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

Newsletter

Number 73 September 24th, 2009

Contents

Calendar

September 28-30, 2009
International conference at IRAM Grenoble: To the Edge of the Universe: 30 years of IRAM

October 1, 2009
IRAM User's meeting at IRAM Grenoble

October 1, 2009
Deadline for the submission of VLBI proposals

October 27-28, 2009
IRAM Program committee meeting in Grenoble

IRAM anniversary

We are pleased to announce the international conference 'To the Edge of the Universe' celebrating the 30th anniversary of IRAM. The conference will be held in Grenoble on September 28-30th, 2009, at the:

Centre de congrès de Grenoble (World Trade Center)
5 place Robert Schuman
38025 Grenoble

The year 2009 marks the 30th anniversary of the creation of IRAM. The institute was founded in 1979 by the French CNRS, the German MPG and the Spanish IGN - initially an associate member, becoming a full member in 1990. The story of IRAM represents a trailblazing European scientific and technical partnership that has set standards in millimeter radio astronomy.

Both of IRAM's observatories, the 30-meter telescope and the interferometer on the Plateau de Bure, are prime facilities for radio astronomy and the most powerful observatories today operating at millimeter wavelengths. The institute is also a worldwide leader in technical expertise related to high frequency technology, from ultra-sensitive super-conducting detectors to complex receiver systems, high-speed digital electronics and advanced data reduction software. Providing manufacture and supply devices to other radio astronomy centers, IRAM has highly valued partnerships with space agencies and is a major partner in the ALMA project.

Over the last 30 years, the IRAM telescopes have been at the origin of a large number of spectacular results. The goal of the conference 'To the Edge of the Universe: 30 years of IRAM' is to review the main results, obtained with the IRAM telescopes, from cosmology to the solar system and to present the technical developments that enabled these observations. The impact of these advances on millimeter and sub-millimeter astronomy will be discussed and future plans for upgrading the IRAM telescopes will be outlined.

The celebration of IRAM's 30 years will be an opportunity to discuss new scientific horizons that will be opened by the next generation of radio telescopes and to explore the role that IRAM will continue to play in this new and fast evolving landscape.

Pierre COX

IRAM Users' Meeting

It has been a long time, more than 5 years, since the last IRAM Users' Meeting was held in Grenoble in December 2003. Taking the opportunity of the IRAM 30 Years International Conference, the IRAM Scientific Advisory Committee has decided to organize a one full-day Users' Meeting on the day after the conference on October 1st 2009.

The sessions will take place at the IRAM headquarters, 300 rue de la Piscine, Domaine Universitaire, Saint-Martin d'Hères.

This Users' Meeting is intended to provide a forum for IRAM users to give feedback and suggestions to IRAM based on their experiences with the IRAM telescopes, software and services. Among the aspects to be covered are: overall science balance, 30m-Telescope and Plateau de Bure interferometer operations, observational strategies (service, pool, remote observing), software, archive policy, public outreach, ARC and other ALMA related issues, Radio Astronomy schools, future science with the IRAM instruments, etc.

It is planned to have short presentations from the users, 4 or 5 in each category, followed by an open discussion. You are cordially invited to propose one or more contributions by sending an abstract to the Scientific Organizing Committee at the following e-mail address: iram-users-meeting@oan.es.

Further information on the program will soon be available on the IRAM web pages (http://www.iram.fr/).

Pierre COX

New IRAM Website

For several months, a completely new IRAM web site has been under development. The idea is to combine an up-to-date and homogeneous web design with general and in-depth information on the scientific and technological work at IRAM. Karin ZACHER has coordinated the effort between the web designers of Rebus (Paris), and the various working groups at IRAM.

The new site does not attempt to mirror the individual Spanish and French IRAM observatory pages; this feature made sense when the old website came online in December 2002 (http://www.iram.fr and http://www.iram.es), but the reliability and speed of internet connections has much improved since then, so that direct links are now more practical.

An effort has been made to offer compatibility with a maximum of different web navigators, although the support of outdated navigator versions is by necessity limited.

In July 2009, the new IRAM web pages went online under the URL http://www.iram-institute.org. Users accessing the old http://www.iram.fr home page have been redirected since then. The underlying page structure is still available, but remains (with only a few exceptions) in a static state. Please refer to the new web pages for up-to-date information.

Michael BREMER

News from the 30m

EMIR Commissioning

The new Eight Mixer Receiver EMIR was installed and commissioned in March and April 2009. Routine observations started end of April.

The large bandwidths provided by EMIR, required a profound upgrade of the IF distribution at the 30m telescope. Inside the receiver cabin, an IF switch box was installed to select 4 outputs of 4GHz to be sent via new IF cables to the backend room. Three new processors, the 4MHz processor, the 4x4 WILMA processor, and the Narrow Backend Processor, were built to distribute the signals finally to the known set of backends.

Major parts of the telescope software had to be rewritten for EMIR. This concerns part of the "New Control System" and, of course, the PaKo user interface. In addition, the entire software producing the data had to be thoroughly revised: the read-out of the spectrometers into data streams, the transformation into IMBfits raw data, and the final transformation into calibrated data on the antenna temperature scale.

The observed alignment between the beams of the two polarisations and between the bands is very good. We derived telescope efficiencies from observations of Mars and from skydips, which show that the coupling of the EMIR beams to the telescope is as expected. All EMIR frequency setups of Bands 1 to 3, which had been requested for the running summer semester, were tested. Spectral line observations were conducted using the WILMA, 4 MHz, and VESPA backends, using all standard observing modes. 3mm VLBI was tested together with the PdB and works well. A more detailed report is available on the EMIR web pages.

Routine observations with EMIR started on April, 28, without encountering major obstacles since then. During the first half of the semester (till mid-August), friends of EMIR have been designated to each observing project, to help with the setups. This extra effort is not continued, as well-tested template scripts exist by now. The Astronomer of Duty is the point of contact in case of questions. A number of projects, in particular extragalactic projects, profited greatly from the much enhanced bandwidths and noise temperatures of EMIR. Below, we present some first astronomical highlights.

What are the next steps? An external cold load and polarizer were installed for polarimetry, which we will try to make available to the general users in the course of this summer. First tests of band 4 showed that the Local Oscillator (LO) lacks output power and needs to be replaced. The measured aperture efficiency at 330 GHz is 30%, confirming the good surface accuracy of the 30m dish, allowing to enter the submillimeter domain. After installation of a new LO, full commissioning of band 4 is planned for October/November, during the HERA and MAMBO2 pool weeks.

Carsten KRAMER

First results with EMIR

M82.

Rebeca Aladro and here team used EMIR to carry out full spectral line surveys in the 3 mm window of the ISM in several galactic nuclei. The aim of this study is to determine the evolution of the chemical complexity with starburst age in a sample of galaxies with different type of nuclear activity. One of the surveyed sources is the well known starburst galaxy M82. This galaxy was also previously observed by the same team using the old 2 mm CD SIS receivers. Fig. 1 shows the result of the frequency survey, covering both atmospheric windows, at 3 mm and 2 mm. While the 3 mm survey was conducted in just 4 days with EMIR, the 2 mm survey was conducted during 2 years. The noise rms of both surveys is approximately the same, 2 mK at 2 MHz resolution. The on+off observing time for the 3 mm survey was just only 11 hours, about a factor of 9 faster than the 2 mm survey, reflecting the huge gain in bandwidth which allows a significant quantitative and qualitative step forward in studies of the chemical complexity in Galaxies. Several transitions from more than 25 molecular species already detected in extragalactic objects provide unique information on the properties of the molecular gas. Thanks to EMIR, the tools to use molecular classification are now in our hands, to fully understand the evolutionary stage of the nuclear starburst. This work is part of the PhD thesis R. Aladro conducts at IRAM/Granada

Rebeca ALADRO and Carsten KRAMER

MAMBO2 pool observations in the period February to April 2009

Before the start of the MAMBO2 observing pool weeks, Albrecht Sievers carried out tests to check the present

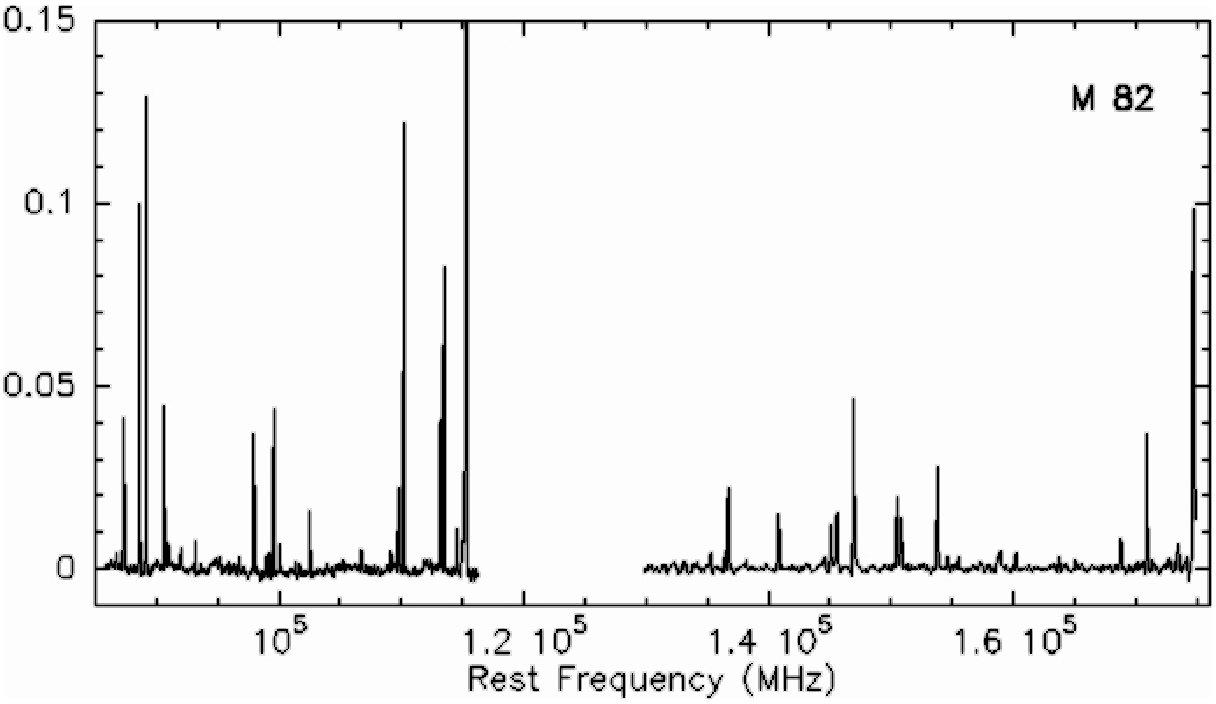


Figure 1: Frequency survey of the nucleus of M82 by Aladro et al.. The 3 mm spectrum shows the result of a quick reduction of EMIR data. The 2 mm spectrum was taken with the old CD receivers.

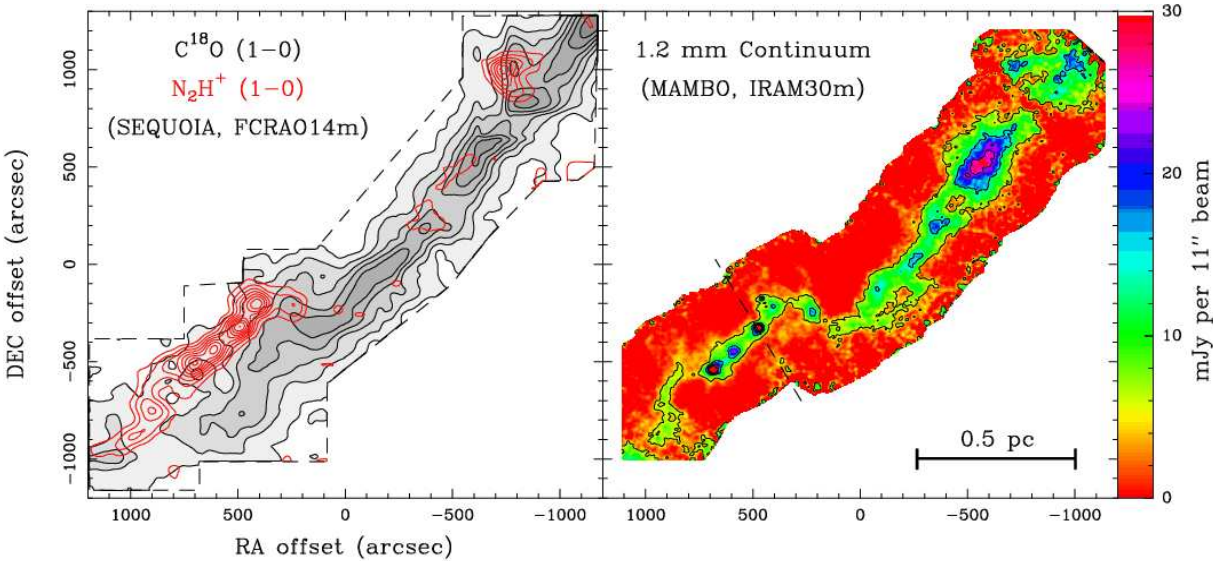


Figure 2: Two large-scale views of the B211-213 star-forming filament in the Taurus Molecular Cloud.

status of the MAMBO2 bolometer. In particular, the rotated wobbler observing mode was checked to be working perfectly, and was extensively used during this pool.

The pooled observations, in general, enjoyed good to excellent weather conditions reaching below 1 mm of water vapor. However, almost two weeks were lost due to bad weather (wind and snow). During this pool session, the old ABCD heterodyne receivers were dismounted and EMIR was installed and commissioned. A total of 12 observing projects were finished, including several Targets-of-Opportunity (ToO) projects. These ToO projects included high-redshift objects, gamma-ray bursts, jets of an weakly accreting stellar black hole, and the comet Lulin. All were detected but the high-z objects.

The main technical problems during this period were spikes and the stability of the backend. The rate of spikes increased strongly relative to the November 2008 pool. The time distribution of spikes is currently investigated together with Robert Zylka. The ABBA2 backend showed the known problem of crashes about 2–4 times per day. This is under investigation together with Giorgio Siringo at the MPIfR. New, upgraded software has been installed after the pool, and is currently tested.

Among the science highlights of this pool session are: the detection of four new circumstellar disks around brown dwarf stars, and the detection of a proto-brown dwarf in rhoOph. Figure 2 shows a map of the B211-213 filament in the Taurus region, which was obtained by Hacar et al..

The left part of Figure 2 shows $C^{18}O$ and N_2H^+ emission as observed with the FCRAO telescope, while the right image presents a combination of a MAMBO2 map obtained during the March 2009 pool (right–top, above the dashed line) and a previously taken MAMBO2 map (Hacar et al. 2009, in prep.). As the images show, each spectral line tracer only provides a biased and incomplete view, due to freeze-out of $C^{18}O$ from the gas phase, and chemical effects.

The 1.2mm continuum image illustrates how the dust emission is the only unbiased tracer of the star-forming region. It shows simultaneously both the extended gas and the dense cores, and provides the only means for determining the true density structure of the filament.

Guillermo QUINTANA-LACACI and Carsten KRAMER

EMIR - a veritable redshift machine

Studies of infra-red luminous galaxies at high redshift are a key element for improving our understanding of galaxy evolution in the early Universe. Sensitive blank-field mm and submm continuum surveys have discovered hundreds of these dusty, star-forming submm galaxies (SMGs) over the past decade. Progress in studying their redshift distribution, however, has been much slower, because the large dust content of SMGs means they often have only weak, if any, counterparts in the rest-frame UV and optical, making spectroscopic redshift determinations extremely difficult.

A promising alternative route to derive the redshift of SMGs is through observations of CO emission lines at mm wavelengths. These lines arise from the material feeding the star formation in SMGs and do not suffer from extinction. Detections can be related unambiguously to the submm continuum source. The narrow bandwidth of the old IRAM receivers, however, placed severe limitations on this technique as it was too time-consuming to search blindly for the CO lines in redshift space via multiple tunings of the receivers.

With the commissioning of the multi-band heterodyne receiver EMIR this situation has greatly improved. The 8-GHz instantaneous dual-polarization bandwidth of EMIR in the 3-mm band implies that a blind search for the CO lines can be done 32 times faster than with the old receiver setup at the 30m telescope. At the same time the 2 MHz spectral resolution guarantees that the CO line profiles can be resolved. To demonstrate the capabilities of EMIR as a "redshift machine" we targeted SMMJ14009+0252 in July 2009. This source was one of the first SMGs discovered by SCUBA a decade ago but - despite several attempts - no spectroscopic redshift could be determined mainly because of its faintness at near-IR/optical wavelengths.

EMIR was used to scan ~ 20 GHz of bandwidth in the 3-mm window (Fig. 3 top). The excellent performance of the receiver allowed to reach an r.m.s noise level of $\sim 200\ \mu$Kelvin in only 6 hours of observing time per tuning. A 5-mJy line was clearly detected and identified as CO(3-2) through observations of the CO(5-4) line in the 2-mm band of EMIR (Fig. 3 bottom). These two lines unambiguously determine the redshift of SMMJ14009+0252 to $z = 2.93449 \pm 5 \times 10^{-5}$.

This exciting result illustrates the excellent performance and sensitivity of EMIR and opens up a new window for studying galaxy evolution over the lifetime of the universe.

Axel WEISS, MPIfR Bonn

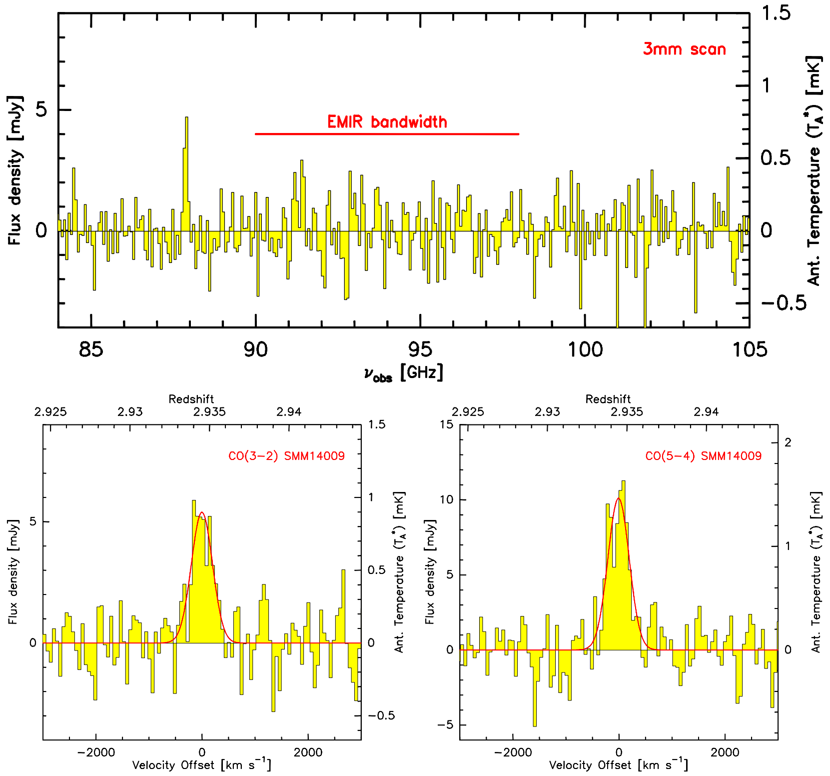


Figure 3: Top: EMIR 3-mm scan covering ∼ 20 GHz of bandwidth at a velocity resolution of 200 km/s. Bottom: CO(3-2) and CO(5-4) transition towards SMMJ14009+0252 at a velocity resolution of 60 km/s.

News from the Plateau de Bure Interferometer

Installation of WideX

We plan to install the new wide band correlator WideX ("Wideband Express") during the upcoming winter semester on Plateau de Bure. WideX will be able to process the two 4 GHz wide IF bands (one per polarization) delivered by the PdBI receivers. It will provide a fixed spectral resolution of 2 MHz over the full 4 GHz bandwidth and will be available in parallel to the existing narrow band correlator. All information presently available on WideX can be found at `http://www.iram.fr/IRAMFR/TA/backend/WideX`. We anticipate that WideX may become available for the second half of the winter semester 2009/2010. Since the installation, testing, and commissioning of WideX has not yet started at the time of writing this call for proposals, any observations requesting WideX will be offered on a best effort basis for the upcoming winter semester.

Weather conditions and observing

Both, the end of the last winter semester and the first two months of the current summer semester were affected by variable weather conditions on the Plateau de Bure. We had periods of excellent atmospheric stability and transparency in the second half of February and after mid of March but already considerable water vapor in April and May. Since the second half of June, typical summer weather conditions hold on the Plateau de Bure with an unstable atmosphere in the afternoons and reasonable 3 mm observing conditions only in the second half of the night and until around noon.

We moved the array from its A configuration directly into the more compact C configuration on March 14. Due to the rather poor weather conditions in the first half of February and March, five projects requesting the A-configuration could not be finished and will be deferred to the upcoming winter semester.

The C configuration was scheduled until April 6, when the interferometer was switched back to the most compact configuration D. The spring VLBI session took place from May 7 to 12 with the interferometer working without technical downtime and in good weather conditions.

Since May 18th, the array is observing with 5 antennas in D configuration. The current antenna maintenance period is foreseen to end in October. During this period it is planned to equip the reflector of antenna 2 with new aluminum panels replacing the current carbon fiber panels. Antenna 3 was recently equipped with a new aluminum subreflector that is performing to our expectations.

As far as A-rated projects are concerned, we still hope to bring most of these to completion before the end of the 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 of the current summer semester which are not started before the proposal deadline have to be resubmitted.

Global VLBI observations, which include the array in the 3 mm phased-array mode, are planned from October 8 to 13.

Investigators who wish to check the status of their project may consult the interferometer schedule on the Web at ../IRAMFR/PDB/ongoing.html[1]. This page is updated daily.

Jan Martin WINTERS

VLBI News

Plateau de Bure received its new Rohde & Schwarz SMA100.B22 frequency generator in early 2009, and performed a short VLBI test on the Pico Veleta - Plateau de Bure (PV-PB) baseline on March 10 only hours before the old 30-m receiver cabin was dismantled to make room for EMIR. The resulting fringes were of excellent quality, and confirmed the VLBI-grade stability of the new generator.

During the commissioning of EMIR, a second PV-PB test was performed that confirmed the VLBI capabilities of the new Pico Veleta receiver and LO system.

In the Global May session from May 8th – May 12th, both IRAM instruments participated. Plateau de Bure observed 78% of the scheduled scans (of the missed scans, a quarter were due to the sun avoidance at Bure, and the rest mainly due to bad weather). Pico Veleta had difficult weather conditions, and could only observe 24% of the scheduled scans.

Michael BREMER

Editor's Note

The appearance of this Newsletter comes a bit later than originally planned. When it became clear that the inclusion of the IRAM "Call for Proposals" would not be of practical interest any more, this section was removed and replaced by the still actual Call for the Global mm VLBI Array (GMVA).

Both IRAM observatories participate twice per year in this international effort, which allows high resolution observations of ultracompact and highly luminous astronomical sources.

If you are interested in this observing mode, the sections below may help in preparing and submitting a VLBI proposal.

Michael BREMER

[1]from here on we give only relative URL addresses. In the absolute address the leading two dots (..) should be replaced by `http://www.iram.fr`

Call for Global VLBI Proposals at 3mm wavelength

Deadlines each year:
February 1st and October 1st

We announce the opportunity for coordinated, high angular resolution and high sensitivity GLOBAL VLBI observations in the 3mm band (85−95 GHz), complementing stand-alone VLBA observations at this frequency.

The Global 3mm VLBI Array consists of 8 VLBA antennas equipped with 3mm receivers, plus the IRAM 30m telescope on Pico Veleta (Spain), the phased 6-element IRAM interferometer on Plateau de Bure (France), the MPIfR 100m radio telescope in Effelsberg (Germany), the OSO 20m radio telescope at Onsala (Sweden), and the 14m telescope in Metsähovi (Finland).

The Global 3mm VLBI Array is the successor to the former Coordinated Millimeter VLBI Array (CMVA) and offers 3 to 4 times more sensitivity than the stand-alone VLBA (although for logistical reasons this global array cannot be "dynamically" scheduled). Observations with the Global 3mm VLBI array will be scheduled in time blocks in special observing sessions, performed twice per year, typically in mid May and mid October. The actual duration of each session depends on proposal pressure and typically ranges between 3 and 5 days.

The Global 3mm VLBI Array supports the same observing modes as the VLBA. Note that 512 Mb/s recording is offered as a standard mode for continuum observations in order to maximize the sensitivity. Correlation will we performed in absentia at the MPIfR MK4 correlator in Bonn 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.

For each session proposers are asked to submit their proposals to both the European mm-VLBI Scheduler, R. Porcas (propvlbi@mpifr-bonn.mpg.de) AND to the VLBA (propsoc@nrao.edu) for the normal VLBI deadlines: October 1st for observations in spring and February 1st for observations in autumn of each year. Proposers should use the standard VLBI cover sheet (from the VLBA web site). Proposals will be reviewed by NRAO and the participating European Observatories.

Global VLBI observations at 3mm are subject to some technical restrictions, which are summarized in the technical guidelines below:

Technical Guidelines for Global VLBI Observations

Main purpose of Global 3mm-VLBI observations:

To image compact radio sources with high angular resolution (up to 50 μarcsec) and better sensitivity than the stand-alone VLBA can provide. Typical single baseline detection thresholds: $0.06 - 0.4$ Jy (see Antenna Characteristics and Sensitivities).

Observing dates:

Twice per year, in spring (April/May) and autumn (October).

How to propose:

For Global 3mm-VLBI observing proposals have to be submitted electronically to the European mm-VLBI Scheduler, R. Porcas (propvlbi@mpifr-bonn.mpg.de) AND in parallel also to the VLBA (propsoc@nrao.edu). The submission deadline for observations in the spring is October 1st, and for observations in the fall is February 1st.

Proposers should use the standard VLBI cover sheet. Proposals will be reviewed by NRAO and the participating European Observatories.

Participating Stations:

- in Europe: Effelsberg (100m (Ef)), Onsala (20m (On)), Pico Veleta (30m (Pv)), Plateau de Bure (6x15m, phased (Pb)), Metsähovi (14m (Mh))
- in the USA: VLBA (8x25m) - BR, NL, PT, LA, FD, KP, OV, MK (HN, SC are not equipped with 3mm receivers)
- other stations: as other stations become available in the future, they may join in (next candidates: Yebes (40m), Noto (32m), GBT (100m))

Frequency:

The standard frequency for continuum observations is 86.2 GHz.

For spectral line observations a range of 84-95 GHz is available at Ef, Pv, Pb. The VLBA at present supports 80-96 GHz (NL, PT, FD, KP, OV, MK) except for the stations LA and BR which at the moment only support 80-90 GHz. Thus for the global 3mm VLBI array the common frequency range at the moment is 84-90 GHz. If other frequency setup than standard is needed, the P.I. is asked to contact the European Schedule Coordinator before proposing.

Recording:

All stations: can do MKV/VLBA recording modes with up to 512 Mbps (the standard for continuum observations is currently 512 Mbps)

European stations: can do MKV recording at up to 1 Gbps on special request

Note: The VLBA will support only its "Validated Observing Modes", which are the modes supported by the NRAO-Sched programme.

For continuum observations the recommended standard recording mode is 512-8-2 (512 Mbps, 16 IFs of 8 MHz bandwidth each, 2 bit sampling in left circular polarisation (LCP) or 8 IFs of 8 MHz bandwidth each, 2 bit sampling in both left and right circular polarisation (LCP and RCP). P.I's who wish to record with 1 bit sampling or with modes not compatible with 512-8-2 should justify this in their proposal and contact the Schedule Maker in order to make sure that their prefered recording mode is possible.

Correlation:

The data will be correlated at the MPIfR-VLBI correlator in Bonn (Germany).

After correlation the data will be made available to the P.I. in UV-FITS format, compatible to be read in into the most recent version of AIPS.

Spectral lines:

Allowed number of lags must be within Bonn-correlator limits (for details see: http://www.mpifr-bonn.mpg.de/EVN/MK4CORstatus)

Disk usage:

A limited number of MarkV disks is available, which have to be correlated and released between two adjacent observing sessions (Spring/Autumn). In standard observing mode (512 Mbps) this corresponds to a duty cycle of 0.5 (an equivalent to 12 hours recording every 24 hours). This is a bit more than double the duty cycle offered by the VLBA alone at 86 GHz (where the equivalent of 2-tapes-per-day guideline applies).

Polarisation:

Dual polarisation receivers available at: Ef, Pv, Pb, Mh, VLBA ; single polarisation receivers available at: ON

Note: At present it is not yet possible to reduce polarization data recorded at PV in AIPS, due to the special mount-type of the PV antenna (Nasmyth focus). An installation of a new AIPS TST version which can deal with

Nasmyth mounted telescopes (kindly provided by R. Dodson) will be available soon. The receivers of PdB have been upgraded recently and now provide dual polarisation (LCP/RCP). However for PdB, the calibration for this observing mode is not yet well tested. Test reports from users, willing to help to characterize the station D-terms are welcome.

Sunavoidance:

A 35 degree limit must be obeyed at Pb.

Pointing/Calibration:

mm-VLBI requires special efforts with regard to antenna pointing and data calibration. To ensure the success of the observations several 'rules' must be obeyed:

For large antennas like Pv, Ef, Pb frequent (3-4 times per hour) pointing and calibration gaps of at least 5-7 min duration must be scheduled between VLBI scans. Pv and Ef will use these pointing scans also for antenna temperature measurements. The PdB-interferometer additionally needs to do the phasing during these gaps.

For the VLBA the pointing is done quasi-automatically on bright SiO-maser sources at 43 GHz. The VLBI schedule (key-file) must contain "reference pointing scans", which are scheduled between adjacent VLBI scans. The pointing gaps need a length of at least 3 min duration.

For continuum imaging the following well tested observing scheme will be used at 512 Mbps: 4 VLBI scans per hour, one every 15 mins, with pointing gaps between adjacent VLBI scans

P.I.'s who wish to deviate from this standard should indicate this in the proposal and should contact the Schedule Coordinator or the Schedule Maker to check whether this is possible.

Scheduling:

For logistical reasons and to ensure optimum use of telescope time, all experiments which got observing time will be scheduled within a block schedule, which is optimized by the Schedule Maker (Thomas Krichbaum). The Schedule Maker will take care of the special needs with regard to antenna pointing, calibration and disk usage.

P.I.'s who wish to participate actively in the scheduling process should indicate this in their proposal. They will contacted by the Schedule Maker during the scheduling process.

The observing schedules (key-files) will made in week 4 and 3 before observing. In week 2 before observing they will be send to the VLBA, where a final check is done. The individual stations fetch the final schedules from the usual '/astronomy' account (http://www.vlba.nrao.edu/astro/VOBS/astronomy/) via ftp during week 1 before observing.

In case of technical questions please contact the following persons at MPIfR Bonn, Germany:

- R. Porcas (Schedule Coordinator),
- T. Krichbaum (Schedule Maker),
- D. Graham (frequency setup),
- W. Alef (Correlation).

The MPIfR VLBI team

Staff changes

IRAM Grenoble

The astronomer's group welcomes a new member: Sascha TRIPPE has started work at IRAM on February 1st.

On April 1st, Pavel JACHIM from the Astronomical Institute of Prague, Czech Republic arrived at IRAM. Pavel is the first "visiting astronomer" in a new program on the exchange of instrumental and scientific expertise.

Three staff members who have been with IRAM from its early days have gone into retirement. We thank them for many years of dedicated work. Jean-Louis POLLET, chef of the mechanical construction and workshop group, left IRAM on March 31st; his expertise and good organisation were essential in the realisation of the innumerable large and small high precision mechanical elements that astronomical instruments require. As announced in the last Newsletter, Bastien LEFRANC has taken over his tasks.

Dennis Downes, head of the astronomer's group, has retired on June 30th. With his encyclopaedic knowledge and analytic mind, his support was invaluable in the solution of many scientific enigmas. Roberto NERI has now taken over as group leader.

Finally, the electronician Iris CERVERA from the Plateau de Bure Observatory has retired. He participated in the construction of the Bure antennas and could quickly pinpoint and resolve the electrical problems that wear and high mountain conditions can cause.

We wish them a good and active retirement.

On August 31st, Bernard LAZAREFF ended his detachment from the CNRS and returned to the LAOG to continue his astronomical career. In his function as Frontend group leader, he has successfully orchestrated the development and realisation of several IRAM cutting-edge receiver generations (with the Pico Veleta EMIR as the latest project), and elements for several international observatories (e.g. ALMA).

On March 25th, Laurent BROCHE has left the Plateau de Bure Mechanics group to start his own business. Laurent has been a long-term member of the Bure team, with a very good understanding of the intricate workings of the antennas.

On March 26th, Jean-Jaques AZPEITIA has started work as a mechanic at the Plateau de Bure.

Michael BREMER

IRAM Granada

Christof Buchbender has joined the astronomers group as PhD student on June, 1st, 2009, after having finished his Diploma thesis at the MPIfR in Bonn. He will work on IRAM and Herschel data of the nearby galaxy M33 in the framework of the HERMES project.

On June, 15th, 2009, Juliette Voyez (Paris University) has joined the astronomers group for a two months summer research internship. She is guided by Guillermo Quintana-Lacaci.

Rosa Montalban left IRAM in May 2009, taking up a position at the Universidad de Granada. On August, 1st, 2009, Pablo Mellado Sanchez has joined the computer group as new system administrator.

Carsten KRAMER

Scientific Results in Press

Interferometric imaging of carbon monoxide in comet C/1995 O1 (Hale-Bopp): evidence for a strong rotating jet

D. Bockelée-Morvan(1), F. Henry(1), N. Biver(1), J. Boissier(2), P. Colom(1), J. Crovisier(1), D. Despois(3), R. Moreno(1), and J. Wink(2)
(1) Observatoire de Paris, F-92195 Meudon, France, (2) IRAM, F-38406 Saint Martin d'Hères, France, (3) Observatoire de Bordeaux, BP 89, F-33270 Floirac, France

Abstract:
Context. Observations of the CO $J(1-0)$ 115 GHz and $J(2-1)$ 230 GHz lines in comet C/1995 O1 (Hale-Bopp) were performed with the IRAM Plateau de Bure interferometer on 11 March, 1997. The observations were conducted in both single-dish (ON-OFF) and interferometric modes with 0.13 km s^{-1} spectral resolution. Images of CO emission with 1.7 to 3$''$ angular resolution were obtained.
Aims. The ON-OFF and interferometric spectra show a velocity shift with sinusoidal time variations related to the Hale-Bopp nucleus rotation of 11.35 h. The peak position of the CO images moves perpendicularly to the spin axis direction in the plane of the sky. This suggests the presence of a CO jet, which is active night and day at about the same extent, and is spiralling with nucleus rotation. The high quality of the data allows us to constrain the characteristics of this CO jet.
Methods. We have developed a 3-D model to interpret the temporal evolution of CO spectra and maps. The CO coma is represented as the combination of an isotropic distribution and a spiralling gas jet, both of nucleus origin.
Results. Spectra and visibilities (the direct output of interferometric data) analysis shows that the CO jet comprises $\sim 40\%$ the total CO production and is located at a latitude $\sim 20°$ North on the nucleus surface. Our inability to reproduce all observational characteristics shows that the real structure of the CO coma is more complex than assumed, especially in the first thousand kilometres from the nucleus. The presence of another moving CO structure, faint but compact and possibly created by an outburst, is identified.

Accepted for publication in A&A

Millimeter HEMT amplifier measurements at cryogenic temperatures

P. Serres(1), Y. Bortolotti(1), G. Buttin(1), B. Pissard(1), G. Valente(1), F. Mattiocco(1), B. Lazareff(1)
(1)IRAM, 300 rue de la Piscine, 38406 St Martin d'Hères, France

Abstract:
IRAM is designing an 84-116 GHz dual polarisation HEMT receiver in order to get experience in using such receivers at the Pico Veleta Observatory, which can then be applied to a future project of building a 3 mm HEMT focal plane array. Preliminary measurements of HEMT MMIC amplifiers in terms of gain, noise temperature, saturation, and stability at 300 K and at 4 K will be described. Two solutions are presented for the down converting of the HEMT amplifier output: the first uses a very large (4-36 GHz) IF band and a fixed tuned LO at 80 GHz while the second is designed with a smaller IF band (4-12 GHz) and a 67-91 GHz tunable LO. In the 84-116 GHz range, receiver noise temperatures between 32 and 51 K were obtained (see Fig. 4). The measured stability ($1s > \tau > 100s$) is below 4×10^{-4} at 101 GHz.

Presentation at the 1st Radionet Engineering Forum Workshop (Chalmers, Gothenburg, Sweden, 23-24 June 2009)

Intermittency of interstellar turbulence: Parsec-scale coherent structure of intense, velocity shear

P. Hily-Blant(1) and E. Falgarone(2)
(1)LAOG, CNRS & Université Joseph Fourier, UMR 5571, 414 Rue de la Piscine BP 53 F-38041 Grenoble Cedex 09 (2)LRA/LERMA, CNRS & École normale supérieure & Observatoire de Paris, UMR 8112, 24 rue Lhomond, 75231 Paris Cedex 05, France

Abstract:
Aims. Benefitting from the duality of turbulence (random

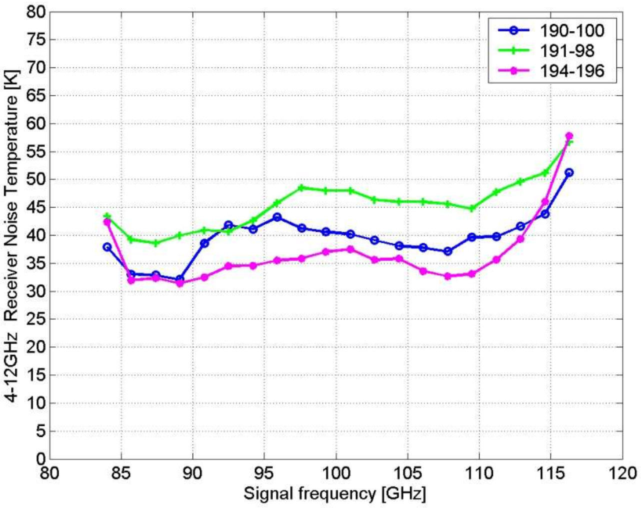


Figure 4: P. Serres et al.: Receiver noise temperature in the 84-116 GHz range, based on HEMT MMIC amplifiers.

versus coherent motions), we search for coherent structures in the turbulent velocity field of molecular clouds, anticipating their importance in cloud evolution.
Methods. We analyse a large map (40′ by 20′) obtained with the HERA multibeam receiver (IRAM-30m telescope) in a high latitude cloud of the Polaris Flare at unprecedented spatial (11) and spectral (0.05 km s^{-1}) resolution for the ^{12}CO$(2-1)$ line.
Results. We find that two parsec-scale components of velocities differing by ~ 2 kms^{-1}, share a narrow interface (< 0.15 pc) that appears to be an elongated structure of intense velocity-shear, ~ 15 to 30 kms^{-1} pc^{-1}. The locus of the extrema of line-centroidvelocity increments (E-CVI) in that field follows this intense-shear structure as well as that of the ^{12}CO$(2-1)$ high-velocity line wings. The tiny spatial overlap in projection of the two parsec-scale components implies that they are sheets of CO emission and that discontinuities in the gas properties (CO enrichment and/or increase in gas density) occur at the position of the intense velocity shear.
Conclusions. These results identify spatial and kinematic coherence on scales of between 0.03 pc and 1 pc. They confirm that the departure from Gaussianity of the probability density functions of E-CVIs is a powerful statistical tracer of the intermittency of turbulence. They provide support for a link between large-scale turbulence, its intermittent dissipation rate and low-mass dense core formation.

Appeared in: A&A 500, L29

The modulation of SiO maser polarization by Jovian planets

Wiesemeyer, H.(1)
(1)IRAM, 300 rue de la Piscine, Domaine Universitaire, 38406 Saint Martin d'Hères, France

Abstract:
Aims. Searching for planets in the atmosphere of AGB stars is difficult, due to confusion with the stellar wind and pulsations. The aim here is to provide a complementary strategy for planet searches in such a dense environment.
Methods. The polarization properties of SiO masers, especially their circular polarization, are, under certain conditions, good tracers of rapid magnetospheric events. A Jovian planet with a magnetosphere whose dipole axis is misaligned with its rotation axis naturally provides such conditions. Here I present several models showing that the polarization will be periodically modulated.
Results. The linear and circular polarization of an SiO maser in a planetary magnetosphere is modulated by the precessing dipole component of the latter. The effect is measurable in saturated masers, while unsaturated masers only exhibit weak changes, because of dilution effects, and because the circular polarization there stems from the Zeeman effect making it as weak as for thermal radiation. The situation would change if anisotropic pump- and loss-rates were included, which would increase the fractional linear and, via magnetorotation, the circular polarization of the modulation.
Conclusions. Single-dish monitoring with a dense enough time sampling and a carefully calibrated polarimeter, in combination with VLBI observations, are suited to detecting and locating a periodic modulation of the circular maser polarization due to a precessing Jovian magnetosphere. The phenomenon will be rare, because a favorable arrangement of maser and magnetosphere is needed. Otherwise the polarization may be below the detection threshold, especially if the maser is unsaturated. Though exhibiting a qualitatively similar modulation, linear polarization is likely to suffer more from confusion due to dilution of the magnetosphere within the maser cross section, even in VLBI observations.

Appeared in: A&A 501, 647

Precessing planetary magnetospheres in SiO stars? First detection of quasi-periodic polarization fluctuations in RLeonis and VCamelopardalis

H. Wiesemeyer(1), C. Thum(1), A. Baudry(2,3), and F. Herpin(2,3)
(1)IRAM, 300 rue de la Piscine, 38406 Saint Martin d'Hères, France, (2)Université de Bordeaux, Laboratoire d'Astrophysique de Bordeaux, 33000 Bordeaux, France, (3)CNRS/INSU, UMR 5804, BP 89, 33270 Floirac, France

Abstract:
Context. The origin of magnetism around asymptotic giant branch (AGB) stars remains an uncertainty. These stars may drive an important dynamo, but if the magnetic energy dissipates entirely into X-rays, the observed X-ray luminosities are too low to maintain a strong, dynamically important global field. Other explanations of the circular polarization in SiO masers in AGB atmospheres may thus be required.
Aims. The interaction of the AGB wind with both previously ejected matter and planets is expected to produce complex magnetohydrodynamic phenomena on a short timescale, such that strong magnetic fields can be maintained locally. Here, we provide observational evidence of the corresponding magnetic fluctuations.
Methods. We use the circular polarization of the $v = 1$, $J = 2-1$ SiO masers as a tracer of magnetic activity. A correlation polarimeter allows us to record simultaneously all Stokes parameters. An SiO maser survey of 77 AGB stars was performed from which eight sources of the strongest circular polarization were selected for further monitoring. *Results.* In two AGB stars, V Cam and R Leo, we find evidence of pseudo-periodic fluctuations in the fractional circular polarization (Fig. 5) on a timescale of a few hours, from which we infer magnetic fluctuations of ~ 1 G. The phenomenon is rare and, if detected in an SiO star, restricted to a narrow range of velocities. It seems to be associated with planetary wake flows suggested by VLBI maps.
Conclusions. While scenarios involving magnetic activity in the extended stellar atmosphere have problems explaining all observed features, precessing Jovian magnetospheres predict all of them without difficulty. For the case of R Leo, we constrain the orbit of the planet (estimated period 5.2 years), derive a stellar mass estimate of 0.7 $M_\odot$ from it, and discuss the impact of planetary magnetism on the survival of planets. Smooth velocity variations in the fluctuating circular polarization feature are predicted as the planet moves along its orbit.

Appeared in A&A 498, 801

The Beam Pattern of Reflector Antennas with Buckled Panels

A. Greve[1], D. Morris[1], J. Peñalver[2], C. Thum[1], and M. Bremer[1]
([1])IRAM, 300 rue de la Piscine, 38406 St. Martin d'Hères, France, ([2])IRAM, Av. Divina Pastora 7, Núcleo Central, 18012 Granada, Spain

Abstract:
On high precision reflector telescopes the transient thermal panel buckling canhave an effective rms-value comparable to the errors in the adjustment of the reflector panels. Under this condition, high signal-to-noise radio holography of high spatial resolution can reveal the characteristic signature of panel buckling in the beam pattern and can map the surface deformation of the buckling, while lower signal-to-noise Moon limb scans may see the buckling onlyunder favourable conditions. Detailed diffraction calculations, and some observations, indicate (1) that the panel buckling produces diffraction rings and/or diffraction spokes, (2) that panel buckling in azimuthal direction may have a smaller degrading effect than panel buckling in radial direction becausefor azimuthal buckling the energy is spread more uniformly over a large solid angle, and (3) that the coverage of the reflector aperture with buckled panels determines the multiplicity of the diffraction rings and/or diffraction spokes.

Accepted for publication in IEEE Trans. on Antennas and Propagation

CO line emission in the halo of a radio galaxy at $z = 2.6$

N.P.H. Nesvadba([1,2]), R. Neri([3]), C. De Breuck([4]), M.D. Lehnert([2]), D. Downes([3]), F. Walter([5]), A. Omont([6]), F. Boulanger([1]) and N. Seymour([7])
([1])Institut d'Astrophysique Spatiale, Université Paris Sud 11, Orsay, France, ([2])GEPI, Observatoire de Paris, CNRS, Université Denis Diderot, Meudon, France, ([3])Institut de Radio Astronomie Millimétrique (IRAM), St. Martin d'Hères, France, ([4])European Southern Observatory, Karl-Schwarzschild Straße, Garching bei München, Germany, ([5])Max Planck Institut für Astronomie, Heidelberg, Germany, ([6])Institut d'Astrophysique de Paris, CNRS, Université Pierre et Marie Curie, Paris, ([7])Mullard Space Science Laboratory, UCL, Holmbury St. Mary, Dorking, Surrey RH5 6NT

Abstract:
We report the detection of luminous CO$(3-2)$ line emission in the halo of the $z = 2.6$ radio galaxy (HzRG) TXS0828+193, which has no detected counterpart at optical to mid-infrared wavelengths implying a stellar mass $\lesssim$ few $\times 10^9 M_\odot$ and relatively low star formation rates. With the IRAM Plateau de Bure Interferometer (PdBI), we find two CO emission-line components at the same position at ~ 80 kpc distance from the HzRG along the axis of the radio jet, with different blueshifts of few 100 km s^{-1} relative to the HzRG and a total luminosity of $\sim 2 \times 10^{10}$ K km s^{-1} pc^2 detected at a total significance of $\sim 8\sigma$. HzRGs have significant galaxy overdensities and extended haloes of metal-enriched gas often with embedded clouds or filaments of denser material, and likely trace very massive dark matter haloes. The CO emission may be associated with a gas-rich, low-mass satellite galaxy with very little ongoing star formation, in contrast to all previous CO detections of galaxies at similar redshifts. Alternatively, the CO may be related to a gas cloud or filament and perhaps jet-induced gas cooling in the outer halo, somewhat in analogy with extended CO emission found in low-redshift galaxy clusters.

Appeared in: MNRAS 395, L16

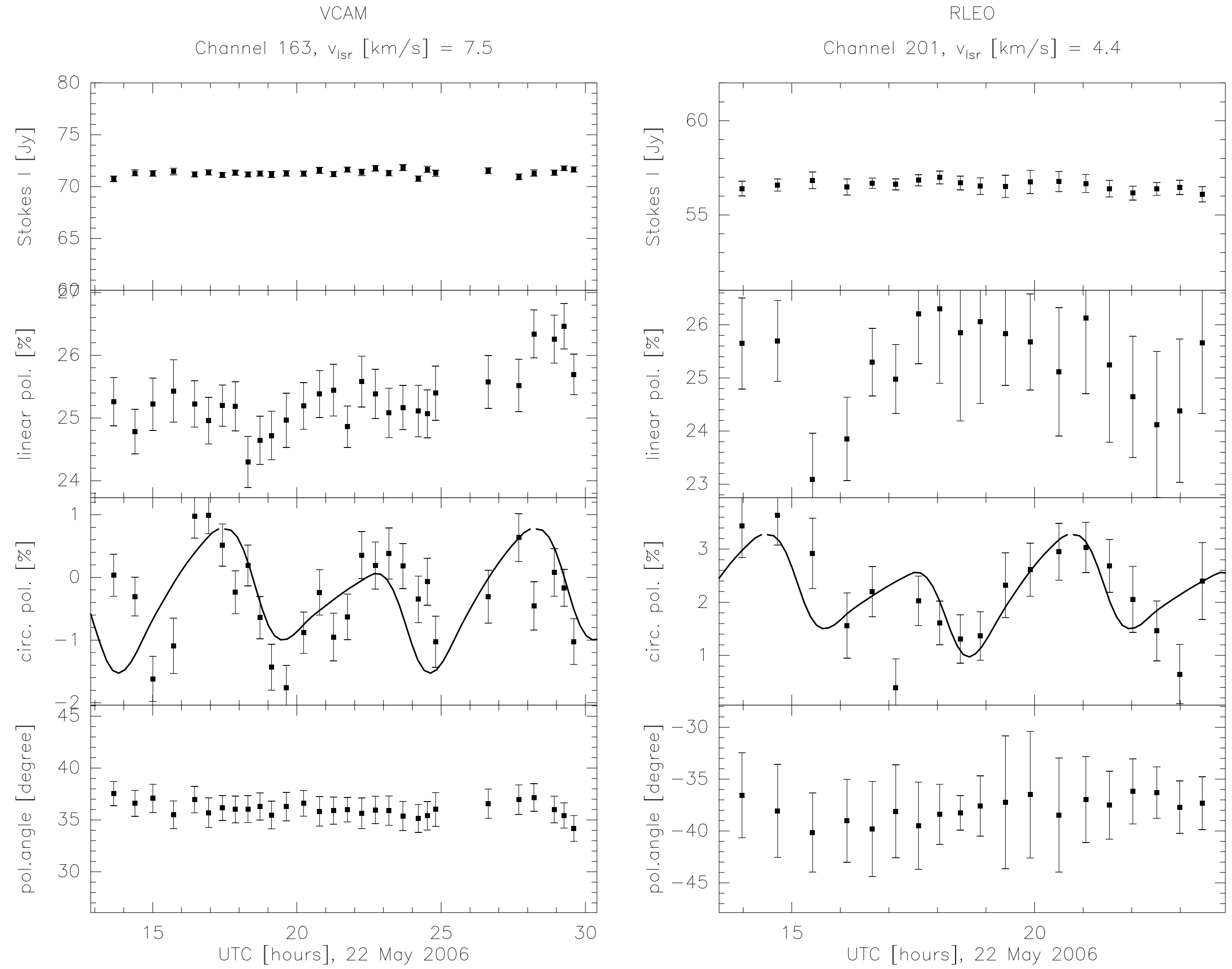


Figure 5: Wiesemeyer et al.: Time series of polarization measurements. From *top to bottom*: Stokes I in Jansky, the fractional linear and circular polarizations, and the polarization angle (i.e. the position angle of linear polarization, in degree E from N), for the SiO maser spots from V Cam at 7.5 km s^{-1} (LSR velocity, left) and R Leo at 4.4 km s^{-1} (LSR velocity, right). The continuous heavy lines in the plots for circular polarization show model results (Wiesemeyer 2009, this newsletter) for a saturated maser in the equatorial plane, at 3 Jupiter radii from the planet, with a magnetic dipole field of eight times Jupiter's and misaligned with the rotation axis (in the sky plane) by 10 degrees, and rotation periods of 10.8 hours (V Cam, left) and 6.3 hours (R Leo, right).

Present and Future Cometary Science with the IRAM Plateau de Bure Interferometer

Boissier J.([1]), Bockelée-Morvan D.([2]), Biver N.([2]), Crovisier J.([2]), Moreno R.([2]), Lellouch E.([2]) and Neri R.([1])
([1])IRAM Grenoble, France, ([2])LESIA Paris, France

Abstract:
Interferometric observations are essential to probe the molecular emission in the inner cometary atmospheres and study the outgassing from the nucleus. Mapping the continuum emission can provide information about the dust and/or nucleus properties. We present here a summary of the observations of the dust and gas coma of comet 17P/Holmes and nuclear observations of 8P/Tuttle, both carried out with the IRAM interferometer at Plateau de Bure (PdBI) in 2007 - 2008. The observations of these two comets demonstrate the ability of the PdBI in terms of cometary science. In the near future, several improvements will be made (new receivers at 0.8 mm, a new wide-band correlator) allowing more frequent and more detailed studies of comets. On the long term, NOEMA, an expansion project, may add up to six antennas to the Plateau de Bure Interferometer, and increase the baseline lengths. Such an instrument would offer a complement to ALMA to track comets of the northern hemisphere with about half the sensitivity of ALMA for continuum studies.

Appeared in: Earth, Moon, and Planets 105, 89

The Chemical Diversity of Comets: Synergies Between Space Exploration and Ground-based Radio Observations

Crovisier J.([1]), Biver N.([1]), Bockelée-Morvan D.([1]), Boissier J.([2]), Colom P.([1]) and Lis D.C.([3])
([1])LESIA, Observatoire de Paris, France, ([2])IRAM Grenoble, France, ([3])California Institute of Technology, USA

Abstract:
A fundamental question in cometary science is whether the different dynamical classes of comets have different chemical compositions, which would reflect different initial conditions. From the ground or Earth orbit, radio and infrared spectroscopic observations of a now significant sample of comets indeed reveal deep differences in the relative abundances of cometary ices. However, no obvious correlation with dynamical classes is found. Further results come, or are expected, from space exploration. Such investigations, by nature limited to a small number of objects, are unfortunately focussed on short-period comets (mainly Jupiter-family). But these in situ studies provide "ground truth" for remote sensing. We discuss the chemical differences in comets from our database of spectroscopic radio observations, which has been recently enriched by several Jupiter-family and Halley-type comets.

Appeared in: Earth, Moon, and Planets 105, 267

The physical conditions in Gomez's Hamburger (IRAS 18059-3211), a pre-MS rotating disk

V. Bujarrabal([1]), K. Young([2]), and A. Castro-Carrizo([3])
([1])Observatorio Astronómico Nacional (OAN-IGN), Apartado 112, 28803 Alcalá de Henares, Spain, ([2])Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA, ([3])IRAM, 300 rue de la Piscine, 38406 St. Martin d'Hères, France

Abstract:
Aims. We aim to study the structure, dynamics, and physical conditions of Gomez's Hamburger (IRAS 18059-3211; GoHam), and in particular confirm that GoHam mainly consists of a flaring disk in Keplerian rotation around a young, probably pre-MS star.
Methods. We present high resolution SMA maps of ^{12}CO $J = 2-1$, ^{13}CO $J = 2-1$, ^{12}CO $J = 3-2$, and C^{17}O $J = 3-2$, as well as data on ^{12}CO $J = 6-5$ and the continuum flux at these wavelengths. Spatial resolutions as high as 1 are attained. Except for the C^{17}O data, the dynamical ranges are larger than 10. The maps are compared with a numerical model, which simulates the emission of a rotating disk with the expected general properties of such objects, and a very satisfactory fitting of our maps is obtained. The meaning and reliability of our results are thoroughly discussed.
Results. Our observations allow measurement of the main properties of GoHam on scales of between $\sim 1''$ ($\sim 5 \times 10^{15}$ cm, for the assumed distance, 300 pc) and the total extent of the nebula, $14''$. We are able to measure the global structure of the gas-rich disk, which is found to be flaring, and its dynamics, which is clearly dominated by Keplerian rotation, with a small degree of turbulence. The combination of different lines, in particular of different opacities, allows us to estimate reasonably the distributions of gas temperature and density. We clearly find a significant and sharp increase in temperature at large distances from the equator, accompanied by a decrease in density of the same order. Finally, we identify a condensation in the southern part of the disk that has no counterparts in the northern nebula. This condensation is quite extended (about 5×10^{15} cm), contains a significant amount of mass (roughly, $\sim 6 \times 10^{-3} M_\odot$), and seems to be associated with a detectable distortion of the global rotation kinematics. We discuss several possible interpretations of that feature.

Appeared in: A&A 500, 1077

Rotating molecular outflows: the young T Tauri star in CB 26

Launhardt R.([1]), Pavlyuchenkov Ya.([1,2]), Gueth F.([3]), Chen X.([1]), Dutrey A.([4,5]), Guilloteau S.([4,5]), Henning Th.([1]), Piétu V.([3]), Schreyer K.([6]), Semenov D.([1])
([1])Max-Planck-Institut für Astronomie, Königstuhl 17, 69117 Heidelberg, Germany, ([2])Institute of Astronomy,

Russian Academy of Sciences, Pyatnitskaya 48, Moscow 109117, Russia, ([3])IRAM, 300 rue de la Piscine, 38406 Saint-Martin-d'Hères, France, ([4])Université Bordeaux 1, Laboratoire d'Astrophysique de Bordeaux (LAB), France, ([5])CNRS/INSU - UMR5804, BP 89, 33270 Floirac, France, ([6])Astrophysikalisches Institut und Universitäts-Sternwarte, Schillergäßchen 2-3, 07745 Jena, Germany

Abstract:
Context: The disk-outflow connection is thought to play a key role in extracting excess angular momentum from a forming proto-star. Although jet rotation has been observed in a few objects, no rotation of molecular outflows has been unambiguously reported so far.
Aims: We report new millimeter-interferometric observations of the edge-on T Tauri star - disk system in the isolated Bok globule CB 26. The aim of these observations was to study the disk-outflow relation in this 1 Myr old low-mass young stellar object.
Methods: The IRAM PdBI array was used to observe $^{12}CO(2-1)$ at 1.3 mm in two configurations, resulting in spectral line maps with $1\farcs5$ resolution. We use an empirical parameterized steady-state outflow model combined with 2-D line radiative transfer calculations and χ^2-minimization in parameter space to derive a best-fit model and constrain parameters of the outflow.
Results: The data reveal a previously undiscovered collimated bipolar molecular outflow of total length $\approx$ 2000 AU, escaping perpendicular to the plane of the disk. We find peculiar kinematic signatures that suggest that the outflow is rotating with the same orientation as the disk. However, we could not ultimately exclude jet precession or two misaligned flows as possible origins of the observed peculiar velocity field. There is indirect indication that the embedded driving source is a binary system, which, together with the youth of the source, could provide a clue to the observed kinematic features of the outflow.
Conclusions: CB 26 is so far the most promising source in which to study the rotation of a molecular outflow. Assuming that the outflow is rotating, we compute and compare masses, mass flux, angular momenta, and angular momentum flux of the disk and outflow and derive disk dispersal timescales of $0.5 \ldots 1$ Myr, comparable to the age of the system.
Based on observations carried out with the IRAM Plateau de Bure Interferometer. IRAM is supported by INSU/CNRS (France), MPG (Germany) and IGN (Spain). Also based on observations collected at the Centro Astronmico Hispano Alemn (CAHA) at Calar Alto, operated jointly by the Max-Planck Institut fr Astronomie and the Instituto de Astrofísica de Andalucía (CSIC). A complete set of channel maps is available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/cgi-bin/qcat?J/A+A/494/147.

Appeared in: A&A 494, 147

A CO Emission Line from the Optical and Near-IR Undetected Submillimeter Galaxy GN10

E. Daddi([1]), H. Dannerbauer([2]), M. Krips([3]), F. Walter([2]), M. Dickinson([4]), D. Elbaz([1]), and G. E. Morrison([5,6])
([1])CEA, Laboratoire AIM, Irfu/SAp, F-91191 Gif-sur-Yvette, France, ([2])MPIA, Königstuhl 17, D-69117 Heidelberg, Germany, ([3])IRAM, St. Martin d'Hères, France, ([4])NOAO, 950 N. Cherry Avenue, Tucson, AZ 85719, USA. ([5])IfA, University of Hawaii, Honolulu, HI 96822, USA, ([6])CFHT, Kamuela, HI 96743, USA

Abstract:
We report the detection of a CO emission line from the submillimeter galaxy (SMG) GN10 in the GOODS-N field. GN10 lacks any counterpart in extremely deep optical and near-IR imaging obtained with the Hubble Space Telescope and ground-based facilities. This is a prototypical case of a source that is extremely obscured by dust, for which it is practically impossible to derive a spectroscopic redshift in the optical/near-IR. Under the hypothesis that GN10 is part of a proto-cluster structure previously identified at $z \sim 4.05$ in the same field, we searched for $CO(4-3)$ at 91.4 GHz with the IRAM Plateau de Bure Interferometer, and successfully detected a line. We find that the most likely redshift identification is $z = 4.0424 \pm 0.0013$, based on: (1) the very low chance that the CO line is actually serendipitous from a different redshift; (2) a radio-IR photometric redshift analysis; (3) the identical radio-IR spectral energy distribution, within a scaling factor of 2 other SMGs at the same redshift. The faintness at optical/near-IR wavelengths requires an attenuation of $A_V \sim 5-7.5$ mag. This result supports the case that a substantial population of very high-z SMGs exists that had been missed by previous spectroscopic surveys. This is the first time that a CO emission line has been detected for an SMG that is invisible in the optical and near-IR. Our work demonstrates the power of existing and planned facilities for completing the census of star formation and stellar mass in the distant universe by measuring redshifts of the most obscured galaxies through millimeter spectroscopy.

Appeared in: APJ Letters 695, L176

Hyperfine structure in the $J = 1-0$ transitions of DCO^+, DNC, and $HN^{13}C$: astronomical observations and quantum-chemical calculations

Floris F. S. van der Tak([1,3]), Holger S. P. Müller([2,3]), Michael E. Harding([4,5]), and Jürgen Gauss([4])
([1])SRON Netherlands Institute for Space Research, Landleven 12, 9747 AD Groningen, The Netherlands, ([2])I. Physikalisches Institut der Universität, Zülpicher Straße 77, 50937 Köln, Germany, ([3])Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany, ([4])Institut für Physikalische Chemie, Universität Mainz,

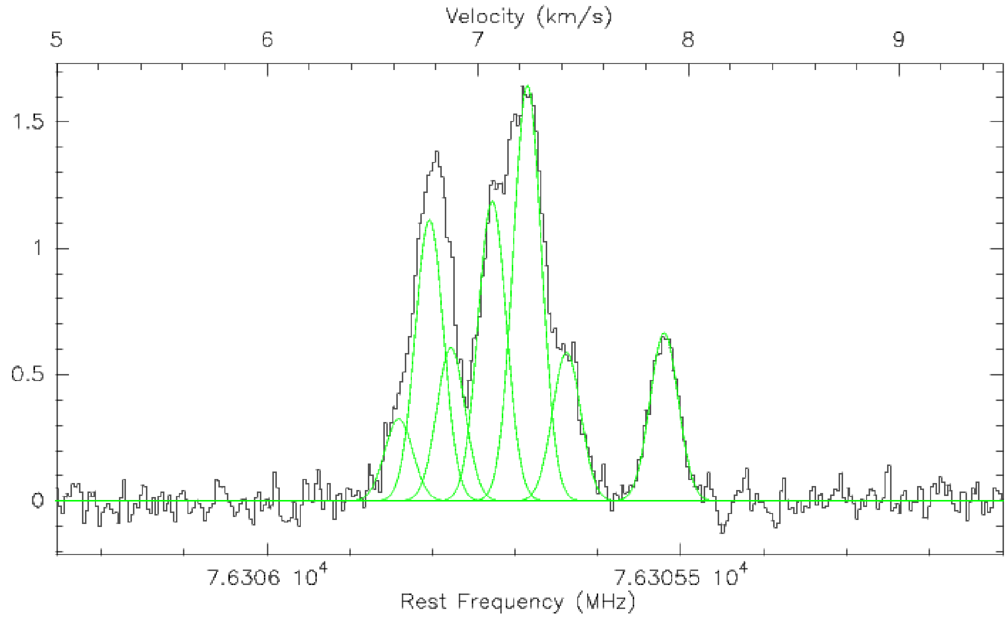


Figure 6: Van der Tak et al.: Spectrum of the DNC $J = 1-0$ line, observed toward the dark cloud LDN 1512 with the IRAM 30m telescope. The extremely small line width of this cloud allow the resolution of six hyperfine components and an accurate determination of the molecular hyperfine parameters.

55099 Mainz, Germany, ([5])Department of Chemistry and Biochemistry, University of Texas, Austin, TX 78712, U.S.A.

Abstract:
Context. Knowledge of the hyperfine structure of molecular lines is useful for estimating reliable column densities from observed emission, and essential for the derivation of kinematic information from line profiles.
Aims. Deuterium bearing molecules are especially useful in this regard, because they are good probes of the physical and chemical structure of molecular cloud cores on the verge of star formation. However, the necessary spectroscopic data are often missing, especially for molecules which are too unstable for laboratory study.
Methods. We have observed the ground-state ($J = 1-0$) rotational transitions of DCO^+, $HN^{13}C$ and DNC with the IRAM 30m telescope toward the dark cloud LDN 1512 which has exceptionally narrow lines permitting hyperfine splitting to be resolved in part. The measured splittings of $50-300$ kHz are used to derive nuclear quadrupole and spin-rotation parameters for these species. The measurements are supplemented by high-level quantum-chemical calculations using coupled-cluster techniques and large atomic-orbital basis sets.
Results. We find $eQq = +151.12(400)$ kHz and $C_I = -1.12(43)$ kHz for DCO^+, $eQq = 272.5(51)$ kHz for $HN^{13}C$, and $eQq(D) = 265.9(83)$ kHz and $eQq(N) = 288.2(71)$ kHz for DNC see Fig. 6. The numbers for DNC are consistent with previous laboratory data, while our constants for DCO^+ are somewhat smaller than previous results based on astronomical data. For both DCO^+ and DNC, our results are more accurate than previous determinations. Our results are in good agreement with the corresponding best theoretical estimates, which amount to $eQq = 156.0$ kHz and $C_I = -0.69$ kHz for DCO^+, $eQq = 279.5$ kHz for $HN^{13}C$, and $eQq(D) = 257.6$ kHz and $eQq(N) = 309.6$ kHz for DNC. We also derive updated rotational constants for $HN^{13}C$: $B = 43545.6000(47)$ MHz and $D = 93.7(20)$ kHz.
Conclusions. The hyperfine splittings of the DCO^+, DNC and $HN^{13}CJ = 1-0$ lines range over $0.47-1.28$ km s^{-1}, which is comparable to typical line widths in pre-stellar cores and to systematic gas motions on ~ 1000 AU scales in protostellar cores. We present tabular information to allow inclusion of the hyperfine splitting in astronomical data interpretation. The large differences in the ^{14}N quadrupole parameters of DNC and $HN^{13}C$ have been traced to differences in the vibrational corrections caused by significant non-rigidity of these molecules, particularly along the bending coordinate.

Accepted for publication in A&A

New CO detections of lensed submillimetre galaxies in A2218: probing molecular gas in the LIRG regime at high redshift

K.K. Knudsen([1]), R. Neri([2]), J.-P. Kneib([3]), and P.P. van der Werf([4])
([1])Argelander-Institut fr Astronomie, Auf dem Hügel

71, 53123 Bonn, Germany, (2)Institut de Radio Astronomie Millimétrique (IRAM), 300 rue de la Piscine, Domaine Universitaire de Grenoble, St. Martin d'Hères 38406, France (3)Laboratoire d'Astrophysique de Marseille, OAMP, Université Aix-Marseille & CNRS, 38 rue F. Joliot-Curie, 13388 Marseille Cedex 13, France (4)Leiden Observatory, Leiden University, PO Box 9513, 2300 RA Leiden, The Netherlands

Abstract:
Context. Submillimetre galaxies (SMGs) are distant, dusty galaxies undergoing star formation at prodigious rates. Recently there has been major progress in understanding the nature of the bright SMGs (i.e. $S_{850\mu m} >$ 5 mJy). The samples for the fainter SMGs are small and are currently in a phase of being built up through identification studies.
Aims. We study the molecular gas content in the two SMGs, SMMJ163555 and SMMJ163541, at redshifts $z =$ 1.034 and $z = 3.187$ with unlensed submillimetre fluxes of 0.4 mJy and 6.0 mJy. Both SMGs are gravitationally lensed by the foreground cluster Abell 2218.
Methods. We used the IRAM Plateau de Bure Interferometer to obtain observations at 3 mm of the lines CO$(2-1)$ for SMMJ163555 and CO$(3-2)$ for SMMJ163541. Additionally, we obtained CO$(4-3)$ observations for the candidate $z = 4.048$ SMMJ163556 with an unlensed submillimetre flux of 2.7 mJy.
Results. The CO$(2-1)$ line was detected for SMMJ163555 at redshift 1.0313 with an integrated line intensity of $1.2\pm$ 0.2 Jy km s^{-1} and a line width of 410 ± 120 km s^{-1}. From this a gas mass of 1.6×10^9 M$_\odot$ is derived and a star formation efficiency of 440 L$_\odot$/M$_\odot$ estimated. The CO$(3-2)$ line was detected for SMMJ163541 at redshift 3.1824, possibly with a second component at redshift 3.1883, with an integrated line intensity of 1.0 ± 0.1 Jy km s^{-1} and a line width of 280 ± 50 km s^{-1} From this a gas mass of 2.2×10^{10} M$_\odot$ is derived and a star formation efficiency of 1000 L$_\odot$/M$_\odot$ is estimated. For SMMJ163556, the CO$(4-3)$ is undetected within the redshift range $4.035 - 4.082$ down to a sensitivity of 0.15 Jy km s^{-1}.
Conclusions. Our CO-line observations confirm the optical redshifts for SMMJ163555 and SMMJ163541. The CO-line luminosity L'_{CO} for both galaxies is consistent with the $L_{FIR} - L'_{CO}$ relation. SMMJ163555 has the lowest far-infrared luminosity of all SMGs with a known redshift and is one of the few high-redshift LIRGs whose properties can be estimated prior to ALMA.

Appeared in: A&A 496, 45

Circumstellar disks around Herbig Be stars

T. Alonso-Albi(1), A. Fuente(1), R. Bachiller(1), R. Neri(2), P. Planesas(1,3), L. Testi(4,6), O. Berné(5), and C. Joblin(5)
(1)Observatorio Astronómico Nacional, Apdo. 112, 28803 Alcalá de Henares (Madrid), Spain, (2)Institut de Radio Astronomie Milimétrique, 300 rue de la Piscine, Domaine Universitaire de Grenoble, 38406 St. Martin d'Hères, France, (3)Atacama Large Millimeter/Submillimeter Array, Joint ALMA Office, Santiago, Chile, (4)INAF - Osservatorio Astrofisico de Arcetri, Largo Enrico Fermi 5, 50125 Firenze, Italy, (5)Centre d'Étude Spatiale des Rayonnements, CNRS et Université Paul Sabatier Toulouse 3, Observatoire Midi-Pyrénées, 9 Av. du Colonel Roche, 31028 Toulouse Cedex 04, France, (6)European Southern Observatory, Karl Schwarzschild Straße 2, 85748 Garching, Germany

Abstract:
Aims. Our goal is to investigate the properties of the circumstellar disks around intermediate mass stars to determine their occurrence, lifetime and evolution.
Methods. We completed a search for circumstellar disks around Herbig Be stars using the NRAO Very Large Array (VLA) and the IRAM Plateau de Bure (PdB) interferometers. Thus far, we have observed 6 objects with 4 successful detections. The results towards 3 of these stars (R Mon, MWC 1080, MWC 137) were presented elsewhere. We present our new VLA and PdBI data for the three objects MWC 297, Z CMa, and LKHα 215. We constructed the SED from near-IR to centimeter wavelengths by adding our millimeter and centimeter data to the available data at other wavelengths, mainly Spitzer images. The entire SED was fitted using a disk+envelope model. In addition, we compiled all the disk millimeter observations in the literature and completed a statistical analysis of all the data.
Results. We show that the disk mass is usually only a small percentage (less than 10%) of the mass of the entire envelope in HBe stars. For the disks, there are large source-to-source variations. Two disks in our sample, R Mon and Z CMa, have similar sizes and masses to those found in T Tauri and Herbig Ae stars. The disks around MWC 1080 and MWC 297 are, however, smaller ($r_{out} < 100$ AU). We did not detect the disks towards MWC 137 and LkHα 215 at millimeter wavelengths, which limits the mass and the size of the possible circumstellar disks.
Conclusions. A comparison between our data and previous results for T Tauri and Herbig Ae stars indicates that although massive disks (~ 0.1 M$_\odot$) are found in young objects ($\sim 10^4$ yr), the masses of the disks around Herbig Be stars are usually $5 - 10$ times lower than those around lower mass stars. We propose that disk photoevaporation is responsible for this behavior. In Herbig Be stars, the UV radiation disperses the gas in the outer disk on a timescale of a few 10^5 yr. Once the outer part of the disk has vanished, the entire gaseous disk is photoevaporated on a very short timescale ($\sim 10^5$ yr) and only a small, dusty disk consisting of large grains remains.

Appeared in: A&A 497, 117

Molecular gas in NUclei of GAlaxies (NUGA) XII. The head-on collision in NGC 1961

F. Combes([1]), A. J. Baker([2]), E. Schinnerer([3]), S. García-Burillo([4]), L. K. Hunt([5]), F. Boone([1]), A. Eckart([6]), R. Neri([7]), and L. J. Tacconi([8])
([1])Observatoire de Paris, LERMA, 61 Av. de l'Observatoire, 75014 Paris, France, ([2])Rutgers, The State University of NJ, 136 Frelinghuysen Road, Piscataway, NJ 08854-8019, USA, ([3])MPIA, Königstuhl 17, 69917 Heidelberg, Germany, ([4])Observatorio Astronómico Nacional (OAN), Observatorio de Madrid, Alfonso XII, 3, 28014 Madrid, Spain, ([5])INAF-Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, 50125 Firenze, Italy, ([6])Universität zu Köln, I. Physikalisches Institut, Zülpicher Straße 77, 50937 Köln, Germany, ([7])IRAM, 300 rue de la Piscine, 38406 St. Martin d'Hères, France, ([8])Max-Planck-Institut für extraterrestrische Physik, Postfach 1312, 85741 Garching, Germany

Abstract:
We present high-resolution maps of the $CO(1-0)$ and $CO(2-1)$ emission from the LINER 2 galaxy NGC 1961. This galaxy is unusual among late-type (Sc) disk galaxies in having a very large radial extent and inferred dynamical mass. We propose a head-on collision scenario to explain the perturbed morphology of this galaxy - both the off-centered rings and the inflated radius. This scenario is supported by the detection of a steep velocity gradient in the $CO(1-0)$ map at the position of a southwest peak in radio continuum and near-infrared emission. This peak would represent the remnant of the disrupting companion. We use numerical models to demonstrate the plausibility of the scenario. While ram pressure stripping could in principle be important for shocking the atomic gas and produce the striking head-tail morphology, the non detection of this small galaxy group in X-ray emission suggests that any hot intragroup medium has too low a density. A prediction of the collision model is the propagation of ring waves from the center to the outer parts, superposed on a probable pre-existing $m = 2$ barred spiral feature, accounting for the observed complex structure of rings and spokes. This lopsided wave accounts for the sharp boundary observed in the atomic gas on the southern side. Through dynamical friction, the collision finishes quickly in a minor merger, the best fit being for a companion with a mass ratio 1:4. We argue that NGC1961 has a strongly warped disk, which gives the false impression of a nearly face-on system; the main disk is actually more edge-on, and this error in the true inclination has led to the surprisingly high dynamical mass for a morphologically late-type galaxy. In addition, the outwardly propagating ring artificially enlarges the disk. The collision de-stabilizes the inner disk and can provide gas inflow to the active nucleus.

Appeared in: A&A 503, 73

HCO mapping of the Horsehead: tracing the illuminated dense molecular cloud surfaces

M. Gerin([1]), J. R. Goicoechea([1]), J. Pety([2,1]), and P. Hily-Blant([3])
([1])LERMA-LRA, UMR 8112, CNRS, Observatoire de Paris and École Normale Supérieure, 24 Rue Lhomond, 75231 Paris, France, ([2])Institut de Radio Astronomie Millimétrique (IRAM), 300 rue de la Piscine, 38406 Saint Martin d'Hères, France, ([3])Laboratoire d'Astrophysique, Observatoire de Grenoble, BP 53, 38041 Grenoble Cedex 09, France

Abstract:
Context. Far-UV photons (FUV) strongly affect the physical and chemical state of molecular gas in the vicinity of young massive stars.
Aims. Finding molecular tracers of the presence of FUV radiation fields in the millimeter wavelength domain is desirable because IR diagnostics (for instance PAHs) are not easily accessible along high extinction line-of-sights. Furthermore, gas phase diagnostics provide information on the velocity fields.
Methods. We have obtained maps of the HCO and $H^{13}CO^+$ ground state lines towards the Horsehead edge at $5''$ angular resolution with a combination of Plateau de Bure Interferometer (PdBI) and the IRAM-30m telescope observations. These maps have been complemented with IRAM-30m observations of several excited transitions at two different positions.
Results. Bright formyl radical emission delineates the illuminated edge of the nebula, with a faint emission remaining towards the shielded molecular core. Viewed from the illuminated star, the HCO emission almost coincides with the PAH and CCH emission. HCO reaches a similar abundance to HCO^+ in the photon dissociation region (PDR), $1-2\times10^{-9}$ with respect to H_2. To our knowledge, this is the highest HCO abundance ever measured. Pure gas-phase chemistry models fail to reproduce the observed HCO abundance by ~ 2 orders of magnitude, except if reactions of atomic oxygen with carbon radicals abundant in the PDR (i.e., CH_2) play a significant role in the HCO formation. Alternatively, HCO could be produced in the PDR by non-thermal processes such as photo-processing of ice mantles and subsequent photo-desorption of either HCO or H_2CO, and further gas phase photodissociation.
Conclusions. The measured $HCO/H^{13}CO^+$ abundance ratio is large towards the PDR ($\simeq 50$), and much lower toward the gas shielded from FUV radiation ($\lesssim 1$). We propose that high HCO abundances ($\gtrsim 10^{10}$) together with large $HCO/H^{13}CO^+$ abundance ratios ($\gtrsim 1$) are sensitive diagnostics of the presence of active photochemistry induced by FUV radiation.

Appeared in: A&A 494, 977

The ionization fraction gradient across the Horsehead edge: an archetype for molecular clouds

J.R. Goicoechea([1]), J. Pety([2,3]), M. Gerin([3]), P. Hily-Blant([4]), and J. Le Bourlot([5])
([1])Laboratorio de Astrofísica Molecular, Centro de Astrobiología. CSIC-INTA, Carretera de Ajalvir, Km 4. Torrejón de Ardoz, 28850 Madrid, Spain, ([2])IRAM, 300 rue de la Piscine, 38406 Grenoble Cedex, France, ([3])LERMA - LRA, UMR 8112, CNRS, Observatoire de Paris and École Normale Supérieure, 24 rue Lhomond, 75231 Paris, France, ([4]) Laboratoire d'Astrophysique, Observatoire de Grenoble, BP 53, 38041 Grenoble Cedex 09, France, ([5])LUTH, UMR 8102 CNRS, Université Paris 7 and Observatoire de Paris, Place J. Janssen, 92195 Meudon, France

Abstract:
Context. The ionization fraction (i.e., the electron abundance) plays a key role in the chemistry and dynamics of molecular clouds.
Aims. We study the $H^{13}CO^+$, DCO^+ and HOC^+ line emission towards the Horsehead, from the shielded core to the UV irradiated cloud edge, i.e., the photodissociation region (PDR), as a template to investigate the ionization fraction gradient in molecular clouds.
Methods. We analyze an IRAM Plateau de Bure Interferometer map of the $H^{13}CO^+$ $J = 1-0$ line at a $6''.8 \times 4''.7$ resolution, complemented with IRAM-30m $H^{13}CO^+$ and DCO^+ higher$-J$ line maps and new HOC^+ and CO^+ observations. We compare self-consistently the observed spatial distribution and line intensities with detailed depth-dependent predictions of a PDR model coupled with a nonlocal radiative transfer calculation. The chemical network includes deuterated species, ^{13}C fractionation reactions and HCO^+/HOC^+ isomerization reactions. The role of neutral and charged PAHs in the cloud chemistry and ionization balance is investigated.
Results. The detection of the HOC^+ reactive ion towards the Horsehead PDR proves the high ionization fraction of the outer UV irradiated regions, where we derive a low $[HCO^+]/[HOC^+] \simeq 75-200$ abundance ratio. In the absence of PAHs, we reproduce the observations with gas-phase metal abundances, [Fe+Mg+...], lower than 4×10^9 (with respect to H), and a cosmic-ray ionization rate of $\xi = (5 \pm 3) \times 10^{-17} s^{-1}$. The inclusion of PAHs modifies the ionization fraction gradient and increases the required metal abundance.
Conclusions. The ionization fraction in the Horsehead edge follows a steep gradient, with a scale length of ~ 0.05 pc (or $\sim 25''$), from $[e^-] \simeq 10^{-4}$ (or $n_e \sim 1-5$ cm^{-3}) in the PDR to a few times $\sim 10^{-9}$ in the core. PAH^{-1} anions play a role in the charge balance of the cold and neutral gas if substantial amounts of free PAHs are present ($[PAH] > 10^{-8}$).

Appeared in: A&A 498, 771

Imaging galactic diffuse clouds: CO emission, reddening and turbulent flow in the gas around ζ Ophiuchi

H.S. Liszt([1]), J. Pety([2,3]), and K. Tachihara([4])
([1])National Radio Astronomy Observatory, 520 Edgemont Road, Charlottesville, VA, USA 22903-2475, USA ([2])Institut de Radioastronomie Millimétrique, 300 rue de la Piscine, 38406 Saint-Martin d'Hères, France ([3])Observatoire de Paris, 61 Av. de l'Observatoire, 75014 Paris, France ([4])National Astronomical Observatory of Japan, 2-21-1, Osawa, Mitaka, Tokyo 181-8588, Japan

Abstract:
Context. Most diffuse clouds are only known as kinematic features in absorption spectra, but those with appreciable H2 content may be visible in the emission of such small molecules as CH, OH, and CO.
Aims. We interpret in greater detail the extensive observations of ^{12}CO emission from diffuse gas seen around the archetypical line of sight to ζ Oph.
Methods. The ^{12}CO emission is imaged in position and position-velocity space, analyzed statistically, and then compared with maps of total reddening E^{∞}_{B-V} and with models of the C^+-CO transition in H_2-bearing diffuse clouds.
Results. Around ζ Oph, ^{12}CO emission appears in two distinct intervals of reddening centered near $E^{\infty}_{B-V} \approx 0.4$ and 0.65 mag, of which $\lesssim 0.2$ mag is background material.Within either interval, the integrated ^{12}CO intensity varies up to $6-12$ K km s^{-1}, compared to 1.5 K km s^{-1} toward ζ Oph. Nearly 80% of the individual profiles have velocity dispersions $\sigma_v < 0.6$ km s^{-1}, which are subsonic at the kinetic temperature derived from H_2 toward ζ Oph, 55 K. Partly as a result, ^{12}CO emission exposes the internal, turbulent, supersonic ($1-3$ km s^{-1}) gas flows with especial clarity in the cores of strong lines. The flows are manifested as resolved velocity gradients in narrow, subsonically-broadened line cores.
Conclusions. The scatter between N(CO) and E_{B-V} in global, CO absorption line surveys toward bright stars is present in the gas seen around ζ Oph, reflecting the extreme sensitivity of $N(^{12}CO)$ to ambient conditions. The two-component nature of the optical absorption toward ζ Oph is coincidental and the star is occulted by a single body of gas with a complex internal structure, not by two distinct clouds. The very bright ^{12}CO lines in diffuse gas arise at $N(H_2) \approx 10^{21}$ cm^{-2} in regions of modest density $n(H) \approx 200-500$ cm^{-3} and somewhat more complete C^+-CO conversion. Given the variety of structure in the foreground gas, it is apparent that only large surveys of absorption sightlines can hope to capture the intrinsic behavior of diffuse gas.

Appeared in: A&A 499, 503

CO emission and variable CH and CH+ absorption towards HD 34078: evidence for a nascent bow shock?

P. Boissé(1), E. Rollinde(1), P. Hily-Blant(2), J. Pety(3), S. R. Federman(4), Y. Sheffer(4), G. Pineau des Forêts(5), E. Roueff(6), B.-G. Andersson(7), and G. Hébrard(1)
(1)Institut d'Astrophysique de Paris (IAP), UMR7095 CNRS, Université Pierre et Marie Curie-Paris 6, 98 bis boulevard Arago, 75014 Paris, France, (3)IRAM, 300 rue de la Piscine, 38406 Saint-Martin-d'Hères; Laboratoire d'Astrophysique, Observatoire de Grenoble, BP 53, 38041 Grenoble Cedex 9, France, (4)IRAM, 300 rue de la Piscine, 38406 Saint Martin d'Hères; Observatoire de Paris, 61 Av. de l'Observatoire, 75014 Paris, France, (5)Department of Physics and Astronomy, University of Toledo, Toledo, OH 43606, USA, (6)IAS, Université d'Orsay, 91405 Orsay Cedex, France, (7)LUTH, Observatoire de Paris-Meudon, 92195 Meudon Cedex, France, (8)NASA Ames Research Center, Moffett Field, CA 94035, USA

Abstract:
Context. The runaway star HD 34078, initially selected to investigate small scale structure in a foreground diffuse cloud, has been shown to be surrounded by highly excited H_2, the origin of which is unclear.
Aims. We first search for an association between the foreground cloud and HD 34078. Second, we extend previous investigations of temporal absorption line variations (CH, CH^+, H_2) in order to better characterize them and understand their relation to small-scale structure in the molecular gas.
Methods. We have mapped the $^{12}CO(2-1)$ emission $at12''$ resolution around HD 34078's position, using the 30 m IRAM antenna. The follow-up of CH and CH^+ absorption lines has been extended over 5 more years: 26 visible spectra have been acquired since 2003 at high or intermediate resolution. In parallel, CH absorption towards the reddened star ζ Per has been monitored to check the instrumental stability and homogeneity of our measurements. Three more FUSE spectra have been obtained to search for $N(H_2)$ variations.
Results. CO observations show a pronounced maximum near HD 34078's position, clearly indicating that the star and diffuse cloud are associated. The optical spectra confirm the reality of strong, rapid and correlated CH and CH^+ fluctuations (up to 26% for $N(CH^+)$ between 2007 and 2008). On the other hand, $N(H_2, J = 0)$ has varied by less than 5% over 4 years, indicating the absence of marked density structure at scales below 100 AU. We also discard N(CH) variations towards ζ Per at scales less than 20 AU.
Conclusions. Observational constraints from this work and from 24μm dust emission appear to be consistent with H_2 excitation but inconsistent with steady-state bow shock models and rather suggest that the shell of compressed gas surrounding HD 34078 or lying at the boundary of a small foreground clump is seen at an early stage of the interaction. The CH and CH^+ time variations as well as their high abundances are likely due to chemical structure in the shocked gas layer located at the stellar wind/ambient cloud interface. Finally, the lack of variation in both $N(H_2, J = 0)$ towards HD 34078 and N(CH) towards ζ Per suggests that quiescent molecular gas is not subject to pronounced small-scale structure.

Appeared in: A&A 501, 221

Why did Comet 17P/Holmes burst out? Nucleus splitting or delayed sublimation?

W.J. Altenhoff(1), E. Kreysa(1), K.M. Menten(1), A. Sievers(3), C. Thum(2), and A. Weiss(1)
(1)Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, 53121 Bonn, Germany (2)IRAM, Domaine Universitaire, 38406 St. Martin d'Hères, France, (3)IRAM, Pico Veleta, Granada, Spain

Abstract:
Based on millimeter-wavelength continuum observations we suggest that the recent "spectacle" of comet 17P/Holmes can be explained by a thick, air-tight dust cover and the effects of H_2O sublimation, which started when the comet arrived at the heliocentric distance $\leq$ 2.5 AU. The porous structure inside the nucleus provided enough surface for additional sublimation, which eventually led to the break up of the dust cover and to the observed outburst. The magnitude of the particle burst can be explained by the energy provided by insolation, stored in the dust cover and the nucleus within the months before the outburst: the subliming surface within the nucleus is more than one order of magnitude larger than the geometric surface of the nucleus - possibly an indication of the latter's porous structure. Another surprise is that the abundance ratios of several molecular species with respect to H_2O are variable. During this apparition, comet Holmes lost about 3% of its mass, corresponding to a "dirty ice" layer of 20 m.

Appeared in: A&A 495, 975

CO and HI observations of an enigmatic interstellar cloud

Y. Libert(1), E. Gérard(2), T. LeBertre(1), L. Matthews(3), C. Thum(4), and J.M. Winters(4)
(1)LERMA, UMR 8112, Observatoire de Paris, 61 Av. de l'Observatoire, 75014 Paris, France, (2)GEPI, UMR 8111, Observatoire de Paris, 5 Place J. Janssen, 92195 Meudon Cedex, France, (3)MIT Haystack Observatory, Off Route 40, Westford, MA 01886, USA, (4)IRAM, 300 rue de la Piscine, 38406 St. Martin d'Hères, France

Abstract:
Context. An isolated HI cloud with peculiar properties has recently been discovered by Dedes et al. (2008, A&A, 491, L45) with the 300-m Arecibo telescope, and subsequently imaged with the VLA. It has an angular size of $\sim 6'$, and the Hi emission has a narrow line profile of width ~ 3 km s^{-1}.
Aims. We explore the possibility that this cloud could be associated with a circumstellar envelope ejected by an evolved star.
Methods. Observations were made in the rotational lines of CO with the IRAM-30m telescope, on three positions in the cloud, and a total-power mapping in the HI line was obtained with the Nanay Radio Telescope.
Results. CO was not detected and seems too underabundant in this cloud to be a classical late-type star circumstellar envelope. On the other hand, the HI emission is compatible with the detached-shell model that we developed for representing the external environments of AGB stars.
Conclusions. We propose that this cloud could be a fossil circumstellar shell left over from a system that is now in a post-planetarynebula phase. Nevertheless, we cannot rule out that it is a Galactic cloud or a member of the Local Group, although the narrow line profile would be atypical in both cases.

Appeared in: A&A 500, 1133

Heracles: The HERA CO Line Extragalactic Survey

Adam K. Leroy(1), Fabian Walter(1), Frank Bigiel(1), Antonio Usero(2,3), Axel Weiss(4), Elias Brinks(2), W.J.G. de Blok(5,6), Robert C. Kennicutt(7), Karl-Friedrich Schuster(8), Carsten Kramer(9), H. W. Wiesemeyer(8,9), and Hélène Roussel(1,10)
(1)Max-Planck-Institut für Astronomie, Königstuhl 17, D-69117, Heidelberg, Germany, (2)Centre for Astrophysics Research, University of Hertfordshire, Hatfield AL10 9AB, UK, (3)Observatorio Astronómico Nacional, C/ Alfonso XII, 3, 28014, Madrid, Spain, (4)MPIfR, Auf dem Hügel 69, 53121, Bonn, Germany, (5)Research School of Astronomy & Astrophysics, Mount Stromlo Observatory, Cotter Road, Weston ACT 2611, Australia, (6)Department of Astronomy, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa, (7)University of Cambridge, Institute of Astronomy, Madingley Road, Cambridge CB3 0HA, UK, (8)IRAM, 300 rue de la Piscine, 38406 St. Martin d'Hères, France, (9)IRAM, Avenida Divina Pastora 7, E-18012 Granada, Spain, (10)Institut d'Astrophysique de Paris, CNRS et Université P. & M. Curie, 98 bis Blvd Arago, 75014 Paris, France

Abstract:
We present the Heterodyne Receiver Array CO Line Extragalactic Survey, an atlas of CO emission from 18 nearby galaxies that are also part of The HI Nearby Galaxy Survey and the *Spitzer* Infrared Nearby Galaxies Survey. We used the HERA multipixel receiver on the IRAM 30-m telescope to map the CO $J = 2 \rightarrow 1$ line over the full optical disk (defined by the isophotal radius r_{25}) of each target, at $13''$ angular resolution and 2.6 km s^{-1} velocity resolution. Here we describe the observations and reduction of the data and show channel maps, azimuthally averaged profiles, integrated intensity maps, and peak intensity maps. The implied H_2 masses range from 7×10^6 to $6\times10^9 M_\odot$, with four low metallicity dwarf irregular galaxies yielding only upper limits. In the cases where CO is detected, the integrated H_2-to-HI ratios range from 0.02 to 1.13 and H_2-to-stellar mass ratios from 0.01 to 0.25. Exponential scale lengths of the CO emission for our targets are in the range $0.8 - 3.2$ kpc, or $0.2 \pm 0.05\, r_{25}$. The intensity-weighted mean velocity of CO matches that of HI very well, with a 1σ scatter of only 6 km s^{-1}. The CO $J = 2 \rightarrow 1/J = 1 \rightarrow 0$ line ratio varies over a range similar to that found in the Milky Way and other nearby galaxies, $\sim 0.6 - 1.0$, with higher values found in the centers of galaxies. The typical line ratio, ~ 0.8, could be produced by optically thick gas with an excitation temperature of ~ 10 K.

Appeared in: AJ 137, 4670

Unveiling the main heating sources in the Cepheus A HW2 region

I. Jiménez-Serra(1), J. Martín-Pintado(2), P. Caselli(1), S. Martín(3), A. Rodríguez-Franco(2,4), C. Chandler(5) and J.M. Winters(6)
(1)School of Physics & Astronomy, E.C. Stoner Building, The University of Leeds, Leeds, LS2 9JT, UK, (2)Centro de Astrobiología (CSIC/INTA), Ctra. de Torrejón a Ajalvir km 4, E-28850 Torrejón de Ardoz, Madrid, Spain, (3)Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA, (4)Escuela Universitaria de Óptica, Departamento de Matemática Aplicada (Biomatemática), Universidad Complutense de Madrid, Avda. Arcos de Jalón s/n, E-28037 Madrid, Spain, (5)National Radio Astronomy Observatory, P.O. Box O Socorro NM 87801, USA, (6)IRAM, 300 Rue de la Piscine, F-38406 St. Martin d'Hères, France

Abstract:
We present high angular resolution PdBI images (beam of $\sim 0\farcs33$) of the $J = 27 \rightarrow 26$ line from several vibrational levels ($v_7 = 1$ and $v_6 = 1$) of HC_3N toward Cepheus A HW2. These images reveal the two main heating sources in the cluster: one centered in the disk collimating the HW2 radio jet (the HW2 disk), and the other associated with a hot core $0\farcs3$ northeast HW2 (the HC). This is the first time that vibrationally excited emission of HC_3N is spatially resolved in a disk. The kinematics of this emission shows that the HW2 disk rotates following a Keplerian law. We derive the temperature profiles in the two

objects from the excitation of HC_3N along the HW2 disk and the HC. These profiles reveal that both objects are centrally heated and show temperature gradients. The inner and hotter regions have temperatures of 350 ± 30 K and 270 ± 20 K for the HW2 disk and the HC, respectively. In the cooler and outer regions, the temperature drops to 250 ± 30 K in the HW2 disk, and to 220 ± 15 K in the HC. The estimated luminosity of the heating source of the HW2 disk is $\sim 2.2 \times 10^4$ $L_\odot$, and ~ 3000 $L_\odot$ for the HC. The most massive protostar in the HW2 region is the powering source of the HW2 radio jet. We discuss the formation of multiple systems in this cluster. The proximity of the HC to HW2 suggest that these sources likely form a binary system of B stars, explaining the observed precession of the HW2 radio jet.

Accepted for publication in ApJL

IRAM Technical Reports

The following technical IRAM reports have recently appeared. The full versions in pdf format are available on our web pages. Please follow the “science users” link to “Letters, results and reports”, and then to “Technical Reports”.

2009-4: Averaging spectra with CLASS

Authors: S. Bardeau (IRAM) and J. Pety (IRAM)
Keywords: AVERAGE, ACCUMULATE, resampling, weighting, concatenation
Related Documents: CLASS manual, IRAM memo 2005-1: CLASS evolution: I. Improved OTF support

Abstract:
CLASS90 (hereafter CLASS) provides a set of commands capable to average two or more spectra. They provide many averaging modes, presented hereafter in this document. The different modes often imply to perform internally and silently some important computations, namely resampling and weighted average. Combining these operations at the same time may imply some non-trivial effects described here. On October 2008, it appeared that some particular combinations of the tunable modes were not behaving as expected (either in CLASS90 and in CLASS77). A complete cleaning and factorization of the algorithm was performed, associated to exhaustive tests of all combinations. A test suite was also provided to check the output of each commands and modes. Following this maintenance of the code, and the use of these capabilities to concatenate the new EMIR spectra, it was decided to write this document in order to keep a trace of all the methods applied. This was also the occasion to investigate deeply in the code and to examine the effects which can occur during all the possible processings.

2009-3: A simulator of interferometric On-the-fly observations

Authors: N. Rodriguez-Fernandez (IRAM), Frederic Gueth (IRAM), Jerome Pety (IRAM)
Keywords: interferometric wide-field imaging, on-the-fly observing, simulations

Abstract:
We have developed a simulator of interferometric on-the-fly observations in the framework of our research on image synthesis for mosaics observed in the on-the-fly (OTF) mode, in which the interferometer takes data at the same time that the antennas move continuously across the source. This simulation tool has been developed on the basis of the IRAM/GILDAS ALMA+ACA simulator (Pety, Gueth & Guilloteau 2001).

2009-2: Imaging of interferometric On-The-Fly observations (I): context and discussion of possible methods

Authors: N. Rodriguez-Fernandez (IRAM), Jerome Pety (IRAM), Frederic Gueth (IRAM)
Keywords: interferometric wide-field imaging, on-the-fly observing

Abstract:
We discuss the measurement equation for interferometric observations of fields larger than the primary beam of the antennas, both for standard “pointed” mosaics and for mosaics observed in on-the-fly (OTF) mode. The main advantages of using the OTF mode are a gain of observing time and a higher homogeneity of the dataset. OTF mosaicing is similar to classical stop-and-go mosaicing but the effective beam when observing OTF is not exactly the primary beam of the antennas. We show that the effective beam is similar to the primary beam when the scanning rate is better than Nyquist. We review different techniques to image and deconvolve mosaic data, in particular the Ekers & Rots 1979 (ER79) scheme, which consist in Fourier transforming the visibility function with respect to the scanning coordinate. We discuss how to implement an OTF-optimized imaging algorithm to deal with the mosaic data as a whole based on the ER79 scheme. Finally we discuss observing time and mosaic size constrains for OTF observations.

EUROPEAN SCIENCE FOUNDATION
SETTING SCIENCE AGENDAS FOR EUROPE

FWF
Der Wissenschaftsfonds.

universität innsbruck · universitätszentrum obergurgl

Two years ago a meeting was held to prepare observing with three major new facilities that are providing European astronomers with data in the sub-mm and far-IR wavebands: the Herschel Space Observatory (HSO), SCUBA-2 on the renewed James Clark Maxwell Telescope (JCMT), and part of the Atacama Large Millimetre Array (ALMA).

The meeting was focused on the science topic of the origin of galaxies, which benefits especially from data taken using these new telescopes. We also discussed how these results will relate to data taken at other wavelengths.
Late 2009 the first data should have been taken, so December 2009 is the right time to provide a platform to present the first science results. The aim of this conference is to bring together many of the European astronomers that have been planning these observations and those that have been improving and extending their galaxy formation models to include sub-mm and far-IR predictions at high redshift. As non-Europeans will have been active as well during this time, we aim to have a sizable fraction of the participants coming from outside of Europe in order to compare results and discuss the consequences for galaxy formation models in the light of all data obtained, including the wealth of multi-wavelengthdata that is being gathered using a wide range of instruments, from GALEX to Spitzer, and from APEX to the GBT.

Sessions will focus on

- Galaxy formation and evolution: theoretical context
- Galaxies from z=0 to z=6
- The ultra high-z universe
- AGN & feedback
- Long wavelength
- Long wavelength surveys
- Line emission sub-mm astrophysics
- Discussion on best strategies for follow-up observations in the various wavebands

THE UNIVERSE YOURS TO DISCOVER
INTERNATIONAL YEAR OF ASTRONOMY 2009

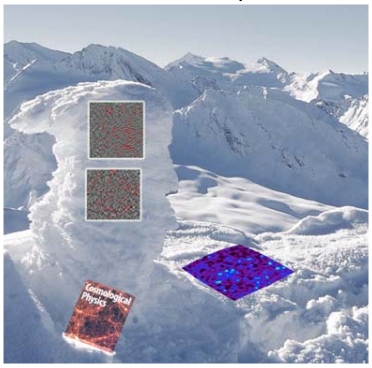
RESEARCH CONFERENCES

ESF-FWF Conference in Partnership with LFUI

The Origin of Galaxies: Lessons from the Distant Universe

Universitätszentrum Obergurgl (Ötz Valley, near Innsbruck) • Austria
12-17 December 2009

Chair: Eelco van Kampen, LFUI, Innsbruck, AT
Vice-Chairs: Jim Dunlop & John Peacock, University of Edinburgh, UK



Invited Speakers will include (* to be confirmed)

Paola Andreani - ESO, Garching, DE
AGN
Andrea Cimatti - Bologna U., IT
The growth of galaxies
Jim Dunlop - Edinburgh U., UK
SHADES and the SCUBA2 Cosmology Legacy Survey
Richard Ellis - Caltech, Pasadena, US
Conference summary and the TMT
Mark Halpern - UBC, Vancouver, CA
BLAST
David Hughes - INAOE, Puebla, MX
Sub-mm spectroscopy with the LMT
Garth Illingworth* - UCO, Lick Obs., US
z>6 Lyman-break galaxies
Rob Ivison - ATC, Edinburgh, UK
Deep radio studies of the high-redshift universe
Ross McLure - Edinburgh U., UK
Galaxies at z=4-6
Kentaro Nagamine - UNLV, LA, US
Cold flows
Desika Narayanan - Harvard U., US
Simulating the first galaxies
Seb Oliver - Sussex U., Brighton, UK
The Herschel HeRMES survey
Masami Ouchi - Carnegie Obs., Pasadena, US
z>6 Lyman-alpha emitters
John Peacock - Edinburgh U., UK
Cosmological context
Max Pettini* - Cambridge U., UK
Galaxies at z=2-3
Steve Rawlings - Oxford U., UK
High-redshift studies with ALMA
Linda Tacconi - MPE, Garching, DE
CO observations of high-redshift galaxies
Leonardo Testi - ESO, Garching, DE
Low-redshift studies with ALMA
Laura Silva - SISSA, Trieste, IT
Galaxy dust models
Rachel Somerville - STScI, Baltimore, US
The role of feedback on galaxy formation models
Eelco van Kampen - LFUI, Innsbruck, AT
Future modelling efforts
Simon White* - MPA Garching, DE
Galaxy formation models

Application Form & Programme available from
www.esf.org/conferences/09224

Closing Date for Application **31 August 2009**

European Science Foundation I Research Conferences Unit
149 avenue Louise I Box 14 I Tour Generali, 15th Floor I Brussels I Belgium
Tel: + 32 (0)2 533 2020 I Fax: +32 (0)2 538 8486
Email: conferences@esf.org I www.esf.org/conferences

www.esf.org

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 (for more details see http://www.iram.fr/mailman/listinfo/newsletter ; this facility is not mirrored on http://www.iram.es). The list 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 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.