IRAM

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

Newsletter

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Contents

Calendar

February 22, 2006:
Expected opening of the proposal submission facility.

March 9th, 2006 17:00h CET (UT+1 hour):
Deadline for the submission of IRAM observing proposals for the period from May 15, 2006 to November 15, 2006.

April 10/11, 2006:
Program committee meeting.

April 24, 2006:
Expected publication of PC grades.

Changes at the IRAM Direction

Since January 1st, 2006, IRAM has a new directorial staff. Karl-Friedrich SCHUSTER has taken over the responsability of the IRAM Deputy Director, succeeding myself who took over the position of IRAM Director. Together with Christelle MESUREUR, who is the Head of Administration since March, 2005, we will form the directorial staff for the next 5 years.

I will succeed Michael GREWING who has been serving as IRAM Director for 16 years. With his dedication, energy and competence, Michael GREWING has served IRAM over a period extending from the early start of the Plateau de Bure interferometer to the instrument as we know it today. Michael deserves a lot of credit for having maintained the level of IRAM to a world leading institute in radioastronomy, especially during the very difficult period following the tragical accidents of 1999. During his directorship, both the interferometer and the 30-meter telescope have seen many profound changes and improvements, enabling new instrumentation to be installed and opening new windows in the exploration of the universe. During the last decade, Michael GREWING has also been instrumental in increasing the participation of IRAM in the European Framework Programmes and in strengthening the role of IRAM in the ALMA project. It is the will of the new directorship to continue the challenging task of maintaining the world leading status of IRAM over the coming years, through both technological developments and cutting-edge scientific activities. Michael GREWING will have finally time to devote his energy and imagination to science and use for his research the instruments he has so much helped to bring to their current state. We wish him all the best in this new endeavour.

Pierre COX

Staff Changes

IRAM Granada

As of December 31st, 2005 our operators Fernando Anel and David Martínez are on a long-term leave of absence. Víctor Espigares, formerly in the informatics group, is now working in the operator group.

Rainer MAUERSBERGER

IRAM Grenoble

The astronomer's group welcomes Vincent PIÉTU, who has started work as a postdoc on January 1st, and Sandrine BOTTINELLI, who has arrived on February 1st to work at IRAM on her astronomy thesis.

On Februray 1st, Olivier GARNIER has joint the receiver group.

Michael BREMER

Fifth IRAM Millimeter Interferometry School - First Announcement

IRAM will organize this year its Fifth Millimeter Interferometry School. The school will take place at the IRAM headquarters (Grenoble, France) on October 2-6, 2006. This event is supported by RadioNet.

This school is intended for PhD students, post-docs and scientists who want to acquire a good knowledge of interferometry techniques and data reduction at millimeter wavelengths. As in the previous series of IRAM Interferometry Schools, the lectures will be focused on the Plateau de Bure interferometer and will include a presentation of the ALMA project. Tutorials will be organized during the entire week to help the participants to become familiar with the reduction and imaging of Plateau de Bure Interferometer data. We would also like to encourage participants to present posters related to their scientific work using radio interferometric techniques.

If you are interested to participate, please contact us by sending an Email to Cathy Berjaud (berjaud@iram.fr).

Regular updates concerning the school will be posted on the IRAM webpage (http://www.iram.fr)

The proceedings and lectures of the previous IRAM Interferometer Schools can be retrieved on line at http://www.iram.fr/IRAMFR/IS/school.htm

Proposals for IRAM Telescopes

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

March 9th, 2006 17:00h CET (UT+1 hour)

The scheduling period extends from May 15, 2006 to November 15, 2006, covering roughly the summer 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 be temporarily 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 contains a bullet, labelled "zero spacing" which should then be checked. 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.

Roberto NERI and Clemens THUM

[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.

Travel funds for European astronomers

IRAM is one of the organizations participating 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 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.

Roberto NERI and Clemens THUM

Confirmation of observation for the 30m telescope

We would like to remind you that a confirmation of observation form is available on-line: http://www.iram.fr/-IRAMFR/PV/obs_request/formulaire.html

Whatever your observation is (standard observation, pool observation, HERA pool observation), please fill in this form and send it *before* your run. It will allow to reserve an accomodation for you and to prepare the reimbursement of you trip.

Cathy BERJAUD

Call for Observing Proposals on the 30m Telescope

Summary

Proposals for three types of receivers will be considered for the coming summer 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 longer wavelengths. 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?

Since November 2005, the telescope runs under the VME and Linux based **New Control System (NCS)**. A short description of the NCS is given elsewhere in this Newsletter. At the time of writing, the last missing major feature of the first NCS installation, namely observations with HERA, is being implemented. The main restriction, still expected to apply during (part of) the summer semester concerns source coordinates. The only system fully supported now by the NCS is equatorial J2000.0, and we request observers to use this system for their source coordinates and offsets.

NCS upgrades, addition of new features, and smoothing out of imperfections will go on during much of the summer semester. The NCS team maintains a web page (../IRAMES/ncs30m) where the current status is described.

Remote observing is expected to be enabled again sometime during the next semester. Observers of accepted proposals should contact the scheduler (thum@iram.fr) about the status at the time.

The **dual polarization HERA** is operational together with its backends for high (VESPA) and low spectral resolution (WILMA, 4 MHz filters). 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. A broken pixel is planned to be repaired before the start of the new semester.

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 or service 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 much of the information necessary to plan 30m telescope observations[6]. It is however outdated in many sections, and we recommend also to consult the NCS web pages (../IRAMES/ncs30m)

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 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. The details of the procedures on which our time estimator is based are explained in a technical report published in the January 1995 issue[2] of the IRAM Newsletter [5].

Proposers should base their time request on normal summer 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.

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

Pooled observing

As in the previous summer semester, we plan to pool the bolometer and other suitable proposals together in one or more observing 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, in particular those using HERA, 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 Pool Coordinator, Stéphane Léon, leon@iram.es.

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 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 summer semester. Potential remote observers are advised 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 summer. 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 2005) 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 are listed in Tab. 1, and an updated user manual (version 1.9) 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 page on our Spanish web site.

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 will be 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. 1. 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. 1. Note that they cannot be combined with HERA nor with the bolometers. Also listed are typical system temperatures which apply to normal summer 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.1). Tests have shown that both 3mm receivers, A 100 and B 100 have good performance (good USB rejection and system temperature) in the range 77 – 80 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

Table 1: Heterodyne receivers available for the next summer observing season. Performance figures are based on recent measurements at the telescope. T^*_{sys} is the SSB system temperature in the T^*_A scale at the nominal center of the tuning range, assuming average summer conditions (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	polari– zation	combinations 1	2	3	4	tuning range GHz	T_{Rx}(SSB) K	g_i dB	ν_{IF} GHz	$\Delta\nu_{IF}$ GHz	T^*_{sys} K	remark
A 100	V	1		3		80 - 115.5	60 - 80	> 20	1.5	0.5	120	
B 100	H	1			4	81 - 115.5	60 - 80	> 20	1.5	0.5	120	1
C 150	V		2		4	129 - 183	70 - 125	15 - 25	4.0	1.0	200	
D 150	H		2	3		129 - 183	80 - 125	8 - 17	4.0	1.0	200	
A 230	V	1		3		197 - 266	85 - 150	12 - 17	4.0	1.0	450	2
B 230	H	1			4	197 - 266	95 - 160	12 - 17	4.0	1.0	450	2
C 270	V		2		4	241 - 281	125 - 250	10 - 20	4.0	1.0	1000	3
D 270	H		2	3		241 - 281	150 - 250	9 - 13	4.0	1.0	1000	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.

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 many frequencies, experience is still limited, particularly at 1.3mm wavelength and with respect to 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, wiesemey@iram.fr). 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 (see [16]).

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 39 mJy $s^{\frac{1}{2}}$. For MAMBO–2 effective sensitivities of 46 mJy $s^{\frac{1}{2}}$ (ON/OFF mode) and 52 mJy $s^{\frac{1}{2}}$ (mapping mode) were measured. The *rms*, in mJy, of a MAMBO–2 map is typically

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

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 conditions (stable atmosphere), (τ(250GHz) $\sim$ 0.3, 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 0.4 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. 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 (quasi 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 2 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 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

[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 2: 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 $R\sigma = 0.07$

$\leq 2''$). 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.

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/1 GHz samplers. An informative technical overview of the architecture is available at URL ../IRAMFR/TA/backend/veleta/-wilma/index.htm.

Note that WILMA cannot presently be connected to any of 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 and Rainer MAUERSBERGER

News from the Plateau de Bure Interferometer

Prototype of the Next Generation Receiver

In view of current plans to upgrade the Plateau de Bure antennas by a new receiver generation, the present winter observing period started with the arrival of a prototype Next Generation Receiver (NGR). It was installed in one of the antennas (antenna 6) at the end of November, followed by a period of initial testing in December. It turned out that the receiver efficiency at certain tuning frequencies is lower than expected from previous tests carried out in the receiver lab at Grenoble. Also, the image band rejection is only about a factor 4-5, again less than what was initially expected. These issues are presently being investigated and we hope to have them solved before the start of the summer observing period.

We will report in the next Newsletter in more detail on these issues, but also offer insights on progress being made and remaining challenges in equipping all six antennas with NGRs.

To stay compatible with the present receivers, the prototype operates for the time being in dual frequency mode at 2.6 mm and 1.3 mm, employing a frequency scheme different from the one used in the present receivers to match the 580 MHz bandwidth of the current system.

According to the different frequency scheme of the prototype receiver, proposers should be aware of the fact that observations in the image sideband at 2.6 mm and 1.3 mm will yield useful data only on baselines which include antennas still equipped with the current receivers.

Due to some subtleties regarding the creation of correct continuum uv-tables from data obtained with the prototype receiver, proposers whose programs were (or will be) observed after December 2005 are advised to get in touch with the Science Operations Group (sog@iram.fr).

Roberto NERI, Jean-Yves CHENU, & Jan Martin WINTERS

New extended configurations scheduled

The beginning of the year 2006 was highlighted on Plateau de Bure by moving the array for the first time into the new extended A-configuration, including the new stations N46 and E68. The change of configuration was accomplished on Friday, 13th January 2006 in less than one day, thanks to excellent weather conditions and a perfect preparation of the tracks, in terms of snow clearing and de-icing. Special thanks go here to Laurent Broche, Bruno Convers and Laurent Lapeyre, all three mechanics at the Plateau de Bure.

After only a few hours, André Rambaud, operator at Plateau de Bure, obtained fringes on all baselines and later in the night Patrick Chaudet (the second operator on site during that week) obtained a baseline solution with an excellent precision. The first scientific project was successfully observed in the new A configuration the following morning, again under excellent atmospheric conditions and on January 24th already 14 tracks have been completed.

This tremendous success would not have been possible without the dedication and hard work of many people, last but not least those who did the snow cleaning! Thanks to all of those involved for their enthusiasm and for their efforts that made this success possible!

Roberto NERI, Bertrand GAUTIER, & Jan Martin WINTERS

Weather conditions and proposal status

The array was moved into the new C configuration in mid December and the most extended new A configuration was scheduled from mid January on. It is planned to move to the B configuration around mid of February and to the C configuration by mid of March. The switch back to the most compact configuration D is foreseen before mid of April. According to these plans, it will not be possible to complete projects requesting deep integrations and low-resolution mapping before end of April.

The beginning of the winter period saw good observing conditions up to Christmas and excellent atmospheric stability since mid of January. Occasional high winds have somewhat reduced the observing efficiency, but by January 24 we had observed 32 out of 43 A-rated and 56 B-rated programs, and already 7 have been classified as being successfully completed.

As far as A-rated projects are concerned, we look forward to bring many of these to completion before the end of the current winter semester. B-rated projects are likely to be observed only if they fall in a favorable LST range. We remind users of the Plateau de Bure interferometer that B-rated proposals which are not started before the end of the winter period have to be resubmitted.

Global VLBI observations, which include the array in the 3mm phased-array mode, are planned from May 4 to 10, 2006.

Investigators, who wish to check the status of their project, may consult the interferometer schedule on the Web at ../PDBI/ongoing.html. The page is updated daily.

Roberto NERI & Jan Martin WINTERS

Call for Observing Proposals on the Plateau de Bure Interferometer

Conditions for the next summer period

As every year, we plan to carry out extensive technical work during the summer period. In parallel to the maintenance, regular scientific observations will be carried out during the whole period with the five element array. Taking these considerations into account, we are confident to be able to schedule about 20 to 30 projects.

We plan to start the maintenance at the latest by the end of May and to schedule the new 5D configuration between June and September and the new 6C configuration in October.

We strongly encourage observers to submit proposals that can be executed during summer operating conditions. To keep the procedure as simple as possible, we ask to focus on:

- observations requesting the use of the 3mm receivers
- circumpolar sources or sources transiting at night between June and September,
- observations that qualify for the 5D and 6C configurations

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

Proposal category

Proposals should be submitted for one of the five categories:

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

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

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

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

SPECIAL: Exploratory proposals: proposals whose scientific interest justifies the attempt to use the PdB array beyond its guaranteed capabilities. This category includes for example non-standard frequencies for which the tuning cannot be guaranteed, non-standard configurations 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

Configurations planned for the summer period are:

Name	Stations
5Dq	W08 E03 N07 N11 W05
6Cq	W12 E10 N17 N11 E04 W09

Part of the projects will be scheduled at the end of the summer period when the six-element array is expected to be back to operation. Projects that should be observed with a subset of the five-element array, will be adjusted in uv-coverage and observing time.

The following configuration sets are available:

Set	Main purpose
D	Detection + "low" resolution mapping at 1.3mm
CD	3.5″ resolution mapping at 3mm

Finally, enter ANY in the proposal form if your project doesn't need any particular configuration.

Receivers

All antennas are equipped with fully operational dual frequency receivers. The available frequency range is 82 GHz to 116 GHz for the 3mm band, and 205 to 245 GHz for the 1.3mm band. The 3mm and 1.3mm receivers are aligned to within about 2″. For details about observing at frequencies beyond the guaranteed tuning range of the 3mm and 1.3mm receivers, please get in touch with the Science Operations Group (sog@iram.fr).

Antenna 6 has been equipped with a prototype new generation receiver, which can only be tuned single sideband. More Details of the prototype are described in the section "PROTOTYPE OF THE NEXT GENERATION RECEIVER" above. Please take these into consideration for your proposal.

For the remaining current receivers, the following rules apply: Below 105 GHz, receivers offer best performances in LSB tuning with high rejection (20 dB): expected system temperatures are 150 to 200 K for the summer time. Above 105 GHz, best performances are obtained with USB tuning, low rejection (4 to 6 dB): expected system temperatures are 300 to 450 K at 115 GHz. DSB tuning is possible over the whole frequency range, but the system temperature may degrade significantly.

The current 1.3mm receivers can only be tuned double sideband. Expected (LSB and USB) system temperatures are 500 K at 230 GHz for sources at declinations higher than 20°.

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

- $T_{\rm sys}$ is the mean system temperature in T_r^* scale (150 K below 110 GHz, 300 K at 115 GHz, 500 K at 230 GHz for sources at $\delta \geq 20°$),
- $J_{\rm pK}$ is the conversion factor from Kelvin to Jansky (22 at 3mm, 35 at 1.3mm),
- η is an efficiency factor due to atmospheric phase noise (0.9 at 3mm, 0.8 at 1.3mm),
- $N_{\rm a}$ is the number of antennas (5), and $N_{\rm c}$ is the basic number of configurations (1 for D, 2 for CD, and so on)
- $T_{\rm ON}$ is the integration time per configuration in seconds (2 to 8 hours, depending on source declination). Because of calibrations and antenna slew time, the effective (on-source) integration time is about 60-70% of the total observing time,
- B is the channel bandwidth in Hz (580 MHz for continuum, 40 kHz to 2.5 MHz for spectral line, according to spectral correlator setup).

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

Coordinates and Velocities

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

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

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

Correlator

The correlator has 8 independent units, each being tunable anywhere in the 110-680 MHz band, and providing 7 different modes of configuration (characterized in the following by couples of total bandwidth/number of channels). In the first 3 modes (= option /BAND DSB): 320MHz/128, 160MHz/256, 80MHz/512 the two central channels may be perturbed by the Gibbs phenomenon (depending on continuum strength) like in the old correlator. 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 modes (the default): 160MHz/128, 80MHz/256, 40MHz/512 and 20MHz/512 the two central channels are not affected by the Gibbs phenomenon and, therefore, these modes should be preferred for spectroscopic studies. The 8 units can be independently placed either on the IF1 (3mm receiver) or on the IF2 (1.3mm receiver). For more details, please refer to the Web page at ../TA/backend/cor6A/

Sun Avoidance

For safety reasons, the sun avoidance circle has been extended to 45 degrees. Please take this into account for your sources AND for the calibrators.

Mosaics

The PdBI has mosaicing capabilities, but the pointing accuracy may be a limiting factor at the highest frequencies. Please contact the 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 reduction. Remote data reduction is possible, especially for experienced users of the Plateau de Bure Interferometer. Please contact your local contact if you’re interested in this possibility.
- 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. Data reduction will be carried out on dedicated computers at IRAM. 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 your local contact or the Science Operations Group (sog@iram.fr) if you are interested in this.
- 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.

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 program complexity, IRAM may require an in-house collaborator instead of the normal local contact.

Technical pre-screening

All proposals will be reviewed for technical feasibility in parallel to being sent to the members of the program 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 Science Operations Group (sog@iram.fr) to discuss the feasibility.

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

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

- CLIC: Continuum and Line Interferometer Calibration.

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

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

All documents can be retrieved via the World-Wide-Web, on either http://www.iram.fr or http://www.iram.es .

Jan Martin WINTERS

New Control System (NCS) in Operation at the 30-Meter Telescope

In November 2005 the control system for the 30-meter telescope was changed to new hardware and software, built on the VME and Linux standards. This step was the result of several years of development by an NCS core team with eight members at IRAM Granada and Grenoble, as well as related work on data processing software.

For early observations, only a limited set of features was supported. More have been added in the meantime or will be in the near future. Since December 2005, observations have been possible with the single-pixel heterodyne receivers and the bolometer. The 4MHz and 1MHz filterbanks and VESPA (autocorrelator) are supported as well as the continuum backends, including ABBA for the bolometer.

All four standard "switching modes" can be used, i.e. Total Power, Beam, Wobbler, and Frequency Switching. Supported observing modes are Calibration for heterodyne receivers, Pointing, Focus, Tip (for the bolometer), Track (single position with frequency switching), ON-OFF, and On-The-Fly (OTF) maps.

Only observations of planets and sources in the Equatorial J2000 system are well tested up to now, with offsets in the radio projection, in true-angle horizontal coordinates, and in the Nasmyth system, i.e., for receiver pixels that are offset from the main axis.

The observer interacts with the NCS through a new command-line interface nicknamed "paKo" using the usual SIC interpreter. Most paKo commands are similar to those in the old control system, but already prepared for additional flexibility. The full paKo program can run detached from the rest of the NCS, e.g. for preparing and testing source and line catalogs and scripts for the setup of hardware and observing modes.

Most data are acquired continuously in independent data streams, which are then automatically combined into raw data files in FITS format. For heterodyne and spectroscopy data, new software (MIRA) can read data from these FITS files and analyze and plot calibration, pointing, and focus measurements. MIRA also applies calibration results to the data to plot calibrated spectra and write them to files in CLASS format for further processing. Up to now MIRA has been used manually, but for standard observations it will be automated in the near future. For bolometer data the MOPSIC software plays a similar role.

Up-to-date news and notes about the NCS are available to visitors on a set of dedicated web pages at the observatory.

Support for HERA and WILMA, more observing modes, and other coordinate systems will be added in early 2006, as well completely new options and observing modes.

Information about the NCS, including the user manual, is available at:
http://www.iram.es/IRAMES/ncs30m/

Hans UNGERECHTS

Scientific Results in Press

HCN J = 5-4 Emission in APM 08279+5255 at z = 3.91

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Abstract:
We detect HCN J=5-4 emission from the ultraluminous quasar APM 08279+5255 at $z = 3.911$ using the IRAM Plateau de Bure Interferometer. This object is strongly gravitationally lensed, yet still thought to be one of the most intrinsically luminous objects in the universe. The new data imply a line luminosity $L'_{HCN(J=5-4)} = (4.0 \pm$

0.5) $\times 10^{10}$ K km s^{-1} pc^2. The $\sim$ 440 km s^{-1} FWHM of the HCN $J = 5-4$ line matches that of the previously observed high-J CO lines in this object and suggests that the emission from both species emerges from the same region: a warm, dense circumnuclear disk. Simple radiative transfer models suggest an enhanced abundance of HCN relative to CO in the nuclear region of APM 08279+5255, perhaps due to increased ionization, or possibly the selective depletion of oxygen. The ratio of far-infrared luminosity to HCN luminosity is at the high end of the range found for nearby star-forming galaxies, but is comparable to that observed in the few high-redshift objects detected in the HCN $J = 1-0$ line. This is the first clear detection of high-J HCN emission redshifted into the 3 mm atmospheric window.

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: ApJ 634, L13

Detection of a hot core in the intermediate-mass Class 0 protostar NGC 7129-FIRS 2

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Abstract:
We report high angular resolution (HPBW $\sim 0.6'' \times 0.5''$ at 1.3 mm) observations of the Class 0 intermediate-mass (IM) protostar NGC 7129-FIRS 2 using the Plateau de Bure Interferometer. Our observations show the existence of an intense unresolved source in the continuum at 1.3 mm and 3 mm at the position of the Class 0 object. In addition, compact CH_3CN emission is detected at this position. The high rotational temperature derived from the CH_3CN lines ($T_{rot} \approx 50$ K), as well as the enhanced CH_3CN fractional abundance ($X(CH_3CN) \sim 7.0 \times 10^{-9}$), shows the existence of a hot core in this IM young stellar object. This is to our knowledge the first IM hot core detected so far. Interferometric maps of the region in the CH_3OH $5_{kk'} \rightarrow 4_{kk'}$ and D_2CO $4_{04} \rightarrow 3_{03}$ lines are also presented in this paper. The methanol emission presents two condensations, one associated with the hot core, which was very intense in the high upper state energy lines ($E_u > 100$ K), and the other associated with the bipolar outflow which dominates the emission in the low excitation lines. Enhanced CH_3OH abundances ($X(CH_3OH)$ 3×10^{-8} - a few 10^{-7}) were measured in both components. While intense D_2CO $4_{04} \rightarrow 3_{03}$ emission was detected towards the hot core, the $N_2D^+ 3 \rightarrow 2$ line was not detected in our interferometric observations. The different behaviors of D_2CO and N_2D^+ emissions suggest different formation mechanisms for the two species and different deuteration processes for H_2CO and N_2H^+ (surface and gas-phase chemistry, respectively). Finally, the spectrum of the large bandwidth correlator shows a forest of lines at the hot core position, revealing that this object is extraordinarily rich in complex molecules. For deeper insight into the chemistry of complex molecules, we compared the fractional abundances of the complex O- and N-bearing species in FIRS 2 with those in hot corinos and massive hot cores. Within the large uncertainty involved in fractional abundance estimates towards hot cores, we did not detect any variation in the relative abundances of O- and N-bearing molecules ($[CH_3CN]/[CH_3OH]$) with the hot core luminosity. However, the O-bearing species H_2CO and HCOOH seemed to be more abundant in low and intermediate mass stars than in massive star-forming regions. We propose that this could be the consequence of a different grain mantle composition in low and massive star-forming regions.

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SIMBA Observations of the Keyhole Nebula

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Abstract:
We report observations made with the SIMBA bolometer at SEST to measure the 1.2 mm continuum emission toward the Keyhole nebula. We have detected 1.2 mm emission toward the ionized gas filaments of the Car II radio source that is attributed to thermal free-free emission. Several compact 1.2 mm emission sources have also been identified and found to correspond to bright-rimmed molecular globules. Under the assumption that for these sources the 1.2 mm emission corresponds to dust, we find mass estimates in the range $3 - 19 M_{\odot}$, which are consistent with previous molecular line measurements. The data also yield new 1.2 mm flux measurements at two different epochs during the cyclic brightness variation of η Carinae. No emission was detected toward the trademark dark keyhole of the nebula, consistent with it being cool molecular gas situated at the outskirts of the H II region.

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Continuum emission in NGC 1068 and NGC 3147: indications for a turnover in the core spectra

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Abstract:
We present new interferometric observations of the continuum emission at mm wavelengths in the Seyfert galaxies NGC 1068 and NGC 3147. Three mm continuum peaks are detected in NGC 1068, one centered on the core, one associated with the jet and the third one with the counter-jet. This is the first significant detection of the radio jet and counter-jet at mm wavelengths in NGC 1068. While the fluxes of the jet components agree with a steep spectral index extrapolated from cm-wavelengths, the core fluxes indicate a turnover of the inverted cm- into a steep mm-spectrum at roughly ~ 50 GHz which is most likely caused by electron-scattered synchrotron emission. As in NGC 1068, the spectrum of the pointlike continuum source in NGC 3147 also shows a turnover between cm and mm-wavelengths at ~ 25 GHz resulting from synchrotron self-absorption different to NGC 1068. This strongly resembles the spectrum of Sgr A*, the weakly active nucleus of our own galaxy, and M 81*, a link between Sgr A* and Seyfert galaxies in terms of activity sequence, which may display a similar turnover.

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Probing isotopic ratios at redshift z=0.89: molecular line absorption toward PKS 1830-211

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Abstract:
Molecular absorption lines in the line of sight to distant quasars are an extremely powerful tool to probe the dense interstellar medium and its chemical composition in intervening galaxies from low to high redshifts. The absorption line measurements of different isotopomers even allow us to study isotopic ratios, which can be interpreted as the signature of past nucleosynthesis activity, and put some constraints on the chemical evolution models.in this paper, we present the study of molecular absorption lines in front of the quasar PKS 1830-211. The absorption is due to an intervening galaxy at $z = 0.89$ which is identified as a nearly face-on spiral galaxy. We have carried out a survey of absorption lines of various HCO^+, HCN, HNC, and CS isotopomers with the plateau de bure interferometer and derived for the first time the C, N, O, and S isotopic ratios in such a distant object.this $z = 0.89$ absorption system offers an unique opportunity to study the chemical composition in the disk of a spiral galaxy only a few gyr old. Our results show significantly different isotopic ratios as compared to those measured in the solar system or in the local ISM, indicating a poorly enhanced abundance of material processed by intermediate and low mass stars.

Appeared in: Probing Galaxies through Quasar Absorption Lines, Proc. IAU 199, March 14-18 2005, Shanghai, Eds. P.R. Williams, Ch.-G. Shu and B. Menard. Cambridge Univ. Press 2005, p.313

On the density of EKOs and related objects

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Abstract:
Recently published mass determinations of EKO binaries, combined with photometric size determinations, allow to derive a mean density of the distant minor planets of ≈ 0.2 g cm^{-3}. This agrees well with the nuclear density of 1P/Halley of 0.26 g cm^{-3}, determined in the Giotto mission, and it suggests that these low density objects are essentially undifferentiated planetesimals.

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Observing Procedures at Millimeter and Submillimeter Wavelengths: Imaging an Astronomical Object

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Abstract:
This lecture, presented at the 2004 IAOC International Workshop *The Cool Universe: Observing Cosmic Dawn*, held in October 2004 at Valparaiso, is a 24 page introduction to radio imaging at millimeter and sub-millimeter wavelengths. The emission from interstellar sources and the absorption by the Earth's atmosphere are briefly discussed. The basic concepts of instrumental transfer function, visibility, noise and image deconvolution are presented.

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Molecular gas in the Andromeda galaxy

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Abstract:
We present a new ^{12}CO(J=1–0)–line survey of the Andromeda galaxy, M 31, with the highest resolution to date (23″, or 85 pc along the major axis), observed *On-the-Fly* with the IRAM 30-m telescope. We mapped an area of about $2° \times 0.5°$ which was tightly sampled on a grid of 9″ with a velocity resolution of 2.6 km s^{-1}. The r.m.s. noise in the velocity-integrated map is around 0.35 K km s^{-1} on the $T_{\rm mb}$-scale.
Emission from the ^{12}CO(1–0) line is detected from galactocentric radius $R = 3$ kpc to $R = 16$ kpc, but peaks in intensity at $R \sim 10$ kpc. Some clouds are visible beyond $R = 16$ kpc, the farthest of them at $R = 19.4$ kpc.
The molecular gas traced by the (1–0) line is concentrated in narrow arm-like filaments, which often coincide with the dark dust lanes visible at optical wavelengths. The HI arms are broader and smoother than the molecular arms. Between $R = 4$ kpc and $R = 12$ kpc the brightest CO filaments and the darkest dust lanes define a two-armed spiral pattern that is well described by two logarithmic spirals with a constant pitch angle of 7°–8°. Except for some bridge-like structures between the arms, the inter-arm regions and the central bulge are free of emission at our sensitivity. The arm–interarm brightness ratio averaged over a length of 15 kpc along the western arms reaches about 20 compared to 4 for HI at an angular resolution of 45″.
In several selected regions we also observed the ^{12}CO(2–1)–line on a finer grid. Towards the bright CO emission in our survey we find normal ratios of the (2–1)–to–(1–0) line intensities which are consistent with optically thick lines and thermal excitation of CO.
We compare the (velocity-integrated) intensity distribution of CO with those of HI, FIR at 175 μm and radio continuum, and interpret the CO data in terms of molecular gas column densities. For a constant conversion factor $X_{\rm CO}$, the molecular fraction of the neutral gas is enhanced in the spiral arms and decreases radially from 0.6 on the inner arms to 0.3 on the arms at $R \simeq 10$ kpc. We also compare the distributions of HI, H_2 and total gas with that of the cold (16 K) dust traced at $\lambda = 175\,\mu$m. The ratios $N(HI)/I_{175}$ and $(N(HI) + 2N({\rm H}_2))/I_{175}$ increase by a factor of ~ 20 between the centre and $R \simeq 14$ kpc, whereas the ratio $2N({\rm H}_2)/{\rm I}_{175}$ only increases by a factor of 4. For a constant value of $X_{\rm CO}$, this means that either the atomic and total gas–to–dust ratios increase by a factor of ~ 20 or that the dust becomes colder towards larger radii. A strong variation of $X_{\rm CO}$ with radius seems unlikely. The observed gradients affect the cross-correlations between gas and dust. In the radial range $R = 8$–14 kpc total gas and cold dust are well correlated; molecular gas is better correlated with cold dust than atomic gas. At smaller radii no significant correlations between gas and dust are found.
The mass of the molecular gas in M 31 within a radius of 18 kpc is $M({\rm H}_2) = 3.6 \times 10^8\,{\rm M}_\odot$ at the adopted distance of 780 kpc. This is 12% of the total neutral gas mass within this radius and 7% of the total neutral gas mass in M 31.

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The trans-neptunian object UB_{313} is larger than Pluto

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Abstract:
The most distant known object in the Solar System, 2003 UB_{313} (97 AU from the Sun), was recently discovered near its aphelion. Its high eccentricity and inclination to the ecliptic plane, along with its perihelion near the orbit of Neptune, identify it as a member of the 'scattered disk'. This disk of bodies probably originates in the Kuiper belt objects, which orbit near the ecliptic plane in circular orbits between 30 and 50 AU, and may include Pluto as a member. The optical brightness of 2003 UB_{313}, if adjusted to Pluto's distance, is greater than that of Pluto, which suggested that it might be larger than Pluto. The actual size, however, could not be determined from the optical measurements because the surface reflectivity (albedo) was unknown. Here we report observations of the thermal emission of 2003 UB_{313} at a wavelength of 1.2 mm, which in combination with the measured optical brightness leads to a diameter of $3000 \pm 300 \pm 100$ km. Here the first error reflects measurement uncertainties, while the second derives from the unknown object orientation. This makes 2003 UB_{313} the largest known trans-neptunian object, even larger than Pluto (2300 km). The albedo is $0.60 \pm 0.10 \pm 0.05$, which is strikingly similar to that of Pluto, suggesting that the methane seen in the optical spectrum causes a highly reflective icy surface.

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