IRAM Newsletter

Contents

Number 48 May 31, 2001

Calendar

June 28/29 2001: IRAM Council

September 14-21 2001: IRAM Summer School in Pradollano (Sierra Nevada, Spain)

Future Access to the Plateau de Bure - a Progress Report

As reported in previous editions of the IRAM Newsletter, CNRS-INSU had contracted to a consortium of engineering companies led by SCETAUROUTE, Lyon, a comprehensive study of new ways to access the Plateau de Bure.

Such a study became necessary after it was decided that the old cable car system between Enclus and the Observatory would be reconstructed only as a 'blondin', i.e. as a system exclusively foreseen for the transport of materials, consumables etc. Whereas the old system was operated, maintained, and controlled according to the legislation for 'téléphériques de service', the modified system will adhere to a different legislation, the 'directive machine'. The necessary changes are being completed right now, and after a series of controls at component level, the cable car will soon be tested at system level according to this new legislation. In June this year it should be ready to transport materials to the station.

This leaves the problem of finding a new transport system for people. The initial SCETAUROUTE study had identified 10 different options, including new cable car systems, telecabin systems, and two 'funiculaire' solutions, some of these combined with a piste at lower altitudes.

In general terms, the access problem consists of three different parts. A first section between 1500m altitude where several public roads arrive which are kept open throughout the entire year, and about 2300-2400m, with a relatively modest slope between these two levels. Then comes the 'falaise', an almost vertical wall of 150-200m height, followed by a third, virtually flat part on the Plateau itself. Its length varies between 300 and 800m, depending on where one arrives at the level of the Plateau.

The problems arising from meteorological parameters like temperature, humidity, cloudiness, dense fog, and in particular rapid changes of some or all of these parameters in less than 30 minutes, are particularly severe in section 2 and 3, i.e. on the Plateau itself and in the zone of the 'falaise'. The consensus is that of all the means of transport considered, an inclined elevator (='funiculaire') would offer the maximum safety, especially as it would run for a large part underground in a tunnel. It has therefore been proposed to build such a system, starting at 2300-2400m altitude and going from there to the Observatory (or very close to it).

This leaves open the question of how to overcome the remaining section between about 1500m and the starting point of the 'funiculaire'? In this context must be mentioned the strong interest of the local authorities, the mayor of St.Etienne en Devoluy, representatives from the Conseil General in Gap, and representatives from the company currently operating the ski station at Superdevoluy, to have a common solution that would serve both the needs of IRAM, and the needs of the community who wants to develop further the skiing resort and to start a small scientific/cultural activity in connection with the Observatory. The highest skiing areas are at about 2300 to 2400m, i.e. at the foot of the 'falaise'. The future means of transport should therefore be capable to bring up large numbers of people to this altitude level. Transport to the level of the Plateau, which is a protected area because of its special flora and fauna, does not need to have the same capacity. Initially it will mostly be used by the IRAM staff, subcontractors, and occasional visitors. Later, when the scientific/cultural center will be ready, the number of visitors is, of course, expected to go up.

The best way in which all these interests can be integrated seems to be the construction of a new cable car system with small cabins ('télécabine') which would connect the ski station Superdevoluy with an area called 'Sommarel' where several ski pistes are starting. The 'funiculaire' would continue from there to the Observatory.

Such a hybrid solution will need the combined efforts of the CNRS/INSU, the local authorities (the Prefet, the Conseil General in Gap, the Mayor of St.Etienne), and the Conseil Regional of PACA (Provence, Alpes, Cote d'Azur) in Marseille. Together they will have to define the details of such a project, to secure its financing, and to solve all related administrative questions. Irrespective of which particular choice will be made for the future means of access to the Plateau de Bure, most of these institutions would be involved in the administrative process anyhow. Working together on a more ambitious project that corresponds to the interests of all partners, could therefore be an enormous advantage despite its increased complexity.

Where are we today? The Director General of the CNRS, Mme Berger, has recently written letters to all the potential partners, asking for the confirmation of their interest in a combined 'télécabine-funiculaire' solution. In parallel, a close contact has been established between the technical division of the CNRS/INSU and of the Conseil General at Gap to discuss technical details on the basis of the existing studies, and to agree on a possible division of tasks. IRAM has been able to follow these discussions. As soon as all the potential partners will have confirmed their interest and the level of their participation in the financing, a final decision on the project will be taken.

For IRAM, the need to have a new, safe way of access to the Plateau de Bure, is, of course, of paramount importance. We are therefore particularly grateful that the CNRS is ready to take under its own responsibility the construction of the 'funiculaire' and the improvement of the piste leading up to the Sommarel area. This will be needed to bring up the workers and the material necessary for building the tunnel and the inclined elevator. Hope is that most of this project can be finished before the end of 2002. By using a 4-wheel drive car in summer, and a ratrack in winter on an improved piste and by using the tunnel as soon as it is ready, the weather dependent problems of accessing the Plateau de Bure Observatory would already greatly be reduced.

Michael GREWING

Personnel changes

IRAM Grenoble and PdBI

At the beginning of April, Florian PERRIN has left the receiver group, after participating in the successful development of the 22 GHz WVR system.

On April 23, Virginie GUERARD has joined the administrative group of IRAM Grenoble as a secretary and responsible for a re-design of the IRAM web pages.

In May, Vincent GRIGIS will leave the receiver group to take up a position in industry.

Christine Roux, member of the PdB logistics group, has left IRAM by the end of March.

After many years of service as an operator on the Plateau de Bure, Didier Robert has left the institute at the end of April.

Michael BREMER

IRAM Granada

On May 31st our cooperant Bertrand THOMAS will leave IRAM Granada. He has supported the receiver group over the last 1 1/2 years. In particular he contributed significantly to the development of our Tau-Meter which is in operation. We wish him all the best for his future career.

On June 1, Gilles BUTIN, head of the backend group, will return to France and work within the IRAM Grenoble receiver group. Gilles Butin has been at the 30-m telescope since the early years. Among his developments is the new set of 4 MHz filterbanks.

From August 1st onward Salvador SANCHEZ will work in the telescope group. All backend-related questions, complaints and praise can be directed to him. He will be the local contact for VLBI.

Rainer MAUERSBERGER

News from the 30m Telescope

New telephone numbers

IRAM Granada will get a new phone system which should be much more reliable than the old one. Every extension can now be dialled directly. The switchboard will be +34 958 805454. The fax number and the numbers at the Pico Veleta observatory will not change. A complete listing is on our web page (http://www.iram.es) or can be obtained from Esther Franzin (franzin@iram.es).

Access to the telescope

Reminder: Anybody who wants to access the Pico Veleta observatory with their own car needs a special permit and a key, which can be obtained at the IRAM office.

Summerschool

The IRAM Summer school 2001 in Granada will be directed mainly to astronomers outside the classical mm-community. There will be lectures and hands-on training. For more information, consult the web site http://www.iram.es/summerschool. Due to generous funding by the European Community participants from EC countries, and some other countries can obtain travel grants. Please notify candidates who could become future "clients" at the IRAM telescopes.

Rainer MAUERSBERGER

News from the PdBI

Observations

Good news! Although the weather reports for Western Europe and the Plateau de Bure could not have been worse during the last few months, the observatory is now on the best way to bring almost every A-rated project to completion before the end of May. The observatory has also been able to invest observing time on a few B projects and on two targets of opportunity. Since last December, 37 different requests have successfully been scheduled for observations. Though the winter session will soon come to an end, we are still confident to have a few more projects observed in the remaining weeks.

The observing efficiency of the interferometer has been lower than in previous years, but the drop in efficiency is nevertheless well balanced by the high quality of the data. The combination of both the D and C2 configuration and the extended bandwidth capabilities of the new six antenna correlator have been beneficial for a good number of projects.

Finally, we would like to remind users of the Plateau de Bure Interferometer that B-rated proposals which were not started have to be resubmitted again. The daily status of all ongoing projects is accessible on the Internet (http://iram.fr/doc/project.html).

Roberto NERI

Summer Activities

This summer, a lot of work is foreseen at the Plateau de Bure to carry on improving on safety and to prepare the observatory thoroughly for the next coming winter period. In particular, we will have to inspect and work on the cladding of the hangar, replace the high-voltage line switch of the observatory and deal with the maintenance of the five antennas. We will rely on external support for other important activities, not at least for the assembly of the reflector of antenna 6. During this period, because of manpower limitations and logistics, we will give priority to the technical issues and therefore have less time available for astronomical observations. Please note also, that during this time the interferometer will be operated with only 4 antennas and mostly in night time. We plan to start the maintenance period by the mid of June.

Work on the thermal insulation of the yoke of antenna 6 is proceeding slightly behind schedule, but should almost be completed by the end of May. Shortly after the transport to the site of the central hub, we will start working on the assembly of the 15m reflector. According to the current plans, this will not happen before mid-June.

Roberto NERI

IRAM Program Committee Recommendations

The IRAM program committee convened in Grenoble on April 2 and 3 to discuss the proposals submitted for the summer 2001 scheduling period. The committee was chaired by Thierry Montmerle.

30M Proposals

98 proposals were received for the 30m telescope, requesting 4520 hours of telescope time. The highest rating "A" was given to 38 proposals; 23 proposals were rated "B", i.e. were given backup status. The remaining proposals, although scientifically valuable in most cases, were rated "C". The individual ratings are listed in the attached table. All A-rated proposals will be scheduled on the telescope, although some with less time than requested. We expect that less than half of the B-rated programs will actually be scheduled. The selection will take into account scientific merit, crowding in certain right ascension ranges, and general aspects of balance. Proposals rated "C" will not get telescope time.

The principal investigators of each proposal will also be informed by letter which will include comments issued by the committee if there are any.

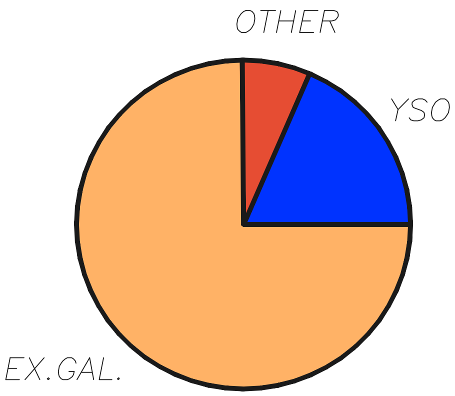

Figure 1: PdBI project distribution per category (March 2001 submission). Extragalactic science (EX.GAL.) accounts for about 75% of the total number of observing requests, young stellar objects (YSO) for 19%. Other categories like solar system objects and circumstellar shells currently account for only 6%.

A Programs		**B** Programs		**C** Programs	
003.01	047.01	002.01	078.01	001.01	053.01
004.01	048.01	008.01	084.01	005.01	056.01
011.01	051.01	009.01	085.01	006.01	059.01
014.01	052.01	015.01	087.01	007.01	061.01
023.01	054.01	017.01	089.01	010.01	062.01
024.01	057.01	020.01	090.01	012.01	064.01
025.01	058.01	028.01	091.01	013.01	065.01
026.01	063.01	037.01	096.01	016.01	066.01
027.01	069.01	040.01		018.01	067.01
029.01	070.01	041.01		019.01	071.01
031.01	073.01	045.01		021.01	076.01
032.01	077.01	050.01		022.01	079.01
033.01	082.01	055.01		030.01	080.01
034.01	086.01	060.01		035.01	081.01
036.01	088.01	068.01		039.01	083.01
038.01	092.01	072.01		042.01	094.01
043.01	093.01	074.01		046.01	095.01
044.01	097.01	075.01		049.01	098.01

Plateau de Bure Interferometer Proposals

For the interferometer, we have received 31 proposals. There has been a clear majority of extragalactic projects as shown by the pie chart (Fig. 1). Programs were classified A (accepted), B (backup) and C (rejected). Programs rated A will be scheduled in priority. Further time, if it becomes available, will go to the B programs, taking into account scientific merit, crowding in certain right ascension ranges and general aspects of balance.

An IRAM contact person will be assigned to all projects rated A and B without an internal collaborator.

A: Accepted, B: Backup, C: Rejected

Project	Rate	Project	Rate	Project	Rate
L001	B	L002	B	L003	B
L004	C	L005	B	L006	C
L007	A‡	L008	B	L009	A
L00A	A‡	L00B	B	L00C	B
L00D	–	L00E	A	L00F	A‡†
L010	C	L011	C	L012	B
L013	A	L014	C	L015	C
L016	A‡	L017	C	L018	A
L019	C	L01A	C	L01B	C
L01C	A	L01D	B	L01E	C
L01F	C				

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

Roberto NERI, Clemens THUM

News from GILDAS

New release: MAY2001

A new release of the GILDAS package, dated MAY2001, is available. It can be downloaded from the IRAM ftp anonymous server, at `ftp://iram.fr/dist/soft/`. As for previous releases, we provide both the complete source codes – to be compiled –, and the binary executables for some platforms (including HPUX 10.2, Linux Red Hat 6.1, Windows98).

What's new: Fortran-90

One significant (but transparent for the user) modification introduced in this release is the use of Fortran-90 to code some part of GILDAS: the MAPPING software has been rewritten and extended, and some new tasks, developed for ALMA simulations, have also been written in this language. Fortran-90 allows a very convenient and efficient coding of mathematical algorithms. It is foreseen that part of the future developments in GILDAS will be done using this language. Compilers can be found on most systems, including HPUX, Linux, Solaris, Windows.

Compiling GILDAS: The BUILD procedure has been modified, to allow the user to indicate whether a Fortran-90 compiler is available or not. If a Fortran-77 compiler is used, the "old" MAPPING program (which does not include the latest developments) is compiled, and the ALMA simulation tools are not available. Please note that only the Fortran-90 version of MAPPING will be supported. The older Fortran-77 version is only provided for convenience during the interim period in which not all users may have access to an operating system supporting the Fortran-90 run time libraries.

Using binary executables: Binary executables are available on the IRAM ftp server. We provide versions compiled with and without Fortran-90. The Linux Red Hat 6.1 version compiled using Fortran-90 should run on any computer: we provide the Fortran-90 run time libraries that are required.

GAG_POINTER

To avoid conflict with Fortran-90 conventions, we had to rename the POINTER function, used when manipulating virtual memory in the GILDAS programs or tasks. The new name of this function is GAG_POINTER. The GILDAS users having written their own tasks and wanting to link them with the MAY2001 release should do this slight modification in their source codes if needed.

Contacting the GILDAS working group

We have set-up a number of email addresses that may be used for inquiries, bug reports, questions, suggestions, etc. For simplicity, each software has its own email address:

CLASS	`class@iram.fr`
CLIC	`clic@iram.fr`
GRAPHIC and tasks	`graphic@iram.fr`
MAPPING	`mapping@iram.fr`
NIC	`nic@iram.fr`

More general inquiries, including installation problems, can be reported to: `gildas@iram.fr`.

We strongly encourage all GILDAS users to make use of these email addresses. The GILDAS software is continuously modified, to follow as closely as possible the evolution of the telescopes and receivers, and include new tasks, methods, or algorithms. The feedback from the users is essential to track the bugs and errors that may be present in the software, and ensure that GILDAS is matching the needs of the astronomers.

All informations can be found on the GILDAS web pages, at `http://iram.fr/GS/gildas.html`.

Frédéric GUETH and the GILDAS working group

An ALMA Simulator

The new release of GILDAS, dated MAY2001, includes a full simulator of the ALMA instrument. Please read the note concerning this release, and especially the use of Fortran-90, in this Newsletter.

Description

The ALMA Simulator was developed to carry out studies of the usefulness of the ALMA Compact Array (ACA), an array of smaller antennas that could be used to recover part of the missing short-spacings and thus complement the main ALMA instrument. To properly assess the impact of ACA on the imaging capabilities of the combined array, it is necessary to perform realistic simulations, including noise and pointing errors.

The simulator includes the following steps:

- simulation of "on-the-fly" single-dish observations;
- simulation of ALMA interferometric observations;
- simulation of ACA interferometric observations;
- thermal and phase noise can be added;
- pointing errors can be simulated as well, using different models;
- the single-dish data are used to extract the short-spacings information;
- all data set are merged together and deconvolved using CLEAN-based technics;
- the result of the simulation is compared to the input model, in the image and/or in the *uv* plane.

A deconvolution algorithm has been developed to process the heterogeneous array ALMA+ACA.

Using the simulator

The simulator is using the MAPPING software. It is available through a window interface (Fig. 2), that can be obtained by clicking on the "ALMA Simulator" button in the main menu. In this window, the user can enter several input parameters, to define the input image, the configurations to be used, the pointing errors models, the deconvolution parameters, etc. Most of these input parameters have reasonably robust default values. The simulator then runs as a pipeline (COMPUTE button): all simulations are performed up to the clean map stage. The DISPLAY procedure can then be used to plot the results, including a comparison between the simulation and the input model (re-sampled on the same grid, and smoothed to the same angular resolution). Different fidelity estimators are also computed and displayed, in the image and/or in the *uv* plane. An example is given in Fig. 3.

An expert mode is also available, in which each step (Single-Dish simulation, ALMA simulation, ACA simulation, data merging, deconvolution) can be performed separately. The intermediate results can thus be checked.

In all modes, please check the HELP associated to each button to get a list of the various possibilities and parameters of the simulator.

Performances

The simulator typically needs 20 minutes to perform a "normal" simulation run on a Linux PC (AMD Athlon

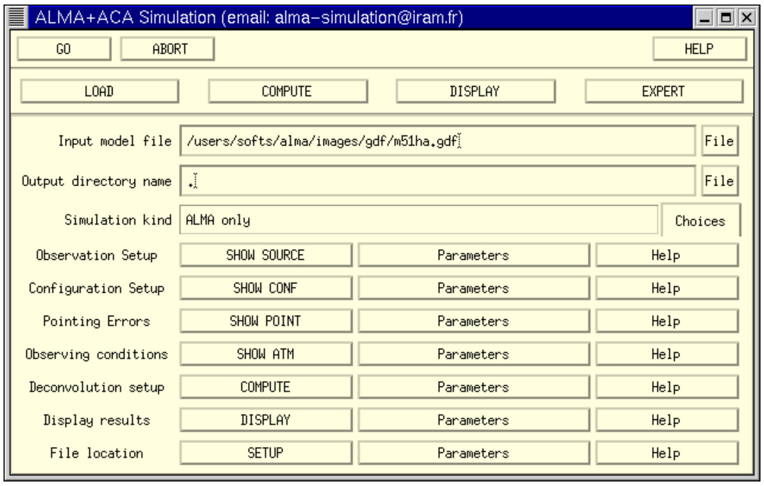

Figure 2: Window interface of the simulator. The COMPUTE button allows to run the simulation pipeline. The DISPLAY button is used to display the results (comparison in the image plane, in the *uv* plane, *uv*-coverage, beam, etc.). The LOAD button allows to reload the results of a previously computed simulation. The EXPERT button changes the interface to allow tests (mostly for use at IRAM). The input parameters are ordered in different sections that pop up when the user pushes the corresponding PARAMETERS button.

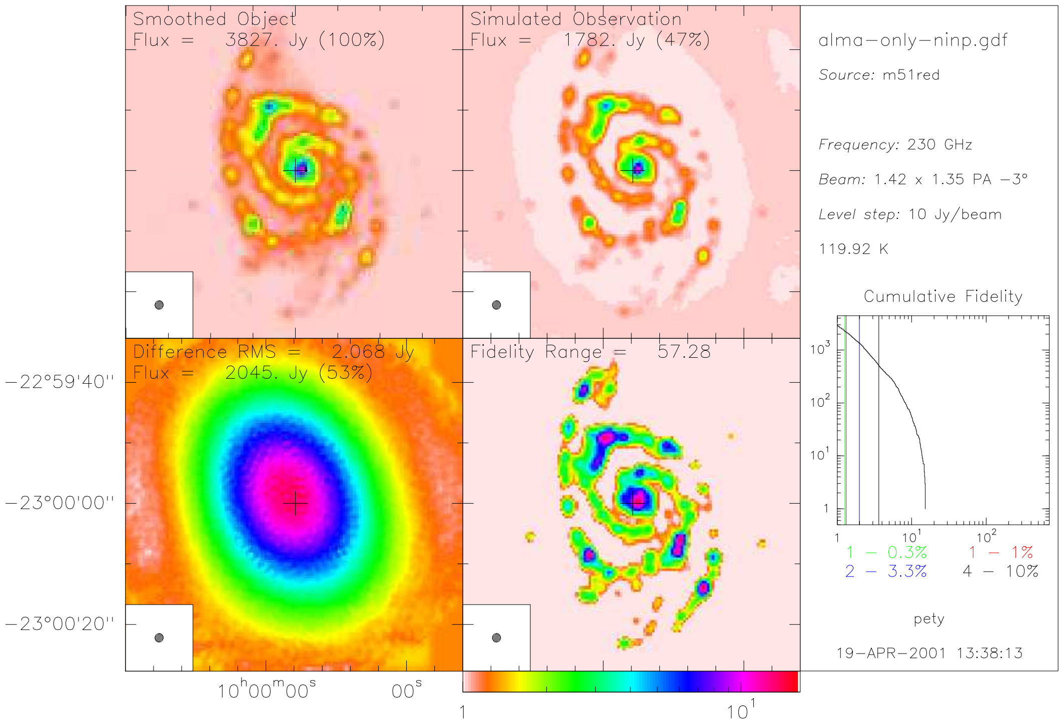

Figure 3: Simulation of an observation made with the ALMA array alone. The input image is an Hα map of the M51 galaxy. The simulated observation is a snapshot (0.3 hour) of a 7–fields mosaic (hexagonal pattern). The two top images show the model (right) and the simulated observation (left). The model is smoothed at the resolution of the observation. The two bottom images show complementary information: the difference (model−simulation, left) and the fidelity (model/(model−simulation), right). To quantify the visual impression, several numbers are provided: integrated fluxes (and the corresponding percentage as compared to the model); rms of the difference image; fidelity range. Finally, the histogram of cumulative fidelity is shown, with median fidelities computed for the image pixels whose intensity is larger than 0.3/1/3.3/10% of the peak value.

800 MHz processor with 756 MB of RAM). Take care that a typical simulation requires 100 to 300 MBytes of disk space.

Current limitations and Warnings

The simulator has currently a few limitations: only continuum observations can be simulated, multi-configuration is not implemented, the phase noise is currently baseline-independent.

Although the joint deconvolution of ALMA, ACA and Single-Dish is offered as a possibility in the current version of the ALMA Simulator, **we caution the users that this is a highly experimental part**. It may require some fine tuning of the parameters to reach convergence, and should not be considered as a final product. We are currently working to make the algorithm more robust.

On the other hand, ALMA only or ALMA + Single-Dish deconvolution is a well tested procedure, and should be quite representative of what ALMA may offer.

Future versions

We expect that the package will evolve quickly in the near future to match the needs of ALMA studies and include a number of new features. On the top of the priority list is the improvement of the ALMA + ACA + Single-Dish tool, as well as a better treatment of the phase and amplitude errors. Developments in the latter area have been performed at DEMIRM by F.Viallefond, J.F.Lestrade and J.R.Pardo and we intend to incorporate these in the ALMA Simulator.

The more recent version of the Simulator can be obtained upon request. Please contact us at `alma-simulation@iram.fr` for any comments, questions, or suggestions.

Jérome PETY, Frédéric GUETH and Stéphane GUILLOTEAU

Scientific Results in Press

Excitation Analysis of SO and SO_2 in the Proto-Planetary Nebula OH 231.8+4.2

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Abstract:
In the nebula OH 231.8+4.2 we have observed SO and SO_2 millimeter-wave emission lines having a wide range of excitation energy. The extent of the SO emission was also mapped. Rotation diagrams were derived from these observations, and we deduced the rotation temperatures and relative abundances of SO and SO_2 for three different velocity ranges corresponding to the spherical mass-loss envelope and the blue and red lobes of the bipolar outflow. The rotation temperatures for SO and SO_2 are higher in the expanding envelope than in the outflow lobes. Subject to modeling uncertainties, the relative abundances of both molecules in the lobes are slightly enhanced by factors 25 times relative to the values in the envelope.

Appeared in ApJ **545**, *379*

275-370 GHz DSB and SSB waveguide mixers employing a tuned Nb/Al-AlOx/Nb SIS tunnel junction

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Abstract:
We discuss the design and optimisation of two full height waveguide SIS mixers for astronomical applications both covering the $275-370$ GHz frequency band: a Double Side Band (DSB) and a Single Side Band (SSB) mixer. The expected SSB receiver noise temperature referred to the mixer input are in the range $23-35$ K for the DSB and $25-38$ K for the SSB mixer. A > 30 % operating bandwidth can be achieved in the DSB case by using an "end-loaded" tuning stub to tune out the junction capacitance of 75 fF (junction size 1 μm^2) followed by two quarter-wave transformer sections. A similar operating bandwidth is obtained in the SSB mixer by using a parallel tuning inductor with a radial microstrip stub. Single junctions are mounted on a 80 mm thick quartz which stretches only part way across the waveguide. In the SSB mixer the image rejection is obtained using a mechanically rugged non-contacting backshort with a circular cross-section which can be moved inside a circular waveguide. Both mixers have a 4 GHz IF passband and a central IF frequency of 6 GHz. A stability criterion for intrinsically DSB and SSB mixers under typical operating conditions has been derived. We have shown that when an inductive series matching structure is used to compensate the junction capacitance, the SSB mixer cannot be operated over a wide frequency range in a stable way. An inductive parallel matching structure allows us to fulfil the necessary conditions of stability.

Receiver performance has been optimised for both mixers in order to guarantee a low mixer noise temperature

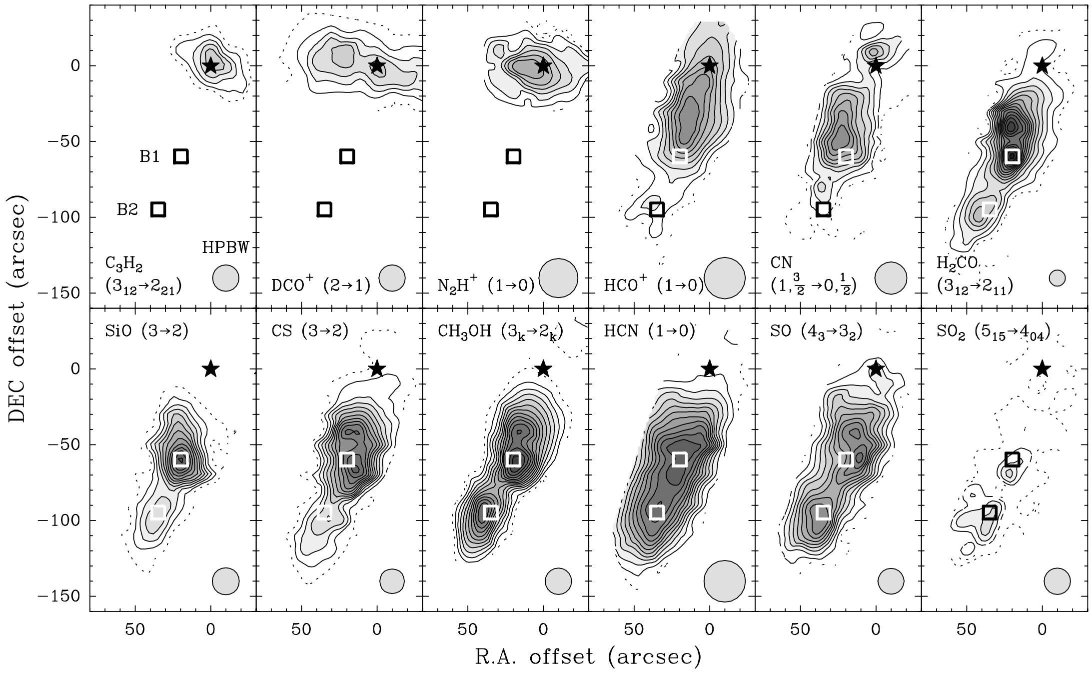

Figure 4: Maps of the molecular emission towards the southern lobe of L 1157. First contour and step are 0.07 K km/s for C_3H_2, 0.3 for DCO^+, 0.8 for N_2H^+, 1.3 for HCO^+ and SO, 0.7 for CN, 2 for H_2CO, CS and SiO, 6 for CH_3OH, and 0.5 K km/s for SO_2. The star symbol marks the position of the Class 0 protostar L 1157-mm, and the squares mark - for orientation- two positions where an initial molecular survey was carried out. Note the striking differences in the line emission distribution which correspond to a strong chemical segregation created by the outflow propagation.

while maintaining adequate gain and stable operations over the whole frequency band of interest.

Appeared in: ALMA Memo **351**, *March 2001*

Chemically active outflow L 1157

R. Bachiller([1]), M. Pérez Gutiérrez([1]), M.S.N. Kumar([1]) & M. Tafalla([1])
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Abstract:
We present millimeter-wave maps of the L 1157 bipolar outflow in several molecular emission lines (Fig. 4). The CO emission traces the bulk of the outflowing gas in the red and blue shifted lobes displaying a remarkable S-shaped symmetry indicating the presence of a precessing jet. We determine the physical characteristics of the CO flow and show evidence for 3 or 4 independent episodes of mass ejection from the source. Molecules such as C_3H_2, N_2H^+ and DCO^+ are seen to be abundant only in the quiescent medium, and result to be the best tracers of the high-density core surrounding the driving source of the outflow. Other molecules (SiO, CH_3OH,H_2CO, HCN, CN, SO, SO_2) are abundant in the outflow lobes, but exhibit strong emission gradients. Multi-line observations of some species indicate that these gradients are not simply due to excitation effects, but are caused by an actual stratification in the chemical composition of the shocked molecular gas. Shock tracers such as SiO, CH_3OH, and sulphur-bearing molecules result to be the most promising candidates as potential chemical clocks to study the evolution of outflows. The characteristics of the L 1157 outflow, when compared to those of other outflows from Class 0 sources, indicate that L 1157 is the prototype of a category of bipolar outflows around Class 0 protostars which we denominate "chemically active outflows".

To appear in A&A. Preprints are available from: bachiller@oan.es

Design of a 275-370 GHz SIS mixer with image sideband rejection and stable operation

A. Navarrini([1]), D. Billon-Pierron([1]), K.F. Schuster([1]) and B. Lazareff([1]),
([1])Institut de Radio Astronomie Millimétrique, 300 rue de la Piscine, 38406 St Martin d'Hères, France

Abstract:
We discuss the design and optimisation of a SIS Single Side Band (SSB) mixer covering the $275 - 370$ GHz frequency band for astronomical applications. The junction is probe-coupled to the full height waveguide. An adjustable circular non-contacting backshort allows SSB tuning in either USB or LSB in the whole RF band. A > 30 % operating bandwidth can be achieved by using

parallel inductive tuning of the junction capacitance. The calculated SSB receiver noise temperature referred to the mixer input is in the range $25-38$ K. A stability criterion for an SSB mixer with distinct signal and image termination impedances under typical operating conditions is derived. We show that when an inductive series matching structure with a two-stage impedance transformer is used to compensate the junction capacitance, the mixer cannot be operated over a wide frequency range in a stable way. An inductive parallel matching structure with a single-stage transformer allows us to fulfill the necessary conditions of stability.

To appear in: Proceedings of the 12th. International Symposium on Space Terahertz Technology, San Diego, California, USA, 14/02/2001 – 16/02/2001

A Reconsideration of Disk Properties in Herbig AE Stars

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Abstract:
This paper presents state-of-the-art spectral energy distributions (SEDs) of four Herbig Ae stars, based in part on new data in the mid and far-infrared and at millimeter wavelengths. The SEDs are discussed in the context of circumstellar disk models. We show that models of irradiated disks provide a good fit to the observations over the whole range of wavelengths. We offer a possible solution to the long-standing puzzle caused by the excess emission of Herbig Ae stars, where a large fraction of the stellar luminosity is re-radiated between ~ 1.25 and $7\,\mu$m, with a peak at about $3\,\mu$m. We suggest that this general behaviour can be caused by dust evaporation in disks where the gas component is optically thin to the stellar radiation, as expected if the accretion rate in very low. The creation of a puffed-up inner wall of optically thick dust at the dust sublimation radius can account for the near-infrared characteristics of the SEDs. It can also naturally explain the H and K band interferometric observations of AB Aur (Millan-Gabet et al. 2001), which reveal a ring of emission of radius ~ 0.3 AU. Finally, irradiated disk models can easily explain the observed intensity of the $10\,\mu$m silicate features and their variation from star to star.

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Disks and Outflows around Intermediate-Mass Stars and Protostars

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Abstract:
In order to study the existence and evolution of circumstellar disks around intermediate-mass stars ($M_\star \gtrsim 3\,M_\odot$), we have obtained single-dish and interferometric continuum images at 2.6 mm and 1.3 mm of the intermediate-mass protostar NGC 7129 FIRS 2 and of the Herbig Be stars LkHα234 and HD 200775. These objects are representative of the different stages of the pre-main sequence evolution with ages ranging from a few 10^3 to $8\,10^6$ years. Single-dish and interferometric observations of the outflows associated with these sources are also presented (Fig. 5). In NGC 7129 FIRS 2, two millimeter sources are required to fit the interferometric 1.3 mm continuum emission. Only the most intense of these millimeter objects, FIRS 2 - MM1, seems to be associated with the CO outflow. The second and weaker source, FIRS 2 - MM2, does not present any sign of stellar activity. The single-dish map of the CO outflow presents an unusual morphology with the blue and red lobes separated by an angle of 82°. The CO (J=1-0) interferometric image shows that this unusual morphology is the result of the superposition of two outflows, one of them associated with FIRS 2 - MM1 (the blue lobe in the single-dish map) and the other (the red lobe) with a new infrared source (FIRS 2 - IR) which is not detected in the millimeter continuum images. The interferometric 1.3 mm continuum image of NGC 7129 FIRS 1 reveals that LkHα234 is a member of a cluster of embedded objects. Two millimeter clumps are detected in this far-infrared source. The strongest is spatially coincident with the mid-infrared companion of LkHα234, IRS6. A new millimeter clump, FIRS 1 - MM1, is detected at an offset ($-3.23''$, $3.0''$) from LkHα234. We have not detected any compact source towards LkHα234 with a limit for the mass of a circumstellar disk, $M_D < 0.1 M_\odot$. The comparison of the interferometric CO (J=1-0) and continuum images reveals that IRS 6 very likely drives the energetic molecular outflow detected towards NGC 7129 FIRS 1 and the [SII] jet. The extremely young object FIRS 1 - MM1 (it has not been detected in the near-and mid-infrared) turns out to be the driving source of the H2 jet. There is no evidence for the existence of a bipolar outflow associated with LkHα234. We have not detected 1.3 mm continuum emission towards HD 200775. Our observations imply a 3σ

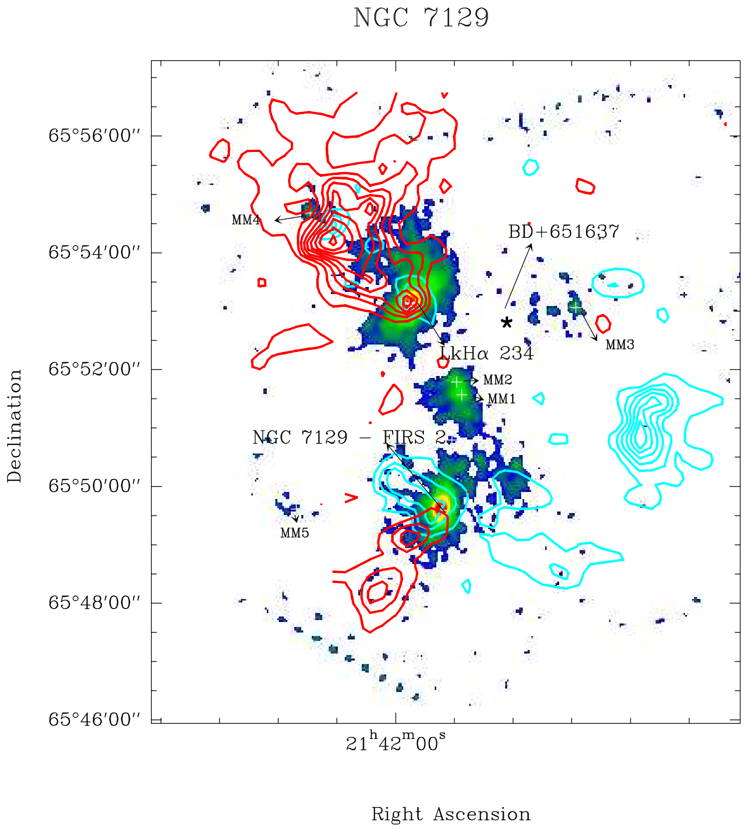

Figure 5: Molecular emission, dust and outflows in NGC 7129

upper limit of $< 0.002 M_\odot$ for the mass of a circumstellar disk. This is the lowest upper limit obtained so far in a Herbig Be star. Thus our observations provide new important information on three protostars (IRS 6, FIRS 1 - MM1 and FIRS 2 - MM1), one infrared star (FIRS 2 - IR) and two Herbig Be stars. The luminosities of the protostars are consistent with being intermediate-mass objects ($M_\star \simeq 3.5 - 4.5 M_\odot$). They are surrounded by thick envelopes with masses ranging between $\simeq 2 - 3.5 M_\odot$ and drive energetic outflows. Circumstellar disks and bipolar outflows are not detected toward the Herbig Be stars. We have obtained an upper limit for the disk/stellar mass ratio, $M_D/M_\star$, of < 0.02 in LkHα234 and of < 0.0002 in HD 200775. Our limit in HD 200775 implies that in evolved Herbig Be stars the $M_D/M_\star$ ratio is more than two orders of magnitude lower than in T Tauri and Herbig Ae stars. We propose that in massive stars ($M_\star \geq 5 M_\odot$) both the dispersal of the outer disk and the energetic mass-loss, occur early in the stellar evolution before the star becomes visible. Some mechanisms for the dispersal of the outer disk are discussed.

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Outgassing Behavior and Composition of Comet C/1999 S4 (Linear) during its Disruption

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Abstract:
Comet C/1999 S4 (LINEAR), which was discovered in September 1999, passed perihelion on 26 July 2000 at 0.765 AU from the Sun. Around that time, visual observations, confirmed by HST and VLT high-resolution images, showed that the comet nucleus broke up into many fragments that rapidly fizzled out. In mid-August,

the comet no longer existed. Thus this object belongs to this class of comets which are disrupted for no apparent reason. Such events can inform us on the internal structure and composition of the comet nuclei, but, being unpredictable, they are difficult to observe.

We observed comet C/LINEAR at several radio telescopes (NRAO 12-m, CSO, JCMT, IRAM 30-m and Nançay) as part of our continuing efforts to expand our data sample used for comparative studies of cometary composition. We had the chance to observe the comet at IRAM at the very moment it underwent its major disruption, and to monitor its gas production rate (using the HCN lines) during this event (see Fig. 6). A surge of gas was observed on 23 July followed by a rapid decrease.

An analysis of the observations indicates that a runaway fragmentation of the nucleus may have begun around 18 July 2000 and proceeded until 23 July. The mass in small icy debris ($\leq$ 30 cm radius) was comparable to the mass in the large fragments seen in optical images. The mass budget after breakup suggests a small nucleus ($\sim$100–300 m radius), that had been losing debris for weeks.

The HNC, H_2CO, H_2S and CS abundances relative to H_2O measured during breakup are consistent with those obtained in other comets, showing that freshly exposed ices from the inner nucleus have a composition similar to the ices of the outer layers of the nucleus. However, a deficiency in CH_3OH and CO is observed.

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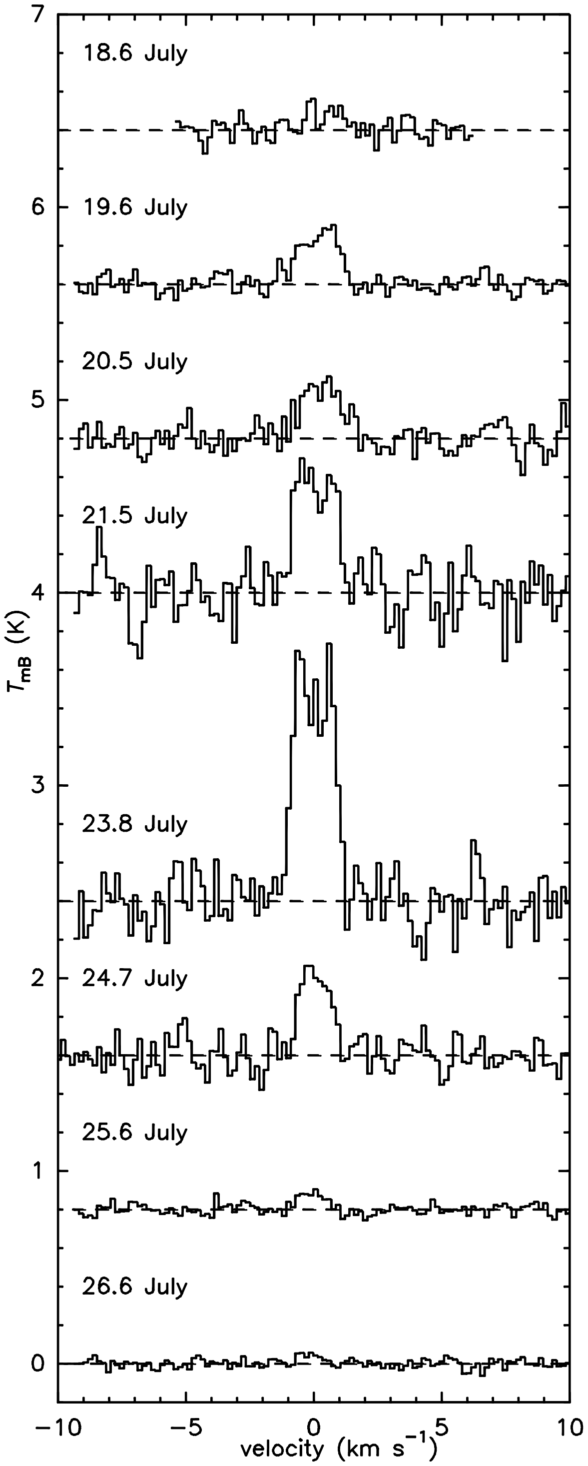

Figure 6: The evolution of the HCN J(3–2) line at 265.9 GHz in comet C/1999 S4 (LINEAR), observed with the IRAM 30-m telescope from July 18 to 26, 2000.

New Preprints

557. THERMAL MODEL CALCULATIONS OF ENCLOSURES FOR MILLIMETER WAVELENGTH RADIO TELESCOPES
A. Greve, G. MacLeod
2001, *Radio Science*

558. CHEMICALLY ACTIVE OUTFLOW L 1157
R. Bachiller, M. Pérez Gutiérrez,
M.S.N. Kumar, M. Tafalla
2001, *Astronomomy and Astrophysics*

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