IRAM

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

Newsletter

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Calendar

February 1st, 2006:
VLBI proposal deadline for the October 2006 session.

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

Message from the outgoing Director

As this edition of the IRAM Newsletter will reach you just a few days before Christmas, and close to the end of 2005, I take the opportunity to wish all our readers a

MERRY CHRISTMAS
and a
HAPPY, SUCCESSFUL NEW YEAR.

On January 1st, 2006, Pierre COX will become the new IRAM Director, and Karl SCHUSTER the new Deputy Director. My special wishes go to them, and to all members of the IRAM staff. The tasks and the goals that lie ahead of them will require hard work, the continued support from the IRAM partner organizations, and from the entire community, but I am sure that the efforts will be very much worthwhile. There are lots of new things to be discovered with the improved instrumentation that is becoming available now or in the near future at the IRAM Observatories.

The outlook for (sub-) mm-radioastronomy in general is very promising, and IRAM has an important role to play in these future developments. I look back with gratitude to what was achieved during the last 16 years, and what has brought us here. As much as progress relies on the contributions of individual scientists and engineers, it also relies on successful team work, and I have always been impressed by, and appreciative of the wide range of talents, competences and experiences within the IRAM staff. My thanks go to each and every member of this team!

IRAM's development and success depend futhermore on good advice from both its Scientific Advisory Committee, and from its Programme Committee. Over the years, a significant fraction of the community has served in these functions, and I am grateful to the present and past members of these advisory groups.

IRAM is governed by its Executive Council in which representatives from the CNRS, the MPG, and the IGN decide on the programme and the funding. Throughout the years, the Council has been extremely supportive, including some very difficult times, and I am deeply grateful for this, both personally, and in the name of IRAM.

Michael GREWING

End of the Court Case

Immediately after the Plateau de Bure cable car accident on July 1st, 1999, a legal inquiry into the penal and civil responsibilities had started. This led to a first judgement in February 2004 in which several persons, including two former IRAM employees, and IRAM as a legal entity were considered responsible and condemned. Following the appeals put in by several parties, and also by the State Prosecutor, the case was reconsidered at the Court of Appeal in Grenoble in May/June this year.

The higher Court delivered its judgement on October 13th this year. It largely confirmed the initial judgement with the exception that the controle organism, APAVE, was also considered responsible as a legal entity (before it had been involved only through one of its employees who was considered responsible).

Despite the fact that the new judgement is less favorable for IRAM and still leaves open many questions, the Executive Council decided to accept the Court decision in order to put an end to the court case. The fine that IRAM has to pay because of its penal responsibility has been paid, and all civil responsibility issues have been settled in the meantime through IRAM's insurance company.

This closes a long and difficult chapter in the history of IRAM. Without ever forgetting what has happened, we all can and must now look ahead.

Michael GREWING

Staff Changes

IRAM Grenoble

The astronomers group welcomes Takeshi NAKAZATO, who has arrived in August at IRAM to work for three years as a postdoc. Besides astronomical topics, he will also work on the ALMA instrumental calibration. Another new arrival is Edwige CHAPILLON who has started her astronomy thesis in October.

After six months of hard work on her physics and astronomy diploma, Lena LINDT has returned to Germany to prepare for her exams. We wish her all the best for her present and future projects.

Amélie TELLIEZ has left the receiver group at the end of November. We wish her all the best for her future career.

Christine DUMÉE has arrived in the administration at the end of November to replace Claude VIANEY-LIAUD during her sabbatical leave.

Michael BREMER

New Task Assignments

Roberto NERI has been appointed recently as Project Scientist for the Plateau de Bure Interferometer. In the next years, the PdBI will become a 'new' instrument with renewed capabilities in terms of angular resolution, sensitivity and frequency coverage due to the extension of both the northern and eastern baselines and due to the replacement of the current receivers by a set of new generation receivers. The interferometer will therefore remain a world-class instrument for many years and enable cutedging science to be done. Both the current developments and the possible future enhancements of the PdBI require a high level of coordination and planning, which will be the main task of the newly appointed Project Scientist.

Jan-Martin WINTERS will take over the previous responsibilities of Roberto Neri as Scientific Coordinator of the Plateau de Bure interferometer starting as of January 1st, 2006. His main tasks include the scheduling of astronomical observations at the PdBI, the coordination of technical actions as required for efficient daily operations at the Plateau de Bure, and the local contact support for visiting astronomers.

Pierre COX

IRAM Granada

Stephane LEON has started his duties as astronomer in IRAM Spain as of October 15th 2005. His main duty will be to manage the observing pool.

In March 2005 Felipe LARA from the logistics group has retired. We wish him all the best, in particular good health.

María MORENO will be hired as a cook starting in January 2006.

Rainer MAUERSBERGER

News from the 30-m telescope

No smoking regulations

As of January 1st 2006, smoking will be strictly forbidden by the Spanish legislation in all working places. This also applies to our IRAM Granada offices and residencia, and to the Pico Veleta Observatory (including dormitories and dining room). The only place where smoking will be allowed is outside the buildings. On the other hand it is strictly forbidden to leave the observatory building under certain weather conditions (e.g. strong wind). Therefore we ask astronomers for whom it might be a problem to be without tobacco, to use our remote observing facilities or to consult their doctor or pharmacist.

Rainer MAUERSBERGER

Some useful hints for traveling to Pico Veleta

Each year several of our 200 visitors to Pico Veleta observatory have to deal with unexpected problems. Some of these can be avoided.

The most common problem deals with baggage being lost during the flight. This occurs several times each year. The airlines should send them by courier to your travel destination. This should be our Granada Office (IRAM, Avda Divina Pastora 7, Local 20, 18012 Granada, tel. 958805454) and not the observatory (which is not reachable by normal cars). Please put the essential things you need in your hand luggage. In direct flights, loss of baggage is less frequent than in flights involving stopovers.

Unfortunately, problems with pickpockets are reported almost every year. Pickpockets concentrate in areas were there are many tourists (airports, bus and train stations, center of the town etc.). The pickpockets are quite “skillful”. A common method e.g. is that they “help” you to clean a stain on your coat, and before you can say “thank you” your bag is stolen. Or, if you are traveling by car, somebody urges you to stop because of a technical problem with your vehicle, and as soon as you open the door of your car, they grab what they can. Our advice is to be careful, always keep an eye on your belongings, and to leave passports, money etc at our residencia when possible. Do not bring large amounts of cash. Credit cards can be used in most shops and restaurants (unfortunately they are not accepted at IRAM), and there are cash dispensors in every bank.

It does not happen often but can be very unpleasant that visitors become sick or have an accident. Please do not forget to bring the documentation of your health insurance (make sure it is valid in Spain). It can be very useful to have an additional travel insurance which also covers repatriation costs.

In order to help you in case you loose your luggage, your documentation or if you should need medical assistance, please feel free to send copies of your flight tickets, passport and health or travel insurance by fax or email to our secretary Esther Franzin (franzin@iram.es , fax: +34 958 222363). This may be particularly useful for visitors from outside the EU.

Rainer MAUERSBERGER

News from the Plateau de Bure Observatory

We are pleased to announce the IRAM highlight of 2005! First interferometric fringes have been detected on the new baseline which connects the two new stations, N46 and E68 (Fig. 1). The fringes were detected both at 3mm and 1mm, on the 730m long baseline, between the stations at the end of the northern and eastern track extensions. The new stations will be implemented into the observing schedule of the upcoming winter 2005/2006 session. We now look forward, with great expectations, to a new era of high-resolution imaging of the Plateau de Bure interferometer.

In the evening of October 24 and after a final verification of the electrical and optical fiber connections to N46, antenna 4 was moved to the end of the newly completed northern track extension and clamped on the new station. Only a few hours later, the antenna and the interferometer were ready for the crucial attempt to obtain fringes, and at 09:59 UT of October 25, Patrick Chaudet, operator at the Plateau de Bure observatory, measured fringes on all the baselines connected to N46. The following night, under excellent weather conditions and after a short baseline session to measure the position of the antenna within a few hundred microns, he was able to observe stable fringes on B0218+357, a gravitationally lensed system with strong radio emission.

Encouraged by the success in bringing station N46 online quickly, we rapidly proceeded to complete the eastern track extension and station E68 before the season's first snowfall. After some initial verifications, the track and the station were made available for first light on November 7h, and first fringes were obtained at 3mm on all baselines in the early morning of the following day. The most exciting result, however, was achieved in the night to November 9 when an antenna was positioned on station N46. After a few hours of debugging and trouble-shooting the operators Michel Dan and Emmanuel Salgado reported first fringes at 1mm on the 730m baseline to station N46. Subsequent baseline measurements refined the positional accuracy of the antenna on E68 and improved the fringe stability on the baseline to N46 (Fig. 2).

The successful commissioning of the new stations is the result of several years of work to achieve new horizons for high angular resolution imaging with the six-element interferometer. While the new stations are already planned for the upcoming winter period, efforts are now directed towards planning and implementing an efficient strategy for moving antennas out to (and back from) E68 and N46 under snowy winter conditions at the Plateau de Bure.

Roberto NERI and Bertrand GAUTIER

Proposal ratings for the 2005/2006 winter session

The IRAM program committee convened in Grenoble on October 10 and 11 to discuss the proposals submitted for the winter 2005/2006 scheduling period. The committee was chaired by Mario Tafalla (Observatorio de Madrid). The principal investigators of each proposal will be informed by letter which will include 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 87 proposals were received for the interferometer (Tab. 1), which represents a new record. 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:

(http://www.iram.fr/IRAMFR/PDB/loca.html)

30m Proposals

132 proposals were received for the 30m telescope, requesting 4946.7 hours of telescope time. The highest rating "A" was given to 35 proposals ; 57 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 Tab. 2. All A-rated proposals will be scheduled on the telescope, although some with less time than requested. We expect that about half of the B-rated programs will actually be scheduled. The selection will take into account scientific merit, crowding in certain right ascension ranges, and general aspects of balance. Proposals rated "C" will not get telescope time.

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

Roberto NERI and Clemens THUM

VLBI News

Both IRAM observatories participated in the Global VLBI session which took place during October 13th-18th, 2005. Pico Veleta started on time, but had to stop early on the 16th October due to bad weather.

Plateau de Bure observed with all six antennas for the whole duration (apart from a short break due to a snow shower, and observations on 3C237 and 3C274 on October 15th which were too close to the sun for Bure). The observatory was operating with the repaired CNRS maser.

Fringes from both observatories have already been confirmed from the correlator specialists at the MPIfR Bonn.

The observing schedule has become significantly denser since the Global Millimeter VLBI Array (GMVA) has completed the switch to Mark5A recording. This increases the fraction of pure observing time, but is also more demanding for the observing crews who have less time for instrumental calibration between VLBI scans. At both IRAM observatories, computer-based methods are being developed which assist the observers. The goal is to reduce the repetitive tasks while keeping a high level of interactive quality control.

Michael BREMER

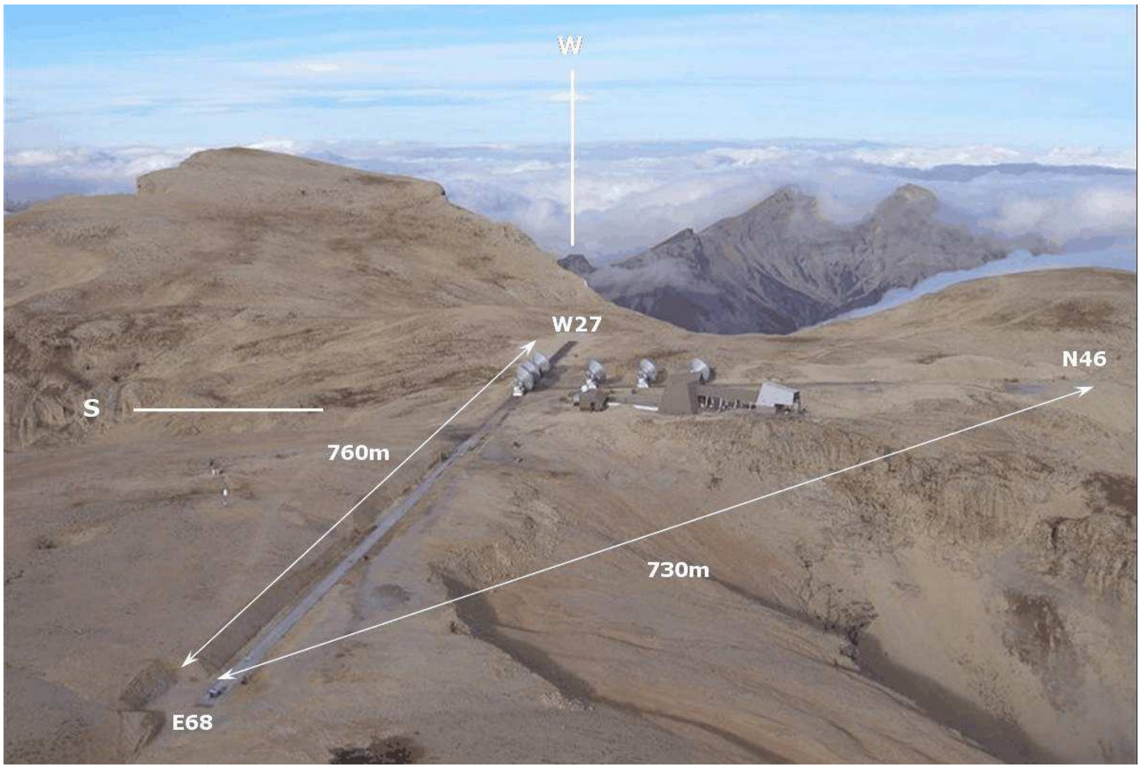

Figure 1: Aerial view of Plateau de Bure with the six-element interferometer in the D configuration and the newly completed northern (368m) and eastern tracks (760m).

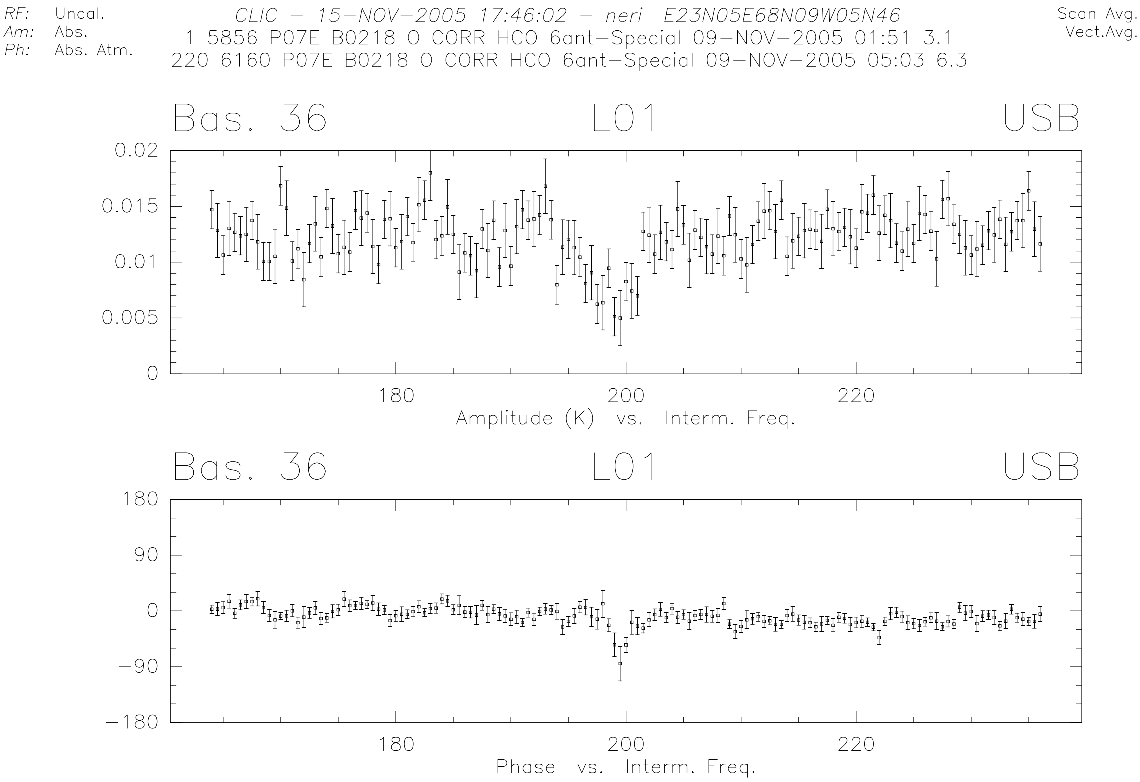

Figure 2: Interferometric fringes were obtained at 3mm in the night to November 9 on the 730m baseline between stations E68 and N46. The top and bottom plot show the visibility amplitudes and phases from the radio source B0218+357 in an 80 MHz spectral window.

Project	Rate	Project	Rate	Project	Rate	Project	Rate	Project	Rate	Project	Rate
P037	B	P038	C	P039	A	P03A	C	P03B	C	P03C	C
P03D	C	P03E	B	P03F	A	P040	C	P041	C	P042	A
P043	A	P044	B	P045	B	P046	B	P047	A	P048	B†
P049	B	P04A	B	P04B	C	P04C	B†	P04D	B	P04E	B†
P04F	B	P050	A	P051	A	P052	C	P053	C	P054	A
P055	A	P056	B	P057	A	P058	C	P059	B	P05A	C
P05B	A†	P05C	A	P05D	A	P05E	A	P05F	B	P060	B
P061	C	P062	B	P063	A	P064	B	P065	A	P066	C
P067	B†	P068	B	P069	A	P06A	C	P06B	B	P06C	B
P06D	C	P06E	C	P06F	B	P070	C	P071	A	P072	C
P073	C	P074	A	P075	B	P076	B	P077	B	P078	B
P079	C	P07A	B	P07B	C	P07C	B	P07D	A‡	P07E	B
P07F	C	P080	B	P081	A	P082	C	P083	C	P084	C
P085	B	P086	B	P087	B	P088	A†	P089	B	P08A	A
P08B	A†	P08C	A†	P08D	A‡						

Table 1: Ratings of the Plateau de Bure Interferometer proposals. A: Accepted, B: Backup, C: Rejected. †: some parts of the program - others rated B or C, ‡: with time restrictions.

A			**B**				**C**		
129-05	141-05	142-05‡	115-05	118-05	119-05	120-05	114-05	116-05	117-05
145-05‡	147-05	148-05	121-05	124-05	127-05	128-05	122-05	123-05	125-05
149-05	150-05	160-05	131-05	132-05	134-05	136-05	126-05	130-05	133-05
167-05	168-05	169-05	137-05	139-05	143-05	146-05	135-05	138-05	140-05
170-05	175-05	178-05	151-05	152-05	154-05	157-05‡	144-05	153-05	155-05
180-05	181-05	182-05	159-05	163-05	165-05	171-05	156-05	158-05	161-05
183-05	188-05	195-05	173-05	174-05	176-05	177-05	162-05	164-05	166-05
197-05‡	202-05	208-05	179-05	184-05	185-05	186-05	172-05	187-05	189-05
210-05	211-05	215-05	190-05	192-05	194-05	204-05	191-05	193-05	196-05
219-05	226-05	231-05	205-05	207-05	212-05	213-05	198-05	199-05	200-05
234-05	236-05‡	239-05	214-05	216-05	217-05	218-05	201-05	203-05	206-05
243-05	245-05		220-05	221-05	222-05	223-05	209-05	227-05	228-05
			224-05	225-05	230-05	232-05	229-05	233-05	240-05
			235-05	237-05	238-05	241-05	244-05		
			242-05						

Table 2: IRAM 30m telescope proposal ratings fopr the winter 2005/2006 session. A: Accepted, B: Backup, C: Rejected. ‡: parts of the proposal are rated lower or are subject to special conditions.

Call for Global VLBI Proposals at 3mm wavelength

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

The Global 3mm VLBI Array offers 3 to 4 times more sensitivity than the stand-alone VLBA. Observations with the Global 3mm VLBI array will be coordinated and scheduled in time blocks during dedicated observing sessions, performed twice per year. Interaction between P.I. and array schedulers guarantees optimum use of observing time.

The date for the spring session has been fixed to May 4-10, 2006 (*proposals for this session were received at the October 1st 2005 deadline*), and for the autumn session to October 12-18, 2006 (*where successful proposals of this call will be observed*). The actual duration of each session will depend on proposal pressure.

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

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

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

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

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

Wednesday, February 1st 2006, 22:00 UT
(17:00 US Eastern Standard Time)

to the following two addresses (in copy):

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

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

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

Global VLBI observations at 3mm are subject to some technical restrictions, which are summarized on the following web-page

(http://www.mpifr-bonn.mpg.de/div/vlbi/-globalmm/index.html).

The IRAM and MPIfR VLBI teams

Some useful web pages

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

- Technical details on VLBI observations: http://www.mpifr-bonn.mpg.de/div/vlbi/-globalmm/index.html
- Technical details on PdBI correlator in VLBI mode by Marc Torres: http://www.iram.fr-/IRAMFR/TA/backend/vlbi/index.html
- Very long baseline array observational status summary (J.M. Wrobel, April 5, 2002) http://www.aoc.nrao.edu/vlba/obstatus/obssum/-obssum.html
- CMVA Technical Information:
  Array sensitivity: http://web.haystack.mit.edu/-cmva/tech_1.html
  Field of view vs. Time averaging:
  http://web.haystack.mit.edu/cmva/tech_2.html

Michael BREMER

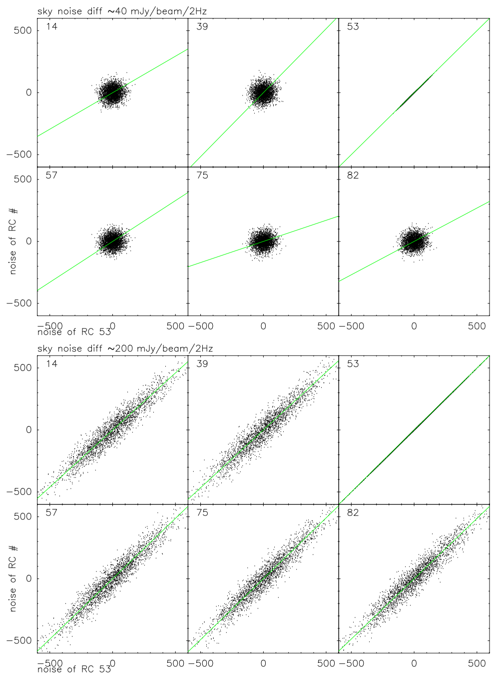

Figure 3: Correlation plots of chopped data obtained with MAMBO2 at very good (**top** - sky noise below the bolometer noise in data chopped with 2Hz) and moderate weather conditions (**bottom** - sky noise ∼200 mJy/beam/2Hz). The noise of various Receiver Channels (RC, number is given in the upper left-hand corner) is plotted against the noise of the RC #53.

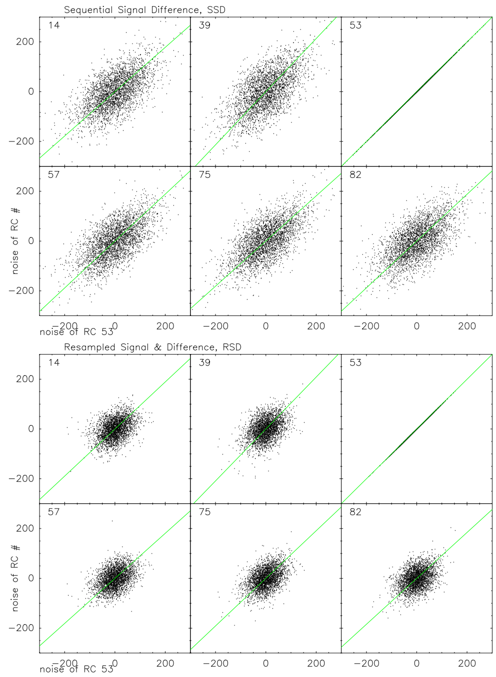

Figure 4: Correlation plots of chopped data obtained with MAMBO2. **Top:** conventional SSD. **Bottom:** The same data with RSD. The correlation coefficient of the noise is considerably lower in the second case (0.4 vs. 0.63), i.e. a large fraction of the correlated noise was removed. The labeling is as in Fig. 3.

Software Chopping with "infinite" Frequency

Astronomical observations in the mm/submm bands are usually made by chopping, that is, by rapidly (1-10 Hz) moving the telescope beam between points on the sky. By differencing the measured flux from two or more nearby points, much of the atmospheric emission can be subtracted from the data. It is the residual atmospheric emission after this subtraction that appears as sky noise in these observations.

At Pico Veleta a chopping frequency of $\nu_{chop} \sim 2$ Hz is used for observations with bolometer receivers. This is usually not sufficient to remove all of the sky noise down to the receiver noise (the statistics of weather conditions at Pico Veleta can be found in the IRAM Data Base). Figure 3 shows two examples of sky noise visible in data chopped with 2 Hz during very good (i.e. the sky noise difference is below the bolometer noise) and moderate weather conditions (i.e. sky noise difference is ∼200 mJy/beam/2Hz).

Here I describe a method to achieve an "infinite" chopping frequency using software. This method was first introduced for mapping with bolometer receivers in October 2003, and during the following year also for all other observing modes. In principle it could be used for any receiver, providing the data streams obtained at both chopper positions are recorded independently. For observations with heterodyne receivers the chopping frequency is far below the ∼2 Hz used with bolometers, therefore the gain in data quality described below should be even higher than for bolometer data.

The chopping via software is possible if the scanning velocity on the sky v fulfills the condition

$$v < 0.5 \times \mathrm{HPBW} \times \nu_{chop}$$

where ν_{chop} is the chopping frequency. In this case the data streams from both chopper positions are **spatially** Nyquist sampled, therefore they can be resampled to different time values. Note that the frequency of the atmospheric variations (i.e. the sky noise) and the sampling frequency of the data are unimportant for this approach. Resampling the data streams from both chopper positions to the same time values and subtracting them afterwards gives mathematically infinite chopping frequency for one data pair.

The total number of data pairs, however, cannot be changed because the data rate is given by the data acquisition system.

Further practical limitations are:

– the receiver might be insensitive to variations of high

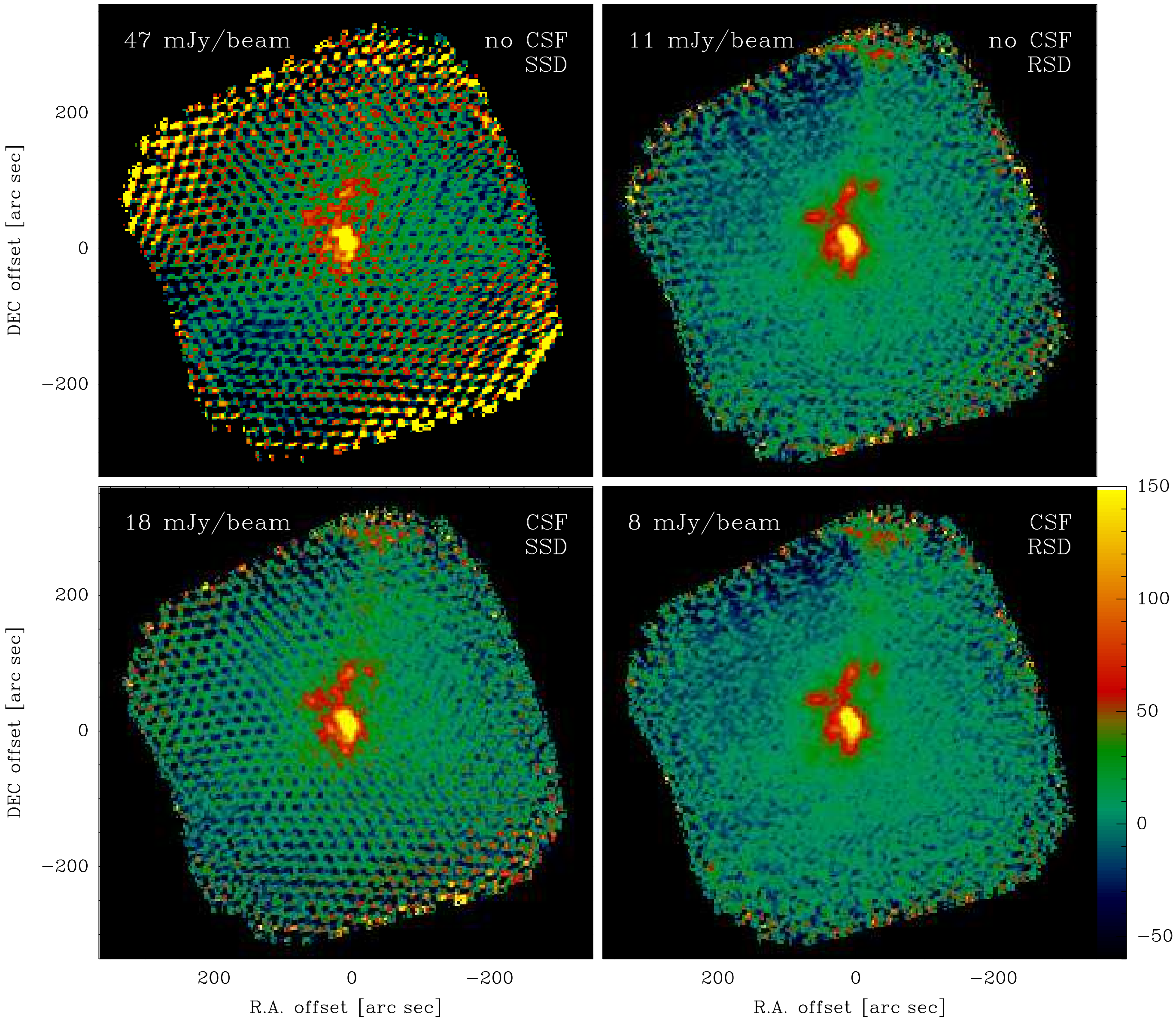

Figure 5: **Upper row:** maps reduced without the sky noise filter CSF; left - the difference signal calculated in the conventional way (SSD), right - the difference signal calculated using the new method (RSD). **Bottom row:** as above, but the sky noise was filtered using the CSF. The grainy structure in the map is due to the fact that MAMBO2 is not a "filled array", i.e. the spacing between the bolometer receivers ist $\sim 2\times$HPBW. As long as a correlated signal exists in the data, i.e. all bolometers show roughly the same signal in the same moment, the grainy structure is visible with the spacings of the bolometers in the final map. The "grains" have a size comparable to the HPBW, appear therefore as true sources for the CSF and can hardly be removed.

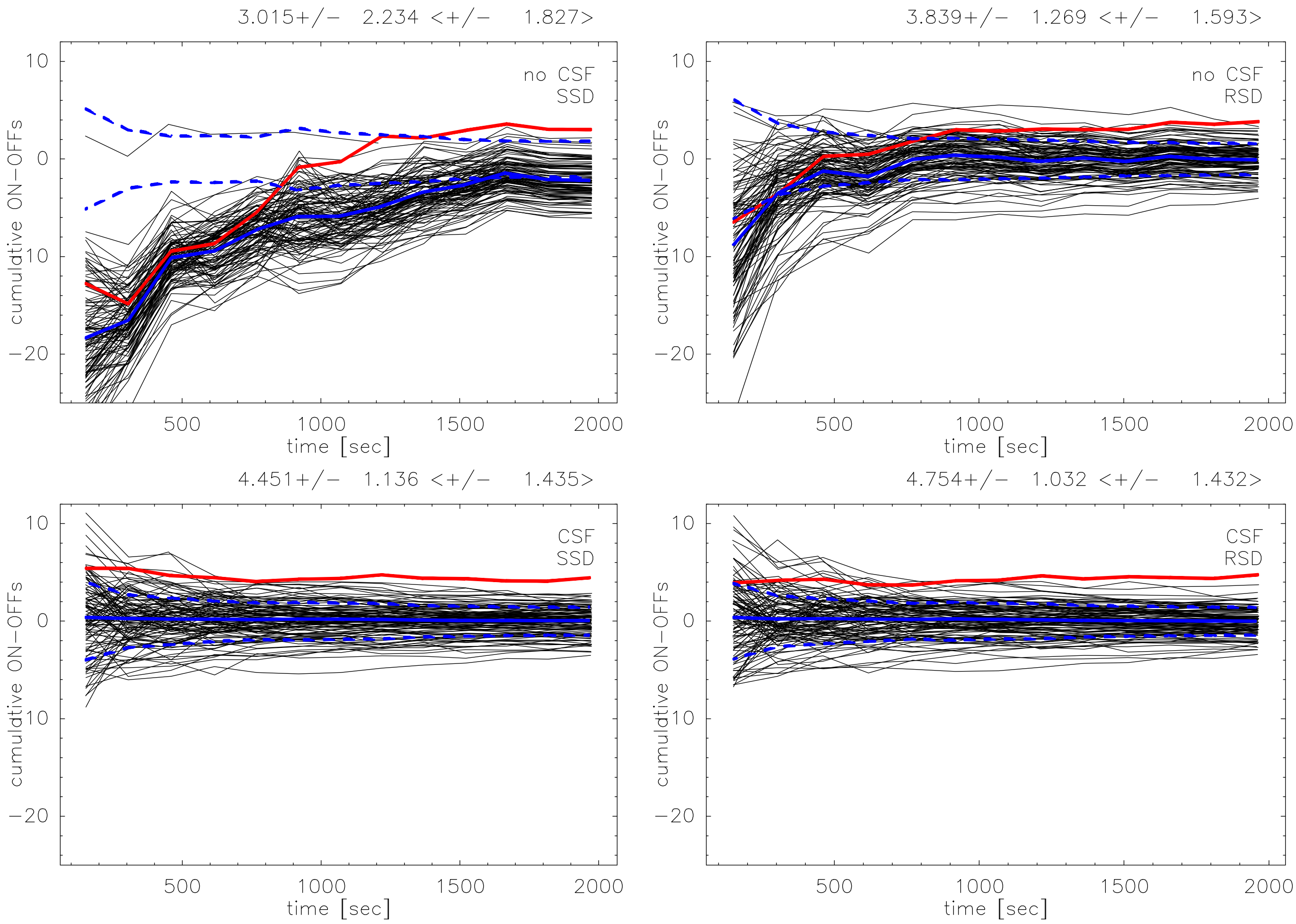

Figure 6: **Upper row:** on-offs reduced without the CSF algorithm; left - the difference signal calculated in the conventional way (SSD), right - the difference signal calculated using the new method (RSD). **Bottom row:** as above, but the sky noise was filtered using the CSF. Within the errors the CSF processed on-offs show the same signal for both methods of calculating the difference signal (the results are written above each plot). In all plots the red line shows the signal of the on-bolometer as a function of integration time, the blue continuous line the mean off all other bolometers; the dashed line the rms value of this mean.

frequency; e.g. the bolometers are insensitive to variations shorter than ~ 10 msec,
- the electronics might have even higher time constants; for MAMBO arrays e.g. it is above 1 sec, the data streams obtained at both wobbler positions are therefore not fully independent.

Figure 4 compares the correlation plots of the difference signal obtained in conventional way (Sequential Signal Difference, SSD) and with the new method (Resampled Signal and then the Difference, RSD). The gain in data quality using different modes of data processing including the Correlated Signal Filter (CSF) in MOPSIC is further shown in Fig. 5.

Although for on-off observations the scanning velocity is exactly 0, i.e. the condition given above is fulfilled, precisely these data usually can't be processed this way. The problem is the very short integration time per nodding positions (usually 10 sec), therefore the data stream obtained at one nodding position of the telescope has just 20 values. This is not enough to ensure really robust resampling, although a significant improvement of data quality can usually be obtained (Fig. 6). More important, the sky noise difference can be very efficiently filtered out using the CSF in MOPSIC. The robustness of the CSF for on-off observations is much higher than that of the resampling of such short time series, therefore I do not suggest to use the new method for on-offs as long as the nodding cycle is shorter than ~ 30 sec.

Robert W. ZYLKA

Cloudsat Status

In the previous IRAM Newsletter (No. 63, August 2005) we reported on the planned Cloudsat satellite launch, whose active cloud radar operates at power levels which can permanently damage the receivers of telescopes observing at 3mm wavelengths.

So far, the satellite has not been launched because of minor technical problems and the side effects of a Boeing workforce strike. According to the latest news available at the edition of this Newsletter, the launch of the Delta-II rocket which will carry the CLOUDSAT and CALIPSO satellites is planned at the earliest for February 2006.

Michael BREMER

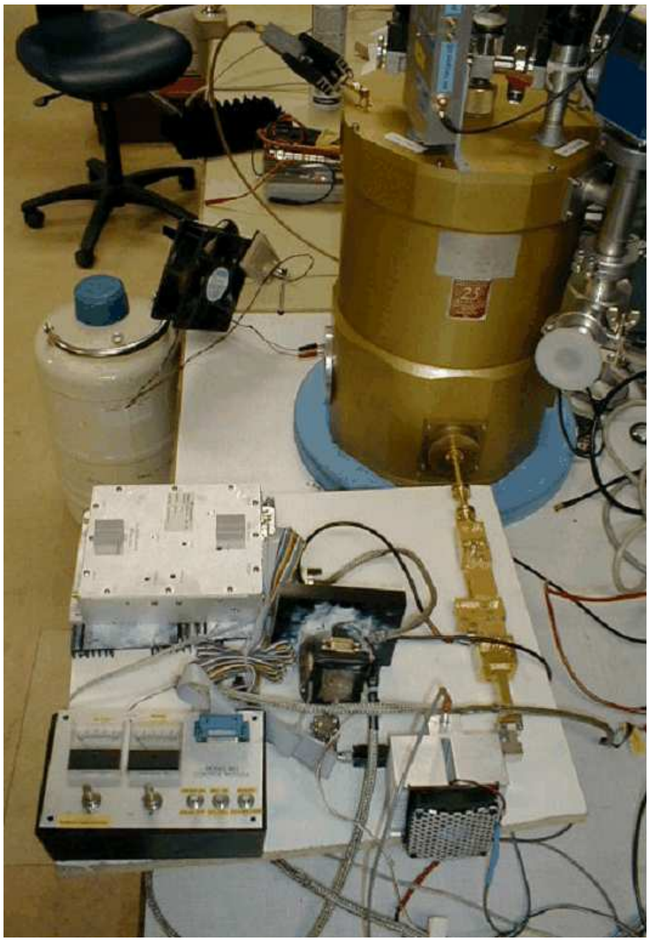

Figure 7: Picture of the 283-365 GHz integrated YIG LO

New 283-365 GHz integrated YIG multiplied local oscillator with full electronic tuning

A new 283-365 GHz integrated multiplied YIG local oscillator with full electronic tuning has been developed at IRAM. The chain includes commercially available devices together with specific band pass filters, couplers, and harmonic mixers, designed in-house (Figs. 7,8).

The LO output power is between 100 and 200μW over the band. The band-pass and high-pass filters included in the new LO chain reduce the harmonic products that fall in the DSB SIS mixer RF bandwidth, and there is no significant noise temperature excess compared with a traditional mechanically tuned Gunn multiplied LO and compared with a NRAO YIG LO when the IRAM YIG LO is used to pump a DSB SIS mixer (Fig. 9). The LO was locked with a 1.875 GHz reference over the full band.

Francois MATTIOCCO

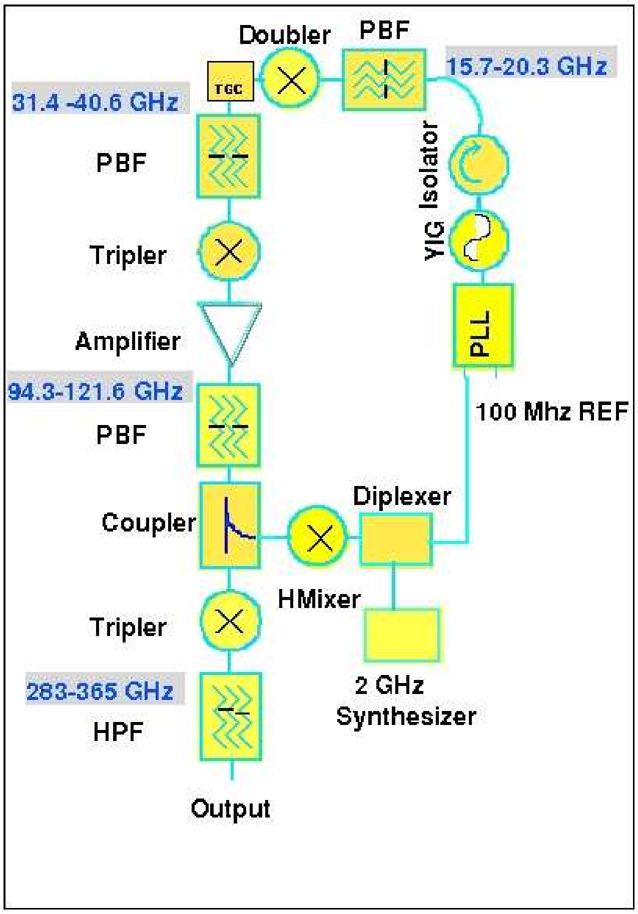

Figure 8: 283-365 GHz integrated YIG LO diagram

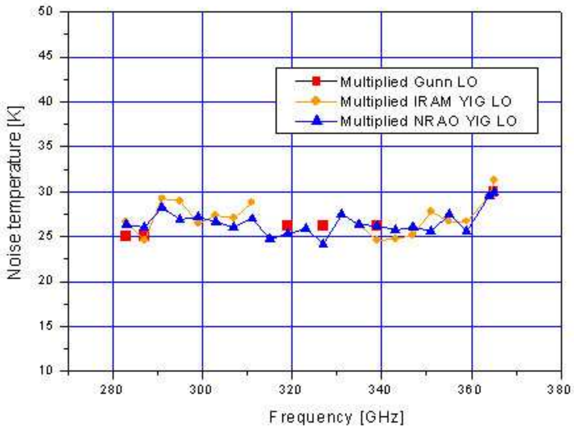

Figure 9: Comparison between the DSB SIS mixer noise temperature when it is pumped with a multiplied mechanically tuned Gunn, and when it is pumped with a full electronically tuned NRAO or IRAM YIG LO

Scientific Results in Press

Caught in the act: The onset of massive star formation

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Abstract:
Combining mid-infrared data from the SPITZER Space Telescope with cold gas and dust emission observations from the Plateau de Bure Interferometer, we characterize the Infrared Dark Cloud IRDC 18223-3 at high spatial resolution. The millimeter continuum data reveal a massive $\sim$184 $M_\odot$ gas core with a projected size of $\sim$28000 AU that has no associated protostellar mid-infrared counterpart. However, the detection of 4.5 μm emission at the edge of the core indicates early outflow activity, which is supported by broad CO and CS spectral line-wing emission. Moreover, systematically increasing N_2H^+(1–0) linewidth toward the mm core center can be interpreted as additional evidence for early star formation. Furthermore, the N_2H^+(1–0) line emission reveals a less massive secondary core which could be in an evolutionary stage prior to any star formation activity.

Accepted for publication in ApJL

Molecular gas and continuum emission in 3C 48: evidence for two merger nuclei?

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Abstract:
We present new interferometer observations of the CO(1-0) line and mm continuum emission from 3C 48 - one of the nearest examples of a merger activating a quasar. Our new CO data show that most of the CO is not in a disk around the quasar 3C 48, but rather in a second nucleus associated with the source 3C 48A $\approx 1''$ to the north-east, recently studied in the near-IR by Zuther et al. (Zuther04). This main CO source has a strong velocity gradient (140 km s^{-1} over about $1''$). Our new data also show a second, weaker CO source at the QSO itself. At 1.2 mm, the continuum emission is elongated in the direction of the radio jet and towards 3C 48A. We model the 1.2 mm continuum with three different sources in 3C 48 - the 3C 48 QSO, the 3C 48 jet, and the second nucleus 3C 48A. We suggest that the unusually bright and extended nature of the jet may be due to its interaction with the second merger nucleus 3C 48A.

Appeared in: A&A 439, 75

The Molecular Gas in the Nuclear Region of NGC 4569

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Abstract:
Millimeter CO observations of the galaxy NGC 4569 made in the frame of the NUGA survey are presented. A large mass of molecular gas is found in the inner 1.6 kpc that can efficiently feed the strong nuclear starburst. The impact of the starburst on the ISM can be seen in the morphology and physical state of the molecular gas. Analysis of the dynamics is in progress.

Appeared in: THE EVOLUTION OF STARBURSTS: The 331st Wilhelm and Else Heraeus Seminar. AIP Conf. Proc 783, 161

Molecular gas in NUclei of GAlaxies (NUGA). III. The warped LINER NGC 3718

Krips M.(1,2), Eckart A.(1), Neri R.(2), Pott J. U.(1,3), Leon S.(4) Combes F.(5), García-Burillo S.(6), Hunt L. K.(7), Baker A. J.(8), Tacconi L. J.(9), Englmaier P.(10), Schinnerer E.(11) and Boone F.(12)
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Abstract:
We present the first interferometric observations of CO(1-0) and CO(2-1) line emission from the warped LINER NGC 3718, obtained with the IRAM Plateau de Bure Interferometer (PdBI). This L1.9 galaxy has a prominent dust lane and on kiloparsec scales, a strongly warped atomic and molecular gas disk. The molecular gas is closely associated with the dust lane across the nucleus and its kinematic center is consistent with the millimeter continuum AGN. A comparison of our interferometric mosaic data, which fully cover the $\approx$ 9 kpc warped disk, with a previously obtained IRAM 30 m single dish CO(1-0) map shows that the molecular gas distribution in the disk is heavily resolved by the PdBI map. On the nucleus the interferometric maps alone contain less than one half of the single dish line flux, and the overall mosaic accounts for about a tenth of the total molecular gas mass of $\approx 2.4 \times 10^8 M_\odot$. After applying a short-spacing correction with the IRAM 30-m data to recover the missing extended flux, we find in total six main source components within the dust lane: one associated with the nucleus, four symmetrically positioned on either side at galactocentric distances of about 1.3 kpc and 4.0 kpc from the center, and a sixth on the western side at $\approx$ 3 kpc with only a very weak eastern counterpart. In the framework of a kinematic model using tilted rings, we interpret the five symmetric source components as locations of strong orbital crowding. We further find indications that the warp appears not only on kpc scales, but continues down to $\approx$ 250 pc. Besides the sixth feature on the western side, the lower flux (a factor of $\approx$ 2) of the eastern components compared to the western ones indicates an intrinsic large scale asymmetry in NGC 3718 that cannot be explained by the warp. Indications for a small scale asymmetry are also seen in the central 600 pc. These asymmetries might be evidence for a tidal interaction with a companion galaxy (large scales) and gas accretion onto the nucleus (small scales). Our study of NGC 3718 is part of the NUclei of GAlaxies (NUGA) project that aims at investigating the different processes of gas accretion onto Active Galactic Nuclei (AGN).

Appeared in: A&A 442, 479

CO and CI at redshift 2.5

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Abstract:
We report on the first results of an in depth study of the molecular gas properties in three high-redshift sources: IRAS FSC 10214 (z = 2.3), SMMJ14011+0252 (z = 2.5) and H1413+117 (Cloverleaf quasar, z = 2.5). Our analysis is based on observations at the IRAM interferometer and the IRAM 30m telescope of atomic carbon and multiple CO lines. Our study shows that the cold molecular gas at large lookback times is already enriched to gas phase abundances similar to those found in the local universe. We find that almost all of the molecular gas in QSOs host galaxies is in form of dense gas at moderate kinetic temperatures concentrated in a compact circum-nuclear toroid around the AGN. The pure starburst galaxy SMMJ14011+0252, in contrast, contains additional large amount of molecular gas at much lower density.

Appeared in: THE EVOLUTION OF STARBURSTS: The 331st Wilhelm and Else Heraeus Seminar. AIP Conf. Proc. 783, 401

Multiple CO lines in SMM J16359+6612 - further evidence for a merger

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Abstract:
Using the IRAM 30 m telescope, we report the detection of the CO(3-2), CO(4-3), CO(5-4) and CO(6-5) lines in the gravitational lensed submm galaxy SMM J16359+6612 at z=2.5. The CO lines have a double peak profile in all transitions. From a Gaussian decomposition of the spectra we show that the CO line ratios, and therefore the underlying physical conditions of the gas, are similar for the blue and the redshifted component. The CO line Spectral Energy Distribution (SED; i.e. flux density vs. rotational quantum number) turns over already at the CO 5-4 transition which shows that the molecular gas is less excited than in nearby starburst galaxies and high-z QSOs. This difference mainly arises from a lower average H_2 density, which indicates that the gas is less centrally concentrated than in nuclear starburst regions in local galaxies. We suggest that the bulk of the molecular gas in SMM J16359+6612 may arise from an overlap region of two merging galaxies. The low gas density and clear velocity separation may reflect an evolutionary stage of the merger event that is in between those seen in the Antennae and in the more evolved ultraluminous infrared galaxies (ULIRGs) like e.g. Mrk 231.

Appeared in: A&A 440, L45

First detection of [CII]158 μm at high redshift: vigorous star formation in the early universe

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Abstract:
We report the detection of the $^2P_{3/2} \rightarrow {}^2P_{1/2}$ fine-structure line of C^+ at 157.74μm in SDSS J114816.64+525150.3 (hereafter J1148+5251), the most distant known quasar, at z=6.42, using the IRAM 30-m telescope. This is the first detection of the [Cii] line at high redshift, and also the first detection in a Hyperluminous Infrared Galaxy ($L_{FIR} > 10^{13} L_\odot$). The [Cii] line is detected at a significance level of 8σ and has a luminosity of $4.4 \times 10^9 L_\odot$. The $L_{[CII]}/L_{FIR}$ ratio is 2×10^{-4}, about an order of magnitude smaller than observed in local normal galaxies and similar to the ratio observed in local Ultraluminous Infrared Galaxies. The [Cii] line luminosity indicates that the host galaxy of this quasar is undergoing an intense burst of star formation with an estimated rate of $\approx 3000 M_\odot$ yr^{-1}. The detection of C^+ in SDSS J1148+5251 suggests a significant enrichment of metals at z$\approx$ 6 (age of the universe $\approx$ 870 Myr), although the data are consistent with a reduced carbon to oxygen ratio as expected from chemical evolutionary models of the early phases of galaxy formation.

Appeared in A&A 440, L51

A CO Survey of Young Planetary Nebulae

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USA, (5)Institut d'Astrophysique Spatiale, Université de Paris Sud, 91405 Orsay, France, (6)IRAM, 300 rue de la Piscine, 38406 St.-Marin-d'Hères, France

Abstract:
We report the results of a sensitive survey of young planetary nebulae in the CO J=2-1 line that significantly increases the available data on warm, dense, molecular gas in the early phases of planetary nebula formation. The observations were made using the IRAM 30 m telescope with the 3×3 pixel Heterodyne Receiver Array (HERA). The array provides an effective means of discriminating the CO emission of planetary nebulae in the Galactic plane from contaminating emission of interstellar clouds along the line of sight. A total of 110 planetary nebulae were observed in the survey, and 40 were detected. The results increase the number of young planetary nebulae with known CO emission by approximately a factor of 2. The CO spectra yield radial velocities for the detected nebulae, about half of which have uncertain or no velocity measurements at optical wavelengths. The CO profiles range from parabolic to double-peaked, tracing the evolution of structure in the molecular gas. The line widths are significantly larger than on the asymptotic giant branch, and many of the lines show extended wings, which probably result from the effects on the envelopes of high-velocity jets.

Based on observations carried out with the IRAM 30 m telescope. IRAM is supported by INSU/CNRS (France), MPG (Germany), and IGN (Spain).

Appeared in: ApJS, 160, 272

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

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

Appeared in: ApJ 628, L61

SiO maser polarization in evolved stars: magnetic field

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Abstract:
We have measured the polarization of the SiO maser emission in a representative sample of evolved stars. We made simultaneous spectroscopic measurement of the 4 Stokes parameters, from which we derive the circular and linear polarization levels. These observations allow us to discuss the existent SiO maser models, to derive the strength of the magnetic field, and thus to determine the real influence of this magnetic field in the life of these evolved objects. The magnetic field strength we derive varies between 0 and 18 Gauss, with a mean value of 3.5 G and may follow a 1/r law throughout the circumstellar envelope. As a consequence, the magnetic field has a real influence on the life of these evolved objects: it definitively plays the role of a collimating, and more generally, of a shaping, agent in evolved objects.

Appeared in: MAGNETIC FIELDS IN THE UNIVERSE: From Laboratory and Stars to Primordial Structures. AIP Conf. Proc. 784, 613

On the density of EKOs and related objects

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

Appeared in: A&A 441, L5

Intermittency of interstellar turbulence: observational signatures in diffuse molecular gas

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Abstract:
Several properties of the cold interstellar molecular gas may be interpreted as the signatures of the intermittency of turbulence. These are non-Gaussian statistics of the velocity field, plus ubiquitous traces of warm gas within the cold medium. The existence of the warm gas is attested to by observations of highly excited molecular hydrogen and by manifestations of a specific chemistry. Small-scale coherent magnetized vortices and low velocity magneto-hydrodynamical shocks are able to reproduce most of these properties. In both kinds of structure, and for different reasons, the neutrals decouple from the ions and magnetic fields. Interferometric observations seem to favor small scale vortices rather than shocks, involving timescales of only a few thousands years.

Appeared in: MAGNETIC FIELDS IN THE UNIVERSE: From Laboratory and Stars to Primordial Structures. AIP Conf. Proc. 784, 299

Successes of and Challenges to GILDAS, a State-of-the-Art Radioastronomy Toolkit

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Abstract:
GILDAS is a collection of state-of-the-art software oriented toward (sub-)millimeter radioastronomical applications (either single-dish or interferometer). It is used daily to reduce data acquired at IRAM. Moreover, parts of GILDAS are used or considered for use in other contexts (JMMC, CSO, APEX, ALMA, Herschel/HIFI). GILDAS is now facing new challenges. New IRAM instruments require important software developments in due time to ensure efficient operation and good scientific preparation of ALMA and Herschel. I describe here the efforts made in the last few years to ensure the success of new developments in the ALMA era while keeping backward compatibility required by our long-term users.

Appeared in: SF2A-2005, Edited by F. Casoli, T. Contini, J.M. Hameury and L. Pagani, EdP-Sciences Conference Series, 2005, p. 721

Radio, millimeter and optical monitoring of GRB 030329 afterglow: constraining the double jet model

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Abstract:
We present radio, millimeter and optical observations of the afterglow of GRB 030329. UBVR_CIC photometry is presented for a period of 3 h to 34 days after the burst. Radio monitoring at 1280 MHz has been carried out using the GMRT for more than a year. Simultaneous millimeter observations at 90 GHz and 230 GHz have been obtained from the Swedish-ESO Submillimeter Telescope (SEST) and the IRAM-PdB interferometer over more than a month following the burst. We use these data to constrain the double jet model proposed by Berger et al. (2003) for this afterglow. We also examine whether instead of the two jets being simultaneously present, the wider jet could result from the initially narrow jet, due to a fresh supply of energy from the central engine after the "jet break".

Appeared in: A&A 440, 477

Extending VLBI to 2mm and 1mm Wavelengths

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Abstract:
Technical VLBI experiments have been carried out at wavelengths shorter than 3mm, yielding the highest angular resolutions ever attained in any waveband. Long baseline detections of AGN at 129 GHz, 147 GHz, and 230 GHz have fringe spacings (λ/D) of 56, 49, and 34μas respectively. We also present the first 129GHz VLBI map of the SiO masers associated with the evolved star VY CMa.

Appeared in: Future Directions in High Resolution Astronomy: The 10th Anniversary of the VLBA, ASP Conf. Proc. Vol. 340, 605

CO(2-1) large scale mapping of the Perseus cluster core with HERA

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Abstract:
Cold molecular gas has recently been found is several cooling flow clusters cores with single dish telescopes. High spatial resolution imaging of some of these clusters then revealed the peculiar morphology and dynamics of the CO emission lines, pointing out a perturbed very cold component in the cluster centers. We report here the observations of NGC 1275, in the Perseus cluster of galaxies. This object is the strongest cooling flow emitter in the millimeter band. The 9 dual polarization pixels of the HERA focal plane array, installed on the 30m telescope, enabled to image the large scale emission of the cold molecular gas which is found to follow the very peculiar Hα filamentary structure around the central galaxy. We discuss here this association and the non-rotating dynamics of the cold gas that argue for a cooling flow origin of the molecular component.

Appeared in: SF2A-2005, Edited by F. Casoli, T. Contini, J.M. Hameury and L. Pagani. EdP-Sciences Conference Series 2005, p. 647

Water in the envelopes and disks around young high-mass stars

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Abstract:
Single-dish spectra and interferometric maps of (sub)mm lines of $H_2^{18}O$ and HDO are used to study the chemistry of water in eight regions of high-mass star formation. The spectra indicate HDO excitation temperatures of $\sim$ 110 K and column densities in an 11″ beam of $\sim 2 \times 10^{14}$ cm^{-2} for HDO and $\sim 2 \times 10^{17}$ cm^{-2} for H_2O, with the N(HDO)/N(H_2O) ratio increasing with decreasing temperature. Simultaneous observations of CH_3OH and SO_2 indicate that 20-50% of the single-dish line flux arises in the molecular outflows of these objects. The outflow contribution to the $H_2^{18}O$ and HDO emission is estimated to be 10-20%. Radiative transfer models indicate that the water abundance is low ($\sim 10^{-6}$) outside a critical radius corresponding to a temperature in the protostellar envelope of $\sim$ 100 K, and 'jumps' to $H_2O/H_2 \sim 10^{-4}$ inside this radius. This value corresponds to the observed abundance of solid water and together with the derived HDO/H_2O abundance ratios of $\sim$ 1/1000 suggests that the origin of the observed water is evaporation of grain mantles. This idea is confirmed in the case of AFGL 2591 by interferometer observations of HDO $1_{10} - 1_{11}$, $H_2^{18}O$ $3_{13} - 2_{20}$ and SO_2 $12_{0,12} - 11_{1,11}$ lines, which reveal compact ($\oslash \sim$ 800 AU) emission with a systematic velocity gradient. This size is similar to that of the 1.3 mm continuum towards AFGL 2591, from which we estimate a mass of $\approx 0.8 M_\odot$, or $\sim$ 5% of the mass of the central star. We speculate that we may be observing a circumstellar disk in an almost face-on orientation.

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