IRAM Newsletter

Number 35 May 18, 1998

Calendar

May 11-12, 1998 IRAM SAC Meeting

June 18-19, 1998 IRAM Council Meeting

July 1st, 1998 Next IRAM Newsletter and Call for Proposals

September 5th, 1998: Deadline for the submission of observing proposals for the period Nov. 15, 1998 to May 15, 1999.

September 14-18, 1998 mm Interferometry Summer School in Grenoble.

Contents

French astronomers choose mm-wave interferometry

At the request of the CNRS, two hundred French astronomers met recently in Arcachon to discuss the main priorities for ground and space-based astronomy during the next 10 years. The preliminary conclusions of this meeting can be found in http://www.insu.cnrs-dir.fr at the section "Dernières Nouvelles". Some of them directly concern the IRAM user community and are summarized below.

Five scientific topics were singled out as the most promising for the coming years, namely:

- The cosmologic background fluctuations and formation of the first large scale structures,
- The formation and evolution of galaxies
- The formation and evolution of stars
- The formation of planetary systems
- The modelization of the Sun-Earth system

It was recognized that 4 of these 5 topics will heavily rely on high sensitivity, high angular resolution observations of molecules and dust at mm/submm-wavelengths. More specifically, it was recognized that new generation mm-wave interferometers, which combine for the first time sub arcsec angular resolution with spectral resolution of $\lambda/\Delta\lambda$, are likely to revolutionize our knowledge in these domains. The Plateau de Bure interferometer, which achieves an angular resolution of $0.5''$ at 1 mm wavelength, should play an important role in this respect. It will include a 6th antenna at the end of 1999 and its collective area will exceed 1000 m^2; it is and should remain until the middle of the next decade the most sensitive mm-wave interferometer.

The completion of large optical telescopes in space and on the ground calls for the construction of a next generation mm-wave interferometer at the end of the next decade. The Large Southern Array (LSA/MMA) project, conceived as a US-European collaboration, has unanimously been recommended as the next cornerstone for ground-based instrumentation to be supported by France. The LSA/MMA will have a collecting area of 7000 m^2 and achieve a synthetized beam $\leq 0.1''$ at mm and submm wavelengths. Most probably, it will be built on a high altitude (5000 m) Chilean site. The construction of the LSA/MMA will require a commitment of several European countries, and in particular of France, Germany and Spain, which have acquired through IRAM a large observational and technical expertise in mm-wave interferometry. It is worth noting that the decision to promote a large European interferometer was taken 60 km away from the Bordeaux Observatory, where the first mm-wave interferometer was constructed and operated, since January 1973 (collecting area 10 m^2 – see Delannoy, Lacroix & Blum *Proc. IEEE* vol. **61** p. 1282).

Michel GUÉLIN

Table 1: mm Interferometry School: program and time table

		LO system & Signal distribution R. Lucas			
9	Radio Astronomy C. Thum		Atm. Transmission M. Guelin	UV Plane Analysis R. Lucas	Using the PdB Why and How ? S.Guilloteau
10		PdB Operation R. Neri	Atmospheric Phase M. Bremer	Standard Imaging S. Guilloteau	Examples (all)
11	Interferometry S. Guilloteau	Transport to Plateau de Bure	Bandpass & Phase Calibration R. Lucas	Other methods E. Anterrieu	
12					
13		*Lunch*			
14	Antennas A. Greve	Visit of PdB	Amplitude & Flux Calibration A. Dutrey	Mosaics F.Gueth	Open Session
15				Short Spacings S.Guilloteau	
16	Receivers B. Lazareff		Standard Calibration A. Dutrey & R.Neri	Astrometry A. Baudry	
17	Correlators H. Wiesemeyer	Descent from PdB			
18		*Conference Dinner*			

IRAM MM-Interferometry Summer School

The "mm Interferometry Summer School" will be held as announced at the IRAM headquarters, in Grenoble, from Sep. 14th to Sep. 18th. It will focus on special aspects of interferometry at millimeter wavelengths, using the Plateau de Bure interferometer as an example.

A visit to the Plateau de Bure interferometer is foreseen as an integral part of the school. Over 50 persons have asked to follow this school, which is now fully booked. Informations on location and accomodation can be found on the IRAM Web page (http://iram.fr/).

30m Telescope news

Reminder: New telephone and fax numbers in Spain

On 4 April 1998, 1:00 h, all telephone and fax numbers in Spain have changed to nine digits. The former area code has become an integral part of fax and telephone numbers, i.e. from anywhere within Spain the same number has to be dialled (a system that is already in use in France for example). In the province of Granada, the present area code 958 has been added to all numbers. Also, telephone and fax numbers as dialled from outside Spain have changed. After the country code (34 for Spain), the digit 9 has to be inserted.

The telephone and fax numbers of IRAM Granada and the 30m telescope are the following:
(dialled from outside Spain, inside Spain drop the 34)

Granada office:

Tel +34-958 22 88 99 and +34-958 22 66 96
Fax +34-958 22 23 63

30m Telescope:

Tel +34-958 48 20 02
Fax +34-958 48 11 48

Updated OTF Guide available

An updated version of the 42-page *Preliminary User's Guide* for spectral-line on-the-fly mapping with the IRAM 30m telescope is available on the IRAM Granada OTF web page (http://www.iram.es/OTF/otf.html) and can be downloaded in postscript format (about 2 Mb).

Remote observing from Granada

Remote observing is possible from the IRAM Granada office. The remote observer has all important control and status screens. Communication with the telescope operator is via a *xhchat* session (a divided window under Linux) or via telephone. This mode of observing may be useful for experienced 30m observers at the beginning or end of their observing session (e.g. in order to get a more convenient flight to or from Granada). Be aware, however, that during nights and weekends no support can be given in the Granada office. Also, longer or more complicated remote observations can be somewhat stressful due to the limited communication with the telescope staff (and to finish the list of inconveniences: there are no meals served in the Granada office ...).

If you are interested in using this mode, please contact the Station Manager W. Wild (wild@iram.es) well in advance in order to arrange a short introduction.

Wolfgang WILD

Interferometer news

Observations

Thanks to exceptional end-winter conditions at Plateau de Bure, all A-rated proposals are now complete with only a few exceptions because of sun avoidance limitations and springtime conditions. Observations at 1.3mm can currently be carried out only during nighttime. Despite the strong delay in the schedule, a small number of B-rated proposal has nevertheless been observed. IRAM will contact the PIs of the proposals which were cut down on the observing time.

Data reduction

Observations at 1.3mm carried out later than March 14 and before March 23, are possibly affected by phase errors on all baselines which include antenna 4. We advise caution when reducing data from this period and to contact IRAM in case of doubts.

Roberto NERI

List of local contacts for the period of May-November 1998

Here is the list of local contacts associated to PdBI projects rated A/B at the last program committee. Only projects without IRAM collaboration need a local contact.

```
project pi-investigator rate  local-contact
==============================================
i004    L.Colina          A        A.Bremer
(colina@stsci.edu)
i009    S.Leon            A        D.Downes
(sleon@mesunb.obspm.fr)
i011    S.Garcia-Burillo  A        H.Wiesemeyer
(burillo@oan.es)
i017    F.Casoli          A        L.Loinard
(casoli@obspm.fr)
i022    E.Falgarone       A        M.Dumke
```

```
(edith@physique.ens.fr)
i028    F.Gueth           A         A.Dutrey
(gueth@mpifr-bonn.mpg.de)
i029    P.Schilke         A         A.Greve
(schilke@mpifr-bonn.mpg.de)
i030    F.Wyrowski        A         M.Guelin
(wyrowski@mpifr-bonn.mpg.de)
i035    J.Martin-Pintado  A         R.Neri
(martin@oan.es)
===============================================
i001    E.Schinnerer      B         R.Lucas
(schinnerer@mpe-graching.mpg.de)
i002/3  F.Combes          B         D.Morris
(bottaro@mesiob.obspm.fr)
i018    G.Henri           B         D.Nuernberger
(henri@obs.ujf-grenoble.fr)
i019    K.Schreyer        B         C.Thum
(martin@astro.uni-jena.de)
i027    F.Gueth           B         J.Wink
(gueth@mpifr-bonn.mpg.de)
i048    P.Myers           B         M.Dumke
(pmyers@cfa.hardvard.edu)
i058    R.Barvainis       B         L.Loinard
(reb@dopey.haystack.edu)
i061    F.Raluy           B         H.Wiesemeyer
(raluy@oan.es)
```

Before a project starts, the local contact in link with the PI writes and checks the observing procedure: **coordinates, velocities, frequencies, offsets for mosaics, correlator configurations**. This point must be done in close cooperation with Roberto Neri who is responsible for the monitoring of PdBI observations.

When the project is near completion, with respect to the planning of visitors managed by Anne Dutrey, the local contact and the PI agree on the best date for data reduction.

Finally during the visit of the PI at Grenoble, the role of the local contact will be to provide expert help in the data reduction.

In order to have a feedback from external users, we are planning to implement project reports, one for data quality, the other about data reduction software. These reports will ask simple standard questions (answers by YES/NO, most of the time). They will help us to optimize PdBI observations and software interfaces. The PI will give the project reports to the local contact before he/she leaves Grenoble.

Since the next observing session is starting at Bure, PI are requested to contact their local contact as soon as possible.

A few practical points:

Our WEB page contains most of the information external users need in order to 1) check the status of their observations and 2) prepare their visit to Grenoble.

All these informations are given at the following address:

http://iram.fr/PDBI/bure.html

Special attention must be given to the "visitor list" (http://iram.fr/PDBI/visitor.html) which contains the list of people coming to Grenoble for data reduction of Bure projects. To avoid overbooking the computer facilities, no more than two groups should reduce data simultaneously.

A.DUTREY

-3cm

April 1998 Program Committee results

30-M TELESCOPE

A	B	C
PROGRAM No.	PROGRAM No.	PROGRAM No.
1.98	11.98	5.98
2.98	15.98	6.98
3.98	17.98	8.98
4.98	18.98	9.98
7.98	21.98	12.9
10.98	22.98	19.9
13.98	24.98	20.98
14.98	29.98	23.98
16.98	30.98	25.98
26.98	32.98	31.98
27.98	33.98	36.98
28.98	34.98	38.98
35.98	42.98	40.98
37.98	44.98	46.98
39.98	47.98	54.98
41.98	49.98	57.98
43.98	51.98	60.98
45.98	53.98	62.98
48.98	58.98	
50.98	64.98	
52.98	65.98	
55.98	66.98	
56.98		
59.98		
61.98		
63.98		
67.98		

The IRAM program committee, chaired by Thierry Montmerle, convened in Grenoble on April 6 - 7 to discuss the 68 proposals submitted for the 30m telescope and xx proposals for the interferometer.

In view of the thorough refurbishing of the 30m receiver cabin planned during September/October this year, only 1800 hours of telescope time were allocated. In total, the committee rated the highest rating "A" to 27 proposals, among which were several of the order of 100 hours or longer. A somewhat higher than usual number of proposals were rated "B" as an insurance for the unlikely event that insurmountable technical problems render the refurbishment of the receiver cabin impossible. The individual ratings are given in the attached table.

We expect all A programs to be scheduled on the 30-m telescope, although some with less time than originally requested. Only part of the B programs will be scheduled. This will take into account scientific merit, crowding in certain right ascension ranges and general aspects of balance.

C.THUM

INTERFEROMETER

Project Status

A: Accepted, B: Backup if available time, C: Rejected.

Project	Rate	Project	Rate	Project	Rate
I001	B	I002	B	I003	B
I004	A	I005	C	I006	C
I007	B	I008	C	I009	A
I010	C	I011	A	I012	–
I013	C	I014	C	I015	B
I016	A	I017	A	I018	B
I019	B	I020	C	I021	C
I022	A	I023	C	I024	A
I025	–	I026	–	I027	B
I028	A	I029	A	I030	A
I031	A	I032	A	I033	C
I034	B	I035	A	I036	C
I037	C	I038	B	I039	C
I040	C	I041	C	I042	A
I043	A	I044	C	I045	C
I046	C	I047	A	I048	B
I049	A	I050	A	I051	A
I052	A	I053	C	I054	C
I055	C	I056	C	I057	A
I058	B	I059	C	I060	A
I061	B	I062	A		

B projects which cannot be started will no longer be automatically resubmitted: authors have to resubmit them explicitly.

Plateau de Bure Interferometer projects discussed by the last program committee for a scheduling period starting May 15, 1998 to November 15, 1998. The A programs will be scheduled in priority. The B programs will be scheduled taking into account scientific merit, crowding in certain right ascension ranges and general aspect of balance. B proposals will only be started in case of available observing time.

Scientific results

METHANOL IN PROTOSTELLAR OUTFLOWS: SINGLE-DISH AND INTERFEROMETRIC MAPS OF NGC 1333/IRAS2

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(2) Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, I-50125 Firenze, Italy

Abstract:

We report high-resolution mapping observations of the 2_k–1_k, 3_k–2_k, and 5_k–4_k thermal lines of CH_3OH toward the young bipolar outflow driven by the Class 0 object NGC1333/IRAS2 (see Fig. 1). Only weak emission has been detected towards the position of the central object, while strong methanol lines have been observed towards the endpoints of the outflow lobes, where the CH_3OH abundance is enhanced by a factor ~ 300. The methanol emission is confined in two jets, with a collimation factor of about 20: redshifted emission comes from the south-east lobe, while blueshifted lines are detected towards the north-west. Statistical equilibrium calculations have been used to fit the relative intensities of the observed transitions. These lead us to the conclusion that the ambient gas surrounding the protostar has a density similar to that of the high velocity gas in the shocked regions ($\sim 10^6$ cm^{-3}).

Interferometric maps with a resolution of $3''$ show that the blueshifted lobe consists of several "bullets" indicating that episodic mass loss has occurred. The age estimate is $\simeq$ 2-5 10^3 yr. The high-velocity redshifted emission comes from a structure which becomes "V-like" at velocities close to that of the ambient gas. These results fit nicely with recent magnetohydrodynamical models where a working surface with a cone–like shape creates elongated naked jets containing bullets in their interior.

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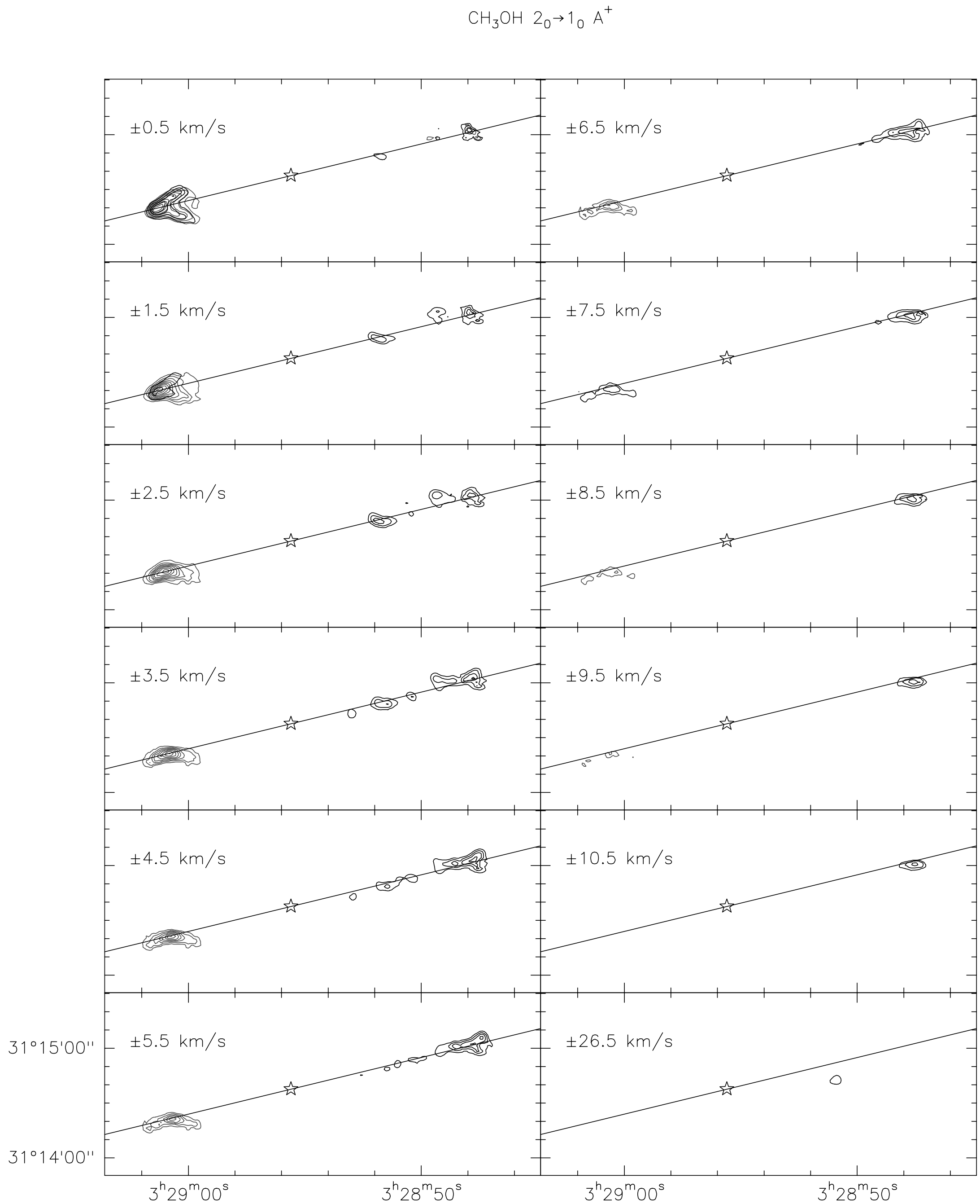

Figure 1: Channel maps of the CH_3OH 2_0–1_0A^+ emission detected with the IRAM interferometer, integrated over velocity intervals of 1 km s^{-1} wide. The white star stands for the coordinates of the central source IRAS2 as measured by Blake (1996), while the straight line points out the direction of the outflow. The central LSR velocities for each interval, measured with respect to the LSR velocity of the ambient gas, are indicated in the upper left corner of each panel. The contours placed at the south-east of IRAS2 are due to redshifted emission, whereas the contours at the north-west are blueshifted emission. Nevertheless, some overlap of redshifted and blueshifted emission is observed at low velocities in the south-east lobe (the left region in the panels at ±0.5 and ±1.5 km s^{-1}). The contour levels range from 0.15 to 1.50 Jy km s^{-1}/beam by step of 0.15 Jy km s^{-1}/beam (1.58 K km s^{-1}).

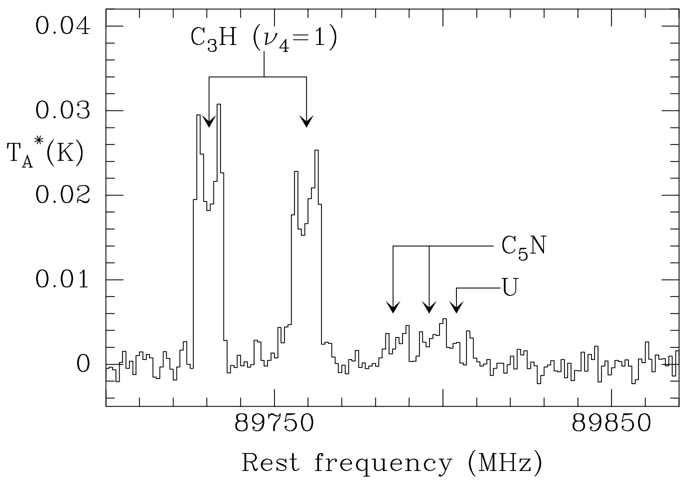

Figure 2: Spectrum observed with the 30-m telescope toward IRC+10216. The C_3H and C_5N line frequencies derived from laboratory measurements are indicated by downward arrows. The spectral resolution is 1 MHz (3.3 kms^{-1}).

Astronomical detection of the cyanobutadiynyl radical C_5N

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([3]) Instituto de Estructura de la Materia, Madrid, Spain

Abstract:

Despite chemical model predictions that C_5N and even longer cyanopolyyne radicals must be abundant in interstellar and circumstellar clouds, C_5N has escaped detection in space for more than 20 years. Following the recent *ab initio* quantum mechanical calculations, made by P. Botschwina (Chem. Phys. Lett. 259, 627, 1996), and the laboratory work of Y. Kasai et al. (ApJ, 477, L65, 1997), this elusive carbon-chain radical has been detected in the dark cloud TMC1 and tentatively detected in the circumstellar envelope IRC+10216 (Fig. 2). C_5N appears to be two orders of magnitude less abundant than the related molecule HC_5N and much less abundant than expected from current gas phase chemistry models. In comparison the HC_3N to C_3N abundance ratio is of the order of 10, in reasonable agreement with model predictions.

We have also detected in IRC+10216, next to C_5N, two lines arising from the C_3H radical in its excited $\nu_4 = 1$ bending state. The intensity ratio between the rotational transitions in the C_3H ground state and in the excited bending state, hence presumably the population ratio between these two states, is $\simeq 10$.

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Search for LiH in the ISM towards B0218+357

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([2])Onsala Space Observatory, S–43992 Onsala, Sweden

Abstract:

We report a tentative detection with the IRAM 30-m telescope of the LiH molecule in absorption in front of the lensed quasar B0218+357 (Fig. 3). We have searched for the $J = 0 \rightarrow 1$ rotational line of lithium hydride at 444 GHz (redshifted to 263 GHz). The line, if detected, is optically thin, very narrow, and corresponds to a column density of N(LiH) = 1.6 10^{12} cm^{-2} for an assumed excitation temperature of 15 K, or a relative abundance $LiH/H_2 \sim 3\ 10^{-12}$. We discuss the implications of this result.

Astronomy & Astrophysics in press e-mail contact: BOTTARO@mesioa.obspm.fr

Progressive dispersal of the dense gas in the environment of early-type and late-type Herbig Ae-Be stars

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Abstract:

We have carried out a systematic study of the environment of 14 Herbig Ae/Be (HAEBE) stars at millimeter wavelenghts. Our data show that there is a progressive dispersal of the dense gas associated with these stars in their evolution to the main sequence. The efficiency of this dispersal is very different for "early-type" (B0-B5) and "late-type" (B5-A5) stars. While in early-type stars the mean gas density in a radius of 0.08 pc decreases by almost two orders of magnitude during their evolution to the main sequence, in late-type stars it decreases by less than an order of magnitude. Because of this different efficiency, there is no correlation between the ages of the stars and the Hillenbrand's infrared (IR) groups. Early-type stars evolve from the Hillenbrand's Group I to Group III in their way to the main sequence, while "late-type" stars evolve from Group II to Group I.

Since the morphology of the parent molecular cloud seems to be strongy dependent on the age of the stars, we propose a new classification for both, early-type and late-type HAEBE stars. We refer as Type I stars

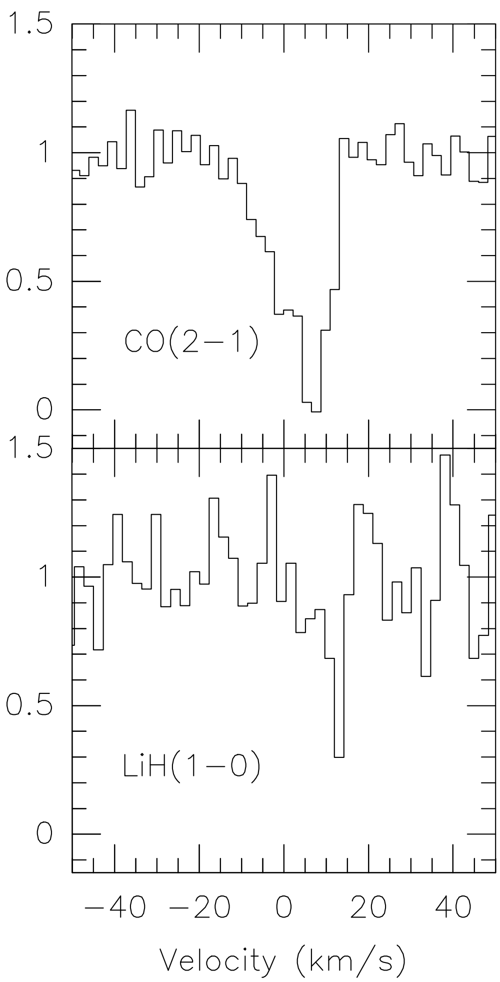

Figure 3: Spectrum of LiH in its fundamental line (1–0) at 444 GHz, redshifted at 263 GHz, in absorption towards B0218+357, compared to the highly optically thick CO(2–1) line previously detected. The tentative LiH line is slightly shifted from the center by about 5km/s, but is still comprised within the CO(2–1) velocity range. Its width is compatible with what is expected from an optically thin line. Spectra have been normalised to the absorbed continuum level and the velocity resolution is 2.3 km/s

to those immersed in a dense clump. These stars are associated with bipolar outflows and have ages $\sim 10^5$ yrs. We call Type III stars those that have completely dispersed the surrounding dense gas and are located in a cavity of the molecular cloud. Bipolar outflows are not associated with them and their ages are $> 10^6$ yrs. Type II stars represent the intermediate case, they are immersed in the molecular cloud but they are not at the peak of a dense clump. The advantage of this new classification is that it allows a simple and easy estimate of the evolutionary stage and age of HAEBE stars.

To appear in *Astronomy & Astrophysics.*

The structure and dynamics of the protoplanetary mebula M1-92

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Abstract:

We present high-resolution (1″0) maps of the ^{13}CO $J = 2-1$ in the protoplanetary nebula M1-92, Minkowski's Footprint, obtained with the IRAM interferometer at Plateau de Bure, We confirm the main components found in our previous works: a central disk-like condensation, a bipolar double-shell structure with axial outwards velocity increasing with the distance to the star, and two opposed features at the tips of the nebula where the maximal deprojected velocity is attained, $\sim 70\,\mathrm{km\,s^{-1}}$. The major quality of the present data allows to estimate the very small width of the double-shell walls, $\sim 0''6$ ($2\,10^{16}$ cm), and the diameter of the central disk, $2'' - 3''$ (10^{17} cm). The whole structure is probably the remnant of the previous AGB shell, after being shocked by the bipolar post-AGB jets. The mass of the molecular envelope is about $0.9\,M_\odot$, and its kinetic momentum and energy (released by the wind interaction) are $\sim 3\,10^{39}\,\mathrm{gr\,cm\,s^{-1}}$ and $\sim 7\,10^{45}$ erg, respectively. Since the interaction time must be significantly smaller than the age of the nebula, 900 yr, these figures imply very energetic post-AGB jets that cannot be driven by radiation pressure. We also notice that the inner disk-like structure is too large for collimating the very narrow post-AGB jets. We propose that reaccretion of material, ejected during the previous AGB phase, is the most likely mechanism to explain the strongly bipolar and very energetic post-AGB ejections.

To appear in the *Astrophysical Journal.*

A SEARCH FOR $(H_2O)_2$ IN THE GALAXY AND TOWARD COMET HALE-BOPP

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Abstract:

The MPIfR 100 m telescope, the NRAO 12 m telescope, and the IRAM 30 m telescope were used to search for low lying rotational transitions of the water dimer, $(H_2O)_2$, toward the Galactic cloud cores Orion-KL, W51 d, W51e1e2, NGC 7538, Sgr B2(M) and L134N, and toward comet Hale-Bopp. The comet was observed on December 20, 1996 and March 25/26, 1997 (i.e. near perihelion on April 1) at 24 GHz. No lines of $(H_2O)_2$ were found. Our limit for the abundance of $(H_2O)_2$ relative to that of water (from $H_2^{18}O$ data) is typically $< 10^{-4}$ toward dense cloud cores. Toward Orion-KL an even more stringent limit of $<8\,10^{-6}$ is derived. The abundance of $(H_2O)_2$ relative to H_2 is typically $< 10^{-10}$. Our data show that at perihelion the production rate of the water dimer of comet C/1995 O1 (Hale-Bopp) was $< 5.7\,10^{29}\,s^{-1}$. This is less than 6% the production rate of H_2O.

Submitted to Astronomy & Astrophysics e-mail contact: mauers@as.arizona.edu

LONG TERM EVOLUTION OF THE OUTGASSING OF COMET HALE-BOPP FROM RADIO OBSERVATIONS

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(2) Observatoire de Paris-Meudon, France
(3) Royal Observatory, Edinburgh, U.K. and Joint Astronomy Centre, Hawaii, U.S.A.
(5) Institut de Radio Astronomie Millimétrique, Grenoble, France
(6) Observatoire de Bordeaux, France
(7) Caltech, California, U.S.A
(8) Uppsala Astronomiska Observatorium, Sweden
(9) Onsala Space Observatory, Sweden
(10) DLR, Institut für Planetenerkundung, Berlin, Germany

Abstract:

C/1995 O1 (Hale-Bopp) has been observed on a regular basis since August 1995 at millimetre and submillimetre wavelengths using IRAM, JCMT, CSO and SEST radio telescopes. The production rates of eight molecular species (CO, HCN, CH_3OH, H_2CO, H_2S, CS, CH_3CN, HNC) have been monitored as a function of heliocentric distance (r_h) from 7 AU pre-perihelion to 4 AU post-perihelion (Fig. 4). As comet Hale-Bopp approached and receded from the Sun, these species displayed different behaviours. Far from the Sun, the most volatile species were found in general relatively more abundant in the coma. In comparison to other species, HNC, H_2CO and CS showed a much steeper increase of the production rate with decreasing r_h. Less than 1.5 AU from the Sun, the relative abundances were fairly stable and approached those found in other comets near 1 AU.

The kinetic temperature of the coma, estimated from the relative intensities of the CH_3OH and CO lines, increased with decreasing r_h, from about 10 K at 7 AU to 110 K around perihelion. The expansion velocity of the gaseous species, derived from the line shapes, also increased with a law close to $r_h^{-0.4}$.

To appear in Proceedings of the *First International Hale-Bopp Conference*, Puerto De La Cruz (Tenerife), Spain, Feb. 2-5, 1998.

New Preprints

460. The initial conditions of star formation in the ρ Ophiuchi main cloud: wide-field millimeter continuum mapping
F. Motte, P. André, R. Neri
1997, *Astronomy and Astrophysics*

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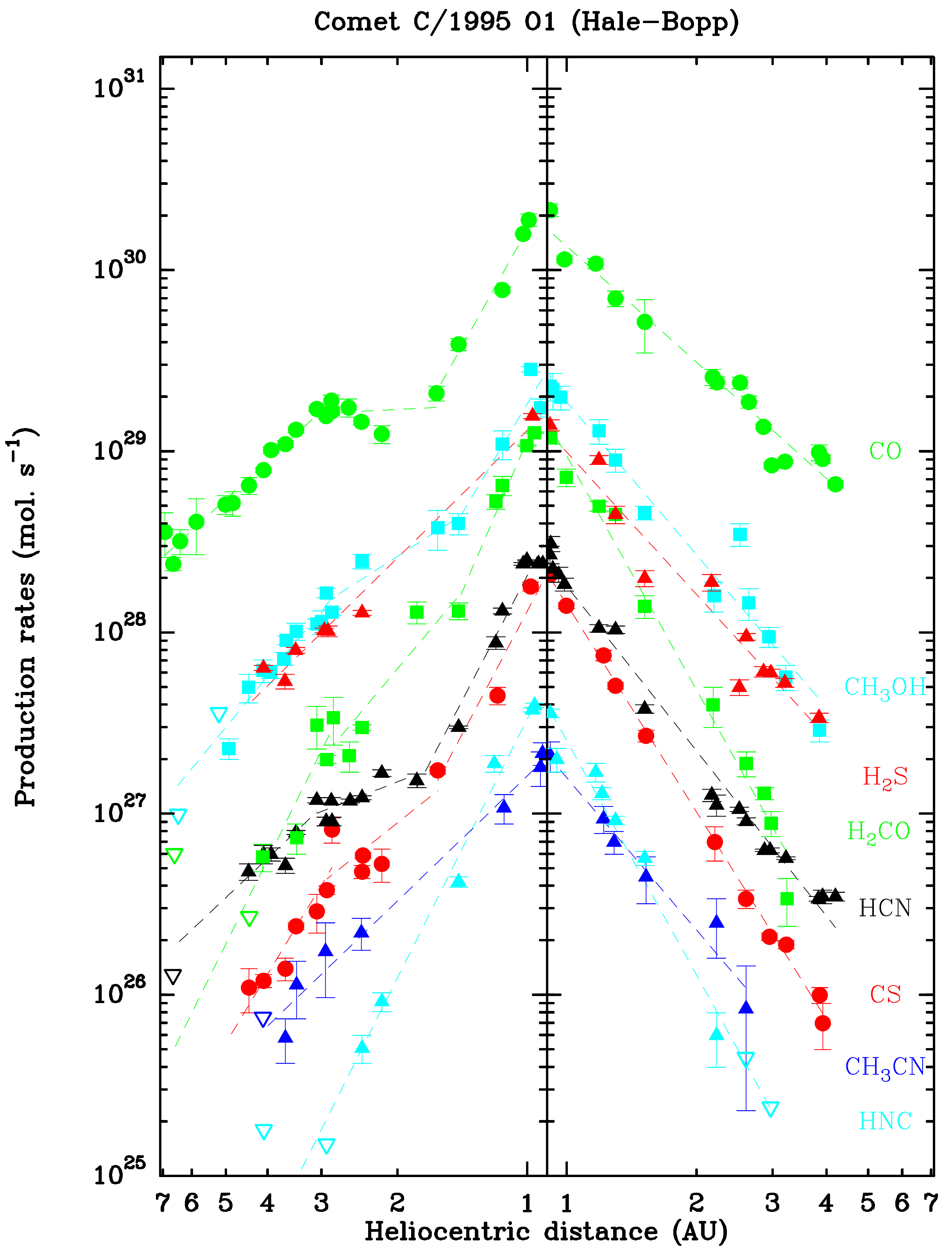

Figure 4: Production rates of the different molecular species as functions of heliocentric distance

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