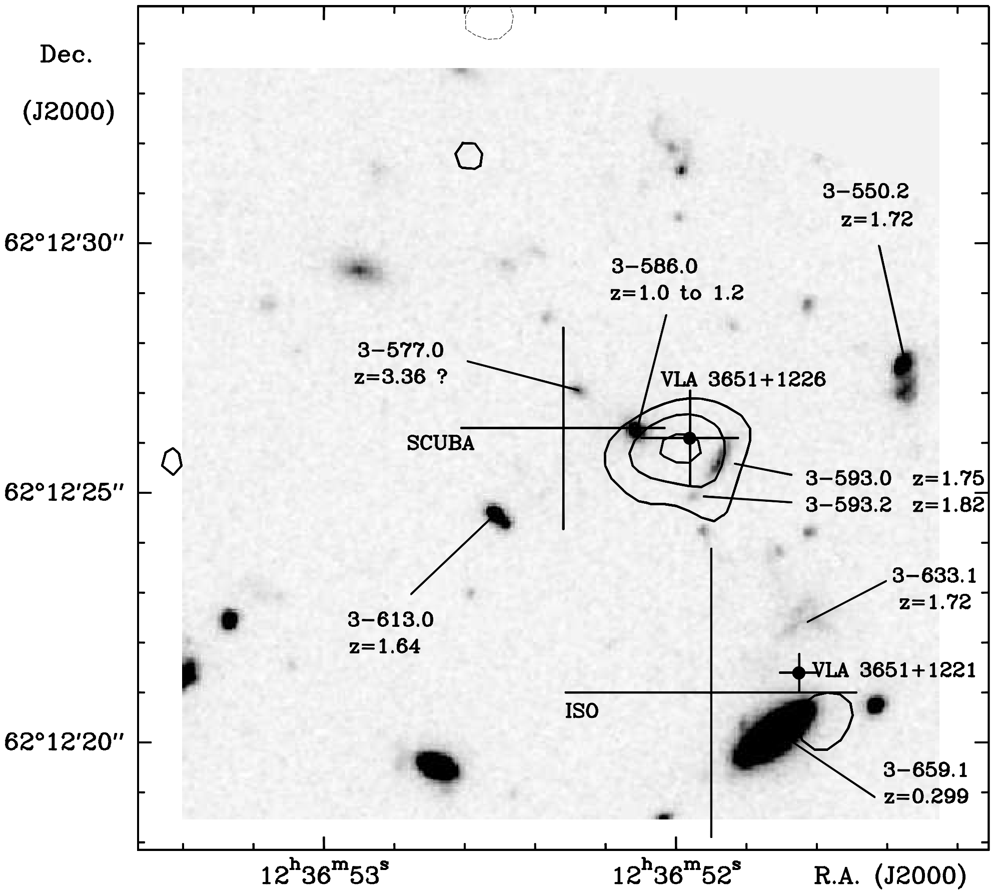
# IRAM Newsletter

## Contents



Number 41 August 6th, 1999

## Cover Picture




**Identification of Hubble Deep Field submillimeter source HDF850.1**
IRAM interferometer map of the dust 1.3 mm (236.3 GHz) continuum emission (contour lines) superimposed on a greyscale version of the *BVI* image from the Hubble Deep Field. Contours are at 0.75 mJy ($3\,\sigma$), 1.25 mJy ($5\,\sigma$), and 1.75 mJy ($7\,\sigma$). The cross marked SCUBA indicates the position and $3\sigma$ uncertainty of HDF 850.1 as given by Hughes et al. (1998, Nature, 394, 241). Small crosses with black dots indicate the positions and $1\sigma$ uncertainties of the VLA sources (Richards, ApJ, 513, L9) and the large cross marked ISO indicates the position and $1\sigma$ uncertainty of the ISOCAM 15$\mu$m source (Aussel et al., 1999, A&A, 342, 313). Optical objects are identified with their *photometric* redshifts, except for the source 3-577.0, which has a tentative *spectroscopic* redshift of 3.36 (from Downes et al. 1999, Astron. and Astrophys., 347, 809).

## Calendar

**Sept 10 th, 1999 18:00h (MET):** Deadline for the submission of observing proposals for the period Nov. 15th, 1999 to May 15, 2000

**Oct 11th, 1999** Next IRAM Newsletter deadline

**Oct. 12, 13th 1999** Program Committee meeting

# IRAM Council Meeting on June 17th/18th, 1999 - New Task Assignments

The 32nd meeting of the IRAM Executive Council was held on June 17th and 18th, 1999 in Granada. In addition to discussing IRAMs ongoing development projects and the budget projections for the year 2000 and beyond, the Council discussed in some detail the Atacama Large Millimetre Array (ALMA) and how this project will affect the short-term and longer- term activities at IRAM. Two of the IRAM partners, the CNRS and the MPG are already co- signatories of the Memorandum of Understanding that has been signed on the European side for the development of the ALMA. The 3rd IRAM partner, the IGN, reported that Spain has recently decided to join the project, too, and will negotiate conditions for the Spanish participation in the near future.

Members of the IRAM Council confirmed the important scientific role which their respective scientific communities assign to the ALMA project in the longer term. They want to support the project as much as possible without, however, compromising their support for IRAM in the near- and medium-term future. Given the limited manpower and financial resources that are available, the IRAM partners consider it essential to avoid unnecessary duplication of work and strongly encourage efforts to maximise the synergy between ongoing development projects. To facilitate this, the IRAM partners expect IRAM to coordinate the ALMA- contributions from French, German, and Spanish institutes participating in the project.

As has been announced before, the European Coordination Committee for the ALMA project has nominated Stephane GUILLOTEAU as the European Project Scientist. Given the scope of this task, he asked the IRAM Council to be relieved of his responsibilities as Deputy Director of IRAM. Acknowledging the important role that he has played not only for the development of the Plateau de Bure interferometer but also in many other respects since his appointment as IRAMs Deputy Director in 1997, and recognising the important contributions that he will be able to make to the ALMA project, the Council agreed to his temporary delegation to the new project. Following a proposal from the CNRS, the members of the IRAM Council have in the meantime appointed Michel GUÉLIN as the new Deputy Director of IRAM. The handover of responsibilities had originally been foreseen for July this year. In the aftermath of the accident of the Plateau de Bure cable car cabin, it will now take effect one month later, on August 16th, 1999.

*Michael Grewing*

# News from the 30-m telescope

Answers to observers' comments

As the station manager of the Pico Veleta Observatory I am very eager to read every single comment our observers are asked to provide after their observing run. This is one of the best ways to evaluate the weaknesses and strengths of our telescope. With our engineers and astronomers we are searching for solutions to the problems pointed out, and, maybe with a delay of a couple of weeks, I answer to every single complaint. Your input is valuable - so please take the time and fill out your comment sheet.

Let me comment on some points that have bothered many of our observers earlier this year. In spring, many of our guests experienced occasional failures of the subreflector spindle control. We found some technical time to dismount the subreflector and identified the cause of our problems in a defective position encoder. Now the subreflector is tracking properly as it should.

A major source of complaints was a temporary instability of our computer system leading to frequent crashes and the infamous D-TIME error (i.e. an integration just does not stop). This behavior often occurs when there is a communication problem within the network formed by the computer, the telescope and various devices. After an analysis of the system, our computer group found a stable configuration and since then the amount of computer related problems has decreased significantly. This shows the necessity to replace our antenna control and data acquisition system (about our efforts, see our web page at www.iram.es).

I received very enthusiastic comments about our new generation receiver system (A100, B100, A230, B230). The B receivers were replaced this spring and have an even better performance now over their tunable range. Unfortunately our old, and up to now faithful, 2 mm receiver gave problems: the receiver temperature was slightly higher than normal, and it was not always easily tuned. But in September it will be replaced by two new generation 2 mm receivers (C150 and D150). In addition, we will get two receivers for the upper 1 mm window (C270 and D270), which will strengthen the position of the IRAM 30-m telescope as the best telescope for the mm-range.

*Rainer Mauersberger,* Station Manager

### Time estimator, Version 2

The Time Estimator (TE) in its first version has been heavily used to prepare the proposals for the summer'99 period (see Newsletter of January 99). More than half of the observers used it to estimate their observing time. From the reading of the proposals and some suggestions we collected along the last months, the tool has been updated to version 2 and should be closer to user expectations.

The new release, available on the IRAM Grenoble and Granada web pages, now includes continuum observations with bolometer arrays, in both ON/OFF and mapping modes. It still contains all available spectroscopic observing modes with some new features (e.g. average of receivers observing at the same frequency). For a detailed description of the updates, refer to the help page on the web. A more complete information about the program can also be found in a recent report [1].

Version 2 accounts for the most recent receiver parameters, notably the improved performances of receivers B100 and B230, and for the 4 new receivers in dewars C and D. Their parameters, which are currently based on lab measurements, may be updated as soon as measurements on the telescope are available. Please send your comments on the current version 2 of the tool to the undersigned.

*David Teyssier*

Reference:
[1] A Time Estimator for Observations at the IRAM 30-m Telescope, David Teyssier. Available on IRAM web pages.

### Miscellaneous

David Teyssier will leave the Pico Veleta Observatory this September and start to write a Ph.D. Thesis at the Ecole Normale Superieur in Paris. His new email address will be teyssier@lra.ens.fr . David has served as a cooperant, in France an option to the military service, for two years. During that period he has not only assisted many of our guests in doing their observations, he was also very involved in developing our spectral line On-The-Fly Mapping procedures. He wrote our web based observing time estimator and investigated the influence of thermal gradients in the 30-m antenna on the surface accuracy. We wish him all the best for his future career as an astronomer.

Our regular observers know that winter transport to the telescope can often be difficult given the uncertainties of road and weather conditions. Our guests are therefore invited to plan the length of their stay generously. But if we have to cancel a transport, be advised that our remote observing station in Granada can be used.

Finally, I invite you to check our web pages, which not only have a new design but also contain new information. In particular, a Meteosat movie of the precipitable water vapour (PWV) is now available to help you to plan your observations (http://www.iram.es/Telescope/weather.html).

*Rainer Mauersberger*

## Call for proposals on the 30-m telescope

### Summary

The *next deadline* for the submission of observing proposals for the IRAM 30m telescope is Sept 10 th, 1999 18:00h (MET). The scheduling period extends from Nov. 15th, 1999 to May 15, 2000, covering roughly the winter period at Pico Veleta. Two types of proposals will be considered:

1. proposals using the observatory's heterodyne receivers at wavelengths of 3, 2 and 1.3 mm.
2. proposals using a 1.3mm bolometer array with 37 channels.

Roughly 2800 hours of observing time will be available, which should allow scheduling of a few longer programmes (of the order of 100 hours), with emphasis on 1.3 mm observations.

The main news, proposal formalities, details of the various receivers, and observing modes are described below.

### What is new ?

Following the successful refurbishment of the receiver cabin last autumn (new optics; four new generation SIS receivers in dewars A and B) two more such **dual frequency dewars** will be installed this October. Each of these dewars, C and D, contains two mixers: one covering the 2mm window and one for the higher frequency part of the 1.3mm window (246 to 293 GHz). The 4 new receivers, designated C150, C270, D150, and D270 can be used together simultaneously, or either C or D can be combined with the A or B receivers. Tab. 1 describes the four possible combinations. Note that the new generation C270 and D270 receivers are expected to make the 30m telescope the most sensitive instrument operating in the high frequency part of the 1.3mm atmospheric window.

The **37 channel bolometer array** which was used last winter on the telescope with unprecedented sensitivity will be available again. Two 37 ch. bolometer sessions are planned, one before the end of this year (Session I) and a second one early next year (Session II). Proposers are asked to clearly indicate on the cover page (section "Special Requirements") which of the two sessions they prefer.

In an effort to improve the chances to successfully observe the scientifically most interesting proposals we plan to introduce a new scheme of **priority scheduling**. The highest rated proposals, up to a total of about 250 hours of telescope time, will be included in this scheme. These proposals will be given a further chance, if their scientific goals were not obtained when scheduled first. Bolometer proposals which require perfect weather may also profit from the priority scheme if they are rated sufficiently high. If the weather is not good enough when the priority proposals are scheduled, backup proposals depending less critically on weather will be observed whenever possible. We strongly encourage investigators whose programs require very good weather conditions to submit their own backup programs. Those must be presented on separate forms as independant proposals and will be rated as such by the Program Committee.

## Applications

Valid proposals consist of the official cover page, up to two pages of text describing the scientific aims, and up to two more pages of figures, tables, and references. The official cover page, in postscript or in LaTeX format, may be obtained by anonymous ftp from `iram.fr` in directory `dist/proposal`, as well as a LaTeX style file `proposal.sty`; or through the IRAM 30m web page at URL `http://iram.fr/PV/veleta.html`. In case of problems, please contact the secretary, Cathy Berjaud (e–mail: `berjaud@iram.fr`). *Do not use characters smaller than 11pt*, which could make your proposal illegible when copied or faxed.

Proposals may be submitted in one of the following ways:

- by the web–based electronic submission facility. Please consult the detailed instructions on the web. The facility will be opened three weeks before the deadline.
- by fax to number: (33/0) 476 42 54 69.
- by ordinary mail addressed to:

  IRAM Scientific Secretariat,
  300, rue de la piscine,
  F-38406 St. Martin d'Hères, France

All proposals must reach the Secretariat before Sept 10 th, 1999 18:00h (MET). The Principal Investigator will receive by return mail an acknowledgement of reception and a proposal number. To avoid the allocation of several numbers per proposal, send *only one* copy of your proposal, either electronically, by ordinary mail, or by fax. Proposals sent in by E–mail are not accepted.

Proposals containing grey scale plots should be submitted electronically to avoid deterioration of image quality in the copying. Color plots will be printed/copied in grey scale. If the proposers want their color plots to be passed on to the program committee, the **entire proposal** must be send in by ordinary mail in **12 copies**.

On the title page, you must fill out the line "special requirements" if you request either spectral line on-the-fly observations, or the polarimeter, service or remote observing, or specific dates for time dependent observations. If there are periods when you cannot observe for personal reasons, please specify them here; beware, however, that such additional restrictions could make your observations difficult or impossible to schedule.

We insist upon receiving, with proposals for heterodyne receivers, a complete list of frequencies corrected for source redshift (to 0.1 GHz). Also specify on the cover sheet which receivers you plan to use.

In order to avoid useless duplication of observations and to protect already accepted proposals, we keep up a computerized list of targets. We ask you to fill out carefully your source list. This list *must contain all the sources* (and only those sources) for which you request observing time. To allow electronic scanning of your source parameters, your list must be typed or printed following the format indicated on the proposal form (no hand writing, please). If your source list is long (e.g. more than 15 sources) you may print it on a separate page keeping the same format.

The scientific aims of the proposed programme should be explained in 2 pages of text *maximum*, plus up to two pages of figures, tables, and references. Proposals should be self-explanatory, clearly state the scientific aims, and explain the need of the 30m telescope. The amount of time requested should be carefully estimated and justified. It should include all overheads (see below).

A scientific project should not be artificially cut into several small projects, but should rather be submitted as one bigger project, even if this means 100–150 hours.

If time has already been given to one project but turned out to be insufficient, explain the reasons, e.g. indicate the amount of time lost due to bad weather or equipment failure; if the fraction of time lost is close to 100%, don't rewrite the proposal, except for an introductory paragraph. For continuation of proposals having led to publications, please give references to the latter.

In all cases, indicate on the first page whether your proposal is (or is not) the *resubmission* of a previously rejected proposal or the *continuation* of a previously accepted 30m telescope proposal. In case of a resubmission, state very briefly in the introduction why the proposal is being resubmitted (e.g. improved scientific justification).

### Reminders

A handbook ("The 30m Manual") collecting most of the information necessary to plan 30-m telescope observations is available [10]. It has been updated recently, including now a description of the refurbished receiver cabin. The report entitled "Calibration of spectral line data at the IRAM 30m telescope" explains in detail the applied calibration procedure. Both documents can be retrieved through the IRAM web pages in Granada (http://www.iram.es) and Grenoble (http://iram.fr/PV/veleta.html). A catalog of well calibrated spectra for a range of sources and transitions (Mauersberger et al. [12]) is very useful for monitoring spectral line calibration.

The On-the-Fly observing mode (OTF) is available for heterodyne observations since more than two years. Considerable progress was made in making the control of the observations and the data reduction user friendly. Documentation is available on the Granada web page. Due to the complexity of the OTF observing mode we advise proposers without a demonstrated experience of this technique on the 30m telescope to contact, or involve in their proposal, an astronomer with such experience. Ute Lisenfeld of the Granada staff (`ute@iram.es`) serves as the principal contact in OTF matters.

Frequency switching is available. It used to yield satisfactory baselines within certain limitations (maximum frequency throw of 45 km/s, backends, phase times etc.; for details see [8]). Little experience exists however with the new generation receivers, but more tests are planned.

Finally, to help us keeping up a computerized source list, we ask you to fill in your 'list of objects' as explained before.

### Observing time estimates

Observing time estimates must take into account:

- integration time on source and comparison field(s), including overheads for ON/OFF telescope motions, deadtime for device switching and data transfer.
- pointing, focus, continuum and/or line calibrations
- telescope slew motions
- receiver tunings (for heterodyne observations),

A technical report explaining how to estimate the telescope time needed to reach a given sensitivity level in various modes of observation was published in the January 1995 issue[1] of the IRAM Newsletter [9]. It has been included in the 30-m telescope Manual [10].

Many proposals still underestimate the time needed to carry out their programme, even under excellent weather conditions. We ask you to pay special attention to this matter as a serious time underestimate may be considered as a sure sign of sloppy proposal preparation.

[1] electronically available by anonymous ftp at `iram.fr`, directory `dist/newsletter/jan95`, or via the www at URL `http://iram.fr/ARN/newsletter.html`

To circumvent such problems we strongly recommend the easy–to–use **Time Estimator** on our web pages. Now in its version 2, the tool gives sufficiently accurate estimates of the total observing time required. The tool now handles the vast majority of both heterodyne and bolometer observing modes (see the description by D. Teyssier in this Newsletter). *Proposers are asked to use this tool whenever applicable.*

If very special observing modes are proposed which are not covered by the Time Estimator proposers must give sufficient technical details so their time estimate can be reproduced. In particular, the proposal must give values for $T_{\rm sys}, \Delta T_{MB}, B$, total integration time, overheads and dead times.

Proposers should base their time request on normal winter conditions, corresponding to 4mm of precipitable water vapor. If exceptionally good transmission or stability of the atmosphere is requested which may be reachable only in perfect winter weather, the proposers must clearly say so in their time estimate paragraph. Such proposals will however be particularly scrutinized, as they may have to be scheduled in our new priority scheme (see above), for which only a small fraction of winter time will be reserved.

### Service observing

To facilitate the execution of short ($\leq$8 h) programmes, we propose "service observing" for some easy to observe (e.g. short, single source) programmes *with only one set of tunings.* Observations are made by the local staff using precisely laid–out instructions by the principal investigator. For this type of observation, we request an acknowledgement of the IRAM staff member's help in the forthcoming publication. If you are interested by this mode of observing, specify it as a "special requirement" in the proposal form. IRAM will decide which proposals can actually go to that mode.

### Remote observing

This observing mode where the remote observer actually controls the telescope very much like on Pico Veleta, is available from the downtown Granada office and from Grenoble. The prospective remote observer receives a quick introduction into the peculiarities of this observing mode, but full time support like on the telescope is not available. Therefore this observing mode is restricted to projects without particular technical demands and to experienced 30m users.

Observers visiting the 30m might opt to do some of their observing from Granada if it eases their travel. In this case, a Granada astronomer should be contacted as soon as possible. If remote observing is planned from Grenoble the proposers are asked to check the corresponding entry in the proposal cover sheet.

## Technical Information about the 30m Telescope

This section gives all the technical details of observations with the 30m telescope that the average user will have to know. See also the concise summary of telescope characteristics published on the IRAM web pages.

### *Heterodyne Receivers*

Eight new generation receivers are expected to be available at the telescope for the upcoming observing season. They are designated according to the dewar in which they are housed (A, B, C, or D), followed by the center frequency (in GHz) of their tuning range. Their main characteristics are summarised in Tab. 1. All receivers are linearly polarized with the E–vectors, before rotation in the Martin–Puplett interferometers, being either horizontal or vertical in the Nasmyth cabin. Up to four of the receivers can be combined for simultaneous observations in the four ways depicted in Tab. 1. Also listed are typical system temperatures which apply to normal winter weather (4mm of water) at the center of the tuning range and 45° elevation. All new generation receivers are tuned entirely from the control room. Experience with the receivers A and B suggests that it takes about 15 min to tune four such receivers. Note however that no experience in operating receivers C and D exists at the time of writing.

#### *General point about receiver operations*

In view of the little experience accumulated with the many new receivers, we recommend that observers restrict their list of frequencies as much as possible and that they send it early to Granada. For late arrivals (less than 2 weeks in advance), or a large number of frequencies, there is no guarantee for a prior test of the requested tunings.

#### *Polarimeter*

A new prototype IF polarimeter has started tests this summer. The instrument is designed for narrowband (40 MHz) line and continuum polarimetry of all Stokes parameters. First tests have demonstrated the viability of the concept for 3mm point sources. Further tests are scheduled.

The RF polarimeter based on switching a quarter wave plate is still available. Interested observers contact IRAM (preferentially B. Lazareff or C. Thum) to discuss what might actually be possible this winter.

### *MPIfR Bolometer array*

The 37–pixel array consists of 3 concentric hexagonal rings of horns centered on the central horn. Spacing between horns is $\simeq 20''$. Each channel has a sensitivity of $\simeq$ 40 mJy $\mathrm{s}^{1/2}$ under normal winter conditions (corresponding to 4mm pwv) and a HPBW of $11''$. The 37-pixel array was used extensively at the telescope last winter with good success. A few improvements are planned, like the repair of a few bad channels and a better rejection of interference. A second 37 channel array of comparable performance or one 19 channel array are available as backup.

The arrays are mostly used in two basic observing modes, ON/OFF and mapping.[2] Experience of last winter shows that the ON/OFF reaches typically an rms noise of $\sim$ 3 mJy in 10 min of total observing time (about 200 sec of on source integration time) under normal winter conditions. Up to 30 percent lower noise may be obtained in perfect weather. In this observing mode, the noise integrates down properly, even over several hours.

In the mapping mode the telescope is scanned in azimuth in such a way that all pixels cover the source and fully sample the beam. A typical such map covers $4 \times 3$ arcmin and takes about 60 min of telescope time. In normal winter conditions, a rms of $\sim$ 4 mJy is thus reached. Again somewhat better values may be obtained in perfect weather. However, attempts to reach significantly lower noise by averaging several maps are fraught with poorly understood problems. Proposers who aim for a rms noise of 2 mJy or less (in mapping mode) are therefore asked to indicate how they plan to reach their demanding goal.

Bolometer time requests should be based on normal winter conditions, like requests using SIS receivers. If exceptionally low noise levels are requested which may be reachable only in a perfectly stable winter atmosphere, the proposers must clearly say so in their time estimate paragraph. Such proposals will however be particularly scrutinized, as they may have to be scheduled in our new priority scheme (see above), for which only a small fraction of winter time will be reserved.

The bolometers are used with the wobbling secondary mirror (typically at a rate of 2 Hz in azimuth) . The orientation of the beams on the sky changes with hour angle due to parallactic and Nasmyth rotation, as the array is fixed in Nasmyth coordinates. Special software is made available at the telescope for data reduction (NIC [11] and MOPSI). Time estimators for planning ON/OFF or mapping observations are also available [11, 16].

### *Efficiencies and error beam*

The telescope efficiencies (main beam and aperture efficiency) are given in Appendix A of "The 30m Manual". A one–page summary of the telescope system is on the web (http://www.iram.es/Telescope/systsumm.ps).

At 1.3 mm (and a fortiori at shorter wavelengths) a large fraction of the power pattern is distributed in an error beam which can be approximated by two Gaussians of FWHP $\simeq 170''$ and $800''$ (see [15, 1] for details). Astronomers should take into account this error beam

[2] see also the contribution elsewhere in this Newsletter by D. Teyssier and A. Sievers on an interesting new fast mapping mode.

Table 1: Heterodyne receivers expected to be available for the winter 1999/2000 observing season. Performance figures for dewars C and D are based on laboratory measurements. $T^*_{sys}$ is the SSB system temperature in the $T^*_A$ scale at the nominal center of the tuning range, assuming average winter conditions and 45° elevation. $g_i$ is the rejection factor of the image side band. $\nu_{IF}$ and $\Delta\nu_{IF}$ are the IF center frequency and width.

| receiver | polar–ization | combinations 1 | 2 | 3 | 4 | tuning range GHz | $T_{Rx}$(SSB) K | $g_i$ dB | $\nu_{IF}$ GHz | $\Delta\nu_{IF}$ GHz | $T^*_{sys}$ K | remark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A 100 | V | * | | * | | 83.5 - 115.5 | 45 - 55 | > 20 | 1.5 | 0.5 | 120 | |
| B 100 | H | * | | | * | 83.5 - 115.5 | 45 - 55 | > 20 | 1.5 | 0.5 | 120 | |
| C 150 | V | | * | | * | 129 - 179 | 75 | 14 | 4.0 | 1.0 | 290 | |
| D 150 | H | | * | * | | 139 - 184 | 75 | 14 | 4.0 | 1.0 | 290 | |
| A 230 | V | * | | * | | 200 - 255 | 90 - 240 | > 10 | 4.0 | 1.0 | 330 | 1 |
| B 230 | H | * | | | * | 200 - 255 | 80 - 240 | > 10 | 4.0 | 1.0 | 330 | 1 |
| C 270 | V | | * | | * | 246 - 293 | 80 - 130 | ~ 12 | 4.0 | 1.0 | 570 | 2 |
| D 270 | H | | * | * | | 246 - 293 | 80 - 130 | ~ 12 | 4.0 | 1.0 | 570 | 2 |

1: noise increasing with frequency
2: performance at $\nu < 275$ GHz; noisier above 275 GHz.

when converting antenna temperatures into brightness temperatures.

The aperture efficiency depends somewhat on the elevation, particularly at shorter wavelengths. This gain/elevation effect is evaluated in [14].

## *Backends*

There are 3 types of spectral line backends which can be individually connected to any receiver.

- The 1 MHz filterbank, consisting of 4 units with 256 MHz each. The units can be connected to different or the same receivers giving bandwidths between 256 MHz and 1024 MHz. The maximum bandwidth of 1 GHz is available for only one receiver, naturally one having a 1 GHz wide IF bandwidth. Connection of the filterbank in 1 GHz mode presently excludes the use of any other backend with the same receiver.
  Other configurations of the 1 MHz filterbank include a setup in 2 units of 512 MHz connected to two different receivers, or 4 units connected to up to four different receivers. Each unit can be shifted in steps of 32 MHz relative to the center frequency of the connected receiver.
- The 100 kHz filterbank, consisting of 256 channels of 100 kHz. It can be split into two halves, each movable inside the 500 MHz IF bandwidth, and connectable to two different receivers.
- The autocorrelator backend with up to 2048 channels. Available nominal resolutions are 10, 20, 40, 80, 320 and 1250 kHz. Nominal bandwidths range from 20 MHz to 2 × 512 MHz, depending on resolution. The correlator can be split into 8 independent subbands, each of which can be configured individually, shifted inside a 500 MHz IF band, and connected to the same or different receivers. For the larger bandwidths (i.e. more than one subband of 80 MHz) there is often a problem of platforming, i.e. baselines from the different subbands have slightly different power levels.

## *Pointing / Focusing*

Pointing sessions are made every one to two weeks; at present, the fitted pointing parameters yield an absolute rms pointing accuracy of better than 3″ [13]. We also try to keep the receivers as closely aligned as possible (to about 2″, however, alignment can be lost occasionally). Checking the pointing, focus, and receiver alignment is the responsibility of the observers (use a planet for alignment checks). Systematic (up to 0.4 mm) differences between the foci of various receivers were noted in the past and may well persist, even with the new generation receivers. In such a case the foci should be carefully monitored and a compromise value be chosen. Not doing so may result in broadened and distorted beams ([1]).

## *Wobbling Secondary*

- Beam–throw is ≤ 240″ depending on wobbling frequency. At 2 Hz, the maximum throw is 90″
- Standard phase duration: 2 sec for spectral line observations, 0.25 sec for continuum observations.

## References


[1] Appendix I: Error beam and side lobes of the 30 m telescope at 1.3 mm, 2 mm and 3 mm wavelength in: Molecular Spiral Structure in Messier 51, S. Garcia-Burillo, M. Guélin, J. Cernicharo 1993 Astron. Astrophys. **274**, 144-146.

[2] A Small Users' Guide to NOD2 at the 30m telescope A. Sievers (Feb. 1993)

[3] Thermal behaviour of mm-wavelength radio telescopes
A. Greve, M. Dan, J. Penalver 1993, IEEE Trans. Ant. Propag. AP–40, 1375

[4] Interferometric measurement of tropospheric phase fluctuations at 86 GHz
L. Olmi, D. Downes 1992 (IRAM report 238)

[5] Thermal design and thermal behaviour of Radio Telescope structures
A. Greve 1992 (IRAM report 253)

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A. Greve, B. LeFloch, D. Morris, H. Hein, S. Navarro 1994, IEEE Trans. Ant. Propag. AP–42, 1345

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[9] Cookbook formulae for estimating observing times at the 30m telescope
M. Guélin, C. Kramer, W. Wild (IRAM Newsletter January 1995 http://iram.fr/newsletter/jan95/jan95.html)

[10] The 30m Manual: A Handbook for the 30m Telescope
W. Wild 1995, IRAM Tech. Report 377/95, also available on WWW pages.

[11] NIC: Bolometer User's Guide
D. Broguiere, R. Neri, A. Sievers 1996, IRAM Tech. Report.

[12] Line Calibrators at $\lambda = 1.3$, 2, and 3mm.
R. Mauersberger, M. Guélin, J. Martín–Pintado, C. Thum, J. Cernicharo, H. Hein, and S.Navarro 1989, A&A Suppl. 79, 217

[13] The Pointing of the IRAM 30m Telescope
A. Greve, J.–F. Panis, and C. Thum 1996, A&A Suppl. 115, 379

[14] The gain–elevation correction of the IRAM 30m Telescope
A. Greve, R. Neri, and A. Sievers 1998, A&A Suppl. 132, 413

[15] The beam pattern of the IRAM 30m Telescope
A. Greve, C. Kramer, and W. Wild 1998, A&A Suppl. 133, 271

[16] A Time Estimator for Observations at the IRAM 30-m Telescope
D. Teyssier 1999, IRAM/Granada Technical Note http://iram.fr/PV/veleta.html

These reports are available upon request (see also previous Newsletters). Please write to Mrs. C. Berjaud, IRAM Grenoble (e–mail: `berjaud@iram.fr`).

*Clemens Thum, Rainer Mauersberger*

## News from the interferometer

### Observatory Status

The tragedy of July 1st, 1999, has very seriously affected the Plateau de Bure staff. Five staff members have lost their lives. They have played a key role for the technical maintenance of the entire observatory, including the telepherique and keeping clear the tracks in winter time. The accident has also disrupted the only regular means of access to the Plateau de Bure site.

All this will have important consequences on the life at the Plateau de Bure in the short and medium term, specifically for the next winter. A first consequence is that a fixed schedule for access to the site can no longer be guaranteed. Permanent presence on the site is required for the safety of the equipment, human safety rules implying that at least 4 people be present. This minimum requirement will be preserved, but it may happen, under bad weather conditions, that a given team be trapped on the Plateau de Bure for several days, without being replaced. Since this will obviously impose an extra load on the staff, it is likely that the normal team will be kept smaller than usual.

The maintenance period will also most likely take longer than foreseen, since the current situation already imposes limitations on the crew size, as well as on the weekly available working hours. The staff has also been busy with priority tasks, such as preparing an autonomous water supply.

We have already started hiring an extra operator to cope with unforeseen situations next winter. We started training astronomers to the interferometer control, in order to allow the operator to focus more efficiently on safety issues in case of longer than average stays.

We also anticipate that snow cleaning will be more difficult than usual, since access could become difficult, or since the snow cleaning engines may be required for transport of personnel. A new crew has also to be hired and trained for that very specific work. Finally, repair time in case of failures could become significant.

### Observing Projects

Despite the situation described above, so far, the observations have remained relatively unaffected. However, as an immediate consequence, current observing projects will be carried out on a "best effort" basis. Because of manpower limitations, we indeed can no longer guarantee that all configurations will be scheduled, even for "A" grade proposals. This is especially true for proposals requiring long baselines (B configurations). Astronomers with such proposals are invited to check regularly with Roberto Neri.

### Interferometer Improvements Delayed

Logistics and manpower limitations will unavoidably result in a delay in the construction of antenna 6. So far, the transport of the central hub to the site remains an unsolved problem (this piece weighs 5 tons and has a diameter of 4.4 m). The installation of the new correlator on the site will also be delayed, since we want to minimize modifications until easier access becomes possible. Finally, station N46 will not be available this winter.

Accordingly, the Plateau de Bure Interferometer configuration remains identical to that of last year.

## Call for proposals on the interferometer

### Conditions for the next winter session

Proposals are thus invited for the 5 antenna interferometer, with the same set of stations as last year. Moreover, because of the access restrictions, we wish to minimize logistic problems on the Plateau de Bure next winter.

Possible ways to do so which are currently under consideration include:

- A reduced set of configurations (e.g. no C1 or no B2 configuration)
- Minimizing snow cleaning by e.g. dropping the longest baseline (A) configuration, or fixing the configuration schedule well in advance.
- Focusing the efforts on a particular type of projects (e.g. detection demanding D configuration)

We want our decisions to be based on scientific requirements as much as possible. Accordingly, proposers are strongly encouraged to emphasize in their proposals:

- The uniqueness of Plateau de Bure for the scientific goals
- The possible observing tradeoff, in particular for mapping projects
- The relative urgency of the proposition, in particular if it is relevant for a PhD thesis
- The degree of internal priority when several proposals are issued by the same team.

In view of the serious impact that the accident has, IRAM will seek the advice from an exceptional advisory panel before taking a final decision on the overall strategy for the next winter (and summer) period.

We still expect to be able to perform the equivalent of about 30-40 full synthesis during next winter. However, projects will be carried on a "best effort" basis.

### Call for Proposals on the interferometer

Following the above rules, proposals are invited for the IRAM Plateau de Bure Interferometer (PdBI) for the period Nov. 15th, 1999 to May 15, 2000. The deadline for applications is Sept 10 th, 1999 18:00h (MET). Applications may now be submitted via the World-Wide-Web using the new *electronic proposal submission* facility, which will be activated three weeks before the deadline.

IRAM expects to schedule and complete at least 30-40 projects with elapsed time of at least two months between start and end of any given project. Selection will be based on scientific merit, technical feasibility, and adequacy to the instrument.

Details of the PdBI and the observing procedures are given in the document "*The Plateau de Bure Interferometer (PdBI)*". A copy can be obtained from the address below or from Internet via the World-Wide-Web (use IRAM's page at `http://iram.fr/PDBI/bure.html`). Proposers should read this document carefully before submitting any proposal.

Applications sent by fax or postal mail should be addressed to:

IRAM Scientific Secretariat
Interferometer Observing Proposal
300 Rue de la Piscine
F-38406 Saint Martin d'Hères Cedex
FRANCE

Proposal templates as well as the Latex style file `proposal.sty` may be obtained by anonymous ftp from `iram.fr` (directory `dist/proposal`); or from Internet via the World-Wide-Web at http://iram.fr/proposal/proposal.html. In case of problems, contact the secretary, Cathy Berjaud.

We encourage the use of the electronic submission facility. Proposals sent by e-mail, however, will *not* be accepted. *Do not use characters smaller than 11pt*, which could make your proposal illegible when copied or faxed. For the same reasons, also avoid sending by fax figures with grey scale maps. In case your proposal reaches us in time, but is incomplete or unreadable when copied, we will try out best to contact you. The Principal Investigator will receive by return mail an acknowledgement of receipt and the proposal number.

The scientific aims of the proposed programme should be explained in 2 pages of text *maximum*, plus up to two pages of figures, tables, and references. Proposals should be self-explanatory, clearly state the scientific aims, and explain the need of the Plateau de Bure interferometer.

In all cases, indicate on the first page whether your proposal is (or is not) the *resubmission* of a previously rejected proposal or the *continuation* of a previously accepted proposal. In case of a resubmission, state very briefly in the introduction why the proposal is being resubmitted (e.g. improved scientific justification).

For this call for proposals, please note the following specificities.

### Backup Projects for the May-Nov. 1999 period

Because of longer than foreseen antenna maintenance, not all the backup projects for the summer period will be scheduled. *We urge proposers to re-submit them* unless they have explicitly been notified of their effective scheduling.

### Proposal category

Proposals should be submitted for one of the five categories:

***1.3mm:*** Proposals that ask for 1.3mm data *only*. 3mm receivers will be used for pointing and calibration purposes, but cannot provide any imaging.

***3mm:*** Proposals that ask for 3mm data *only*. 1.3 mm receivers can still be used to provide either phase stability information or purely qualitative information such as the mere existence of fringes.

***dual freq.:*** Proposals that ask for dual-frequency observations (i.e. simultaneous observations at 3mm and 1.3mm).

***time filler:*** Proposals that have to be considered as background projects to fill in periods where the atmospheric conditions do not allow mapping, or eventually, to fill in gaps in the scheduling, or even periods when only a subset of the standard 4 and 5-antenna configurations will be available. These proposals will be carried out on a "best effort" basis only.

***special:*** Exploratory proposals: proposals whose scientific interest justifies the attempt to use the PdB array beyond its guaranteed capabilities. This category includes for example non-standard frequencies for which the tuning cannot be guaranteed, and more generally all non-standard observations; for this winter non-standard configurations will not be considered.

The proposal category will have to be specified *on the proposal cover sheet* and should be carefully considered by proposers.

### Configurations

Standard configurations for the next winter period are:

| 5 Antenna configurations | |
|---|---|
| Name | Stations |
| D | W05 W00 E03 N05 N09 |
| C1 | W05 W01 E10 N07 N13 |
| C2 | W12 W09 E10 N05 N15 |
| B1 | W12 E18 E23 N13 N20 |
| B2 | W23 W12 E12 N17 N29 |
| A | W27 W23 E16 E24 N29 |

The following configuration sets are available:

| Set | Configs | Main purpose |
|---|---|---|
| D | D | "Low" resolution at 1.3 mm |
| CD | D, C2 or C1 | 3.5″ resolution at 3mm, 1.8″ resolution at 1.3 mm |
| CC | C1, C2 | Slightly higher resolution than CD. |
| BC | B1, C2 | 2″ resolution at 3 mm |
| BB | B1, B2, C2 | Better sensitivity than BC |
| AB | A, B1, B2 | 1″ resolution at 3 mm, 0.5″ resolution at 1.3mm |

The time order of the configurations for a given project cannot be guaranteed. Enter ANY in the proposal form if your project doesn't need any particular configuration.

### Receivers

All antennas are equipped with fully operational dual frequency receivers. The available frequency range will be 82 GHz to 116 GHz for the 3mm band, and 210 to 245 GHz for the 1.3 mm band. The 3mm and 1.3mm receivers are aligned to within about 2″.

Below 110 GHz, receivers offer best performances in LSB tuning with high rejection (20 dB): expected system temperatures are (in $T_{\mathrm{R}}^*$ scale) 100 to 150 K for the winter time. Above 110 GHz, best performances are obtained with USB tuning, low rejection (4 to 6 dB): expected system temperatures are 250 K at 115 GHz. DSB tuning is possible over the whole frequency range, but the system temperature may degrade significantly.

The 1.3 mm receivers give DSB tuning with typical $T_{\mathrm{REC}}$ below 50 K. Expected SSB system temperature are 250 to 350 K. The guaranteed tuning range is 210-245 GHz, but it may be possible to reach lower frequencies for specific cases. Higher frequencies are not feasible because of limitations in the triplers.

### 1.3mm band observations

Experience based on past years shows that sub-arc-second resolution can be achieved in good winter conditions, but cannot be guaranteed. Note that the field of view at 1.3 mm is very restricted (about 20″).

### Atmospheric phase compensation

Software is available to provide real-time atmospheric phase compensation on spectral and continuum data, as well as a-posteriori processing for continuum data. Experience shows that a final phase noise below 30 degrees at 230 GHz is obtained under good circumstances.

### Signal to Noise

The rms noise can be computed from

$$\sigma = \frac{J_{\mathrm{pK}} T_{\mathrm{SYS}}}{\eta \sqrt{N_{\mathrm{a}}(N_{\mathrm{a}}-1) N_{\mathrm{c}} T B}} \tag{1}$$

where

- $T_{\mathrm{SYS}}$ is the system temperature in $T_r^*$ scale (150 K below 110 GHz, 200 K at 115 GHz, 400 K at 230 GHz)
- $J_{\mathrm{pK}}$ is the conversion factor from Kelvin to Jansky (22 at 3mm, 40 at 1.3mm)
- $\eta$ is an efficiency factor due to atmospheric phase noise (0.9 at 3 mm, 0.8 at 1.3 mm)
- $N_{\mathrm{a}}$ is the number of antennas (5), and $N_{\mathrm{c}}$ is the basic number of configurations (1 for D, 2 for CD, 3 for BC)
- $T$ is the integration time per configuration in seconds (3 to 8 hours, depending on source declination)
- $B$ is the channel bandwidth in Hz (500 MHz for continuum, 40 kHz to 2.5 MHz for spectral line observations, according to the spectral correlator setup)

### Coordinates and Velocities

The interferometer operates in the J2000.0 system. For best positioning accuracy, source coordinates *must* be in the J2000.0 system; position errors up to 0.3″ may occur otherwise.

Please do not forget to specify LSR velocities for the sources. For pure continuum projects, the "special" velocity `NULL` (no Doppler tracking) can be used.

**Coordinates and velocities in the proposal MUST BE CORRECT: A coordinate error is a potential cause for proposal rejection.**

### Correlator

The correlator has 6 independent units, each being tunable anywhere in the 110-610 MHz band, and providing 4 choices of bandwidth/channel configuration: 160 MHz/64, 80 MHz/128, 40 MHz/256 and 20 MHz/256. For the 40, 80 and 160 MHz bandwidth, the two central channels may be perturbed by the Gibbs phenomenon (depending on continuum strength): it is recommended to avoid centering the most important part of the lines in the middle of the band of the correlator unit.

The 6 units can be independently placed either on IF1 (3 mm receiver) or on IF2 (1.3 mm receiver).

### 40 KHz resolution

One (and *only one*) of the 6 units has been retrofitted to offer a higher frequency resolution (40 kHz instead of 80 kHz). This is obtained by operating at half clock speed and inserting an anti-aliasing filter of effective bandwidth 8 MHz. Because the filter reduces the input power to the sampler, this unit should be placed near the maximum amplitude of the IF bandpass: band edges must be avoided.

### Sun Avoidance

For safety reasons, the sun avoidance circle extends to 45 degrees. Please take this into account for your sources *and* for the calibrators.

### Mosaics

The PdBI has mosaicing capabilities, but the pointing accuracy may be a limiting factor at the highest frequencies. Please contact R. Neri in case of doubt.

### Data reduction

Proposers should be aware of constraints for data reduction:

- In general, data should be reduced in **Grenoble**. Proposers will not come for the observations, but will have to come for the reduction.
- We keep the data reduction schedule very flexible, but wish to avoid the presence of more than 2 groups at the same time in Grenoble. Please contact us in advance.
- IRAM may consider splitting the data reduction in two phases: intermediate calibration and final mapping. Such a splitting is often necessary for the high resolution images. In such a case, the proposers must be ready to come at IRAM for fast data reduction of the "compact" configurations.
- CLIC is still evolving fast to cope with the evolution of the PdBI array. The newer versions are upward compatible with the previous releases, but the reverse is not true. Observers wanting to finish data reduction at their home institute should obtain an updated version of CLIC, which is now available. Because differences between CLIC versions may potentially result in imaging errors if new data are reduced with an old package, we insist that observers having a copy of CLIC take special care in maintaining it up-to-date.

Data reduction will be carried out on the dedicated HP workstations.

### Local contact

A local contact will be assigned to every proposal which does not involve an in-house collaborator. Depending upon the programme complexity, IRAM may require an in-house collaborator instead of the normal local contact.

### Technical pre-screening

All proposals will be reviewed for technical feasibility in parallel to being sent to the members of the programme committee. Please help in this task by submitting technically precise proposals. Note that your proposal must be complete and exact: **velocities, position and frequency setup must be exactly specified**.

### Non-standard observations

Please contact R.Neri, R.Lucas, or A. Dutrey in case of doubt about non-standard program feasibility.

### Documentation

The documentation for the IRAM Plateau de Bure Interferometer includes documents of general interest to potential users:

- An Introduction to the IRAM Plateau de Bure Interferometer.
- IRAM Plateau de Bure Interferometer: Calibration CookBook.
- IRAM Plateau de Bure Interferometer: Mapping CookBook.
- IRAM Plateau de Bure Interferometer: Frequency Setup.
- CLIC: Continuum and Line Interferometer Calibration.

More specialized documents are also available; they are intended for observers on the site (IRAM on-duty astronomers, operators, or observers with non-standard programs):

- IRAM Plateau de Bure Interferometer: OBS Users Guide.
- IRAM Plateau de Bure Interferometer: Amplitude Calibration.
- IRAM Plateau de Bure Interferometer: Flux Measurements.
- IRAM Plateau de Bure Interferometer: Pointing Parameters.
- IRAM Plateau de Bure Interferometer: Trouble Shooting Guide.

All documents can be retrieved on Internet via the World-Wide-Web. IRAM's home page is `http://iram.fr/`

Finally, we would like to stress again the importance of the quality of the observing proposal. The technical preparation of observing proposals is unfortunately often insufficient. In the past, proposals were received which did not even include exact observing frequencies or even source coordinates, or worse, with coordinates with the wrong epoch !... The IRAM interferometer is a powerful, but complex and unique instrument, and proposal preparation requires special care. Information is available in the documentation and at http://iram.fr/PDBI/bure.html. The IRAM staff can help in case of doubts if contacted well before the deadline. Note that the proposal should not only justify the scientific interest, but also demonstrate how the Plateau de Bure interferometer will bring new information.

*Roberto NERI*

# Technical report

### A fast mapping method for bolometer array observations at the IRAM 30-m telescope

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*Abstract*: We present a fast-mapping method that can be used to map large fields with array receivers mounted in the nasmyth focus of the 30-m Telescope. This method was successfully tried using the 37-channel MPIfR Bolometer array during the winter 1999. Usually, maps are done in Azimuth, Elevation in such a way that a fully sampled map is obtained with each "pixel" of the array. All these maps are finally averaged to give a vastly oversampled final map. For this, we use vertical offsets (in elevation) of 4" or 5" between consecutive subscans (i.e. scanlines in azimuth). If we drop the requirement that the individual coverages fully sample the region to be mapped, one may use larger vertical offsets and still obtain a fully sampled final map. As we show in this technical report, a vertical offset of 23" is a good compromise when using the 37-channel bolometer. Examples of such maps are presented. For a given time one can thus observe a 6 times larger field than before. Instead of e.g. 6.5'×5', a 15'×13.5' field can be mapped within 1.5 hours.
*Available on the* IRAM web pages

## New IRAM Preprints

**509.** Jets and High-Velocity Bullets in the Orion Outflows
Is the IRc2 Outflow Powered by a Variable Jet?
A. Rodriguez-Franco, J. Martin-Pintado, T.L. Wilson
1999, *Astronomy and Astrophysics*

**510.** Low Velocity Ionized Winds from Regions around Young O Stars
D.T. Jaffe, J. Martin-Pintado
1999, *Astrophys. Journal*

**511.** Intergalactic Cold Dust in the NGC 4631 Group
N. Neininger, M. Dumke
1999, *Nat. Academy of Sciences (USA)*

**512.** Interferometric Observations of Nearby Galaxies
N. Neininger 1999 *Contr. to the Cologne-Zermatt Symposium, Sept. 1998*

**513.** Carbon-Chain Molecules as Tracers of Time-Dependent Chemistry
M. Guélin, N. Neininger, R. Lucas, J. Cernicharo
1999 *Contr. to the Cologne-Zermatt Symposium, Sept. 1998*

**514.** A Molecular Counterpart to the Herbig-Haro 1–2 Flow
A. Moro-Martin, J. Cernicharo, A. Noriega-Crespo, J. Martin-Pintado
1999, *ApJ Letters*

**515.** Stars, HII Regions, and Shocked Gas in the Bar of NGC 1530
A. Greve, D. Reynaud, D. Downes
1999, *Astronomy and Astrophysics*

**516.** $^{13}$CO(1–0) and $^{12}$CO(2–1) in the Center of the Barred Galaxy NGC 1530
D. Reynaud, D. Downes
1999, *Astronomy and Astrophysics*

**517.** Gas Dynamics in the Luminous Merger NGC 6240
L.J. Tacconi, R. Genzel, M. Tecza, J.F. Gallimore, D. Downes, N.Z. Scoville
1999, *Astrphys. Journal*

**518.** GG Tau: The Ring World
S. Guilloteau, A. Dutrey, M. Simon
1999, *Astronomy and Astrophysics*

**519.** Dust and CO Lines in High Redshift Quasars
S. Guilloteau, A. Omont, P. Cox, R.G. McMahon, P. Petitjean
1999, *Astronomy and Astrophysics*

**520.** A Cluster of Young Stellar Objects in L1211
M. Tafalla, P.C. Myers, D. Mardones, R. Bachiller
1999, *Astronomy and Astrophysics*

**521.** NBN Phonon-Cooled Hot Electron Bolometer Mixer Development at IRAM
C. Rösch, F. Mattiocco, K.H. Gundlach, K.-F. Schuster
1999, *Tenth Int. Symp. on Space Terahertz Technology*
Univ. of Virginia, USA

# Scientific results in press

## Proposed identification of Hubble Deep Field submillimeter source HDF850.1

D.Downes(1), R.Neri(1), A.Greve(1), S.Guilloteau(1), F.Casoli(2), D.Hughes(3,4), D.Lutz(5), K.M.Menten(6), D.J.Wilner(7), P.Andreani(8), F.Bertoldi(6), C.L.Carilli(9), J.Dunlop(3), R.Genzel(5), F.Gueth(6), R.J.Ivison(10), R.G. Mann(11), Y.Mellier(2,12), S.Oliver(11), J.Peacock(3), D.Rigopoulou(5), M.Rowan-Robinson(11), P.Schilke(6), S.Serjeant(11), L.J.Tacconi(5), M.Wright(13)
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*Abstract*:

The IRAM Interferometer has been used to detect the submillimeter source HDF 850.1 found by Hughes et al. the Hubble Deep Field (1998, Nature, 394, 241). The 1.3 mm (236 GHz) map is shown in the Cover Picture of this issue; The flux density measured at 1.3 mm is $2.2\pm0.3(1\sigma)$ mJy, in agreement with the flux density measured at the JCMT. The flux densities and upper limits measured at 3.4, 2.8, 1.3, 0.85, and 0.45 mm show that the emission comes from dust. We suggest that the 1.3 mm dust source is associated with the optical arc-like feature, 3-593.0, that has a photometric redshift $z \approx 1.7$. If HDF 850.1 is at this redshift and unlensed, its spectral energy distribution, combined with that of 3-593.0, matches closely that of the ultraluminous galaxy VII Zw 31. Another possibility is that the dust source may be gravitationally lensed by the elliptical galaxy 3-586.0 at $z \approx 1$.

The position of the dust source agrees within the errors with that of the tentative VLA radio source 3651+1226.

*Astronomy and Astrophysics, 347, p.809-820 1999*

## CO(4–3) and CO(3–2) studies of M 51 and NGC 6946

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*Abstract*: We have mapped several nearby galaxies in the CO(4–3) line transition with the Heinrich-Hertz-Telescope on Mt. Graham, Arizona, during an excellent weather period in December 1998. In this Letter we report on our observations of M 51 (Fig. 1) and NGC 6946. The results suggest a concentration of highly excited CO gas to the nuclei of these galaxies. Moreover, in both objects CO(4–3) line emission was also detected for the first time in the spiral arms, several kiloparsecs away from the centre.

*Astron. Astrophys. 347, L5 (1999)*

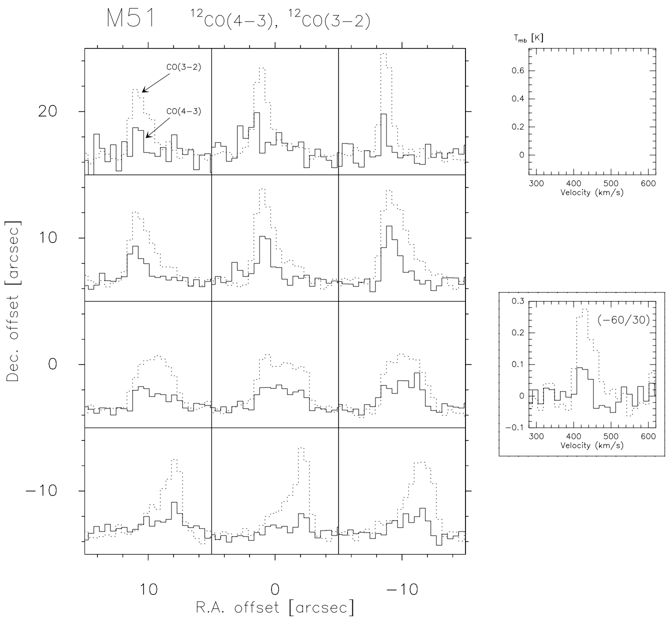


Figure 1: $^12$CO(4–3) spectra in M 51 at 17″ resolution, with positions relative to the central coordinates R.A.[1950] = $13^h27^m46^s.1$, Dec.[1950] = 47°27′14″. In addition HHT observations of the CO(3–2) transition at 22″ resolution are plotted as dashed lines. In the box on the right the spectrum of a position on a dust lane of a spiral arm at an offset of (−60″/30″) is shown.

## A cluster of young stellar objects in L 1211

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*Abstract*: We present millimeter continuum and line observations of a dense core in L1211, a member of the Cepheus cloud complex. We find a small cluster of at least 4 millimeter (mm) sources with no optical counterpart, but each associated with near infrared (NIR) diffuse emission. The strongest mm source has no NIR point-like counterpart, and constitutes a good candidate for a Class 0 object. The other mm objects seem associated with NIR sources and most likely belong to Class I, as also suggested by the spectral energy distributions derived from combining our mm data with IRAS HIRES fluxes. As evidenced by our line data, the mm sources are embedded in an elongated, turbulent core of about 150 $M_\odot$ of mass and 0.6 pc length. Two of the millimeter sources power bipolar molecular outflows, another signature of their extreme youth. The outflows are well resolved by our observations and seem to have unrelated orientations.

The combination of millimeter sources and bipolar outflow emission indicates that multiple star formation in L1211 has occurred during a short period of time (a few $10^5$ yr). The lack of a noticeable enhancement in the number of NIR sources suggests that the core has not had enough time to form a cluster, so we infer that L1211 is undergoing a first episode of star formation.

*Astron.& Astrophys. in press.* Preprints available at: http://www.oan.es/preprints

## Unveiling the disk-jet system in the massive (proto)star IRAS 20126+4104

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*Abstract*: We present the results of line and continuum observations towards the source IRAS 20126+4104, performed at 1.3 mm and 3.5 mm with the Plateau de Bure interferometer, from 350 $\mu$m to 2 mm with the James Clerk Maxwell telescope, and at 10 and 20 $\mu$m with the United Kingdom infrared telescope. The results fully confirm the findings of Cesaroni et al. (1997), namely that IRAS 20126+4104 is a very young stellar object embedded in a dense, hot core and lying at the centre of a rotating disk. The bipolar jet imaged by Cesaroni et al. (1997) in the 2.122 $\mu$m $H_2$ line is seen also in the SiO(2-1) transition, which allows to study the velocity field in the jet. A simple model is developed to obtain the inclination angle of the jet (and hence of the disk axis), which turns out to be almost perpendicular to the line of sight. By studying the diameter of the disk in different transitions and the corresponding line widths and peak velocities, one can demonstrate that the disk is Keplerian and collapsing, and thus compute the mass of the central object and the accretion luminosity. We show that if all the mass inducing the Keplerian rotation is concentrated in a single star, then this cannot be a ZAMS star, but more likely a massive protostar which derives its luminosity from accretion.

*Appeared in Astron. and Astrophys.* 345, 949

## Spectroscopic monitoring of comet C/1996 B2 (Hyakutake) with the JCMT and IRAM radio telescopes

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*Abstract*: Molecular radio lines were monitored in comet C/1996 B2 (Hyakutake) from February 10 to June 23, 1996, using the James Clerk Maxwell Telescope, and the 30-m telescope and the Plateau-de-Bure interferometer of the Institut de Radio Astronomie Millimétrique. We report on observations of HCN, $CH_3OH$, CO, $H_2CO$, CS and $H_2S$ and on the evolution of their production rates with heliocentric distance ($r_h$), from 1.86 down to 0.24 AU at perihelion. Most production rates increased roughly as $r_h^{-2.2}$ down to 0.6 AU pre-perihelion. Closer to the Sun, they stalled before decreasing beyond 0.6 AU post-perihelion when observations resumed. The CS/HCN ratio varied as $r_h^{-0.8}$ from 1.2 to 0.24 AU. A rapid increase of the mean gas temperature in the coma is measured, and the gas expansion velocity increased from 0.55 to 1.6 km s$^{-1}$, as the comet approached the Sun from 1.6 to 0.3 AU. Molecular abundances of the minor species around 1 AU are similar to those observed in other comets whilst the CO abundance relative to water is high ($\approx$ 22%). Coarse mapping was used to check the comet's position and to investigate the density distribution of the molecules within the coma. It provides constrains on the size of the extended source of formaldehyde, found to be between 1.2 and 2 times the scale-length of $H_2CO$ itself. The density distribution of CS is compatible with its production from the photodissociation of a short lived molecule such as $CS_2$. The density distribution observed for CO can be mostly explained by a nuclear source.

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## A 2 MM MOLECULAR LINE SURVEY OF THE C-STAR ENVELOPE IRC+10216

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*Abstract*: The mm-wave spectrum of the C-star envelope IRC+10216 has been continuously surveyed between 129.0 and 172.5 GHz with the IRAM 30-m telescope. This spectrum (see Fig. 2 and Fig. 3) can be inspected on the IRAM WEB page.

380 lines are detected, of which 317 have been identified. The identified lines arise from 30 different molecules and radicals which, in their vast majority, are not observed in hot and dense interstellar clouds such as Orion A or W3(OH). Actually, half of the molecular species identified in the mm-wave spectrum of IRC+10216 were first observed in the course of this spectral survey.

The new species include several carbon-chain molecules and radicals, as well as silicon and metallic compounds. They also include molecules containing rare isotopes of C, Mg, Si, S and Cl, whose elemental abundance ratios in the envelope are redetermined.

We observe, in particular, four $^{13}$C isotopomers of $C_4H$, three of $C_3N$ and $HC_3N$, and four doubly-substituted isotopomers of SiS and CS .

63 lines remain unidentified. Probably, a large fraction of those are rotational transitions inside the excited bending states of the abundant species NaCN, $C_5H$, and $C_6H$. We can also expect some lines to be ground state transitions of poorly known silicon and metal compounds, such as the slightly asymmetrical top molecule SiCSi.

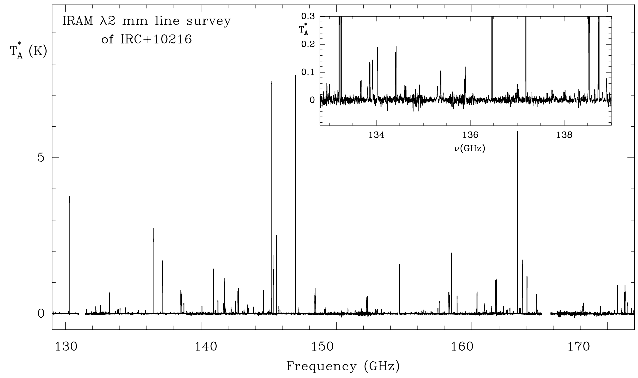


Figure 2: Overview of the 2mm spectrum of IRC+10216, smoothed to a resolution of 3 MHz (10 kms$^{-1}$).

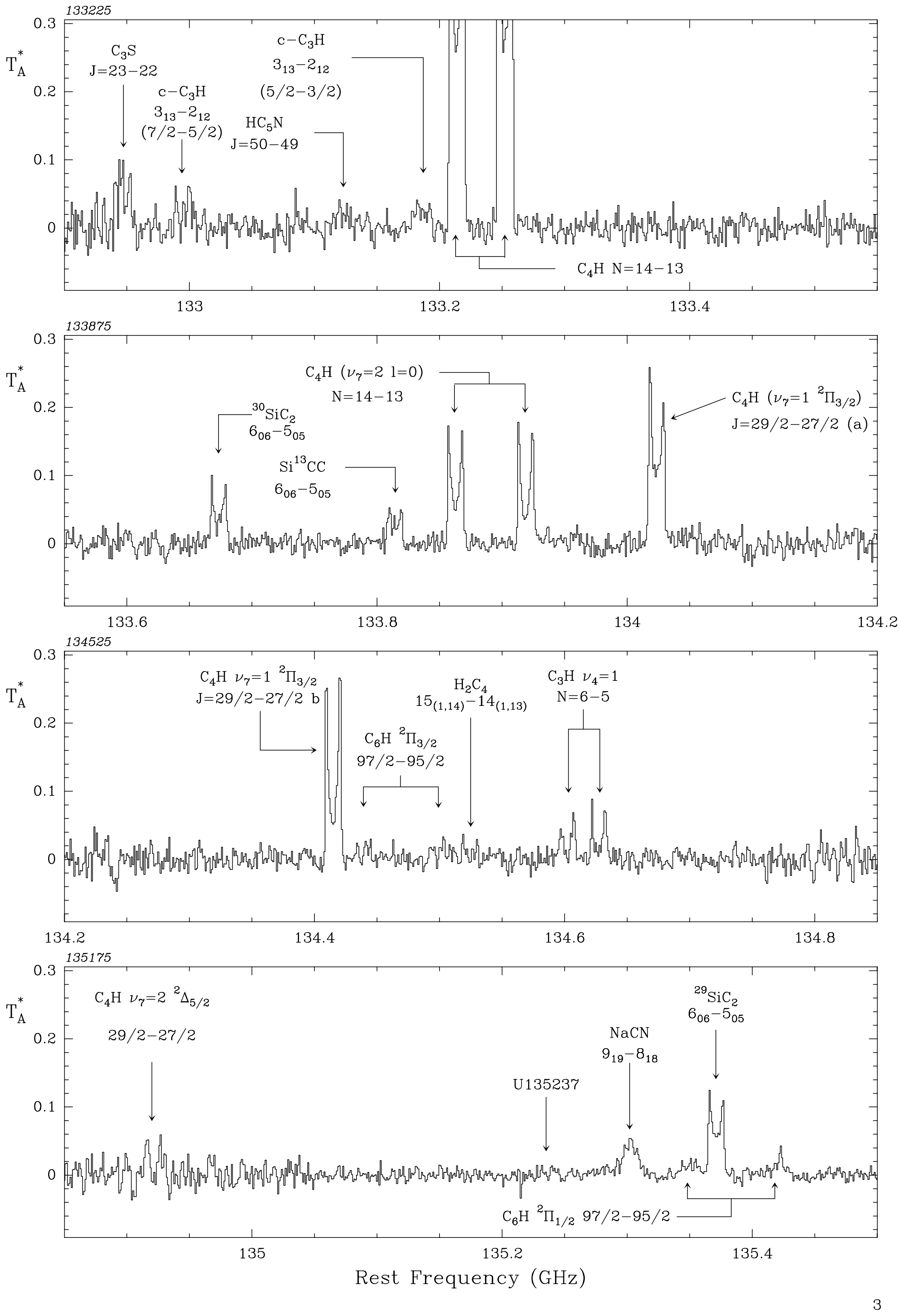


Figure 3: Portion of the 2mm spectrum of IRC+10216 at full resolution. The rest frequencies of the identified lines are marked by vertical arrows.

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