Newsletter

Number 69 July 19th, 2007

Contents

Calendar

September 13, 2007 17:00 CEST (UT+2h):
Deadline for the submission of IRAM observing proposals for the period from December 1, 2007 to May 31, 2008.

Sept. 28-Oct.5th 2007:
IRAM Observing School 2007, Pradollano (Sierra Nevada, Spain)

October 1st 2007:
Deadline for the submission of Global VLBI proposals

Introductory remarks

Since the last IRAM Newsletter, earlier this year, many important things have happened at IRAM. At the Plateau de Bure interferometer, the New Generation Receivers performed as expected and, despite a winter with rather poor 'winter conditions', first-class observations could be performed. The increased sensitivity of the receivers allows today for detection of sub-mJy lines in a single track, and the detection in the continuum of many (up to six) proto-planetary disks using the snap-shot mode in less than one track. First papers, based on these results, have already been submitted for publication.

The New Generation Receivers together with the extended baselines make the Plateau de Bure interferometer the world leading facility of its kind, enabling to explore astronomical sources in the dust continuum emission and in the molecular gas at both high sensitivity and subarcsecond angular resolution. Such angular resolutions are comparable to those obtained with the largest optical ground-based telescopes. A total of 15 Letters, based on results obtained using the extended configurations, have been published this year in Astronomy & Astrophysics (including a special issue with 11 papers in June 2007). Their abstracts are given in this Newsletter at the end of the 'Scientific Results in Press' section.

The implementation of new receivers will continue with the 2 mm band, which is planned to be installed this fall and to become available during the winter period. In 2008, receivers operating at 0.8mm will be brought to the Plateau de Bure, and will hopefully be available during the following winter. Together with the new broadband correlator, which will be installed in 2008/2009, this will complete the current cycle of major upgrades of the 'new' Plateau de Bure interferometer.

At the IRAM Executive Council meeting in June 2007, the Associates approved an extraordinary contribution to replace (in 2008 and 2009) the degraded carbon fiber panels of two interferometer antennas with aluminum panels, which are known to be robust and long-lasting under the harsh (winter) conditions of the Plateau de Bure. This will ensure a long lifetime and a better surface accuracy for the Plateau de Bure interferometer antennas, which will become mandatory when observations at the highest frequencies (i.e. 350 GHz) will start with the 0.8 mm receivers. The new panels will also considerably reduce antenna maintenance overheads and therefore increase the available overall observing time.

At the 30-meter telescope, HERA, the 1.3mm multibeam heterodyne instrument, is more and more requested and is producing excellent mapping results of molecular gas in nearby galaxies and unprecedented deep, large-scale maps of galactic star-forming regions.

An important new impact will come next year with the installation of a new generation large band single pixel heterodyne receiver on Pico Veleta including for the first time a performant 350 GHz channel. To continue excellent observing also in the continuum with the 30m telescope IRAM has started to explore ways to develop next generation wide field continuum instrumentation.

IRAM will soon issue a Call for Proposals to build a wide field bolometer camera operating at millimeter wavelengths to be installed at the IRAM 30-meter telescope not later than 2011. To prepare this call, a call for Letters of Interest was issued in April 2007 to see which groups would like to participate in this project and five institutes responded.

Finally, we are glad to announce that the IRAM Partners (CNRS, MPG and IGN) have signed an extension of the IRAM Contract until 2014. This contract, which was originally signed for a period of 30 years, would have ended in 2009.

Pierre COX and Karl SCHUSTER

New IRAM logo

IRAM has a new visual identity, which was created by REBUS, a graphical design bureau in Paris. The leading idea behind this logo is to suggest the shape of an antenna (to identify both the 30-meter and the Plateau de Bure interferometer) and to evoke images of typical astronomical sources, which are observed with the IRAM facilities, such as spiral galaxies, proto-planetary disks, outflows, comets and many others. The logo will soon be introduced on the website, which will also be rebuild on that occasion.

Pierre COX

Preparations for a new wide field bolometer camera on the 30m telescope

After various meetings on future 30m optics and bolometer instrumentation for the 30m, a preliminary set of specifications has been worked out and a large number of possible collaborators has been contacted. IRAM will continue working towards a more formal call for proposals by end of the year. The collaboration will offer opportunities in:

- Cryogenics,
- Detector Arrays,
- Cryogenic and room temperature electronics
- Quasi-optics including dichroic elements
- Data acquisition and software

It is foreseen to base large parts of this collaboration on the compensation through guaranteed observing time with the built bolometer.

Karl SCHUSTER

Proposals for IRAM Telescopes

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

September 13, 2007 17:00 CEST (UT+2h)

The scheduling period extends from December 1, 2007 to May 31, 2008. Proposals should be submitted through our web–based submission facility. Instructions can be found on our web page at URL:

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

This web page also provides a link to the Call for Proposals where detailed information on time estimates, special observing modes, technical information and references for both the IRAM interferometer and the IRAM 30m telescope can be found. 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 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 cancelation 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 possibility as we always receive a number of corrupted proposals (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.

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 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. 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 described. 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.

A mailing list has been set up for astronomers interested in being notified about the availability of a new Call for Proposals. A link to this mailing list is on the IRAM web page. The list presently contains all users of IRAM telescopes during the last 2 years. Please check that your email address in this list is correct, and point out the existence of this list to interested colleagues.

Jan Martin WINTERS & 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 and associated countries. 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 some limited TNA funds to pay travel expenses for eligible 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 & Clemens THUM

News from the 30-m telescope

Remote observing

Remote observing with the 30m telescope is now routinely possible from IRAM Granada by experienced observers. If you want to use this station, please contact the Astronomer on Duty and/or the Granada informatics group well in advance of any remote observing sessions.

Grenoble offices also have a remote control station for the 30-m. Its use is encouraged for experts, but still experimental. Interested astronomers should contact J. Pety or C. Thum well before the observations.

MPIfR Bonn has now also a remote observing workplace for the 30-m. Remote stations at the ENS in Paris and the OAN in Madrid are in preparation.

Rainer MAUERSBERGER

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. The MAMBO–2 bolometer array with 117 pixels operating at 1.2 mm; the smaller MAMBO–1 array with 37 pixels is kept as a backup.

Emphasis will be put on observations at the shorter wavelengths. About 2800 hours of observing time will be available.

The main news relevant for the coming winter semester are described below. The details of proposal formalities, instrumentation, observing modes, and estimation of observing time are described on the IRAM web site.

What is new?

Since November 2005, the telescope runs under a VME and Linux based new control system (NCS). Virtually all functionality of the old control system has been recovered. Notable exceptions are the coordinate system (only J2000 is currently supported) and the `RASTER` command. OTF, ONOFF or TRACKING (with frequency switching) commands together with SIC loops should be used instead. Observations with the rotated wobbler (non–azimuth wobbling directions) which are of interest mainly for bolometer mapping, are possible again. Other ongoing work concerns fine–tuning the tracking and slewing motions of the telescope.

Remote observing is available from the IRAM offices in Granada and Grenoble, and from the MPIfR in Bonn. The remote stations in Madrid and Paris are planned to become available also during this winter semester.

The NCS team maintains a web page (../IRAMES/ncs30m) where the current NCS status is described in detail.

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 requested to send us HERA frequencies in advance.

Like last semester, a **bolometer array**, preferentially the 117–channel MAMBO–2, will be available. Users should be aware that this instrument has lately shown some performance instabilities. Trouble shooting and maintenance efforts might reduce the available observing time.

A replacement of the current single pixel receivers by a modern more compact receiver is planned for next year. The new receiver will have strongly improved sensitivities and much larger IF bandwidth. However in a first time the frequency range below 83 GHz will not be covered. In view of this fact we encourage astronomers with an interest in

frequencies below 83 GHz to propose such observations now.

The **full Call for 30m Proposals** is available on the IRAM web site.

Clemens THUM & Rainer MAUERSBERGER

News from the Plateau de Bure Interferometer

Weather conditions and observing

Following the successful installation and commissioning of the New Generation Receivers (NGRs) for the 3 mm and 1.3 mm atmospheric windows last autumn, regular observing was resumed on January 18th, 2007 when the array in its D configuration. We switched to the A array on January 28 and moved to a configuration intermediate between A and B (keeping the three longest baselines) on March 7. The B configuration was scheduled from March 18 until March 30 only, because of very poor weather conditions. The C configuration was then available until April 24, when the interferometer was brought back into its D configuration. Many projects requesting the C configuration, notably at 1mm, could not be finished yet and will be deferred to the end of the summer/beginning of the upcoming winter semester. Since May 22nd the array is observing with 5 antennas in D configuration. The current antenna maintenance period is foreseen to end in October.

All in all, the observing conditions were quite mediocre due to the unusually warm winter and humid spring in Europe.

As far as A-rated projects are concerned, we look forward to bring many of these to completion before the end of the current summer 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 upcoming proposal deadline have to be resubmitted. In any case, **all** projects will be kept on the schedule until the end of the summer semester (i.e. until November 30). 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.

The global VLBI session, which includes the array in the 3 mm phased-array mode, started on time on May 10. The interferometer, equipped with a new maser and the new receiving system successfully participated for two nights.

Installation of the 2 mm band

It is foreseen to equip all 6 antennas with 2 mm mixers still in the current summer period. The 2 mm band will be offered to the community in the following Call for Proposals on a shared-risk basis only, since delays in the installation cannot be excluded and the overall performance of the receivers is not known yet.

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 in winter conditions with limited access to the observatory, we plan to schedule four configuration changes next winter. We therefore ask investigators to submit proposals for any of the 4 primary configurations of the six antenna array.

A preliminary configuration schedule for the winter period is outlined below. Adjustments to the provisional configuration planning will be made according to proposal pressure, weather conditions, installation of the 2 mm receiver band and other contingencies. Due to the installation of the new generation receivers last fall, the C configuration was not available in December, and this spring not all of the projects requesting the C configuration could be worked off. These projects are now postponed for the C configuration to be scheduled at the end of the summer semester and at the beginning of the upcoming winter. We therefore may again have less time available in C configuration this winter than in regular previous years. The configuration schedule given below should be taken as a guideline, in particular when the requested astronomical targets cannot be observed during the entire winter period (sun avoidance circle of radius 45°).

Conf	Scheduling Priority Winter 2007/2008
C	December
A	December – January
B	February – March
C	March – April
D	April – May

We strongly encourage observers to submit proposals for the new set of AB configurations that include 730 and 760 meter baselines. For these proposals we ask to focus on bright compact sources, possibly at high declination.

We invite proposers to submit proposals also for observations at 3 mm. When the atmospheric conditions are not good enough at 1.3 mm, 3 mm projects will be observed:

in a typical winter, $20-30\%$ of the time used for observations is found to be poor at 1.3 mm, but still excellent at 3 mm.

Proposals requesting the 2 mm band should be submitted on a shared-risk basis only.

All applications under this call for proposals will have to take into account that the new receivers cannot be operated simultaneously at more than one frequency band. Investigators will therefore have to make it clear whether a request is made for one (e.g., 3 mm) or more (e.g., 3 mm and 1 mm) frequency bands.

Proposal category

Proposals should be submitted for one of the five following categories:

1.3 mm: Proposals that ask for 1.3 mm data. 3 mm receivers can be used for pointing and calibration purposes, but cannot provide any science data.

2 mm: Proposals that ask for 2 mm data. These proposals will be observed on a shared risk basis as "science verification" projects to inaugurate the new receiver band should it become available for the winter semester.

3 mm: Proposals that ask for 3 mm data.

time filler: Proposals that have to be considered as backup projects to fill in periods where the atmospheric conditions do not allow mapping, to fill in gaps in the scheduling, or even to cover periods when only a subset of the standard 6-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 of the six-antenna array

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

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

The general properties of these configurations are:

- `A` alone is well suited for mapping or size measurements of very compact, strong sources. It provides a resolution of $0\farcs8$ at 100 GHz, $\sim 0\farcs35$ at 230 GHz.
- `B` alone yields $\sim 1\farcs2$ at 100 GHz and, in combination with A provides an angular resolution of $\sim 1\farcs0$ at 100 GHz. 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 ($\sim 3\farcs5$ at 100 GHz, $\sim 1\farcs5$ at 230 GHz) and with B for higher resolution ($\sim 1\farcs7$ at 100 GHz, $\sim 0\farcs7$ 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 (resolution $\sim 5''$ at 100 GHz). This configuration provides both the highest sensitivity and the lowest atmospheric phase noise.

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.

Please consult the documentation on the Plateau de Bure configurations and the IRAM Newsletter No. 63 (August 4th., 2005, accessible on the web at `../IRAMFR/ARN/aug05/aug05.html`) for further details.

Receivers

Since December 2006, all antennas are equipped with a new generation of dual polarization receivers for the 3 mm and 1.3 mm atmospheric windows. The frequency range is 81 GHz to 116 GHz for the 3 mm band, and 201 GHz to 256 GHz for the 1.3 mm band. For the upcoming winter semester, the 2 mm band may additionally become available, covering the frequency range 129 GHz to 168 GHz.

Each band of the new receivers is dual-polarization with the two RF channels observing at the same frequency. The mixers are single-sideband, with a typical image rejection of 10 dB. Only one frequency band (dual polarization) can be connected to the IF transmission lines at any time. Because of this reason and due to pointing offsets between different frequency bands, only one band can be observed at any time. The other band is in stand-by (power on and local oscillator phase-locked) and is available, e.g., for pointing and focusing. Time-shared observations between two frequency bands cannot be offered for the winter (this mode is currently being tested).

The two IF-channels (one per polarization), each 4 GHz wide, are transmitted by optical fibers to the central

building. At present, the 4 GHz bandwidth can be processed only partially by the existing correlator, through a dedicated IF processor that converts selected 1 GHz wide slices of the 4-8 GHz first IFs down to 0.1-1.1 GHz, the input range of the existing correlator. Further details are given in the section describing the correlator setup and the IF processor.

PdBI Receiver Specifications			
	Band 1	*Band 2**	Band 3
RF coverage	81–116	*129–168*	201–256
T_{rec} LSB	40–55	*40–60*	40–60
T_{rec} USB	”	”	50–70
G_{im}	-10 dB		-12 -8 dB
RF range LSB	81–104		201–244
RF range USB	104–116		244–256

*: preliminary values

Signal to Noise

The rms noise can be computed from

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

where

- $J_{\rm pK}$ is the conversion factor from Kelvin to Jansky (22 Jy/K at 3 mm, 35 Jy/K at 1.3 mm, *29 Jy/K at 2 mm*)
- $T_{\rm sys}$ is the system temperature ($T_{\rm sys}$ = 100 K below 110 GHz, 170 K at 115 GHz, *130 K at 150 GHz*, 200 K at 230 GHz for sources at $\delta \geq 20°$ and for typical winter conditions.)
- η is an efficiency factor due to atmospheric phase noise (0.9 at 3 mm, *0.85 at 2 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, 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 (up to 2 GHz for continuum, 40 kHz to 2.5 MHz for spectral line, according to the spectral correlator setup)
- $N_{\rm pol}$ is the number of polarizations: 1 for single polarization and 2 for dual polarization (see section *Correlator* for details).

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 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

IF processor

At any given time, only one frequency band is used, but with the two polarizations available. Each polarization delivers a 4 GHz bandwidth (from IF= 4 to 8 GHz). The current correlator accepts as input two signals of 1 GHz bandwidth, that must be selected within the 4 GHz delivered by the receiver. In practice, the new IF processor splits the two input 4–8 GHz bands in four 1 GHz “quarters”, labeled *Q1...Q4*. The system allows the following choices:

- first correlator entry can only be Q1 HOR, or Q2 HOR, or Q3 VER, or Q4 VER
- second correlator entry can only be Q1 VER, or Q2 VER, or Q3 HOR, or Q4 HOR

where HOR and VER refers to the two polarizations:

Quarter	Q1	Q2	Q3	Q4
IF1 [GHz]	4.2 - 5.2	5 - 6	6 - 7	6.8 - 7.8
input 1	H	H	V	V
input 2	V	V	H	H

How to observe two polarizations? To observe simultaneously two polarizations at the same sky frequency, one must select the same quarter (Q1 or Q2 or Q3 or Q4) for the two correlator entries. This will necessarily result in each entry seeing a different polarization. The system thus gives access to 1 GHz x 2 polarizations.

How to use the full 2 GHz bandwidth? If two different quarters are selected (any combination is possible), a bandwidth of 2 GHz can be analyzed by the correlator. But only one polarization per quarter is available in that case; this may or may not be the same polarization for the two chunks of 1 GHz.

Is there any overlap between the four quarters? In fact, the four available quarters are 1 GHz wide each, but with a small overlap between some of them: Q1 is 4.2 to 5.2 GHz, Q2 is 5 to 6 GHz, Q3 is 6 to 7 GHz, and Q4 is 6.8 to 7.8 GHz. This results from the combination of filters and LOs used in the IF processor.

Is the 2 GHz bandwidth necessarily contiguous? No: any combination of two quarters can be selected. Adjacent quarters will result in a continuous 2 GHz band. Non-adjacent quarters will result in two independent 1 GHz

bands. Note that in any case, the two correlator inputs are analyzed independently.

Where is the selected sky frequency in the IF band? It would be natural to tune the receivers so that the selected sky frequency corresponds to the middle of the IF bandwidth, i.e. 6.0 GHz. However, this corresponds to the limit between Q2 and Q3. It is therefore highly recommended to center a line at the center of a quarter (see Section "ASTRO" below). At 3 mm, the receivers offer best performance in terms of receiver noise and sideband rejection in Q3 (i.e. the line should be centered at an IF1 frequency of 6500 MHz) whereas at 1 mm best performance is obtained in Q2 (i.e. the line should be centered at 5500 MHz).

Spectral units of the correlator

The correlator has 8 independent units, which can be placed anywhere in the 100–1100 MHz band (1 GHz bandwidth). 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 x 512	20	SSB
0.078	1 x 512	40	SSB
0.156	2 x 256	80	DSB
0.312	1 x 256	80	SSB
0.625	2 x 128	160	DSB
1.250	1 x 128	160	SSB
2.500	2 x 64	320	DSB

Note that 5% of the passband is lost at both ends of each subband. The 8 units can be independently connected to the first or the second correlator entry, as selected by the IF processor (see above). Please note that the center frequency is expressed – as in the old system – in the frequency range seen by the correlator, i.e. 100 to 1100 MHz. The correspondence to the sky frequency depends on the parts of the 4 GHz bandwidth which have been selected as correlator inputs.

ASTRO

The software `ASTRO` has been updated to reflect these new receiver/correlator setup possibilities. Astronomers are urged to download the most recent version (**February 2007 or later**) of GILDAS at `../IRAMFR/GILDAS/` to prepare their proposals.

The old `LINE` command has been replaced by several new commands (see internal help):
- `NGR_LINE`: receiver tuning
- `NARROW`: selection of the narrow-band correlator inputs
- `SPECTRAL`: spectral correlator unit tuning
- `PLOT`: control of the plot parameters.

A typical session would be:

```
! choice of receiver tuning
ngr_line xyz 230 lsb

! choice of the correlator windows
narrow Q1 Q3

! correlator unit #1, on entry 1
spectral 1  20 520 /narrow 1

! correlator unit #2, on entry 1
spectral 2 320 260 /narrow 1

! correlator unit #3, on entry 2
spectral 3  40 666 /narrow 2
...
```

Sun Avoidance

For safety reasons, a sun avoidance limit is set at 45 degrees sun distance. Please take this into account for your target sources AND for the calibrators. We are currently working toward a reduction of the sun avoidance limit.

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 view of the new receiver system, **data have to be reduced in Grenoble**. Proposers will not come for the observations, but will have to come for the reduction. For the time being, remote data reduction will not be offered for projects observed with the NGR system.
- 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 NGR 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. The upgrade of CLIC to handle the NGR data implied many modifications for which backward compatibility with old PdBI receiver data has not yet been fully checked. To calibrate data obtained with the "old" receiver system, we thus urge you to use the January 2007 version of CLIC.

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 and on the help requested by the PI, 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 Interferometer 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`

Note however, that the documentation on the web has not yet been updated with respect to the new generation receivers. All information currently available on the new generation receiver system is given in this call for proposals.

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 this call 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.

Jan Martin WINTERS

Proposal ratings for summer 2007

The IRAM program committee convened in Grenoble on April 10 and 11 to discuss the proposals submitted for the summer 2007 scheduling period. The committee was chaired by Fabian Walter. The principal investigators of each proposal have been informed by letter which included comments issued by the committee if there are any. As usual, the proposals were classified A (accepted), B (backup), and C (rejected).

Plateau de Bure Interferometer Proposals

A total of 90 proposals were received for the interferometer, which is the highest number ever submitted for the summer period (Tab. 1). Proposals 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 proposals rated A or B which do not have an IRAM internal collaborator, please consult the list of local contacts.

Table 1: IRAM PdBI proposal ratings for summer 2007. A: Accepted, B: Backup, C: Rejected

Project	Rate	Project	Rate	Project	Rate	Project	Rate	Project	Rate	Project	Rate
R001	B	R002	B	R003	A	R004	B	R005	C	R006	B
R007	B	R008	C	R009	C	R00A	C	R00B	A†	R00C	C
R00D	A	R00E	A	R00F	B	R010	A	R011	B	R012	C
R013	A	R014	A†	R015	B	R016	C	R017	B	R018	C
R019	A†	R01A	A$^{\times}$	R01B	C	R01C	A‡	R01D	C	R01E	A?
R01F	C	R020	B	R021	B‡	R022	B‡	R023	C	R024	A
R025	C	R026	–	R027	C	R028	A	R029	A†	R02A	A
R02B	C	R02C	A†	R02D	C	R02E	A†	R02F	B$^{\times}$	R030	A
R031	B†	R032	B†	R033	A	R034	A‡	R035	–	R036	C
R037	C	R038	B†	R039	C	R03A	A†	R03B	C	R03C	B
R03D	C	R03E	A	R03F	B	R040	B†	R041	A†	R042	B
R043	B	R044	A	R045	A	R046	B	R047	A‡	R048	A†
R049	B†	R04A	A	R04B	C	R04C	C	R04D	B†	R04E	–
R04F	A†	R050	B‡	R051	C	R052	C	R053	B‡	R054	C
R055	B‡	R056	A†	R057	B	R058	B	R059	B	R05A	A‡

† some parts of the program – others rated B or C

‡ with time restrictions

$^{\times}$ time filler

– not rated

Table 2: IRAM 30m telescope proposal ratings for summer 2007

A		B			C	
001-07	005-07[1]	003-07	004-07	008-07	002-07	011-07
006-07[1]	007-07	009-07[1]	010-07	012-07	015-07	016-07
014-07[1]	019-07	013-07	022-07	023-07	017-07	018-07
021-07	025-07	024-07	026-07	030-07	020-07	028-07
027-07	029-07	032-07	033-07	036-07[1]	031-07	039-07
034-07	035-07	038-07	040-07	041-07	045-07	046-07
037-07	043-07	042-07	044-07	047-07	065-07	072-07
053-07	054-07	048-07[1]	049-07	050-07	076-07	079-07
056-07	057-07	051-07	052-07	055-07	083-07	091-07
061-07[1]	062-07	058-07	059-07	060-07[1]	093-07	097-07
063-07	064-07	068-07[1]	069-07[1]	070-07	101-07	106-07
066-07	067-07	073-07[1]	074-07	077-07		
071-07	075-07	078-07	080-07	082-07		
081-07[1]	100-07	084-07	085-07[1]	086-07		
102-07	104-07	087-07	088-07	089-07		
105-07		090-07	092-07[1]	094-07		
		095-07	096-07	098-07		
		099-07	103-07[1]			

[1]: time reduced

30m telescope

IRAM received 106 proposals for the 30m telescope (see alphabetic list in Tab. 2), requesting 4636 hours of telescope time. Another 45 hours were requested by 12 interferometer proposals for zero spacing observations. The highest rating "A" was given to 31 proposals ; 53 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 the attached table. 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 zero spacing proposals are not listed here. They will be scheduled on the 30m if they get observed at Bure.

Jan Martin WINTERS and Clemens THUM

VLBI News - The return of the PdBI

In 2006 and early 2007, major modifications and upgrades have been done at the Plateau de Bure Interferometer. A number of them had a possible impact on the performance of the PdBI as a phased array VLBI station:

- new receivers
- new LO system with fiberoptics and IF processor
- software upgrade for the new system
- new total power detectors integrated on the correlator phased array cards
- new active hydrogen maser
- move of the VLBI formatter and Mark5A recording hardware to a different location in the Bure correlator room

The new system had proven itself in local interferometric observations, and high expectations had been met and surpassed. However, VLBI is more demanding in terms of signal stability than local observations, and it is quite difficult to test a system locally to the required precision. There was a possibility that a flaw or even a fundamental characteristic of the new system would make VLBI observations impossible.

The refinement of the data reduction and calibration for local interferometer observations with the new system delayed the work on the VLBI part. Finally local VLBI software tests were successful, but while a first VLBI test between Bure and Pico Veleta produced powerful autocorrelations, cross-correlation fringes remained elusive. A second Bure - Pico Veleta test on the brightest quasars and masers in the sky produced very weak fringes, with a S/N of just 30 on 3C273 over 30 seconds. Although observing conditions had been excellent, the data suffered from a strong phase noise.

With just three weeks left to the Global session (10-15 May), major hardware modifications were excluded. The fact that the system worked well in local interferometry mode allowed to eliminate a number of causes for the instability. A thorough verification with a spectral analyzer by J.-Y. Mayvial from the IRAM backend group allowed to spot a partly broken cable, and to improve the quality of the 5 MHz reference distribution, which is the "heartbeat" of the interferometer from which all local oscillator frequencies are derived. But it remained doubtful if this had been indeed the problem which perturbed the VLBI.

In order to allow a test on several baselines connecting to the PdBI, it was agreed to start the Global session on a strong astronomical source and transfer the data by network to the MPIfR correlator in Bonn. Unfortunately, the Bonn correlator suffered a technical problem shortly before the Global session, and could not be repaired in time to perform the fringe test. On Friday evening after 19h of Bure VLBI participation, the IRAM direction decided that the risk of a week-end of unusable observations was too high to be taken with the present proposal pressure. PdBI therefore returned to local observing mode, promising to join the Global session again as soon as fringes were found. Pico Veleta continued with the VLBI observations. Meanwhile the colleagues of MPIfR Bonn worked on the fringe search with the Swinburne software correlator in Australia, which runs on a parallel supercomputer (300 CPU Beowulf cluster).

On Monday, fringes were found: 30 seconds on 3C273 yielded a S/N of 462 on the Bure-Pico Veleta baseline, with an excellent phase stability (Fig. 1). Bure stepped back into the Global session in time for the observation of the Galactic center, and continued until the end of the schedule.

One week later, the PdBI phased array joined with Pico Veleta in the second VLBI observation of the Galactic center.

A first analysis of the VLBI performance of the Plateau de Bure shows that the phased array is now better than ever before. The new hardware provides excellent stability (including the new IF processor developed by IRAM and the new EFOS-38 maser by T4Science), and the new dual polarisation receivers allow now simultaneous LCP/RCP observations with an improved system temperature on all antennas (before, Bure could only observe in LCP).

Many thanks to all who have contributed to this success.

Michael BREMER

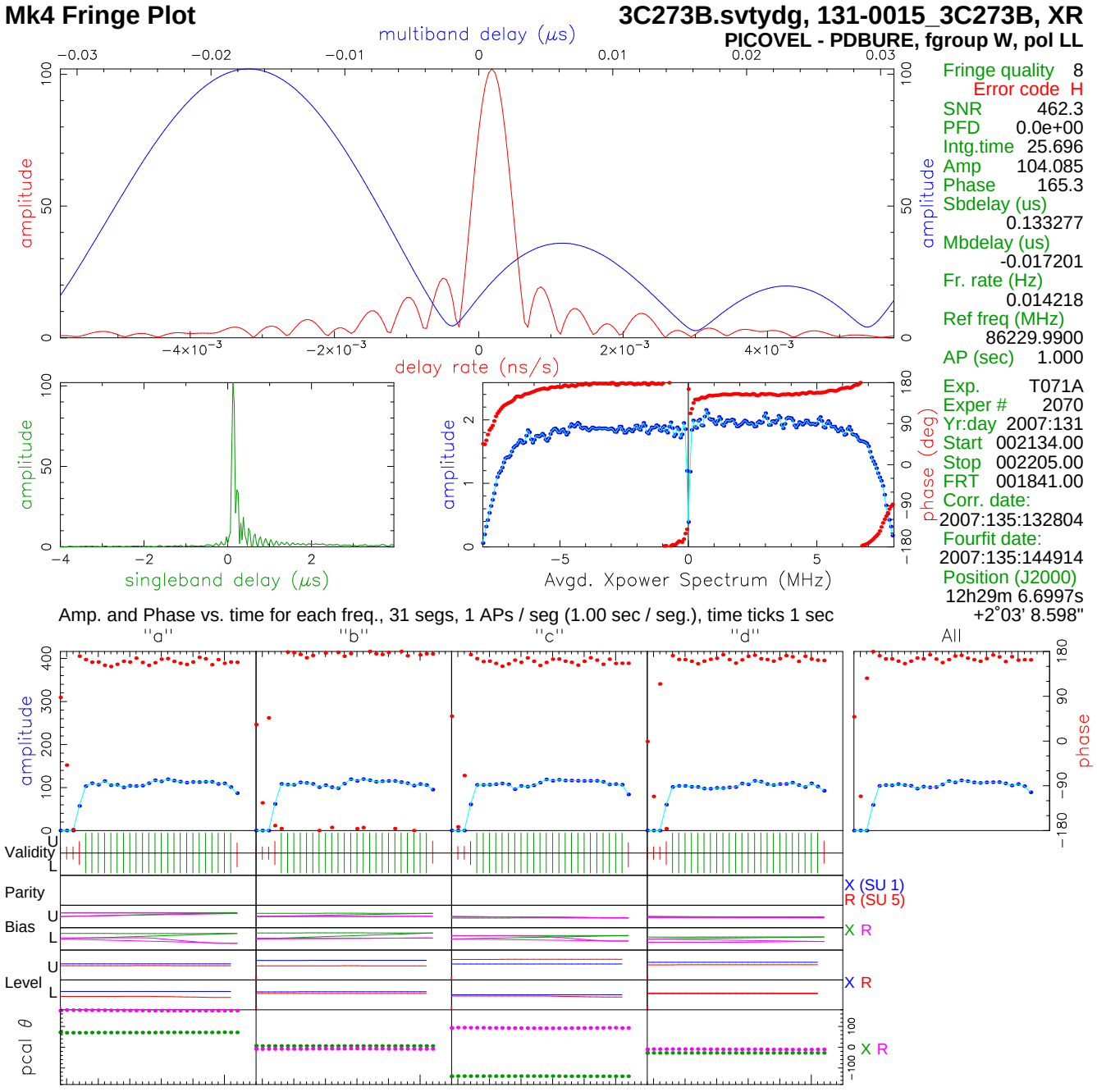

Figure 1: Fringes on 3C273 on the Pico Veleta - Plateau de Bure baseline at the beginning of the Global session (Friday, May 11th 2007). Amplitude and phase vs. time are given in the 3rd row of the graphs.

Staff Changes

IRAM Granada

Ms. Núria MARCELINO has finished her thesis work at Pico Veleta Observatory on a spectral line survey of dark clouds. Since March 15th she has obtained a fellowship at the Instituto de la Estructura de la Materia (CSIC) in Madrid. We wish her all the best for her future career.

Ms. Rebeca ALADRO has started her PhD thesis work at Pico Veleta Observatory in June 2007.

Rainer MAUERSBERGER

IRAM Grenoble

Roger WOJKOWIAK, a senior member of the Grenoble backend group, has gone into retirement on March 22nd. He joined IRAM in 1982, just when the institute was moving to its present location on the university campus in St. Martin d'Hères. Besides his qualities as a technician, who participated in the construction of the three generations of Bure correlators, he has been active in the Comité d'Entreprise of IRAM. We wish him all the best, and an active retirement.

The backend group welcomes Maryse BALDINO, who has started work as a CAD technician on March 19th.

Christine DUMÉE has left the accountancy group on May 31st. We wish her all the best for her future career.

Michael BREMER

Scientific Results in Press

Arcsecond-resolution ^{12}CO mapping of the yellow hypergiants IRC +10420 and AFGL 2343

A. Castro-Carrizo([1]), G. Quintana-Lacaci([2]), V. Bujarrabal ([2]), R. Neri([1]) and J. Alcolea([3])
([1])Institut de Radio Astronomie Millimétrique, 300 rue de la Piscine, 38406 Saint Martin d'Hères, France, ([2])Observatorio Astronómico Nacional (IGN), Apdo. 112, E-28803 Alcalá de Henares, Spain, ([3])Observatorio Astronómico Nacional (IGN), c/ Alfonso XII nº13, E-28014 Madrid, Spain

Abstract:
IRC +10420 and AFGL 2343 are the unique, known yellow hypergiants (YHGs) presenting a heavy circumstellar envelope (CSE). We aim to study the morphology, exceptional kinematics, and excitation conditions of their CSEs, and the implications for mass-loss processes. We have mapped the ^{12}CO J=2−1 and 1−0 emission in these YHGs with the IRAM Plateau de Bure interferometer and the 30m telescope. We developed LVG models in order to analyze their circumstellar characteristics. The maps show that the overall shape of both CSEs is approximately spherical, although they also reveal several aspherical features. The CSE around IRC +10420 shows a rounded extended halo surrounding a bright inner region, with both components presenting aspherical characteristics. It presents a brightness minimum at the center. The envelope around AFGL 2343 is a detached shell, showing spherical symmetry and clumpiness at a level of $\sim$ 15% of the maximum brightness. The envelopes expand isotropically at $\sim$ 35 km s^{-1}, about two or three times faster than typical CSEs around AGB stars. High temperatures ($\sim$ 200 K) are derived for the innermost regions in IRC +10420, while denser and cooler ($\sim$ 30 K) gas is found in AFGL 2343. The mass-loss processes in these YHGs have been found to be similar. The deduced mass-loss rates ($\sim 10^{-4} - 10^{-3}$ M$_\odot$yr^{-1}) are much higher than those obtained in AGB stars, and they present 5significant variations on time scales of $\sim$ 1000 yr.

Appeared in: A&A 465, 457

Dust and Molecular Content of the Lensed Quasar, MG0751+2716, at $z = 3.2$

Danielle Alloin([1,2]), Jean-Paul Kneib([3]), Stéphane Guilloteau([4]) and Michael Bremer([5])
([1])European Southern Observatory, Casilla 19001, Santiago 19, Chile, ([2])AIM, CEA/DSM-CNRS-Université Paris 7, SAp, Bât.709, CE Saclay, l'Orme des Merisiers, 91191 Gif-sur-Yvette Cédex, France, ([3])Laboratoire d'Astrophysique de Marseille, OAMP Traverse du Siphon, BP 8, 13376 Marseille Cedex 12, France, ([4])UMR5804 CNRS, OASU, Université Bordeaux 1, BP 89, 33270

Floirac, France, ([5])Institut de Radio Astronomie Millimétrique, 300 rue de la Piscine, 38406 Saint Martin d'Hères, France

Abstract:
Gravitational lenses offer unique opportunities to explore the molecular content around active galactic nuclei at high redshift, through the magnification and gain in angular resolution. We study here the molecular and dust content of the high redshift (z=3.2), gravitationally lensed quasar MG0751+2716. We used the IRAM Plateau de Bure interferometer to measure the CO J=3-2, J=4-3 and J=8-7 rotation lines and continuum flux between 1.1 mm and 3 mm in MG0751+2716. We use HST data and constraints from the high resolution MERLIN map at 6.2 cm to build an improved model of the lens. The position agreement between the CO emission and the millimeter continuum suggests that dust and molecules are closely related. A 500 $\mathrm{km\,s^{-1}}$ velocity gradient is tentatively detected from the CO lines across the central $0\farcs5$. The continuum SED in the range 0.45 mm – 204 mm exhibits the signatures of two components: synchrotron emission from a core/jet system, and thermal emission related to warm dust. The CO line intensities are compatible with warm, dense molecular gas, suggesting a location in the close environment of the quasar. These observational constraints lead us to consider a source/quasar model made of a point-like core, a radio jet, and a molecular and dusty ring-like structure (∼460 pc in radius) located in a plane perpendicular to the jet axis and seen almost edge-on. For this configuration, we derive a total magnification of 16 for the quasar radiation at rest frequency above 350 GHz and a magnification of 25 below 350 GHz. The dust mass (assuming a likely temperature $T = 50$ K) is $\mathrm{M}_{dust} = 1.7 \times 10^8 \mathrm{M}_\odot$, the mass of molecular material is $\mathrm{M(H_2)} = 6 \times 10^{10} \mathrm{M}_\odot$ and a lower limit to the dynamical mass is $\mathrm{M}_{dyn} = 1.5 \times 10^{10} \mathrm{M}_\odot$. Such values are comparable to those found in the small sample of CO detected sources at high redshifts.

Accepted for publication in A&A

A Detailed Study of Gas and Star Formation in a Highly Magnified Lyman Break Galaxy at z=3.07

Coppin K.E.K.([1]), Swinbank A.M.([1]), Neri R.([2]), Cox P.([2]), Smail Ian([1]), Ellis R.S.([3]), Geach J.E.([1]), Siana B.([4]), Teplitz H.([4]), Dye S.([5]), Kneib J.-P.([6]), Edge A.C.([1]), Richard, J.([3])
([1])Institute for Computational Cosmology, Durham University, South Road, Durham, DH1 3LE, UK, ([2])IRAM, 300 rue de la Piscine, Domaine Universitaire, 38406 Saint Martin d'Hères, France, ([3])Caltech, MC 105-24, 1200 East California Blvd, Pasadena, California, CA91125, USA, ([4])Spitzer Science Center, Caltech, MC 314-6, 1200 East California Blvd, Pasadena, California, CA91125, USA, ([5])School of Physics and Astronomy, Cardiff University, 5, The Parade, Cardiff, Wales, CF24AA, UK, ([6])Laboratoire d'Astrophysique de Marseille, Traverse du Siphon - B.P.8 13376, Marseille Cedec 12, France

Abstract:
We report the detection of CO(3-2) emission from a bright, gravitationally lensed Lyman Break Galaxy, LBG J213512.73-010143 (the "Cosmic Eye"), at $z = 3.07$ using the Plateau de Bure Interferometer. This is only the second detection of molecular gas emission from an LBG and yields an intrinsic molecular gas mass of $(2.4 \pm 0.4) \times 10^9$ $\mathrm{M}_\odot$. The lens reconstruction of the UV morphology of the LBG indicates that it comprises two components separated by ~ 2 kpc. The CO emission is unresolved, $\Theta \lesssim 2''$, and appears to be centered on the intrinsically fainter (and also less highly magnified) of the two UV components. The width of the CO line indicates a dynamical mass of $(8 \pm 2) \times 10^9$ $csc^2 i$ $\mathrm{M}_\odot$within the central 2 kpc. Employing mid-infrared observations from *Spitzer* we derive a stellar mass of $\sim (6 \pm 2) \times 10^9$ $\mathrm{M}_\odot$and a star-formation rate of ~ 60 $\mathrm{M}_\odot$/yr, indicating that the molecular gas will be consumed in ~ 40 Myr. The gas fractions, star-formation efficiencies and line widths suggests that LBG J213512 is a high-redshift, gas-rich analog of a local luminous infrared galaxy. This galaxy has a similar gas-to-dynamical mass fraction as observed in the submillimeter-selected population, although the gas surface density and star-formation efficiency is a factor of 3× less, suggesting less vigorous activity. We discuss the uncertainties in our conclusions arising from adopting a CO-to-H_2 conversion factor appropriate for either the Milky Way or local luminous infrared galaxies. These observations demonstrate that current facilities, when aided by fortuitous gravitational magnification, can study 'ordinary' galaxies at high-redshift and so act as pathfinders for ALMA.

Accepted for publication in ApJ

Detection of emission from the CN radical in the Cloverleaf Quasar at z=2.56

Dominik A. Riechers([1]), Fabian Walter([1]), Pierre Cox([2]), Christopher L. Carilli([3]), Axel Weiß([4]), Frank Bertoldi([5]), and Roberto Neri([2])
([1])MPIA, Königstuhl 17, Heidelberg, D-69117, Germany, ([2])IRAM, 300 Rue de la Piscine, Domaine Universitaire, 38406 Saint Martin d'Hères, France, ([3])NRAO, PO Box O, Socorro, NM 87801, USA, ([4])MPIfR, Auf dem Hügel 69, Bonn, D-53121, Germany, ([5])Argelander-Institut für Astronomie, Universität Bonn, Auf dem Hügel 71, Bonn, D-53121, Germany

Abstract:
We report the detection of CN($N = 3 \rightarrow 2$) emission towards the Cloverleaf quasar (z = 2.56) based on observations with the IRAM Plateau de Bure Interferometer.

This is the first clear detection of emission from this radical at high redshift. CN emission is a tracer of dense molecular hydrogen gas ($n(H_2) > 10^4 cm^{-3}$) within star-forming molecular clouds, in particular in regions where the clouds are affected by UV radiation. The HCN/CN intensity ratio can be used as a diagnostic for the relative importance of photodissociation regions (PDRs) in a source, and as a sensitive probe of optical depth, the radiation field, and photochemical processes. We derive a lensing-corrected CN($N = 3 \rightarrow 2$) line luminosity of L'CN(3-2)= $(4.5 \pm 0.5) \times 10^9 Kkms^{-1}pc^2$. The ratio between CN luminosity and far-infrared luminosity falls within the scatter of the same relationship found for low-z (ultra-) luminous infrared galaxies. Combining our new results with CO($J = 3 \rightarrow 2$) and HCN($J = 1 \rightarrow 0$) measurements from the literature and assuming thermal excitation for all transitions, we find a CO/CN luminosity ratio of 9.3 ± 1.9 and a HCN/CN luminosity ratio of 0.95 ± 0.15. However, we find that the CN($N = 3 \rightarrow 2$) line is likely only subthermally excited, implying that those ratios may only provide upper limits for the intrinsic 1!0 line luminosity ratios. We conclude that, in combination with other molecular gas tracers like CO, HCN, and HCO^+, CN is an important probe of the physical conditions and chemical composition of dense molecular environments at high redshift.

Accepted for publication in ApJ

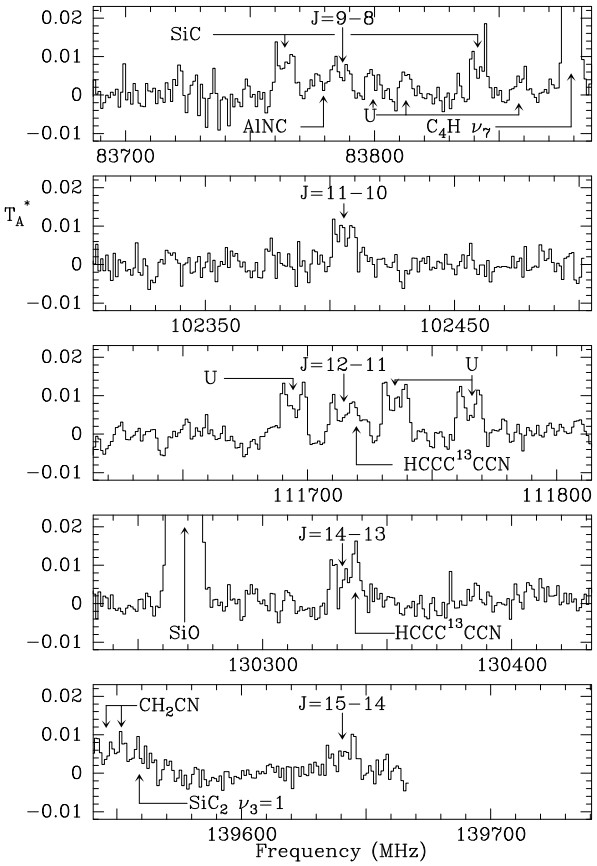

Figure 2: J=9-8, 11-10, 12-11, 14-13 and 15-14 lines of C_4H^- toward IRC+10216. The spectral resolution is 1 MHz and the frequency scale (rest frequency) is relative to a systemic velocity of -26.5 km s^{-1}. The positions of the C_4H^- lines are indicated by downward arrows. The lines of $HCCC^{13}CCN$ correspond to its J=42-41, and 49-48 transitions. The corresponding transitions of $HCC^{13}CCCN$ could be present in the same panels. However, within the S/N of the data these lines are not detected. Spectral intensities are in the antenna temperature scale, T_A^*.

Astronomical detection of C_4H^-, the second interstellar anion

J. Cernicharo([1]), M. Guélin([2]), M. Agundez([1]), K. Kawaguchi([3]), M. McCarthy([4]) and P. Thaddeus ([4])
([1])Dpt. Molecular and Infrared Astrophysics. Instituto de Estructura de la Materia, CSIC, Serrano 121, E28006, Spain, ([2])IRAM, Domaine Universitaire, 300 rue de la Piscine, 38406 St Martin d'Hères, France, ([3])Department of Chemistry, Faculty of Science, Okayama University, Tsushimanaka, Okayama 700-8530, Japan ([4])Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA

Abstract:
The presence of negative ions in the interstellar medium has been predicted many years ago on general grounds or on the basis of ion-molecule chemical models (see e.g. Herbst 1981). It was pointed out that a high electron affinity and a large number of vibrational states increase greatly the sticking coefficient of electrons, so that large, negatively charged carbon chains of the form C_nH^- may be abundant. In particular, Millar et al. (2000) predicted an abundance of C_8H^- as large as 1/4 of that of its neutral counterpart C_8H in the outer envelope of the C-star IRC +10216, a source known to be particularly rich in C-chain molecules. For a long time, however, negative ions escaped detection because of lack of accurate transition frequencies.

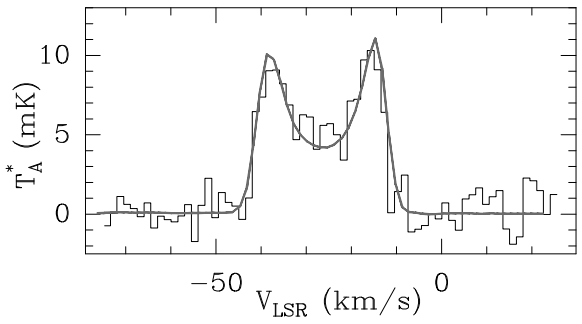

Figure 3: Averaged spectrum of the J=9-8, 11-10, 12-11, 14-13 and 15-14 lines of C_4H^- (histogram) and C_4H (thick continuous line). All lines blended with those of C_4H^- have been fitted and removed. The C_4H averaged spectrum has been scaled by a factor 100.

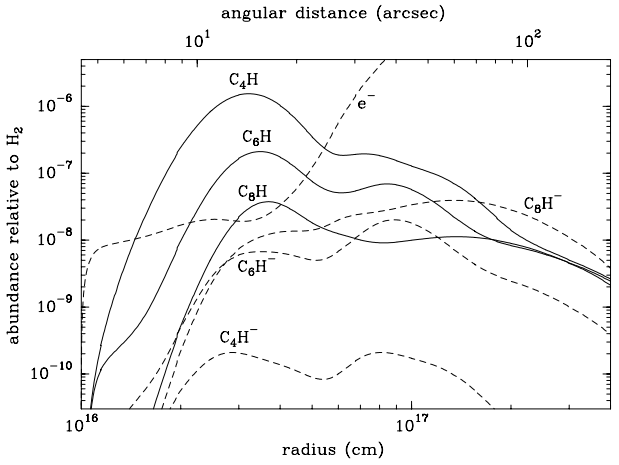

Figure 4: Abundance profiles of C_nH and C_nH^- given by chemical modelling of the envelope, using the model parameters of Agundez & Cernicharo (2006). Angular distance is given in the top axis for an assumed distance to the star of 150 pc. The model predicts that anions have a more extended distribution than their neutral counterparts, which is related to the increase of the electron abundance with radius.

Recently, McCarthy et al. (2006) have succeeded in studying the microwave spectrum of C_6H^- in the laboratory and identified this species as the carrier of a series of lines observed in 1996 by Kawaguchi and co-workers in the C-rich circumstellar envelope IRC +10216. Pursuing their laboratory work, McCarthy and colleagues have measured the rotational spectra of two more polyacetylenic anions, C_8H^- and C_4H^- (Gupta et al. 2007). In this Letter, we report the astronomical detection of the latter species in IRC+10216.

We have observed five lines corresponding to the J= 9-8, 11-10, 12-11, 14-13 and 15-14 rotational transitions of C_4H^- (Fig. 2). The C_4H^- lines have a cusped shape, denoting that this ion is formed in the outer part of the envelope, like its neutral counterpart C_4H (Fig. 3). The abundance of C_4H^- in IRC+10216 is 1/6 of the abundance of C_6H^- and 1/4200 of that of C_4H. The detection of C_4H^-, after that of C_6H^-, confirms the theoretical prediction that C-chain anions are abundant in interstellar clouds (Fig. 4) and yields a first measurement of the electron radiative attachment rates.

The abundance decrement between the two ions, $[C_4H^-]/[C_6H^-] = 1/6$, is more than two orders of magnitude smaller than that between their neutral counterparts, $[C_4H]/[C_6H] = 45$. The two negative ions appear more abundant than their positive ion analogs which, so far, have not been identified.

The detection of C_4H^- and C_6H^- sustains the farsighted prediction of Herbst and co-workers that carbon-chain anions may be abundant in the interstellar medium. Other negative ions from the same family, such as CN^-, C_3N^-, CCH^- and C_8H^-, are likely to be detectable, although, probably, at lower intensity levels. Some of these species have already been studied in the laboratory and their millimeter rotational frequencies are accurately known, awaiting only for deeper astronomical searches. The observed $[C_4H^-]/[C_6H^-]$ abundance ratio differs significantly from that estimated from statistical calculations of radiative electron attachment. This shows that surprising results are likely in this matter.

Accepted for publication in A&A

NUclei of GAlaxies: V. Radio emission in 7 NUGA sources

M. Krips([1,2]), A. Eckart([1]), T.P. Krichbaum([3]), J.-U. Pott([1,4]), S. Leon([5,6]), R. Neri([7]), S. García-Burillo([8]), F.Combes([9]), F. Boone([9]), A.J. Baker([10]), L.J. Tacconi([11]), E. Schinnerer([12]), and L.K. Hunt([13])
([1])Universität zu Köln, I.Physikalisches Institut, Zülpicher Str. 77, 50937 Köln, Germany, ([2])Harvard-Smithsonian Center for Astrophysics, SMA project, 645 North A'ohoku Place, Hilo, HI 96720, ([3])MPIfR, Auf dem Hügel 69, 53121 Bonn, Germany, ([4])ESO, Karl-Schwarzschild-Str. 2, 85748 Garching, Germany, ([5])Instituto de Astrofísica de Andalucía (CSIC), C/ Camino Bajo de Huétor,24, Apartado 3004, 18080 Granada, Spain, ([6])IRAM, Avenida Divina Pastora, 7, Núcleo Central, 18012 Granada, Spain, ([7])Institut de Radio-Astronomie Millimétrique (IRAM), 300, rue de la Piscine, 38406 St.Martin-d'Hères, France, ([8])Observatorio Astronómico Nacional (OAN)-Observatorio de Madrid, Alfonso XII, 3, 28014 Madrid, Spain, ([9])Observatoire de Paris, LERMA, 61 Av. de l'Observatoire, 75014 Paris, France, ([10])Department of Physics and Astronomy, Rutgers, the State University of New Jersey, 136 Frelinghuysen Road, Piscataway, NJ 08854-8019, United States, ([11])Max-Planck-Institut für extraterrestrische Physik, Postfach 1312, 85741 Garching, Germany, ([12])MPIA, Königstuhl 17, 69117 Heidelberg, Germany, ([13])INAF-Istituto di Radioastronomia/Sezione Firenze, Largo E. Fermi, 5, 50125 Firenze, Italy

Abstract:
We present high angular resolution radio snap-shot observations of seven nearby low-luminosity active galaxies (LLAGN) from the NUclei of GAlaxies (NUGA) survey. The observations were conducted with MERLIN and EVN/VLBI at 18cm and 6cm. At all observed angular resolutions and frequencies, we find indications for extended emission in about $\sim$ 40% of the sources, consistent with the decrease of flux with increasing angular resolution. The extended components resemble jet emission in a majority of cases, consistent with the optically thin synchrotron emission implied by their steep spectra. We consider the compact 6cm EVN/VLBI radio emission of our sources in the context of the "fundamental plane" that previous LLAGN studies

identified within the three-dimensional parameter space of radio luminosity, X-ray luminosity, and black hole mass. We demonstrate, using NGC7217 and NGC1068 as particular examples, that high-resolution, multi-epoch radio observations offer useful information about the origin of offsets from the fundamental plane.

Appeared in A&A 464, 553

Detection of HNC and tentative detection of CN at z = 3.9

Guélin M.([1]), Salomé P.([1]), Neri R.([1]), García-Burillo S.([2]), Graciá-Carpio J.([2]), Cernicharo J.([3]), Cox P.([1]); Planesas P.([2]), Solomon P.M.([4]), Tacconi L.J.([5]), vanden Bout P.([6])
([1])IRAM, Domaine Universitaire, 300 rue de la Piscine, St Martin d'Hères, 38400, France ([2])Observatorio Astronómico Nacional, Calle Alfonso XII 3, 28014 Madrid, Spain, ([3])IEM-DAMIR, CSIC, Serrano 121, 28006, Spain, ([4])Dept. of Physics and Astronomy, State Univ. of N.Y., Stony Brook, NY 11974, USA, ([5])Max-Planck-Institut fr extraterrestrische Physik, Postfach 1312, 85741 Garching, Germany, ([6])NRAO, 520 Edgemont road, Charlottesville, VA 22903, USA

Abstract:
Molecular line emission from high-redshift galaxies holds great promise for the study of galaxy formation and evolution. The weak signals can only be detected with the largest mm-wave telescopes, such as the IRAM interferometer. We report the detection of the $J = 5 - 4$ line of HNC and the tentative detection of the $N = 4 - 3$ line of CN in the quasar APM 08279+5255 at z=3.9. These are the 4th and 5th molecular species detected at such a high redshift. The derived HNC and CN line intensities are 0.6 and 0.4 times that of HCN $J = 5 - 4$. If HNC and HCN are co-spatial and if their $J = 5 - 4$ lines are collisionally excited, the [HNC]/[HCN] abundance ratio must be equal to 0.6 within a factor of 2, similar to its value in the cold Galactic clouds and much larger than in the hot molecular gas associated with Galactic HII regions. It is possible, however, that fluorescent infrared radiation plays an important role in the excitation of HNC and HCN.

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The millimetre variability of M 81*. Multi-epoch dual frequency mm-observations of the nucleus of M 81

Schödel R.([1]), Krips M.([2]), Markoff S.([3]), Neri R.([4]), Eckart A.([1])
([1])I. Physikalisches Institut, Universität zu Köln, Zülpicher Str. 77, 50937 Köln, Germany, ([2])Harvard-Smithsonian Center for Astrophysics, SMA project, 645 North A'ohoku Place, Hilo, HI 96720, USA, ([3])Sterrenkundig Instituut "Anton Pannekoek", Universiteit van Amsterdam, Kruislaan 403, 1098 SJ Amsterdam, The Netherlands, ([4])IRAM, 300 rue de la Piscine, Domaine Universitaire, 38406 Saint Martin d'Hères

Abstract:
There are still many open questions as to the physical mechanisms at work in Low Luminosity AGN that accrete in the extreme sub-Eddington regime. Simultaneous multi-wavelength studies have been very successful in constraining the properties of Sgr A*, the extremely sub-Eddington black hole at the centre of our Milky Way. M 81*, the nucleus of the nearby spiral galaxy M 81, is an ideal source to extend the insights obtained on Sgr A* toward higher luminosity AGN. Here we present observations at 3 and 1 mm that were obtained within the framework of a coordinated, multi-wavelength campaign on M 81*. The continuum emission from M 81* was observed during three epochs with the IRAM Plateau de Bure Interferometer simultaneously at wavelengths of 3 and 1 mm. We present the first flux measurements of M 81* at wavelengths around 1 mm. We find that M 81* is a continuously variable source with the higher variability observed at the shorter wavelength. Also, the variability at 3 and 1 mm appears to be correlated. Like Sgr A*, M 81* appears to display the strongest flux density and variability in the mm-to-submm regime. There remains still some ambiguity concerning the exact location of the turnover frequency from optically thick to optically thin emission. The observed variability time scales point to an upper size limit of the emitting region of the order 25 Schwarzschild radii. The data show that M 81* is indeed a system with very similar physical properties to Sgr A* and an ideal bridge toward high luminosity AGN. The data obtained clearly demonstrate the usefulness and, above all, the necessity of simultaneous multi-wavelength observations of LLAGN.

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Highly-excited CO emission in APM08279+5255 at z=3.9

A. Weiß([1]), D. Downes([2]), R. Neri([2]), F. Walter([3]), C. Henkel([1]), D.J. Wilner([4]), J. Wagg([4,5]), and T. Wiklind([6])
([1])MPIfR, Auf dem Hügel 69, 53121 Bonn, Germany, ([2])IRAM, Domaine Universitaire, 38406 St-Martin-d'Hères, France, ([3])MPIA, Königstuhl 17, 69117 Heidelberg, Germany, ([4])Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, 02138, ([5])Instituto Nacional de Astrofisica, Óptica y Electrónica (INAOE), Aptdo. Postal 51 y 216, Puebla, Mexico, ([6])ESA-Space Telescope Division, STScI, 3700 San Martin Drive, Baltimore, MD 21218, USA

Abstract:
We report the detection of the CO $4 - 3$, $6 - 5$, $9 - 8$,

$10-9$, and $11-10$ lines in the Broad Absorption Line quasar APM08279+5255 at z=3.9 using the IRAM 30m telescope. We also present IRAM PdBI high spatial resolution observations of the CO $4-3$ and $9-8$ lines, and of the 1.4mm dust radiation as well as an improved spectrum of the HCN(5−4) line. Unlike CO in other QSO host galaxies, the CO line SED of APM08279+5255 rises up to the CO(10−9) transition. The line fluxes in the CO ladder and the dust continuum fluxes are best fit by a two component model, a "cold" component at ~ 65K with a high density of $n(H_2) = 1 \times 10^5$ cm^{-3}, and a "warm", ~ 220K component with a density of 1×10^4 cm^{-3}. We show that IR pumping via the 14 micron bending mode of HCN is the most likely channel for the HCN excitation. From our models we find, that the CO(1-0) emission is dominated by the *dense* gas component which implies that the CO conversion factor is higher than usually assumed for high-z galaxies with $\alpha \simeq 5$ M$_\odot$/(K km/s pc^2)$^{-1}$. Using brightness temperature arguments, the results from our high-resolution mapping, and lens models from the literature, we argue that the molecular lines and the dust continuum emission arise from a very compact ($r \sim 100-300$ pc), highly gravitationally magnified ($m = 60-110$) region surrounding the central AGN. Part of the difference relative to other high-z QSOs may therefore be due to the configuration of the gravitational lens, which gives us a high-magnification zoom right into the central 200-pc radius of APM08279+5255 where IR pumping plays a significant role for the excitation of the molecular lines.

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Large-scale molecular shocks in galaxies

Usero A., García-Burillo S.([1]), Martín-Pintado J.([2]), Fuente A.([1]), Neri R.([3])
([1])Observatorio Astronómico Nacional (OAN), Observatorio de Madrid, C/Alfonso XII, 3, 28014 Madrid, Spain, ([2])Instituto de Estructura de la Materia, DAMIR-CSIC, C/Serrano 121, 28006 Madrid, Spain, ([3])IRAM, 300 rue de la Piscine, Domaine Universitaire, 38406 St. Martin d'Hères, Cedex, France

Abstract:
We review our on-going study of the shock-driven molecular gas chemistry in star-forming galaxies, based on observations with the IRAM Plateau de Bure Interferometer. We have obtained high-resolution ($\sim 5''$) images of the emission of silicon monoxide (SiO) in the nuclei of the nearby galaxies NGC 253, IC 342 and M 82. From observations in the Galaxy and theoretical models, SiO is known to be a privileged tracer of molecular shock chemistry. The large SiO abundances, $< X(SiO) > \sim 10^{-10}10^{-9}$, found along several hundreds of pc imply that large-scale shock chemistry must be at play in the inner disks of the three surveyed galaxies. Noticeable differences in the morphology of the SiO emission call to different driving mechanisms, however. In NGC 253 and IC 342, the most plausible scenario is that of shocks arising in cloud cloud collisions, dynamically triggered along the bar potential. In the case of M 82, shocks arise in the disk halo interface, probably boosted by local episodes of mass ejection from the disk. These dissimilarities are explained in terms of the evolutionary stage of the starburst episodes. This work illustrates how high-resolution imaging of specific chemical tracers provide useful inputs to the understanding of galaxy evolution.

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Anatomy of HH 111 from CO Observations: A Bow-Shock-driven Molecular Outflow

Bertrand Lefloch([1]), José Cernicharo([2]), Bo Reipurth([3]), Juan Ramon Pardo([2]), Roberto Neri([4])
([1])Laboratoire d'Astrophysique de l'Observatoire de Grenoble, Grenoble, France, ([2])Instituto de Estructura de la Materia, Departamento Fsica Molecular, Madrid, Spain, ([3])Institute for Astronomy, University of Hawaii, Hilo, HI, ([4])IRAM, Domaine Universitaire, St. Martin d'Hères, France

Abstract:
We present single-dish and interferometric millimeter line observations of the HH 111 outflow and its driving source. The physical conditions of the core have been determined from the emission of the millimeter line of CO and its isotopomers and CS with the IRAM 30 m telescope, and the CO $J = 7 \rightarrow 6$ line with the Caltech Submillimeter Observatory. The emission reveals a small condensation of cold (T= $20-25$ K) and dense gas [$n(H_2) = 3 \times 10^5$ cm^{-3}]. The outflow has been mapped with the IRAM Plateau de Bure interferometer (PdBI). The cold gas is distributed in a hollow cylinder surrounding the optical jet. The formation of this cavity and its kinematics are well accounted for in the frame of outflow gas entrainment by jet bow shocks. Evidence of gas acceleration is found along the cavity walls, correlated with the presence of optical bow shocks. The separation of the inner walls reaches $8''-10''$, which matches the transverse size of the wings in the bow shock. CSO observations of the $J = 7 \rightarrow 6$ line show evidence of a high-velocity and hot gas component ($T = 300-1000$ K) with a low filling factor. This emission probably arises from shocked gas in the jet. Observations of the $^3P_2-{}^3P_1$ [C I] line are consistent with C-type nondissociative shocks. Mapping of the high-velocity molecular bullets B1-B3, located beyond the optical jet, reveals small structures of $3'' \times 7''$ flattened perpendicular to the flow direction. They are made of cold ($T \sim 30$ K), moderate density gas [$n(H_2) = (0.5-1.0) \times 10^4$ cm^{-3}], expanding into the low-density surrounding medium. Their properties are consistent with their being shocked gas knots resulting from past time-variable ejections in the jet.

Appeared in: ApJ 658, 498

Millimeter imaging of HD 163296: probing the disk structure and kinematics

Andrea Isella([1,2]), Leonardo Testi([1]), Antonella Natta([1]), Roberto Neri([3]), David Wilner([4]), and Chunhua Qi([4])
([1])Osservatorio Astrofisico di Arcetri, INAF, Largo E.Fermi 5, I-50125 Firenze, Italy, ([2])Dipartimento di Fisica, Universitá di Milano, Via Celoria 16, 20133 Milano, Italy, ([3])Institut de Radio Astronomie Millimétrique (IRAM), 300 Rue de la Piscine, Domaine Universitaire de Grenoble, St. Martin d'Hères F-38406, France, ([4]) Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, MS 42, Cambridge, MA 02138, USA

Abstract:
We present new multi-wavelength millimeter interferometric observations of the Herbig Ae star HD 163296 obtained with the IRAM/PBI, SMA and VLA arrays both in continuum and in the ^{12}CO, ^{13}CO and C^{18}O emission lines. Gas and dust properties have been obtained comparing the observations with self-consistent disk models for the dust and CO emission. The circumstellar disk is resolved both in the continuum and in CO.We find strong evidence that the circumstellar material is in Keplerian rotation around a central star of 2.6 $M_\odot$. The disk inclination with respect to the line of sight is $46^\circ \pm 4^\circ$ with a position angle of $128^\circ \pm 4^\circ$. The slope of the dust opacity measured between 0.87 and 7 mm ($\beta = 1$) confirms the presence of mm/cm-size grains in the disk midplane. The dust continuum emission is asymmetric and confined inside a radius of 200 AU while the CO emission extends up to 540 AU. The comparison between dust and CO temperature indicates that CO is present only in the disk interior. Finally, we obtain an increasing depletion of CO isotopomers from ^{12}CO to ^{13}CO and C^{18}O. We argue that these results support the idea that the disk of HD 163296 is strongly evolved. In particular, we suggest that there is a strong depletion of dust relative to gas outside 200 AU; this may be due to the inward migration of large bodies that form in the outer disk or to clearing of a large gap in the dust distribution by a low mass companion.

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Chemistry in disks I. Deep search for N2H+ in the protoplanetary disks around LkCa 15, MWC 480, and DM Tauri

A. Dutrey([1]), T. Henning([2]), S. Guilloteau([1]), D. Semenov([2]), V. Piétu([3]), K. Schreyer([4]), A. Bacmann([1]), R. Launhardt([2]), J. Pety([3]), and F. Gueth([3])
([1])L3AB, Observatoire de Bordeaux, 2 rue de l'Observatoire, BP 89, 33270 Floirac, France, ([2])Max-Planck-Institut fr Astronomie, Königstuhl 17, 69117 Heidelberg, Germany, ([3])IRAM, 300 rue de la Piscine, 38406 Saint-Martin-d'Hères, France, ([4])Astrophysikalisches Institut und Universitäts-Sternwarte, Schillergässchen 2-3, 07745 Jena, Germany

Abstract:
To constrain the ionization fraction in protoplanetary disks, we present new high-sensitivity interferometric observations of N_2H^+ in three disks surrounding DM Tau, LkCa 15, and MWC 480. We used the IRAM PdBI array to observe the N_2H^+ $J = 1 - 0$ line and applied a χ^2-minimization technique to estimate corresponding column densities. These values are compared, together with HCO^+ column densities, to results of a steady-state disk model with a vertical temperature gradient coupled to gas-grain chemistry. Results. We report two N_2H^+ detections for LkCa 15 and DM Tau at the 5σ level and an upper limit for MWC 480. The column density derived from the data for LkCa 15 is much lower than previously reported. The $[N_2H^+/HCO^+]$ ratio is on the order of $0.02 - 0.03$. So far, HCO^+ remains the most abundant observed molecular ion in disks. All the observed values generally agree with the modelled column densities of disks at an evolutionary stage of a few million years (within the uncertainty limits), but the radial distribution of the molecules is not reproduced well. The low inferred concentration of N_2H^+ in three disks around low-mass and intermediate-mass young stars implies that this ion is not a sensitive tracer of the overall disk ionization fraction.

Appeared in: A&A 464, 615

Sulfur chemistry in the Horsehead: An interferometric view of the Horsehead PDR

J.R. Goicoechea([1]), J. Pety([1,2]), M. Gerin([1]), D. Teyssier([3]), E. Roueff([4]), P. Hily-Blant([2])
([1])LERMA-LRA, UMR 8112, CNRS, Observatoire de Paris and Ecole Normale Supérieure, 24 Rue Lhomond, 75231 Paris, France, ([2])IRAM, 300 rue de la Piscine, 38406 Grenoble cedex, France, ([3])European Space Astronomy Centre, Urb. Villafranca del Castillo, P.O. Box 50727, Madrid 28080, Spain, ([4])LUTH UMR 8102, CNRS and Observatoire de Paris, Place J. Janssen 92195 Meudon cedex, France

Abstract:

Sulfur is an abundant element which remains undepleted in diffuse interstellar gas ($A_V < 1$) but it is traditionally assumed to deplete on dust grains at higher densities and larger AV. Photodissociation regions (PDRs) are an interesting intermediate medium between translucent and dark clouds where the chemistry and energetics are domi- nated by the illuminating FUV radiation field. Thus they can provide new insights about the sulfur depletion problem. However, physical and chemical gradients in PDRs take place at small angular scales (~ 1 to $10''$). Aperture synthesis observations are therefore required to resolve such gradients. Besides, a complete understanding of molecular excitation is needed to correctly determine molecular abundances but also the preavailing physical

conditions. Hence, multi-J observations at increasing frequencies are also required. Such high an- gular resolution and broad frequency coverage observa- tions will be provided by ALMA in the near future. In this work we present IRAM-PdBI observations of the CS $J = 2-1$ line toward the Horsehead PDR comple- mented with IRAM-30m observations of several rota- tional lines of different sulfur bearing molecules (CS, HCS^+, SO, H_2S, etc.). Photochemical and nonlocal, non-LTE radiative transfer models adapted to the Horsehead geometry have been developed. The gas phase sulfur abundance has been inferred in the PDR.

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Deuterium fractionation in the Horsehead edge

J. Pety([1,2]), J. R. Goicoechea([2]), P. Hily-Blant([1]), M. Gerin([2]), and D. Teyssier([3])
([1])IRAM, 300 rue de la Piscine, 38406 Grenoble Cedex, France, ([2])LERMA, UMR 8112, CNRS, Observatoire de Paris and École Normale Supérieure, 24 rue Lhomond, 75231 Paris Cedex 05, France, ([3])European Space Astronomy Centre, Urb. Villafranca del Castillo, PO Box 50727, Madrid 28080, Spain

Abstract:
Deuterium fractionation is known to enhance the $[DCO^+]/[HCO^+]$ abundance ratio over the $D/H \sim 10^{-5}$ elemental ratio in the cold and dense gas typically found in pre-stellar cores. We report the first detection and mapping of very bright DCO^+ $J = 3-2$ and $J = 2-1$ lines (3 and 4K respectively) towards the Horsehead photodissociation region (PDR) observed with the IRAM-30m telescope. The DCO^+ emission peaks close to the illuminated warm edge of the nebula ($< 50''$ or $\lesssim 0.1$pc away). Detailed nonlocal, non-LTE excitation and radiative transfer analyses have been used to determine the prevailing physical conditions and to estimate the DCO^+ and $H^{13}CO^+$ abundances from their line intensities. A large $[DCO^+]/[HCO+^+]$ abundance ratio (≥ 0.02) is inferred at the DCO^+ emission peak, a condensation shielded from the illuminating far-UV radiation field where the gas must be cold ($10-20$ K) and dense (2×10^5 cm^{-3}). DCO^+ is not detected in the warmer photodissociation front, implying a lower $[DCO^+]/[HCO^+]$ ratio ($< 10^{-3}$). According to our gas phase chemical predictions, such a high deuterium fractionation of HCO^+ can only be explained if the gas temperature is below 20K, in good agreement with DCO^+ excitation calculations.

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Unveiling the Chemistry of Hot Protostellar Cores with ALMA

M. Guélin([1]), N. Brouillet([2]), J. Cernicharo([3]), F. Combes([4]) and A. Wooten([5])
([1])IRAM, 300 rue de la Piscine, 38406 St. Martin d'Hères, France, ([2])Observatoire de Bordeaux, France, ([3])DAMIR/CSIC, Madrid, Spain, ([4])Observatoire de Paris, France, ([5])NRAO, Charlottesville, USA

Abstract:
High angular resolution mm-wave observations of the Orion-KL region, made with the IRAM Plateau de Bure interferometer (PdBI), reveal the presence of several hot cores (**A,B, C, D**) with distinct spectral signatures (Fig. 5) and different molecular content. The emission from complex molecules seems confined to these cores, the size of which is typically 10^3 AU. As can be seen on the maps of Fig. 6, the bulk of the emission from ethyl cyanide (CH_3CH_2CN), vinyl cyanide (CH_2CHCN), ethanol (CH_3CH_2OH) and, to a lesser degree, methanol (CH_3OH) arise from such cores. Ethyl- and vinyl cyanide emission is observed in two small sources located few arcsec NE and W of IRC2 (triangle) and devoid of any visible ethanol or methanol emission. The alcohol emission actually peaks in another clump, S of IRC2, called the Orion "Hot Core".

The absence of vinyl- and ethyl cyanide in the "Hot Core" has yet to be explained. It does not result from a lack of nitrogen as HCN, NH_3 and H_2CO are abundant in both the NE core and in the "Hot Core" (as a matter of fact, the NH_3 column density is a factor of 8 larger in the NE core). It is not a temperature effect, as both cores have teperatures > 150K, high enough for desorbing from grains most molecular species. The chemical differences may come from the warm-up time of the cores, a critical parameter according to models, which depends on the mass of the protostar.

The emission from each molecule covers only a small fraction (1/10 to 1/30) of the 30-m telescope beam, so that the column densities of the species in the cores are more than one order of magnitude larger than the beam-averaged column densities observed with the 30-m telescope or the JCMT. The abundance ratios between e.g. ethyl- or vinyl cyanide, on the one hand, and ethanol or methyl formate, on the other hand, also differ by large factors from those derived with single dish telescopes. Obviously, the predictions of hot core chemistry models must be compared only with high resolution interferometric observations.

The PdBI observations were part of a search for interstellar glycine, also carried out with the IRAM 30-m telescope and the Green Bank Telescope. We derive a 3σ upper limit of $1 \cdot 10^{15}$ cm^{-2} per $2'' \times 3''$ beam in the Orion *Hot Core* and *Compact Ridge* – the lowest to date at this scale.

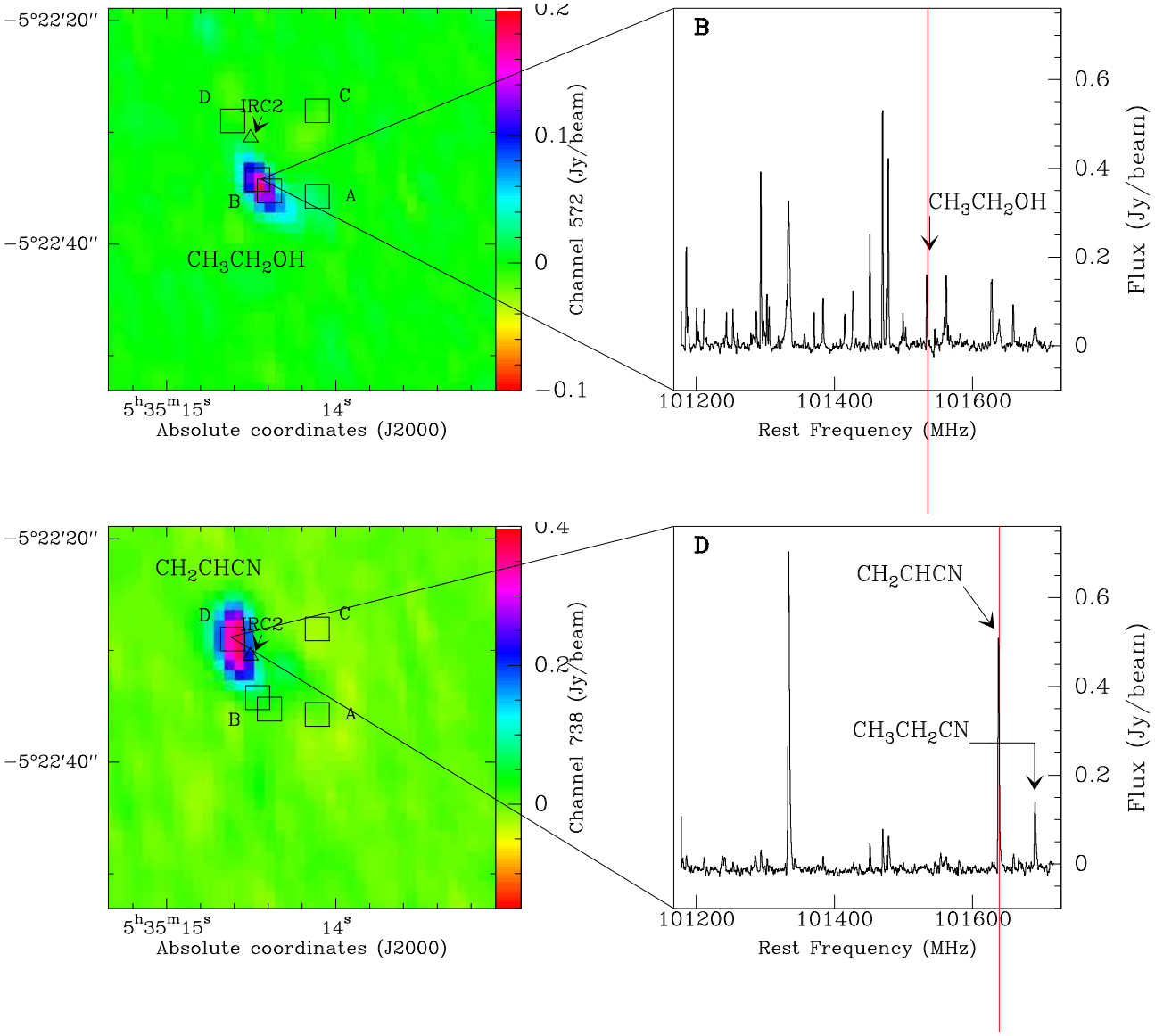

Figure 5: *Right*: PdB interferometer spectra observed toward sources **B** and **D**. *Left*: maps of the emission in the 101 GHz lines of CH_3CH_2OH, and CH_3CH_2CN. The continuum emission was subtracted.

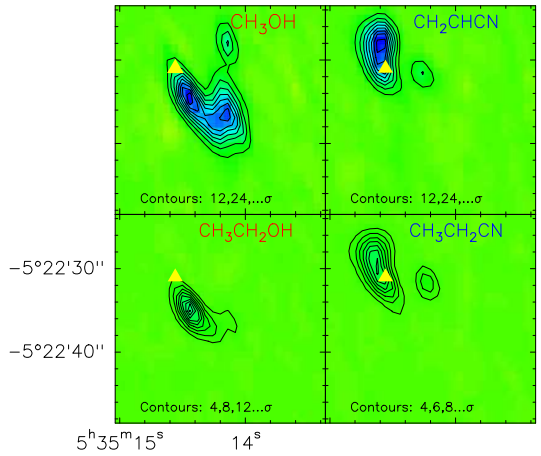

Figure 6: Maps of the emission in the 101 GHz lines of CH_3OH, CH_3CH_2OH, CH_2CHCN and CH_3CH_2CN. The continuum emisssion has been subtracted. First contour and contour steps are 4 or 12 σ, as indicated. The triangle shows the position of IRC2. Axis are J2000 coordinates.

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The initial conditions of star formation in the Ophiuchus main cloud: Kinematics of the protocluster condensations

Philippe André([1,2]), Arnaud Belloche([1,3]), Frédérique Motte([1,2]) and Nicolas Peretto([1,4])
([1])CEA/DSM/DAPNIA, Service d'Astrophysique, C.E. Saclay, Orme des Merisiers, F-91191 Gif-sur-Yvette, France, ([2])Laboratoire AIM, Unité Mixte de Recherche CEA – CNRS – Université Paris Diderot, C.E. Saclay, France, ([3])Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, D-53121 Bonn, Germany, ([4])Physics & Astronomy Department, University of Manchester, P.O. Box 88, Manchester M60 1QD, UK

Abstract:
The earliest phases of clustered star formation and the origin of the stellar initial mass function (IMF) are currently much debated. In one school of thought the IMF of embedded clusters is entirely determined by turbulent fragmentation at the prestellar stage of star formation, while in a major alternative view it results from dynamical interactions and competitive accretion at the protostellar stage. In an effort to discriminate between these two pictures for the origin of the IMF, we investigated the internal and relative motions of starless condensations and protostars previously detected by us in the dust continuum at 1.2 mm in the L1688 protocluster of the Ophiuchus molecular cloud complex. The starless condensations have a mass spectrum resembling the IMF and are therefore likely representative of the initial stages of star formation in the protocluster. We carried out detailed molecular line observations, including some N_2H^+(1-0) mapping, of the Ophiuchus protocluster condensations using the IRAM 30m telescope. We measured subsonic or at most transonic levels of internal turbulence within the condensations, implying virial masses which generally agree within a factor of ~ 2 with the masses derived from the 1.2 mm dust continuum. This supports the notion that most of the L1688 starless condensations are gravitationally bound and prestellar in nature. We detected the classical spectroscopic signature of infall motions in CS(2–1), CS(3–2), $H_2CO(2_{12}-1_{11})$, and/or HCO^+(3–2) toward six condensations, and obtained tentative infall signatures toward 10 other condensations. In addition, we measured a global one-dimensional velocity dispersion of less than 0.4 km s^{-1} (or twice the sound speed) between condensations. The small relative velocity dispersion implies that, in general, the condensations do not have time to interact with one another before evolving into pre-main sequence objects.

Our observations support the view that the IMF is partly determined by cloud fragmentation at the prestellar stage. Competitive accretion is unlikely to be the dominant mechanism at the protostellar stage in the Ophiuchus protocluster, but it may possibly govern the growth of starless, self-gravitating condensations initially produced by gravoturbulent fragmentation toward an IMF, Salpeter-like mass spectrum.

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Discovery of Interstellar Propylene (CH_2CHCH_3): Missing Links in Interstellar Gas-Phase Chemistry

N. Marcelino([1,4]), J. Cernicharo([1]), M. Agundez([1]), E. Roueff([2]), M. Gerin([3]), J. Martin-Pintado([1]), R. Mauersberger([4]), and C. Thum([5])
([1])DAMIR-IEM-CSIC, Spain, ([2])LUTH, Obs. de Paris, France, ([3])LERMA, Obs. de Paris and Ecole Normale Superieure, France, ([4])IRAM, Spain, ([5])IRAM, France

Abstract:
We report the discovery of propylene (also called propene, CH_2CHCH_3) with the IRAM 30-m radio telescope toward the dark cloud TMC-1. Propylene is the most saturated hydrocarbon ever detected in space through radio astronomical techniques. In spite of its weak dipole moment, 6 doublets (A and E species) plus another line from the A species have been observed with main beam temperatures above 20 mK. The derived total column density of propylene is 4×10^{13} cm^{-2}, which corresponds to an abundance relative to H_2 of 4×10^{-9}, i.e., comparable to that of other well known and abundant hydrocarbons in this cloud, such as c–C_3H_2. Although this isomer of C_3H_6 could play an important role in interstellar chemistry, it has been ignored by previous chemical models of dark clouds as there seems to be no obvious formation pathway in gas phase. The discovery of this species in a

dark cloud indicates that a thorough analysis of the completeness of gas phase chemistry has to be done.

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Discovery of Phosphaethyne (HCP) in Space: Phosphorus Chemistry in Circumstellar Envelopes

Marcelino Agúndez([1]), José Cernicharo([1]) and Michel Guélin([2])
([1])Departamento de Astrofisica Molecular e Infrarroja, Instituto de Estructura de la Materia, CSIC, Serrano 121, E-28006 Madrid, Spain, ([2])Institut de Radioastronomie Millimétrique, 300 rue de la Piscine, F-38406 St. Martin d'Hères, France

Abstract:
We present the first detection in space of phosphaethyne, the phosphorus analogue of HCN. We have observed with the IRAM 30-m telescope four successive rotational transitions of HCP in the AGB star envelope IRC+10216. After PN and CP, HCP is the third phosphorus-bearing molecule identified in the interstellar medium. HCP forms under thermochemical equilibrium in the surroundings of the stellar photosphere, from which it is expelled into space. It locks 3 % of the phosphorus present in the expanding envelope, the remaining most likely being condensed on grains. We further discuss the chemistry of phosphorus in circumstellar envelopes in the light of our findings and speculate on other phosphorus compounds that may be detectable.

Appeared in: ApJ Letters, 662, L91

Particularly Efficient Star Formation in M33

E. Gardan([1]), J. Braine([1]), K.F. Schuster([2]), N. Brouillet([1]), A. Sievers([2])
([1])Université Bordeaux 1, CNRS, Laboratoire d'Astrophysique, Observatoire de Bordeaux, OASU, UMR 5804, Floirac, F-33270, ([2])IRAM, 300 Rue de la Piscine, F-38406 St Martin d'Hères, France

Abstract:
The Star Formation (SF) rate in galaxies is an important parameter at all redshifts and evolutionary stages of galaxies. In order to understand the increased SF rates in intermediate redshift galaxies one possibility is to study star formation in local galaxies with properties frequently found at this earlier epoch like low metallicity and small size. We present sensitive observations of the molecular gas in M33, a small Local Group spiral at a distance of 840 kpc which shares many of the characteristics of the intermediate redshift galaxies. The observations were carried out in the CO$(2-1)$ line with the HERA heterodyne array on the IRAM 30m telescope. A $11' \times 22'$ region in the northern part of M33 was observed, reaching a detection threshold of a few $10^3 M_\odot$. The correlation in this field between the CO emission and tracers of SF (8μm, 24μm, H_α, FUV) is excellent and CO is detected very far North, showing that molecular gas forms far out in the disk even in a small spiral with a subsolar metallicity. One major molecular cloud was discovered in an interarm region with no HI peak and little if any signs of SF – without a complete survey this cloud would never have been found. The radial dependence of the CO emission has a scale length similar to the dust emission, less extended than the H or FUV. If, however, the $N(H_2)/I_{CO}$ ratio varies inversely with metallicity, then the scale length of the H_2 becomes similar to that of the H or FUV. Comparing the SF rate to the H_2 mass shows that M33, like the intermediate redshift galaxies it resembles, has a significantly higher SF eciency than large local universe spirals. The data presented here also provide an ideal test for theories of molecular cloud formation and cover a new region in parameter space, where $\sum_{stars} < \sum_{gas}$. We find that a simple pressure-based prescription for estimating the molecular to atomic gas fraction does not perform well for M33, at least in the outer parts. On the other hand, we show that the molecular gas fraction is influenced by (i) the total Hydrogen column density, dominated in M33 by the HI, and (ii) the galactocentric distance.

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Imaging of thermal domains in ultra-thin NbN films for hot electron bolometers

D. Doenitz([1]), R. Keller([1]), D. Koelle([1]), T. Scherer([2]), K.F.Schuster([2])
([1])Physikalisches Institut-Experimentalphysik II, Universität Tübingen, Auf der Morgenstelle 14, D-72076 Tübingen, Germany, ([2])Institut de Radio Astronomie Millimétrique (IRAM), 300 rue de la Piscine, 38406 St. Martin d'Hères, France

Abstract:
The authors present low-temperature scanning electron microscopy (LTSEM) investigations of superconducting microbridges made from ultrathin NbN films as used for hot electron bolometers. LTSEM probes the thermal structure within the microbridges under various dc bias conditions, either via electron-beam-induced generation of an unstable hot spot or via the beam-induced growth of a stable hot spot. Such measurements reveal inhomogeneities on a micron scale, which may be due to spatial variations in the NbN film or film-interface properties. Comparison with model calculations for the stable hot spot regime confirms the basic features of common hot spot models.

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Fabrication of sub-micrometer SIS Junctions for Radio Astronomy

N. Krebs([1]), A. Barbier([1]), D. Billon-Pierron([1]), S. Halleguen([1]), M. Schicke([1]) and K. F. Schuster([1])
([1])Institut de Radio Astronomie Millimétrique (IRAM), 300 rue de la Piscine, 38406 St. Martin d'Hères, France

Abstract:
We present a new fabrication scheme for high quality Nb-AlOx-Nb junctions as used for mm-wave mixers in radio astronomy. The key features of the fabrication process are high-resolution e-beam lithography for junction and contact definition as well as highly selective Niobium and SiO_2 inductively coupled plasma etching. Chemical-mechanical polishing, which is difficult to control for low volume production is not required. We further show that a new type of spin-on glass can be used as a reliable replacement for sputtered SiO_2. We present yield and parameter scattering of these devices.

Accepted for publ. in: IEEE Trans. Appl. Supercond.

Niobium SupraMEMS for Reconfigurable Millimeter Wave Filters

Matthias Schicke([1]), Alessandro Navarrini([2]), Philippe Ferrari([3]), Teresa Zöpfl([4]), Franz Wittmann([4]), Witek Bedyk([4]), Gabi Schrag([4]), and Karl-Friedrich Schuster([1])
([1])IRAM, 300, rue de la Piscine, Domaine Universitaire de Grenoble, 38406 St. Martin d'Hères Cedex, France, ([2])Osservatorio Astronomico di Cagliari /INAF Loc. Poggio dei Pini, Strada 54 09012 Capoterra (CA) - Italy, ([3])Institute for Microelectronics Electromagnetism and Photonics (IMEP) - INPG/Université Joseph Fourier, 23 rue de Martyrs, 38016 Grenoble, France, ([4])Institute for Physics of Electrotechnology, Munich University of Technology, Arcisstrae 21, 80290 Munich, Germany

Abstract:
Reconfigurable passive superconducting devices for the mm-wave regime offer a large spectrum of novel applications in scientific and industrial remote sensing. Several groups have reported on cm-wave devices. We developed a surface mounted Niobium (Nb) MEMS technology that can be integrated with a wide range of cryogenic semiconductor and superconducting circuits. A first generation of circuits using our Niobium SupraMEMS has been optimized for radio astronomical applications. In this paper we present the micro-mechanical and electrical characterization of the devices. Mechanical modeling results in an improved understanding of the specific behavior of metallic cryogenic MEMS devices. The influence of the fabrication procedure on the mechanical properties of the devices and the resulting limitations are discussed. A particular design for improved tuning range has been investigated.

Accepted for publ. in in: IEEE Trans. Appl. Supercond.

Special A&A Letters edition for recent high-resolution PdBI results

Editorial A&A Letters 468 (2007):
The IRAM interferometer, located on the Plateau de Bure at 2500 meters altitude in the French Alps, has entered a new era since the beginning of 2006. The tracks, on which the six 15-meter diameter antennas move, have been extended, nearly doubling the east-west and north-south baselines. The largest separation of the antennas is now 760 meters, enabling sub-arcsecond angular resolution at millimeter wavelengths.

This special issue of Astronomy & Astrophysics Letters presents first results with the extended baselines of the Plateau de Bure interferometer. Eleven Letters report observations done at sub-arcsecond resolution of objects ranging from nearby star-forming regions and evolved stars to starburst galaxies.

M. Walmsley and C. Bertout

PdBI sub-arcsecond study of the SiO microjet in HH212 Origin and collimation of class 0 jets

S. Cabrit([1]), C. Codella([2]), F. Gueth([3]), B. Nisini([4]), A. Gusdorf([5]), C. Dougados([6]), and F. Bacciotti([7])
([1])LERMA, UMR 8112 du CNRS, Observatoire de Paris, 61 Av. de l'Observatoire, 75014 Paris, France, ([2])INAF, Istituto di Radioastronomia, Sezione di Firenze, Largo E. Fermi 5, 50125 Firenze, Italy, ([3])IRAM, 300 rue de la Piscine, 38406 Grenoble Cedex, France, ([4])INAF-Osservatorio Astrofisico di Roma, via di Frascati 33, 00040 Monte Catone, Italy, ([5])Physics Department, The University, Durham DH1 3LE, UK, ([6])Laboratoire d'Astrophysique de l'Observatoire de Grenoble, BP 53, 38041 Grenoble Cedex, France, ([7])INAF-Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, 50125 Firenze, Italy

Abstract:
Context. The bipolar HH 212 outflow has been mapped in SiO using the extended configuration of the Plateau de Bure Interferometer (PdBI), revealing a highly collimated SiO jet closely associated with the H2 jet component. Aims. We study at unprecedented resolution ($0\farcs34$ across the jet axis) the properties of the innermost SiO "microjet" within 1000 AU of this young Class 0 source, to compare it with atomic microjets from more evolved sources and to constrain its origin. Methods. The SiO channel maps are used to investigate the microjet collimation and velocity structure. A large velocity gradient analysis is applied to SiO $(2-1)$, $(5-4)$ and $(8-7)$ data from the PdBI and the Submillimeter Array to constrain the SiO opacity and abundance. Results. The HH212 Class 0 microjet shows striking similarities in collimation and energetic budget with atomic microjets from T Tauri sources. Furthermore, the SiO lines appear optically thick, unlike what is generally assumed. We infer $T_{\rm k} \simeq$ 50-500

K and an SiO/H_2 abundance $\geq 4 \times 10^{-8} - 6 \times 10^5$ for $n(H_2) = 10^7 - 10^5$ cm^{-3}, i.e. $0.05 - 90\%$ of the elemental silicon. Conclusions. This similar jet width, regardless of the presence of a dense envelope, definitely rules out jet collimation by external pressure, and favors a common MHD self-collimation (and possibly acceleration) process at all stages of star formation. We propose that the more abundant SiO in Class 0 jets could mainly result from rapid (≤ 25 yrs) molecular synthesis at high jet densities.

Appeared in: A&A 468, L29

The IC 1396 N proto-cluster at a scale of $\sim$ 250 AU

R. Neri([1]), A. Fuente([2]), C. Ceccarelli([3]), P. Caselli([4,5]), D. Johnstone([6,7]), E. F. van Dishoeck([8]), F. Wyrowski([9]), M. Tafalla([2]), B. Lefloch([3]), and R. Plume([10])
([1])Institut de Radioastronomie Millimétrique, 300 rue de la Piscine, 38406 St Martin d'Hères Cedex, France ([2])Observatorio Astronómico Nacional (OAN), Apdo. 112, 28803 Alcalá de Henares (Madrid), Spain, ([3])Laboratoire d'Astrophysique de l'Observatoire de Grenoble, BP 53, 38041 Grenoble Cedex 9, France, ([4])Osservatorio Astrofisico di Arcetri (INAF), Largo E. Fermi 5, 50125 Firenze, Italy, ([5])Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 0213, USA, ([6])Department of Physics and Astronomy, University of Victoria, Victoria, BC V8P 1A1, Canada, ([7])National Research Council of Canada, Herzberg Institute, 5071 West Saanich Road, Victoria, BC V9E 2E7, Canada, ([8])Leiden Observatory, PO Box 9513, 2300 RA Leiden, The Netherlands, ([9])Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany, ([10])University of Calgary, 2500 University Drive NW, Alberta T2N 1N4, Canada

Abstract:
Aims. We investigate the mm-morphology of IC 1396 N with unprecedented spatial resolution to analyze its dust and molecular gas properties, and draw comparisons with objects of similar mass. Methods. We have carried out sensitive observations in the most extended configurations of the IRAM Plateau de Bure interferometer, to map the thermal dust emission at 3.3 and 1.3 mm, and the emission from the $J = 13_k \rightarrow 12_k$ hyperfine transitions of methyl cyanide (CH_3CN). Results. We unveil the existence of a sub-cluster of hot cores in IC 1396 N, distributed in a direction perpendicular to the emanating outflow. The cores are embedded in a common envelope of extended and diffuse dust emission. We find striking differences in the dust properties of the cores ($\beta \simeq 0$) and the surrounding envelope ($\beta \simeq 1$), very likely testifying to differences in the formation and processing of dust material. The CH_3CN emission peaks towards the most massive hot core and is marginally extended in the outflow direction.

Appeared in: A&A 468, L33

Protostellar clusters in intermediate mass (IM) star forming regions

A. Fuente([1]), C. Ceccarelli([2]), R. Neri([3]), T. Alonso-Albi([1]), P. Caselli([4,5]), D. Johnstone([6,7]), E. F. van Dishoeck([8]), and F. Wyrowski([9])
([1])Observatorio Astronómico Nacional (OAN), Apdo. 112, 28803 Alcalá de Henares (Madrid), Spain, ([2])Laboratoire d'Astrophysique de l'Observatoire de Grenoble, BP 53, 38041 Grenoble Cedex 9, France, ([3])Institute de Radioastronomie Millimétrique, 300 rue de la Piscine, 38406 St Martin d'Hères Cedex, France, ([4])INAF-Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, 50125 Firenze, Italy, ([5])Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 0213, ([6])Department of Physics and Astronomy, University of Victoria, Victoria, BC V8P 1A1, Canada, ([7])National Research Council of Canada, Herzberg Institute of Astrophysics, 5071 West Saanich Road, Victoria, BC V9E 2E7, Canada, ([8])Leiden Observatory, PO Box 9513, 2300 RA Leiden, The Netherlands, ([9])Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany

Abstract:
Context. The transition between the low density groups of T Tauri stars and the high density clusters around massive stars occurs in the intermediate-mass (IM) range ($M_* \sim 2 - 8 M_\odot$). High spatial resolution studies of IM young stellar objects (YSO) can provide important clues to understand the clustering in massive star forming regions. Aims. Our aim is to search for clustering in IM Class 0 protostars. The high spatial resolution and sensitivity provided by the new A configuration of the Plateau de Bure Interferometer (PdBI) allow us to study the clustering in these nearby objects. Methods. We have imaged three IM Class 0 protostars (Serpens-FIRS 1, IC1396 N, CB 3) in the continuum at 3.3 and 1.3 mm using the PdBI. The sources have been selected with different luminosity to investigate the dependence of the clustering process on the luminosity of the source. Results. Only one millimeter (mm) source is detected towards the low luminosity source Serpens-FIRS 1. Towards CB 3 and IC1396 N, we detect two compact sources separated by $\sim$ 0.05 pc. The 1.3 mm image of IC1396 N, which provides the highest spatial resolution, reveal that one of these cores is splitted in, at least, three individual sources.

Appeared in: A&A 468, L37

Minkowski's footprint revisited Planetary nebula formation from a single sudden event?

J. Alcolea([1]), R. Neri([2]), and V. Bujarrabal([3])
([1])Observatorio Astronómico Nacional (OAN-IGN), Calle Alfonso XII 3, 28014 Madrid, Spain, ([2])Institut de Radio Astronomie Millimétrique (IRAM), 300 rue de la Piscine,

38406 St. Martin d'Hères, France, ([3])Observatorio Astronómico Nacional (OAN-IGN), Apartado 112, 28803 Alcalá de Henares, Spain

Abstract:
Context. M 1-92 can be considered an archetype of bipolar pre-planetary nebulae. It shows a clear axial symmetry, along with the kinematics and momentum excess characteristic of this class of envelopes around post-AGB stars. Aims. By taking advantage of the new extended configuration of the IRAM Plateau de Bure interferometer, we wanted to study the morphology and velocity field of the molecular gas better in this nebula, particularly in its central part. Methods. We performed sub-arcsecond resolution interferometric observations of the $J = 2 - 1$ rotational line of ^{13}CO in M 1-92. Results. We found that the equatorial component is a thin flat disk, which expands radially with a velocity proportional to the distance to the center. The kinetic age of this equatorial flow is very similar to that of the two lobes. The small widths and velocity dispersion in the gas forming the lobe walls confirm that the acceleration responsible for the nebular shape could not last more than 100-120 yr. Conclusions. The present kinematics of the molecular gas can be explained as the result of a single brief acceleration event, after which the nebula reached an expansion velocity field with axial symmetry. In view of the similarity to other objects, we speculate on the possibility that the whole nebula was formed as a result of a magneto-rotational explosion in a common-envelope system.

Appeared in: A&A 468, L41

The nebula around the post-AGB star 89 Herculis

V. Bujarrabal([1]), H. Van Winckel([2]), R. Neri([3]), J. Alcolea([4]), A. Castro-Carrizo([3]), and P. Deroo([2])
([1])Observatorio Astronómico Nacional (OAN-IGN), Apartado 112, 28803 Alcalá de Henares, Spain, ([2])Instituut voor Sterrenkunde, KU Leuven, Celestijnenlaan 200B, 3001 Leuven, Belgium, ([3])Institut de Radio Astronomie Millimétrique (IRAM), 300 rue de la Piscine, 38406 St. Martin d'Hères, France, ([4])Observatorio Astronómico Nacional (OAN-IGN), C/ Alfonso XII 3, 28014 Madrid, Spain

Abstract:
Aims. We aim to study the structure of the nebula around the post-AGB, binary star 89 Her. The presence of a rotating disk around this star had been proposed but not been yet confirmed by observations. Methods. We present high-resolution PdBI maps of CO $J = 2 - 1$ and $1 - 0$. Properties of the nebula are directly derived from the data and model fitting. We also present N-band interferometric data on the extent of the hot dust emission, obtained with the VLTI. Results. Two nebular components are found: (a) an extended hour-glass-like structure, with expansion velocities of ~ 7 km s^{-1} and a total mass $\sim 3 \times 10^{-3}$ M$_\odot$, and (b) an unresolved very compact component, smaller than $\sim 0\farcs4$ and with a low total velocity dispersion of ~ 5 km s^{-1}. We cannot determine the velocity field in the compact component, but we argue that it can hardly be in expansion, since this would require too recent and too sudden an ejection of mass. On the other hand, assuming that this component is a Keplerian disk, we derive disk properties that are compatible with expectations for such a structure; in particular, the size of the rotating gas disk should be very similar to the extent of the hot dust component from our VLTI data. Assuming that the equator of the extended nebula coincides with the binary orbital plane, we provide new results on the companion star mass and orbit.

Appeared in: A&A 468, L45

Jet-disturbed molecular gas near the Seyfert 2 nucleus in M 51

S. Matsushita([1]), S. Muller([1]), and J. Lim([1])
([1])Academia Sinica, Institute of Astronomy and Astrophysics, PO Box 23-141, Taipei 106, Taiwan, R.O.C.

Abstract:
Context. Previous molecular gas observations at arcsecond-scale resolution of the Seyfert 2 galaxy M 51 suggest the presence of a dense circumnuclear rotating disk, which may be the reservoir for fueling the active nucleus and obscures it from direct view in the optical. However, our recent interferometric CO$(3 - 2)$ observations show a hint of a velocity gradient perpendicular to the rotating disk, which suggests a more complex structure than previously thought. Aims. To image the putative circumnuclear molecular gas disk at sub-arcsecond resolution to better understand both the spatial distribution and kinematics of the molecular gas. Methods. We carried out CO$(2 - 1)$ and CO$(1 - 0)$ line observations of the nuclear region of M 51 with the new A configuration of the IRAM Plateau de Bure Interferometer, yielding a spatial resolution lower than 15 pc. Results. The high resolution images show no clear evidence of a disk, aligned nearly east-west and perpendicular to the radio jet axis, as suggested by previous observations, but show two separate features located on the eastern and western sides of the nucleus. The western feature shows an elongated structure along the jet and a good velocity correspondence with optical emission lines associated with the jet, suggesting that this feature is a jet-entrained gas. The eastern feature is elongated nearly east-west ending around the nucleus. A velocity gradient appears in the same direction with increasingly blueshifted velocities near the nucleus. This velocity gradient is in the opposite sense of that previously inferred for the putative circumnuclear disk. Possible explanations for the observed molecular gas distribution

and kinematics are that a rotating gas disk disturbed by the jet, gas streaming toward the nucleus, or a ring with another smaller counter- or Keplarian-rotating gas disk inside.

Appeared in: A&A 468, L49

Distribution of the molecular absorption in front of the quasar B0218+357

S. Muller([1]), M. Guélin([2]), F. Combes([3]), and T. Wiklind([4])
([1])Academia Sinica Institute of Astronomy and Astrophysics (ASIAA), PO Box 23-141, Taipei, 106 Taiwan, ([2])Institut de Radio Astronomie Millimétrique (IRAM), 300 rue de la piscine, 38406 St Martin d'Hères, France, ([3])Observatoire de Paris, LERMA, 61 Av. de l'Observatoire, 75014 Paris, France, ([4])ESA Space Telescope Division, STScI, 3700 San Martin Drive, Baltimore, MD 21218, USA

Abstract:
The line of sight to the quasar B0218+357, one of the most studied lensed systems, intercepts a z = 0.68 spiral galaxy, which splits its image into two main components A and B, separated by ca. 0.″3, and gives rise to molecular absorption. Although the main absorption component has been shown to arise in front of image A, it is not established whether some absorption from other velocity components is also occuring in front of image B. To tackle this question, we have observed the $HCO^+(2-1)$ absorption line during the commissioning phase of the new very extended configuration of the Plateau de Bure Interferometer, in order to trace the position of the absorption as a function of frequency. Visibility fitting of the self-calibrated data allowed us to achieve position accuracy between 12 and 80 mas per velocity component. Our results clearly demonstrate that all the different velocity components of the $HCO^+(2-1)$ absorption arise in front of the south-west image A of the quasar. We estimate a flux ratio $f_A/f_B = 4.2^{+1.8}_{-1.0}$ at 106 GHz.

Appeared in: A&A 468, L53

Black hole in the West nucleus of Arp 220

D. Downes([1]) and A. Eckart([2,3])
([1])Institut de Radio Astronomie Millimétrique, Domaine Universitaire, 38406 St. Martin d'Hères, France, ([2])I.Physikalisches Institut, Universität zu Kln, Zulpicherstrasse 77, 50937 Köln, Germany, ([3])Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany

Abstract:
We present new observations with the IRAM Interferometer, in its longest-baseline configuration, of the $CO(2-1)$ line and the 1.3 mm dust radiation from the Arp 220 nuclear region. The dust source in the West nucleus has a size of $0.''19 \times 0.''13$ and a 1.3 mm brightness temperature of 90 K. This implies that the dust ring in the West nucleus has a high opacity, with $\tau = 1$ at 1.1 mm. Not only is the dust ring itself optically thick in the submm and far-IR, but it is surrounded by the previously-known, rapidly rotating molecular disk of size 0.″5 that is also optically thick in the mid-IR. The molecular ring is cooler than the hot dust disk because the $CO(2-1)$ line is seen in absorption against the dust disk. The dust ring is massive ($10^9 M_\odot$), compact (radius 35 pc), and hot (true dust temperature 170 K). It resembles rather strikingly the dust ring detected around the quasar APM 08279+52, and is most unlike the warm, extended dust sources in starburst galaxies. Because there is a strong temperature gradient from the hot dust ring to the cooler molecular disk, the heating must come from a concentrated source, an AGN accretion disk that is completely invisible at optical wavelengths, and heavily obscured in hard X-rays.

Appeared in: A&A 468, L57

Molecular gas in NUclei of GAlaxies (NUGA): VI. Detection of a molecular gas disk/torus via HCN in the Seyfert 2 galaxy NGC 6951?

M. Krips([1]), R. Neri([2]), S. García-Burillo([3]), F. Combes([4]), E. Schinnerer([5]), A. J. Baker([6]), A. Eckart([7]), F. Boone([5]), L. Hunt([8]), S. Leon([9]), and L. J. Tacconi([10])
([1])Harvard-Smithsonian Center for Astrophysics, SMA project, 645 N A'ohoku Pl., Hilo, HI,96720, USA, ([2])Institut de Radio Astronomie Millimétrique (IRAM), 38406, Saint Martin d'Hères, France, ([3])Observatorio Astronómico Nacional (OAN)- Observatorio de Madrid, C/ Alfonso XII 3, 28014 Madrid, Spain, ([4])Observatoire de Paris, LERMA, 61 Av. de l'Observatoire, 75014 Paris, France, ([5])Max-Planck-Institut für Astronomie, Königstuhl 17, 69117 Heidelberg, Germany, ([6])Department of Physics and Astronomy, Rutgers, State University of NJ, 136 Frelinghuysen Rd., Piscataway, NJ 08854-8019, USA, ([7])Universität zu Köln, I.Physikalisches Institut, Zülpicher Str. 77, 50937 Köln, Germany, ([8])INAF-Istituto di Radioastronomia/Sezione Firenze Largo E. Fermi 5, 50125 Firenze, Italy, ([9])IRAM, Avenida Divina Pastora, 7, Núcleo Central, 18012 Granada, Spain, ([10])Max-Planck-Institut fr extraterrestrische Physik, Postfach 1312, 85741 Garching, Germany

Abstract:
Context. Several studies of nearby active galaxies indicate significantly higher HCN-to-CO intensity ratios in AGN (e.g., NGC 1068) than in starburst (e.g., M 82) environments. HCN enhancement can be caused by many different effects, such as higher gas densities and/or temperatures, UV/X-ray radiation, and non-collisional excitation. As active galaxies often exhibit intense circumnuclear star formation, high angular resolution/high

sensitivity observations are of paramount importance to disentangling the influence of star formation from that of nuclear activity on the chemistry of the surrounding molecular gas. The tight relation of HCN enhancement and nuclear activity may qualify HCN as an ideal tracer of molecular gas close to the AGN, providing complementary and additional information to that gained via CO. Aims. NGC 6951 houses nuclear and starburst activity, making it an ideal testbed in which to study the effects of different excitation conditions on the molecular gas. Previous lower angular resolution/sensitivity observations of HCN($1-0$) carried out with the Nobeyama Millimeter array by Kohno et al. (1999a, ApJ, 511, 157) led to the detection of the starburst ring, but no central emission has been found. Our aim was to search for nuclear HCN emission and, if successful, for differences of the gas properties of the starburst ring and the nucleus. Methods. We used the new A, B, C and D configurations of the IRAM PdBI array to observe HCN($1-0$) in NGC 6951 at high angular resolution ($1'' \equiv 96$ pc) and sensitivity. Results. We detect very compact ($\leq$50 pc) HCN emission in the nucleus of NGC 6951, supporting previous hints of nuclear gas structure. Our observations also reveal HCN emission in the starburst ring and resolve it into several peaks, leading to a higher coincidence between the HCN and CO distributions than previously reported by Kohno et al. (1999a). Conclusions. We find a significantly higher HCN-to-CO intensity ratio (≥ 0.4) in the nucleus than in the starburst ring ($0.02-0.05$). As for NGC 1068, this might result from a higher HCN abundance in the centre due to an X-ray dominated gas chemistry, but a higher gas density/temperature or additional non-collisional excitation of HCN cannot be entirely ruled out, based on these observations. The compact HCN emission is associated with rotating gas in a circumnuclear disk/torus.

Appeared in: A&A 468, L63

Sub-arcsecond CO(1-0) and CO(2-1) observations of the ultraluminous infrared galaxy IRAS 10190+1322

J. Graciá-Carpio([1]), P. Planesas([1]), and L. Colina([2])
([1])Observatorio Astronómico Nacional (OAN), Observatorio de Madrid, Alfonso XII 3, 28014 Madrid, Spain, ([2])Consejo Superior de Investigaciones Científicas (CSIC), Instituto de Estructura de la Materia, Serrano 121, 28006 Madrid, Spain

Abstract:
We present the results of high resolution mapping of the CO($1-0$) and CO($2-1$) emission of the ultraluminous infrared galaxy (ULIRG) IRAS 10190+1322, with the IRAM interferometer, down to an angular resolution of $\sim 0.3''$. This object is composed of two interacting galaxies with a projected nuclear separation of 6 kpc, and was selected to analyze the physical and dynamical properties of the molecular gas in each galaxy in order to study the conditions that lead a galaxy pair to become ultraluminous in the infrared. With the exception of Arp 220, the closest ULIRG, this is the first time that the CO emission is morphologically and kinematically resolved in the two interacting galaxies of a ULIRG system. In one of the galaxies the molecular gas is highly concentrated, distributed in a circumnuclear disk of 1.7 kpc in size. The molecular gas in the presumably less infrared luminous galaxy is distributed in a more extended disk of 7.4 kpc. The molecular gas mass accounts for $\sim 10\%$ of the dynamical mass in each galaxy. Both objects are rich enough in molecular gas, $M_{\rm gas} \sim 4 \times 10^9 {\rm M}_\odot$, as to experience an infrared ultraluminous phase.

Appeared in: A&A 468, L67

Fueling the central engine of radio galaxies I. The molecular/dusty disk of 4C 31.04

S. García-Burillo([1]), F. Combes([2]), R. Neri([3]), A. Fuente([1]), A. Usero([1,4]), S. Leon([5]), and J. Lim([6])
([1]) Observatorio Astronómico Nacional, Alfonso XII, 3, 28014 Madrid, Spain, ([2]) Observatoire de Paris, LERMA, 61 Av. de l'Observatoire, 75014 Paris, France, ([3]) Institut de Radioastronomie Millimétrique, 300 rue de la Piscine, 38406 St. Martin d'Hères, France, ([4]) Centre for Astrophysics Research, University of Hertfordshire, College Lane, AL10 9AB, UK, ([5]) Instituto de Astrofísica de Andalucía, C Bajo de Huétor, 50, 18008 Granada, Spain, ([6]) Inst. of Astron. and Astrophysics, Academia Sinica, PO Box 23-141, Taipei 106, Taiwan

Abstract:
We report the detection of a massive ($M_{\rm gas} > 5{\times}10^9$ M$_\odot$) molecular/dusty disk of 1.4 kpc-size fueling the central engine of the compact symmetric object (CSO) 4C 31.04, based on high-resolution ($0\farcs5 - 1\farcs2$) observations done with the IRAM Plateau de Bure interferometer (PdBI). These observations allow us for the first time to detect and map the continuum emission from dust at 218 GHz in the disk of a CSO. The case for a massive disk is confirmed by detection of strong HCO$^+$($1-0$) line emission and absorption. The molecular gas mass of 4C 31.04 is in the range $0.5 \times 10^{10} - 5 \times 10^{10}$ M$_\odot$. While the distribution and kinematics of the gas roughly correspond to those of a rotating disk, we find evidence of distortions and non-circular motions that suggest the disk is not in a dynamically relaxed state. We discuss the implications of these results for the understanding of the evolution of radio galaxies.

Appeared in: A&A 468, L71

First Announcement: IRAM Observing School 2007

– mm Observing in Times of HERSCHEL –

September 28 - October 5, 2007

Pradollano (Sierra Nevada, Spain)

The purpose of the school is to attract new users to current and future mm-telescopes. This fourth school in IRAM Spain will concentrate on single dish mm-astronomy.

There will be a lecture course 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".

http://www.iram.es/IRAMES/events/summerschool2007/

Lecturers: Philippe André (CEA, Saclay), José Cernicharo (IEM/CSIC, Madrid), Pierre Cox (IRAM, Grenoble), Pierre Hily-Blant (IRAM, Grenoble), Peter Schilke (MPIfR, Bonn), Clemens Thum (IRAM, Grenoble)

Topics:

- mm-astronomical observing techniques
- Inter- and circumstellar chemistry
- Physical and chemical conditions of the interstellar medium
- dust continuum observations
- The early universe
- Synergies between mm-observations and Herschel

Applications will be accepted from young scientists with little previous experience in mm-astronomy. The course is limited to 45 students, who will be selected on the basis of their CV and references. Up to one officially supported student from each institute participating in the FP6 network "The Molecular Universe" will be admitted. Information and inscription are via http://www.iram.es/IRAMES .

Rainer MAUERSBERGER

IRAM OBSERVING SCHOOL 2007

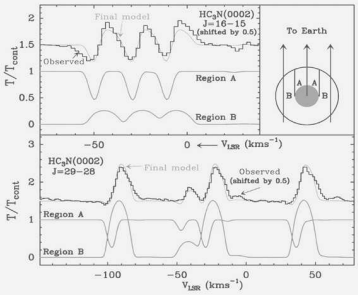
Millimeterwave observations in times of Herschel

September 28 - October 5, 2007, Pradollano (Sierra Nevada, Spain)

The purpose of this school is to attract new users to current and future mm-telescopes and to foster the synergy with FIR observatories. There will be a lecture course on FIR and 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"

Lecturers:

P. André (Saclay)
J. Cernicharo (CSIC)
P. Cox (IRAM)
P. Hily-Blant (IRAM)
P. Schilke (MPIfR)
C. Thum (IRAM)



Applications will be accepted from scientists with little previous experience in mm-astronomy. The course is limited to 45 students who will be selected on the basis of their CV and references.

IRAM, Avda. Divina Pastora 7, Local 20, 18012 Granada, Spain,
phone: +34 958 805461
FAX: +34 958 222363
e-mail: summerschool2007@iram.es
http://www.iram.es/IRAMES

Topics:

mm-astronomical techniques
molecular spectroscopy and dust continuum
synergies between mm-wave telescopes and Herschel
physics and chemistry of the interstellar medium
cosmology using mm and FIR observations

iram
Institut de Radioastronomie Millimétrique

esa HERSCHEL

http://www.iram.es/IRAMES/events/summerschool2007/index.html

The figure above is a B/W negative version of the true observing school poster. The original can be downloaded from the school's website (http://www.iram.es/IRAMES/events/summerschool2007).

IRAM Astronomy Postdoctoral Position - Scientific Software Group

The Institute for Millimetre Radio Astronomy (IRAM) in Grenoble (France) seeks to fill an Astronomy Postdoctoral Position to work on the development of the CLASS scientific software.
Operating two of the largest and most technologically advanced instruments in the world, a 30-meter single-dish telescope (located in the Sierra Nevada, Spain), and an interferometer of six 15-meter antennas (located in the French Alps), IRAM (http://www.iram.fr) offers a competitive environment to do cutting-edge research in (sub)-millimeter astronomy. IRAM staff astronomers are in contact with worldwide researchers who come acquiring or reducing their data either in Spain and France. IRAM also offers multiple connections with ALMA (http://www.eso.org/projects/alma) as a key player in its construction.
CLASS is a GILDAS (http://www.iram.fr/GILDAS) software for reduction and analysis of (sub)–millimeter spectroscopic data. It is used daily to reduce spectra acquired with the IRAM 30m telescope, but also many other facilities (e.g. Effelsberg, HHT, CSO, APEX, ...). CLASS will be able to read the Herschel/HIFI data format and efforts are being made to read spectra from other telescopes (Nobeyama, MOPRA).
IRAM is searching for candidates with a PhD in astronomy or in a related field. Candidates should have experience in (sub)-millimeter radio astronomy and scientific programing (e.g. FORTRAN90). The successful candidate is expected to contribute 50% of his/her working time to extend the capabilities of CLASS. The candidate will have to develop new algorithms for the data reduction and analysis of both large scale mapping with multi-beam receivers and line-survey with single-pixel receivers. This work will be done in collaboration with the GILDAS team (about six astronomers and two software engineers). The successful candidate will have regular contact with the IRAM staff in Spain and staff of other facilities using CLASS.
The successful candidate will have 50% of his/her working time to conduct his/her own research, in particular with the 30m telescope and the Plateau de Bure interferometer. The current main fields of interest of the IRAM astronomy group are observational cosmology, physics and chemistry of the interstellar medium, properties of proto-planetary disks and outflows and circumstellar envelopes around evolved stars.
The appointment is initially for two years with a possibility of extension, starting January 01, 2008. Adequate research resources, including travel funding, will be provided. To apply, please send curriculum vitae, bibliography and statement of research interests, and arrange for three letters of reference. Applications should be submitted no later than September 30th, 2007 for full consideration.

Email submission: indigo@iram.fr
– Mrs. Brigitte Indigo, Personnel Department
Email inquires: pety@iram.fr
– Dr. Jérôme Pety, GILDAS manager

Pierre COX and Jérôme PETY

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

In order to reduce costs we are now sending paper copies of this Newsletter to astronomical libraries only. The IRAM Newsletter is available in electronic form by using the World Wide Web: from the IRAM home pages (`http://www.iram.fr/` or `http://www.iram.es/`), click on item "Events & News" and follow the links...

The NEWSLETTER e-mail list can be subscribed (and cancelled) via a web-based facility. It is used to send warning messages when a new edition of the Newsletter is available, but also to provide fast information, if needed. The list members are not visible on the web or to fellow subscribers to reduce the risk of unsolicited commercial e-mail.

Please visit the web-based facility http://www.iram.fr/mailman/listinfo/newsletter for details. This facility is not mirrored on http://www.iram.es.

Please keep M. Bremer informed of any problem you may encounter.

IRAM Addresses:

	Address:	Telephone:	Fax:
Grenoble	Institut de Radioastronomie Millimétrique, 300 rue de la Piscine, Domaine Universitaire, 38406 St Martin d'Hères Cedex, France		
	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.