.

The transport of this frequency standard to the Plateau de Bure was more difficult than expected. Although much care had been taken during the transport, the maser showed an abnormal behaviour on arrival in Grenoble. Fortunately, repairs and fine-tuning could be done rapidly at the Observatoire de Neuchatel. EFOS-1 was then transported to the Plateau de Bure, and was successfully employed in the October 2004 Global VLBI session. This time, both IRAM instruments were successfully participating for a large fraction of the scheduled time.

Due to the maser problem, the Bure phase stability problem had not been solved during the summer of 2004, and turned out to be still present in the correlations of the Global October session. More test observations have therefore been scheduled for 2005 and recently been carried out between Pico Veleta and Plateau de Bure. The cause of the phase instability was found and will be corrected for the VLBI sessions later in 2005.

These improvements would not have been possible without the support by the VLBI experts at the MPIfR in Bonn who helped with the observations and carried out the correlation of the data.

4.5 Infrastucture improvements

The Ratrack garage

The reconstruction of this building, which collapsed in 2001 under the pressure of the snow, was carried out by the companies MRB and SOCOTEC. As shown in the pictures below, only half of the building has been refurbished, leaving an open space between the garage and the maintenance hall (where the snow can accumulate). The left part can accommodate one Ratrack and is now designed to resist at least a weight of snow of 2 tons/m^2.

Fig. 4.6: The Ratrack garage before and after refurbishment

New Ratrack

A new Ratrack "Pisten Bully PB300" developing 300 Horse Power was bought this year to replace the "PB270" which was 17 years old. With the planned track extensions (see below), the demand on snow clearing will increase by almost a factor of two. More powerful machines are needed to remove the snow on such a long distance. This aspect is critical considering the fact that the configurations of the interferometer have to be changed several times during winter.

Fig. 4. 7: The new Ratrack "Pisten Bully PB300" in front of the interferometer.

Blondin

The completely overhauled old cable car, now modified to transport only materials (the "blondin") has been tested during 2004 on a one day per week basis by the constructor (ERIC). Those test days were used to carry our food and our light equipment to the observatory. Meanwhile, new stops from platform to platform (instead of quay to quay) have been studied to improve the machine and the efficiency of the transportation of our materials.

Preparatory activities for further track extensions

Northern track extension (N46)

The trenches for the power supply line and the different cables necessary for the interferometer were dug from the station N46 to the entry of the maintenance hall (around 220 meters). The unfinished part of the Northern track extension is programmed for 2005, together with the work on the Eastern track extension.

Eastern track extension (E68)

The preparation of the ground between the station E24 and the future station E68 started in June 2004 and finished at the beginning of October. 23000 m^3 of rocks were removed to clear the 352-meter long new track extension. 5 persons from the QUEYRAS TP Company with their equipment were hired to carry out this job during a period of 3.5 months. The gears (mechanical digger, etc…) were brought to the Plateau de Bure in pieces by the "blondin" and reassembled at the observatory. The QUEYRAS TP team was accommodated in the rooms of POM2 during the whole time. Our main contractor for this operation is the engineering company " OSTIAN".

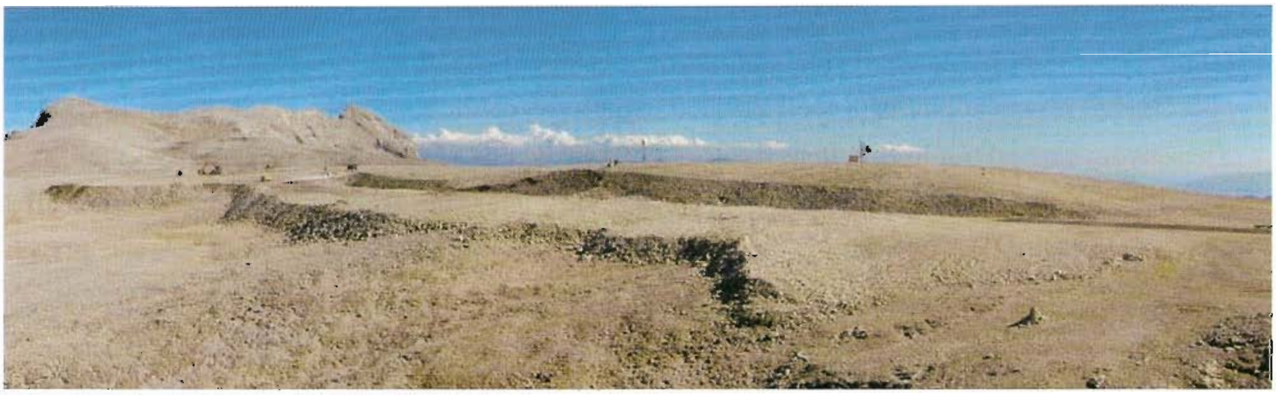


Fig. 4.8: View of the Eastern track extension. On the right side of the picture, the existing track (ending with the station E24) can be seen. The mechanical digger on the left side is near the location of the future station E68.

4.6 Safety issues

The large number of ongoing activities required the preparation and signature of more than 40 preventive safety plans. One particularly difficult task was the control and tightening of the entire cladding of the main building.

Other safety related activities include the control of all of the electrical wiring, the verification of the fire detection system, a check of the automatic air extraction system in the correlator room, and the control of the lifting and individual protection devices. These controls are stipulated by the program of preventive measures and by the French safety regulations in force.

To improve the safety on the road, the two small vans which were used for the transport of IRAM staff to and from the Plateau de Bure have been replaced by new cars which are equipped with Airbags and ABS systems.

4.7 Data calibration, reduction and archiving

Data Calibration

As in 2003, efforts were continued on refining the calibration pipeline, optimising the flux density calibration strategy to increase the quality of the flux calibrator database, and improving the automatic assessment of data quality. To verify the consistency and assess the relative precision of standard flux calibration measurements at the two IRAM observatories, coordinated observations of a well defined sample of calibrators were made in April 2004. These were carried out in excellent weather conditions, and clearly demonstrated that the flux densities measured with the 30m telescope and the Plateau de Bure Interferometer were all consistent to better than 5% at 86 GHz, and 15% at 1mm

Data Reduction

The computer infrastructure was substantially improved for astronomers visiting IRAM. Four computers running RedHat9.0 are now available for speedy data reduction and analysis, and high-speed Internet connections can be used for remote data reduction, i.e. for astronomers accessing the IRAM computers directly from their home institutes.

The year 2004 saw 28 investigators from Europe and overseas visiting IRAM Grenoble and spending a total of 125 days to reduce data from the Plateau de Bure Interferometer, and 2 astronomers reducing data remotely from their home institutes.

Since January 2004, limited travel funds are available to eligible astronomers from non IRAM partner countries for expenses incurred during their stay in Grenoble for reducing data from the Plateau de Bure Interferometer. These funds are made available by the European

Commission in the frame of the FP6 programme. As of December 31, 2004, access time was allocated to 12 eligible proposals corresponding to a total of 272 hours of observing time.

Data archiving

As a collaborative 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 since June 2004, and are available for viewing via the CDS' search tools. For now, 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 December 1990 to September 2003. To preserve the confidentiality of some pieces of information such as frequencies and coordinates, updates of the archive are made available at the CDS with a delay of one year from the end of the scheduling semester in which the project was observed. Users of the Plateau de Bure Interferometer are invited to consult the archive before submitting new observing proposals.

IRAM has started to analyse the conditions under which raw data files could be made available, too. The policy on proprietary periods and the exact format in which data will be released requires a decision by the Executive Council after consultation of the Scientific Advisory Committee.

4.8 4th School on Millimeter Interferometry

The Fourth IRAM Millimeter Interferometry School took place from November 22 to 27, 2004, at IRAM in Grenoble. The school consisted of a series of lectures presented by in-house and invited experts, and practical exercises in order to familiarize the participants with all phases of the observing, data reduction and data analysis process. A total of 55 researchers came to Grenoble, working in ten different countries mostly as PhD students or postdoctoral associates: Germany (20), Spain (11), France (6), United Kingdom (6), Italy (4), Canada (2), Chile (2), Denmark (1), Finland (1), Poland (1), and India (1).

The participants were invited to contribute as much as possible with posters describing research conducted at interferometers worldwide. The proceedings of the Interferometry School will be published in 2005 and will be made widely available to the community.

5. GRENOBLE HEADQUARTERS

5.1 SIS GROUP ACTIVITIES

The work of the SIS group during 2004 has focussed on the preparation for ALMA and the transition from device optimisation to the production of a large number of similar devices as required for the 2SB mixers. At the same time, production of SIS junctions with new layouts for the next generation PdB receivers has been pursued. Research on advanced topics like millimetre wave micro-electro-mechanical systems (MEMS) and hot electron bolometers (HEBs) has been continued.

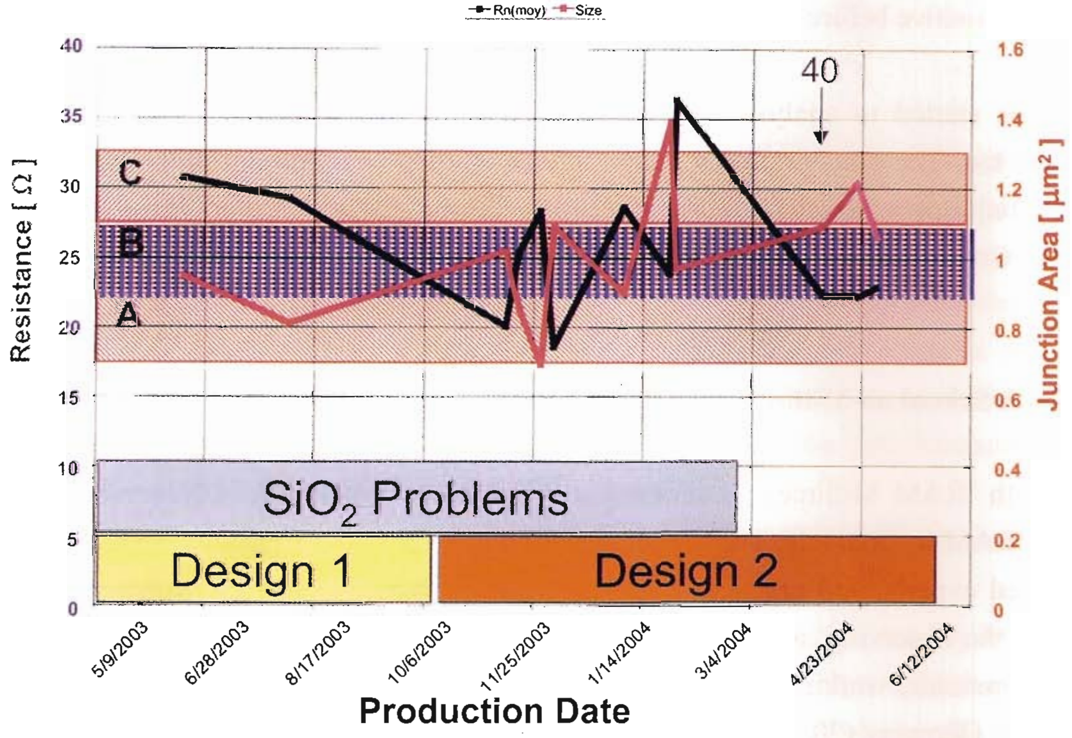


Fig. 5.1: Parameter diagram characterising the development phase of SIS junctions for the ALMA Band 7 receivers. The hatched areas indicate the values of normal resistance and tunnel contact area for three different design variations that had been set out as goals.

ALMA has required a paradigm change from prototype development style to a semi-industrial way of fabricating SIS junctions for mm-wave heterodyne mixers. A large part of this transition has been achieved in the course of the year. This change includes a dedicated equipment maintenance plan, a global calibration scheme, and the introduction of elements of statistical process control with the help of a process data-base. This approach was valued positively during the ALMA Band 7 project design review (PDR).

The development of new broad-band devices for the next generation of IRAM-PdB mixers, including new layouts of SIS mixer circuits, has been another important working area during 2004. New mask sets for 100, 230 and 150 GHz single backshort waveguide mixers were produced, and the first 230 GHz devices showed very promising results.

The quality of the standard SIS fabrication process has been further improved with the help of advanced methods like Focused Ion Beam (FIB) cuts of tunnel junctions and transmission electron microscopy (see Fig. 5.2). The etching process of Nb layers has been further refined and allows now the fabrication of structures in the sub-100 nanometer range

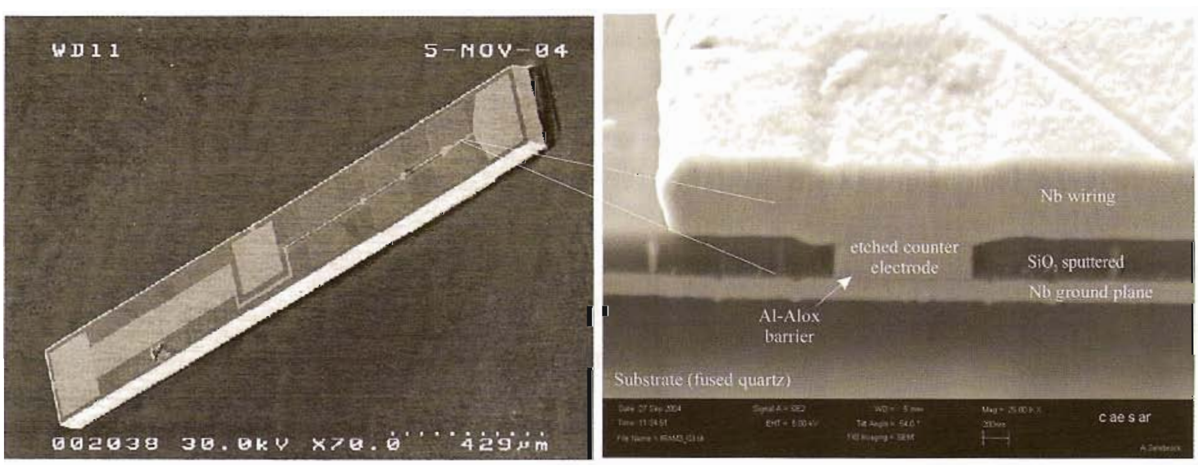


Fig. 5.2: Micrograph of an SIS device for ALMA Band 7 (left) and an E-beam microscope picture of a cross section through the tunnel contact area of a similar device (right).

The development of millimetre wave MEMS has been concentrating on work towards a first real tuneable GHz circuit. For this purpose, tuneable filters have been designed for the 22 GHz band in collaboration with the Berkeley Radioastronomy Laboratory. A multilevel resist technology was successfully introduced. Such a technique will allow for various improvements of MEMS as for example the stabilization of free standing thin layers and topologies for increased tuning ranges of variable capacitors.

In the framework of the EU Radionet AMSTAR project, IRAM has followed up its activities on hot electron bolometers for THz applications. The work has focussed on the optimisation of ultra-thin NbN films and related buffer layers for various substrate types. A novel way of investigating these very thin (<5nm) NbN films has been identified through ellipsometry and

Raman scattering (see Fig. 5.3). Collaboration on wave guide HEB devices has been started with the Smithsonian Astrophysical Observatory.

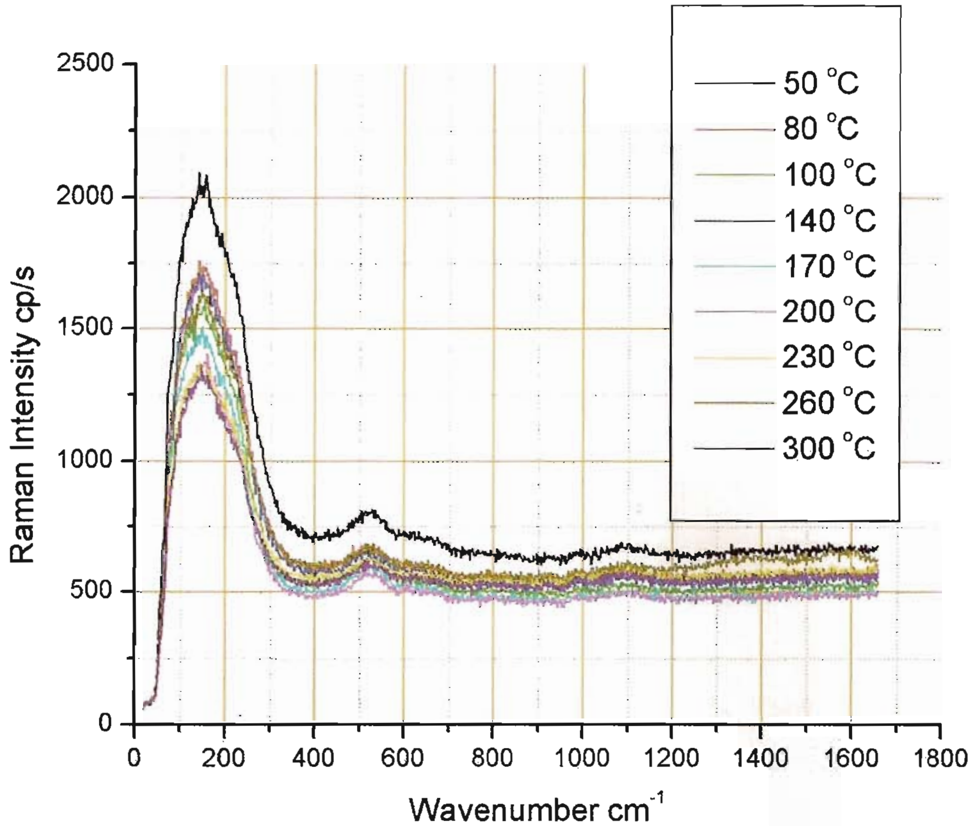


Fig. 5.3: Raman signal from 5nm thick NbN films on fused quartz for different deposition temperatures. The broad peak at 180 cm^{-1} is due to light scattering from acoustic phonons, a fact which indicates a polycrystalline structure with relatively small grain sizes. The peak around 500 cm^{-1} is due to optical phonons.

5.2 RECEIVER GROUP ACTIVITIES

5.2.1 IRAM Receivers

HERA (1.3mm Multibeam) 2nd polarization

The receiver group completed the characterization of the nine new mixers. The assembly was completed and tested for vacuum integrity. The installation at the Pico Veleta telescope was performed in March 2004. Following cooldown (36 hours), the initial RF tests were found to be satisfactory except for one defective pixel.

PdBI new generation receivers.

Vacuum and cooldown tests were performed on the prototype dewar that had been received in December 2003. Following these tests, a few modifications were found necessary:

a) a decrease of the mass of the 15K plate, initially Copper, replaced by an Aluminium alloy;

b) a change of the position and shape of the GFRP struts linking the 300K-70K-15K stages in order to decrease the stresses caused by the differential contraction. The drawings for the series of 6 dewars were updated accordingly, finalized, and contracted out for fabrication.

The prototype #1 cryostat was wired and assembled with optical/RF modules for band 1 and band 3.

The five last (out of seven) Sumitomo closed-cycle cryocoolers were received and acceptance tested; they were found to be within contractual specifications, with the exception of one of the compressors, damaged during the transport, that was sent back for repair.

Following the delivery of the first junctions by the SIS group, the first tests of the new backshort-tuned SSB mixer for Band 3 (200-260 GHz) were performed, and gave quite encouraging results.

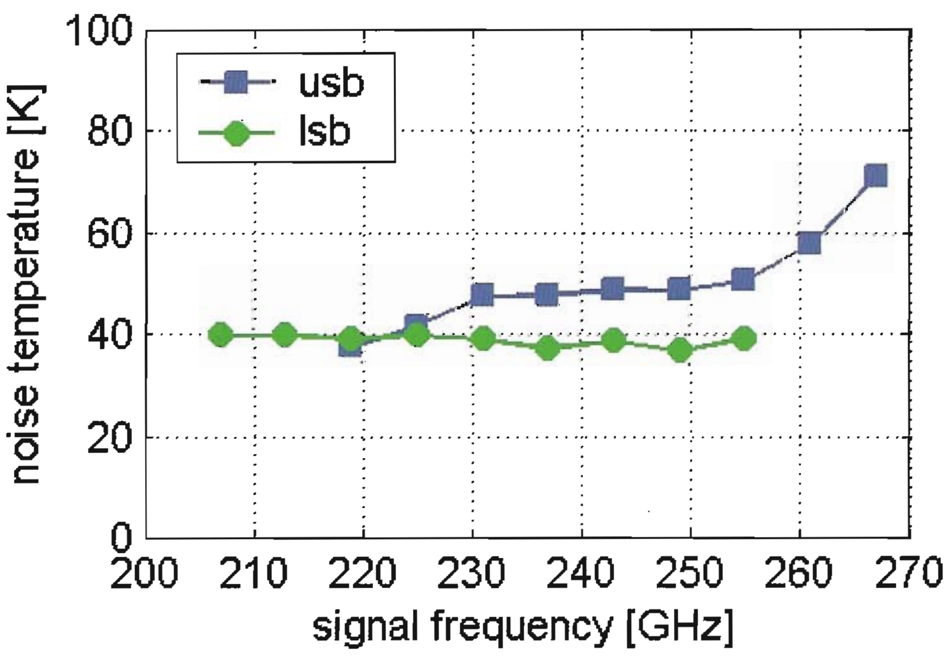


Fig. 5.4: Results obtained with one of the PdBI SSB 230GHz mixers. That mixer was designed for the signal frequency range 200-260 GHz, but the operation can be extended to higher frequencies (HCO^+(3-2), HCN(3-2)) with slightly degraded performance. It can operate either LSB or USB over a large fraction of the RF band, while the lower and upper edges of the band can be reached, respectively, in LSB or USB mode.

Pico Veleta receivers

A scheduled maintenance of the Daikin cryocooler of HERA was performed in June by SHI-APD. At the same time, a repair of the defective pixel was attempted, however, without success. In July, it was found that after the maintenance the cryocooler of HERA could not any more reach 4K. The cold head was replaced with the spare in September, and HERA is again operational. Following more tests in Grenoble, the replaced cold head was recognized defective by SHI-APD, and replaced by a functional one, which is now the spare unit.

One of the 100/230 receivers has been replaced on the site with a spare unit because of a He leak. The dewar was sent for repair to Infrared Laboratories. Subsequently it was re-fitted with the RF equipment, characterized for tuning parameters and noise performance, and aligned on the antenna range. It is now available as a spare.

PdBI receivers

The receiver of Antenna 4 was replaced with a spare unit in September, following a failure of the 230GHz channel and poor performance of the 100GHz channel.

5.2.2 ALMA work

Band 7 cartridge development and construction.

Following the convergence of the SIS fabrication process towards the design specifications of the mixer chip, the results of Band 7 mixers reached and surpassed contractual noise specifications. The total power stability was also found to be within contractual specifications.

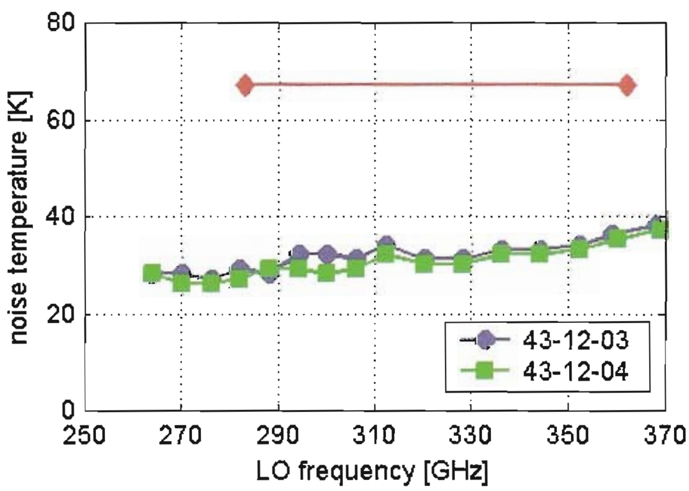


Fig. 5.5: DSB noise temperature for two junctions from wafer 43. These junctions are of the design variant "B", i.e. the tuning structure is designed for the nominal junction area of 1μm^2. The red line is at 1/2 the 2SB ALMA noise specification.

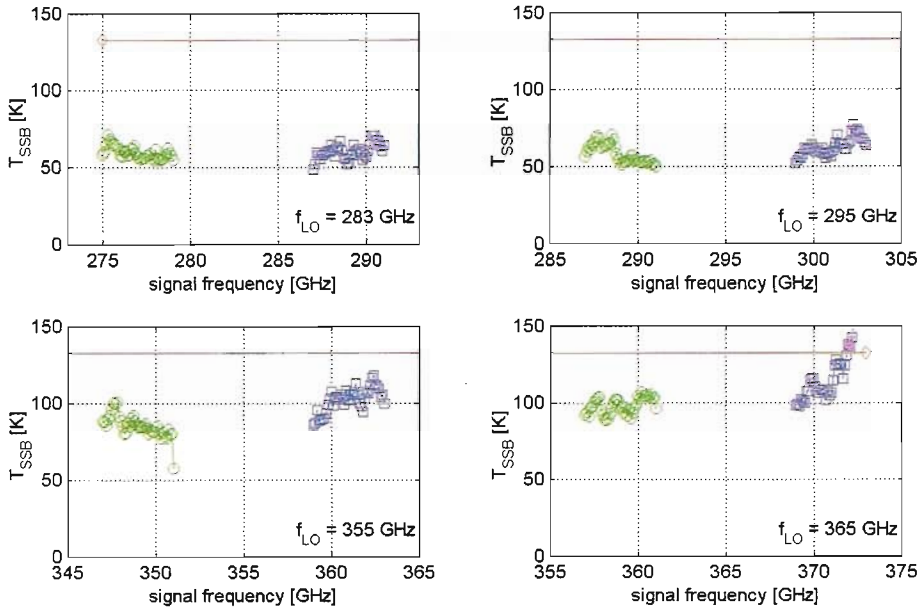


Fig. 5.6: SSB noise results of 2SB mixer No. 002. The measurements are performed for discrete values of the LO frequency, and for each of those, the SSB receiver noise is measured across each of the upper and lower sidebands. Only a subset of the full characterization dataset is shown here. LSB measurements are shown in green and USB measurements in blue. The ALMA limit (specification to be met over 80% of the band) is represented by the red line. Points not within the specs are marked in magenta. The receiver noise values plotted are true SSB, corrected for residual image response.

Fig. 5.7: Complete prototype Band 7 cartridge

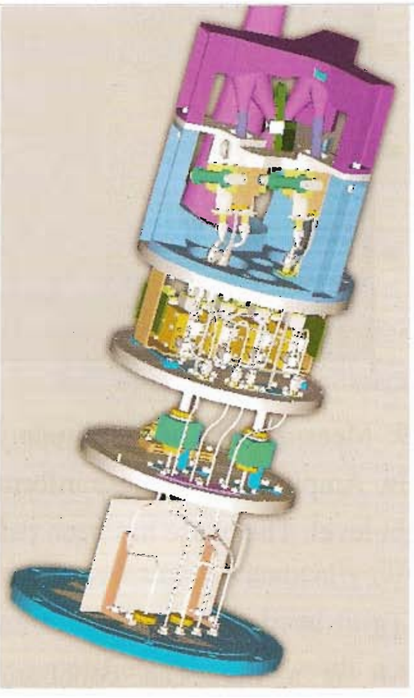


Fig. 5.8: CAD rendering of the Band 7 cartridge, showing the population of the various temperature stages and the optical beam.

Following the detailed design phase, a complete prototype cartridge has been assembled and tested. While not all of the (numerous) contractual specifications could be verified, it was found that the noise performance of 2SB mixer assemblies could be reproduced after integration into the cartridge with its complex cold optics.

A Preliminary Design Review was held in Grenoble in June 2004, and passed (conditional on finalization of Interface Control Documents). Following the PDR, a number of minor design changes were made, mostly to improve reliability against thermal stresses, and a new version of the 4K optics assembly was designed and fabricated, to meet the stringent mass budget.

5.2.3 Other contract work

Herschel (HIFI) Band 1

The receiver group characterized several horns (engineering model, flight model, flight spares) for Band 6 of the Herschel instrument, in the framework of a contract with CNES. This made it necessary to enhance the performance of the antenna test range to achieve a dynamic range of about 50dB in the band 480-640 GHz.

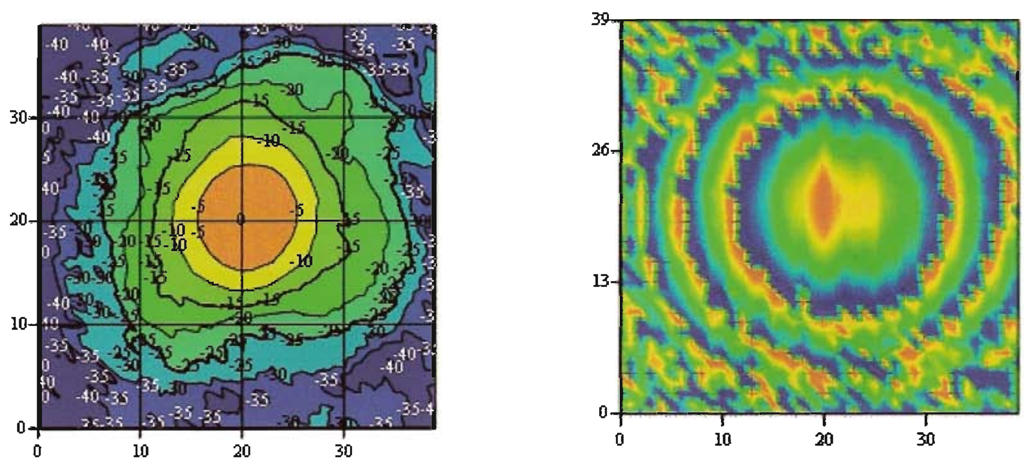


Fig. 5.9: Measurement of amplitude (dB) and phase for Herschel flight model horn #7, at 604 GHz. Amplitude and phase information can be retrieved down to at least –40dB from the boresight level. The phase has been partly unwrapped to improve the clarity of the graph.

AMSTAR

AMSTAR is a European collaborative development programme within the EU FP6 programme "RadioNet". The receiver group started work on two work packages within AMSTAR. These development projects are directly linked to IRAM's medium-term instrumentation plan:

WP 2.1.1; *Development of wide IF band SIS mixers for 80-116 GHz*, with the goal to achieve a 8 GHz IF bandwidth for a 3mm SIS mixer;
WP 2.4.1; *Focal plane heterodyne array* (in collaboration with the Rutherford Appleton Laboratories), with the goal to design and build a demonstrator array receiver for the 2mm band, using SIS mixers with photonic local oscillators.

5.2.4 Instrumentation and development activities

3mm HEMT low noise amplifiers

IRAM started a program of hands-on evaluation of potential cryogenic HEMT amplifiers for the 3mm band, as a possible option for the construction of a multibeam wideband receiver. Amplifier modules were purchased or borrowed from the Fraunhofer Institute in Freiburg, and from JPL. So far, the evaluation of the first one is complete. A strawman configuration and preliminary budget have been worked out for a 3mm multibeam HEMT-based receiver under several design options.

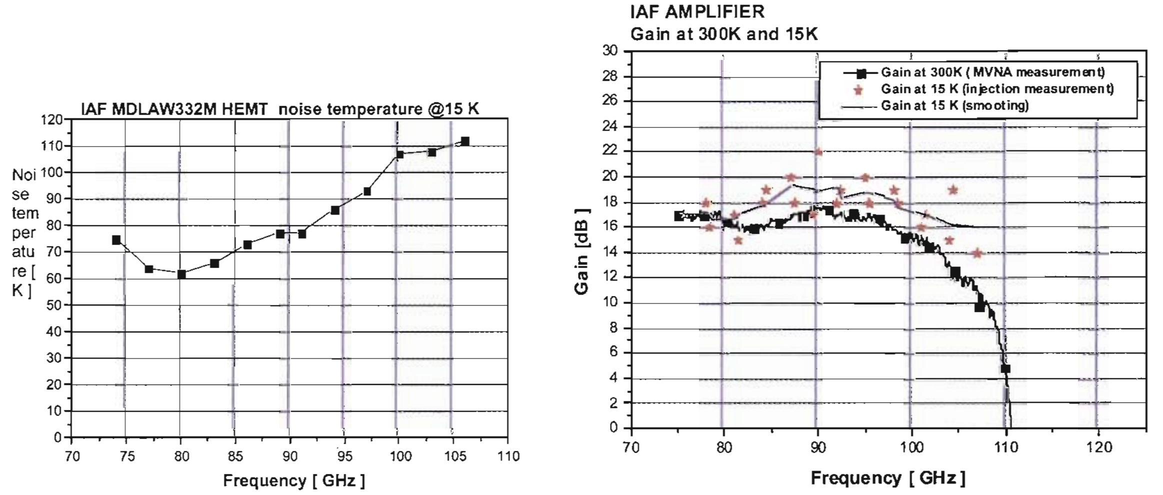


Fig. 5.10: Noise temperature and gain of the HEMT amplifier from IAF (Fraunhofer Institute in Freiburg). That amplifier, designed for room temperature operation, was characterized at 15K by IRAM.

Solid-state local oscillator with full electronic tuning

This development is driven by the increasing difficulties to procure mechanically tuned Gunn oscillators. The recent commercial availability of high efficiency, wide-band mm- and sub-mm band multipliers and 3mm-band medium-power amplifiers, together with commercial components in the microwave and low millimeter frequency bands, makes it possible to develop LO sources with full electronic tuning. Such a development has been made in IRAM, in parallel with similar developments at NRAO. The outcome is very encouraging. The prototype IRAM LO is designed to cover the frequency band 90-120 GHz, such that, associated with a commercially available frequency tripler, it can cover the 270-360 GHz band for PdBI Band 4. When used as an LO source for a 3mm SIS mixer, the resulting noise temperature is equal or better than what is obtained with a Gunn local oscillator. The elimination of moving parts should result in better reliability during on-site operation, and is also a definite advantage for automated testing in the laboratory.

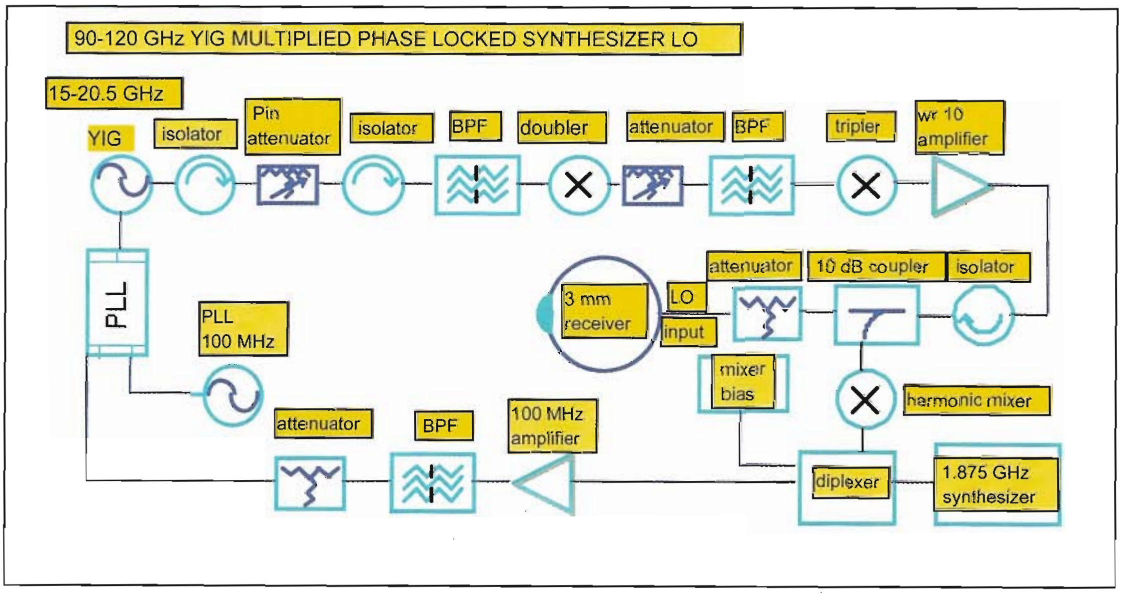


Fig. 5.11: Block diagram of the 3mm-band electronic tuning LO, including the phase-lock loop.

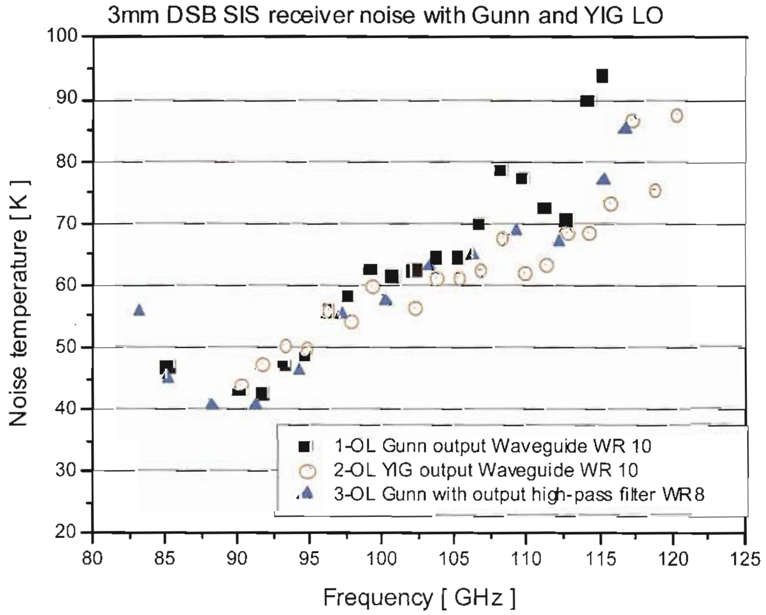


Fig. 5.12: Comparison of the noise performance of a 3-mm band SIS mixer, when pumped with a) a regular Gunn oscillator (black squares); b) the new electronically-tuned LO (red circles); c) the Gunn oscillator associated with a low-pass filter to reject spurious harmonics (blue triangles).

5.3 BACKEND DEVELOPMENTS

5.3.1 Delivery of ALMA digitizer clocks

The design of the 4 GHz clocks for the fine delay system has been completed. The first three prototype units have been built, tested and sent to Socorro, where NRAO successfully appended them to the ALMA prototype antenna electronics.

5.3.2 Delivery of the digital test equipment for the ALMA backend

The digital 4 GHz autocorrelator and its software for testing the ALMA sampler/demux chipset has been completed and delivered to the University of Bordeaux. It provides a very convenient means of evaluating the quality of a digitizing system by giving information on level dispersion, frequency response, and amplitude stability. It can work with 1, 2, or 3-bit sampling schemes with a minimum of 160 channels.

5.3.3 IF transport and IF processing for the PdB interferometer

The design phase of the new 4-8 GHz IF processor has been completed, and prototypes for its various elements have been built. The coaxial part of the equipment has been tested and validated. Most of the critical components (including lasers) have been ordered and delivered.

In order to measure the different values of Tsys across the new 4 GHz IF, the retrofitting of each existing correlator unit with a pair of digital total power detectors has been proposed.

A detailed documentation on the IF processor can be found at the following web-address: www.iram.fr/IRAMFR/TA/backend/processor

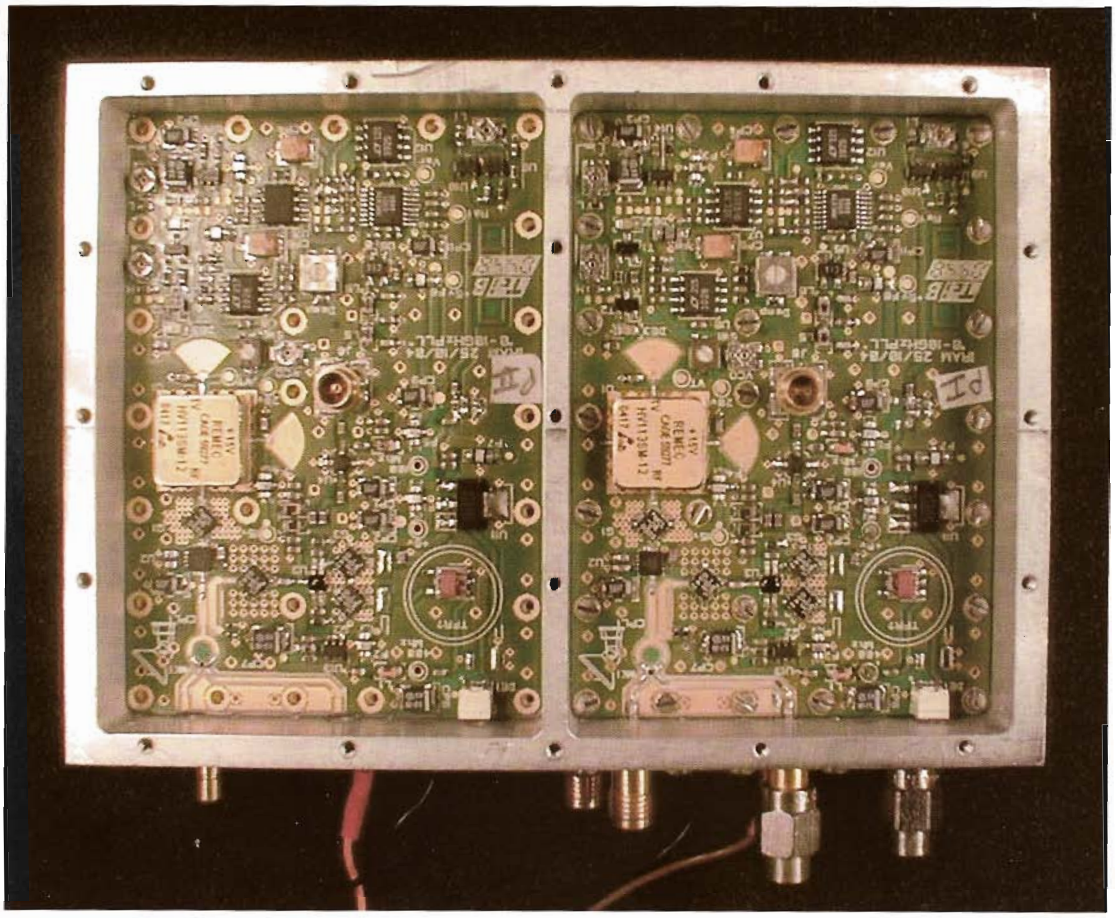


Fig. 5.13: The new dual LO2, digitally phase-controlled at 8 and 10 GHz.

5.4 COMPUTER GROUP

5.4.1 General Hard- and Software Support

A new Network Attached Storage file server has been installed at Grenoble to respond to the increasing need of reliable disk space, visible from the network on all PCs under MS Windows or Linux. A total of more than 1.5 Terabytes are available through a trunk at 2 GigaBits/s to our central network switch. The reliability and the security are based on RAID technologies, disk and power supply redundancies and on a specific OS. Data protection against user mistakes or software/hardware failures, is achieved with periodic snapshots that allow users to recover lost data, and from a complete backup of the server content every week on bimonthly recycled cartridges.

The previous file server with a capacity of nearly 800 GB is now dedicated to data reduction projects.

The network has been upgraded with the acquisition of a Gigabit switch, central in the network configuration, and by the replacement of the old routers by new ones which are better matched to the required quality of service and bandwidth. These new services were needed for the connection of our telephone PABXs over IP on a permanently rented line between Grenoble and Bure which allows a data rate of 1Mbits/s.

An authentication server has been evaluated but not yet installed.

At the end of 2004, all our PCs under Linux, and most of our servers, are running the RedHat distribution version 9. In view of the new commercial policy of RedHat, different public and free distributions have been evaluated. For the time being IRAM-Grenoble continues with the Fedora distribution which is simply the beta-version of the next RedHat Enterprise linux commercial product.

Following a request from the Front End group, special software from "epiware" has been installed. It will help to respond to the increasing need of information sharing and should improve the ability to organize information and to manage documents. It is a browser-based service.

Also, with a browser interface, a new database has been set up in order to manage the configurations (hard and soft) of the IRAM computers (personal and servers). It is the aphp/mysql public package, named "glpi", and tuned for our specific needs.

A large fraction of time was devoted to the maintenance of the numerous PCs at Grenoble and Bure, the installation of security patches, and to the customisation of new machines. Under Linux, customisation and house-keeping scripts have been developed to simplify these tasks. Under Windows, disk images simplify new PC setups. A Software Update Service has been started to download Windows security patches without any privileged user intervention but nevertheless, still under administrator control.

5.4.2 Real-Time Software Developments

A substantial amount of time was spent in order to prepare the arrival of the next generation receivers on the Plateau de Bure. Several CAN clients have been designed and prototyped: CAN to digital input/output, CAN to digital/analog or analog/digital conversions, CAN bridges to VME bus or to I2C bus.

With clearly defined interfaces, agreed long in advance between the different participating groups, drivers and low level software can be developed and then tested against simulators. Python is ***one of*** the favourite object oriented languages used for the upper layers.

The modifications made to the multibeam receiver for Pico-Veleta required some changes in the software which have successfully been implemented.

Two technical test periods at the 30m-telescope were used to develop and test a first version of the astronomy layer in connection with the development of a new generation telescope drive and data acquisition software.

5.5 SCIENTIFIC SOFTWARE DEVELOPMENT ACTIVITIES

5.5.1 GILDAS Infrastructure

The major efforts that started in 2003 to modernize the infrastructure of the GILDAS package arrived at maturity in 2004. The software architecture, distribution, and building mechanisms have been fully overhauled. This implied a number of significant changes for the users:

- Fortran-77 compilers (including G77) are not supported anymore. The use of a Fortran-90 compiler is mandatory to build GILDAS.
- GRAPHIC is now obsolete; its features have been transferred to GREG and/or MAPPING. Old GRAPHIC procedures still run in GREG and/or MAPPING.
- GILDAS libraries and general include files have been redefined and renamed.

A new web page (http://www.iram.fr/IRAMFR/GILDAS) has been written and is regularly updated. Users will find there the most recent version of the package to download as well as documentation and other useful information. The main development platform of GILDAS is Linux, but the package has been successfully installed on several other operating systems, including MacOSX and Windows. All requests, remarks, and suggestions concerning GILDAS should be sent to gildas@iram.fr.

Ongoing activities include updating the documentation as well as work on the GILDAS kernel to support 64 bits processors, Cygwin OS under Windows, and the new GNU G95 compiler.

5.5.2 GILDAS Data Reduction Software

Besides the above improvements and the day-to-day maintenance of the GILDAS package, a number of new tools have been developed. Worth mentioning are the support for the 22 GHz radiometers (CLIC), an updated UV table format (CLIC, MAPPING), an improvement of the automatic data selection in the Plateau de Bure pipeline (CLIC), or new versatile visualization tools of data cubes (GREG).

An important effort has been devoted to the software for the 30-m. CLASS is currently being rewritten in Fortran-90, with an improved support for on-the-fly observations. MIRA, a new software dedicated to the processing of heterodyne multi-beam instruments, is being developed. This software will play a key role in the context of the 30-m New Control System (NCS), by performing the real-time data calibration on the raw data to produce a CLASS-file.

5.5.3 ALMA

The GILDAS software has been adapted and was extensively used for the testing of the ALMA antenna prototypes at the ALMA Test Facility near Socorro (New Mexico, USA).

IRAM is deeply involved in a number of software developments for ALMA, within the ALMA Computing IPT. The institute is responsible for the real-time calibration pipeline (automatic reduction of instrument and atmospheric calibration observations), which is currently being developed in the ALMA software environment.

IRAM astronomers are also playing a key role in the ALMA Science Software Requirement committee (chaired by an astronomer of the institute). This group is in charge of determining and maintaining the scientific requirements on the ALMA software and contributing to the test and validation of the software. A major contribution in 2004 has been the definition of the ALMA Science Data Model.

5.6 TECHNICAL GROUP

5.6.1 Mechanical Workshop

The staff in the workshop has dealt with a total of **185 requests** for mechanical components. 111 of these were handled internally. The remaining 74 projects were subcontracted to outside companies after preparing the necessary documentation, and with careful checking of the work delivered.

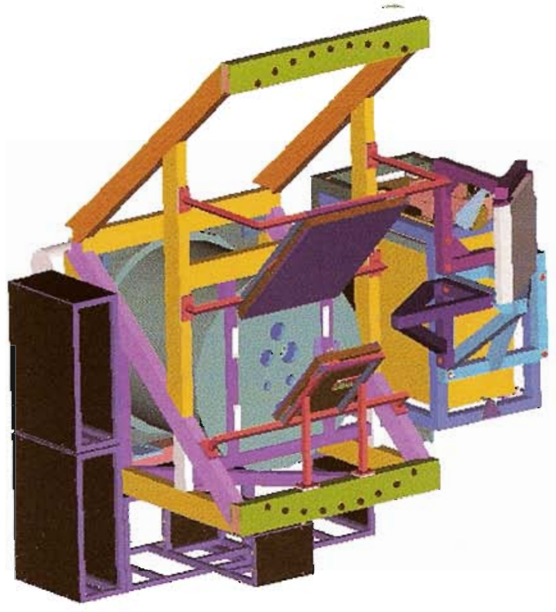
Among the pieces produced at IRAM were a large number of microwave components, 2SB mixers, couplers, horns for ALMA band 7, and for the next generation PdB-receivers at 100/150/230 GHz.

Fig. 5.14: A series of 2SB mixer for the ALMA band7.

5.6.2: Drawing Office

The drawing office worked on numerous mechanical designs, in close collaboration with the other groups. These were in particular:

-the design of all new microwave components for the next generation PdB receivers, and for the ALMA receivers,
-the study for the support structure that will accommodate the new receivers in the cabin of the PdB antennas,
-various design work for other groups.



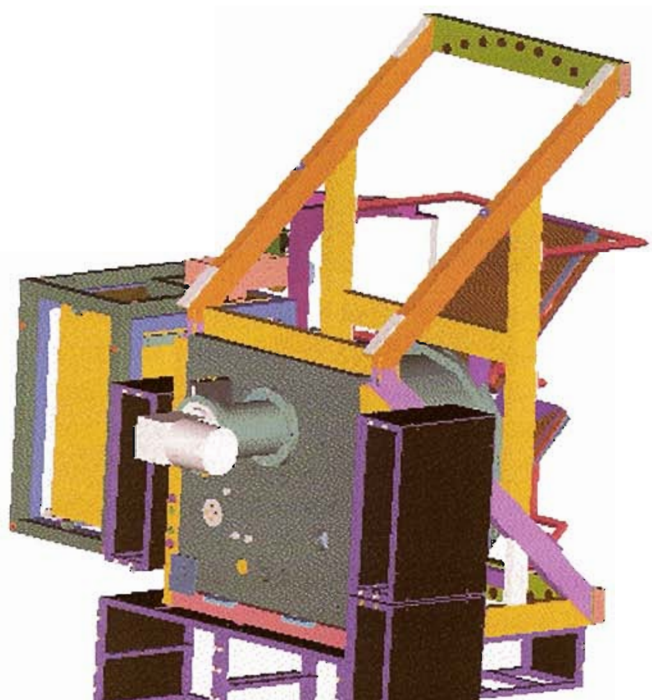


Fig. 5.15: Backside *(top)*, and frontside view *(bottom)* of the new receiver support structure for the Plateau de Bure telescopes

5.6.3 Electro-forming

The equipment and supplies needed for electro-forming were installed in a new, dedicated area near the mechanical workshop. On this occasion several changes have been made in order to comply with the latest legislation.

Fig. 5.16 : The new installations for electro-forming

5.6.4 Technical support for antennas

As in previous years, the technical group has closely collaborated with the technical staff on the Plateau de Bure during the antenna maintenance period.

6. PERSONNEL AND FINANCES

6.1 Personnel

In 2004, 102 positions were foreseen in the Personnel Plan.
IRAM had a total of 99.6 positions filled with staff on longer-term or unlimited contracts, of which 71.4 in France and 28.2 in Spain.
In addition, the equivalent of 9.7 positions was used for shorter-term contracts (see below).

Furthermore, 3 post-docs (FR) and 2 thesis students (ES) worked at IRAM.

Extra workload during certain periods of the year made it necessary to issue a number of limited-term contracts, and to call on staff from a manpower company. This corresponded to :

- 3.2 man/year on Plateau de Bure, including interim workers, to complete the 3 teams for maintenance and medical support,
- 3.5 man/year in Grenoble, for replacements and additional work in the Administration and technical groups.
- 3 man/year in Spain, for replacements and additional work in the Administration and technical groups.

6..2 Finance

IRAM's financial situation in 2004, as well as budget provisions for 2005, are summarised in the attached tables.

2004 - Operating budget

a) Expenditure was slightly lower than anticipated:

- Savings were made under personnel budget, since a) not all positions were occupied and b) part of the salary costs are allocated to a project budget and not IRAM budget;
- Global savings could be achieved under "subcontracting", although some items under this category did notably increase (security, maintenance of equipment on Plateau de Bure);
- Increase of provisions made in particular in connection with the cable car accident in 1999, due to the continuation of the legal procedure to higher Court in 2005.

b) Income was higher than expected, due to

- exceptional income from previous years budgets, linked to the re-allocation of expenditure to a project budget instead of IRAM budget;
- Additional funding from the European Union for a post-doc;
- A contract signed with CNES for the Herschel mission project;
- Higher bank interests;
- Cancellation of some provisions previously made.

This led to an under spending in the operation budget of 1,077,860.37 €, taking into account a carry-forward of 3,995.82 € from the 2003 operation budget.

2004 - Investment budget

a) Expenditure was lower than foreseen and concerned mainly scientific equipment and instrumentation (Bure "new generation" receivers, spectrum analysers, computers, etc.), East-track extension on Plateau de Bure, vehicles for Plateau de Bure to ensure snow-removal.

b) Income
The income was in line with the budget estimate.

Taking into account the carry-forward from the 2002 and 2003 budgets, there was an under spending in the 2004 investment budget of 1,494,992.51 €. Note, however, that this amount includes 813,160.48 € for orders that have been signed but not yet paid.

BUDGET 2004
(in €)

2004 - EXPENDITURE

Budget heading	Approved	Actual
Operation / Personnel	6 883 000	6 202 738
Operation / other items	3 195 000	3 411 640
TOTAL OPERATION	**10 078 000**	**9 614 377**
Investment	3 494 288	1 999 750
TOTAL EXPENDITURE excl. VAT	***13 572 288***	***11 614 128***
VAT	842 992	842 992
TOTAL EXPENDITURE incl. VAT	***14 415 280***	***12 457 120***

2004 - INCOME

Budget heading	Approved	Actual
CNRS contributions	5 136 120	5 136 120
MPG contributions	5 136 120	5 136 120
IGN contributions	655 675	655 675
TOTAL CONTRIBUTIONS	***10 927 915***	***10 927 915***
Carry forward from 02+03 (Op+Inv.)	1 782 839	1 782 840
IRAM's own income	861 536	1 476 227
TOTAL INCOME excl. VAT	***13 572 290***	***14 186 982***
CNRS contribution for VAT (19,6%) *	842 992	842 992
TOTAL INCOME incl. VAT	***14 415 282***	***15 029 974***

* = 19,6% on CNRS contribution to operation budget

BUDGET PROVISIONS 2005

(in €)

2005 - EXPENDITURE

Budget heading	Approved
Operation / Personnel	7 086 000
Operation / other items	3 302 000
TOTAL OPERATION	**10 388 000**
Investment - general	1 804 127
TOTAL INVESTMENT	**1 804 127**
TOTAL EXPENDITURE	***12 192 127***
VAT (19,6%)	862 592
TOTAL EXPENDITURE incl. VAT	***13 054 719***

2005 - INCOME

Budget heading	Approved
CNRS contributions	5 136 120
MPG contributions	5 136 120
IGN contributions	655 675
TOTAL CONTRIBUTIONS	**10 927 914**
IRAM's own income	1 264 213
Carry forward from 2004	0
TOTAL INCOME excl. VAT	***12 192 127***
CNRS contribution for VAT *	862 592
TOTAL INCOME incl. VAT	***13 054 719***

* = 19,6% on CNRS contribution to operation budget

7. ANNEX I : TELESCOPE SCHEDULES

7.1. IRAM 30m-Telescope

DECEMBER 30 – JANUARY 13

Ident.	Title	Freq. (GHz)	Authors
147.03	Dense Molecular Gas and the Role of Starburst Activity in Local PG QSOs	78.3, 78.5, 79.6, 81.5, 82.2, 83.5, 84.4, 84.8, 85.4	Evans Aaron S. , Downes D. , Solomon P. Tacconi Linda, Vavilkin T
237.03	Search for LiD in cold molecular gas	100	Ceccarelli Cecilia
238.03	Deep Search for N-containing PAH analogs: Isoquinoline and Quinoline	100	Despois Didier
217.03	A spectral line survey of Sgr B2-M and LMH in the 3mm window	Line Survey	Menten Karl M. , Schilke Peter , Comito Claudia Belloche Arnaud, Leurini Silvia, Müller Holger Thorwirth Sven , Snyder L. E. Mauersberger Rainer, Kanekar Nissim
216.03	The molecular outflows in the W3(OH) complex	230	Menten Karl M., Stanke Thomas Wyrowski Friedrich, Schilke Peter
404.03	OBSERVING POOL n°4	MAMBO	
086.03	A search for deuterated small hydrocarbons in dark clouds	135.2,232.6,237.7	Cernicharo Jose

JANUARY 13 – JANUARY 27

Ident.	Title	Freq. (GHz)	Authors
405.03	OBSERVING POOL	MAMBO	
406.03	OBSERVING POOL	MAMBO	
197.03	The extended source of CO in comet 29P/Schwassmann-Wachmann 1	230	Gunnarsson Marcus, Bockelée-Morvan Dominique, Biver Nicolas Crovisier J., Festou M., Rickman H.
189.03	Unbiased Spectral Survey of the Low-Mass Protostar IRAS16293-2422	81-115, 130-177	Caux Emmanuel, Schilke Peter, Castets Alain Ceccarelli Cecilia , Comito Claudia, Parise Bérengère, Wakelam Valentine, Helmich Frank, Kahane Claudine, Tielens Xander, van Dishoeck Ewine, Walters Adam, Cazaux Stéphanie

JANUARY 27 – FEBRUARY 10

Ident.	Title	Freq. (GHz)	Authors
407.03	OBSERVING POOL	MAMBO	
115.03	Temporal & latitudinal dispersal of trace species HCN, CO and CS in Jupiter's stratosphere : a long-term monitoring	88,115,146,230, 265	Marten, Moreno, Matthews
228.03	HERA imaging of IC5146 : studies of depletion and cloud structure	219	Richer, Kramer, Bell, Hills, Lada
229.03	The structure of molecular clumps associated with high-mass YSOs	219,224,222	Fontani, Cesaroni, Caselli, Olmi
407.03	OBSERVING POOL	MAMBO	
134.03	SiO maser emission monitoring in the protoplanetary nebula OH231.8+4.2	86	Sanchez-Contreras, Alcolea, Soria, Desmurs, Colomer
183.03	Carbon chemistry and fractional ionisation in the horsehead nebula	83-98,144-279	Gerin, Teyssier, Roueff, Pety, Hily-Blant

FEBRUARY 10 – FEBRUARY 24

Ident.	Title	Freq. (GHz)	Authors
155.03	Investigating the environment of the remarkable line of sight towards HD 34078	115,230	Boissé, Roueff, Gerin, Pagani
408.03	OBSERVING POOL	MAMBO	
409.03	OBSERVING POOL	MAMBO	

FEBRUARY 24 – MARCH 09

Ident.	Title	Freq. (GHz)	Authors
410.03	OBSERVING POOL	MAMBO	
154.03	CO in outer disks – fuel for tidal dwarfs ? Dark matter ?	115,230	Braine, Cuillandre, Brouillet
134.03	SiO maser emission monitoring in the protoplanetary nebula OH231.8+4.2	86	Sanchez-Contreras, Alcolea, Soria, Desmurs, Colomer
189.03	Unbiased spectral survey of the low-mass protostar IRAS16293-2422	81-115,130-177, 197-241	Caux, Schilke, Castets, Ceccarelli, Comito, Parise, Wakelam, Helmich, Kahane, Tielens, van Dishoeck, walters, Cazaux

MARCH 09 – MARCH 23

Ident.	Title	Freq. (GHz)	Authors
411.03	OBSERVING POOL	MAMBO	
412.02	OBSERVING POOL	MAMBO	

MARCH 23 – APRIL 06

Ident.	Title	Freq. (GHz)	Authors
235.03	Completion of the CCH and CCD low-mass star-forming cores survey	87,144,262	Shirley, Hogerheijde
200.03	Detection of flares from Sgr A*	231	Schuster,Thum, Wiesemeyer
120.03	The composition of Io's volcanic gases	104,143,215,204,234,245	Lellouch, Paubert, Moreno, Moses, Schneider, Strobel
236.03	Probing the relationship between starburst and AGN activity in $z > 1.5$ QSOs		Beelen, Omont, Bertoldi, Cox, Carilli, Mohan
134.03	SiO maser emission monitoring in the protoplanetary nebula OH231.8+4.2	86	Sanchez-Contreras, Alcolea, Soria, Desmurs, Colomer
196.03	A 2mm line survey of selected position in the nucleus of the Milky Way	141-166	Martin-Ruiz, Mauersberger, Martin-Pintado, Requena
413.02	OBSERVING POOL	MAMBO	

APRIL 06 – APRIL 20

Ident.	Title	Freq. (GHz)	Authors
153.03	A CO survey of early-type galaxies from the SAURON sample	115-142,231-229,226	Combes, Bureau, Young, van Gorkom
146.03	N_2H^+ excitation, deuteration and depletion in L183/L134N	93,110,154,231	Pagani, Daniel, Dubernet, Apponi, Bacmann
124.03	Neutral carbon $C_I(^3P_1 \rightarrow {}^3P_0)$ line at 2mm in dusty quasars at $z = 2.5$	138,149,259,245	Weiss, Henkel, Downes, Walter
149.03	Chemical differenciation in massive cores : molecular freeze out or temperature effects ?	222	Zinchenko, Caselli, Johansson, Myers, Pirogov, Turner
174.03	A search for molecular envelopes around a new type of nova-like stars	115,230,110,220	Banerjee, Ashok, Alcolea, Bachiller, Varricatt
V01.03	Global 3mm VLBI observations		

APRIL 20 – MAY 04

Ident.	Title	Freq. (GHz)	Authors
V01.03	Global 3mm VLBI observations		
211.03	The linear polarization of CH_3OH masers – a clue to their environment	84,95,107,132,157	Wiesemeyer, Thum, Walmsley, Menten, Watson
168.03	A search for redshifted LiH, DCN and CDO^+ at z = 0.9	114,115,235	Lubowich, Henkel, Combes, Wiklind, Turner
134.03	SiO maser emission monitoring in the protoplanetary nebula OH231.8+4.2	86	Sanchez-Contreras, Alcolea, Soria, Desmurs, Colomer
203.03	Star formation in a chain		Tafalla, Johnstone
120.03	The composition of Io's volcanic gases	104,143,215,204,234,245	Lellouch, Paubert, Moreno, Moses, Schneider, Strobel
207.03	Measuring line polarization using the Goldreich-Kylafis effect	109	Forbrich, Menten, Belloche, Thum, Wiesemeyer
225.03	Chemical investigation of comets C/2002 T7 and C/2001 Q4	88,145,157,219, 225,230,241	Biver, Bockelée-Morvan, Crovisier, Colom, Gunnarsson, Lecacheux, Moreno, Despois, Paubert

MAY 04 – MAY 18

Ident.	Title	Freq. (GHz)	Authors
168.03	A search for redshifted LiH, DCN and CDO^+ at z = 0.9	114,115,235	Lubowich, Henkel, Combes, Wiklind, Turner
200.03	Detection of flares from Sgr A*	231	Schuster, Thum, Wiesemeyer, Downes
133.03	Tentative detection of ^{25}MgNC in CRL 618 : A possible enhancement of ^{25}Mg	138,140,152, 163	Ziurys, Halfen, Milam
127.03	Confirmation of KCN in IRC+10216 : The fifth metal cyanide ?	150,103,101, 94,85	Savage, Ziurys, Guélin
126.03	CN Zeeman observations in molecular clouds	113	Falgarone, Crutcher, Troland, Hily-Blant
214.03	CO and 1.3mm continuum survey of HyLIGs	146,151,89,108, 129,84,87,88	Verma, Tecza, Baker, Serjeant, Rigopoulou, Farrah, Rowan-Robinson, Efstathiou
196.03	A 2mm line survey of selected position in the nucleus of the Milky Way	141-166	Martin-Ruiz, Mauersberger, Martin-Pintado, Requena
175.03	Mass-loss variations in AGB stars : Detached shells in their making ?	115,230	LeBertre, Winters, Pety, Neri
225.03	Chemical investigation of comets C/2002 T7 and C/2001 Q4	88,147,157,168 218,219,225,...	Biver, Bockelée-Morvan, Crovisier, Colom, Gunnarsson, Lecacheux, Moreno, Despois, Paubert
157.03	The vertical distribution of carbon monoxide in Neptune's atmosphere	115	Lellouch, Paubert

MAY 18 – JUNE 01

Ident.	Title	Freq. (GHz)	Authors
078.04	MAMBO observations of comets C/2001 Q4 & C/2002 T7	250	Altenhoff, Bertoldi, Menten, Thum, Winters
048.04	Gas & dust combined study of a cold condensation in Taurus	77,93,109,219	Ristorcelli, Pagani, Boudet, Dupac, Bernard, Abergel
037.04	Post-perihelion activity of comet C/2002 T7 (LINEAR)	88,145,147,157 225,241,271	Biver, Bockelée-Morvan, Crovisier, Colom, Gunnarsson, Lecacheux, Moreno, Paubert
030.04	Salient HCO^+ small scale structure with no counterpart	87,93,99,220	Falgarone, Hily-Blant, Pineau des Forêts
046.04	A pre-prestellar core in L183/L134N ?	77,93,154,231 279	Pagani, Apponi, Bacmann
038.04	The local IR-HCN correlation in nearby normal galaxies	88,244	Gao, Solomon
300.04	MAMBO Observing Pool		

JUNE 01 – JUNE 15

Ident.	Title	Freq. (GHz)	Authors
023.04	The physical & chemical structure of the envelope of young intermediate mass (IM) stars		Fuente, Ceccarelli, Caselli, Johnstone, Van Dishoeck, Plume, Lefloch, Tafalla, Wyrowski
003.04	A study of the photon-dominated chemistry in M82	88,113,89,87,85 226,235,217	Fuente, Garcia-Burillo, Gerin, Usero, Rizzo, Teyssier
099.04	30m observations of the NUGA sample	88,115,230	Garcia-Burillo, Combes, Eckart, Krips, Baker, Enghmaier, Tacconi, Boone, Hunt, Leon, Neri, Schinnerer
300.04	MAMBO Observing Pool		
044.04	Search for new compounds in Venus' atmosphere during the June 8, 2004 transit	138,146,167,22 0,218,204,225	Fouchet, Lellouch, Moreno, Paubert
179.03	Mapping high mass infall candidates	89,93,140,265	Fuller, Thomas, Williams

JUNE 15 – JUNE 29

Ident.	Title	Freq. (GHz)	Authors
189.03	Unbiased spectral survey of the low-mass protostar IRAS16293-2422	81,130,197,241	Caux, Schilke, Castets, Ceccarelli, Comito, Parise, Wakelam, Helmich, Kahane, Tielens, van Dishoeck, Walters, Cauzaux
094.04	^{12}CO J=1-0 emission profiles complementary to low-latitude HCO^+ absorption	115,230	Lucas, Pety, Liszt
039.04	The chemistry of the galactic molecular ring	110,220,86,130, 217,97,146,244.	Rodriguez-Fernandez, Brüll, Kramer, Martin-Pintado, Combes
073.04	The HI cloud J1023+1952 in NGC 3227/6 : A tidal dwarf galaxy in formation ?	114,229	Mundell, Schinnerer, Lisenfeld
005.04	Radial distribution of the HCN and HCO^+ emission in the M31 disk	88,89	Brouillet, Braine, Herpin, Jacq, Muller
072.04	SiO maser emission monitoring in the proto-PN OH231.8+4.2	86	Sanchez-Contreras, Alcolea, Soria, Desmurs, Colomer
059.04	A CO survey of H_2O megamaser galaxies	115,230	Henkel, Weiss, Downes, Braatz, Tarchi
009.04	Cold dust in galaxies of the Spitzer SINGS survey	250	Weiss, Walter, Mauersberger, Bendo, Kennicut
035.04	Completion of the survey of a new chemically rich outflow in CepA-East	85,206,97,101 202,244,241	Codella, Bachiller, Caselli

JUNE 29 – JULY 13

Ident.	Title	Freq. (GHz)	Authors
041.04	Oxigen-burning, neon-burning, and s-process nucleosynthesis : Interstellar sulphur isotopes in the galactic disk	90,92,95,96,97, 98	Mauersberger, Ott, Henkel, Gallino
026.04	Cloud temperature structure and gas-phase depletion in IC5146	93,109,112,216	Bell, Kramer, Richer, Hills, Lada
012.04	Detection of flares from Sgr A*	231	Schuster, Thum, Wiesemeyer, Downes, Eckart
052.04	Molecular content of a type-Ia SN host galaxy at z=0.6	146,219	Melchior, Combes, Pain, Pennypacker
058.04	Neutral carbon $C_I(^3P_1 \rightarrow {}^3P_0)$ line in dusty quasars and starbursts at z = 2.5	129,138,162, 195	Weiss, Downes, Henkel, Walter
078.04	MAMBO observations of comets C/2001 Q4 & C/2002 T7	250	Altenhoff, Bertoldi, Menten, Thum, Winters
010.04	A 3mm line survey of the simplest star forming regions	86	Marcelino, Mauersberger, Martin-Pintado, Thum, Tafalla, Paubert, Cernicharo, Fonfria, Roueff
090.04	Probing the earliest stages of high mass star formation in Cygnus X	91,112,224,144 146,147,244	Schneider, Bontemps, Motte, Simon, Wyrowski
124.03	Neutral carbon $C_I(^3P_1 \rightarrow {}^3P_0)$ line at 2mm in dusty quasars at z = 2.5	138,149,259 245	Weiss, Henkel, Downes, Walter

JULY 13 – JULY 27

Ident.	Title	Freq. (GHz)	Authors
008.04	The location of large PDRs in the nuclear region of the starburst galaxy NGC 253	86,173,259,219	Martin-Ruiz, Mauersberger, Martin-Pintado, Henkel, Garcia-Burillo
043.04	Search for interstellar CD_3OD	110,156,221,27 3	Van der Tak, Schilke, Müller, Xu, Thorwirth
100.04	A 2mm line survey of selected position in the central region of the Milky Way	141-166	Martin-Ruiz, Mauersberger, Martin-Pintado, Requena
020.04	The extent of the molecular gas distribution in the merger NGC 4441	114,228	Manthey, Hüttemeister, Aalto

JULY 27 – AUGUST 10

Ident.	Title	Freq. (GHz)	Authors
046.04	A pre-prestellar core in L183/L134N ?	77,93,154,231, 279	Pagani, Apponi, Bacmann
029.04	A search for a nascent CO outflow in CB101	230	De Gregorio-Monsalvo, Gomez, Anglada, Patel
007.04	A complete study of Perseus cores	77,93,154,224	Tafalla, Caselli, Goodman, Ridge, Johnstone, Heyer, di Francesco, Alves, Arce, Li, Wilson
075.04	The C153 galaxy in Abell 2125 : ram pressure, cooling flow or both ?	92	Salomé, Combes
042.04	High-resolution spectroscopy of deuterium-bearing molecules	72,75,108	Van der Tak, Müller, Muders, Schmid-Burgk
053.04	A giant repository of organic molecules around the galactic center ?	2mm band	Menten, Schilke, Comito, Belloche, Leurini, Müller, Thorwirth, Snyder
013.04	Molecular absorption in the complex gravitational lens at z =0.7645	130	Kanekar, Briggs, Combes, Wiklind
057.04	Search for $HCNH^+$ absorption in diffuse clouds	74,148	Liszt, Lucas, Pety
048.04	Gas & dust combined study of a cold condensation in Taurus	77,93,109,219	Ristorcelli, Pagani, Boudet, Giard, Dupac, Bernard, Abergel
060.04	What excites the cold molecular gas in cooling flow cores ?	77-99,199-258	Edge, Wilman, Salomé
065.04	Chemical differenciation and evolution in translucent cloud cores	93,109,112,219 244	Bensch, Heithausen, Böttner
072.04	SiO maser emission monitoring in the proto-PN OH231.8+4.2	86	Sanchez-Contreras, Alcolea, Soria, Desmurs, Colomer
098.04	Study of the possible variation of ^{15}N isotopic abundances from sources to sources	72-91,216-231	Roueff, Gerin
093.04	Shocks, jets and outflows associated with a group of YSOs in CB230	115,230109,98, 86,93	Brand, Codella, Massi, Wouterloot

AUGUST 10 – AUGUST 24

Ident.	Title	Freq. (GHz)	Authors
087.04	The effects of X-rays on molecular clouds	86,89,110,144 216,220,260, 267	Caselli, Randich
067.04	New metals in molecular form in IRC+10216 : Confirmation of CaC and CrN	144,165,255, 259	Halfen, Ziurys, Milam
047.04	Density and temperature maps of massive protostars	241	Leurini, Schilke, Menten, Beuther
061.04	Central infall in pre-stellar cores	77,85,231,259	Caselli, Bourke, Crapsi, Lee, Myers, Tafalla, Walmsley
066.04	Large deuterium fractionation in Ophiuchus : a local or a global phenomenon ?	77,93,112,154 224	Caselli, André, Belloche, Ceccarelli, Crapsi, Gatti, Tafalla, Walmsley
008.04	The location of large PDRs in the nuclear region of the starburst galaxy NGC 253	86,173,259,219	Martin-Ruiz, Mauersberger, Martin-Pintado, Henkel, Garcia-Burillo
036.04	Infall, rotation and outflow toward bolometer protostellar condensations	85-98,144-267	André, Belloche, Onishi

AUGUST 24 – SEPTEMBER 07

Ident.	Title	Freq. (GHz)	Authors
047.04	Density and temperature maps of massive protostars	241	Leurini, Schilke, Menten, Beuther
096.04	The polarization of HCN masers : radiative processes and magnetic fields in carbon-rich circumstellar envelopes	89	Wiesemeyer, Thum, Paubert
012.04	Detection of flares from Sgr A*	231	Schuster, Thum, Wiesemeyer, Downes, Eckart
024.04	Formation of methanol in pre-stellar cores : tests of grain surface chemistry	106,134,168, 256	Bacmann, Parise, Lefloch, Castets, Ceccarelli, Caux

SEPTEMBER 07 – SEPTEMBER 21

Ident.	Title	Freq. (GHz)	Authors
016.04	$^{12}CO(2\text{-}1)$ & $^{13}CO(2\text{-}1)$ mapping of M51 with HERA	220,230	Mookerjea, Kramer, Schuster, Wiesemeyer, Garcia-Burillo, Stutzki
068.04	Dense cores as tracer particles : testing turbulent cloud models	93,219	Tafalla, Santiago, Galli, Walmsley, Caselli
072.04	SiO maser emission monitoring in the proto-PN OH231.8+4.2	86	Sanchez-Contreras, Alcolea, Soria, Desmurs, Colomer
006.04	Molecular gas in radio galaxies with new and re-started activity	115,230	Mack, Saripalli, Schilizzi, Snellen, Staveley-Smith, Subrahmanyan
102.04	A spectral line survey of Sgr B2-M and LMH in the 3mm window	Line survey	Menten, Schilke, Comito, Belloche, Leurini, Müller, Thorwirth, Snyder, Mauersberger, Kanekar, Martin
074.04	L1521E : the first starless core with no molecular depletion ?	96,144,241,99 138,86,158…	Tafalla, Santiago, Caselli, Crapsi, Aikawa, Herbst

SEPTEMBER 21 – OCTOBER 05

Ident.	Title	Freq. (GHz)	Authors
072.04	SiO maser emission monitoring in the proto-PN OH231.8+4.2	86	Sanchez-Contreras, Alcolea, Soria, Desmurs, Colomer
097.04	Age and mass segregation of methanol protostars	86,97,110,146 150,230,244	Szymczak, Niezurawska, Colom
031.04	Chemistry of the ISM close to high mass X-ray binaries	115,150,113,88 86,98,230,250...	Boone, Garcia-Burillo, Hüttemeister, Martin-Pintado, Usero, Martin, Fuente, Mauersberger
071.04	Observations of pre-protostellar cores in Perseus	97,93,244,231	Olmi, Testi

OCTOBER 05 – OCTOBER 19

Ident.	Title	Freq. (GHz)	Authors
V01.04	GLOBAL 3mm VLBI observations		
400.04	POOL SESSION No. 1		

OCTOBER 19 – NOVEMBER 02

Ident.	Title	Freq. (GHz)	Authors
400.04	OBSERVING POOL SESSION No. 2	MAMBO	

NOVEMBER 02 – NOVEMBER 16

Ident.	Title	Freq. (GHz)	Authors
400.04	OBSERVING POOL SESSION No. 3	MAMBO	

NOVEMBER 16 – NOVEMBER 30

Ident.	Title	Freq. (GHz)	Authors
167.04	HCO^+ observations of dense molecular gas in ULIGs	85,87,88	Gracia, Garcia-Burillo, Planesas, Colina
146.04	Chemistry of Class I protostars	90,143,233,257 98,158,226,257	Cazaux, Caselli, Walmsley, Ceccarelli, Bottinelli, Castets, Teyssier
143.04	Formation of methanol in pre-stellar cores : tests of grain surface chemistry	134,137,256	Bacmann, Parise, Lefloch, Castets, Ceccarelli, Caux
230.04	A study of the photon-dominated chemistry in M82 (II)	226,265,261, 217,260,268,...	Fuente, Garcia-Burillo, Gerin, Usero, Rizzo, Teyssier
214.04	The physical conditions in IR dark cloud cores	110,112,88,146 144,220,265...	Simon, Rathborne, Jackson, Shah, Chambers
121.04	HDO abundance in the envelope of solar-mass protostars	80,151,225,241	Castets, Caux, Ceccarelli, Parise, Tielens

NOVEMBER 30 – DECEMBER 14

Ident.	Title	Freq. (GHz)	Authors
500.04	OBSERVING POOL		

DECEMBER 14 – DECEMBER 28

Ident.	Title	Freq. (GHz)	Authors
500.04	OBSERVING POOL		
240.04	Chemical fingerprints of heating sources in starburst galaxies and AGNs	104,114,138, 146,150,161,...	Martin-Ruiz, Mauersberger, Martin-Pintado, Henkel, Garcia-Burillo
237.04	$H^{17}{}_2O$ and $H^{18}{}_2O$ in galactic hot cores	194,203	Mauersberger, Wilson, Cernicharo
171.04	3mm HCN vibrationally excited masers in C-rich AGB stars	89	Alcolea, Desmurs, Soria-Ruiz, Bujarrabal, Colomer
008.04	The location of large PDRs in the nuclear region of the starburst galaxy NGC 253	86,173,259,219	Martin-Ruiz, Mauersberger, Martin-Pintado, Henkel, Garcia-Burillo
241.04	2mm line survey of selected position in the central region of the Milky Way. Last step.	159-173	Martin-Ruiz, Mauersberger, Martin-Pintado, Requena

7. ANNEX I: TELESCOPE SCHEDULES

7.2 PdB Interferometer

Ident.	Title	Line	Authors
M002	Chemistry of the DM Tau disk	C_2H H_2CO	V.Piétu A.Dutrey S.Guilloteau
M00B	Probing the nucleosynthesis in the young Universe (II)	HCO^+ $H^{13}CO^+$ DCO^+ HCN $H^{13}CN$ HNC $HN^{13}C$	S.Muller M.Dumke M.Guélin R.Lucas F.Combes M.Gérin T.Wiklind
M022	The Formation of Cometary Globules in Planetary Nebulae	$^{12}CO(1–0)$ $^{12}CO(2–1)$	R.Bachiller P.Huggins P.Cox T.Forveille E.Josselin
M039	Identification of mm sources without radio counterpart: The highest redshifts?	Cont3mm Cont1mm	D.Lutz F.Bertoldi K.Menten H.Dannerbauer M.Lehnert L.Tacconi R.Genzel C.Carilli
M042	A bright submm source possibly associated with a gravitationally lensed arc	Cont3mm Cont1mm	C.Borys D.Lutz L.Tacconi D.Scott P.Newbury G.Fahlman
M05D	CO identification of submillimetre galaxies	$^{12}CO(3–2)$ $^{12}CO(4–3)$ $^{12}CO(7–6)$ Cont1mm	R.Ivison R.Genzel F.Bertoldi R.Neri A.Omont P.Cox T.Greve S.Chapman A.Blain I.Smail
N001	Grain growth around an intermediate mass class I source	$C^{18}O + C^{17}O$ Cont3mm	E.Dartois L.d'Hendecourt
N004	NUclei of GAlaxies (NUGA)	$^{12}CO(1–0)$ $^{12}CO(2–1)$	S.García-Burillo F.Combes A.Eckart L.Tacconi L.Hunt S.Leon A.Baker P.Englmaier F.Boone E.Schinnerer R.Neri
N005	Episodic mass loss on the AGB: the detached CO shell around S Sct	$^{12}CO(1–0)$	H.Olofsson R.Lucas P.Bergman J.Bieging
N006	The temperature of high-mass protostellar cores	$CH_3C_2H(5–4)$ $CH_3C_2H(13–12)$	F.Fontani M.T.Beltrán R.Cesaroni L.Testi C.M.Walmsley J.Brand S.Molinari F.Palla
N00D	Molecular Gas in Massive low surface brightness galaxies	$^{12}CO(1–0)$ $^{12}CO(2–1)$	K.O'Neil E.Schinnerer
N01C	The role of clumping in the Wind Momentum-Luminosity Relationship for OIf Supergiants	Cont3mm Cont1mm	F.Najarro A.Herrero J.Martín-Pintado
N021	Mass-loss variations in AGB stars: Detached shells in their making?	$^{12}CO(1–0)$ $^{12}CO(2–1)$	T.LeBertre J.M.Winters J.Pety R.Neri
N028	CO identification of submillimetre galaxies. II	$^{12}CO(3–2)$ $^{12}CO(4–3)$ Cont1mm	R.Genzel R.Ivison F.Bertoldi R.Neri P.Cox A.Omont T.Greve S.Chapman I.Smail
N--3	Search for CO emission from the most distant QSOs	$^{12}CO(6–5)$	F.Bertoldi C.Carilli P.Cox A.Beelen G.Djorgovski Bogosavljevic Mahabal X.Fan A.Omont M.Strauss R.Neri
N02C*	Molecular gas in a large stellar complex in NGC 6946	$^{13}CO(1–0)$ $^{13}CO(2–1)$	U.Lisenfeld E.J.Alfaro Y.N.Efremov
N02F	Properties and evolution of disks in high-mass YSOs	$CH_3CN(6–5)$ $CH_4CN(12–11)$	R.Cesaroni M.T.Beltrán C.Codella R.S.Furuya R.Neri L.Olmi L.Testi
N030	Neutral Carbon (2–1) Line at 1mm in high-z Quasars and Starbursts	HCN(3–2) $^{13}CO(3–2)$ CI(2–1)	A.Weiss D.Downes C.Henkel F.Walter

Ident.	Title	Line	Authors
N032	Water in regions of high-mass star formation	HDO $H_2^{18}O$	F.van der Tak F.Herpin M.Walmsley C.Ceccarelli S.Viti
N033	Structure in the Debris Disk around a Nearby G Star	$^{12}CO(2\text{–}1)$	D.Wilner J.Williams
N035	V836 Tau: a transition disk?	$^{12}CO(1\text{–}0)$ $^{12}CO(2\text{–}1)$	A.Bacmann A.Dutrey S.Guilloteau
N036	Grain Growth in Disks of Pre-Main–sequence Intermediate Mass Stars	Cont3mm Cont1mm	A.Natta L.Testi R.Neri
N038	High Resolution mm-Interferometry of Submm Galaxies: Testing High-z Mass Assembly	$^{12}CO(4\text{–}3)$ $^{12}CO(3\text{–}2)$	R.Neri R.Genzel R.Ivison F.Bertoldi A.Blain S.Chapman P.Cox T.Greve A.Omont I.Smail L.Tacconi
N039	Mapping of Titan's trailing hemisphere	HC_3N CH_3CN	R.Moreno A.Marten
N03A	NUclei of GAlaxies (NUGA)	$^{12}CO(1\text{–}0)$ $^{12}CO(2\text{–}1)$	S.García-Burillo F.Combes A.Eckart L.Tacconi L.K.Hunt S.Leon A.Baker P.Englmaier F.Boone E.Schinnerer R.Neri
N03D	The outflows of Orion KL revisited – SiO(5–4) and 1.3 mm continuum	SiO(2–1) SiO(5–4)	H.Beuther L.Greenhill M.Reid K.Menten C.Chandler
N03F	Dense Clumps in the Orion Bar Photon Dominated Region	^{13}CO CH_3CN H_2CO	P.Schilke D.Lis
N041	An orbiting molecular disk around the central star of the Red Rectangle	$^{12}CO(1\text{–}0)$ $^{12}CO(2\text{–}1)$	V.Bujarrabal R.Neri J.Alcolea A.Castro-Carrizo
N04A	A Search for Pure Rotational Emission from TiO toward the Peculiar Red Supergiant VY Canis Majoris – Second Attempt	SiO(2–1) TiO(7–6)	K.Menten P.Schilke S.Leurini J.Alcolea
N04B	Resolving a Strong Dynamical Interaction at the Center of the NGC2264C Protocluster	N_2H^+ $C^{18}O$	N.Peretto P.André A.Belloche F.Motte P.Hennebelle
N04C	Peculiar SO_2 emission from VY CMa – Evidence for asymmetric outflow?	SiO(2–1) $^{12}CO(2\text{–}1)$ CSiO(5–4) SO_2	K.Menten K.Young J.Alcolea
N050	A molecular counterpart of the HI outflow in 3C293	HCO^+ $^{12}CO(2\text{–}1)$	S.García-Burillo F.Combes A.Usero S.Léon A.Fuente
N051	Resolving the Nature of the 30pc Nuclear Gas Disk in IC342	88 + 110 230GHz	E.Schinnerer D.S.Meier T.Böker
N053	Search for Glycine and Precursors	Glycine-3mm Glycine-1mm	F.Combes D.Despois G.Wlodarczak A.Wootten M.Guélin N.Brouillet
N056	A circumstellar ring around the Herbig Ae/Be star AB Auriga ?	$^{13}CO(1\text{–}0)$ $^{13}CO(2\text{–}1)$	V.Piétu A.Dutrey S.Guilloteau E.Dartois
N05A	Vertical structure of Protoplanetary disks orbiting PMS stars of mass $\leq 2.5 M_{\odot}$	$^{13}CO(1\text{–}0)$ $^{13}CO(2\text{–}1)$	V.Piétu A.Dutrey S.Guilloteau E.Dartois
N05B	CO-Dynamics of Bright Sub-mm Galaxies in Abell 2218	$^{12}CO(3\text{–}2)$ $^{12}CO(7\text{–}6)$	J.Kneib R.Neri I.Smail K.Kraiberg P.Van der Werf A.Blain K.Sheth
N05C	Structure of Embedded Protostars in the ρ Ophiuchi Protocluster	$C^{18}O(1\text{–}0)$ $C^{18}O(2\text{–}1)$	P.André F.Motte N.Grosso
N05E	Properties of the dense gas in the redshift 6.42 quasar J1148+5251	$^{12}CO(7\text{–}6)$ CI H_2O	F.Bertoldi P.Cox R.Neri C.L.Carilli F.Walter A.Omont J.Black A.Beelen X.Fan M.A.Strauss K.M.Menten
N05F	The Hot Core of the solar type protostar IRAS16293–2422	CH_3CN CH_3OCHO	C.Ceccarelli R.Neri E.Caux S.Cazaux B.Lefloch S.Maret
N061	CO identification of submillimetre galaxies III.	$^{12}CO(2\text{–}1)$ $^{12}CO(3\text{–}2)$ Cont1mm	R.Genzel R.Ivison F.Bertoldi R.Neri A.Omont P.Cox T.Greve S.Chapman A.Blain I.Smail

Ident.	Title	Line	Authors
N062	Confronting MHD shock models with observations – a case study of IC443–G –	$^{12}CO(1–0)$ $^{12}CO(2–1)$	R.Güsten S.Philipp H.Wiesemeyer R.Zylka
N064	[CI] in the $z = 4.12$ QSO PSS 2322+1944 – continued	CI H_2O	P.Cox A.Beelen J.Pety D.Downes F.Bertoldi C.Carilli A.Omont J.Back
N065	The young detached shell around U Camelopardalis	HCN(1–0) CN(2–1)	M.Lindqvist H.Olofsson F.L.Schöier R.Neri R.Lucas
N069*	Studying the circumbinary and circumstellar material around AS2005	$^{13}CO(1–0)$ $^{13}CO(2–1)$	S.Guilloteau A.Dutrey F.Gueth J.Pety
N06B	Deuteration and depletion in two massive pre/protocluster candidates	NH_2D $C^{18}O(2–1)$	F.Wyrowski A.G.Gibb M.A.Thompson J.Hatchell T.Pillai
N06F	The molecular outflows in the W3(OH) complex	SiO(2–1) $^{12}CO(2–1)$	K.Menten T.Stanke F.Wyrowski P.Schilke
N070	Properties of the high-mass accretion disk in Cepheus–A	SiO(2–1) CS(2–1) CS(5–4) CH_3CN	C.Comito P.Schilke
N071	HCN in Ultraluminous Galaxies	HCN $^{12}CO(2–1)$ $^{13}CO(2–1)$	D.Downes P.Solomon
N072	Very dense gas in the Cloverleaf Quasar: search for HCN 4–3 emission	HCN(4–3) H_2O	P.Vanden Bout M.Guélin P.Solomon C.Carilli
N075	Tidally excited CO accretion streamers in RW Aur ?	$^{12}CO(1–0)$ $^{12}CO(2–1)$	N.Pesenti C.Dougados S.Cabrit J.Pety
N076	The ISM in the Young Universe: CO at Very Low Metallicity	$^{12}CO(1–0)$	F.Walter A.D.Bolatto A.Weiss
N079	The circumstellar disk around the massive star R Mon	$^{13}CO(1–0)$ $^{13}CO(2–1)$	A.Fuente A.Natta L.Testi R.Neri R.Bachiller
N07B	Hot molecular spots in the circumstellar disk around the radiojet Cep A HW2	SiO(2-1) CH_3CN	I.Jiménez J.Martin-Píntado A.Rodríguez S.Martin C.Thum
N--5	A Search for Pure Rotational Emission from TiO toward the Peculiar Red Supergiant VY Canis Majoris – Another Attempt	SiO(2–1) TiO(7–6)	K.Menten P.Schilke S.Leurini J.Alcolea J.M.Winters
N--6	Search for AAN in Titan's atmosphere	HC_3N CH_3CN	K.Menten P.Schilke C.Comito
N--8	Search for AAN in SgrB2	AAN	K.Menten C.Comito
O001	Plateau de Bure observations of Comet C/2991 Q4 and C/2002 T7	Cont3mm Cont1mm	W.Altenhoff F.Bertoldi K.Menten C.Thum J.M.Winters
O002	On the structure and abundance of molecular clumpuscules	$^{13}CO(1–0)$ $^{12}CO(1–0)$ $^{13}CO(2–1)$ $^{12}CO(2–1)$	A.Heithausen
O004	Probing the depletion of N_2H^+ in a Taurus dense core on the verge of protostar formation	$N_2H^+(1–0)$ $N_2H^+(2–1)$	A.Belloche P.André T.Onishi
O005*	A high-mass starless core	$N_2H^+(1–0)$ $^{12}CO(2–1)$	H.Beuther T.K.Sridharan M.Saito
O00A	Multiplicity and nature of cold high-mass protostars in Cygnus X	SiO(2–1) $^{12}CO(2–1)$	S.Bontemps F.Motte N.Schneider
O00B	Deeply Embedded Clusters around Massive Protostars	N_2H^+	A.Palau R.Estalella H.Beuther M.T.Beltrán P.Ho
O00C	The Nature of Small Proto-Clusters	HCO^+ $^{12}CO(2–1)$	M.S.N.Kumar M.Tafalla L.Testi D.Shepherd
O013	Tracing the early time evolution of C-shocks in the L1448-mm outflow	SiO(2–1) CH_3OH	I.Jiménez-Serra J.Martín-Pintado A.Rodríguez-Franco
O014	The physical structure of chemically rich clumps along outflows: the case of L1157	CS(2–1) CS(5–4)	M.Benedettini S.Viti R.Bachiller C.Codella

Ident.	Title	Line	Authors
O015	Testing PDR morphology on sub-clump scales	HCN/HCO^+ ^{13}CO(2–1)	E.Polehampton F.Wyrowski P.Schilke
O016*	Resolving the density gradient at the edge of the horsehead nebula	CS(2–1)	M.Gérin J.Pety A.Abergel J.Goicoechea C.Joblin E.Roueff D.Teyssier E.Habart
O018	Search for orbiting molecular disks around post-AGB stars	^{12}CO(1–0) ^{12}CO(2–1)	V.Bujarrabal H.V.Winckel R.Neri J.Alcolea A.Castro-Carrizo
O019	Deep study of the circumstellar envelopes of AGB & early post-AGB stars	^{12}CO(1–0) ^{12}CO(2–1)	A.Castro-Carrizo J.Alcolea V.Bujarrabal M.Grewing M.Lindqvist R.Lucas R.Neri H.Olofsson F.L.Schöier J.M.Winters
O01C	Molecular gas chemistry in the circumnuclear disk of NGC 1068	SiO(2–1) CN(2–1)	S.García-Burillo F.Boone A.Usero S.Hüttemeister J.Martín-Pintado A.Fuente L.Tacconi E.Schinnerer A.Baker S.Aalto
O01E	Mapping cold molecular gas in a cooling flow cluster of galaxies : Abell 1795	^{12}CO(1–0) ^{12}CO(2–1)	P.Salomé F.Combes
O025	Deep HCO^+ absorption profiles along low-latitude lines of sight in the Galaxy	HCO^+	J.Pety R.Lucas H.Liszt
O029	Searches for CO in z c. 2 quasar host galaxies	^{12}CO(3-2)	K.Isaak R.Priddley R.McMahon P.Cox A.Beelen A.Omont N.Nagar P.Hirst
O02A	CO identification of (sub)millimeter galaxies IV.	^{12}CO(3–2) ^{12}CO(4–3) Cont1mm	R.Genzel R.Ivison F.Bertoldi R.Neri A.Omont P.Cox T.Greve S.Chapman A.Blain I.Smail
O02B	Molecular gas in the lensed LBG Arc384	^{12}CO(3–2) ^{12}CO(7–6)	A.Baker L.Tacconi R.Genzel D.Lutz M.Lehnert
O--1	Search for CO in a massive galaxy at z=2.4	^{12}CO(3–2) ^{12}CO(7–6)	H.-W.Rix P.Papadopoulos P.V.Werf M.Franx K.K.Knudsen
O--2	CO at Redshift 10	^{12}CO(8–7)	F.Bertoldi C.Henkel J.Ott L.Staveley-Smith A.Weiss R.Neri F.Walter C.Carilli
O--3	Confirm the CO detections in SMM1C and SMM2	^{12}CO(3–2)	R.Neri J-P.Kneib
O--4	Is cold H_2 a major constituent of the dark matter	H_2D^+ D_2H^+	C.Ceccarelli R.Neri C.Dominik
VLBI	Precession of 1633+382 after a Major Millimeter Flare?	Cont3mm	T.P.Krichbaum B.W.Sohn I.Agudo A.Witzel J.A.Zensus H.Ungerechts H.Teräsranta
VLBI	Sub-milliarcsecond-scale polarization properties of the jet in 0716+714	Cont3mm	U.Bach S.Friedrichs C.M.V.Impellizzeri A.Witzel T.P.Krichbaum J.A.Zensus
VLBI	Imaging Cygnus A with 75 milli-pc resolution	Cont3mm	U.Bach T.P.Krichbaum W.Alef E.Middleberg D.Graham A.Witzel J.A.Zensus A.Greve M.Bremer M.Grewing R.Booth J.Conway
VLBI	A binary black hole system in 3C345? Probing quasi-periodic signatures in the pc-scale jet with highest resolution	Cont3mm	J.Klare T.P.Krichbaum A.Lobanov E.Ros J.A.Zensus A.Witzel
VLBI	A precessing jet in NRAO 150?	Cont3mm	I.Agudo U.Bach D.Graham T.P.Krichbaum M.Bremer A.Witzel J.A.Zensus W.Alef M.Grewing H.Teräsranta

Ident.	Title	Line	Authors
VLBI	Frequency dependent curvature in the jet of 3C454.3	Cont3mm	A.Pagels J.Klare J.A.Zensus T.P.Krichbaum A.Witzel
VLBI	Jet Formation and Matter Content in 3C120: 3mm observations	Cont3mm	J.L.Gómez A.P.Marscher S.Jorstad I.Agudo I.McHardy T.P.Krichbaum A.P.Lobanov
VLBI	The precessing jet nozzle of 3C84 – images at 2000 R_S resolution	Cont3mm	A.Pagels T.P.Krichbaum A.Witzel J.A.Zensus
VLBI	Global 3mm VLBI observations of the Gravitational Lens B0218+357	Cont3mm	R.Mittal R.W.Porcas I.W.A.Browne A.Biggs
VLBI	The Relative Spatial Distribution of SiO Masers in AGB stars at $\lambda = 3\,\mathrm{mm}$	SiO(2–1)	F.Colomer R.Soria-Ruiz V.Bujarrabal J.Alcolea J.F.Desmurs
VLBI	Looking through the obscuring torus of NGC1052	Cont3mm	M.Kadler E.Ros T.P.Krichbaum J.A.Zensus D.Graham A.P.Lobanov M.Bremer M.Grewing
VLBI	Studying the nearest super-massive Black-Hole – Millimeter-VLBI on SgrA*	Cont3mm	A.Eckart T.P.Krichbaum D.Graham A.Witzel J.A.Zensus
N02E*	Search for Glycine and Precursors	Glycine-3mm Glycine-1mm	F.Combes D.Despois G.Wlodarczak A.Wooten M.Guélin N.Brouillet
O03B*	The temperature structure of a high-mass protocluster and the origin of the IMF	$^{13}CO(1–0)$ H_2CO	H.Beuther P.Schilke
O040*	The First Extremely High Velocity Outflow in Taurus	SiO(2–1) $^{12}CO(2–1)$	J.Santiago M.Tafalla R.Bachiller D.Johnstone
O044*	Dust in embedded disks: when does grain growth occur?	Cont3mm Cont1mm	A.Natta L.Testi R.Neri
O045*	Chemistry in Proto-Planetary Disks	N_2H^+ C_2H HCO^+ CO-ISO HCN H_2CO $^{12}CO(2–1)$ $^{13}CO(2–1)$ CN(2–1) CS(5–4)	A.Dutrey T.Henning A.Bacmann E.Dartois F.Gueth S.Guilloteau P.Hily-Blant R.Launhardt G.Pineau des Forets V.Pietu D.Semenov J.Pety K.Schreyer
O04D*	Mass-loss variations in AGB stars II.	$^{12}CO(1–0)$ $^{12}CO(2–1)$	T.LeBertre J.M.Winters J.Pety R.Neri
O04E*	Deep study of the circumstellar envelopes of AGB & early post-AGB stars	$^{12}CO(1–0)$	A.Castro-Carrizo J.Alcolea V.Bujarrabal M.Grewing R.Lucas R.Neri H.Oloffson F.Schöier J.M.Winters M.Lindqvist
O056*	Molecular Gas in the latest-type Spirals: II. Mapping the nuclear CO distribution	$^{12}CO(1–0)$	T.Böker E.Schinnerer U.Lisenfeld
O05E*	Deep inside the Perseus cluster core – II - A dynamically perturbed cooling flow	$^{12}CO(1–0)$ $^{12}CO(2–1)$	P.Salome F.Combes
O060*	Molecular Gas in the Local Analogs of LBGs	$^{12}CO(1–0)$ $^{12}CO(2–1)$	A.Baker L.Tacconi C.Martin R.Genzel D.Lutz M.Lehnert T.Heckman
O066*	Neutral Carbon CI($^3P_2 \rightarrow ^3P_1$) and ^{13}CO in high$-z$ Quasars and Starbursts	$^{13}CO(3–2)$ CI(2–1)	A.Weiss D.Downes C.Henkel F.Walter
O06E	Millimeter observations of GRB and XRF afterglows in the SWIFT era (ToO)	Cont3mm Cont1mm	A.Castro-Tirado M.Bremer D.Battacharya S.Truskin J.Gorosabal S.Guziy

* Projects close to completion on December 31, 2004.

8. ANNEX II : PUBLICATIONS/ 8.1 PUBLICATIONS WITH IRAM STAFF MEMBERS AS (CO-)AUTHORS

1012. MASS-LOSS FROM DUSTY, LOW OUTFLOW-VELOCITY AGB STARS
I. Wind Structure and Mass-Loss Rates
J.M. Winters, T. Le Bertre, K.S. Jeong, L.-Å. Nyman, N. Epchtein
2003, A&A 409, 715

1013. IRAS 23385+6053: A CANDIDATE PROTOSTELLAR MASSIVE OBJECT
F. Fontani, R. Cesaroni, L. Testi, C.M. Walmsley, S. Molinari, R. Neri, D. Shepherd, J. Brand, F. Palla, Q. Zhang
2004, A&A 414, 299

1014. A MULTI-PARTICLE MODEL OF THE 3C 48 HOST
J. Scharwächter, A. Eckart, S. Pfalzner, J. Zuther, M. Krips, C. Straubmeier
2004, A&A 414, 497

1015. MOLECULAR GAS IN NUclei OF GAlaxies (NUGA)
II. The ringed LINER NGC 7217
F. Combes, S. García-Burillo, F. Boone, L.K. Hunt, A.J. Baker, A. Eckart, P. Englmaier, S. Leon, R. Neri, E. Schinnerer, L.J. Tacconi
2004, A&A 414, 857

1016. NIR OBSERVATIONS OF THE QSO 3C 48 HOST GALAXY
J. Zuther, A. Eckart, J. Scharwächter, M. Krips, C. Straubmeier
2004, A&A 414, 919

1017. WARPED MOLECULAR GAS DISK IN NGC 3718
J.-U. Pott, M. Hartwich, A. Eckart, S. Leon, M. Krips, C. Straubmeier
2004, A&A 415, 27

1018. THE ROTATING VISIBLE OUTFLOW IN M82
A. Greve
2004, A&A 416, 67

1019. A SEARCH FOR EVOLVED DUST IN HERBIG Ae STARS
A. Natta, L. Testi, R. Neri, D.S. Shepherd, D.J. Wilner
2004, A&A 416, 179

1020. L1157: INTERACTION OF THE MOLECULAR OUTFLOW WITH THE CLASS 0 ENVIRONMENT
M.T. Beltrán, F. Gueth, S. Guilloteau, A. Dutrey
2004, A&A 416, 631

1021. CARBON BUDGET AND CARBON CHEMISTRY IN PHOTON DOMINATED REGIONS
D. Teyssier, D. Fossé, M. Gerin, J. Pety, A. Abergel, E. Roueff
2004, A&A 417, 135

1022. THE ASSOCIATION BETWEEN MASERS AND OUTFLOWS IN MASSIVE STAR FORMING REGIONS
C. Codella, A. Lorenzani, A.T. Gallego, R. Cesaroni, L. Moscadelli
2004, A&A 417, 615

1023. EARLY OPTICAL AND MILLIMETER OBSERVATIONS OF GRB 030226 AFTERGLOW
S.B. Pandey, R. Sagar, G.C. Anupama, D. Bhattacharya, D.K. Sahu, A.J. Castro-Tirado, M. Bremer
2004, A&A 417, 919

1024. A STUDY OF TRANS-NEPTUNIAN OBJECT 55636 (2002 TX_{300})
J.L. Ortiz, A. Sota, R. Moreno, E. Lellouch, N. Biver, A. Doressoundiram, P. Rousselot, P.J. Gutiérrez, I. Márquez, R.M. González Delgado, V. Casanova
2004, A&A 420, 383

1025. NEW LIGHT ON THE S235A-B STAR FORMING REGION
M. Felli, F. Massi, A. Navarrini, R. Neri, R. Cesaroni, T. Jenness
2004, A&A 420, 553

1026. DENSE GAS IN NEARBY GALAXIES XVI. THE NUCLEAR STARBURST ENVIRONMENT IN NGC 4945
M. Wang, C. Henkel, Y.-N. Chin, J.B. Whiteoak, M. Hunt Cunningham, R. Mauersberger, D. Muders
2004, A&A 422, 883

1027. STARBURST ACTIVITY IN THE HOST GALAXY OF THE z = 2.58 QUASAR J1409+5628
A. Beelen, P. Cox, J. Pety, C.L. Carilli, F. Bertoldi, E. Momjian, A. Omont, P. Petitjean, A.O. Petric
2004, A&A 423, 441

1028. EXTENDING THE RADIO SPECTRUM OF MAGNETIC CHEMICALLY PECULIAR STARS TO THE MM RANGE
F. Leone, C. Trigilio, R. Neri, G. Umana
2004, A&A 423, 1095

1029. A 230 GHz HETERODYNE RECEIVER ARRAY FOR THE IRAM 30 M TELESCOPE
K.-F. Schuster, C. Boucher, W. Brunswig, M. Carter, J.-Y. Chenu, B. Fouillieux, A. Greve, D. John, B. Lazareff, S. Navarro, A. Perrigouard, J.-L. Pollet, A. Sievers, C. Thum, H. Wiesemeyer
2004, A&A 423, 1171

1030. THE ABUNDANCE OF ^{36}S IN IRC+10216 AND ITS PRODUCTION IN THE GALAXY
R. Mauersberger, U. Ott, C. Henkel, J. Cernicharo, R. Gallino
2004, A&A 426, 219

1031. DETECTION OF THE SiNC RADICAL IN IRC+10216
M. Guélin, S. Muller, J. Cernicharo, M.C. McCarthy, P. Thaddeus
2004, A&A 426, L49

1032. THE ABUNDANCE OF HOC^+ IN DIFFUSE CLOUDS
H. Liszt, R. Lucas, J.H. Black
2004, A&A 428, 117

1033. MM-WAVE HCO^+, HCN AND CO ABSORPTION TOWARD NGC 1052
H. Liszt, R. Lucas
2004, A&A 428, 445

1034. THE POLARIZATION OF MM METHANOL MASERS
H. Wiesemeyer, C. Thum, C.M. Walmsley
2004, A&A 428, 479

1035. ATOMIC CARBON IN PSS 2322+1944, A QUASAR AT REDSHIFT 4.12
J. Pety, A. Beelen, P. Cox, D. Downes, A. Omont, F. Bertoldi, C.L. Carilli
2004, A&A 428, L21

1036. SUBMILLIMETER CONTINUUM OBSERVATIONS OF NGC 7538
G. Sandell, A. Sievers
2004, ApJ 600, 269

1037. ROTATING DISKS IN HIGH-MASS YOUNG STELLAR OBJECTS
M.T. Beltrán, R. Cesaroni, R. Neri, C. Codella, R.S. Furuya, L. Testi, L. Olmi
2004, ApJ 601, L187

1038. TRACING THE SHOCK PRECURSORS IN THE L1448-mm/IRS 3 OUTFLOWS
I. Jiménez-Serra, J. Martín-Pintado, A. Rodríguez-Franco, N. Marcelino
2004, ApJ 603, L49

1039. MASSIVE MOLECULAR OUTFLOWS AT HIGH SPATIAL RESOLUTION
H. Beuther, P. Schilke, F. Gueth
2004, ApJ 608, 330

1040. DETECTION OF THE LINEAR RADICAL HC_4N IN IRC+10216
J. Cernicharo, M. Guélin, J.R. Pardo
2004, ApJ 615, L145

1041. 1" RESOLUTION MAPPING OF THE MOLECULAR ENVELOPE OF THE PROTOPLANETARY NEBULA CRL 618
C. Sánchez Contreras, V. Bujarrabal, A. Castro-Carrizo, J. Alcolea, A. Sargent
2004, ApJ 617, 1142

1042. NEAR-ARCSECOND RESOLUTION OBSERVATIONS OF THE HOT CORINO OF THE SOLAR-TYPE PROTOSTAR IRAS 16293-2422
S. Bottinelli, C. Ceccarelli, R. Neri, J.P. Williams, E. Caux, S. Cazaux, B. Lefloch, S. Maret, A.G.G.M. Tielens
2004, ApJ 617, L69

1043. NEUTRAL HYDROGEN ABSORPTION AT THE CENTRE OF NGC 2146
A. Tarchi, A. Greve, A.B. Peck, N. Neininger, K.A. Wills, A. Pedlar, U. Klein
2004, Mon. Not. R. Astron. Soc. 351, 339

1044. THE QUASAR Q0957+561: LENSED CO EMISSION FROM A DISK AT z~1.4?
M. Krips, R. Neri, A. Eckart, J. Martín-Pintado, P. Planesas, L. Colina
2004, in *The Dense Interstellar Medium in Galaxies*
eds. S. Pfalzner, C. Kramer, C. Staubmeier, A. Heithausen
Springer Verlag, 23

1045. THE SPIRAL ARMS OF M51: PHYSICAL PROPERTIES OF THE GAS
E. Schinnerer, A. Weiss, S. Aalto, N.Z. Scoville
2004, in *The Dense Interstellar Medium in Galaxies*
Springer Verlag, 117

1046. MOLECULAR GAS IN THE ANDROMEDA GALAXY
M. Guélin, S. Muller, C. Nieten, N. Neininger, H. Ungerechts, R. Lucas, R. Wielebinski
2004, in *The Dense Interstellar Medium in Galaxies*
Springer Verlag, 121

1047. NUclei of GAlaxies (NUGA): THE IRAM SURVEY OF LOW LUMINOSITY AGN
S. García-Burillo, F. Combes, A. Eckart, L.J. Tacconi, L.K. Hunt, S. Leon, A.J. Baker, P. Englmaier, F. Boone, E. Schinnerer, R. Neri
2004, in *The Dense Interstellar Medium in Galaxies*
Springer Verlag, 139

1048. THE SPECTRAL LINE SURVEY OF NGC 253
S. Martín, R. Mauersberger, J. Martín-Pintado, C. Henkel, S. García-Burillo
2004, in *The Dense Interstellar Medium in Galaxies*
Springer Verlag, 173

1049. SMALL CARBON CHAINS AND RINGS IN PHOTO-DOMINATED REGIONS
D. Teyssier, J. Pety, M. Gerin, D. Fosse, A. Abergel, E. Roueff, C. Joblin
2004, in *The Dense Interstellar Medium in Galaxies*
Springer Verlag, 521

1050. A SQUARE DEGREE SURVEY FOR MOLECULAR FLOWS IN TMC1
K.-F. Schuster, B. Lefloch, H. Ungerechts, C. Thum, F. Gueth, M. Sterzik, H. Wiesemeyer
2004, in *The Dense Interstellar Medium in Galaxies*
Springer Verlag, 611

1051. MILLIMETER PROPERTIES OF THE PROTOPLANETARY DISK SURROUNDING HH30
J. Pety, F. Gueth, A. Dutrey, S. Guilloteau
2004, in *The Dense Interstellar Medium in Galaxies*
Springer Verlag, 649

1052. MILLIMETRE-VLBI MONITORING OF AGN WITH SUB-MILLARCSECOND RESOLUTION
A. Pagels, T.P. Krichbaum, D.A. Graham, W. Alef, M. Kadler, A. Kraus, J. Klare, A. Witzel, J.A. Zensus, A. Greve, M. Grewing, R. Booth, J. Conway
2004, in *Proc. of the 7th European VLBI Network Symposium*
eds. R. Bachiller, F. Colomer, J.F. Desmurs, P. de Vicente
Oct. 12th-15th 2004, Toledo, Spain, p. 7

1053. TOWARDS THE EVENT HORIZON THE VICINITY OF AGN AT MICRO-ARCSECOND RESOLUTION
T.P. Krichbaum, M. Bremer, A. Greve, M. Grewing et al.
2004, in *Proc. of the 7th European VLBI Network Symposium*
eds. R. Bachiller, F. Colomer, J.F. Desmurs, P. de Vicente
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1054. 86 GHz VLBI POLARIMETRY OF OVV1633+382 AFTER A MAJOR MM FLARE
B.W. Sohn, T.P. Krichbaum, I. Agudo, A. Witzel, J.A. Zensus, H. Ungerechts, H. Teräsranta
2004, Proc. of the 7th European VLBI Network Symposium
eds. R. Bachiller, F. Colomer, J.-F. Desmurs, P. de Vicente
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1055. HIGH RESOLUTION OBSERVATIONS OF MOLECULAR GS IN THE OUTFLOW OF M82
F. Walter, A. Weiss, N. Scoville
2004, in *Recycling Intergalactic and Interstellar Matter*
eds. P.-A. Duc, J. Braine, E. Brinks
IAU Symp. 217
Astron. Soc. Pacific, San Francisco, 314

1056. WIDE-FIELD IMAGING OF ALMA WITH THE ATACAMA COMPACT ARRAY: IMAGING SIMULATIONS
T. Tsutsumi, K. Morita, T. Hasegawa, J. Pety
2004, ALMA Memo 488, NRAO, Socorro
http://www.alma.nrao.edu/memos/htlm-memos/alma488/memo488.pdf

1057. ESTIMATION OF ALMA DATA RATE
R. Lucas, J. Richer, D. Shepherd, L. Testi, M. Wright, C. Wilson
2004, ALMA Memo 501, NRAO, Socorro
http://www.alma.nrao.edu/memos/htlm-memos/alma501/memo501.pdf

1058. ALMA BAND 6 PROTOTYPE CARTRIDGE: Design and Performance
G.A. Ediss, M. Carter, A.R. Kerr, et al.
2004, ALMA Memo 502, NRAO, Socorro
http://www.alma.nrao.edu/memos/htlm-memos/alma502/memo502.pdf

1059. BANDPASS CALIBRATION FOR ALMA
A. Bacmann, S. Guilloteau
2004, ALMA Memo 505, NRAO, Socorro
http://www.alma.nrao.edu/memos/htlm-memos/alma505/memo505.pdf

1060. SEARCH FOR CIRCUMSTELLAR DISKS AROUND HERBIG BE STARS
A. Fuente, A. Rodríguez-Franco, L. Testi, A. Natta, R. Bachiller, R. Neri
2004, Astrophys. & Space Scie., 292, 465

1061. 210-320 GHz MULTI-HOLE DIRECTIONAL COUPLER DESIGN AND MEASUREMENT
F. Mattiocco
2003, International Journal of Infrared and Millimeter Waves, 24, 1127

1062. LONG-TERM EVOLUTION OF CO, CS AND HCN IN JUPITER AFTER THE IMPACTS OF COMET SHOEMAKER-LEVY 9
R. Moreno, A. Marten, H.E. Matthews, Y. Biraud
2003, Planetary and Space Scie., 51, 591

1063. COLD MOLECULAR GAS IN COOLING FLOWS
P. Salomé, F. Combes
2004, in *SF2A Scientific Highlights 2004*
eds. F. Combes, D. Barret, T. Contini, F. Meynadier, L. Pagani
EDP Sciences, Les Ulis, 483

1064. MOLECULAR GAS MAPS OF THE RX J0821+07 CLUSTER CORE
P. Salomé, F. Combes
2004, in *SF2A Scientific Highlights 2004*
eds. F. Combes, D. Barret, T. Contini, F. Meynadier, L. Pagani
EDP Sciences, Les Ulis, 505

1065. MOLECULAR GAS IN NUCLEI OF GALAXIES (NUGA): INTERSTELLAR GAS AND TORQUES IN NGC 4579, NGC 4826 AND NGC 6951
S. García-Burillo, F. Combes, F. Boone, E. Schinnerer, A.J. Baker, L.K. Hunt, A. Eckart, L.J. Tacconi, R. Neri, S. Leon, M. Krips, . Englmaier
2004, in *SF2A Scientific Highlights 2004*
eds. F. Combes, D. Barret, T. Contini, F. Meynadier, L. Pagani
EDP Sciences, Les Ulis, 603

8. ANNEX II : PUBLICATIONS/ 8.2 PUBLICATIONS BY MEMBERS OF THE IRAM USER COMMUNITY

1015. SULPHUR-BEARING SPECIES IN THE STAR FORMING REGION L1689N
V. Wakelam, A. Castets, C. Ceccarelli, B. Lefloch, E. Caux, L. Pagani
2004, A&A 413, 609

1016. THE STRUCTURE OF THE NGC 1333-IRAS2 PROTOSTELLAR SYSTEM ON 500 AU SCALES
J.K. Jørgensen, M.R. Hogerheijde, E.F. van Dishoeck, G.A. Blake, F.L. Schöier
2004, A&A 413, 993

1017. COLD DUST AND MOLECULAR GAS TOWARDS THE CENTERS OF MAGELLANIC TYPE GALAXIES AND IRREGULARS
I. The Data
M. Albrecht, R. Chini, E. Krügel, S.A.H. Müller, R. Lemke
2004, A&A 414, 141

1018. L1521E: THE FIRST STARLESS CORE WITH NO MOLECULAR DEPLETION
M. Tafalla, J. Santiago
2004, A&A 414, L53

1019. COLD DUST IN A SELECTED SAMPLE OF NEARBY GALAXIES
I. The interacting galaxy NGC 4631
M. Dumke, M. Krause, R. Wielebinski
2004, A&A 414, 475

1020. HIGH RESOLUTION MILLIMETER IMAGING OF THE PROTO-PLANETARY NEBULA He 3-1475
P.J. Huggins, C. Muthu, R. Bachiller, T. Forveille, P. Cox
2004, A&A 414, 581

1021. MAPPING THE COLD MOLECULAR GAS IN A COOLING FLOW CLUSTER: ABELL 1795
P. Salomé, F. Combes
2004, A&A 415, L1

1022. SIZE ESTIMATES OF SOME OPTICALLY BRIGHT KBOs
W.J. Altenhoff, F. Bertoldi, K.M. Menten
2004, A&A 415, 771

1023. FIRST DETECTION OF TRIPLY-DEUTERATED METHANOL
B. Parise, A. Castets, E. Herbst, E. Caux, C. Ceccarelli, I. Mukhopadhyay, A.G.G.M. Tielens
2004, A&A 416, 159

1024. ON THE INTERNAL STRUCTURE OF STARLESS CORES
I. Physical conditions and the distribution of CO, CS, N_2H^+, and NH^3 in L1498 and L1517B
M. Tafalla, P.C. Myers, P. Caselli, C.M. Walmsley
2004, A&A 416, 191

1025. THE H_2CO ABUNDANCE IN THE INNER WARM REGIONS OF LOW MASS PROTOSTELLAR ENVELOPES
S. Maret, C. Ceccarelli, E. Caux, A.G.G.M. Tielens, J.K. Jørgensen, E. van Dishoeck, A. Bacmann, A. Castets, B. Lefloch, L. Loinard, B. Parise, F.L. Schöier
2004, A&A 416, 577

1026. MOLECULAR INVENTORIES AND CHEMICAL EVOLUTION OF LOW-MASS PROTOSTELLAR ENVELOPES
J.K. Jørgensen, F.L. Schöier, E.F. van Dishoeck
2004, A&A 416, 603

1027. L183 (L134N) REVISITED
II. The dust content
L. Pagani, A. Bacmann, F. Motte, L. Cambrésy, M. Fich, G. Lagache, M.-A. Miville-Deschênes, J.-R. Pardo, A.J. Apponi
2004, A&A 417, 605

1028. ETHYLENE GLYCOL IN COMET C/1995 01 (HALE-BOPP)
J. Crovisier, D. Bockelée-Morvan, N. Biver, P. Colom, D. Despois, D.C. Lis
2004, A&A 418, L35

1029. COLLIDING MOLECULAR CLOUDS IN HEAD-ON GALAXY COLLISIONS
J. Braine, U. Lisenfeld, P.-A. Duc, E. Brinks, V. Charmandaris, S. Leon
2004, A&A 418, 419

1030. THE COMPOSITION OF ICES IN COMET C/1995 01 (HALE-BOPP) FROM RADIO SPECTROSCOPY
Further results and upper limits on undetected species
J. Crovisier, D. Bockelée-Morvan, P. Colom, N. Biver, D. Despois, D.C. Lis, and the Team for target-of-opportunity radio observations of comets
2004, A&A 418, 1141

1031. DISAPPEARANCE OF N_2H^+ FROM THE GAS PHASE IN THE CLASS 0 PROTOSTAR IRAM 04191
A. Belloche, P. André
2004, A&A 419, L35

1032. MOLECULAR GAS CHEMISTRY IN AGN
I. The IRAM 30 m survey of NGC 1068
A. Usero, S. García-Burillo, A. Fuente, J. Martín-Pintado, N.J. Rodríguez-Fernández
2004, A&A 419, 897

1033. HYPERFINE STRUCTURE IN $H^{13}CO^+$ AND ^{13}CO: MEASUREMENT, ANALYSIS, AND CONSEQUENCES FOR THE STUDY OF DARK CLOUDS
J. Schmid-Burgk, D. Muders, H.S.P. Müller, B. Brupbacher-Gatehouse
2004, A&A 419, 949

1034. OBSERVATIONS OF L1521F: A HIGHLY EVOLVED STARLESS CORE
A. Craspi, P. Caselli, C.M. Walmsley, M. Tafalla, C.W. Lee, T.L. Bourke, P.C. Myers
2004, A&A 420, 957

1035. METHANOL AS A DIAGNOSTIC TOOL OF INTERSTELLAR CLOUDS
I. MODEL CALCULATIONS AND APPLICATION TO MOLECULAR CLOUDS
S. Leurini, P. Schilke, K.M. Menten, D.R. Flower, J.T. Pottage, L.-H. Xu
2004, A&A 422, 573

1036. A HIGHLY COLLIMATED, EXTREMELY HIGH VELOCITY OUTFLOW IN TAURUS
M. Tafalla, J. Santiago, D. Johnstone, R. Bachiller
2004, A&A 423, L21

1037. A MULTI-WAVELENGTH STUDY OF THE PROTO-CLUSTER SURROUNDING THE z=4.1 RADIO GALAXY TN J1338-1942
C. De Breuck, F. Bertoldi, C. Carilli, A. Omont, B. Venemans, H. Röttgering, R. Overzier, M. Reuland, G. Miley, R. Ivison, W. van Breugel
2004, A&A 424, 1

1038. NATURE OF TWO MASSIVE PROTOSTELLAR CANDIDATES: IRAS 21307+5049 AND IRAS 22172+5549
F. Fontani, R. Cesaroni, L. Testi, S. Molinari, Q. Zhang, J. Brand, C.M. Walsmley
2004, A&A 424, 179

1039. THE ISOPHOT-MAMBO SURVEY OF 3CR RADIO SOURCES: FURTHER EVIDENCE FOR THE UNIFIED SCHEMES
M. Haas, S.A.H. Müller, F. Bertoldi, R. Chini, S. Egner, W. Freudling, U. Klaas, O. Krause, D. Lemke, K. Meisenheimer, R. Siebenmorgen, I. van Bemmel
2004, A&A 424, 531

1040. ON THE CONSTRAINING OBSERVATIONS OF THE DARK GRB 001109 AND THE PROPERTIES OF A z=0.398 rad SELECTED STARBURST GALAXY CONTAINED IN ITS ERROR BOX
J.M. Castro Cerón, U. Lisenfeld et al.
2004, A&A 424, 833

1041. THE EMISSIVITY OF DUST GRAINS IN SPIRAL GALAXIES
P.B. Alton, E.M. Xilouris, A. Misiriotis, K.M. Dasyra, M. Dumke
2004, A&A 425, 109

1042. A SEARCH FOR COLD DUST AROUND NEUTRON STARS
O. Löhmer, A. Wolszczan, R. Wielebinski
2004, A&A 425, 763

1043. ORGANIC MOLECULES IN PROTOPLANETARY DISK AROUND T TAURI AND HERBIG Ae STARS
W.-F. Thi, G.-J. van Zadelhoff, E.F. van Dishoeck
2004, A&A 425, 955

1044. THE STRUCTURE OF THE ONSALA 1 STAR FORMING REGION
M.S.N. Kumar, M. Tafalla, R. Bachiller
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9. ANNEX III - IRAM Executive Council and Committee Members, January 2004

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