IRAM

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

Newsletter

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Contents

Calendar

June 15, 2006: Limit to apply for financial support for participation at the fifth IRAM interferometry school.

September 1, 2006: Inscription deadline for the interferometry school.

September 7th, 2006 17:00 CEST (UT+2h): Deadline for the submission of IRAM observing proposals for the period from November 15, 2006 to May 15, 2007.

October 2-6, 2006: Fifth IRAM Millimeter interferometry school.

Fifth IRAM Millimeter Interferometry School - Second Announcement

IRAM will organize this year its Fifth Millimeter Interferometry School. The school will take place at the IRAM headquarters (Grenoble, France) on October 2-6, 2006 (Fig. 1). This event is supported by RadioNet.

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

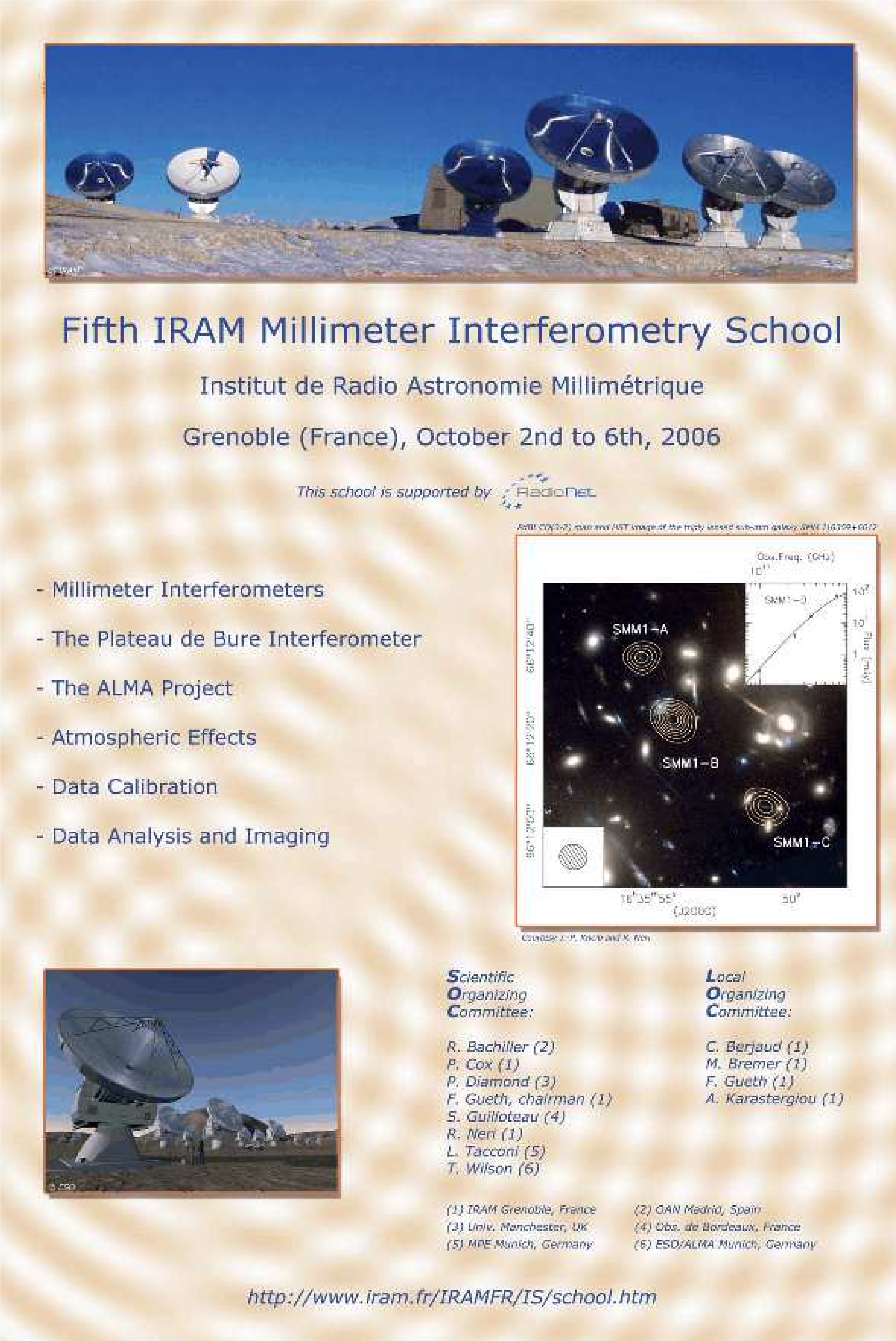

Figure 1: Poster of the 2006 IRAM interferometry school. High resolution copies in jpeg format are available on our web site.

Plateau de Bure interferometer data. We would like to encourage participants to present posters related to their scientific work using radio interferometric techniques.

If you are interested to participate, please fill in the inscription form that can be found on the school web pages and send it by email to Cathy Berjaud (berjaud@iram.fr). We have a limited budget for travel support, so please register as soon as possible if you want to apply for such funding.

Deadlines:

– Applying for financial support: June 15th 2006
– Inscription to school: Sept. 1st 2006

School web page:
http://www.iram.fr/IRAMFR/IS/school.htm

Frédéric Gueth

Director's Note

Since the successful move on the Plateau de Bure to the extended A-configuration at the beginning of 2006, very good weather conditions have allowed us to make full use of this new instrumental capacity. All the programmes, which requested the new configuration, were completed before changing to the next configuration by mid-February. With a synthesized beam at 230 GHz between 0.3 to 0.5 arcseconds, these new observations show spectacular details in the structure and dynamics of many sources spanning the range of galactic star formation regions, proto-planetary disks, outflows, evolved stars and starbursts in the early universe. These results, which will be published soon, illustrate the potential of observing with long baselines at the sensitivity of the Plateau de Bure interferometer.

Another extension concerns the addition of a new floor on the eastern wing at the IRAM headquarters in Grenoble. This addition will be completed by the end of 2006 and provide new working space for the scientific groups and visitors. Together with the recently extended receiver lab, this will give the needed support for the planned future activities at IRAM.

Pierre COX

Staff Changes

IRAM GRENOBLE

We are pleased to announce the appointement of Matthias SCHICKE as head of the SIS group as of June 1st, 2006, where he will replace Karl-Friedrich SCHUSTER. We welcome and wish him all the best in his new functions.

Further staff changes are planned in the SIS group: Arnaud BARBIER will replace Nicolas KREBS, who will leave the group at the end of June.

Pierre COX

IRAM GRANADA

Since March 2006, Ms. Breezy Ocaña is working as a predoctoral fellow in IRAM Granada/ Pico Veleta.

Rainer MAUERSBERGER

Call for contributions for the IRAM calendar 2007

Since several years, IRAM publishes an annual calendar which is composed of scientific results obtained with the IRAM instruments, technical innovations and photos of both observatories.

If you think that the graphics of your IRAM results could decorate other offices than your own, please contact Cathy Berjaud (berjaud@iram.fr). Should we receive a large number of equally attractive spectacular results (with only 12 months to illustrate), we will decide by lottery drawing.

Michael BREMER

IRAM Program Committee Recommendations

The IRAM program committee convened in Grenoble on April 10 and 11 to discuss the proposals submitted for the summer 2006 scheduling period. The committee was chaired by Mario Tafalla (Observatorio de Madrid). The principal investigators of each proposal have been informed by letter which includes comments issued by the committee if there are any. As usual, the proposals were classified A (accepted), B (backup), and C (rejected).

Table 1: IRAM PdBI proposal ratings for Summer 2006. A: Accepted, B: Backup, C: Rejected

Project	Rate	Project	Rate	Project	Rate	Project	Rate	Project	Rate
Q001	C	Q002	B	Q003	C	Q004	A	Q005	A
Q006	A†	Q007	A	Q008	A‡	Q009	B	Q00A	B
Q00B	B†	Q00C	C	Q00D	A	Q00E	#	Q00F	B‡
Q010	A	Q011	B	Q012	A	Q013	C	Q014	B
Q015	B‡	Q016	B	Q017	A†	Q018	B	Q019	C
Q01A	#	Q01B	A‡	Q01C	C	Q01D	C	Q01E	C
Q01F	B	Q020	B‡	Q021	B	Q022	B	Q023	A
Q024	C	Q025	A	Q026	B	Q027	A‡	Q028	A†
Q029	A	Q02A	C	Q02B	C	Q02C	C	Q02D	B
Q02E	C	Q02F	A†	Q030	B‡				

†: some parts of the program - others rated B or C
‡: with time restrictions
: not rated, observations of previous proposal already started

Table 2: IRAM 30-m proposal ratings for Summer 2006

A		B		C	
001-06	007-06	003-06	004-06	002-06	010-06
008-06	009-06	005-06	006-06	011-06	016-06
012-06	013-06	014-06	018-06	017-06	021-06
015-06†	020-06†	019-06	022-06	023-06	035-06
024-06	025-06	029-06	030-06	039-06	040-06
026-06	027-06	031-06	032-06	041-06	042-06
028-06	033-06	034-06	036-06	045-06	051-06
044-06	046-06	037-06	038-06	054-06	057-06
047-06	049-06	043-06	048-06	061-06	063-06
050-06	059-06	052-06	053-06	064-06	066-06
062-06	065-06	055-06	056-06	067-06	076-06
068-06	070-06	058-06	060-06	077-06	083-06
073-06	074-06	069-06	071-06	090-06	094-06
079-06	080-06	072-06	075-06	095-06	097-06
082-06	084-06	078-06	081-06	107-06	109-06
089-06	091-06	085-06	086-06	115-06	
098-06	099-06	087-06	088-06		
101-06	102-06	092-06	093-06		
105-06	110-06	096-06	100-06		
112-06		103-06	104-06		
		106-06	108-06		
		111-06	113-06		
		114-06			

†part of proposal rated B

Plateau de Bure Interferometer Proposals

A total of 48 proposals were received for the interferometer. 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.

30m Proposals

115 proposals were received for the 30m telescope, requesting 4126 hours of telescope time. The highest rating "A" was given to 39 proposals; 45 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.

Additional 52 hours of 30m time were requested by 5 accepted interferometer proposals for measurement of short spacings. These proposals will get scheduled on the 30m if they get observed at Bure.

Jan Martin WINTERS and Clemens THUM

Cloudsat News

In recent numbers of the IRAM Newsletter, we have reported on the progress of the launch preparation of the Cloudsat satellite, whose cloud profiling radar operates at power levels which can permanently damage astronomical receivers in the 3mm band.

Cloudsat was launched successfully on April 28th, 2006. A first four-hours test with active radar was conducted on May 20th, on an orbital element well away from known radio astronomical observatories. On June 2nd 2006, the cloud profiling radar was activated in normal operational mode. Software tools for predicting the ground tracks and the latest orbital elements can be obtained from links on the Cloudsat home page (http://cloudsat.atmos.colostate.edu/).

Protective measures against receiver damage have been implemented at the IRAM-30 (see the article by Peñalver and Navarro elsewhere in this Letter) as well as at the IRAM-PdBI.

We will closely follow the effect of the satellite on the observations.

Michael BREMER

News from the IRAM 30-m telescope

Advice for travel to Granada

A new pair of terminals, T4 and T4S, have been recently inaugurated at Madrid Barajas airport. These terminals are poorly connected with each other, with the other terminals and with the metro station to Madrid. According to the official information on the Iberia website, which under some circumstances may be over-optimistic, the transport between the terminals can be as long as 45 minutes (waiting plus transfer time). You have to add the time necessary for security checks when changing terminals.

When planning your travel to Granada, please ensure that you have sufficient transfer time when travelling via Madrid. Sometimes it may be better to travel directly to Granada (currently there are international flights from London (Monarch and Ryanair) and Liverpool (Ryanair); direct connections to Rome and Lisbon are planned), to Malaga or via Barcelona.

Starting October 26th 2006, there will be direct flight connections between Frankfurt/Hahn and Granada. These Ryanair flights will be on Tuesdays, Thursdays and Saturdays. From Hahn airport, there are bus connections to major cities in the area.

If you choose Iberia, please note that according to the AEA consumer report of May 5th 2006 (association of European Airlines, http://www.aea.be "Press Releases"), this airline has been in the first quarter of 2006 on place 24 of 25 European airlines in the category of baggage losses (19.7 lost per 1000 transported). The reported range of baggage losses was between 4.1/1000 and 19.8/1000. Averaged on the entire year of 2005, Iberia was on place 21 (with Air France on place 20, and Deutsche Lufthansa on 22). On average 85% of the missing bags are traced and delivered to the passenger within 48 hours; however, we recommend that you keep material that you need for your observations in your hand luggage.

Rainer MAUERSBERGER

Tarifs at IRAM Granada

As of April 1st, 2006 the tarif for boarding and lodging at Pico Veleta Observatory and the Granada residence is 2.70 Euro for breakfast, 15.40 Euro for lunch or dinner, 33.00 Euro for a room at Pico Veleta or Granada, and 66.50 Euro for full board and lodging (drinks included).

Rainer MAUERSBERGER

The 30m and the CloudSat

After several unsuccessful attempts the Earth exploration (active) satellite CloudSat is expected to be launched on 28 April 2006. The CloudSat operates in the frequency band 94 - 94.1 GHz that has been primary allocated for the Earth exploration (active) satellites according to the ITU footnote 5.562, sharing a secondary allocation for the radio astronomy service. The contiguous bands 92 - 94 GHz and 94.1 - 95 GHz continue primary allocated for radio astronomy service, although there is a potential risk for harmful interferences.

The CloudSat has a nearly circular orbit at 705 km altitude with a 99 min. period that repeats every 233 orbital revolutions. The orbital trajectories describe a reticular grid around the Earth that repeats every 16 days. The transmitted signal has the form of short pulses of 1.8 kW peak, with approx. 3.3 μs duration and 250 μs repetition rate. The antenna gain is 64 dBi giving a peak surface power flux density over all emitted frequencies of -31 dB(Wm^{-2}). The emission is to the nadir with a maximum deviation of $0\overset{\circ}{.}1$.

The first effect to consider with respect to the CloudSat emission is the possible damage of the receivers due to the direct impact when the antenna points to the zenith and the satellite crosses just above. Considering the effective collecting area of the 30m telescope of 700 m^2 and the flux density of -31 dB(Wm^{-2}) the power concentrated into the mixer reaches 556 mW. This power is in the order of millions times more than the standard required LO power for normal operation and enough to permanently damage the junction.

We have protected the receivers against this situation by installing an automatic closing mechanism on the vertex window for antenna elevations higher than $88\overset{\circ}{.}5$. In order to minimize a possible failure on the system, two redundant processes are in charge. The first process is implemented at the level of hardware by means of the PLC (programmable logic controller) of the servo system. When the antenna prelimit-up in elevation is reached the electrical power that keeps the vertex open is switched off, and the vertex is then closed. The second process, implemented by software, is permanently running in a VME machine, monitoring the antenna parameters: antenna elevation bigger than $88\overset{\circ}{.}5$, elevation prelimit-up and working limit-up, and if any of these three conditions is reached the vertex is commanded to close. Any failure of the previous operation is notified to the operator by the acoustic alarm in the control desk alarm system.

Making pointing scans on Venus at 94.05 GHz we have measured the total power collected by the receiver with the vertex open and closed. We conclude that the attenuation introduced by the vertex closed is, at least, of 30 dB, enough to protect the receivers.

According to the transmit signal characteristics of the CloudSat (http://www.iucaf.org/CloudSat/CloudSat-TechDetailsV3.pdf) the satellite antenna gain at 1° from the peak emission drops by more than 40 dB and the expected power reaching the receiver seems not dangerous. With the protection implemented, the vertex is closed within $1\overset{\circ}{.}5$ from the zenith, outside that cone the vertex can remain open since the level of power flux density from the CloudSat, even if the 30m is pointing to it, is not harmful for the receivers.

In the foreseen CloudSat ephemeris data (http://www.iucaf.org/CloudSat/CloudSat-Approaches-WebPage.htm) the closest approach estimate to the zenith of the 30m every 16 days cycle is very favourable, with no orbits or tracks in a 30 km radius from the zenith ($2\overset{\circ}{.}4$). The situation is less favourable at Plateau de Bure site with two orbits at less than 15 km in a similar time period. The final CloudSat tracks will be similar, but not identical.

The second effect to consider with the CloudSat is the harmful interference in the adjacent bands 92 - 94 GHz and 94.1 - 95 GHz. According to the ITU Recommendation 769 and CCIR 224-7 the harmful interference level for Radioastronomy Continuum Observations at 89 GHz with 2000 seconds of integration time is a power flux density of -125 dB(Wm^{-2}).

The signal transmitted by the CloudSat has a minimum attenuation outside the window 94 - 94.1 GHz of 50 dB. On the other side, far side lobes more than 10° away from the peak have a minimum attenuation respect to the peak of 75 dB. Then, the maximum power flux density reaching the observatory when observing outside the band 94 - 94.1 GHz and farther than 10° from the satellite will be $-31 - 50 - 75 = -156$ dB(Wm^{-2}), well below the threshold recommended by the ITU. In addition, if this maximum value is averaged over 2000 second (or 250 μs) the averaged power flux density is even 18.4 dB smaller or $-156 - 18.4 = -174.4$ dB(Wm^{-2}).

Nevertheless, if the observation is done in the window 94 $-$ 94.1 GHz or with the antenna pointing closer than 10° from the satellite, the harmful threshold of -125 dB(Wm^{-2}) at the observatory could be exceeded. In the first case with $-31-75-18.4 = -124.4$ dB(Wm^{-2}) and in the second case with $-31-50-18.4 = -99.4$ dB(Wm^{-2}).

A good criteria to guarantee that the running observation has not harmful interference due to the CloudSat would be monitoring (and notifying in the control room) the short periods when the CloudSat is above the horizon, informing of the instantaneous azimuth and elevation of the satellite. If the observation is outside the band 94 - 94.1 GHz and the antenna is pointing farther than 10° away from the satellite no interference must occur. On the other hand if this is not the case the situation must be analysed carefully or the observation be even rejected.

J. Peñalver and S. Navarro

VLBI News

The 3mm Global VLBI spring session took place on May 4-8 this year. Pico Veleta participated using the NCS and its new capabilities, only limited by bad weather conditions at the beginning of the session. Plateau de Bure experienced a breakdown of its CNRS maser five days before the session, which could not be repaired although a specialist from the OCA (Observatoire de la Côte d'Azur) came to the mountain. This resulted in a 100% loss of the Plateau de Bure phased array in the session. The CNRS maser has already returned to its laboratory in Grasse, where it will be repaired and renovated to play a role in Earth-space-Earth time transfer experiments.

IRAM has ordered in 2005 (with an important contribution by the MPIfR Bonn) a new active hydrogen maser at the Observatoire de Neuchâtel, with a construction time of 15 months. If everything goes according to plan, the new maser will be installed in summer 2006 at the Plateau de Bure. The EFOS-C maser series by Neuchatel is a synthesis of robust Russian technology and Swiss precision, and the specifications for the Plateau de Bure unit were chosen to allow VLBI observations up to 350 GHz. The maser on Pico Veleta is also a Neuchâtel model (EFOS-B series, delivered in 1991), which has already permitted in 2003 VLBI observations at 230 GHz with an excellent stability.

With the new Plateau de Bure maser and the planned Bure receiver upgrade (with two simultaneous polarisations), the stability and sensitivity of the phased array will improve considerably.

Michael BREMER

Scientific Results in Press

Radio wavelength molecular observations of comets C/1999 T1 (McNaught-Hartley), C/2001 A2 (LINEAR), C/2000 WM$_1$ (LINEAR) and 153P/Ikeya-Zhang

N. Biver(1), D. Bockelée-Morvan(1), J. Crovisier(1), D.C. Lis(2), R. Moreno(1,3), P. Colom(1), F. Henry(1), F. Herpin(4), G. Paubert(5) and M. Womack(6)
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Abstract:
We present a comparative study of the relative abundances of CO, CH_3OH, H_2CO, HCN, HNC, CS, H_2S, CH_3CN, SO and HNCO in comets C/1999 T1 (McNaught-Hartley), C/2001 A2 (LINEAR), C/2000 WM$_1$(LINEAR) and 153P/Ikeya-Zhang, four of the brightest comets seen in 2001–2002. This investigation is based on millimetre/submillimetre observations made with the IRAM 30-m, SEST, CSO and Kitt Peak 12-m telescopes. Although these four comets are expected to originate from the Oort cloud, they present significant differences in molecular abundances, especially as regards to the most volatile species: CO and H_2S. In particular comet C/2000 WM$_1$ looks quite depleted in these volatiles, suggesting it may have a different origin that the others. Heliocentric variations of molecular relative abundance in the coma are also investigated. Significant increases in the CS/HCN and HNC/HCN production rate ratios with decreasing heliocentric distances are observed.

Appeared in: A&A 449, 1255

A Multi-Layered Thermal Model of Backup Structures for mm-Wavelength Radio Telescopes

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Abstract:
An unfavourable influence that degrades the performance of any millimeter wavelength radio telescope is the deformation of the reflector surface due to temperature differences in the supporting backup structure. To avoid, or at least reduce this in influence, the backup structures are typically protected by a rear side cladding, insulation at the panel inner side, and ventilation or climatization of the air inside the backup structure. During the design of a mm-wavelength telescope, the layout of a thermal protection system is made, based on experience gained on other telescopes, and on thermal model calculations of the complete backup structure. The available thermal programs allow today the construction of a multi-layered backup structure model, consisting of the backup structure tube network, without and with ventilation/climatization, the panels, insulation behind the panels, and the rear side cladding. We provide a guideline for the construction of such a multi-layered thermal model, and demonstrate that realistic temperature gradients across and through a backup structure can be calculated. These gradients can be used in a finite element model to calculate the reflector surface deformations, which can be used in a diffraction program to calculate the radio beam pattern.

Submitted to: SPIE conference proceedings "Astronomical Telescopes and Instrumentation", 24-31 May 2006, Orlando, Florida, USA

First evidence for molecular interfaces between outflows and ambient cloud in high-mass star forming regions?

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Abstract:
We present new observations of the CepA-East region of massive star formation and describe an extended and dynamically distinct feature not previously recognised. This feature is present in emission from H_2CS, OCS, CH_3OH, and HDO at –5.5 km s^{-1}, but is not traced by conventional tracers of star forming regions H_2S, SO_2, SO, CS. The feature is extended up to at least 0.1 pc. We show that the feature is neither a hot core nor a shocked outflow. However, the chemistry of the feature is consistent with predictions of a model of an eroding interface between a

fast wind and a dense core; mixing between the two media occurs in the interface on a timescale of 10-50 years. If these observations are confirmed by detailed maps and by detections in species also predicted to be abundant (e.g. HCO^+, H_2CO, and NH_3) this feature would be the first detection of such an interface in regions of massive star formation. An important implication of the model is that a significant reservoir of sulfur in grain mantles is required to be in the form of OCS.

ApJ Letters, in press

High-Resolution Millimeter Imaging of Submillimeter Galaxies

Tacconi L.J.(1), Neri R.(2), Chapman S.C.(3), Genzel R.(1), Smail I.(4), Ivison R.J.(5), Bertoldi F.(6), Blain A.(3), Cox P.(2,7), Greve T.(3), Omont A.(8)
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Abstract:
We present $\sim 0\farcs6$ resolution IRAM PdBI interferometry of eight submillimeter galaxies at $z \sim 2-3.4$, where we detect continuum at 1 mm and/or CO lines at 3 and 1 mm. The CO 3-2/4-3 line profiles in five of the sources are double-peaked, indicative of orbital motion either in a single rotating disk or of a merger of two galaxies. The millimeter line and continuum emission is compact; we marginally resolve the sources or obtain tight upper limits to their intrinsic sizes in all cases. The median FWHM diameter for these sources and the previously resolved sources, SMM J023952-0136 and SMM J140104+0252, is $\leq 0\farcs5$ (4 kpc). The compactness of the sources does not support a scenario in which the far-IR/submillimeter emission comes from a cold (T< 30 K), very extended dust distribution. These measurements clearly show that the submillimeter galaxies (SMGs) we have observed resemble scaled-up and more gas-rich versions of the local universe, ultraluminous galaxy population. Their central densities and potential well depths are much greater than those in other $z \sim 2-3$ galaxy samples studied so far. They are comparable to those of elliptical galaxies or massive bulges. The SMG properties fulfill the criteria of "maximal" starbursts, in which most of the available initial gas reservoir of $10^{10} - 10^{11} M_{\odot}$ is converted to stars on a timescale $\sim 3^{-10} t_{dyn} \sim$ a few times 10^8 yr.

Based on observations obtained at the IRAM Plateau de Bure Interferometer (PdBI). IRAM is funded by the Centre National de la Recherche Scientifique (France), the Max-Planck Gesellschaft (Germany), and the Instituto Geografico Nacional (Spain).

Appeared in: ApJ 640, 228

Large-scale molecular shocks in galaxies: the SiO interferometer map of IC 342

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Abstract:
We present the first high-resolution ($5\farcs6 \times 5\farcs1$) images of the emission of silicon monoxide (SiO) in the nucleus of the nearby spiral IC 342, obtained with the IRAM Plateau de Bure Interferometer (PdBI). Using a two-field mosaic, we have simultaneously mapped the emission of the SiO(v=0, J=2-1) and $H^{13}CO^+$(J=1-0) lines in a region of 0.9 kpc ×1.3 kpc (RA × Dec) centered around the nucleus of IC 342. The bulk of the emission in the two lines comes from a $\sim$ 290 pc spiral arm located to the North and a central component that forms the southern ridge of a $r \sim 80$ pc nuclear ring that was identified in other interferometer maps of the galaxy. We detect continuum emission at 86.8 GHz in a $\sim 80 - 180$ pc central source. The continuum emission, dominated by thermal free-free bremsstrahlung, is mostly anticorrelated with the observed distribution of SiO clouds. The SiO-to-$H^{13}CO^+$ intensity ratio is seen to increase by an order of magnitude from the nuclear ring (0.3) to the spiral arm (3.3). Furthermore the gas kinematics show significant differences between SiO and $H^{13}CO^+$ over the spiral arm, where the linewidths of SiO are a factor of 2 larger than those of $H^{13}CO^+$. The average abundance of SiO in the inner $r \sim 320$ pc of IC 342 is X(SiO) $\gtrsim 2 \times 10^{-10}$. This shows that shock chemistry is at work in the inner molecular gas reservoir of IC 342. To shed light on the nature of shocks in IC 342, we have compared the emission of SiO with another tracer of molecular shocks: the emission of methanol (CH3OH). We find that the significant difference of the abundance of SiO measured between the spiral arm (X(SiO) a few 10^{-9}) and the nuclear ring (X(SiO)10^{-10}) is not echoed by a comparable variation in the SiO-to-CH3OH intensity ratio. This implies that the typical shock velocities should be similar in the two

regions. In contrast, the fraction of shocked molecular gas should be 5-7 times larger in the spiral arm (up to 10% of the available molecular gas mass over the arm region) compared to the nuclear ring. In the light of these results, we revise the validity of the various scenarios that have been proposed to explain the onset of shock chemistry in galaxies and study their applicability to the nucleus of IC 342. We conclude that the large-scale shocks revealed by the SiO map of IC 342 are mostly unrelated to star formation and arise instead in a pre-starburst phase. Shocks are driven by cloud-cloud collisions along the potential well of the IC 342 bar. The general implications for the current understanding of galaxy evolution are discussed.

Appeared in: A&A 448, 457

Full polarization study of SiO masers at 86 GHz

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Abstract:

Aims. We study the polarization of the SiO maser emission in a representative sample of evolved stars in order to derive an estimate of the strength of the magnetic field, and thus determine the influence of this magnetic field on evolved stars.
Methods. We made simultaneous spectroscopic measurements of the 4 Stokes parameters, from which we derived the circular and linear polarization levels. The observations were made with the IF polarimeter installed at the IRAM 30 m telescope.
Results. A discussion of the existing SiO maser models is developed in the light of our observations. Under the Zeeman splitting hypothesis, we derive an estimate of the strength of the magnetic field. The averaged magnetic field varies between 0 and 20 Gauss, with a mean value of 3.5 Gauss, and follows a 1/r law throughout the circumstellar envelope. As a consequence, the magnetic field may play the role of a shaping, or perhaps collimating, agent of the circumstellar envelopes in evolved objects.

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Comparative chemistry of diffuse clouds. V. Ammonia and formaldehyde

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Abstract:
Using the VLA and NRAO 140' telescopes we observed the λ1.3 cm (1, 1) and (2, 2) lines of NH_3 in absorption and emission toward the compact extragalactic continuum sources NRAO150 (B0355+508) and 3C 111 (B0415+379). These sources are occulted by some seven local diffuse and translucent clouds showing molecular absorption in OH, CO, HCO^+ and C_2H: for the four features having NH_3 absorption, we find rotational excitation temperatures 18-24 K, suggesting kinetic temperatures of at least 25-30 K. The abundance ratio $N(NH_3)/N(HCO^+)$ is comparable to values quoted for the cyanopolyyne peak in TMC-1 (i.e., 2.5) in three of four cases where NH_3 was seen. For clouds with higher column density $N(HCO^+) \lesssim 10^{12}$ cm^{-2}, the NH_3 column density $N(NH_3)$ is well correlated only with N(CS) ($<N(NH_3)/N(CS)> \approx 1.0$) and $N(H_2CO)$ ($<N(NH_3)/N(H_2CO)> \approx 0.4$). $N(H_2CO)$ is well correlated with $N(NH_3)$ and N(CS) ($<N(H_2CO)/N(CS)> \approx 2.3$) and the H_2CO abundance relative to other species is like TMC-1, with ($<N(H_2CO)/N(HCO^+)> \approx 2.3$).

Appeared in A&A 448, 253

Deuterated molecules in DM Tauri: DCO+, but no HDO

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Abstract:
We report the detection of the J=2-1 line of DCO^+ in the proto-planetary disk of DM Tau and re-analyze the spectrum covering the 465 GHz transition of HDO in this source, recently published by Ceccarelli et al. (2005, ApJ, 631, L81). A modelling of the DCO^+ line profile with the source parameters derived from high resolution HCO^+ observations yields a DCO^+/HCO^+ abundance ratio of $\simeq 4 \times 10^{-3}$, an order of magnitude smaller than that derived in the low mass cores. The re-analysis of the 465 GHz spectrum, using the proper continuum flux (0.5 Jy) and source systemic velocity (6.05 km s^{-1}), makes it clear that the absorption features attributed to HDO and C_6H are almost certainly unrelated to these species. We show that the line-to-continuum ratio of an absorption line in front of a Keplerian disk can hardly exceed the ratio of the turbulent velocity to the projected rotation velocity at the disk edge, unless the line is optically very thick ($\tau > 10^4$). This ratio is typically 0.1-0.3 in proto-planetary disks and is $\simeq$ 0.15 in DM Tau, much smaller than that for the alleged absorption features. We also show that the detection of $H2D^+$ in DM Tau, previously reported by these authors, is only a 2-sigma detection when the proper velocity is adopted. So far,

DCO^+ is thus the only deuterated molecule clearly detected in proto-planetary disks.

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A 2 mm spectral line survey of the starburst galaxy NGC 253

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Abstract:
We present the first unbiased molecular line survey towards an extragalactic source, namely the nuclear region of the starburst galaxy NGC 253. The scan covers the frequency band from 129.1 to 175.2 GHz, i.e. most of the 2 mm atmospheric window. We identify 111 spectral features as transitions from 25 different molecular species. Eight of which (three tentatively) are detected for the first time in the extragalactic interstellar medium. Among these newly detected species, we detected the rare isotopomers ^{34}SO and $HC^{18}O^+$. Tentative detections of two deuterated species, DNC and N_2D^+, are reported for the first time from a target beyond the Magellanic Clouds. Additionally, three hydrogen recombination lines are identified, while no organic molecules larger than methanol are detected. Column densities and rotation temperatures are calculated for all the species, including an upper limit to the ethanol abundance. A comparison of the chemical composition of the nuclear environment of NGC 253 with those of selected nearby galaxies demonstrates the chemical resemblance of IC 342 and NGC 4945 to that of NGC 253. On the other hand, the chemistries characterizing NGC 253 and M 82 are clearly different. We also present a comparison of the chemical composition of NGC 253 with those observed in Galactic prototypical sources. The chemistry of NGC 253 shows a striking similarity with the chemistry observed toward the Galactic center molecular clouds, which are thought to be dominated by low-velocity shocks. This resemblance strongly suggests that the heating in the nuclear environment of NGC 253 is dominated by the same mechanism as that in the central region of the Milky Way.

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Methanol detection in M 82

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Abstract:
The nuclear starburst region in M 82 shows systematical low abundances of some complex molecules when compared with other starburst galaxies. This is likely related to a presumably photodissociation dominated environment. In particular, methanol is known to show relatively low abundance because it is easily photodissociated. We present a multilevel study of the emission of methanol, detected for the first time in this galaxy, and discuss the origin of its emission. Observations of three transitions of CH_3OH towards the center and two positions around the nucleus of M 82 are presented. Two different components are found, one with high excitation ($n(H_2) \sim 106\mathrm{cm}^{-3}$, $T_{\rm rot} \sim 20\,\mathrm{K}$) and a the other with low excitation ($n(H_2) \sim 104\mathrm{cm}^{-3}$, $T_{\rm rot} \sim 5\,\mathrm{K}$). The high observed methanol abundance of a few 10^{-9} can only be explained if injection of methanol from dust grains is taken into account. While the overall $[CH_3OH]/[NH_3]$ ratio is much larger than observed towards other starbursts, the dense high excitation component shows a similar value to that found in NGC 253 and Maffei 2. Our observations suggest the molecular material in M 82 to be formed by dense warm cores, shielded from the UV radiation and similar to the molecular clouds in other starbursts, surrounded by a less dense photodissociated halo. The dense warm cores are likely the location of recent and future star formation within M 82.

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Is HCN a True Tracer of Dense Molecular Gas in Luminous and Ultraluminous Infrared Galaxies?

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Abstract:
We present the results of the first HCO^+ survey probing the dense molecular gas content of a sample of 16 luminous and ultraluminous infrared galaxies (LIRGs and ULIRGs). Previous work, based on HCN(1-0) observations, had shown that LIRGs and ULIRGs possess a significantly higher fraction of dense molecular gas compared to normal galaxies. While the picture issued from HCO^+

partly confirms this result, we have discovered an intriguing correlation between the HCN(1-0)/HCO^+(1-0) luminosity ratio and the IR luminosity of the galaxy (L_{IR}). This trend casts doubts on the use of HCN as an unbiased quantitative tracer of the dense molecular gas content in LIRGs and ULIRGs. A plausible scenario explaining the observed trend implies that X-rays coming from an embedded active galactic nucleus may play a dominant role in the chemistry of molecular gas at $L_{IR} \geq 10^{12} L_{\odot}$. We discuss the implications of this result for the understanding of LIRGs, ULIRGs, and high-redshift gas-rich galaxies.

Appeared in: ApJ 640, L135

A NEW PROBE OF DENSE GAS AT HIGH REDSHIFT: DETECTION OF HCO+(5-4) LINE EMISSION IN APM 08279+5255

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Abstract:
We report the detection of HCO^+(5-4) emission from the Broad Absorption Line (BAL) quasar APM 08279+5255 at $z = 3.911$ based on observations conducted at the IRAM Plateau de Bure interferometer. This represents the first detection of this molecular ion at such a high redshift. The inferred line luminosity, uncorrected for lensing, is $L'(HCO^+) = (3.5 \pm 0.6) \times 10^{10}$K km s^{-1}pc^2. The HCO^+ J=5-4 source position coincides within the errors with that reported from previous HCN J=5-4 and high-J CO line observations of this quasar. The HCO^+ line profile central velocity and width are consistent with those derived from HCN. This result suggests that HCO^+(5-4) emission comes roughly from the same circumnuclear region probed by HCN. However, the HCN(5-4)/HCO^+(5-4) intensity ratio measured in APM 08279+5255 is significantly larger than that predicted by simple radiative transfer models, which assume collisional excitation and equal molecular abundances. This could imply that the [HCN]/[HCO^+] abundance ratio is particularly large in this source, or that the J=5 rotational levels are predominantly excited by IR fluorescent radiation.

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New Preprints

583. A MULTI-LAYERED THERMAL MODEL OF BACKUP STRUCTURES FOR MM-WAVELENGTH RADIO TELESCOPES
A. Greve, D. R. Smith, M. Bremer
2006, *SPIE Astronomical Telescopes and Instrumentation*

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

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