IRAM Newsletter

Contents

Number 43 February 10th, 2000

Calendar

March 2nd, 2000 18:00h (MET): Deadline for the submission of observing proposals for the period May 15, 2000 to Nov 15, 2000

April 2000 Programme Committee meeting

May 2000 Scientific Advisory Committee

June 12-16 2000 IRAM Summer School

June 22/23 2000 IRAM Council

Extraordinary IRAM Executive Council Meeting on January 27th, 2000

The IRAM Executive Council held an extraordinary meeting in Grenoble on January 27th, 2000 in order to discuss the situation after the two terrible accidents which happened in the course of 1999 when transporting people to and from the Plateau de Bure Observatory: the cable car accident on July 1st, 1999, which took the lives of all twenty passengers, and the helicopter accident on December 15th, 1999, in which five people died.

The Council started with a moment of silence in memory of the victims. Having heard what is currently known about the circumstances and possible causes of the accidents, the Council then faced the question if in the light of these events the observatory's activities must be stopped completely, or if they can be resumed at some point in the future, under conditions to be defined. All three IRAM partners as well as members from the IRAM staff came to the conclusion that the Plateau de Bure Observatory must have a future as one of the leading installations of its kind because of the contributions it can make to answering the most important questions of present day astronomy. This view was also shared by a CNRS scientific advisory committee which had addressed this question in an earlier meeting. In addition, it was felt that the facilities on the Plateau de Bure will have an important role to play in preparing one of the biggest astronomy projects of the future, the Atacama Large Millimetre Array (ALMA). The scientific use of the instrument should therefore be made possible again, under the best of conditions.

The most important of these conditions concerns the safe access to the Observatory. This question will be addressed in two steps, and the community will be informed as progress is made.

The first step consists of a number of studies which include:

i) a new analysis of the means of access to the Plateau de Bure that can be envisaged. This is a repetition of the study made in 1978. Among the options to be analysed will be a cable car solution as well as an access by road ;

ii) a risk analysis by independent experts will be carried out for the different means of access ;

iii) a detailed diagnostic will be carried out by the chosen project manager (the company E.R.I.C.) for the existing cable car installations in order to determine which modifications would be necessary, should it be decided to construct a "téléphérique à voyageurs" ;

The results from the official inquiries into the causes of the accidents will, of course, play a key role in deciding on any new solution.

The CNRS who is responsible for providing access to the Plateau de Bure announced that at the end of this phase, which will last several months as a minimum, a decision on the means of access will be taken after listening to the advice and the wishes of the IRAM partner organisations, the IRAM staff, the Committees for Hygiene and Safety of IRAM, INSU and the CNRS, the local authorities, as well as from the wider community.

Should it be decided to reconstruct a cable car and/or to construct a road, execution will start as soon as possible. Taking into account the administrative steps for obtaining the necessary authorisations and performing the necessary controls and tests, one can hope that by the end of the summer of 2001 a new, regular means of access to the Plateau de Bure will exist. The General Direction of the CNRS, with the support from its Executive Council and the Ministry of Education and Research, has already created a budget line for these activities.

Concerning the near-term future, the IRAM Direction presented to the Executive Council the rules and guidelines which have been established in consultation with the IRAM Committee for Hygiene and Safety, for the present activities on the Plateau de Bure. The main elements of this scheme are:

i) the minimisation of the risks by minimising the number of helicopter flights during the winter,
ii) the minimisation of the number of people on the mountain (volunteers only),
iii) the limitation of the activities to the protection of the installations to avoid lasting damages,
iv) a new set of weather conditions which must be fulfilled when a helicopter is called,
v) the confirmation of the pilot's responsibility to decide whether or not a particular flight can take place, and
vi) the right of each individual staff member to decide whether or not to participate in a particular flight.

An analogous set of strict rules is enforced for people who wish, for personal reasons, to come to the Plateau by ground route under the responsibility of a mountain guide.

The IRAM Executive Council supported these measures taken by the IRAM Direction.

Concerning the medium-term future, the CNRS/INSU informed the other two IRAM partners about the plan to repair the existing cable car installations, to construct a "blondin" to ensure the de-icing of the cables to avoid further damages, and to bring up material to the Plateau de Bure with this load carrying device, to reduce the number of helicopter flights. The feasibility of this plan is presently being studied by the chosen project manager (E.R.I.C.), and a final decision will be taken soon. The IRAM Executive Council strongly endorsed this concept.

As described above, at present no observations are carried out with the Plateau de Bure Interferometer. It was decided, however, that the CNRS/INSU and IRAM should start discussions with the various groups concerned about the conditions under which observations could be restarted, at least in some limited way. These discussions will involve the staff, the Committee for Hygiene and Safety of IRAM, the local authorities, as well as the wider community. In parallel, a risk analysis will be made by independent experts, considering the transport problem and the risks associated with the various tasks that must be executed if observations were to restart, and the full system would have to be maintained.

It is important to stress that the present compact configuration of the antennas allows important scientific projects to be carried out even if it remains unchanged until summer has arrived.

Another decision of the IRAM Executive Council concerns the completion of Antenna 6. A "green light" was given to restart this work later in the spring and to aim for its completion by the end of the summer 2000. With this additional antenna, the efficiency of the interferometer will greatly be enhanced. The Council considered the proposals made by the IRAM Direction in consultation with the IRAM staff both for the operation of the array and for the construction work as justified and feasible.

Looking at longer-term aspects, the Council has expressed its confidence in the teams and in the Institute. The receiver development program, the active participation in the preparation of the ALMA project, and the co-ordination of the work of the three IRAM partners in this project will allow IRAM to play a key role in mm-astronomy for many years to come.

Finally, the IRAM Executive Council took note of the negotiations concerning the implementation of the new French labour legislation which enforces an average regular working time of no more than 35 hours per week, to be compared with 39 hours in the past. This change will have a profound impact on the organisation of the work at the IRAM sites. The idea is to compensate some of the loss in manpower by new hirings. This will, however, only be possible in a concerted effort between the IRAM staff, the Direction, and the IRAM partners.

Michael GREWING *François BAUDIN*
Michel GUÉLIN *Geneviève DEBOUZY*
Eric ESPARRE
Jean-François MINSTER

New Task Assignments / Personnel Changes

IRAM Grenoble

IRAM Newsletter:
Michel Guélin's new responsibilities as Deputy Director of IRAM made it necessary to appoint a new Editor for the IRAM Newsletters. Michael BREMER has accepted this task, and this is the first issue under his editorship.

The Newsletter is not only an efficient means for distributing information about the IRAM instruments to the community, for inviting observing proposals for the 30m telescope and for the Plateau de Bure Interferometer, but also for highlighting scientific results before they are generally available in refereed journals. It can also serve as a platform for informing a wide community about new projects, and for discussion. In all this, the Editor relies on the active support from many colleagues, and I hope that this help will be given to him!

Training Program for Millimeter-Interferometry:
Anne DUTREY has been appointed as co-ordinator for a special training program for interferometry at mm-wavelengths which aims, in the short-term at increasing the community that uses the Plateau de Bure Interferometer, and in the longer-term as part of the preparations on the European side for the ALMA project. Details of this program are given in this newsletter.

Interferometer Calibration Software CLIC:
Raphael MORENO will as of now be in charge of maintaining the CLIC software together with Robert LUCAS who will devote 50% of his time to the ALMA project.

Bolometer-Array Software NIC:
Since the beginning of the year, Helmut WIESEMEYER is supporting the maintenance and further development of the NIC software together with Roberto NERI, Dominique BROGUIERE, and Albrecht SIEVERS. Since all four have also several other obligations, the support of the NIC software is a part-time effort.

Michael GREWING

IRAM Granada

Departures:
Gilles NICCOLINI will leave IRAM Granada in January 2000. He has been a cooperant in the astronomy group, and many of our visiting astronomers have appreciated his help during his frequent AoD shifts. Christophe RISACHER, our cooperant in the receiver group, will leave IRAM Granada in April 2000. We wish both of them much success in their future careers.

Arrivals:
We welcome two new cooperants: Bertrand THOMAS has started work with the receiver group, and Pierre HILY-BLANT has joint the astronomy group as a new member.

Rainer MAUERSBERGER

Editor's Note

As you know from the "New Task Assignments," this newsletter is the first I have edited. On this occasion I would like to thank all those who have sent contributions and helped me getting started with the basics and subtleties of the IRAM Newsletter tools.

It seems that editorship has a lot in common with a lens: focussing incoming information into a sharp image while preserving individual colours. As the volume of this newsletter suggests, information has been plentiful. So I hope my lensing efforts have been, and will be, up to the task.

Michael BREMER

Training Program in Interferometry at mm-Wavelengths

While the steeply increasing scientific impact of radio interferometry is evident from many recent journal publications and conference proceedings, the tools necessary to utilise this technique are still not readily available in many institutes. "Tools" in this context include basic hardware concepts, the signal transport and processing techniques, the data calibration steps, and eventually the data analysis software.

As other institutes before, e.g. the NRAO, IRAM has made an effort to transmit this knowledge to users of the Plateau de Bure Interferometer by organising a first summer school in 1998, and by starting preparations for a second one in the year 2000. Details can be found in this newsletter, and on the IRAM www-page (http://iram.fr).

We now want to step up this effort by creating a special training program for interferometry at mm-wavelengths that will be co-ordinated by Dr. Anne DUTREY. In the short-term, this program aims at increasing the community, especially of young radio astronomers, that can successfully use the Plateau de Bure Interferometer. In the longer-term, this program aims to help preparing, in Europe, the scientific exploitation of the Atacama Large Millimetre Array (ALMA).

In support of this training program, we offer at IRAM a limited number of:

(a) student subsidies, and
(b) fellowship positions.

Student subsidies will allow one or more stays at IRAM for typical periods of 2 months during the preparation of a PhD-thesis that requires observations at mm-wavelengths.

Fellowship positions are for young post-docs who want to familiarise themselves with the techniques of mm-interferometry. During their typically 2 year stay at IRAM, which could be extended by 1 year, they will participate in scientific, technical, and software projects related to mm-interferometry, in a team with IRAM staff astronomers. After this, the successful candidates will return to their home institutes, or join other astronomical institutes, to share their acquired knowledge with their colleagues.

The visits of students at IRAM will be arranged in consultation with the thesis supervisors on a case-by-case basis, taking into account the available resources. The fellowship positions will be advertised on the IRAM www-page and in the IRAM Newsletters, and allocated on a competitive basis. Details will be given in the first announcement, expected in one of the next Newsletters.

Michael GREWING

News from the 30-m Telescope

Visitor Information

From now on, the operators will perform the data backup for our observers at the end of their run. You may choose between a DAT tape or a CD-ROM as storage device, and have the option to include your raw data. The data will remain on disk for a couple of days and can be accessed from the computers at the Pico Veleta Observatory and our office in Granada. In case our visitors have to catch the transport immediately at the end of their observing run, the data backup will be written to a storage device at the Granada office on the same day.

In the past months air traffic in Spain has been a disaster. If you have a choice, we recommend to fly directly into Malaga instead of having a stopover in Madrid or Barcelona. There are excellent direct connections and cheap fares from many European cities. From Malaga take the airport bus to the bus station (135 ptas, every 30 minutes). At the Alsina counter buy a ticket to Granada (1100 ptas). Buses leave every hour, the last one at 21:00. Travel time is about 2 hours. For your orientation: the taxi fare from Malaga to Granada is approximately 13000 ptas. At the Granada bus station take a taxi to Jardines del Triunfo (400 ptas).

Rainer MAUERSBERGER

Observing with the 30m

We have a new pointing scheme at the 30-m telescope. Pointing runs are done more often now (twice a week) with fewer sources and using additional information from inclinometer readings.

We have been observing through the "millennium" at the 30-m telescope with a system performing better than ever, thanks to the computer group who helped to avoid any big Y2K problems so far.

Have a look on our web site (http://www.iram.es). We have updated the system summary, and the link to the Telescope Characteristics contains many recent data on the receiver parameters. We have added a picture gallery (visitors are encouraged to send us their own photos from the telescope to be included). Our weather page now contains the most recent measurements of wind speed, temperature and humidity from our weather station as well as a symbol representing the cloud coverage. We have added a link to the weather page of the nearby Sierra Nevada Ski station which contains a detailed weather forecast tailored for the site (in Spanish). The telescope operator has similar information and can be contacted by remote observers.

Rainer MAUERSBERGER

Telescope Surface Quality

A surface adjustment was made in October 1998 and again in July 1999. Both settings were made on the basis of holographic measurements made in September 1998 with the new 39 GHz phase coherent receiver operating at the prime focus (Mattiocco et al. IRAM Internal Report March 1996). An opportunity to check the new surface occured during the installation of the new receivers C and D in September 1999. Several good quality maps of the aperture plane phase distribution were obtained. They yield a root mean square error of 52 microns for the paraboloid, when projected onto the aperture plane and amplitude weighted. The value appropriate for secondary focus operation is then 55 microns, after correction for the estimated errors in the subreflector. This new result is a significant improvement over the corresponding value of 74 microns, measured in September 1998 before the latest surface adjustments. It should be noted that all these estimates of surface error refer to elevation 43 degrees and to calm nightime conditions. In daytime under full solar illumination the surface error rises to about 66 microns.

Measurements of beam efficiency made in January 2000 (Lisenfeld and Mauersberger) show an improvement at 235 GHz from 42 % (see Newsletter 38, January 1999) to 51 %, with corresponding increases at 86 GHz (73 to 78 %) and 150 GHz (54 to 65 %). The improvement in surface quality is displayed visually in Fig. 1 which shows the aperture plane phase distributions before, (a) on the left, and (b) after the last adjustments (on the right). For

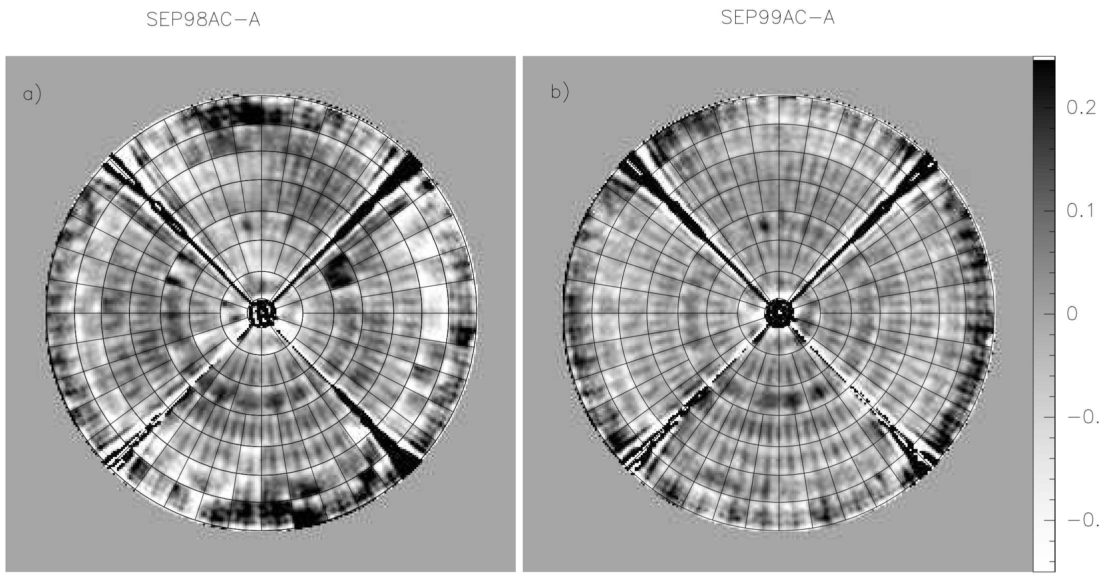

Figure 1: Aperture plane phase distribution a) in September 1998, and b) in September 1999

a clearer display of the fine surface structure, the time variable astigmatism has been removed from these plots. The range of the grey scale is ±0.2 radians at 39 GHz (±120 microns). The visual aspect of these distributions is dominated by an almost regular scalloping of the surface mainly due to the manufacturing errors of individual panels, which contributes about 40 microns to the error budget.

Dave MORRIS

Call for Observing Proposals on the 30m Telescope

Summary

The *next deadline* for the submission of observing proposals for the IRAM 30m telescope is March 2nd, 2000 18:00h (MET). The scheduling period extends from May 15, 2000 to Nov 15, 2000, covering roughly the summer period at Pico Veleta. Proposals will be considered for the observatory's standard heterodyne receivers at wavelengths of 3, 2 and 1.3 mm. Emphasis will be put on proposals for 3 and 2 mm. Proposals for bolometers or other special receivers will only be accepted in a few well justified cases.

Roughly 3000 hours of observing time will be available, which should allow scheduling of a few longer programmes (up to $\sim$ 150 hours).

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

What is new ?

The telescope is now fully equipped with 8 new generation receivers which are housed in 4 dewars designated A, B, C, and D. Each of them contains a "low frequency" and a "high frequency" receiver, and together they cover nearly all of the 2, 3 and 1.3 mm atmospheric windows. At each frequency two orthogonally linearly polarized receivers are available. Up to 4 receivers can be used simultaneously. The 4 different ways of combining them are listed in Tab. 1 together with their technical characteristics.

A new filter spectrometer built by IRAM Granada is approaching completion. The new spectrometer has 512 filters of 4 MHz width. They are configured as 2×1 GHz for use with a pair of receivers of 1 GHz instantaneous bandwidth each. The new spectrometer is expected to be available for the summer scheduling period. It will make low spectral resolution observations more efficient, since 4 receivers can then be connected simultaneously to four broadband filter spectrometers.

For the last deadline, more than two thirds of the 30m proposals were submitted electronically. We strongly encourage proposers to use this medium (except for proposals with color plots; see below) rather than ordinary mail or fax which we tend to discontinue in the future.

The proposers for the last deadline made even heavier use ($>$ 90 percent of the proposals) of the web based observing time estimator. This tool is now available in its version 2.1 which now contains realistic parameters for all receivers as they were measured recently at the telescope. In view of the good quality of the time estimates obtained with this tool, we strongly recommend its use whenever possible.

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 LaTeXformat, 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, 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 three following ways:

- by the web–based electronic submission facility (preferred). 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

Please note that proposals submitted electronically by means other than our web–based facility (e.g. ordinary E–mail) will not be accepted.

All proposals must reach the Secretariat before March 2nd, 2000 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 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 programme committee, the **entire proposal** must be sent in by ordinary mail in **12 copies**.

On the title page, you must fill out the line 'special requirements' if you request either polarimetric observations, 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 these 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 a 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. We strongly recommend to state very briefly in the introduction why the proposal is being resubmitted (e.g. improved scientific justification) or is proposed to be continued (e.g. last observations wiped out by bad weather).

Reminders

A handbook ("The 30m Manual") collecting most of the information necessary to plan 30m 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. [13]) is very useful for monitoring the 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 designing the control of the observations and the data reduction more 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.

Observing time estimates

This matter needs special attention as a serious time underestimate may be considered as a sign of sloppy proposal preparation. 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 30m telescope Manual [10].

In order to facilitate the rather complex calculation of observing time we strongly recommend the easy–to–use **Time Estimator** on our web pages. Now in its version 2.1, the tool gives sufficiently accurate estimates of the total observing time required. The tool handles the vast majority of both heterodyne and bolometer observing modes. *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 $T_{\rm sys}$, spectral resolution, expected antenna temperature of the source signal, the signal/noise ratio which is aimed for, all overheads and dead times, and the resulting observing time).

Proposers should base their time request on normal summer conditions, corresponding to 7mm of precipitable water vapor. Conditions during summer afternoons may be degraded due to anomalous refraction. The observing efficiency is then reduced and the temperature calibration is more uncertain than the typical 10 percent. If exceptionally good transmission or stability of the atmosphere is requested which may be reachable only in near winter conditions, the proposers must clearly say so in their time estimate paragraph. Such proposals will however be particularly scrutinized.

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

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 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

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

receiver	polar–	combinations				tuning range	T_{Rx}(SSB)	g_i	ν_{IF}	$\Delta\nu_{IF}$	T^*_{sys}	remark
	ization	1	2	3	4	GHz	K	dB	GHz	GHz	K	
A 100	V	1		3		80 - 115.5	45 - 65	> 20	1.5	0.5	150	
B 100	H	1			4	81 - 115.5	60 - 85	> 20	1.5	0.5	160	
C 150	V		2		4	129 - 183	60 - 150	12 - 24	4.0	1.0	370	
D 150	H		2	3		129 - 183	75 - 180	8 - 17	4.0	1.0	370	
A 230	V	1		3		197 - 266	100 - 200	12 - 17	4.0	1.0	700	1
B 230	H	1			4	197 - 266	100 - 250	12 - 17	4.0	1.0	700	1
C 270	V		2		4	241 - 281	180 - 400	10 - 15	4.0	1.0	1000	2
D 270	H		2	3		241 - 281	140 - 260	9 - 13	4.0	1.0	1000	2

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

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 summer weather (7mm of water) at the center of the tuning range and 45° elevation. All new generation receivers are tuned entirely from the control room. Experience shows that it normally takes about 15 min to tune four such receivers.

General point about receiver operations

We recommend that observers send a list of their frequencies to Granada in time, in particular if frequencies near the edges of the tuning range are requested. 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 which had started tests last summer is now available on a restricted basis. The instrument is designed for narrow-band (40 MHz) line and continuum polarimetry. It needs two orthogonally polarized receivers as input and it generates 4 signals from which spectra of all four Stokes parameters can be derived. The tests made so far have demonstrated the viability of the concept for 3mm point sources. In particular, drift of the relative phase between the two receivers was found to be sufficiently slow so that it can be calibrated. A preliminary description of the instrument is available on the web at URL `http://iram.fr/~thum.html`.

Polarimetry proposals are invited with the following restrictions: *(i)* the target sources should not be larger than the main beam and *(ii)* the observing frequency should be in the 3mm tuning range. A few higher frequency proposals may also be accepted on a shared risk basis. They may be observed if the 2 and 1.3mm tests planned this summer are successful.

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

Efficiencies and error beam

Extensive work during the last years in measuring and setting the telescope surface has resulted in significantly improved aperture and beam efficiencies which have increased nearly by a factor 2 at the highest frequencies accessible to the telescope (see report by D. Morris elsewhere in this Newsletter). The current numbers are shown in Table 2.

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 [16, 1] for details). Astronomers should take into account this error beam 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 [15].

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

Table 2: Forward and main beam efficiencies, η_F and η_{mb}, and beam width θ_b.

frequency [GHz]	θ_b ["] ^{1})	η_F	η_{mb} ^{2})
86	29	0.95	0.80
110	22	0.95	0.80
145	17	0.93	0.65
170	14.5	0.91	0.66
210	12	0.90	0.54
235	10.5	0.91	0.50
260	9.5	0.88	0.51
279	9	0.86	0.46

^{1}) fit to all data: θ_b ["] = 2460 / frequency [GHz]
^{2}) measured with receivers B and C. Values from receivers A are less than 3 percent different, values from receivers D not available

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 of 256 MHz width connected to up to four (not necessarily) 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.
– Should the new 4 MHz filterbank become available during the coming summer semester it could be used, but observing time estimates should not be done on this assumption.

Pointing / Focusing

Pointing sessions are normally scheduled twice per week; at present, the fitted pointing parameters yield an absolute rms pointing accuracy of better than $3''$ [14]. Receivers are closely aligned (within $< 2''$). 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 $\leq 240''$ 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.

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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

We had not yet recovered from the terrible cable-car accident on July 1st, when on December 15th five people were killed in a helicopter crash a few hundred meters from the observatory. These circumstances forced us to stop all observing activities at the interferometer for an unspecified period of time. The principal investigators were all notified about this decision and they will be kept up-to-date in the weeks to come about any new development concerning the scheduling of projects at the Plateau de Bure Interferometer.

These accidents have an important impact on the short-term exploitation of the observatory, and also in the medium-term. For the time being, a team of four volunteers is present on the site, working on a weekly basis and providing for emergencies and the safety of the installations. When the observations will eventually be restarted, we will have to increase the staff on the site.

Despite these serious problems we hope to complete the construction of the sixth antenna before the end of summer. On the other hand, we will defer the extension of the northern track to the next year at the earliest, because it requires a much larger team to be present on the Plateau de Bure than for all the other activities. We hope we will soon be able to give you more detailed information on these developments which should help to establish a high level of productivity of the Plateau de Bure Interferometer for many years to come.

Observations

Before the accident, we had been able to bring a few observing requests to completion and to start several others (the status of these programmes can be found on the IRAM Web page `http://iram.fr/PDBI/ongoing.html`).

The current stop of the observations will have severe consequences for the remaining programmes of the winter session:

- The interferometer will stay in the D configuration, and we plan only very limited observations. Observing time, if available at all, will be used to complete programmes already started and which need only D data to achieve their scientific goals.
- All other programmes, including A-rated programmes, will have to be resubmitted either for this summer session, if their goals can be achieved in the D configuration (see the next Section), or for the next winter session.

Roberto NERI

Call for Observing Proposals on the Plateau de Bure Interferometer

Conditions for the next summer session

Although at present all observations on the Plateau de Bure have been stopped (as described earlier in this Newsletter), we strongly encourage the submission of observing proposals for the period of May 15 to November 15, 2000. The reasons are as follows:

- The interferometer will remain in the D configuration at least until the end of the winter period. Depending on when observations will be restarted, we may need additional "A-rated" proposals for this configuration. The Programme Committee will be informed about the situation when it meets in early April. Deep integrations and/or low-resolution observations in either snapshot, mapping or mosaicing mode could qualify for this opportunity if it arises.
- Although we want to keep the total number of people working on the Plateau de Bure as small as possible during the coming summer months, we hope to be able to support both the technical maintenance and construction work for antenna 6, and observations for some fraction of the time.

How much time can be allocated for scientific observations will not be known until the beginning of the summer period. There are still too many uncertainties, as to how much observational activity can be carried out in the months to come, especially in view of the fact that we will need some time for astronomical testing as soon as Antenna 6 is ready and the new correlator has been installed. The current planning predicts that this could happen during October/early November.

We realize that writing proposals under such conditions will not be easy. However, we must be ready should observing opportunities arise.

To keep the procedures as simple as possible, we suggest that you focus on

- proposals for the D configuration,
- observations that use the 3mm receivers.

Call for Proposals

Observing proposals are invited for the Plateau de Bure Interferometer for the period May 15, 2000 to Nov 15, 2000. The deadline for applications is **March 2nd, 2000 18:00h (MET)**.

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 the World-Wide-Web at `http://iram.fr/PDBI/bure.html`). Proposers should read this document carefully before submitting any proposal.

We strongly suggest that applications be submitted via the electronic submission facility available at `http://iram.fr/submission/submission.html`. Note that applications sent by e-mail will not be accepted.

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 Cédex
FRANCE

Updated proposal templates `proposal.tex` as well as the Latex style file `proposal.sty` can be retrieved by anonymous ftp from `iram.fr` (in directory `dist/proposal`); or from the Internet via the World-Wide-Web at http://iram.fr/proposal/proposal.html. In case of problems, contact the scientific secretary, Mrs Cathy Berjaud (berjaud@iram.fr).

Do not use characters smaller than 11pt, which could make your proposal illegible when duplicated or faxed. For the same reasons, also avoid sending figures with grey scale maps by fax. In case your proposal reaches us in time, but is incomplete or unreadable when copied, we will try our 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 their 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 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, observational restrictions).

> Details on receivers, signal to noise, atmospheric phase compensation, correlator configuration choices, observing modes, data reduction and local contacts have not changed, and can be found in Newsletter 38 (January 1999).

Documentation available

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 programmes):

- 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/`

Roberto NERI

New GILDAS Release

A new release of GILDAS, dated FEB2000, is available.

A Major Revision of GILDAS

Following a number of discussions and developments, the GILDAS working group has implemented a number of significant revisions in the GILDAS software. These modifications concern the command interface, SIC, the support of FITS files, and speed improvements in the synthesis imaging package (MAPPING and associated imaging tasks) to allow handling of large images in view of the ALMA project.

SIC syntax

The most important change for the user is a modification of the syntax of SIC commands. This will be annoying for some users in a first step, but has proved to be practical because it offers a much simpler handling of filenames and mathematical expressions. The change concerns command options and case conversion.

- *Option delimiter:*
  In the previous release, options were recognized as words following a slash (/). The slash did not need to be preceded by a space. This had the disadvantage of preventing to use the slash (/) as a divide operator in mathematical expression. Spaces and slashes were both recognized as word delimiters, and redundant delimiters were ignored.
  In the new release, the space is the only word delimiter. Options are words beginning with a slash. Hence to be recognized as an option identifier, a slash must be preceded by a space. The slash can now be used as the divide operator (although the vertical bar continues to work).
  Example where `/NEW` is an option:
  ```
  LET A 1|COS(PI*0.01)/NEW REAL    ! Old
  LET A 1/COS(PI*0.01) /NEW REAL   ! New
  ```
- *Case conversion:*
  SIC is now case sensitive, with the exception of command names and options, SIC variables, and generally command keywords (unless implemented differently by the application programmer).
  In particular, command procedure names, which are derived from filenames, are case sensitive (if the underlying operating system is case sensitive for filenames). For example `@ ToTo` and `@ TOTO` are no longer equivalent.
- *Filename handling:*
  The previously cumbersome way of preventing case conversion for filenames is obsolete (it consisted in enclosing the filename between quotes, and preceding it with an exclamation mark (!)).

```
TYPE "!../DIREC/MyFilename.dat"  ! Old
type ../DIREC/MyFilename.dat     ! New
```

In addition, to improve interoperability between Unix and Windows, the backslash (\) is also recognized as a directory delimiter in filenames.

```
TYPE ..\DIREC\Myfilename.dat
TYPE ../DIREC/MyFilename.dat     ! Same
```

With the above modifications, the SIC syntax is more rigorous and avoids some of the confusing messages which occurred in the previous version. While we acknowledge that this will be slightly frustrating at the beginning for some users (50 % of the users used to type the space before the option delimiter anyhow), it greatly simplifies the handling of filenames.

SIC Command Procedures

Two new facilities have been implemented to simplify the maintenance of the large set of command procedures used as user interfaces for several data reduction packages based on SIC, like the Plateau de Bure imaging tools, or the NIC bolometer software.

First, the procedures have been grouped by type (file extension) in separate sub-directories for Class, Clic, Graphic, GreG, Mapping, Nic, and Astro. The access path to these sub-directories is defined by a SIC logical name called `MACRO#DIR:`.

Second, new commands have been added to allow a command procedure to create any sub-procedure or data set it may need. The commands

```
SIC\BEGIN PROCEDURE ProcedureName
SIC\BEGIN HELP HelpFileName
SIC\BEGIN DATA DataFile
```

and

```
SIC\END PROCEDURE ProcedureName
SIC\END HELP HelpFileName
SIC\END DATA DataFile
```

allow to create new procedures, their associated help files, and even (ASCII) data files in a procedure. The corresponding files are located in the directory associated to the SIC logical name `GAG_PROC:`.

SIC - FITS interface

Two new commands have been implemented to allow reading for any type of FITS file in SIC.

```
DEFINE FITS Name FitsFile
```

will read a FITS format file, and define a SIC structure which will contain in its variables and sub-structures all the content of the FITS file. Simple FITS images are stored in variable `Name%DATA`. Binary and ASCII table extensions are recognized and stored in suitable variables. FITS keywords are also stored (e.g. `Name%KEYWORD`).

Standard keywords like `NAXIS, NAXISi, CRPIXi, CRVALi,` etc... are re-mapped to the SIC variables `Name%NDIM NAME%DIM Name%CONVERT` to be similar to SIC image headers.

SIC structures are ensembles of SIC variables. The syntax of SIC structures is similar to Fortran-90 (e.g. `Name%SubName%SubSubName`). Besides the structures automatically defined by the `DEFINE FITS` command, the commands

```
DEFINE STRUCTURE Name
DEFINE REAL Name%A Name%B
```

can be used to define new SIC structures.

A special hook has been provided in `GreG` to easily display FITS images using the `DEFINE FITS` command. The following procedure will plot a FITS image:

```
DEFINE FITS A FitsFile
LIMITS /RGDATA A
PLOT
BOX
```

Most type of FITS files are supported. However, the UVFITS format is not supported, because it has been declared as obsolescent by the IAU FITS Working Group, and should be replaced by binary tables.

Imaging Improvements

Simulation of ALMA images has required to invest some effort into optimization of the imaging tasks in GILDAS. Based on work by Alain COULAIS (now at IAS) and Francois VIALLEFOND (DEMIRM - Observatoire de Paris), the basic imaging tool, `UV_MAP` has been considerably speeded up (by factors 4 to more than 20, depending on problem size).

The new `UV_MAP` tool can process more than 1 Million visibilities and create a 2048 x 2048 image in about 1 minute of elapsed time on a HP-J240 machine. On a Dell Inspiron (a laptop) PII-366 MHz with 256 MBytes of memory, and running Windows-98, the same problem takes 90 seconds. On the HP machine, which had 512 Mbytes of memory, a 4096x4096 image takes 3 minutes. The command `UV_STAT` which allows to compute beam sizes as function of taper and/or robust weighting parameter, has also been improved.

Several new tasks have been added to allow array simulation. Use the command

```
GRAPHIC> @ simulate
```

to access the simulation package in Graphic.

S. GUILLOTEAU and the GILDAS Working Group

IRAM Summer Schools

PROCEEDINGS OF THE FIRST SUMMER SCHOOL

The proceedings of the first IRAM summer school are now available and complete. You can download them at http://iram.fr under "Interferometry School". If your printer has trouble handling large PS files, try the alternative version which has been split into separate chapters.

SECOND SUMMER SCHOOL: FIRST ANNOUNCEMENT

IRAM plans to organize its second "mm Interferometry Summer School" in June 2000. The school will take place at the IRAM headquarters, in Grenoble, from June 12th to June 16th. The school is intended for PhD students, post-docs and scientists with or without a priori knowledge of radio interferometry techniques. In the same spirit as the first school, it will be focused on the specifics and applications of the millimeter domain, with examples from the Plateau de Bure Interferometer.

For this second school, we would like to encourage participants to present posters related to their own experience in interferometry (VLBI, cm, mm, optical...). In their posters, they should emphasize 1) the choice of the observing strategy with respect to the scientific goals, 2) the possible problems encountered during observations, data reduction or image analysis with their possible impact on data quality and science, 3) the scientific results.

IRAM lecturers will also provide posters. These posters will complement the lectures by presenting observational techniques used at the Plateau de Bure Interferometer, their limitations and possible instrumental biases.

Finally, a special session will be dedicated to a qualitative comparison between mm and optical interferometry techniques.

The number of participants will be limited to a maximum of 50 persons. Participation to the school will be free of charges, but participants are expected to pay their own travel and lodging expenses. Relatively cheap hotel accommodation ($\sim$ 150 – 300 FF/night with breakfast) is available in Grenoble. Transport time is about 15–20 min by public transportation. IRAM will provide information and assistance for hotel reservations, please contact C.Berjaud (berjaud@iram.fr).

A preliminary program and the pre-registration forms can be found in Appendix I+II of this newsletter.

More details and updates will be posted under the "Interferometry School" link on the IRAM Grenoble home page (http://iram.fr).

Anne DUTREY

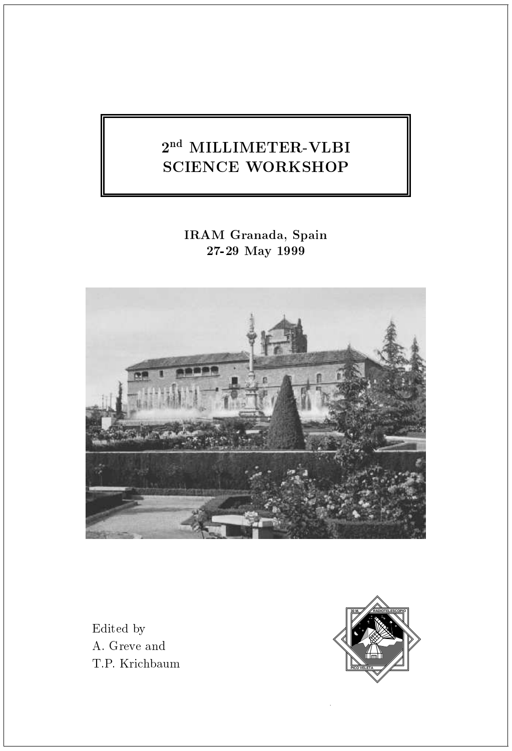
2nd Millimeter-VLBI Workshop Proceedings

Two years after the 1st Millimeter–VLBI Science Workshop held at Boston (1996), it was timely to again bring together the scientists, the users, and the engineers of the Coordinated Millimeter VLBI Array (CMVA).
The **2nd Millimeter–VLBI Science Workshop** was held on 27 – 29 May 1999 at IRAM, Granada, Spain. We hope that this second meeting initiates a series of similar future Millimeter VLBI workshops.

For this meeting approximately 50 participants convened from all over the world. The group of astronomers and engineers working in millimeter VLBI is still relatively small, and many of the participants know each other well, although they usually cannot communicate face to face. The workshop gave the opportunity to meet and discuss the progress made during the last years, but also to express wishes and suggestions for further improvements. The contributions presented here illustrate the results of the common effort in mm–VLBI, the scientific progress, and the future possibilities as seen today.

Since 1996, new VLBI experiments were performed at 3 mm, 2 mm and 1 mm. At 3 mm, to date up to 12 stations participate in global VLBI sessions, which are organized through the CMVA, and which are performed twice a year. Although sometimes affected by unfavourable weather conditions and technical problems at some sites, these VLBI campaigns are usually successfull and provide good data of compact galactic and extragalactic radio sources. In the continuum, compact active galactic nuclei (AGN) and their jets can be imaged with a dynamic range of up to a few hundred and with resolutions of up to 50 micro–arseconds. This allows detailed studies of the structure and kinematics in the inner–most regions of these radio sources. The reliable mapping of SiO masers and the combination of 3 mm data with data obtained at longer wavelengths (7 mm) opens promising possibilities for further studies and a comprehensive interpretation of the underlying astrophysical processes.

At the wavelengths of 2 mm and 1 mm, the number of telescopes is much smaller than at 3 mm; the new Heinrich-Hertz telescope on Mount Graham participated in a VLBI experiment at 1 mm for the first time. At these wavelengths, small antenna diameters and the presently limited bandwidth allow us to observe only the brightest sources. Therefore, VLBI observations at 2 mm and 1 mm wavelength are still in an experimental state, and questions of local oscillator, frequency, and clock stability governed the discussions. At 1.3 mm, fringes have been obtained already, however only on short continental baselines, and efforts are undertaken to overcome the remaining technical problems of global 1 mm VLBI. Here the development of atmospheric phase correction will play an important role. With the addition in the near future of more collecting area (eg. adding Plateau de Bure as



phased interferometer in 2001), high angular resolution imaging of continuum sources and spectral line VLBI should become possible soon.

A. GREVE and T.P. KRICHBAUM, November 1999

Copies are available at:
Library IRAM
300 rue de la Piscine
38406 St. Martin d'Hères
FRANCE

Scientific Results in Press

Molecular outflows in intermediate-mass star forming regions: the case of CB3

C. Codella([1,2]) and R. Bachiller([1])
([1]) Observatorio Astronomico Nacional (IGN), Apartado 1143, E-28800 Alcalá de Henares (Madrid), Spain, ([2]) Istituto di Fisica dello Spazio Interplanetario, CNR, Area di Ricerca Tor Vergata, Via Fosso del Cavaliere, 00133 Roma, Italy

Abstract:

The intermediate-mass star forming region in the Bok globule CB3 has been investigated through a multiline survey at mm-wavelengths. We have detected a chemically rich bipolar outflow, driven by a probably Class 0 submillimetre source, which reveals different clumps along the main axis, indicating episodic increases of the mass loss process. The outflow is quite massive (4 $M_\odot$) and very powerful, since the kinetic energy is 5.5 10^{45} ergs and the mechanical luminosity is 5.6 $L_\odot$. The outflow motion is able to affect the structure of the globule and to clear a significant amount of the high-density gas hosting the star forming process. The dynamical flow parameters, as well as the analysis of the CO velocity profiles, place the CB3 outflow close to the HH7-11 and NGC2071 ones.

The CS maps reveal the molecular clump around the driving source, while the CS line profiles show a self-absorption feature consistent with the presence of infall motions. The CH_3OH and SiO molecules are present only along the main outflow axis, confirming their close association with outflows, and their emission allows to detect the jet-like outflow structure and to point out four clumps with size less than 0.1 pc. We have detected two episodic mass losses, with ages of about 10^4 and 10^5 yr, indicating that the CB3 outflow is in a quite evolved evolutionary stage. Moreover, also the emission of S-bearing molecules such as SO, SO_2, H_2S and OCS is definitely enhanced towards the outflow. We have derived quite high densities, close to 10^5-10^6 cm^{-3}, and the indication that SiO is tracing gas at higher density with respect to SO and CH_3OH. The SiO molecule traces the highest velocity jet-like structure, while SO and CH_3OH play an intermediate role between SiO and CO, being associated with more extended regions produced by interaction of the mass loss with the surrounding gas. We have found $SO/H_2S \sim SO_2/H_2S \geq 1$, $SO/SO_2 \simeq 1$, $OCS/H_2S \geq 1$ and $SO/SiO \gg 1$. These column density ratios, used as crude chemical clocks, indicate that the CB3 outflow in a relatively evolved evolutionary stage, in agreement with the age estimations based on its dynamics.

Accepted for publication in A&A
Preprints available at http://www.ifsi.rm.cnr.it or http://www.oan.es/preprints/lista.html
E-mail contact: codella@ifsi.rm.cnr.it

Interferometric mapping of a ∼ 600 pc SiO/$H^{13}CO^+$ circumnuclear disk in the starburst galaxy NGC253

S.García-Burillo([1]), J.Martín-Pintado([1]), A.Fuente([1]), R.Neri([2])
([1]) OAN (IGN), Apartado 1143, E-28800 Alcalá de Henares, Madrid, Spain, ([2]) IRAM, 300 rue de la Piscine, F-38406 St. Martin d'Hères, France

Abstract:

This paper presents the first high-resolution SiO map made in an external galaxy (Fig. 2). The nucleus of the nearby barred spiral NGC 253 has been observed simultaneously in the v=0, J=2–1 line of SiO and in the J=1–0 line of $H^{13}CO^+$ with the IRAM interferometer, with a resolution of 7.5″×2.6″. Emission from SiO and $H^{13}CO^+$ is extended in the nucleus of NGC 253. The bulk of the SiO/ $H^{13}CO^+$ emission arises from a 600 pc×250 pc circumnuclear disk (CND) with a double ringed structure. The inner ring (**I**), of radius r=60 pc, viewed edge-on along PA=51°, hosts the nuclear starburst; the outer pseudo-ring (**II**) opens out as a spiral-like arc up to r=300 pc. The kinematics of the gaseous disk, characterized by strong non-circular motions, is interpreted in terms of the resonant response of the gas to the barred potential. The inner ring would correspond to the inner Inner Lindblad Resonance(iILR), whereas the outer region is linked to the onset of a trailing spiral wave across the outer ILR (oILR). Most notably, we report the detection of a molecular gas counterpart of the giant outflow of hot gas, previously seen in X-ray and optical lines, and tentatively identified as a dust chimney in the the 450 μ continuum band.

The SiO shows a high average fractional abundance in the CND of X(SiO)=1.5×10^{-10}. This is more than an order of magnitude above the predicted value of a PDR. Moreover, X(SiO) varies at least by an order of magnitude between the inner starburst region, which dominates the global emission, where we derive X(SiO)= 1–2×10^{-10}, and the outer region, where X(SiO) reaches a few 10^{-9}. SiO abundance is also significantly enhanced in the outflow (X(SiO)=3–5×10^{-10}). Different mechanisms are explored to explain the unlike chemical processing of molecular gas within the nucleus.

To appear in A&A
Preprints can be obtained from
http://iram.fr/papers/papers.html

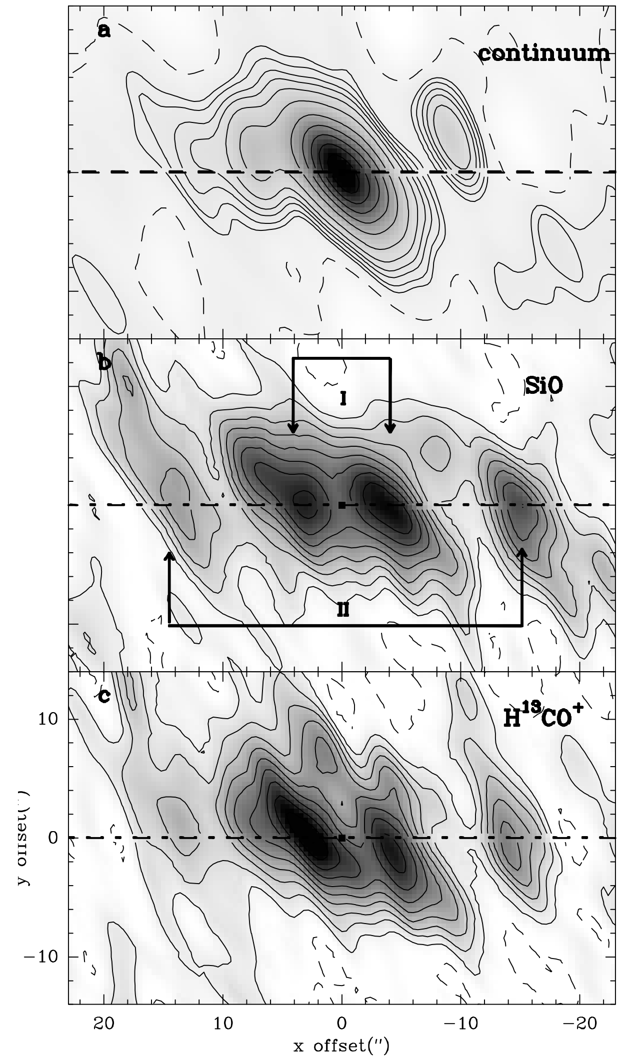


Figure 2: **(a,top)**: Emission contours of the 3mm (86.7GHz) continuum source at the center of NGC 253. x and y are offsets (in arcsec) with respect to the dynamical center derived in this work, at α_{J2000}=00^{h}47^{m}33.18^s, δ_{J2000}=-25°17′17.2″; x and y axes are parallel to the major and minor axes of the stellar bar, respectively (x runs parallel to PA$_{bar}$=68°). Contours are -1.5, 1.5, 2.5, 4, 5.5, 8 and 13 to 64 mJybeam^{-1} by steps of 9 mJybeam^{-1}. 1σ-noise level is 0.44 mJybeam^{-1}. **(b,middle)**: SiO(v=0,J=2–1) integrated intensity contours towards the center of NGC 253. Contours are -0.2, 0.2 to 2.2 Jy.kms^{-1}beam^{-1} by steps of 0.25 Jy.kms^{-1}beam^{-1}. 1σ-noise level in the integrated intensity is 0.07 Jy.km s^{-1}beam^{-1}. Orientation as in Figure 1a. Rings **I** and **II** are highlighted (see text). **(c,bottom)**: same as (b) but for the J=1–0 line of $H^{13}CO^+$, with same contours, noise level and orientation.

Gas-rich galaxy pair unveiled in the lensed quasar 0957+561

P.Planesas([1]), J.Martín-Pintado([1]), R.Neri([2]), L.Colina([3])
([1]) OAN (IGN), Apartado 1143, E-28800 Alcalá de Henares, Madrid, Spain, ([2]) IRAM, 300 rue de la Piscine, F-38406 St. Martin d'Hères, France, ([3]) CSIC-UC, Facultad de Ciencias, E-39005 Santander, Spain

Abstract:

Molecular gas in the host galaxy of the lensed quasar 0957+561 at the redshift of 1.41 has been detected in the carbon monoxide line. This detection shows the extended nature of the molecular gas distribution in the host galaxy and the pronounced lensing effects due to the differentially magnified CO luminosity at different velocities. The estimated mass of molecular gas is about $4\,10^9\,M_\odot$, a molecular gas mass typical of a spiral galaxy like the Milky Way. A second, weaker component of CO is interpreted as arising from a close companion galaxy that is rich in molecular gas and has remained undetected so far. Its estimated molecular gas mass is $1.4\,10^9$ solar masses, and its velocity relative to the main galaxy is $660\,km.s^{-1}$. The ability to probe the molecular gas distribution and kinematics of galaxies associated with high-redshift lensed quasars can be used to improve the determination of the Hubble constant H_0.

Appeared in Science, 1999, **286**, *2493*

Gas-rich galaxy pair unveiled in the lensed quasar 0957+561

A.Natta([1]), T.Prusti([2]), R.Neri([3]), W.F.Thi([4]), V.P.Grinin([5]), V.Mannings([6])
([1])OA-Arcetri, Largo E.Fermi 5, I-50125 Firenze, Italy, ([2])SSD-ESA, Villafranca del Castillo, E-28020 Madrid, Spain, ([3])IRAM, 300 rue de la Piscine, F-38406 St. Martin d'Hères, France, ([4])Leiden Observatory, P.O. Box 9513, 2300 RA Leiden, The Netherlands, ([5])Crimean Astrophysical Observatory, 334413 Nauchny, Ukraine, ([6])CalTec, MS 169-327, 4800 Oak Grove Drive, Pasadena, CA 91109, USA

Abstract:

This paper presents new observations of UX Ori obtained with the millimeter interferometer of Plateau de Bure and with ISO. UX Ori is the prototype of a group of pre-main-sequence, intermediate-mass stars, often indicated as precursors of beta Pic. The interferometry observations at 1.2 and 2.6 mm show that UX Ori has a circumstellar disk, with outer radius ≤ 100 AU. We determine the spectral index between these two wavelengths to be 2.1±0.2, consistent with the disk being optically thick at mm wavelengths. Alternatively, the disk solid matter can be in the form of "pebbles" (radius ~ 10 cm). In both cases most of the disk mass must be in gas form, and small grains must be present, at least in the disk atmosphere. In both cases also, the disk must be rather massive ($\geq 0.1\,M_\odot$). The existence of a circumstellar disk supports the model of the UXOR phenomenon in terms of a star+disk system. Self-consistent models of almost edge-on disks account well for the observed emission at all wavelengths longer than about $8\,\mu$m, if we include the emission of the optically thin, superheated layers that enshroud the disk. These rather simple disk models fail to account for the strong emission observed in the near-IR (i.e., between ~ 2 and $7\,\mu$m), and we suggest a number of possible explanations.

Appeared in A&A, 1999, **350**, *541*

Carbon dioxide-methanol intermolecular complexes in interstellar grain mantles

E. Dartois([1,2]), K. Demyk ([2]), L. d'Hendecourt([2]), P. Ehrenfreund,([3])
([1])Institut de Radioastronomie Millimétrique, 300 rue de la Piscine, 38406 Saint Martin d'Hères,France, ([2]) Institut d'Astrophysique Spatiale, Bât. 121, Université Paris XI, 91405 Orsay Cedex, France, ([3]) Leiden Observatory, P.O. Box 9513, 2300 RA Leiden, The Netherlands

Abstract:

We present new laboratory data to interpret the Infrared Space Observatory (ISO) spectra of protostellar objects, and particularly RAFGL7009S. Our experimental results show that solid methanol and carbon dioxide exhibit specific intermolecular interactions. We propose the

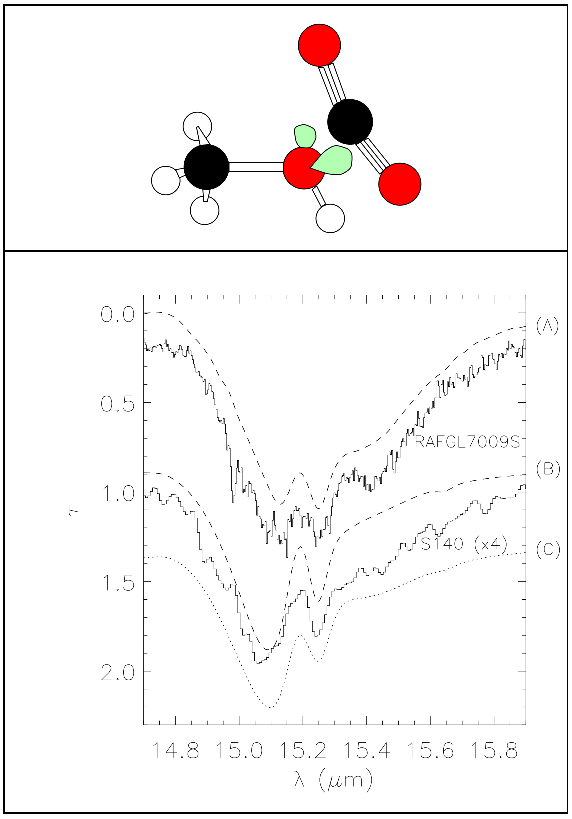


Figure 3: Upper panel: schematic representation of the possible complex geometry between the CO_2 and CH_3OH interstellar ices. Lower panel: CO_2 bending mode band shape following the complex formation as measured in the laboratory in different mixtures (dashed and dotted line) as compared to ISO Short Wavelength Spectrometer data for RAFGL7009S and S140 protostellar objects.

formation of a Lewis acid-base complex between carbon dioxide and methanol molecules to explain specific substructure of the 15.2 μm CO_2 bending mode observed in different objects. The various CO_2 bending mode patterns (Fig. 3) observed in many lines of sight can be interpreted as a combination of both this complex formation and the temperature evolution of the ices. The temperature induced segregation of ice mantles containing CO_2 can be monitored by the $^{13}CO_2$ stretching mode shift toward the pure CO_2 ice position. The large width observed for this mode towards interstellar sources partly results from the different temperatures sampled along the line of sight.

Given the amount of methanol involved in RAFGL7009S, on the basis of ground based observations, we derive that about half of the so called "6.85 μm" band and a quarter of the 4.9 μm bands can be accounted for by the deformation modes and $2\nu_8$ transitions of CH_3OH.

Based on observations with ISO, an ESA project with instruments funded by ESA Member States (especially the PI countries: France, Germany, the Netherlands and the United Kingdom) and with the participation of ISAS and NASA.

Appeared in A&A 1999, **351**, *1066*

CO detection of the extremely red galaxy HR10

Paola Andreani[1],Andrea Cimatti[2],Laurent Loinard[3], Huub Röttgering[4]
[1]Osservatorio Astronomico di Padova vicolo dell'Osservatorio 5, I-35122 Padova, Italy, Present-address: Max-Planck I. f. extraterrestrische Physik, Postfach 1603, D-85740 Garching, Germany, [2]Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, I-50125 Firenze, Italy, [3]Institut de Radioastronomie Millimétrique, 300, rue de la Piscine, St. Martin d'Hères, France, [4]Sterrewacht Leiden, Sterrewacht, Postbus 9513, Leiden 2300 RA the Netherlands

Abstract:

CO $J = 5-4$ and $J = 2-1$ emission lines were detected towards the extremely red galaxy (ERG) HR10 (J164502+4626.4) at $z = 1.44$. The CO intensities imply a molecular gas mass $M(H_2)$ of 1.6×10^{11} h_{50}^{-2} $M_\odot$, and, combined with the intensity of the dust continuum, a gas-to-dust mass ratio around 200-400 (assuming galactic values for the conversion factors). The peak of the CO lines are at the same redshift as the [OII]3727 line, but blue-shifted by 430 km s^{-1} from the Hα line. These CO detections confirm the previous results that HR10 is a highly obscured object with a large thermal far–infrared luminosity and a high star–formation rate. The overall properties of HR10 (CO detection, L_{FIR} to L'_{CO} ratio, and FIR to radio flux ratio) clearly favour the hypothesis that its extreme characteristics are related to star–formation processes rather than to a hidden AGN.

Accepted for publiction in A&A Letters

The Structure and Stability of Interstellar Molecular Absorption Line Profiles at Radio Frequencies

H. Liszt[1] and R. Lucas[2]
[1]NRAO, 520 Edgemont Road, Charlottesville, VA, USA 22903-2475, [2]IRAM, 300 Rue de la Piscine, F-38406 Saint Martin d'Hères, France

Abstract:

We have taken new, broader-band and higher-resolution profiles of Galactic 1667 MHz OH and 89.2 GHz HCO^+ absorption toward several compact, extragalactic mm-wave continuum sources. The profiles are generally stable – quite similar between epochs and between the two species – but with occasional time-variations and differences. Typical linewidths are 1.0 km s^{-1} (FWHM) in either OH or HCO^+ and there are no differences in mean velocity. Profiles are compound but do not show broad wings, multiplicity, assymmetry, or other phenomena strikingly indicative of formation under extraordinary circumstances, consistent with the low ambient thermal pressures reflected in the weak rotational excitation of CO and HCO^+.

However, we have also discovered the existence of a low-lying, broad component of HCO^+ absorption covering just those portions of the spectrum where $\tau_{HI} \geq 0.1 - 0.2$ at λ21 cm. Toward B0355+508 at $b = -1.6$ °, HCO^+ absorption extends continuously over more than 40 km s^{-1}. The broadly-distributed HCO^+ absorption can be understood in terms of the known molecular fraction of local gas, as long as HCO^+ is generally present at about its typical abundance $n(HCO^+)/n(H_2) = 2 \times 10^{-9}$. The fact that CO forms rapidly from HCO^+ in diffuse gas then suffices to account for the abundance of CO in diffuse/translucent material over the entire range $10^{12} \leq N(CO) \leq 10^{16}$ cm^{-2}, $10^{19} \leq H_2 \leq 10^{21}$ cm^{-2}, using otherwise standard cloud models.

Using models of molecular formation and excitation and the H-H_2, C^+-CO transition in diffuse gas, and noting the absence of HCO^+ emission at levels of 0.02-0.05 K, we show very directly that the line profile variations are not the result of AU-sized inclusions of high hydrogen volume density, in the manner usually inferred. Instead, it is necessary to account for small-scale chemical and other inhomogeneities.

Accepted for publiction in A&A

SiO in Diffuse, Translucent And 'Spiral-Arm' Clouds

R. Lucas[1] and H. S. Liszt[2]
[1]IRAM, 300 Rue de la Piscine, F-38406 Saint Martin d'Hères, France, [2]NRAO, 520 Edgemont Road, Charlottesville, VA, USA 22903-2475

Abstract:

Using the Plateau de Bure interferometer, we searched for thermal SiO J=1-2 absorption at 86 GHz from the diffuse and translucent clouds which lie toward our sample of extragalactic continuum sources. SiO is present at a level N(SiO)/N(HCO^+) $\approx 0.01 - 0.1$, or N(SiO)/N(H_2) $\approx 2 \times 10^{-11} - 2 \times 10^{-10}$. N(SiO) declines with increasing N(HCO^+) and with increasing thermal pressure measured in the J=1-0 lines of CO. SiO is grossly underabundant, even compared to the known gas-phase depletion of Si in diffuse clouds.

To pursue the subject further, we mapped the $H^{13}CO^+$ J=1-0 and SiO J=2-1 lines toward the core of W49A: SiO and many other molecular absorption lines have been studied in spiral-arm' clouds seen along the galactic plane at v = 40 and 60 km s^{-1} using single dishes. $H^{13}CO^+$ absorbs quite strongly at these velocities, with column densities at least 3-4 times larger than in any of the clouds we have studied toward extragalactic sources. But SiO absorption is absent at 40 km s^{-1} and perhaps at 60 km s^{-1} as well since the latter is overlaid by a series of dimethyl ether lines originating in the dense core of the W49A molecular gas: the dimethyl ether was not recognized as such in singledish absorption profiles. Our upper limit for SiO in the 'spiral-arm' cloud at 40 km s^{-1} is consistent with the trends seen in the more diffuse gas at higher galactic latitudes toward the extragalactic sources.

Accepted for publiction in A&A

Detection of CO in the inner part of M 31's bulge

A.-L. Melchior(1), F. Viallefond(2), M. Guélin(3), N. Neininger(4)
(1)Astronomy Unit, Queen Mary and Westfield College, Mile End Road, London E1 4NS, UK, (2)DEMIRM, Observatoire de Paris, UMR8540, 61 Avenue de l'Observatoire, 75014 Paris Cédex, France, (3)IRAM, 300 rue de la Piscine, F-38406 St.Martin d'Hères, France, (4)Radioastronomisches Institut der Universität Bonn, Auf dem Hügel 71, D-53121 Bonn, Germany

Abstract:

We report the first detection of CO in M 31's bulge. The ^{12}CO (1–0) and (2–1) lines are both detected in the dust complex D395A/393/384, at 1$'$.3 ($\sim$ 0.35 kpc) from the centre (Fig. 4). From these data and from visual extinction data we derive a CO-luminosity to reddening ratio (and a CO-luminosity to H_2 column density ratio) quite similar to that observed in the local Galactic clouds. The (2–1) to (1–0) line intensity ratio points to a CO rotational temperature and a gas kinetic temperature > 10 K. The molecular mass of the complex, inside a diameter of 25" (100 pc), is 1.5 10^4 $M_\odot$.

MNRAS, in press

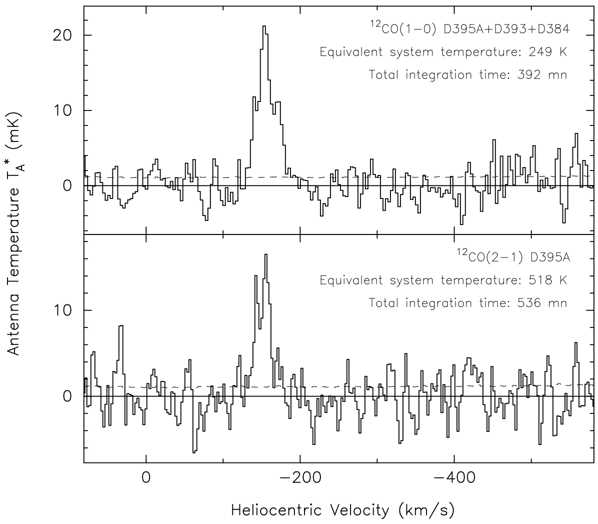


Figure 4: ^{12}CO(1–0) and ^{12}CO(2–1) spectra obtained for the complex D395A/393/384 in the bulge of M31.

Formation of molecular gas in the debris of violent galaxy interaction

J. Braine(1), U. Lisenfeld(2), P.-A. Duc(3), S. Léon(4)
(1)Observatoire de Bordeaux, UMR 5804, CNRS/INSU, B.P. 89, F-33270 Floirac, France, (2)IRAM, Avenida Divina Pastora 7 NC, 18012 Granada, Spain, (3)Institute of Astronomy, Madingley Rd. Cambridge, CB3OHA, UK, and CNRS and CEA/DSM/DAPNIA Service d'Astrophysique, Saclay, 91191 Gif sur Yvette Cedex, France, (4)ASIAA, Academica Sinica, P.O. Box 1-87, Nanking, Taipei 115, Taiwan

Abstract:

In many gravitational interactions between galaxies, gas and stars that have been torn from either or both of the precursor galaxies can collect in 'tidal tails'. Star formation begins anew in these regions to produce 'tidal dwarf galaxies' (TDGs), giving insight into the process of galaxy formation through the well-defined timescale of the interaction. But tracking the star formation process has proved to be difficult: the TDGs with stars showed no evidence of molecular gas out of which new stars form. Here we report the first discovery of molecular gas (CO emission) in two TDGs (Arp 105 and Arp 245) with the IRAM 30m telescope. In both cases, the molecular gas peaks at the same location as the maximum in H I density, unlike most gas-rich galaxies. We infer from this that the molecular gas formed from the H I, rather than being torn in molecular form from the interacting galaxies. Star formation in the tidal dwarfs therefore appears to mimic that process in normal spiral galaxies like our own.

Nature, in press

New Preprints

522. CO DEPLETION IN THE STARLESS CLOUD CORE L1544
P. Caselli, C.M. Walmsley, M. Tafalla, L. Dore, P.C. Meyers
1999, *ApJ Letters*

523. THE MOLECULAR GAS IN THE CIRCUM-NUCLEAR REGION OF SEYFERT GALAXIES
E. Schinnerer, A. Eckart, L.J. Tacconi
1999, *Astrophys. Journal*

524. MOLECULAR OUTFLOWS IN INTER-MEDIATE MASS STAR FORMING REGIONS: THE CASE OF CB3
C. Codella, R. Bachiller
1999, *Astronomy and Astrophysics*

525. A CO SURVEY OF THE SOUTHWEST HALF OF M 31
L. Loinard, T.M. Dame, M.H. Heyer, J. Lequeux, P. Thaddeus
1999, *Astronomy and Astrophysics*

526. JET DRIVEN MOLECULAR OUTFLOWS IN ORION
A. Rodríguez-Franco, J. Martín-Pintado, T.L. Wilson
1999, *Astronomy and Astrophysics*

527. MID-INFRARED AND FAR-ULTRAVIOLET OBSERVATIONS OF THE STAR-FORMING RING OF M31
L. Pagani, J. Lequeux, D. Cesarsky, J. Donas, B. Milliard, L. Loinard, M. Sauvage
1999, *Astronomy and Astrophysics*

528. BARS AND WARPS BY THE MOLECULAR GAS IN THE SEYFERT 2 GALAXY NGC 1068
E. Schinnerer, A. Eckart, L.J. Tacconi, R. Genzel, D. Downes
1999, *Astrophys. Journal*

529. DISTRIBUTION AND KINEMATICS OF THE CIRCUM-NUCLEAR MOLECULAR GAS IN THE SEYFERT GALAXY NGC 3227
E. Schinnerer, A. Eckart, L.J. Tacconi
1999, *Astrophys. Journal*

530. CO CONTENT OF BIPOLAR PLANETARY NEBULAE
E. Josselin, R. Bachiller, A. Manchado, M.A. Guerrero
1999, *Astronomy and Astrophysics*

531. A HIGH-RESOLUTION STUDY OF EPISODIC MASS LOSS FROM THE CARBON STAR TT CYGNI
H. Olofsson, P. Bergman, R. Lucas, K. Eriksson, B. Gustafsson, J.H. Bieging
1999, *Astronomy and Astrophysics*

532. MULTIPLE MOLECULAR OUTFLOWS IN AFGL 2688
P. Cox, R. Lucas, P.J. Huggins, T. Forveille, R. Bachiller, S. Guilloteau, J.P. Maillard, A. Omont
1999, *Astronomy and Astrophysics*

533. THE YOUNG DETACHED CO SHELL AROUND U CAMELOPARDALIS
M. Lindqvist, H. Olofsson, R. Lucas, F.L. Schöier, R. Neri, V. Bujarrabal, C. Kahane
1999, *Astronomy and Astrophysics*

534. THE CIRCUMSTELLAR ENVIRONMENT OF UX ORI
A. Natta, T. Prusti, R. Neri, W.F. Thi, V.P. Grinin, V. Mannings
1999, *Astronomy and Astrophysics*

535. UNVEILING THE DISK-JET SYSTEM IN THE MASSIVE (PROTO) STAR IRAS 20126+4104
R. Cesaroni, M. Felli, T. Jenness, R. Neri, L. Olmi, M. Robberto, L. Testi, C.M. Walmsley
1999, *Astronomy and Astrophysics*

536. IRAM 30-m CONTINUUM SURVEYS OF STAR-FORMING REGIONS
P. André, F. Motte, R. Neri
1999, *Imaging at Radio through Sub-mm Wavelengths*
Proc. of NRAO Symp. 6–9 June, 1999
Tucson, Arizona

537. GAS-RICH GALAXY PAIR UNVEILED IN THE LENSED QUASAR 0957+561
P. Planesas, J. Martin-Pintado, R. Neri, L. Colina
1999, *Science*

Appendix I : Preliminary Summer School Program

• Basic Principles	
— Radio Astronomy Fundamentals	*C.Thum*
— Interferometry and aperture synthesis	*D.Downes*
— mm VLBI	*A.Greve*
— Antennas	*A.Greve*
— Receivers	*B.Lazareff*
— Correlators	*H.Wiesemeyer*
— LO system and signal transport	*R.Lucas*
• The Plateau de Bure Interferometer	
— Operation of the interferometer I	*R.Neri*
— Operation of the interferometer II	*R.Lucas*
• Calibration	
— Atmospheric transmission	*J.Pardo*
— Atmospheric phase fluctuations	*M.Bremer*
— Bandpass Calibration	*R.Lucas*
— Phase calibration	*R.Lucas*
— Amplitude & Flux Calibration	*A.Dutrey*
— A standard Calibration procedure	*R.Neri & A.Dutrey*
• Image Processing & Data Analysis	
— UV Plane analysis	*R.Lucas*
— Imaging & Deconvolution: standard methods	*S.Guilloteau*
— Mosaicing	*F.Gueth*
— The short spacing problem	*S.Guilloteau*
— Astrometry	*R.Neri*
• Application of mm interferometry	
— Using the Plateau de Bure: How and Why ?	*R.Lucas*
— Several posters by lecturers:	
∗ mm VLBI	*A.Greve*
∗ Detection of weak sources	*D.Downes, L.Loinard*
∗ Mapping CO on Mars	*R.Moreno, S.Guilloteau*
∗ Mosaicing & short spacing	*F.Gueth*
∗ Surveys & snapshots	*A.Dutrey, E.Dartois*
∗ Atmospheric phase correction	*M.Bremer, R.Lucas, R.Neri*
∗ Absorption in front of quasars	*R.Lucas*
∗ Holography	*R.Lucas, D.Morris, B.Lazareff*
∗ Deconvolution techniques	*F.Boone, F.Viallefond, S.Guilloteau*
• Optical interferometry	
— Introduction to optical interferometry	*F.Malbet*
— Data reduction, examples...	*F.Malbet*
— Panel Discussion: mm versus optical	*All*
• The future of mm/submm interferometry: ALMA	*S.Guilloteau*

Appendix II: Summer School Pre-Registration

Further information will be placed on IRAM Web page (http://iram.fr/). Interested scientists should complete the pre-registration form below and send it to

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(please specify "Summer School" in the topic field).

IRAM Interferometry Summer School
12-16 June 2000, IRAM, Grenoble
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Institute:
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+ is interested by the "IRAM Interferometry Summer School" and wishes to receive further information. yes no
+ would like to present a poster yes no

(posters not directly linked to interferometric observations will be rejected)

Title:
Author(s):
Abstract: (10 lines at most)

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Dowtown Grenoble	(250 – 300 FF/night, breakfast included)	☐

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	from abroad:	33 476 82 49 00	33 476 51 59 38
	from France:	0 476 82 49 00	0 476 51 59 38
Plateau de Bure	Institut de Radioastronomie Millimétrique, Observatoire du Plateau de Bure, 05250 St Etienne en Dévoluy, France		
	from abroad:	33 492 52 53 60	33 492 52 53 61
	from France:	0 492 52 53 60	0 492 52 53 61
Granada	Instituto de Radioastronomía Milimétrica, Avenida Divina Pastora 7, Núcleo Central, 18012 Granada, España	(34) 958 22 88 99	(34) 958 22 23 63
Pico Veleta	Instituto de Radioastronomía Milimétrica, Estación Radioastronómica IRAM-IGN del Pico Veleta, Sierra Nevada, 18012 Granada, España	(34) 958 48 20 02	(34) 958 48 11 48

E-Mail Addresses:

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