# IRAM Newsletter

Number 15 May 19, 1994

## Calendar 1994

**IRAM Council Meeting:** *June 27,28th, 1994*
Location: Bonn

**Observing proposals:** Proposals for the period *Nov. 15, 1994 to May 15, 1995* should be submitted before *Thursday, September 8th 1994*

## Contents



## Ten years of observing with the 30-m Telescope

The first astronomical observation with the *fully assembled* 30 m telescope was made on 15 May 1984. From this day onwards, the telescope was used without any major shut-down and today with $\sim 70-80\%$ of the time used for observations.

In order to provide the telescope for commissioning, a number of important preparations were terminated on 15 May 1984:

- the reflector was adjusted to an accuracy of 120 microns
- the subreflector was aligned
- the Nasmyth mirrors were aligned, with M 3 following the tilt of the telescope
- the 3 mm Schottky receiver was installed, aligned and tuned to 86 GHz
- the focal plane chopper was working
- the drive program was installed and tested.
- the filter bank(s) and the continuum detector(s) were connected
- the VAX computers (A + B) were available for telescope control, data acquisition and data reduction
- the accommodation building was ready and habitable

and with many more other technical and logistic supports being also available.

In order to find any source, the first observation (fig. 1) was a scan across the Sun (it was cloudy), immediately followed by pointing on bright quasars. In this *first* observation, using the full system and with no elaborate corrections applied, we "missed" the point source by $\sim 20''$ — with this the telescope was considered to be ready; quickly after this the first spectra were taken (Fig. 2).

It took approximately one more year of optimization and improvements to open the telescope for guest observers (May 1985).

Many persons of the Home Institutes and of the Construction Firms participated in the final preparations.

*Albert GREVE*

## 30-m Telescope

### Pointing Receiver

The Schottky continuum receiver has been repaired during the bolometer observing period. The receiver temperature is below 200 K at 86 GHz. During the time when the receiver was not operational pointing has sometimes been difficult due to instabilities in the 3 mm SIS receiver.

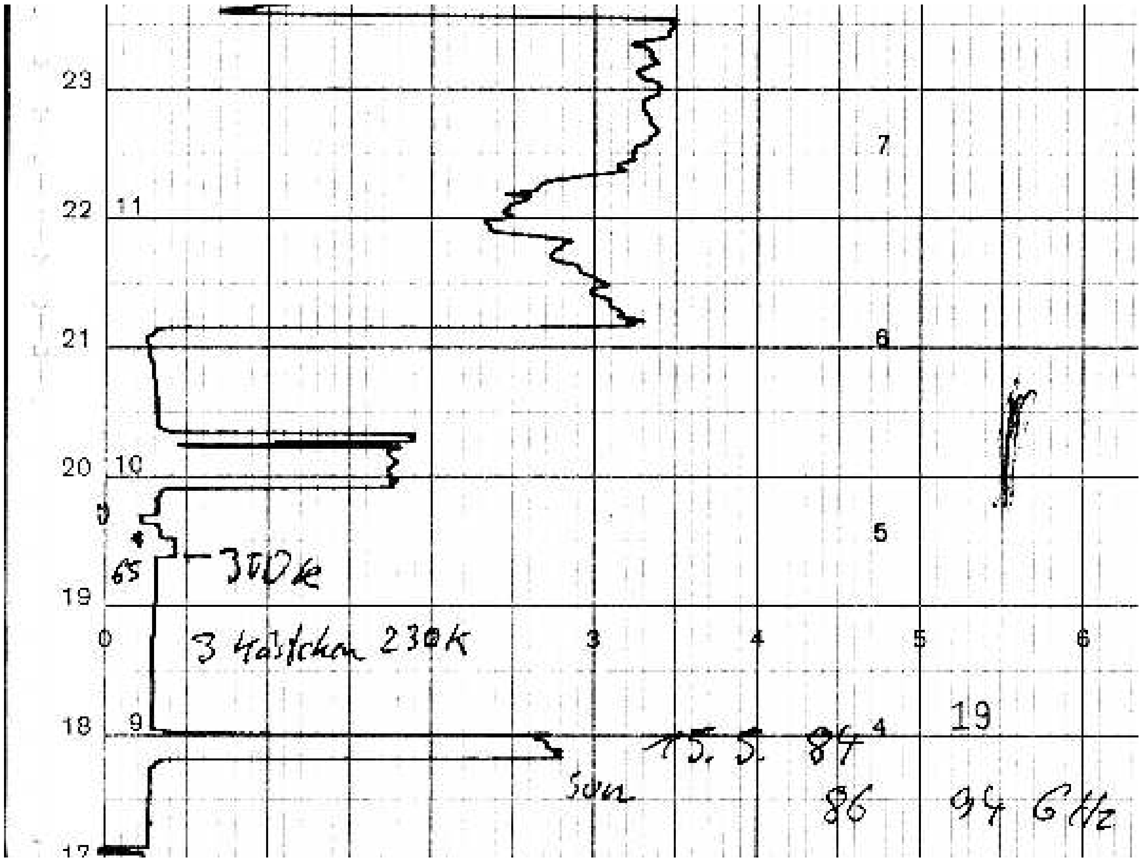


Figure 1: A *fac simile* of the original Sun recording on May 15, 1984.

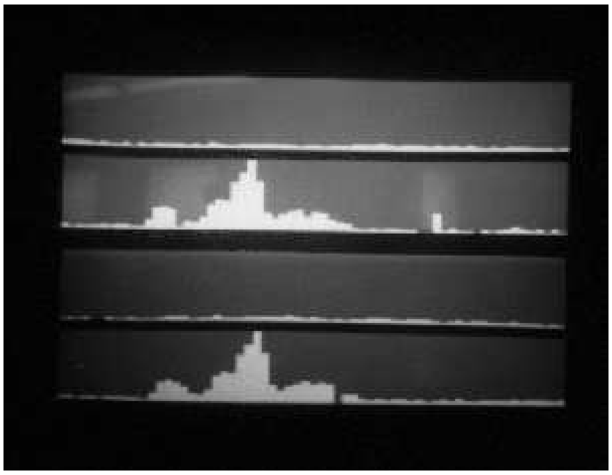

Figure 2: One of the first spectra taken (SiO maser in R Cas), captured on the screen of the TV monitor.

### 230 G2 Receiver

In the last issue of the Newsletter it was announced that the G2 receiver covers the frequency band from 202 to 245 GHz. Through changes in the local oscillator system we have been able to extend the frequency coverage up to 268 GHz (there is an astrophysically interesting line at 267.5 GHz). The receiver noise temperature at this frequency is on the order of 400 K (SSB). One should take into account that the newly installed G2 mixer was not designed to work at such high frequencies.

### Computer News

Computer power has been increased at Pico Veleta through the additional installation of a VAX Station 4000/60. It can be accessed from the other computers or PCs using the node name "IramEF".

The connection between the Pico Veleta and Granada computer networks via radio link is now using dedicated communication processors (so-called "routers"). This removes some work load from the main computers (which handled the communication up to now), and makes the radio link faster and more reliable.

Due to the fact that IRAM Granada is sometimes cut off from telnet connections, we advise all observers to bring important files (e.g. source catalogues, previous data etc.) on DAT, tape or PC floppy disks. For questions about formats etc. please contact Walter Brunswig (brunswig@iram.es).

*Wolfgang WILD*

## Backends

Correlator chips:

A probation period on one unit of the Plateau de Bure correlator has demonstrated that the recently manufactured correlator chips are free of the failures experienced with the previous ones. The replacement of all the present chips has been considered and a reasonable compromise has been found with the manufacturer: 1254 new chips will be delivered by the end of June. All first generation chips will be replaced, both on Pico Veleta and Plateau de Bure. This operation is not urgent and may take place during maintenance or bad weather. Hopefully this will end the trouble.

*Mark TORRES*

## Interferometer

### Next Deadline

The next deadline for Plateau de Bure proposals will be *Thursday, September 8th 1994*, for a scheduling period *Nov. 15, 1994 to May 15, 1995.* In view of the current extension of Plateau de Bure (baselines, receivers), we are currently revising the proposal form. Please check carefully in the following Newsletter (July 1994), or through the IRAM Mosaic information server.

### Baseline extension

Work has begun on the Plateau to extend the baselines by about 50 % in length. After a detailed feasibility study including tests of ground quality and simulation of $UV$ coverages, a solution with 4 new stations has been selected. 3 new stations are on the *West* arm: W20, W23 and W27 (the number is the distance from station W00 in units of 8 meters). These stations will allow better UV coverage and longer baselines. "Scaled" arrays (between 3mm and 1.3mm) will also be possible. One new station is on the *North* arm: N29, to improve resolution at low declination, and to allow better diagonal baselines. The extension phase will last for two summer periods. We hope to complete the West arm extension this year, and the North arm is foreseen for next year.

Optimum choice of the configurations is under study.

### Antenna Maintenance

The first 3 antennas require major maintenance this summer. In particular, the protection of the receiver cabins must be replaced. The estimated down time is 3 weeks per antenna. During the corresponding 2 months (June and July), the interferometer will operate in 3 antenna mode, concentrating on non-mapping or backup projects.

### Receivers

It is foreseen to install a dual channel receiver (3 and 1.3 mm bands) on Antenna 4 in June, and a second one (presumably on Antenna 2) in September. Work is in progress to upgrade all receivers to dual-channel systems by January 1995. The new receivers will have SSB tuning with 10 to 20 dB rejection, with the drawback that truly DSB tuning may not be possible at all frequencies. CO(J=1-0) will be reachable in LSB, thus improving the sensitivity by a factor 2 as compared to the current system. The upgrade plan also includes a complete replacement of the LO2 system.

Table 1: Project Status

A: Accepted, B: Backup if available time, C: Rejected.

| Project | Rate | Project | Rate | Project | Rate | Project | Rate | Project | Rate |
|---|---|---|---|---|---|---|---|---|---|
| C013 | C | C043 | C | D010 | C | D017 | A | D039 | A |
| D049 | A | D051 | A | D053 | A | D068 | A | D072 | C |
| D074 | A | E001 | C | E002 | C | E003 | A/B | E004 | C |
| E005 | B | E006 | C | E007 | A | E008 | A | E009 | C |
| E010 | B | E011 | A | E012 | C | E013 | A | E014 | C |
| E015 | A | E016 | A/B | E017 | A/B | E018 | C | E019 | A |
| E020 | A | E021 | A | | | | | | |

**B projects which cannot be started will no longer be automatically resubmitted: authors have to resubmit them explicitly.**

### Observing Projects

New Plateau de Bure Interferometer projects were discussed by the last program committee, for the scheduling period starting May 15, 1994, to November 15, 1994. The results are summarized in Table 1. The A programs will be scheduled with priority. The A/B programs will also be scheduled if feasible. Further time, if it becomes available, will go to the B programs, taking into account scientific merit, crowding in certain right ascension ranges and general aspects of balance. B proposals will only be started in case of available observing time.

### Documentation

All Plateau de Bure documentation is available through the NCSA-Mosaic WWW server. From the IRAM home page (http://iram.fr/www/iram.html), click on item "Interferometer" and follow the links... Information on the on-going projects is also available.

*Stéphane GUILLOTEAU*

## Software

The next software release is scheduled for *June 1994*. Please consult the item "GILDAS" through Mosaic for more details. Improvements have been made in CLIC (antenna based calibration), CLASS (commands MEMORIZE and RETRIEVE are back, command POPUP improved), MAPPING (A new program for deconvolution of Plateau de Bure images), ASTRO (ephemerides up to year 3000 and beyond), and documentation (usage of the Mosaic software under X-Windows).

The major activity in preparing this release is currently porting the software to DEC-Alpha machines operating under OSF-1. First results are encouraging, but a lot remains to be done... It is likely that the first OSF-1 version may be restricted to major programs like GREG, ASTRO and CLASS, and may not include any GILDAS task.

Because the porting to 64 bit machines requires many changes, we would appreciate having contact with owners of SUN workstations in order to test the JUN94 version prior to its official release. Volunteers, please contact S.Guilloteau.

*Stéphane GUILLOTEAU*

# A correction method for 30-m error beam pick-up in large spectral line maps

*Abstract*: We discuss a method to use lower angular resolution spectral line maps, e.g. from the KOSMA 3m telescope, to correct IRAM 30m high angular resolution maps for their error beam pick-up. We show that the corrected maps exhibit significantly stronger contrast, both spatially and in velocity.

Garcia-Burillo et al. 1993 (A&A 274, 144) used Moon cross scans to fit the IRAM error beam at 230 GHz with a gaussian main beam with 13.5″ FWHM and a fraction $\beta_{13} = 0.46$ of the total intensity on the Moon, two gaussian error beams (170″ resp. 800 ″ FWHM and $\beta_{170} = 0.31$ resp. $\beta_{800}$=0.13) and a ring–shaped secondary lobe with 5″ extension and $\beta_5 = 0.08$. The $\beta_i$ determined by Garcia–Burillo et al. do not sum up to 1. According to M. Guélin, this is due to rounding errors and non Gaussian terms. We simply attribute the remaining 2% efficiency to the 800″ beam and thus use $\beta_{800}$=0.15 in the following. The observed antenna temperature ($T_A^*=T_A'/F_{\rm eff}$) is now a *full beam brightness temperature* $T^*_{\rm A,fb}$ including the contributions from the different lobes, in the nomenclature of Downes ("Introductory courses in Galaxies", Springer 1989) :

$$T^*_{\rm A,fb} = \frac{\left(B_{13}T^I_{\rm mb,13} + B_5 T^I_{\rm mb,5} + B_{170}T^I_{\rm mb,170} + B_{800}T^I_{\rm mb,800}\right)}{F_{\rm eff}} \tag{1}$$

$T^I_{{\rm mb},i}$ are the IRAM "main beam brightness temperatures" for each error beam, $B_i$ the respective "main beam" efficiencies and $F_{\rm eff}$ the forward efficiency. From equation (1) it is obvious that $\sum B_i = F_{\rm eff}$ (response to an uniform, extended source of brightness $T_{\rm b}$ requires $T^*_{\rm A,fb} = T_b = T_{{\rm mb},i}$) and hence $B_i = \beta_i F_{\rm eff}$. Due to the compactness of the 5″ secondary lobe, we assume the main beam brightness temperatures in this lobe and the main lobe to be equal. We then get for the main beam brightness temperature in the 13″ beam :

$$T^I_{\rm mb,13} = \frac{1}{\beta_{13}+\beta_5}\left(T^*_{\rm A,fb} - \beta_{170}T^I_{\rm mb,170} - \beta_{800}T^I_{\rm mb,800}\right) \tag{2}$$

As the main beam brightness temperature is the same at every telescope (assuming a clean gaussian beam as we have assumed in the decomposition of the IRAM 30m error beam) we can now use an independently measured map from a smaller telescope to correct the IRAM data for the pick-up from the error beams. This assumes that the smaller telescope map is not severly affected by pick-up from its error beam. It is usually a good approximation, for one because the smaller telescope error beam will be much more extended, and hence not couple significantly to the source, and for second because, if the smaller telescope has a better surface quality, its beam efficiency will be high anyway and hence error beam contributions can be regarded as "second order" effects. A similar technique is used for HI observations but to our knowledge has not been applied to molecular spectral line data so far.

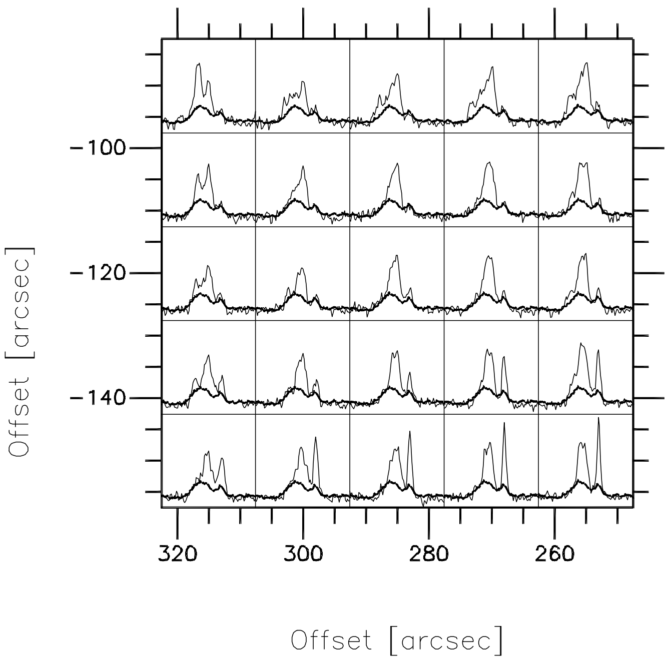


Figure 3: The smoothed (to 170″ resolution) and resampled KOSMA $^{13}$CO J=2→1 data (thick line) are overlayed to the original IRAM spectra (thin line). The temperature scale (-0.5 to 4.5 K) is in antenna temperatures $T^*_{\rm A,fb}$, the velocity interval ranges from 3 to 23 km s$^{-1}$.

The KOSMA 3m–telescope is well suited for this correction method due to its HPBW of 132″ at 1.3 mm with a main beam efficiency of 0.64 (coupling to Jupiter). The data are smoothed to 170″ resp. 800″ resolution with a gaussian intensity distribution, resampled on the grid observed at IRAM, and can then be substracted from the IRAM spectra. According to equation (2) $T^I_{{\rm mb},i}$ are replaced by the KOSMA main beam temperatures $T^K_{{\rm mb},i}$ taking KOSMA as an "ideal" telescope. With the values quoted above, the resulting IRAM–main beam brightness temperature for the 13″ main beam now reads :

$$T^I_{\rm mb,13} = \frac{1}{0.54}\left(T^*_{\rm A,fb} - 0.31\ T^K_{\rm mb,170} - 0.15\ T^K_{\rm mb,800}\right) \tag{3}$$

To demonstrate the applicability of this method to real observations, we discuss in the following the results of $^{13}$CO observations of the Rosette Molecular Cloud. Fig. 3 shows as an example a set of 5×5 original IRAM $^{13}$CO J=2→1 spectra overlayed to the smoothed and resampled KOSMA data. Note the very good match between the error beam spectra synthesized from the KOSMA data and the corresponding feature in the original IRAM line profiles. Due to the large velocity dispersion in between individual emission regions in the source, the error beam spectra substract a substantial fraction, mainly the underlying broad velocity structure, in the IRAM raw data. In fact, the good match between the spectral features, in particular the fact that the error beam contribution is always close to, but never exceeds, the raw spectra in the maps, is a very good confirmation of the amplitudes $\beta_i$ determined by Garcia–Burillo et al., in particular the one of the 170″ beam causing most of the correction. The magnitude of the correction is up to 100% for the extended, broad weak line emission, which can be concluded to be due mainly to the error beam pick-up, and 20% at CO peak emission positions. Fig. 4 shows a comparison between a large scale map before and after the correction method was applied. The extended weak emission is removed and the overall structure has a higher contrast, both spatially and spectrally.

We point out that after the correction, there still remains a discrepancy between the IRAM and KOSMA temperature scales. If we smooth the corrected IRAM data to the KOSMA resolution, we find that, though the intensity matches within the noise at most positions, preferentially in more extended emission regions, the corrected and smoothed IRAM spectra still exceed the KOSMA scale by up to 30% in regions with strong emission and small scale structure. At this point we can only speculate about the origin for this discrepancy. It might partially be due to pickup in smaller scale structure whithin the error beams not accounted for by the Gaussian beam model used.

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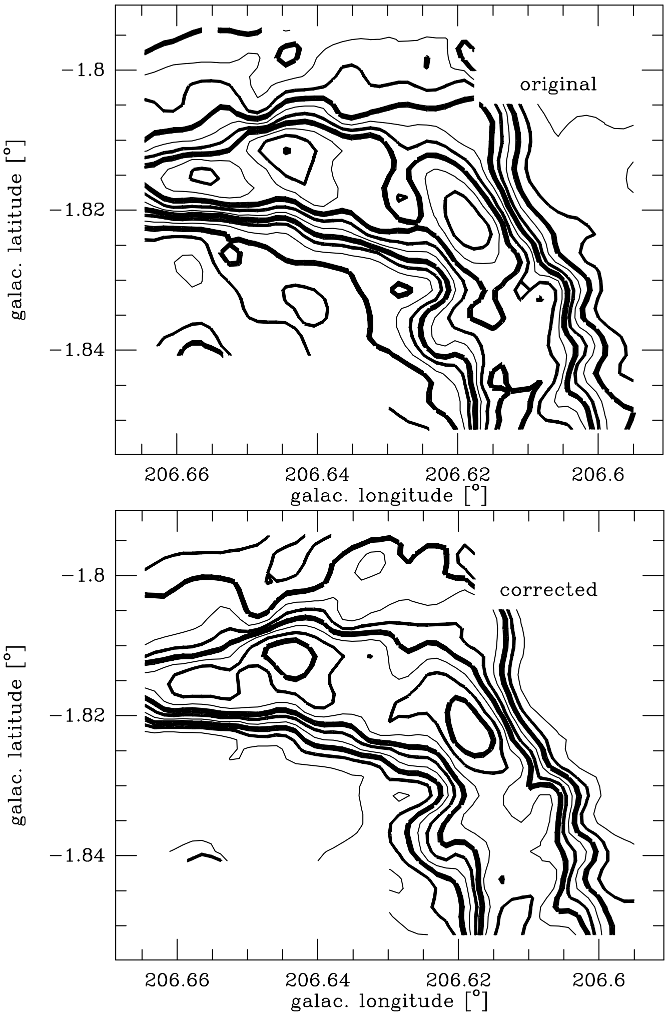


Figure 4: Contour plots of the integrated $^{13}CO$ J=2→1 intensity from the original (top) and corrected (bottom) IRAM data show clearly how the extended weak emission due to the error beam pickup is removed and the overall structure of the molecular cloud is visible with much higher contrast. The emission was integrated between 7 and 13 km s$^{-1}$ and the contour levels range from 1.14 K kms$^{-1}$ ($3\sigma$) to 26.2 K km s$^{-1}$ (original data) resp. 21.5 K km s$^{-1}$ (corrected data) in steps of $6\sigma$.

## Scientific Results

NGC 1569: IDENTIFICATION FROM CA II INFRARED LINE SPECTRA OF THE OBJECTS A, B, AS SUPERLUMINOUS STAR CLUSTERS

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*Abstract*: We present blue and near-infrared spectroscopic data which provide evidence that the stellar-like objects (called A and B) in the nucleus of NGC 1569 are star clusters. The Ca II infrared triplet absorption lines and the slope of the spectral continuum reveal that the star cluster B is in the red supergiant phase of the cluster evolution at an age of 12 Myr, while the star cluster A is in the blue star phase at an age of 13-20 Myr. Evidence for a stellar condensation is also found within the large H II region close to A as indicated by the Ca II triplet present in its near-infrared spectrum. We give reddening-corrected emission line ratios for this H II region.

ASTIGMATISM IN REFLECTOR ANTENNAS: MEASUREMENT AND CORRECTION

A. Greve, B. LeFloch, D. Morris, H. Hein, S. Navarro

*Abstract*: We investigate astigmatism in Cassegrain antennas from cross scans through in–and–out–of–focus diffraction images of extended radio sources. The use of extended sources is of interest for large (mm–wavelength) telescopes where the bright planets subtend a substantial fraction of the beam. The experimental and theoretical results presented here refer to the IRAM 30–m telescope and measurements at 7.7 – 1.3 mm wavelength; however, extrapolation to other telescopes is evident.
*Trans. IEEE Ant. Propag., in print*

## New Preprints

*The following preprints are available from IRAM:*

**316.** *Successive ejection events in the L 1551 molecular outflow*
*R. Bachiller, M. Tafalla, J. Cernicharo*
*1994, Ap. J. Letters*

**317.** *The nature of the dense obscuring material in the nucleus of NGC 1068*
*L.J. Tacconi, R. Genzel, M. Blietz, M. Cameron, A.I. Harris, S. Madden*
*1994, Ap.J. Letters*

**318.** *Arc-minute sky fluctuations at 1.25mm*
*P. Andreani*
*1994, Ap.J.*

**319.** *Observation of circumstellar shells with the IRAM telescopes*
*M. Guélin, R. Lucas, R. Neri*
*1994, Contributed Paper at the 34th Herstmonceux Conference, held in Cambridge, United Kingdom, July 1993*

**320.** *Shocked molecular gas around the extremely young source IRAS 03282+3035*
*R. Bachiller, S. Terebey, T. Jarrett, J. Martin-Pintado, C.A. Beichman, D. Van Buren*
*1994, Ap.J.*