IRAM

Institut de Radioastronomie Millimétrique
Institut für Radioastronomie im Millimeterbereich
Instituto de Radioastronomía Milimétrica

Newsletter

Number 63 August 4th, 2005

Contents

Calendar

31. August 2005
Extended Pradollano Summerschool inscription: some places are still available!

September 8th, 2005:
Deadline for the submission of IRAM observing proposals for the period from November 15, 2005 to May 15, 2006.

30. September- 7. October 2005:
IRAM Summerschool on mm observing techniques and applications in Pradollano, Spain.

3. October 2005, 21:00 UT:
Deadline for the submission of Global mm VLBI proposals for the April 2006 session.

IRAM SUMMER SCHOOL 2005 - mm Observing Techniques and Applications

September 30 - October 7, 2005
Pradollano (Sierra Nevada, Spain)

The purpose of the school is to attract new users to current and future mm-telescopes. This third school in IRAM Spain will concentrate on single dish mm-astronomy. There will be lectures on mm-techniques and applications to different areas of research, scientific highlight talks, observations with the IRAM 30-m telescope and a lab course on “Data analysis and interpretation”.

The 2001 Summerschool has received good marks by the European Commission (European Commission: "Training Researcher: High-level scientific conferences" EUR20724, 2004, page 16/17).

Topics in the forthcoming school will be:
- mm-astronomical observing techniques
- Inter- and circumstellar chemistry
- Physical conditions of the interstellar medium
- dust continuum observations
- The early universe

Lecturers: M. Guélin (IRAM), P. Cox (IRAM), M. Hogerheijde (Leiden Observatory), A. Weiss (IRAM, MPIfR Bonn), T.L. Wilson (ESO, Garching).

LOC: J. Lobato (), R. Mauersberger () ...

SOC: F. Combes (Obs. de Paris), A. Eckart (Cologne), M. Grewing (Grenoble), R. Mauersberger (Granada), M. Moles (IAA, Granada), T.L. Wilson (ESO, Munich)

Applications will be accepted from young scientists with little previous experience in mm-astronomy. The course is limited to 40 students, who will be selected on the basis of their CV and references.

Dr. Rainer Mauersberger
IRAM
Avda. Divina Pastora 7, Local 20
18012 - Granada, Spain
Phone: +34 958 80546
Fax: +34 958 222363

More information and inscritions can be found under http://www.iram.es/IRAMES/.

Rainer MAUERSBERGER

IRAM Executive Council Meeting 2005

The annual meeting of the Executive Council took place on June 27 and 28th, 2005 in Alcala de Henares in Spain. It was hosted by the IGN, and the first meeting chaired by the new President of the Council, Prof. Reinhard GENZEL, who succeeded Dr. Genevieve DEBOUZY in this position. Like in 2004, much of discussion was focussed on IRAM's longer-term future, and a number of important decisions have been taken.

The most important of these is the appointment of Dr. Karl SCHUSTER as the next IRAM Deputy Director, who will start in this new function on January 1st, 2006. Karl Schuster has been the Project Scientist for IRAM's first multibeam heterodyne receiver (HERA), and since October 1st 1997 he has been the Head of IRAM's SIS Group. He succeeds Pierre COX, who had been appointed by the Council in 2004 as the new IRAM Director as of January 1st, 2006.

Following the exchange of a Letter of Intent between the CNRS and the MPG, all three IRAM partner organisation, the CNRS, the MPG, and the IGN, decided at the Executive Council meeting to prepare an Amendment to the current IRAM contract that will move the current limit date of the inter-agency agreement from 2009 to 2014, with the possibility of a further extension to be decided in due time.

Concerning IRAM's budgets for 2005 and 2006, the Council approved the proposed budget levels, which include i.a. the money for the track extensions on the Plateau de Bure (completion of the northern track extension and doubling of the E-W baseline), and the installation of the next generation receivers, which will not only substantially improve the instrument capabilities at 3mm and 1mm w.r.t. to the current receivers, but also add the 2mm and 0.8mm bands.

IRAM's Scientific Advisory Committee (SAC) has looked not only at these shorter term improvements but also at new investment projects for the coming 5 years. As key issues, a larger format bolometer array, a decision on the next generation wideband spectroscopic (array-) receivers, the development of more powerful backends, and of new software tools have been identified. This ambitious programme will not only require substantial resources within IRAM, but also close collaboration with other institutes.

Michael GREWING

Staff Changes

IRAM GRENOBLE

An important change has taken place in the IRAM administration: Since March 14th, Christelle MESUREUR is the new Head of Administration, succeeding Gilbert KLEIN, who left IRAM.

On June 30th, 2005 Gaby MARCOUX has officially retired. She has been working as a secretary of the IRAM Direction, supporting especially the Head of Administration, for nearly 23 years. In addition, she has been responsible for organising all the travel for IRAM staff as well as for many visiting astronomers, and she has done this with great competence, patience, and efficiency. We gratefully acknowledge the enormous amount of work that Gaby Marcoux did for IRAM, and wish her all the best for her retirement.

Edel CLEMENT has officially taken over the tasks of Gaby Marcoux as of July 1st, 2005. She had actually started already on October 1st, 2004 to allow for a period of overlap during which Gaby Marcoux had already reduced her working time. Edel Clement has previously worked at the reception desk, and has been replaced in this capacity by Beatrice MAIRE.

Since March 14th, Aris KARASTERGIOU is back at IRAM Grenoble as an Astronomer/Postdoc. Elena LINDT has started her work on a diploma thesis on May 1st.

The receiver group welcomed three new technicians: Baptiste JAMMET has started work on June 13th, Yoann SALOMEZ on June 27th and Daniel GEOFFROY on July 1st

On July 18th, Claude VIANEY-LIAUD, a long-term member of the IRAM administration, started a one-year-sabbatical leave. We wish her a good time in India.

Michael Bremer

IRAM Spain

On June 30 2005, Axel WEISS left IRAM Spain. Axel had been managing the Pico Veleta Observation Pool very effectively and has made important improvements. We wish him all the best at his new job at the Max Planck Institue for Radioastronomy in Bonn. A new pool manager will be announced soon. In the meanwhile any questions regarding the summer pool can be directed to the station manager Rainer Mauersberger (mauers@iram.es) or the scheduler Clemens Thum (thum@iram.fr).

Rainer Mauersberger

IRAM Program Committee Recommendations

The IRAM program committee convened in Madrid on April 11 and 12 to discuss the proposals submitted for the summer 2005 scheduling period. The committee was chaired by Mario Tafalla (Observatorio de Madrid). The principal investigators of each proposal have been informed by letter which will include comments issued by the committee about the outcome, if there are any.

Plateau de Bure Interferometer Proposals

A total of 54 proposals were received for the interferometer. The programs were classified A (accepted), B (backup) and C (rejected), as given in Tab. 1. Programs rated A will be scheduled in priority. Further time, if it becomes available, will go to the B programs, taking into account scientific merit, crowding in certain right ascension ranges and general aspects of balance.

For projects rated A and B and without IRAM internal collaborator, please consult the list of local contacts, which will be made available shortly.

A: Accepted, B: Backup, C: Rejected

Project	Rate	Project	Rate	Project	Rate
P001	A	P002	B	P003	B
P004	B	P005	C	P006	A
P007	C	P008	B	P009	A†
P00A	B	P00B	C	P00C	-
P00D	B	P00E	B	P00F	C
P010	A	P011	A	P012	C
P013	B	P014	C	P015	C
P016	B	P017	A	P018	C
P019	C	P01A	C	P01B	B
P01C	C	P01D	C	P01E	-
P01F	C	P020	A†	P021	B
P022	C	P023	A	P024	C
P025	C	P026	B	P027	C
P028	B	P029	A	P02A	C
P02B	A	P02C	C	P02D	C
P02E	A	P02F	A	P030	C
P031	B	P032	A	P033	B
P034	C	P035	A	P036	A†

Table 1: PdBI ratings: Summer 2005. †: some parts of the program, others rated B or C

A		B		C	
001-05	002-05	004-05	005-05	007-05	012-05
003-05	006-05	008-05	010-05	016-05	027-05
009-05	013-05	011-05	015-05	029-05	030-05
014-05	022-05	017-05	018-05	035-05	036-05
024-05	025-05	019-05	020-05	042-05	043-05
028-05	031-05	021-05	023-05	046-05	048-05
037-05	041-05	026-05	032-05	050-05	051-05
044-05	045-05	033-05	034-05	052-05	056-05
055-05	071-05	038-05	039-05	061-05	063-05
073-05	074-05	040-05	047-05	067-05	069-05
079-05	080-05	049-05	053-05	077-05	088-05
081-05	085-05	054-05	057-05	097-05	100-05
090-05	091-05	058-05	059-05	104-05	
093-05	096-05	060-05	062-05		
		064-05	065-05		
		066-05	068-05		
		070-05	072-05		
		076-05	078-05		
		082-05	083-05		
		084-05	086-05		
		087-05	089-05		
		092-05	094-05		
		095-05	098-05		
		099-05	101-05		
		102-05	103-05		
		105-05			

Table 2: IRAM 30m proposal ratings: Summer 2005

30m Proposals

104 proposals were received for the 30m telescope, requesting 4491.6 hours of telescope time. The highest rating "A" was given to 28 proposals; 51 proposals were rated "B", i.e. were given backup status. The remaining proposals, although scientifically valuable in most cases, were rated "C". The individual ratings are listed in Tab. 2. All A-rated proposals will be scheduled on the telescope, although some with less time than requested. We expect that about half of the B-rated programs will actually be scheduled. The selection will take into account scientific merit, crowding in certain right ascension ranges, and general aspects of balance. Proposals rated "C" will not get telescope time.

The principal investigators of each proposal have been informed by letter which will include comments issued by the committee if there are any.

Accepted interferometer proposals which had requested time for measurement of zero spacings will also get 30m time if they get observed at Bure.

Roberto NERI and Clemens THUM

CLOUDSAT - consequences for Radio Astronomy

For a long time, mm-radio astronomy has been relatively safe from man-made interference which has been continuously worsening for cm-radio astronomy in the last decades. Due to the high demand for spectral bands for new activties, astronomers are more and more obliged to share spectrum with other users. Now, a major perturbing - and potentially destroying - emitter is about to appear on the mm-radio sky.

The Cloudsat satellite is planned to be part of a five-satellite-constellation (Aqua, Cloudsat, Calipso, Parasol, Aura) which will monitor the Earth's atmosphere to study the environment, meteorology and climate. From this constellation, only Cloudsat has a significant impact on Radio Astronomy. Its cloud profiling radar operates at 94.05 GHz and will point directly downwards to generate a central footprint of approx. 3 km diameter. The instrument will orbit at an altitude of 705 km, and the pulsed signal will be about 1.8 kilowatts at maximum (3.3 μs pulses, max. 4240 pulses per second).

This power is by a large factor sufficient to burn out the SIS junction of a radio telescope pointed at Zenith during satellite transit (no matter to which frequency the receiver is tuned), and to detect the satellite through the telescope sidelobes as soon as it clears the horizon, no matter where the telescope will be pointed. Continuum observations with large spectral bands which contain this frequency will have to be checked for parasites and may suffer from non-linear saturation effects.

Details on the efforts which were made by the radio astronomical community to prevent this threat can be found on the NRAO web pages http://www.iucaf.org/CloudSat/. Details on the technical impact, and how it threatens large instruments which are in development and what countermeasures can be envisaged, can be found in the ALMA Memo 504 (http://www.alma.nrao.edu/memos/html-memos/alma504/memo504.pdf).

As of the edition of this Newsletter, the final launch date was not yet fixed; the Cloudsat Homepage speaks of late summer or autumn 2005.

An immediate reaction to the presence of Cloudsat will be of course to avoid parking antennas in Zenith position, or when that cannot be avoided (e.g. during PdBI antenna configuration changes) to close the central hub. The nominal lifetime for the satellite is 2-3 years, and its orbit will lead to six or seven passes per day over most observatories. Typically the satellite will be above the horizon for 10-15 minutes, so that a maximum of time lost will be about 2 percent. This pattern of transits repeats every 16 days. It is difficult to predict how serious the effects will be as they depend on the telescope sidelobes far from the telescope beam, and the rejection of the filters of the receivers and their saturation properties. Observers are encouraged to report interference. With experience it may be possible to draw up observing guidelines. Considering that more satellites operating at mm wavelengths (and more powerful ones) are on the drawing boards, however, it is a precursor of a future where mm-wavelengths will be reached by a rising tide of interference.

Other than for optical astronomy, public awareness of this kind of "invisible" light pollution is low. This means that there is little public pressure to limit radio interference, and sometimes a lot of economic interest to create services which cause interference as a byproduct.

The Cloudsat project shows that even within the scientific community, it is possible to create negative - and potentially destructive - side effects for other branches of science. It also shows that sometimes assurances that satellites could be turned off during transit over known telescope sites do not make it into the final design phase. For future instruments, it would be preferable to limit the mutual negative impact of scientific projects. To this end NASA will provide prediction tools.

Michael BREMER and David MORRIS

Freq.(GHz)	F_{eff}	HPBW($''$)	η_A	B_{eff}
86	0.950 ± 0.015	28.3 ± 0.4	0.60 ± 0.02	0.76 ± 0.04
145	0.945 ± 0.021	17.0 ± 0.2	0.51 ± 0.02	0.65 ± 0.02
210	0.915 ± 0.019	11.8 ± 0.4	0.45 ± 0.06	0.57 ± 0.04
260	0.877 ± 0.020	9.5 ± 0.4	0.37 ± 0.04	0.46 ± 0.04

Table 3: Measurements of the 30-m telescope characteristics in March 2005

Date	Publisher	η_{ill}	$\sigma_s(\mu\text{m})$
up to 1992	collected by H. P. Reuter	0.59	92
August 1994	C. Kramer & W. Wild	0.63	87
July 1997	The 30m Manual, V. 2.0	0.63	80
July 1999	holography and panels adjustment		
January 2000	U. Lisenfeld & R. Mauersberger	0.66	72
September 2002	installed temperature control of the counterweights		
March 2005	actual measurements	0.63	67

Table 4: Historical review of the 30-m η_{ill} and σ_s.

30-m Antenna Efficiencies

Efficiency measurements have been carried out with the 30m antenna during two technical time sessions in March 2005. The four cryostats A, B, C and D have been used at frequencies of 86, 145, 210 and 260 GHz. At each frequency we used two different receivers with orthogonal polarization.

The astronomical sources used have been Mars (diameter 5.8$''$, Sun distance 63°) and Uranus (diameter 3.3$''$, Sun distance 32°) at elevations between 23° and 45°. The atmospheric conditions were good with a precipitable water vapour of ≈ 4.3 mm during the first session and ≈ 1.2 mm during the second session.

The antenna forward efficiency F_{eff} has been determined by means of 10 skydips spaced at different times during our test measurements and using our standard dual load calibration system. The parameters: beam width HPBW, aperture efficiency η_A and beam efficiency B_{eff} have been determined with 37 continuum cross scans of 8 subscans in beam switching mode, each subscan crosses the source with a length of 110$''$ and a duration of 30 seconds. The Gaussian fit parameters to the cross scans (i.e. maximum intensity, half width) were then used together with the physical parameters of the planets to determine the deconvolved beam size and the aperture and beam efficiencies using the methods described in Kramer, C. 1997, "Calibration of spectral line data at the IRAM 30m radio telescope", IRAM Report.

The results of the measurements are compiled in Tab. 3.

The main contribution to the errors of the previous results comes by the fact that two independent receivers have been used at each frequency and it seems that the illumination, the optic or both are slightly different.

With the η_A values at several frequencies we can apply a linear least-square fit to the "Ruze" formula $\eta_a = \eta_{ill} \times exp((4\pi\sigma_s/\lambda)^2)$ where λ is the wavelength at which the observations have been made, η_{ill} the illumination efficiency and σ_s the total r.m.s. of antenna roughness; and we find that $\eta_{ill} = 0.63 \pm 0.02$ and $\sigma_s = 67.4 \pm 7.6\mu$m.

A historical overview of the 30m η_{ill} and σ_s is given in Tab. 4.

The total r.m.s. of antenna roughness σ_s has improved in the course of the years due to several modifications of the antenna, which are resumed below.

In July 1999 the last holography measurements and panel adjustments were carried out. Results of surface inhomogeneities given by the holography were nominally slightly better than the value shown in the previous table because those results only considered the roughness due to the main reflector, while the value of σ_s given above also includes in the budget the roughness due to the subreflector, Nasmyth mirrors and receiver optics.

In September 2002 the antenna temperature control was modified to include the counterweights. Previously, only the main reflector support structure was controlled in temperature. The main goal was to remove the structural stress that produced the astigmatism, but also the antenna pointing and antenna efficiencies were improved.

The actual results show an excellent performance of the 30m surface, which is better than ever. Various improvements also lead to a much better pointing stability. While prior to 1992 η_A at 350 GHz was just 0.1, actual conditions predict an η_A of 0.23. We conclude that, technically, the 30m telescope seems now suitable for observations at frequencies above 300 GHz, which might be an option e.g. for zero spacing for the Plateau de Bure interferometer.

Juan PEÑALVER and Rainer MAUERSBERGER

Proposals for IRAM Telescopes

The next deadline for submission of observing proposals on IRAM telescopes, both the interferometer and the 30m, is

September 8th, 2005, 17:00 CEST (UT + 2 hours)

The scheduling period extends from November 15, 2005 to May 15, 2006, covering roughly the winter period at our observatories.

Proposals should be submitted through our web–based submission facility. Instructions are found on our web page at URL:

http://www.iram.fr/GENERAL/submission/submission.html

The submission facility will be opened about three weeks before the proposal deadline. Proposal form pages and the 30m time estimator are available now.

Please avoid last minute submissions when the network could temporarily be congested. As an insurance against network congestion or failure, we still accept, in well justified cases, proposals submitted by:

– fax to number: (+33) 476 42 54 69 or by
– ordinary mail addressed to:
IRAM Scientific Secretariat,
300, rue de la piscine,
F-38406 St. Martin d'Hères, France

Proposals sent by e–mail are not accepted. Color plots will be printed/copied in grey scale. If color is considered essential for the understanding of a specific figure, a respective remark should be added in the figure caption. The color version may then be consulted in the electronic proposal by the referees.

Soon after the deadline the IRAM Scientific Secretariat sends an acknowledgement of receipt to the Principal Investigator of each proposal correctly received, together with the proposal registration number. To avoid the allocation of several numbers for the same proposal, send in your proposal *only once*. Note that the web facility allows cancellation and modification of proposals before the deadline. The facility also allows to view the proposal in its final form as it appears after re–compilation at IRAM. We urge proposers to make use of this facility as we always receive a number of proposals with serious formal defects (figures missing, blank pages, etc.).

Valid proposals contain 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. Proposals should *not exceed these 5 pages* of scientific material. Except for the technical pages for the interferometer, longer proposals will be cut.

Proposals should be self-explanatory, clearly state the aims, and explain the need of the requested telescope. The amount of time requested should be carefully justified (see below).

The cover page, in postscript or in LaTeX format, and the LaTeX style file `proposal.sty` may be obtained from the IRAM web pages[1] at URL `../GENERAL/submission/proposal.html`. In case of problems, contact the secretary, Cathy Berjaud (e–mail: `berjaud@iram.fr`). Please, make sure that your proposals use the current form pages.

In all cases, indicate on the proposal cover page whether your proposal is (or is not) a *resubmission* of a previously rejected proposal or a *continuation* of a previously accepted interferometer or 30m proposal. We request that the proposers describe very briefly in the introductory paragraph (automatically generated header "Proposal history: ") why the proposal is being resubmitted (e.g. improved scientific justification) or is proposed to be continued (e.g. last observations suffered from bad weather).

Do not use characters smaller than 11pt. This could render your proposal illegible when copied or faxed. If we notice any formal problems sufficiently before the deadline, we will make an effort to contact the principal investigator and solve the problem together.

Applications for **zero spacing observations** have been simplified. If the need for complementary 30m observations is evident already at the time when the PdB interferometer proposal is prepared, just note this need on the interferometer proposal. A separate proposal for the 30m telescope is not required anymore. The blank form for Interferometer proposals now contains a new bullet, labelled "zero spacing" which should be checked if 30m observations are requested to fill in the missing zero spacings. The interferometer style file will prompt for an additional paragraph in which the scientific need for the zero spacings should be decribed. It is essential to give here all observational details, including size of map, sampling density and rms noise, spectral resolution, receiver configuration and time requested.

R. NERI & C. THUM

Travel funds for European astronomers

IRAM is one of the organizations partipating in the RadioNet project, an initiative funded by the European Commission within the FP6 Programme to improve and encourage communication among astronomers of the European Community. Transnational access (TNA) is the largest RadioNet programme and provides funding for travel expenses incurred by eligible users for carrying out

[1]from here on we give only relative URL addresses. In the absolute address the leading two dots (..) have to be replaced by the address of one of our mirror sites: http://www.iram.fr or http://www.iram.es.

their observations or reducing their data. As a partner of RadioNet, IRAM has now some limited TNA funds to pay travel expenses for European users. Detailed information about user eligibility, TNA contacts, policies and travel claims for the IRAM 30m telescope and Plateau de Bure Interferometer can be found on the RadioNet home page at `http://www.radionet-eu.org`.

Observers requesting TNA support will be asked to provide the necessary personal and professional information to IRAM. Funding through RadioNet should be acknowledged in publications resulting from TNA supported observations.

R. NERI & C. THUM

Call for Observing Proposals on the 30m Telescope

Summary

Proposals for three types of receivers will be considered for the coming winter semester:

1. the observatory's set of four dual polarization heterodyne receivers centered at wavelengths of 3, 2, 1.3, and 1.1 mm.
2. the 9 pixel dual–polarization heterodyne receiver array, HERA, operating at 1.3 mm wavelength
3. a 1.2 mm bolometer array with 37 or 117 pixels

Emphasis will be put on observations at the shorter wavelengths, but 3mm proposals are also encouraged inasmuch as they are suited for medium or low quality weather backup onservations. In total, about 2800 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 transition to the **New Control System (NCS)** of the telescope is planned to be essentially complete at the start of the winter semester. Hardware control will be through VME based systems, and all user-interface and data processing software will run on Linux. The VAX computers will finally be retired.

All familiar receivers (Tab. 5), backends (page 12), and observing modes will be available under the NCS. Some new features, mostly concerning more powerful on–the–fly observations, may also be available, and more new features will be implemented later. The coordinate system fully supported by the NCS is equatorial J2000.0, and we request observers to use this system for their source coordinates and offsets. Other coordinate systems will be available later.

Remote observing will, however, not generally be possible early in the winter semester. It is therefore necessary for observers to travel to the telescope, except for service or pool observations. IRAM staff astronomers and operators will help observers to get familiar with the NCS. Documentation on the NCS is being prepared.

The **dual polarization HERA** is operational together with its backends for high (VESPA) and low spectral resolution (WILMA). Although tuning parameters are now available for a large range of frequencies, it is still recommended to send us HERA frequencies in advance. Observers should be aware, however, that the second polarization channels tend to be somewhat noisier, and the receiver noise varies substantially across the 1 GHz bandpass in some pixels of the second polarization.

Like last semester, a **bolometer array**, most likely the 117–channel MAMBO II which should be used for observing time estimates, will be available.

Applications

On the official cover page, please fill in the line 'special requirements' if you request either polarimetric observations, service or remote observing. If the observations need or have to avoid specific dates, enter them here. If there are periods when you cannot observe for personal reasons, please specify them here.

We insist upon receiving, with proposals for heterodyne receivers, a complete list of frequencies corrected for source redshift (to 0.1 GHz) and precise positions. If in very special cases the proposers do not feel to be in a position to give this information, they should take up contact with the scheduler (thum@iram.fr). The proposers should also specify on the cover sheet which receivers they 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 the source list in equatorial J2000 coordinates. 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 adhere to the format indicated on the proposal form (no hand writing, please). If your source list is longer (e.g. more than 15 sources) than what fits onto the cover page, please use the LaTeXmacro `\extendedsourcelist`.

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.

Reminders

A handbook ("The 30m Manual") collects most of the information necessary to plan 30m telescope observations[6]. Documentation about the New Control System is in preparation and will soon be made available on the IRAM web page. 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 from the URL /IRAMES/otherDocuments/manuals/index.html. A catalog of well calibrated spectra for a range of sources and transitions (Mauersberger et al. [9]) is very useful for monitoring spectral line calibration. A copy of the 30m file with the calibrated spectra can be downloaded from the Spanish web site.

The astronomer on duty (whose schedule can be found at URL /IRAMES/groups/astronomy/aodsched.html) should be contacted well in advance of an observing run for any special questions concerning the preparation of an observing run (e.g. setup of on-the-fly maps etc).

Frequency switching is available for both HERA and the single pixel SIS receivers. This observing mode is interesting for observations of narrow lines where flat baselines are not essential, although the spectral baselines with HERA are among the best known in frequency switching. Certain limitations exist with respect to maximum frequency throw ($\leq$ 45 km/s), backends, phase times etc.; for a detailed report see [4]. This report also explains how to identify mesospheric lines which may easily be confused in some cases with genuine astronomical lines from cold clouds.

Observing time estimates

This matter needs special attention as a serious time underestimate may be considered as a sure sign of sloppy proposal preparation. We strongly recommend to use the web–based Time Estimator (URL: /IRAMES/obstime/-time_estimator.html), whenever applicable. Versions 2.6 and higher handle heterodyne (single pixel and HERA) as well as bolometer observations with updated instrumental parameters.

If very special observing modes are proposed which are not covered by the Time Estimator, proposers must give sufficient technical details so that their time estimate can be *reproduced*. In particular, the proposal must give values for $T_{\rm sys}$, the spectral resolution, the expected antenna temperature of the signal, the signal/noise ratio which is aimed for, all overheads and dead times, and the resulting observing time. A technical report explaining how to estimate the telescope time needed to reach a given sensitivity level in various observing modes was published in the January 1995 issue[2] of the IRAM Newsletter [5]. It has been included in the 30m telescope Manual [6].

Proposers should base their time request on normal winter conditions, corresponding to 4mm of precipitable water vapor. Conditions during afternoons can 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 best winter conditions, the proposers must clearly say so in their time estimate paragraph. Such proposals will however be particularly scrutinized.

Pooled observing

As in the previous semesters, we plan to pool the bolometer and other suitable proposals together. A large fraction of the winter semester will be dedicated to this observing pool, split up in several sessions. The proposals participating in the pool are observed by Granada staff and cooperating external astronomers, as organised by the Pool Coordinator. The participating proposals are grouped according to their demand on weather quality, and they get observed following the priorities assigned by the program committee. The organization of the observing pool is described at /IRAMES/observing/flexible/flexible.html. Typically, the bolometer proposals are included in the pool, but very weather sensitive heterodyne proposals may also request inclusion in the pool. Bolometer and heterodyne proposals which are particularly weather tolerant qualify as backup for the pool. Participation in the pool is voluntary, and the respective box on the proposal form should be checked.

Any questions concerning the pool organization should be directed to the scheduler (thum@iram.fr) or the Station Manager (mauers@iram.es), while the new Pool Coordinator, succeeding Axel Weiß, has not yet taken up duty.

Service observing

To facilitate the execution of short ($\leq$8 h) programmes, we propose "service observing" for some easy to observe 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

[2]electronically available via the WWW starting at URL on our web pages `/IRAMFR/PV/ARN/newsletter.html`

then decide which proposals can actually be accepted for this mode.

Remote observing

This observing mode where the remote observer actually controls the telescope very much like on Pico Veleta, used to be available from the downtown Granada office, from the MPIfR in Bonn, from the ENS in Paris, from the OAN in Madrid (near Parque de Retiro), and from IRAM in Grenoble. However, due to the transition to the telescope's new control system, remote observing will not be working during several months. Observers are strongly encouraged either to consider service observing for their shorter proposals or to come to the telescope.

Remote observing may possibly become available again later in the winter semester. Potential remote observers are adviced to contact the scheduler, Clemens Thum, for the most recent status.

Technical Information about the 30m Telescope

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

HERA

The **HE**terodyne **R**eceiver **A**rray is expected to be available for most of next winter. The 9 dual–polarization pixels are arranged in the form of a center–filled square and are separated by 24$''$. Each beam is split into two linear polarizations (after a successful upgrade in March) which couple to separate SIS mixers. The 18 mixers feed 18 independent IF chains. Each set of 9 mixers is pumped by a separate local oscillator system. The same positions can thus be observed simultaneously at any two frequencies inside the HERA tuning range (210-276 GHz).

A derotator optical assembly can be set to keep the 9 pixel pattern stationary in the equatorial or horizontal coordinates. Receiver characteristics (of the single polarization system) are listed in Tab. 5, and an updated user manual (version 1.7) is available on our web page.

Frequency tuning of HERA, although fully under remote control and automatic, is substantially more complicated than for the observatory's other SIS receivers. A new tuning tool has been developed which speeds up considerably the DSB and SSB tuning of the 18 mixers. Despite this good progress, there may still be some difficult frequency spots. HERA observers are therefore advised to send a list of their frequencies to Granada at least 2 weeks ahead of their run.

Recent observations have shown that the noise temperature of the pixels of the second polarization array varies across the 1 GHz IF band. The highest noise occurs towards the band edges which are, unfortunately, picked up when HERA is connected with VESPA whose narrow observing band is located close to the lower edge of the 1 GHz band. Therefore, while not as dramatic for wide band observations with centered IF band, the system noise in narrow mode is considerably higher (factor 1.5 – 2) as compared to the first polarization array. The problem will be tackled during the next 6 months and improvements will be announced on the HERA webpage.

HERA can be connected to three sets of backends:

- ▷ VESPA with the following combinations of nominal resolution (KHz) and maximum bandwidth (MHz): 20/40, 40/80, 80/160, 320/320, 1250/640. The maximum bandwidth can actually be split into two individual bands for each of the 18 detectors at most resolutions. These individual bands can be shifted separately up to ±200 MHz offsets from the sky frequency (see also the sections on backends below).
- ▷ a low spectral resolution (4 MHz channel spacing) filter spectrometer covering the full IF bandwidth of 1 GHz. Nine units (one per HERA pixel) are available. Note that only one polarization of the full array is thus connectable to these filter banks.
- ▷ WILMA with a 1 GHz wide band for each of the 18 detectors. The bands have 512 spectral channels spaced out by 2 MHz.

HERA is operational in two basic spectroscopic observing modes: *(i)* raster maps of areas typically not smaller than 1$'$, in position, wobbler, or frequency switching modes, and *(ii)* on–the–fly maps of moderate size (typically $2' - 10'$). Extragalactic proposals should take into account the current limitations of OTF line maps, as described in the User Manual, due to baseline instabilities induced by residual calibration errors. HERA proposers should use the web–based Time Estimator. For details about observing with HERA, consult the User manual. The HERA project scientist, Karl Schuster (schuster@iram.fr), or Albrecht Sievers (sievers@iram.es), the astronomer in charge of HERA, may also be contacted.

The single pixel heterodyne receivers

Four dual polarization SIS 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. 5. All receivers are linearly polarized with the E–vectors, before rotation in the Martin–Puplett interferometers, either horizontal or vertical in the Nasmyth cabin. Up to four of these eight receivers can be combined for simultaneous observations in the four ways depicted in Tab. 5. Note that they cannot be combined with HERA nor with the bolometers. Also listed are typical system temperatures which apply to normal winter weather (4mm of water) at the center of the tuning range and at 45° elevation. All receivers are tuned by the operators from the control room. Experience shows that it normally takes not more than 15 min to tune four such receivers.

Extended tuning range: 72 – 80 GHz

Several molecules of high astrophysical importance have transitions in the frequency band 66 – 80 GHz, i.e. between the atmospheric O_2 absorption band and the low frequency edge of the nominal 3mm tuning range (see Tab.5). Tests have shown that both 3mm receivers, A 100 and B 100 have good performance (good USB rejection and system temperature) in the range 80 – 77 GHz. The receivers become increasingly DSB below 77 GHz, until their behavior becomes erratic around 72 GHz. Due to the rapid variation of the image gain, special care must be exercised with calibration. A new image gain calibration tool is provided and described in the test report available on the IRAM web site (at /IRAMFR/PV/veleta.htm). The report includes a set of reference spectra.

Following the considerable demand for this frequency range in the last 2 semesters, the LO hardware has been simplified. As a result, observations in the 72 – 80 GHz range do not require any special arrangements, except that the A 230 (B 230) receiver is unusable when the A 100 (B 100) receiver is used below 80 GHz.

General point about receiver operations

Tuning of the single pixel/dual polarization receivers is now considerably faster and more reproducible than before. Particular frequencies, like those in the range 72 – 80 GHz or those near a limit of the tuning range, may still be problematic. In these cases, we recommend to check with a Granada receiver engineer at least two weeks before the observations. HERA observers, however, are requested to send their frequencies as soon as their project gets scheduled.

Polarimeter XPOL

An upgrade of the IF polarimeter [16] is now available, where the cross correlation between the IF signals from a pair of orthogonally polarized receivers is made digitally in VESPA. The new observing procedure, designated XPOL, generates simultaneous spectra of all 4 Stokes parameters. The following combinations of spectral resolution (kHz) and bandwidth (MHz) are available: 40/120, 80/240, and 320/480.

Although successful XPOL observations were made at several frequencies, experience is still limited, particularly with respect to long integrations and observations of extended sources. Considerable progress was made in reducing polarization sidelobes, notably for Stokes V. Interested users should contact C. Thum for details. Data reduction software using CLASS enhanced with a graphical user interface is available (H. Wiesemeyer). A short guide (at /IRAMFR/PV/veleta.htm) describes XPOL observations. Polarimetry proposals for observation of extended sources should demonstrate that their observations are feasible in the presence of the known sidelobes.

MPIfR Bolometer arrays

The bolometer arrays, MAMBO–1 (37 pixels) and MAMBO–2 (117 pixels), are provided by the Max–Planck–Institut für Radioastronomie. They consist of concentric hexagonal rings of horns centered on the central horn. Spacing between horns is $\simeq 20''$. Each pixel has a HPBW of $11''$. We expect that MAMBO–2 will be normally used, but MAMBO–1 is kept as a backup.

The effective sensitivity of MAMBO–1 for onoff and mapping observations is 35 mJy $\mathrm{s}^{\frac{1}{2}}$. For MAMBO–2 effective sensitivities of 40 mJy $\mathrm{s}^{\frac{1}{2}}$ (ON/OFF mode) and 45 mJy $\mathrm{s}^{\frac{1}{2}}$ (mapping mode) were measured. The *rms*, in mJy, of a MAMBO–2 map is typically

$$rms = 0.4f\sqrt{v_{scan}\Delta s}$$

where v_{scan}, in arc sec/sec, is the velocity in the scanning direction and Δs, in arc sec, is the step size in the orthogonal direction. The factor f is 1 (2) for sources of size $< 30''$ ($> 60''$). It is assumed that the map is made large enough that all beams cover the source. The sensitivities apply to bolometric winter conditions (τ(250GHz) $\sim$ 0.25, elevation 45 deg, and application of skynoise filtering algorithms). In cases where skynoise filtering algorithms are not or not fully effective (e.g. extended source structure, atmosphere not sufficiently stable), the effective sensitivity is typically about a factor of 2 worse. For those projects, only atmospheric conditions with low skynoise (i.e. stable atmosphere, no clouds, little turbulence) are recommened unless the expected signal is about 1 Jy/beam or stronger.

The bolometer arrays are mostly used in two basic observing modes, ON/OFF and mapping. Previous experience with MAMBO–2 shows that the ON/OFF reaches typically an rms noise of $\sim$ 2.3 mJy in 10 min of total observing time (about 200 sec of ON source, or about 400 sec on sky integration time) under stable conditions. Up to 30 percent lower noise may be obtained in perfect weather. In this observing mode, the noise integrates down with time t as $\sqrt{t}$ to rms noise levels below 0.5 mJy.

In the mapping mode, the telescope is scanning in the direction of the wobbler throw (default: azimuth) in such a way that all pixels see the source once. A typical single map[3] with MAMBO–2 covering a fully and homogeneously sampled area of $150'' \times 150''$ (scanning speed: $5''$per sec, raster step: $8''$) reaches an rms of 2.8 mJy/beam in 1.9 hours if skynoise filtering is effective.

[3]see also the Technical report by D. Teyssier and A. Sievers on a special fast mapping mode (IRAM Newsletter No. 41, p. 12, Aug. 1999).

Table 5: Heterodyne receivers available for the next winter 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 winter conditions (4mm pwv) 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. Note that the 8 standard receivers can be combined in 4 different ways.

receiver	polar–	combinations				tuning range	T_{Rx}(SSB)	g_i	ν_{IF}	$\Delta\nu_{IF}$	T^*_{sys}	remark
	ization	AB	CD	AD	BC	GHz	K	dB	GHz	GHz	K	
A 100	V	1		3		80 - 115.5	45 - 65	> 20	1.5	0.5	120	1
B 100	H	1			4	81 - 115.5	60 - 85	> 20	1.5	0.5	130	1
C 150	V		2		4	129 - 183	70 - 115	15 - 25	4.0	1.0	200	
D 150	H		2	3		129 - 183	60 - 150	8 - 17	4.0	1.0	200	
A 230	V	1		3		197 - 266	85 - 185	12 - 17	4.0	1.0	420	2
B 230	H	1			4	197 - 266	95 - 160	12 - 17	4.0	1.0	420	2
C 270	V		2		4	241 - 281	125 - 290	10 - 20	4.0	1.0	900	3
D 270	H		2	3		241 - 281	130 - 300	9 - 13	4.0	1.0	900	3
HERA	H/V					210 - 276	110 - 380	~ 10	4.0	1.0	400	2, 4

1: tuning range extended to ≥ 72 GHz under special conditions (see text)
2: noise increasing with frequency
3: performance at $\nu < 275$ GHz; noisier above 275 GHz.
4: the V–array of HERA has slighly higher noise which may vary across the IF band.

Much more time is needed (see Time Estimator) if sky noise filtering cannot be used. The area actually scanned ($8.0' \times 6.5'$) must be larger than the map size (add the wobbler throw and the array size ($4'$), the source extent, and some allowance for baseline determination) if the EHK–algorithm is used to restore properly extended emission. Shorter scans may lead to problems in restoring extended structure. Mosaicing is also possible to map larger areas. Under many circumstances, maps may be co–added to reach lower noise levels. If maps with an rms $\lesssim 1$ mJy are proposed, the proposers should contact R. Zylka (zylka@iram.fr).

The bolometers are used with the wobbling secondary mirror (wobbling at a rate of 2 Hz). The wobbling direction which used to be fixed in azimuth, can now be freely chosen within some limits (see IRAM Newsletter No. 61). This allows in virtually all cases to adapt the wobbling/scanning direction to the source under study. Nevertheless, the orientation of the beams on the sky changes with hour angle due to parallactic and Nasmyth rotations, as the array is fixed in Nasmyth coordinates and the wobbler direction is fixed with respect to azimuth during a scan. Bolometer proposals participating in the pool have their observations (maps and ONOFFs) pre-reduced by a data quality monitor which runs scripts in the newly developed MOPSIC. This package, complete with all necessary scripts, is also installed for off-line data analysis in Granada and Grenoble. It is also available for distribution from the IRAM Data Base for Pooled Observations or directly from R. Zylka (zylka@iram.fr). The older software packages (NIC [7] and MOPSI[8]) are still available, but will not be updated.

Bolometer proposals will be pooled together like in previous semesters along with suitable heterodyne proposals as long as the respective PIs agree. The web–based time estimator handles well the usual bolometer observing modes, and its use is again strongly recommended. The time estimator uses rather precise estimates of the various overheads which will be applied to all bolometer proposals. If exceptionally low noise levels are requested which may be reachable only in a perfectly stable (perfect winter) atmosphere, the proposers must clearly say so in their time estimate paragraph. Such proposals will however be particularly scrutinized. On the other extreme, if only strong sources are observed and moderate weather conditions are sufficient, the proposal may be used as a backup in the observing pool. The proposal should point out this circumstance, as it affects positively the chance that the proposal is accepted and observed.

The Telescope

Beam and Efficiencies

Table 6 lists the size of the telescope beam for the range of frequencies of interest. Forward and main beam efficiencies are also shown (see also the note by U. Lisenfeld and A. Sievers, IRAM Newsletter No. 47, Feb. 2001). The variation of the coupling efficiency to sources of different sizes can be estimated from plots in Greve et al. [12].

At 1.3 mm (and a fortiori at shorter wavelengths) a large fraction of the power pattern is distributed in an

Table 6: Main observational parameters of 30m telescope.

frequency [GHz]	θ_b ["] (1)	η_F (2)	η_{mb} (3)	S_ν/T_A^* [Jy/K]
86	29	0.95	0.78	6.0
110	22	0.95	0.75	6.3
145	17	0.93	0.69	6.7
170	14.5	0.93	0.65	7.1
210	12	0.91	0.57	7.9
235	10.5	0.91	0.51	8.7
260	9.5	0.88	0.46	9.5
279	9	0.88	0.42	10.4

(1) beam width (FWHP). A fit to all data gives: θ_b ["] = 2460 / frequency [GHz]
(2) forward efficiency (coupling efficiency to sky)
(3) main beam efficiency. Based on a fit of measured data to the Ruze formula:
$\eta_{\rm mb} = 1.2\epsilon \exp(-(4\pi R\sigma/\lambda)^2)$
with $\epsilon = 0.69$ and $R\sigma = 0.07$

error beam which can be approximated by two Gaussians of FWHP $\simeq 170''$ and $800''$ (see [12] for details). Astronomers should take into account this error beam when converting antenna temperatures into brightness temperatures. A variable and sometimes large contribution to the error beam was known to come from telescope astigmatism[3]. Extensive work during the last years had shown that the astigmatism resulted from temperature differences between the telescope backup structure and the yoke. The recent installation of heaters in the yoke by J. Peñalver has nearly completely removed the astigmatism[15].

Pointing and Focusing

With the systematic use of inclinometers the telescope pointing became much more stable. Pointing sessions are now scheduled at larger intervals. The fitted pointing parameters typically yield an absolute rms pointing accuracy of better than $3''$ [10]. Receivers are closely aligned (within $\leq 2''$). 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 can occasionally occur. 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.

Unnecessarily large wobbler throws should be avoided, since they introduce a loss of gain, particularly at the higher frequencies, and imply a loss of observing efficiency (more dead time).

Backends

The following four spectral line backends are available which can be individually connected to any single pixel receiver and, if indicated, also to HERA.

The 1 MHz filterbank consists of 4 units. Each unit has 256 channels with 1 MHz spacing and can be connected to different or the same receivers giving bandwidths between 256 MHz and 1024 MHz. The maximum bandwidth is available for only one receiver, naturally one having a 1 GHz wide IF bandwidth. Connection of the filterbank in the 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 consists of 256 channels of 100 KHz spacing. It can be split into two halves, each movable inside the 500 MHz IF bandwidth, and connectable to two different single pixel receivers.

VESPA, the versatile spectrometric and polarimetric array, can be connected either to HERA or to a subset of 4 single pixel receivers, or to a pair of single pixel receivers for polarimetry. The many VESPA configurations and user modes are summarized in a Newsletter contribution [14] and in a user guide, but are best visualised on a demonstration program which can be downloaded from our web page at URL /IRAMFR/PV/veleta.htm. Connected to a set of 4 single pixel receivers VESPA typically provides up to 12 000 spectral channels (on average 3 000 per receiver). Up to 18 000 channels are possible in special configurations. Nominal spectral resolutions range from 3.3 KHz to 1.25 MHz. Nominal bandwidths are in the range 10 — 512 MHz. When VESPA is connected to HERA, up to 18 000 spectral channels can be used with the following typical combinations of nominal resolution (KHz) and maximum bandwidth (MHz): 20/40, 40/80, 80/160, 320/320, 1250/640.

The 4 MHz filterbank consists of nine units. Each unit has 256 channels (spacing of 4 MHz, spectral resolution at 3 dB is 6.2 MHz) and thus covers a total bandwidth of 1 GHz. The 9 units are designed for connection to HERA, but a subset of 4 units can also be connected to the backend distribution box which feeds the single pixel spectral line receivers. All these receivers have a 1 GHz RF bandwidth except for A100 and B100 (500 MHz only).

At the present time, a 4 MHz filterbank cannot be used simultaneously with the autocorrelator or the 100 KHz filterbank on the same receiver.

An on–line calibration routine automatically writes calibrated spectrometer data, including the 4 MHz filterbanks, to the Linux machines. The routine, although still experimental, works for all observing modes. A logical link named "data.30m" pointing to this file of calibrated spectra is made available in all newly created project accounts.

The **wideband autocorrelator WILMA** consists of 18 units. They can be connected to the 18 detectors of HERA. Each unit provides 512 spectral channels, spaced out by 2 MHz and thus covering a total bandwidth of 1 GHz. Each band is sliced into two 500 MHz subbands which are digitized with 2 bit/1GHz samplers. An informative technical overview of the architecture is available on the web page (URL: ../IRAMFR/-TA/backend/veleta/wilma/index.htm).

WILMA can be connected to the 18 detectors of HERA or, with 4 units maximum, to the single pixel receivers.

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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 Plateau de Bure Interferometer

The eastern and northern track extensions

In connection with the long-term plans to extend the capabilities of the Plateau de Bure Interferometer, work is currently progressing in parallel on the eastern and northern track extensions. The cargo lifting system ("blondin") for the transport of heavy equipment and materials to the Plateau de Bure site is in operation since the beginning of May. Work on excavating and backfilling the trenches with steel reinforced concrete, work on the foundation of the new stations at the far end of the track extensions and on the electrical cabling are progressing close to schedule. Current plans foresee to have the track extensions completed in time for the upcoming winter 2005/2006 scheduling period.

With two new stations at the far ends of the eastern (E68) and northern track (N46), a new set of configurations had to be defined that reflects an optimized trade-off between desired uv-sample distributions and the difficulties of moving antennas on the plateau in snowy winter conditions. The current total number of 4 configurations is mainly imposed by current operational constraints. With E68 and N46, the six-element array will observe on baselines up to 760 m east-west (+86%) and 368 m north-south (+59%) with only 4 primary configurations. Despite this small number, the four new configurations and their combinations result in synthesized beams with low sidelobe levels and a wide range of spatial resolutions (see Tables for details), and provide a very significant improvement (factor $\sim$2.5) in the surface resolving power of the six-element array.

The four entirely new configurations range from the most compact (D) to the most extended (A). The design of the configurations has been a product of careful considerations, which are outlined together with the properties of the new beams in a forthcoming publication. The primary aim has been to find configurations which result in close to circular beams with low sidelobes and can be combined in pairs to better sample the uv-plane and achieve a variety of spatial resolutions. The process that was followed consisted of the optimisation of the most extreme (A and D) configurations first. A slightly less extended configuration (B) was adapted to match the uv-coverage of A and the last configuration (C) was designed to complement both B and D.

Conf	Stations					
A	W27	E68	N46	E24	E04	N29
B	W12	W27	N46	E23	E12	N20
C	W12	E10	N17	N11	E04	W09
D	W08	E03	N07	N11	N02	W05

Table 7: The new configurations of the PdB array and associated station codes.

Conf	Synthesized beam at 100 GHz	
	New	Current
A	$0.9'' \times 0.7''$ @ $38°$	$1.4'' \times 1.3''$ @ $22°$
B	$1.3'' \times 1.1''$ @ $68°$	$2.0'' \times 1.6''$ @ $63°$
C	$2.9'' \times 2.6''$ @ $61°$	$2.6'' \times 2.1''$ @ $48°$
D	$5.5'' \times 4.6''$ @ $103°$	$6.1'' \times 4.1''$ @ $90°$
AB	$1.1'' \times 0.9''$ @ $45°$	$1.6'' \times 1.4''$ @ $41°$
BC	$1.9'' \times 1.6''$ @ $59°$	$2.3'' \times 1.9''$ @ $55°$
CD	$3.8'' \times 3.4''$ @ $82°$	$3.8'' \times 3.0''$ @ $68°$

Table 8: Synthesized beams, sizes and position angles, for the future and current configurations of the PdB array and their different combinations. Beams are for a source at declination $+45°$ and 8 hours of observation per single configuration, around transit.

A. KARASTERGIOU & R. NERI

Weather conditions and observations

All in all, the winter conditions have been very good at the Plateau de Bure with almost no snow (contrary to other regions in Europe) and with long periods of excellent phase stability and low atmospheric opacity. The interferometer recorded a 50-60% observing efficiency from January to April. To optimize the observing efficiency with respect to the sun avoidance constraints of A-rated projects, the configuration schedule of the interferometer was slightly adjusted. The array was moved to the most extended configuration (A) at the end of December, moved to the B configuration at the beginning of February and to the C configuration at the middle of March. Because of the weather conditions, the array was rearranged to the most compact configuration (D) at the beginning of April. Global VLBI observations, which include the array in the 3mm phased-array mode, were carried out from April 15 to 20, 2005.

Almost every A-rated project was completed before the end of the winter period. We have also invested observing time on a number of B projects, and even on a few targets of opportunity. Since last December, a total of 48 different projects has successfully been scheduled for observations. Concerning projects that have been started shortly before the end of the winter period, we plan to bring these to completion in the next few months. A few deep integration and low-resolution observations of sources in the Orion-Taurus region had to be suspended because of sun avoidance contraints and are now deferred to the end of the summer semester.

Finally, we would like to remind users of the Plateau de Bure Interferometer that B-rated summer proposals which were not started by the September 08, 2005 deadline, should be resubmitted. Investigators, who would like to check the status of their project, may consult the interferometer schedule on the Web at `./IRAMFR/PDB/ongoing.html`.

Call for Observing Proposals for the Plateau de Bure Interferometer

Conditions for the next winter session

Based on our experience in carrying out configuration changes with limited access to the Observatory, we plan to schedule three configuration changes next winter. We therefore ask investigators to submit proposals for all 4 of the current primary configurations of the six antenna array. Projects will be properly adjusted in observing time and uv-coverage, in collaboration with the principal investigators, should the new configurations (see preceding section "News from the Plateau de Bure Interferometer") become available in time for the winter scheduling period.

A preliminary configuration schedule for the winter period is outlined below. Please note that the more compact configurations (C and D) will be available only at the end of January at the earliest. The scheduling priority will later be adapted according to pressure in right ascension ranges and may further be changed during the winter period depending on weather conditions. The configuration schedule should be taken as a guideline, in particular when the requested astronomical targets cannot be observed during the entire winter period (45° sun avoidance circle).

Conf	Scheduling Priority Winter 2005/2006
B	November – December
A	December – January
C	February – March
D	March – April

We strongly encourage observers to submit proposals that would highly benefit from observations in the new set of AB configurations. For these proposals we ask to focus on:

- bright compact sources, possibly at high declination,
- observations that qualify also for the 3mm receivers.

When the atmospheric conditions are not good enough at 1.3mm, 3mm projects will be observed: in a typical winter, 20-30% of the observing time is found to be poor at 1.3mm, but still excellent at 3mm. We therefore invite proposers to submit proposals also for observations at 3mm.

Call for Proposals

Under normal operating conditions, IRAM schedules and completes between 40 to 60 projects during the winter period, with an elapsed time of at least two months between start and end of a project, on average. Selection is based on scientific merit, technical feasibility, and suitability for the instrument.

Details of the PdBI and the observing procedures are given in the document "An Introduction to the IRAM Plateau de Bure Interferometer". A copy can be obtained from the address below or from the World-Wide-Web at `./IRAMFR/PDB/docu.html`. Proposers should read this document carefully before submitting any proposal.

Proposal category

Proposals should be submitted for one of the five categories:

`dual freq.`: Proposals that ask for simultaneous observations at 3mm and 1.3mm.

`1.3mm`: Proposals that ask for 1.3mm data only. 3mm receivers will be used for pointing and calibration purposes, but the scientific goals of the proposal rely on the 1.3mm receivers.

`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.

`time filler`: Proposals that have to be considered as backup projects to fill in periods where the atmospheric conditions do not allow mapping, or eventually, to fill in gaps in the scheduling, or periods when only a subset of the standard 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. These proposals will be carried out on a "best effort" basis only.

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

Configurations of the six-antenna array

The six-element array can presently be arranged in the following configurations:

Conf	Stations					
A	W27	W23	E16	E23	N13	N29
B	W12	E04	E23	N07	N17	N29
C	W12	E10	E16	N02	N09	N20
D	W05	W00	E03	N05	N09	N13

Note that a new set of configurations is proposed for the upcoming winter semester (see preceding contribution "News from the Plateau de Bure Interferometer"), should work on the eastern and northern track extension be completed in time.

The general properties of the current configurations (see also Table 2, section "News from the Plateau de Bure Interferometer") are:

- `A` alone is well suited for mapping or size measurements of very compact objects. It provides a resolution of 1.1″ at 100 GHz, ~0.5″ at 230 GHz. In addition, because it contains long, intermediate and some short baselines, it could still be used in a tapered mode when a project is observed in marginal weather conditions despite some loss of sensitivity (for backup projects).
- `B` in combination with A already provides slightly higher angular resolution (~1.5″ at 100 GHz). Short baselines have been included to facilitate calibration (less decorrelation) and give some sensitivity to extended structure, although this is clearly not the primary goal of the AB configuration. It is mainly used for relatively strong sources.
- `C` provides a fairly complete coverage of the uv-plane (low sidelobe level) and is well adapted to combine with D for low angular resolution studies (~3.5″ at 100 GHz, ~1.5″ at 230 GHz) and with B for higher resolution (~2″ at 100 GHz, ~0.9″ at 230 GHz). C alone is also well suited for snapshot and size measurement experiments.
- `D` alone is best suited for deep integration and coarse mapping experiments. This configuration provides both the highest sensitivity and the lowest atmospheric phase noise. It is slightly more extended than the 5-element D configuration: the beam is smaller, but slightly more elliptical.

The four configurations can be used in different combinations to achieve complementary sampling of the uv-plane, and to improve on angular resolution and sensitivity. Mosaicing is usually done with D or CD, but the combination BCD can also be requested for high resolution mosaics. Check the ANY bullet in the proposal form if the scientific goals can be reached with any of the four configurations or their subsets.

Investigators interested in observations with the new set of extended configurations only, should check the NEW bullet in addition to the requested configurations. Note that the general properties of the current configurations also apply to the new configurations.

Please consult the documentation on the Plateau de Bure configurations for further details.

Receivers

All antennas are equipped with fully operational dual frequency receivers. The guaranteed frequency range will be 82 to 116 GHz for the 3mm band, and 205 to 245 GHz for the 1.3 mm band. The 3mm and 1.3mm receivers are aligned to within about 2″.

Below 105 GHz, receivers offer best performances in LSB tuning with high rejection (20 dB): expected system temperatures are 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.

The 1.3 mm receivers have DSB tuning with typical T_{REC} below 50 K. Expected SSB system temperature are 350 to 450 K. The guaranteed tuning range is 205–245 GHz, but it is possible to reach some lower and higher frequencies. Higher frequencies are not feasible on all antennas because of limitations in the triplers. For details about observing at frequencies slightly below or above the guaranteed tuning range of the 3mm and 1.3mm receivers, please get in touch with the Interferometer Science Operations Group (sog@iram.fr).

Signal to Noise

The rms noise can be computed from

$$\sigma = \frac{J_{\rm pK} T_{\rm SYS}}{\eta\sqrt{N_{\rm a}(N_{\rm a}-1)N_{\rm c}T_{\rm ON}B}} \quad (1)$$

where

- $J_{\rm pK}$ is the conversion factor from Kelvin to Jansky (22 Jy/K at 3mm, 35 Jy/K at 1.3mm)
- $T_{\rm SYS}$ is the system temperature (150 K below 110 GHz, 200 K at 115 GHz, 400 K at 230 GHz for sources at $\geq 20°$)
- η is an efficiency factor due to atmospheric phase noise (0.9 at 3 mm, 0.8 at 1.3 mm).
- $N_{\rm a}$ is the number of antennas (6), and $N_{\rm c}$ is the number of configurations: 1 for D, 2 for CD, 2 for BC, and so on.
- $T_{\rm ON}$ is the on-source integration time per configuration in seconds (2 to 8 hours, depending on source declination). Because of various calibration observations the total observing time is typically 1.4 $T_{\rm ON}$.
- B is the spectral bandwidth in Hz (580 MHz for continuum, 40 kHz to 2.5 MHz for spectral line, according to the spectral correlator setup)

Investigators have to specify the 1σ noise level which is necessary to achieve each individual goal of a proposal, particularly for projects aiming at deep integrations.

Coordinates and Velocities

The interferometer operates in the J2000.0 coordinate 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 new correlator has 8 independent units, which can be placed anywhere in the 100–680 MHz band. 7 different modes of configuration are available, characterized in the following by couples of total bandwidth/number of channels. In the 3 DSB modes (320MHz/128, 160MHz/256, 80MHz/512 – see Table) the two central channels may be perturbed by the Gibbs phenomenon if the observed source has a strong continuum. When using these modes, it is recommended to avoid centering the most important part of the lines in the middle of the band of the correlator unit. In the remaining SSB modes 160MHz/128, 80MHz/256, 40MHz/512, 20MHz/512) the two central channels are not affected by the Gibbs phenomenon and, therefore, these modes may be preferable for some spectroscopic studies.

Spacing (MHz)	Channels	Bandwidth (MHz)	Mode
0.039	1×512	20	SSB
0.078	1×512	40	SSB
0.156	2×256	80	DSB
0.312	1×256	80	SSB
0.625	2×128	160	DSB
1.250	1×128	160	SSB
2.500	2×64	320	DSB

Note that 5% of the passband is lost at each end of a subband. The 8 units can be independently connected either with the 3mm or 1.3mm IFs.

Sun Avoidance

For safety reasons, a sun avoidance circle is enforced at 45 degrees. Please take this into account for your sources `AND` calibrators.

Mosaics

The PdBI has mosaicing capabilities, but the pointing accuracy may be a limiting factor at the highest frequencies. Please contact the Interferometer Science Operations Group (sog@iram.fr) in case of doubts.

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 may have to come for the data 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.
- In certain cases, proposers may have a look at the uv-tables as the observations progress. If necessary, and upon request, more information can be provided. Please contact us if you are interested in this possibility.
- CLIC evolves to cope with upgrades of the PdBI array. The newer versions are downward compatible with the previous releases. Observers who wish to finish data reduction at their home institute should obtain the most recent version of CLIC. Because differences between CLIC versions may potentially result in imaging errors if new data are reduced with an old package, we advise observers having a copy of CLIC to take special care in maintaining it up-to-date.

Data reduction will be carried out on dedicated computers at IRAM. Remote data reduction is possible, and especially for experienced users of the Plateau de Bure Interferometer. Please contact the Interferometer Science Operations Group (sog@iram.fr) if you're interested in this possibility.

Local contact

A local contact will be assigned to every A or B rated proposal which does not involve an in-house collaborator. He/she will assist you in the preparation of the observing procedures and provide help to reduce the data. Assistance is also provided before a deadline to help newcomers in the preparation of a proposal. 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 addition to the scientific review by the programme committee. Please help in this task by submitting technically precise proposals. Note that your proposal must be complete and exact: the source position and velocity as well as the requested frequency setup must be correctly given.

Non-standard observations

If you plan to execute a non-standard program, please contact the Inteferometer Science Operations Group (sog@iram.fr) to discuss the feasibility.

Documentation

The documentation for the IRAM Plateau de Bure Interferometer includes documents of general interest to potential users, and more specialized documents intended for observers on the site (IRAM on-duty astronomers, operators, or observers with non-standard programs). All documents can be retrieved on the Internet at `./IRAMFR/PDB/docu.html`

> Finally, we would like to stress again the importance of the quality of the observing proposal. The IRAM interferometer is a powerful, but complex instrument, and proposal preparation requires special care. Information is available in the documentation and at `./IRAMFR/PDB/docu.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 the need for the Plateau de Bure Interferometer.

Roberto NERI

VLBI News

Global VLBI

In the April 2005 Global VLBI session, the VLBA observed for the first time, and successfully, with the Mark5A recording system. This upgrade will help to improve the available recording rates in the future.

Both IRAM observatories participated in the Global session; Pico Veleta to 100% under good conditions. Plateau de Bure observed only to a small fraction due to bad meteo conditions with snow, freezing fog and winds up to 160 km/h (a large part of southeastern France suffered from heavy snowfalls, bad traffic conditions and power failures at the time). Directly after the main Global session, a weather improvement allowed Bure to participate in the observation of the Galactic center with a recording rate of 1 Gbit/s (the maximum data rate possible with the Mark5A system installed in 2004), although only with 3 antennas, as the other three had developed substantial icicles on the subreflector and quadrupods.

From the technical point of view, the PdBI phased array has operated with several improvements. The results of the February 2005 tests on Bure have been applied, and the Bure VLBI system has now a reduced phase noise and improved efficiency. For the April 2005 session, the constraints were purely meteorological.

A polarization VLBI test between Bure, Pico Veleta and Effelsberg followed. Bure joined late due to high wind, first with four antennas, then with six, as the daylight progressively de-iced the frozen antennas. The experiment showed that Bure can observe simultaneously with two sub-arrays, one in Left Circular Polarization (LCP) and one in Right Circular Polarization (RCP), but that some software modifications are still necessary before this observing mode can be offered in Global VLBI sessions.

During the session, Bure still operated with the EFOS-1 maser on loan from the geodetical station Wettzell, Germany. Directly after the VLBI session, the repaired CNRS maser was transported by cablecar to the PdBI and successfully installed in the correlator room, where EFOS-1 was disconnected from the system.

The Pico Veleta and Plateau de Bure teams were reinforced by visiting astronomers from the MPIfR Bonn. At both observatories, the good preparations by the technical staff were fundamental for the success of the experiment; on the Plateau de Bure, additional efforts were necessary to de-ice all antennas with a motorized platform at the beginning of the Global session (one removed icicle had reached a length of more than two meters!). Many thanks to all who have made the observations possible.

Michael BREMER

Return voyage of EFOS-1

EFOS-1 left the Plateau de Bure on the 19. May 2005, after being switched to standby mode (stop of the maser emission, but the rest of the instrument remaining under power) and conditioned for transport two days earlier. Figure 1 gives a short summary of the return voyage. This time, the maser was brought down from the mountain via cablecar, using a spacious platform which had not been available last year. The operation was supervised on the PdB by the IRAM safety engineer D. Thievent, and from the lower cablecar station on to its final destination by the maser technician G. Blaser (Observatoire de Neuchâtel) and M. Bremer. The transport from St. Etienne en Devoluy (France) to Wettzell (Germany) was done by road with a rented minivan, and the maser ion pumps and heating were kept under power with four 180 Ah 12V-batteries. Numerous precautions were taken to

Figure 1: Top left: Packing of EFOS-1. Top right: Transport to the cablecar, the batteries are stacked on top. Middle left: EFOS-1 on the cablecar platform, seen from the lower station. Middle right: the Maser crate has been stowed in the minivan. Lower left: the 20m VLBI antenna from the geodetic station Wettzell. Lower right: EFOS-1 in its habitual place. Top right photo by D. Thievent, the other photos were taken by M. Bremer.

avoid shocks and to reduce vibrations for this high precision frequency standard.

On arrival at the Fundamentalstation Wettzell (http://www.wettzell.ifag.de/), the maser was installed on its usual place in the basement and successfully restarted. Many people from Wettzell, Neuchâtel and IRAM were involved in the logistics and technical aspects of this operation, and their contributions have been essential in this positive outcome.

Michael BREMER

Call for Global VLBI Proposals at 3mm wavelength

We announce the opportunity for coordinated, high angular resolution and high sensitivity GLOBAL VLBI observations in the 3mm band (near 86 GHz), complementing existing stand-alone VLBA observations at these frequencies. At present, the Global 3mm VLBI Array consists of 8 VLBA antennas equipped with 3mm receivers, plus the IRAM 30-m telescope on Pico Veleta (Spain), the IRAM phased 6-element interferometer on Plateau de Bure (France), the 20-m radio telescope in Onsala (Sweden) the 14-m telescope in Metsähovi (Finland) and the MPIfR 100-m radio telescope in Effelsberg (Germany). With this VLBI-array, compact radio sources can be imaged with an angular resolution of down to 40 microarcseconds.

The Global 3mm VLBI Array offers 3 to 4 times more sensitivity than the stand-alone VLBA. Observations with the Global 3mm VLBI array will be coordinated and scheduled in time blocks during dedicated observing sessions, performed twice per year. Interaction between P.I. and array schedulers guarantees optimum use of observing time. The dates for the spring and autumn sessions in 2006 are not yet fixed, but will be near to April and October 2006. The actual duration of each session will depend on proposal pressure.

The Global 3mm VLBI Array supports most of the standard observing modes used at the VLBA, and uses MK5 hard disk recording. For continuum observations the standard recording rate is 512 Mbit/s. For logistical reasons, the duty cycle (recording time/total time) of the observations is limited to 0.2-0.3 for 512 Mbit/s (VLBA requests changes of 8packs every 24 hrs).

Recording at 1024 Mb/s is also possible at the European stations (the VLBA formatters cannot yet reach this bit rate), but is available only on request and after special justification.

These new and higher recording rates now lead to an improvement in continuum detection sensitivity by a factor of 1.4 - 2. This became possible owing to the upgrade of the VLBA to Mark5 disk recording last year.

The correlation will be performed in absentia at the Bonn MK5 VLBI correlator unless some technical reason for using another correlator is given in the proposal. The P.I. will receive the correlated data in uv-fits format.

Proposals for the April 2006 session should be prepared in a similar fashion to "normal cm-VLBI proposals", using the standard VLBI cover sheet and instructions available on the web under URL http://www.nrao.edu/-administration/directors_office/vlba-gvlbi.shtml and should be submitted electronically **as e-mail** before

Saturday, October 1rd 2005, before 21:00 UT
(17:00 US Eastern Standard Time)

to the following two addresses (in copy):

propsoc@nrao.edu
and propvlbi@mpifr-bonn.mpg.de

Proposals will be reviewed by NRAO and the participating European Observatories.

The European VLBI Scheduler, Dr. R. Porcas (MPIfR), will forward proposal copies to the participating European Institutes and ensure the scientific evaluation of the proposals by the respective local committees. Whether a project is scheduled will depend upon the combination of both the European and VLBA review processes.

Global VLBI observations at 3mm are subject to some technical restrictions, which are summarized on the following web-page (http://www.mpifr-bonn.mpg.de/div/vlbi/-globalmm/index.html).

The IRAM and MPIfR VLBI teams

Some useful web pages

VLBI observations allow unique insights in the astrophysics of compact and bright sources. Please prepare your proposals carefully, as they are equivalent to asking simultaneously for observing time on a large number of telescopes. Avoid last minute submissions: the e-mail submission may bounce large e-mails (critical limit about 5 Megabytes), returning them with details on how to submit via anonymous FTP. See http://www.nrao.edu/administration/-directors_office/vlba-gvlbi.shtml for more information.

- Technical details on VLBI observations: http://www.mpifr-bonn.mpg.de/div/vlbi/-globalmm/index.html
- Technical details on PdBI correlator in VLBI mode by Marc Torres: http://www.iram.fr-/IRAMFR/TA/backend/vlbi/index.html

- Very long baseline array observational status summary (J.M. Wrobel, April 5, 2002) http://www.aoc.nrao.edu/vlba/obstatus/obssum/-obssum.html
- CMVA Technical Information:
  Array sensitivity: http://web.haystack.mit.edu/-cmva/tech_1.html
  Field of view vs. Time averaging:
  http://web.haystack.mit.edu/cmva/tech_2.html

Michael BREMER

Scientific Results in Press

Detection of the Linear Radical HC_4N in IRC+10216

Cernicharo J.(1), Guélin M.(2), Pardo J. R.(1)
(1)Department of Molecular and Infrared Astrophysics, Instituto de Estructura de la Materia, CSIC, C/Serrano 121, 28006 Madrid, Spain, (2)Institut de Radioastronomie Millimétrique, 300 rue de la Piscine, F-38406 St. Martin d'Hères, France

Abstract:
We report the detection of the linear radical HC_4N in the C-rich envelope of IRC +10216. After HCCN, HC_4N is the second member of the allenic chain family $HC_{2n}N$ observed in space. The column density of HC_4N is found to be 1.5×10^{12} cm^{-2}. The abundance ratio HC_2N/HC_4N is 9, a factor of 2 larger than the decrement observed for the cyanopolyynes ($HC_{2n+1}N/HC_{2n+3}N$). Linear HC_4N has a $^3\Sigma$ electronic ground state and is one of the three low-energy isomeric forms of this molecule. We have searched for the bent and ringed HC4N isomers but could only derive an upper limit to their column densities: $\leq 3 \times 10^{12}$ cm^{-2} (at 3σ).

Appeared in: ApJ 615, p. L145

AGB mass-loss and recycling

T. Le Bertre(1), E. Gérard(2) and J.M. Winters(3)
(1)LERMA, UMR 8112, Observatoire de Paris, 61 av. de l'Observatoire, F-75014 Paris, France (2)GEPI, UMR 8111, Observatoire de Paris, 5 place J. Janssen, F-92195 Meudon Cedex, France (3)IRAM, 300 rue de la Piscine, F-38406 Saint-Martin-d'Hères, France

Abstract:
Mass-loss from AGB stars is a highly variable process which renders the determination of its rate and of its balance as a function of the stars' evolutionary stage a difficult task. Several diagnostic tools can be considered. The most commonly used are the rotational lines of molecules, like CO or SiO, and the emission by dust at infrared wavelengths. However they are sensitive to only a part of the material, sometimes in limited regions of the circumstellar shells. Other tracers, which may be very useful like lines of H I and H_2, should also be considered in order to get a more representative picture of these shells which extend out to the Interstellar Medium.

High spatial and spectral resolution, large fields of view and high dynamical range are all important to reveal the 3-D structure of the outflows and to identify the relevant driving process(es) involved, and finally to determine the mass-loss history for individual sources and the contribution of the AGB star population to the recycling of matter.

Appeared in: Proceedings of the dusty and molecular universe: a prelude to Herschel and ALMA, 27-29 October 2004, Paris, France. Ed. by A. Wilson. ESA SP-577, Noordwijk, Netherlands: ESA Publications Division, ISBN 92-9092-855-7, 2005, p. 217 - 222

The millimeter and submillimeter spectrum of CRL618

Pardo J. R.(1), Cernicharo J. R.(1), Goicoechea J. R.(1), Guélin M.(2), Phillips, T. G(3)
(1)Department of Molecular and Infrared Astrophysics, Instituto de Estructura de la Materia, CSIC, C/Serrano 121, 28006 Madrid, Spain (2)Institut de Radioastronomie Millimétrique, 300 rue de la Piscine, F-38406 St. Martin d'Hères, France (3)California Institute of Technology, Downs Laboratory of Physics 320-47, Pasadena, CA 91125

Abstract:
We present the millimeter and submillimeter line survey of the proto-planetary nebula CRL618. The survey has been carried out with the 30-m IRAM radiotelescope (80-115, 129-180, and 202-278 GHz) and the CSO telescope (280-350 GHz). The line survey shows the rotational lines of several molecular species that are produced in the proto-planetary nebula stage and that are absent in the AGB phase represented by IRC+10216. The wide frequency coverage allows a precise modelling of the molecular emission and permits to derive the physical parameters of the inner regions of CRL618 at angular scales below 5″. The abundances of HC_3N and HC_5N, the dominant species in number of detected lines, are enhanced by a factor larger than 100 relative to those found in red giants and AGB stars.

Appeared in: Proceedings of the dusty and molecular universe: a prelude to Herschel and ALMA, 27-29 October 2004, Paris, France. Ed. by A. Wilson. ESA SP-577, Noordwijk, Netherlands: ESA Publications Division, ISBN 92-9092-855-7, 2005, p. 455 - 456

Q0957+561 REVISED: CO EMISSION FROM A DISK AT $z = 1.4$

Krips M.([1,2]), Neri R.([2]), Eckart A.([1]), Downes D.([2]), Martín-Pintado J.([3]) Planesas, P.([4])
([1])I. Physikalisches Institut, University of Cologne, Zülpicherstr. 77, 50937 Köln, ([2])Institut de Radio Astronomie Millimétrique, 300 rue de la Piscine, 38406 Saint Martin d'Hères, France, ([3])Instituto de Estructura de la Materia (CSIC), Serrano 121, 28006 Madrid, Spain, ([4])Observatorio Astronómico Nacional (IGN), Apartado 112, 28800 Alcalá de Henares, Spain

Abstract:
Based on additional interferometric observations, we reanalysed the CO(2-1) and 3 mm continuum emission of Q0957+561, a lensed QSO at a redshift of z=1.4141. The emission in the CO(2-1) lines reveals a gas-rich host galaxy with a peculiar double-peaked profile at one of the two lensed images. Our new interferometric CO maps of the host galaxy agree well with HST images obtained by Keeton et al. (2000) and we thus argue that the two velocity components arise from molecular gas in the disk of the host galaxy. We also present new model calculations, all in excellent agreement with recent time delay measurements and simulations.

Based on observations carried out with the IRAM Plateau de Bure Interferometer. IRAM is supported by INSU/CNRS (France), MPG (Germany) and IGN (Spain).

Appeared in: A&A 431, 879

CHEMICAL DIFFERENTIATION ALONG THE CEPA-EAST OUTFLOWS

C. Codella([1]), R. Bachiller([2]), M. Benedettini([3,4]), P. Caselli([5]), S. Viti([4]) and V. Wakelam([6,7])
([1])Istituto di Radioastronomia, INAF, Sezione di Firenze, Largo E. Fermi 5, 50125 Firenze, Italy, ([2])Observatorio Astronómico Nacional (IGN), Apartado 1143, E-28800, Alcalá de Henares (Madrid), Spain, ([3])Istituto di Fisica dello Spazio Interplantario, INAF, Area di Ricerca Tor Vergata, Via Fosso del Cavaliere 100, 00133 Roma, Italy, ([4])Department of Physics and Astronomy, University College London, Gower Street WC1E6 BT London, UK, ([5])Osservatorio Astrofisico di Arcetri, INAF, Largo E. Fermi 5, 50125 Firenze, Italy, ([6])Observatoire de Bordeaux, BP 89, 33270 Floirac, France, ([7])The Ohio State University, Department of Physics, 174 W. 18th Ave., Columbus, OH 43210-1106 USA

Abstract:
We present the results of a multiline survey at mm-wavelengths of the Cepheus A star forming region. Four main flows have been identified: three pointing in the SW, NE, and SE directions and accelerating high density CS clumps. The fourth outflow, revealed by high-sensitivity HDO observations, is pointing towards South and is associated with conditions particularly favourable to a chemical enrichment. At the CepA-East position the emissions due to the ambient clump and to the outflows coexist and different molecules exhibit different spectral behaviours. Some species ($C^{13}CH$, C_3H_2, CH_2CO, CH_3C_2H, $HC^{18}O^+$) exhibit relatively narrow lines at ambient velocities (ambient peak). Other molecules (CO, CS, H_2S, SiO, SO, SO_2) show extended wings tracing the whole range of the outflow velocities. Finally, OCS, H_2CS, HDO, and CH_3OH are associated with wings and, in addition, show wings and in addition reveal a bright high velocity redshifted spectral peak (outflow peak) which can be used to investigate the southern outflows. At ambient velocities the gas is dense ($> 10^5$ cm^{-3}) and different components at distinct temperatures coexist, ranging from the relatively low kinetic temperatures (≤ 50 K) measured with H_2S, CH_3OH, H_2CS, and CH_3C_2H, to definitely higher temperature conditions, $\sim$ 100-200 K, obtained from the SiO, SO, and SO_2 spectra. For the outflow peak we derive densities between $\sim 10^4$ cm^{-3} to $\sim 10^7$ cm^{-3} and high temperatures, $\simeq$ 100-200 K, indicating regions compressed and heated by shocks.

The analysis of the line profiles shows that the SiO molecule dominates at the highest velocities and at the highest excitation conditions, confirming its close association with shocks. H_2S, SO_2, and SO preferentially trace more quiescent regions than SiO, and in particular a lack of bright H_2S emission at the highest velocities is found. OCS and H_2CS emit at quite high velocities, where the abundances of three shock tracers like SiO, CH_3OH, and HDO are higher. These results may indicate that H_2S is not the only major sulphur carrier in the grain mantles, and that OCS and H_2CS may probably play an important role on the grains; or that alternatively they rapidly form once the mantle is evaporated after the passage of a shock. Finally, the outflow peak emission has been compared with recent time-dependent sulphur chemistry models: the results indicate that, if associated with accurate measurements of the physical conditions, the CH_3OH/H_2CS column density ratio can be used as an effective chemical clock to date the age of shocked gas.

MNRAS, in press

THE ORBITING GAS DISK IN THE RED RECTANGLE

V. Bujarrabal([1]), A. Castro-Carrizo([2]), J. Alcolea([3]), R. Neri([2])
([1])Observatorio Astronómico Nacional (IGN), Apdo. 112, 28803 Alcalá de Henares, Spain, ([2])Institute de Radio Astronomie Millimétrique, 300 rue de la Piscine, 38406 St. Martin d'Hères, France, ([3])Observatorio Astronómico Nacional (IGN), c/ Alfonso XII 3, 28014, Madrid, Spain

Abstract:
We present accurate maps of the CO J=2–1 and 1–0 lines made with the Plateau de Bure interferometer of the gas

disk around the central star(s) of the Red Rectangle, a well known protoplanetary nebula. We confirm that the molecular gas in this source forms a disk perpendicular to the conspicuous axis of symmetry of the optical nebula and that this disk is in rotation. We present detailed modeling of the CO emission and extensive discussion on the accuracy of the values fitted for the different parameters. The outer radius of the disk is $\sim 2.7\ 10^{16}\ (\frac{D(\mathrm{pc})}{710})$ cm, as a function of the assumed distance D, which is thought to vary between 380 and 710 pc. The rotation is found to be keplerian, at least in the inner disk. From this velocity field, we derive a central mass between 0.9 $M_\odot$, for a distance of 380 pc, and 1.7 $M_\odot$, for 710 pc. Previous studies on the nature of the stellar component favor the highest value. In the outer disk, we deduce the presence of a slow expansion velocity ($\sim 0.8\ \mathrm{km\,s^{-1}}$), superimposed to rotation. We find gas temperatures decreasing from ~ 400 to 30 K across the disk and densities $\gtrsim 3 \cdot 10^4$.

A&A, in press

Warm gas in the cold diffuse interstellar medium: Spectral signatures in the H_2 pure rotational lines

Falgarone E.([1]), Verstraete L.([2]), Pineau Des Forêts G.([2]), Hily-Blant P.([3])
([1])Laboratoire de Radioastronomie, LERMA, École Normale Supérieure, 24 rue Lhomond, 75231 Paris Cedex 05, France, ([2])Institut d'Astrophysique Spatiale, Bât. 121, Université de Paris XI, 91405 Orsay Cedex, France, ([3])Institut de Radio Astronomie Millimétrique, 300 rue de la Piscine, 38406 Grenoble, France

Abstract:
We present ISO-SWS observations of five pure rotational lines of H_2 along a line of sight through the Galaxy which avoids regions of massive star formation. It samples 30 mag of gas, half of it (i.e. 15 mag) being diffuse gas running from the solar neighbourhood to the molecular ring, up to the far side of the Galaxy. The intensities of the S(1) and S(2) lines are too large relative to S(0) to be produced by UV excitation in the known radiation field of the Galaxy. The excitation of these transitions has to tap a more powerful source of energy. We investigate the possibility that it takes place in a large number of magneto-hydrodynamic (MHD) shocks or coherent small-scale vortices, two processes responsible for the intermittent dissipation of MHD turbulence. These dissipation bursts locally and temporarily heat the diffuse gas to temperatures ($T_k \approx 10^3$ K) well above that of the ambient diffuse gas. We compute the spectroscopic signatures of these processes in the H_2 lines. Not only are the computed relative line intensities in good agreement with the observations, but the few percent of warm gas involved is consistent with other independent determinations. We find that the fraction of warm H_2 in the diffuse gas (i.e. H_2 molecules in $J_u \geq 3$ levels) on that line of sight, $N(H_2^*)/A_v \approx 4 \times 10^{17} cm^{-2} mag^{-1}$, is the same as that found from far UV spectroscopy in the direction of nearby stars. It is also the same as that estimated in the solar neighbourhood to reproduce the large observed abundances of molecules like CH^+. These results suggest that the existence, within the cold neutral medium (CNM), of a few percent of warm gas, for which UV photons cannot be the sole heating source, is ubiquitous and presumably traces the intermittent dissipation of MHD turbulence in the cold diffuse gas.

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A study of the Keplerian accretion disk and precessing outflow in the massive protostar IRAS 20126+4104

Cesaroni R.([1]), Neri R.([2]), Olmi L.([3]), Testi L.([1]), Walmsley C. M.([1]), Hofner P.([4])
([1])Osservatorio Astrofisico di Arcetri, INAF, Largo E. Fermi 5, 50125 Firenze, Italy, ([2])IRAM, 300 rue de la Piscine, Domaine Universitaire, 38406 St. Martin d'Hères Cedex, France, ([3])Istituto di Radioastronomia, CNR, Sezione di Firenze, Largo E. Fermi 5, 50125 Firenze, Italy, ([4])National Radio Astronomy Observatory, PO Box O, Socorro, NM 87801, USA

Abstract:
We report on interferometric observations at 3.2 and 1.3 mm of the massive young stellar object IRAS 20126+4104 obtained in the $C^{34}S$ and CH_3OH lines and in the continuum emission. The $C^{34}S$ data confirm the existence of a Keplerian disk, as already suggested by various authors. However, the mass of the central object is $\approx 7 M_\odot$, significantly less than previous estimates. We believe that such a discrepancy is due to the fact that the rotation curve is affected not only by the star but also by the mass in the innermost regions of the disk itself: this leads to an overestimate of the stellar mass when low-density tracers are used to study the velocity field over regions larger than a few seconds of arc (i.e. a few 0.01 pc). On the basis of the line profiles we speculate that accretion onto the star might be still occurring through the disk. This seems consistent with current models of high-mass star formation which predict an accretion luminosity equal to that of IRAS 20126+4104 for a $7 M_\odot$ protostar. The CH_3OH lines trace both the disk and the bipolar outflow previously detected in other molecules such as HCO^+, SiO, and H_2. New H_2 images obtained at $2.2 \mu m$ confirm that the outflow axis is undergoing precession. We elaborate a simple model that suitably fits the data thus allowing derivation of a few basic parameters of the precession.

Appeared in A&A 434, 1039

A detailed study of the rotating toroids in G31.41+0.31 and G24.78+0.08

Beltrán M. T.([1]), Cesaroni R.([1]), Neri R.([2]), Codella C.([3]), Furuya R. S.([4]), Testi, L.([1]) and Olmi L.([3])
([1])INAF, Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, 50125 Firenze, Italy,
([2])IRAM, 300 rue de la Piscine, 38406 Saint Martin d'Hères, France ([3])Istituto di Radioastronomia, INAF, Sezione di Firenze, Largo E. Fermi 5, 50125 Firenze, Italy, ([4])Division of Physics, Mathematics, and Astronomy, California Institute of Technology, MS 105-24, Pasadena, CA 91125, USA

Abstract:
We present the results of high angular resolution millimeter observations of gas and dust toward G31.41+0.31 and G24.78+0.08, two high-mass star forming regions where four rotating massive toroids have been previously detected. The CH_3CN (12-11) emission of the toroids in G31.41+0.31 and core A1 in G24.78+0.08 has been modeled assuming that it arises from a disk-like structure seen edge-on, with a radial velocity field. For G31.41+0.31 the model properly fits the data for a velocity $v_{rot} \simeq$ 1.7 km s^{-1} at the outer radius $R_{out} \simeq$ 13400 AU and an inner radius $R_{inn} \simeq$ 1340 AU, while for core A1 in G24.78+0.08 the best fit is obtained for $v_{rot} \simeq 2.0$ km s^{-1} at $R_{out} \simeq 7700$ AU and $R_{inn} \simeq 2300$ AU. Unlike the rotating disks detected around less luminous stars, these toroids are not undergoing Keplerian rotation. From the modeling itself, however, it is not possible to distinguish between constant rotation or constant angular velocity, since both velocity fields suitably fit the data. The best fit models have been computed adopting a temperature gradient of the type $T \propto R^{-3/4}$, with a temperature at the outer radius $T_{out} \simeq 100$ K for both cores. The M_{dyn} needed for equilibrium derived from the models is much smaller than the mass of the cores, suggesting that such toroids are unstable and undergoing gravitational collapse. The collapse is also supported by the CH_3^13CN or CH_3CN line width measured in the cores, which increases toward the center of the toroids. The estimates of v_{inf} and $\dot{M}_{acc}$ are 2 km s^{-1} and $\propto 3 \times 10^{-2} M_\odot$ yr^{-1} for G31.41+0.31, and 1.2 km s^{-1} and $\propto 9 \times 10^{-3} M_\odot$ yr^{-1} for G24.78+0.08 A1. Such large accretion rates could weaken the effect of stellar winds and radiation pressure and allow further accretion on the star. The values of T_{rot} and N_{CH_3CN}, derived by means of the RD method, for both G31.41+0.31 and the sum of cores A1 and A2 (core A of Codella et al. 1997, A&A, 325, 282) in G24.78+0.08 are in the range 132-164 K and $2 - 8 \times 10^{16}$ cm^{-2}. For G31.41+0.31, the most plausible explanation for the apparent toroidal morphology seen in the lower K transitions of CH_3CN (12-11) is self-absorption, which is caused by the high optical depth and temperature gradient in the core.

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An interferometric CO survey of luminous submillimetre galaxies

Greve T. R.([1,5]), Bertoldi F.([2]), Smail Ian([3]), Neri R.([4]), Chapman S. C.([5]), Blain A. W.([5]), Ivison R. J.([1,6]), Genzel R.([7,8]), Omont A.([9]), Cox P.([10]), Tacconi L.([7]) and Kneib J.-P.([5,11,12])
([1])Institute for Astronomy, University of Edinburgh, Blackford Hill, Edinburgh EH9 3HJ, ([2])Max-Planck Institut für Radioastronomie(MPIfR), Bonn, Germany, ([3])Institute for Computational Cosmology, University of Durham, South Road, Durham DH1 3LE, ([4])Institut de Radio Astronomie Millimétrique (IRAM), St Martin d'Hères, France, ([5])California Institute of Technology, Pasadena, CA 91125, USA, ([6])Astronomy Technology Centre, Royal Observatory, Blackford Hill, Edinburgh EH9 3HJ, ([7])Max-Planck Institut für extraterrestrische Physik (MPE), Garching, Germany ([8])Department of Physics, University of California, Berkeley, USA, ([9])Institut d'Astrophysique de Paris, CNRS, Université de Paris, Paris, France, ([10])Institut d'Astrophysique Spatiale, Université de Paris Sud, Orsay, France, ([11])Observatoire Midi-Pyrénées, UMR5572, 14 Avenue Edouard Belin, 31400 Toulouse, France ([12])Laboratoire d'Astrophysique de Marseille, UMR 6110, CNRS-Université de Provence, Traverse du Siphon-Les trois Lucs, 13012 Marseille, France

Abstract:
In this paper, we present results from an Institut de Radio Astronomie Millimétrique (IRAM) Plateau de Bure millimetre-wave Interferometer (PdBI) survey for carbon monoxide (CO) emission towards radio-detected submillimetre galaxies (SMGs) with known optical and near-infrared spectroscopic redshifts. Five sources in the redshift range $z \approx 1 - 3.5$ were detected, nearly doubling the number of SMGs detected in CO. We summarize the properties of all 12 CO-detected SMGs, as well as six sources not detected in CO by our survey, and use this sample to explore the bulk physical properties of the submillimetre galaxy (SMG) population as a whole. The median CO line luminosity of the SMGs is $\langle L'_{CO} \rangle =$ $(3.8 \pm 2.0) \times 10^{10}$Kkms^{-1}pc^2. Using a CO-to-H_2 conversion factor appropriate for starburst galaxies, this corresponds to a molecular gas mass $\langle M(H_2) \rangle = (3.0 \pm 1.6) \times 10^{10} M_\odot$ within an $\approx$ 2kpc radius, approximately 4 times greater than the most luminous local ultraluminous infrared galaxies (ULIRGs) but comparable to that of the most extreme high-redshift radio galaxies (HzRGs) and quasi-sellar objects (QSOs). The median CO FWHM linewidth is broad, $\langle FWHM \rangle = 780 \pm 320$kms^{-1}, and the SMGs often have double-peaked line profiles, indicative of either a merger or a disc. From their median gas reservoirs ($\approx 3 \times 10^{10} M_\odot$) and star formation rates ($\gtrsim 700 M_\odot$ yr^{-1}), we estimate a lower limit on the typical gas-depletion time-scale of $\gtrsim$40Myr in SMGs. This is marginally below the typical age expected for the starbursts in SMGs and suggests that negative feedback processes may play an

important role in prolonging the gas consumption timescale. We find a statistically significant correlation between the far-infrared and CO luminosities of the SMGs, which extends the observed correlation for local ULIRGs to higher luminosities and higher redshifts. The non-linear nature of the correlation implies that SMGs have higher far-infrared to CO luminosity ratios and possibly higher star formation efficiencies (SFEs), than local ULIRGs. Assuming a typical CO source diameter of $\Theta \approx 0.5$ arcsec ($D \approx 4$kpc), we estimate a median dynamical mass of $\langle M_{dyn} \rangle \approx (1.2 \pm 1.5) \times 10^{11} M_{\odot}$ for the SMG sample. Both the total gas and stellar masses imply that SMGs are very massive systems, dominated by baryons in their central regions. The baryonic and dynamical properties of these systems mirror those of local giant ellipticals and are consistent with numerical simulations of the formation of the most massive galaxies. We have been able to impose a lower limit of $\gtrsim 5 \times 10^{-6} Mpc^{-3}$ to the comoving number density of massive galaxies in the redshift range $z \approx 2-3.5$, which is in agreement with results from recent spectroscopic surveys and the most recent model predictions.

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Molecular gas in a $z \approx 2.5$ triply-imaged, sub-mJy submillimetre galaxy typical of the cosmic far-infrared background

Kneib J.-P.([1,2,3]), Neri R.([4]), Smail I.([5]), Blain A.([2]), Sheth K.([2]), van der Werf P.([6]), Knudsen K. K.([6])
([1])Observatoire Midi-Pyrénées, CNRS-UMR5572, 14 avenue E. Belin, 31400 Toulouse, France ([2])Caltech-Astronomy, MC105-24, Pasadena, CA 91125, USA, ([3])OAMP, Laboratoire d'Astrophysique de Marseille, traverse du Siphon, 13012 Marseille, France, ([4])IRAM, 300 rue de la Piscine, 38640 Saint Martin d'Hères, France, ([5])Institute for Computational Cosmology, University of Durham, South Road, Durham DH1 3LE, UK, ([6])Leiden Observatory, PO Box 9513, NL - 2300 RA Leiden, The Netherlands

Abstract:
We present the results of observations from the Plateau de Bure IRAM interferometric array of the submillimetre (submm) galaxy SMMJ16359+6612 lying at $z = 2.516$ behind the core of the massive cluster A 2218. The foreground gravitational lens produces three images with a total magnification of 45 of this faint submm galaxy, which has an intrinsic submm flux of just $f_{850 \mu m} = 0.8$ mJy - placing it below the confusion limit of blank-field surveys. The substantial magnification provides a rare opportunity to probe the nature of a distant sub-mJy submm-selected galaxy, part of the population which produces the bulk of the cosmic far-infrared background at submm wavelengths. Our observations detect the CO(3-2) line in all three images, as well as the CO(7-6) line and the dust continuum at 1.3 mm for the brightest image but only at a 3σ level. The velocity profile of the CO(3-2) line displays a double-peak profile which is well fit by two Gaussians with FWHM of 220 km s^{-1} and separated by 280 km s^{-1}. We estimate the dynamical mass of the system to be $\approx 1.5 \times 10^{10} M_{\odot}$ and an H_2 gas mass of $4.5 \times 10^{9} M_{\odot}$. We identify a spatial offset of $\approx 1''$between the two CO(3-2) velocity components, again benefiting from the magnification due to the foreground lens, modeling of which indicates that the offset corresponds to just ≈ 3 kpc in projection at $z = 2.516$. The spatial and velocity properties of these two components are closely related to features detected in previously published Hα spectroscopy. We propose that this source is a compact merger of two typical Lyman-break galaxies with a maximal separation between the two nuclei of about 3 kpc, although a dusty disk explanation is not excluded. This system is much less luminous and massive than other high-redshift submillimetre galaxies studied to date, but it bears a close similarity to similarly luminous, dusty starburst resulting from lower-mass mergers in the local Universe.

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Velocity field and star formation in the Horsehead nebula

P. Hily-Blant([1,2]), D. Teyssier([3,4]), S. Philipp([5]) and R. Güsten([5])
([1])LRA-LERMA, École normale supérieure et Observatoire de Paris, 24 rue Lhomond, 75231 Paris cedex 05, France, ([2])Institut de Radio Astronomie Millimétrique, 300 Rue de la Piscine, F-38406 Saint Martin d'Hères, France, ([3])Space Research Organization Netherlands, P.O.Box 800, 9700 AV Groningen, The Netherlands, ([4])Departamento de Astrofisica Molecular e Infrarroja, Instituto de Estructura de la Materia, CSIC, Serrano 121, 28006, Madrid, Spain ([5])Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, D-53121 Bonn, Germany

Abstract:
Using large scale maps in $C^{18}O(2-1)$ and in the continuum at 1.2mm obtained at the IRAM-30m antenna with the Heterodyne Receiver Array (HERA) and MAMBO2, we investigated the morphology and the velocity field probed in the inner layers of the Horsehead nebula. The data reveal a non–self-gravitating ($m/m_{\rm vir} \approx 0.3$) filament of dust and gas (the "neck", $\emptyset = 0.15 - 0.30\,$pc) connecting the Horsehead western ridge, a Photon-Dominated Region illuminated by σOri, to its parental cloud L1630. Several dense cores are embedded in the ridge and the neck. One of these cores appears particularly peaked in the 1.2 mm continuum map and corresponds to a feature seen in absorption on ISO maps around 7 μm. Its $C^{18}O$ emission drops at the continuum peak, suggestive of molecular depletion onto cold grains. The channel maps of the Horsehead exhibit an overall north-east velocity gradient whose orientation swivels east-west, showing

a somewhat more complex structure than was recently reported by Pound 2003 et al. using BIMA CO$(1-0)$ mapping. In both the neck and the western ridge, the material is rotating around an axis extending from the PDR to L1630 (angular velocity $= 1.5 - 4.0\,\mathrm{km\cdot s^{-1}}$). Moreover, velocity gradients along the filament appear to change sign regularly (3 km·s−1·pc−1, period=0.30 pc) at the locations of embedded integrated intensity peaks. The nodes of this oscillation are at the same velocity. Similar transverse cuts across the filament show a sharp variation of the angular velocity in the area of the main dense core. The data also suggest that differential rotation is occurring in parts of the filament. We present a new scenario for the formation and evolution of the nebula and discuss dense core formation inside the filament.

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Photon dominated regions in the spiral arms of M83 and M51

C.Kramer([1]), B.Mookerjea([1]), E.Bayet([2]), S.Garcia-Burillo([3]), M.Gerin([2]), F.P. Israel([4]), J.Stutzki([1]), and J.G.A. Wouterloot([5])
([1])KOSMA, I. Physikalisches Institut, Universität zu Köln, Zülpicher Straße 77, 50937 Köln, Germany, ([2])Radioastronomie Millimetrique: UMR 8540 du CNRS, Laboratoire de Physique de l'ENS, 24 Rue Lhomond, 75231 Paris cedex 05, France, ([3])Centro Astronomico de Yebes, IGN, E-19080 Guadalajara, Spain, ([4])Sterrewacht Leiden, P.O. Box 9513, 2300 RA Leiden, The Netherlands, ([5])Joint Astronomy Centre, 660 N. A'ohoku Place, Hilo, HI, USA

Abstract:
We present [CI] $^3\mathrm{P}_1$–$^3\mathrm{P}_0$ spectra at four spiral arm positions and the nuclei of the nearby galaxies M83 and M51 obtained at the JCMT. The spiral arm positions lie at galacto-centric distances of between 2 kpc and 6 kpc. This data is complemented with maps of CO 1–0, 2–1, and 3–2, and ISO/LWS far-infrared data of [CII] (158 μm), [OI] (63 μm), and [NII] (122 μm) allowing for the investigation of a complete set of all major gas cooling lines. From the intensity of the [NII] line, we estimate that between 15% and 30% of the observed [CII] emission originate from the dense ionized phase of the ISM. The analysis indicates that emission from the diffuse ionized medium is negligible. In combination with the FIR dust continuum, we find gas heating efficiencies below $\sim 0.21\%$ in the nuclei, and between 0.25 and 0.36% at the outer positions. Comparison with models of photon-dominated regions (PDRs) of Kaufman et al. (1999) with the standard ratios [OI](63)/[CII]$_{\mathrm{PDR}}$ and (OI(63)+[CII]$_{\mathrm{PDR}}$) vs. TIR, the total infrared intensity, yields two solutions. The physically most plausible solution exhibits slightly lower densities and higher FUV fields than found when using a full set of line ratios, [CII]$_{\mathrm{PDR}}$/[CI](1–0), [CI](1–0)/CO(3–2), CO(3–2)/CO(1–0), [CII]/CO(3– 2), and, [OI](63)/[CII]$_{\mathrm{PDR}}$. The best fits to the latter ratios yield densities of $10^4\,\mathrm{cm}^{-3}$ and FUV fields of $\sim G_0$ =20–30 times the average interstellar field without much variation. At the outer positions, the observed total infrared intensities are in perfect agreement with the derived best fitting FUV intensities. The ratio of the two intensities lies at 4–5 at the nuclei, indicating the presence of other mechanisms heating the dust. [CI] area filling factors lie below 2% at all positions, consistent with low volume filling factors of the emitting gas. The fit of the model to the line ratios improves significantly if we assume that [CI] stems from a larger region than CO 2–1. Improved modelling would need to address the filling factors of the various submm and FIR tracers, taking into consideration the presence of density gradients of the emitting gas by including cloud mass and size distributions within the beam.

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GRB 050509b: the elusive optical/nIR/mm afterglow of a short-duration GRB

A. J. Castro-Tirado([1]), A. de Ugarte Postigo([1]), J. Gorosabel([1]), T. Fathkullin([2]), V. Sokolov([2]), M. Bremer([3]), I. Márquez([1]), A. J. Marín([1]), S. Guziy([1,4]), M. Jelínek([1]), P. Kubánek([5]), R. Hudec([5]), S. Vitek([6]), T. J. Mateo Sanguino([7]), A. Eigenbrod([8]), M. D. Pérez-Ramírez([9]), A. Sota([1]), J. Masegosa([1]), F. Prada([1]), and M. Moles([1])
([1])Instituto de Astrofísica de Andalucía (IAA-CSIC), P.O. Box 3.004, E-18.080 Granada, Spain, ([2])Special Astrophysical Observatory, Russian Academy of Sciences, Karanchai-Cherkessia, Nizniy-Arkhyz, 357147, Russia, ([3])Institute de Radioastronomie Milimétrique (IRAM), 300 rue de la Piscine, 38406 Saint Martin d'Hères, France, ([4])Nikolaev State University, Nikolskaya 24, 54.030 Nikolaev, Ukraine, ([5])Astronomical Institute, Academy of Sciences of the Czech Republic, 25165 Ondřejov, Czech Republic, ([6])Fakulta electrotechnická, Czech Technical University, 121 35 Praha, Czech Republic, ([7])Dept. de Ing. Electrónica, Sistemas Informáticos y Automática, Univ. de Huelva, 21.819 Palos de la Frontera (Huelva), Spain, ([8])Ecole Polytechnique Fédérale de Lausanne, Lab. d'Astrophysique, Observatoire, CH-1290 Chavannes-des-Bois, Switzerland, ([9])Departamento de Física (EPS), Univ. de Jaén, Campus Las Lagunillas, E-23,071 Jaén, Spain

Abstract:
We present multiwavelength (optical/near infrared/millimetre) observations of a short duration gamma-ray burst detected by Swift (GRB 050509b) collected between 0 seconds and $\approx$ 18.8 days after the event. No optical, near infrared or millimetre emission has been detected in spite of the well localised X-ray afterglow, confirming the elusiveness of the short duration

events. We also discuss the possibility of the burst being located in a cluster of galaxies at z = 0.225 or beyond. In the former case, the spectral energy distribution of the neighbouring, potential host galaxy, favours a system harbouring an evolved dominant stellar population (age $\approx$ 360 Myr), unlike most long duration GRB host galaxies observed so far, i.e. thus giving support to a compact binary merger origin. Any underlying supernova that could be associated with this particular event should have been at least 3 magnitudes fainter than the type Ib/c SN 1998bw and 2.3 magnitudes fainter than a typical type Ia SN.

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A New Intermediate-Mass Protostar in the Cepheus A HW2 Region

Jesús Martín-Pintado([1]), Izaskun Jiménez-Serra([1]), Artur Rodríguez-Franco([1]), Sergio Martín([2]), Clemens Thum([3])
([1])Departamento de Astrofísica Molecular e Infrarroja, Instituto de Estructura de la Materia, CSIC, Calle Serrano 121, E-28006 Madrid, Spain, ([2])Instituto de Radioastronomía Milimétrica, Local 20, Avenida Divina Pastora 7, E-18012 Granada, Spain, ([3])Institut de Radioastronomie Millimétrique, 300 rue de la Piscine, F-38406 Saint Martin d'Hères, France

Abstract:
We present the discovery of the first molecular hot core associated with an intermediate-mass protostar in the Cep A HW2 region. The hot condensation was detected from single-dish and interferometric observations of several high-excitation rotational lines (from 100 to 880 K above the ground state) of SO_2 in the ground vibrational state and of HC_3N in the vibrationally excited states $v_7 = 1$ and $v_7 = 2$. The kinetic temperature derived from both molecules is $\approx$ 160 K. The high angular resolution observations ($1.25'' \times 0.99''$) of the SO_2 $J = 28_{7,21} \to 29_{6,24}$ line (488 K above the ground state) show that the hot gas is concentrated in a compact condensation with a size of $\approx 0.6''$ ($\approx$ 430 AU), located $0.4''$ (300 AU) east from the radio jet HW2. The total SO_2 column density in the hot condensation is $\approx 10^{18}$ cm^{-2}, with an H_2 column density ranging from $\approx 10^{23}$ to 6×10^{24} cm^{-2}. The H_2 density and the SO_2 fractional abundance must be larger than 10^7 cm^{-3} and 2×10^{-7}, respectively. The most likely alternatives for the nature of the hot and very dense condensation are discussed. From the large column densities of hot gas, the detection of the HC_3N vibrationally excited lines, and the large SO_2 abundance, we favor the interpretation of a hot core heated by an intermediate-mass protostar of 10^3 $L_\odot$. This indicates that the Cep A HW2 region contains a cluster of very young stars.

Appeared in: ApJ 628, L61

New Preprints

580. INTERSTELLAR DEUTERATED AMMONIA: FROM NH_3 TO ND_3
E. Roueff, D.C. Lis, F.F.S. van der Tak, M. Gerin, P.F. Goldsmith
2005, *Astronomy & Astrophysics*

The IRAM Newsletter is edited by Michael Bremer at IRAM-Grenoble (e-mail address: bremer@iram.fr).

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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 80 54 54	(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:

- IRAM-Grenoble: username@iram.fr
- IRAM-Granada: username@iram.es

The username is generally the last name of the person to be contacted.