IRAM Newsletter

Number 20 March 17, 1995

Calendar

S.A.C.: March 23/24, 1995

Program Committee: April 6/7, 1995

Executive Council: June 28/29, 1995

Observing proposals: Proposals for the period *Nov 15, 1995 to May. 15, 1996* should be submitted before *September 4th, 1995*

Contents

30m Telescope

New 1.3 mm VLBI experiment between Pico Veleta and Plateau de Bure

After detection of fringes at 1.3 mm between the two IRAM observatories in December 1994 (see Newsletter No. 19, January 1995), a new experiment was undertaken on March 2. This time more sources were covered. The tapes are currently being correlated at MPIfR Bonn.

345 GHz observing period from January 17 to 31

The IRAM 345 GHz receiver was installed at the telescope on January 17, and was available for observations until January 31. The installation went smoothly without problems. The receiver was basically the same as used in February 1994. A detailed report about the 1994 observing period is available. The receiver temperature at 345'GHz was about 65 K (DSB). The main beam efficiency was 0.25.

Weather conditions were quite variable. Due to very bad weather, the telescope could not be used for the first four days of the observing period. In the remaining time the weather was changing quickly. Several excellent nights (water vapor below 0.5 mm) were used for observations. About 30% of the observing time were lost because of bad weather (the average for 1994 is somewhat lower than 20%, see below).

7-channel bolometer period in February 1995

The MPIfR 7-channel bolometer array was installed and available for observations from February 1 to 27. The measured sensitivity on an absorber for the central channel was 40 $mJ/\sqrt{s}$. The sensitivity of the other channels was similar, except channel 4 which was up to a factor of two worse. In general, the instrument worked without problems and could be used almost all of the time. Some interruptions were caused by problems with the wobbler. The weather conditions seem to have been somewhat worse than expected for February. Fig. 1 shows the zenith optical depths (measured with skydips) during February. Even during periods with high τ values, useful data could sometimes be obtained because of the very stable (but poor) atmosphere.

Telescope time statistics for 1994

Fig. 2 shows how the 30m telescope was used during the year 1994. This is not the scheduled time but how the telescope was actually used. For example, if an observation could not be carried out because of high wind (the major cause for loss of telescope time), the time lost is attributed to the segment "Stop Wind". Please note that the telescope status is recorded every 2 hours which means that e.g. technical problems of shorter duration may not be included in the statistics.

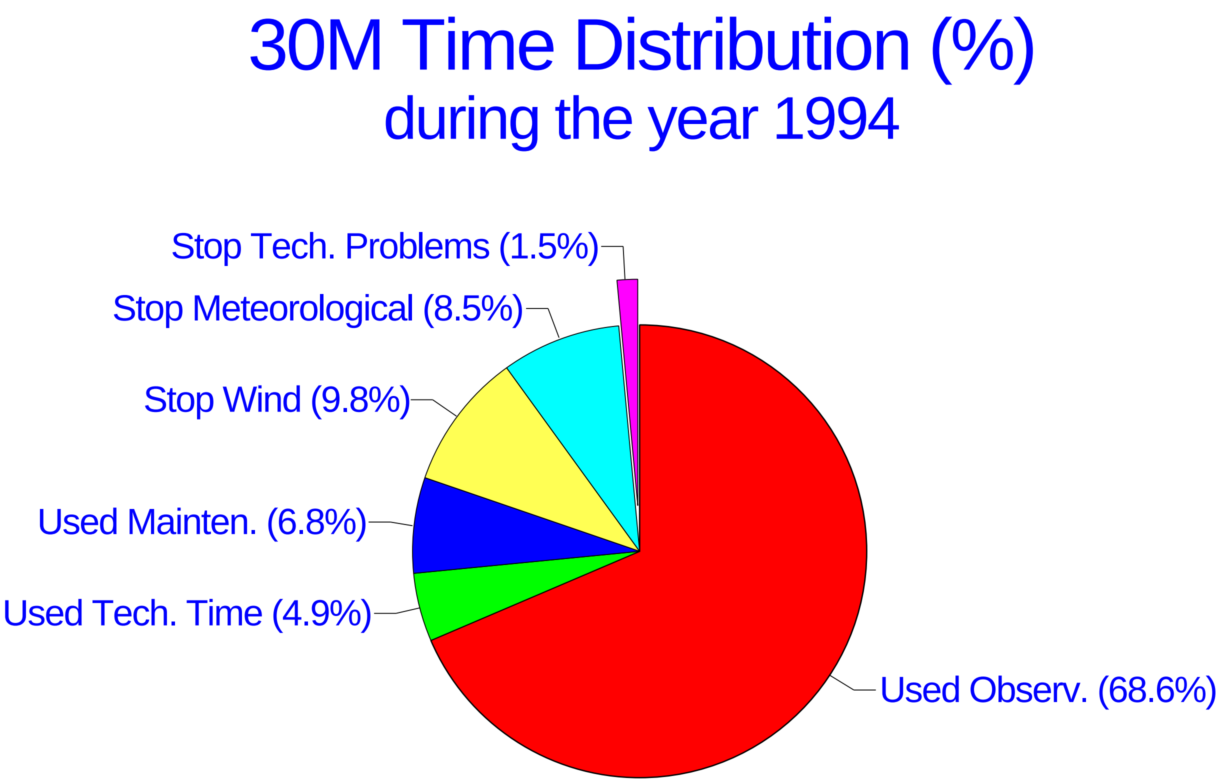

Figure 2: 30-m usage statistics for 1994.

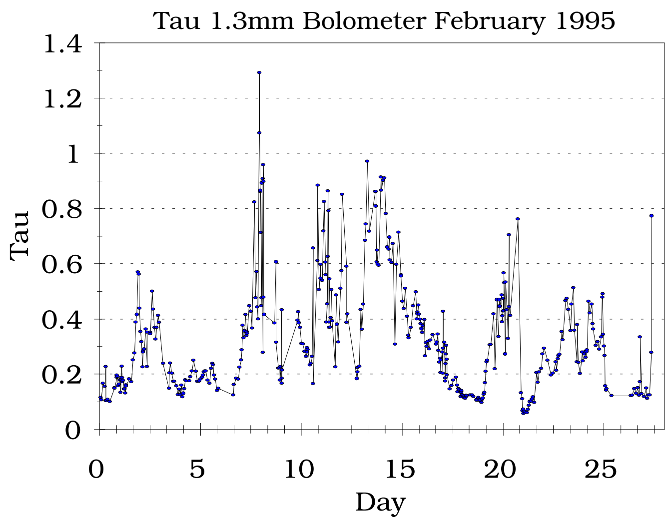

Figure 1: Zenith optical depth during February 1995.

Computers

A Unix workstation (HP 9000 Model 715/80) has been installed at the telescope. Its main use will be for spectral line data reduction with CLASS, GREG etc., and future bolometer data reduction (being implemented at the moment). There is direct access to spectral line data through a NFS mounted disk. Connection to the Vax computers can be done via *telnet* and *ftp*.

Wolfgang WILD

Computers

HP workstations on FDDI

On our 4 HP workstations the data are distributed on more than 15 disks mounted, for most of them, NFS wide, to provide to every user, whichever machine he may be connected to, an access to his personal information, project data, data reduction software source ...

In order to improve this interconnection between those workstations, we have created a "pseudo FDDI" local network which links the machines. The Fiber Distributed Data Interface is based on rings running at 100 Mbits/s.

Since our workstations are located in the same room, we use a concentrator to connect them together. The FDDI network is limited to one single hub backplane on which the concentrator is plugged.

The HP FDDI adapters have only a single-attach station (SAS) feature which limits their use to connecting the workstations with only one pair of optical cables and which does not provide any redundancy. Apart from the concentrator, the DEC hub has also an Ethernet bridge to connect the HP workstations to the IRAM Ethernet network, which includes VMS servers, X terminals and VME micros.

The hub installation was straightforward and used a local terminal connected to the hub to define an IP address.

The firmware was downloaded from a PC and the hub management is based on a solution from DEC, running on a PC which provides a graphic representation of the hub.

The connections between the FDDI ports, the Ethernet bridge and the internal pseudo FDDI ring are achieved through menus and buttons.

This FDDI solution drastically improves the interconnection bandwidth between our workstations, as can be seen on the following table:

Type of transfer:	write (Kbytes)	max (%)	read (Kbytes)	max (%)
rcp	3496	(27)	3510	(27)
ftp	4166	(32)	3785	(30)
nfs asynchronous	6258	(49)	5230	(41)
nfs	220	(2)	5230	(41)
nfs Ethernet 10 Mbits	197	(15)	895	(70)

(nfs asynchronous in write mode means that data are not directly written on disk but only in cache memory on the remote NFS host; data are transferred later on disk).

Although there are a few emerging technologies as fast as FDDI, or even faster,we think that FDDI remains a good choice for high-speed networking without surprise in installation or management.

Alain PERRIGOUARD, Patrick DUMONTROTY

Interferometer

Observing projects are progressing on schedule, but poor weather conditions (heavy snowfalls) have delayed the testing of the long baseline configuration. The following table gives the status of current projects:

Project	Done	Remaining	Total
C061	D, C2	C1	CD
B032	B2, B1, C2, C1, D		Done
D039	C1, B2, B1, C2		Done
D072	D, C2	C1	CD
E005	D		Done
E012	D	C1 C2	CD
E014	D, C2	C1	CD
E028	B1, B2, C2, C1		Done
E031	C2	C1 (C2) D	CD [c]
E033	C1, C2, B2	Any	Any
E035	C1, C2, D		Done
E037	D, C2	C1	CD [b]
E039	D, C2	C1	CD
E040		B1 B2	B [b]
E041		C1 C2 D	CD [b]
E043		C1 C2 B1 B2	BC [b]
E044	D	C1 C2	CD
E045		C1 C2 B1 B2	BC [b]
E048	B2, B1, C2	A,	AB
E054	B2, B1, C1, C2		Done
E056	B2, B1, C1, C2		Done
E057		C1 C2 B1 B2	BC [b]
E059	B1, B2, C1, C2		Done
E062		C1 C2 D	CD
E063	B2, B1, (C2), C1	C2	BC [b]
E064	B2, B1, C2, C1, D		Done
E075	C1, C2		Done
E076	(C2)		3-ant

[b] backup
[c] canceled/backup

Note that although some backup projects are well advanced, it is unlikely that those requiring long baselines will be started. This is because technical time is required to install the second IF and new receivers on Plateau de Bure.

Stéphane GUILLOTEAU

Software

SIC has been significantly revised in order to comply with Fortran-90 programming standards. This revision implied changing the calling sequence of most SIC interface routines. The old interface routines are still available, but programmers are encouraged to use the new syntax. Most GILDAS programs have been revised accordingly.

We have developed a version of CLIC which does not require the NAG library anymore. Instead, CLIC can be linked to the LAPACK library. If none of these is available, a CLIC version which does not allow to solve for antenna based calibration will be build.

This new version is undergoing final tests before being released.

Stéphane GUILLOTEAU

Observation reports

1.2 mm detection of 6 radio quiet QSOs with $z > 4$. Dust in ultraluminous QSOs

Report by: A. Omont[1], R.G.M. McMahon[2], P. Cox[3,4], E. Kreysa[4], J. Bergeron[1,5]
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[2] Institute of Astronomy, Cambridge
[3] Observatoire de Marseille
[4] Max-Planck-Institut für Radioastronomie, Bonn
[5] ESO, Garching

The detections of CO and dust mm continuum emission at $z \sim 2$ in the ultraluminous infrared galaxy IRAS F10214+4724 and the gravitationally lensed QSO H1413+117 (the Cloverleaf) have proved that millimeter (and submillimeter) radioastronomy will become a major cosmological tool to study primeval galaxies. Therefore, two years ago we proposed a systematic search of 1.2mm continuum millimeter emission in radio quiet QSOs with z>4. We then argued that their far IR luminosity could be comparable to their huge UV luminosity, and that, despite their large distance, they should be detectable since the steep spectrum of dust emission in the millimeter range means that the observed flux increases with red shift for constant luminosity.

Such a hypothesis was apparently confirmed by the first 1.2mm detection in February 1993 of BR1202-07, the brightest object of the sample and the third highest red shift known ($z = 4.7$) (Mc Mahon et al. 1994). Its subsequent detection at JCMT at submillimeter wavelengths confirmed a very large spectral index (~3.5) characteristic of dust (Isaak et al. 1994). However, during the last two years, the continuation of our programme had been repeatedly plagued by bad weather, until its decisive completion during our last run in early February 1995 with the remarkable MPIfR 7-channel bolometer array which allows a very efficient subtraction of the remaining sky background. The results, together with those of Chini and Krügel (1994), prove that the era of systematic millimeter studies at high z is already opened with the unique capacities provided by the 30m with bolometer arrays.

Five radio quiet QSOs with z>4 have been detected at a 5–sigma level in addition to the initial detection of BR1202-07 reported in McMahon et al. 1994. Their fluxes range from 2.5 to 10 mJy. All the detections were independently detected during at least three different nights. In addition ~ 10 other sources of the Cambridge APM survey sample were searched for but not detected with rms levels $\leq$1.5 mJy i.e. with fluxes probably smaller than 3 mJy. We have also observed the $z = 3.2$ QSO, PC2132+0126 and find a flux of 1.0±0.8 mJy, whereas Andreani et al. (1994) reported a flux of 11.5±1.7 mJy.

Accordingly, we have shown that a large fraction of the color identified $z > 4$ radio quiet QSOs have a strong millimeter emission detectable with the 30 meter. Although the following point remains to be verified with the JCMT, it is very likely that the detected sources have a large spectral index characteristic of dust emission, similar to what is observed for BR1202-07. The very large amount of dust implied, $\sim 10^8$ $M_\odot$, is comparable to what is found in the most luminous infrared starburst galaxies. It is quite possible that a giant starburst is taking place or has recently taken place in the host galaxies of these QSOs at a scale $>\sim$ the central kiloparsec. However, it is possible that most of the heating of the observed dust is provided by the UV emitted by the central engine of the quasar.

It is crucial to complement our results by submillimeter observations at the JCMT and by sensitive far–infrared photometry with ISO in order to characterize the dust temperature and derive the far–infrared luminosity. In addition, it is important to extend our work at z>4 to lower red shifts i.e. 1 to 3, in order to determine the frequency among them of detectable millimeter emission and investigate the relationship between this emission in QSOs with the dust emission in ultraluminous IRAS galaxies and radio galaxies.

References

[1] Andreani P., La Franca F., Christiani S. 1993, MNRAS 261, L35

[2] Chini R., Krügel E., 1994, A&A, 288, L33

[3] Isaak K.G., McMahon R.G., Hills R.E., Withington S. 1994, MNRAS 269, L28

[4] McMahon R.G., Omont A., Bergeron J., Kreysa E., Haslam C.G.T. 1994, MNRAS 267, L9

Scientific Results

1.3mm continuum emission from the late-type spiral NGC 4631

J. Braine, E. Krügel, A. Sievers, R. Wielebinski

Abstract: We have used the IRAM 30meter telescope with the MPIfR 7-channel bolometer to map the λ1.3mm continuum emission from the central $4' \times 3'$ region of the edge-on spiral NGC 4631. About 6/7 of the flux is due to thermal radiation from cool dust and its distribution has been compared with recent HI and CO maps at similar angular resolution. The remaining 15% is due to the ^{12}CO(2–1) line ($\sim$ 11%), the ^{13}CO(2–1) line ($\sim$ 1%), and synchrotron and free-free emission.

Both the CO and 1.3mm continuum are concentrated in the inner $\sim$ 2kpc and have a similar morphology whereas the HI emission is much more extended. To within observational uncertainties, however, the dust emission per gram of interstellar matter is similar in the atomic and molecular components after making the usual assumptions to convert HI and CO line fluxes to HI and H_2 column densities.

The fact that the gas mass calculated from the thermal dust emission is equal to or slightly higher than the mass from the HI and CO lines suggests that in NGC 4631 the $N(H_2)/I_{CO(1-0)}$ ratio is not overestimated.

A method to search for high-redshift protogalaxies

J. Braine (IRAM Grenoble)

Abstract: A method of searching for high redshift objects ($z > 5$) is proposed. It is shown that observations at 100 and 230 GHz provide the most powerful means of searching for protogalaxies which emit most of their radiation in the far infra-red (like IRAS 10214+4724). Not only has the sensitivity of millimeter-wave interferometers reached the necessary levels but the synthesized beam is also well adapted to this sort of project. Protogalaxies invisible to IRAS and much weaker than IRAS 10214+4724 can be detected. Unlike low frequency radio observations, confusion is not a problem. Based on the current number density of bright ellipticals, a reasonable guess for the current evolutionary state of systems similar to IRAS 10214+4724, the expected number of sources per square arc minute between $z = 5$ and $z = 15$ is close to unity. The number is not very sensitive to the redshift limits chosen.

Hydrogen Recombination β–Lines in MWC349

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Abstract: We have detected four β–lines out of six observed in the frequency range from 100 to 400 GHz toward the radio star MWC349A. The detected β–lines have similar parameters as the pedestal features of the short mm α–lines and probably have the same origin in the ionized wind.

We find that the flux ratios of β– and α–line pedestals of nearly the same frequency are much smaller than expected from an optically thin plasma in LTE in all cases. We show with the help of simplified NLTE models of the recombination line emission that low β/α–ratios are due to enhancement of the α–lines by stimulated emission. This is a natural consequence of the high free–free continuum opacity in the ionized wind of MWC349A. The models also predict that the β/α–ratio is a sensitive probe of the electron density. For the 33β line emitting region the density thus derived is compatible with previous estimates, $n_e \sim 3 \cdot 10^7$ cm^{-3}, based on a model of the wind's continuum emission.

The four newly detected β–lines provide, together with the high frequency α–line pedestals, the most reliable value of the center velocity of the ionized outflow, $v_{LSR} = 8 \pm 3$ km s^{-1}. This value agrees well with the centroid velocity of the disk, $v_{LSR} = 8.2 \pm .3$ km s^{-1}, as derived from the velocities of the blue and red maser spikes, and thus represents the best estimate of the stellar velocity.

H32β, at 366.6 GHz the highest frequency β–line observed to date, displays on top of the pedestal two weak narrow emission features whose velocities and widths are in qualitative agreement with those of the α–line maser spikes. We tentatively interpret these H32β spikes as a weak disk maser whose estimated optical depth, $|\tau| \leq 1$, confirms earlier estimates of the α–line maser gain ($|\tau| \simeq 6$).

The jet-driven molecular outflow in L 1448: CO and continuum synthesis images

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Abstract: The central region of the L1448 molecular outflow has been mapped in the CO $J = 1-0$ line, and in the λ 2.6 mm continuum, with angular resolution of $3'' \times 2.5''$ ($\sim$ 4 10^{-3} pc at the distance of L 1448, 300 pc). In the mapped area, there are two partially overlapping

outflows emerging from two different continuum sources (L 1448/IRS3 and L 1448-mm).

The continuum maps are used to study the nature of the two exciting sources. The strong mm peak around L 1448/IRS3 is coincident in position with the VLA cm source L 1448N(B), and it likely is the source driving the outflow in the northern region. L 1448-mm is at the origin of the main outflow. The spectral energy distributions confirm that both sources (L 1448-mm and IRS3) are among the youngest known protostellar candidates ("Class 0" sources)

New details on the structure of the L 1448-mm outflow are revealed by the CO observations. Weak line emission at extremely-high velocities is detected along the jet which is at the axis of the outflow. Such emission is associated with the molecular bullets detected with single-dish telescopes. The jet is inclined at PA $-21°$, and its actual jet speed is in excess of 200 km.s^{-1}.

Limb-brightened cavities are detected at low CO velocities. The cavities have a biconical morphology, suggesting that a bipolar nebula is forming. The formation of the cavity is well explained in the frame of models for jet-driven bipolar outflows, where the jet entrains ambient molecular material through the propagation of large bow-shocks which are able to disturb the ambient gas at long transverse distances from the jet axis. A comparison of the CO data with H_2 images at 2.12 μm provides further support to this scenario.

The blue shifted lobe of the L 1448-mm outflow exhibits a continuous bending that can be explained as a result of direct collision of the two outflows in L 1448.

Detection of MgCN in IRC+10216 : A New Metal-bearing Free Radical

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([2]) IRAM, 300 rue de la Piscine, 38406 St. Martin d'Hères, France
([3]) Centro Astronómico de Yebes, I.G.N., 19080 Guadalajara, Spain

Abstract: A new metal-containing molecule, MgCN, has been detected towards the late-type star IRC+10216, using the NRAO 12m and IRAM 30m telescopes (Fig. 3). The $N = 11 \rightarrow 10, 10 \rightarrow 9$, and $9 \rightarrow 8$ transitions of this species, which has a $^2\Sigma^+$ ground state, have been observed in the outer envelope of this objects at 3mm. For the $N = 11 \rightarrow 10$ transition, the two spin-rotation components are clearly resolved and conclusively identify this new radical. These measurements imply a column density for MgCN of $N_{\rm tot} \sim 10^{12}$ cm^{-2} in the outer shell, which corresponds to a fractional abundance of $f \sim 7 \times 10^{-10}$. This molecule, the metastable isomer of MgNC, is the third metal-bearing species thus far identified in the outer shell of IRC+10216, and its detection implies a ratio of MgNC/MgCN $\sim$ 22/1. MgCN may be formed through a reaction scheme involving magnesium and HNC or CN, both prominent outer shell molecules, or through synthesis or grains.

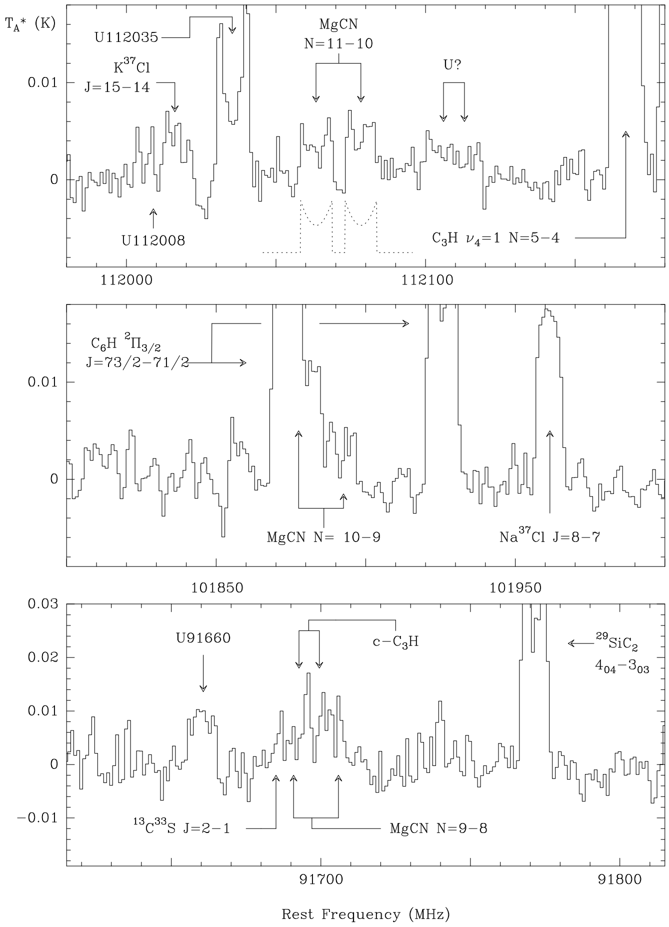

Figure 3: Spectrum of the $N=11 \rightarrow 10$, $10 \rightarrow 9$, and $9 \rightarrow 8$ transitions of MgCN obtained with the IRAM 30m telescope towards IRC+10216 at 112, 102, and 92 GHz, using 1 MHz resolution. Assumed LSR velocity is -26.4 km/s. The $N=11 \rightarrow 10$ spin-doublets are clearly resolved in these data (see the expected doublet profile drawn below the spectrum in dotted line). Again, one doublet of the $N=10 \rightarrow 9$ transition is partially obscured by C_6H. For the $N=9 \rightarrow 8$ lines, the center of the two doublets is contaminated by c-C_3H, but MgCN emission is distinctly present.

New Preprints

The following preprints are available from IRAM:

345. CO, HI and cold dust in a sample of IRAS galaxies
P. Andreani, F. Casoli, M. Gerin
1994, *Astron. and Astrophys.*

346. The distorted kinematics of molecular gas in the center of NGC 891
S. Garcia-Burillo, M. Guélin
1995 *Astron. and Astrophys.*

347. λ6cm and λ2mm H_2CO absorption toward compact extragalactic mm-wave continuum sources
H. Liszt, R. Lucas
1995 *Astron. and Astrophys.*

348. Hydrogen recombination β-lines in MWC349
C. Thum, V.S. Strelnitski, J. Martin-Pintado, H.E. Matthews, H.A. Smith
1995 *Astron. and Astrophys.*

349. 1.3mm continuum emission in the late-type spiral NGC 4631
J. Braine, E. Kruegel, A. Sievers, R. Wielebinski
1995 *Astron. and Astrophys.*

350. The jet-driven molecular outflow in L 1448: CO and continuum synthesis images
R. Bachiller, S. Guilloteau, A. Dutrey, J. Martin-Pintado
1995 *Astron. and Astrophys.*

351. Carbon monoxide outgassing from comet P/Schwassmann-Wachmann 1
J. Crovisier, N. Biver, D. Bockelée-Morvan, P. Colom, L. Jorda, E. Lellouch, G. Paubert, D. Despois
1995 *Icarus*

352. A method to search for high redshift protogalaxies
J. Braine
1995 *Astron. and Astrophys.*

Programs Scheduled on the 30-m Telescope in 1994

JUL 5 - JUL 19

Ident.	Title	Freq. (GHz)	Authors
8.94	A CH_3CN survey towards ultracompact HII regions	110, 147	Cesaroni, Walmsley, Olmi
9.94	A search for high mass protostars	89,96,147, 221	Cesaroni, Churchwell, Felli, Walmsley
10.94	Silicon monoxide towards ultracompact HII regions	86, 130,217	Acord, Shepherd, Churchwell, Walmsley, Cesaroni
31.94	CO studies of galaxies in the Coma/A1367 supercluster	113, 112	Dickey, Kazès, Casoli, Combes, Lavezzi
21.94	CO emission from a gas-rich lensed galaxy at z=1.116	108,163,217	Krishna, Morris, Henkel
19.94	CO^+ in photon dominated regions	118,235,236	Stutzki, Sternberg, Stoerzer
96.94	Small scale structure in the high latitude cirrus cloud toward HD 210121	220,230	Stark
-	Comet Shoemaker-Levy observations		Festou, Paubert
18.94	A multiline CO study in the Rosette molecular cloud	109,115,220,230	Schneider, Stutzki

JUL 19 - AUG 2

Ident.	Title	Freq. (GHz)	Authors
96.94	Small scale structure in the high latitude cirrus cloud toward HD 210121	220,230	Stark
	Comet Shoemaker-Levy observations		Lellouch, Paubert
74.94	Ortho/para abundance ratios in molecular clouds	89,140,150,211,225	Lucas, Liszt
53.94	Confirmation of high redshift galaxy detection at the IRAM 30m	89,149	Sams, Schuster, Brandl
86.94	IRAS 19379+2838, a bipolar outflow or a M star surrounded by a disc ?	115,230	Loup, Josselin, Panis, Waters
81.94	Origin of the anomalous CO emission in cold O-rich circumstellar envelopes	115,130,230	Omont, Loup, Josselin, Barnbaum
83.94	Further search for CO in a dusty, radio quiet QSO at z=3.2	82,109,137	Omont, Solomon, Radford, Downes, McMahon

AUG 2 - AUG 16

Ident.	Title	Freq. (GHz)	Authors
83.94	Further search for CO in a dusty, radio quiet QSO at z=3.2	82,109,137	Omont, Solomon, Radford, Downes, McMahon
4.94	Search for glycine		Combes, Rieu
6.94	True velocity dispersion of molecular gas		Combes, Braine
16.94	CO observations of a sample of high redshift radio galaxies	86,90,102,110,137,164	Van Ojik, van der Werf, Miley, Roettgering
34.94	Studies of cold molecular gas (continuation)	88,98,110,115,230,265	Lequeux, Allen
33.94	CO emission from intermediate z progenitors of normal galaxies	150,162,225,243,256	Lo, Steidel, Genzel
33.94	CO emission from intermediate z progenitors of normal galaxies	150,162,225,243,256	Lo, Steidel, Genzel
56.94	Relating high density gas with Megamaser activity	88	Baudry, Rieu, Baan
36.94	Molecular clouds beyond the optical disk of the Galaxy	97,109,146,220,244	Henkel, Digel, Chin, Mauersberger, de Geus, Thaddeus
84.94	CO in early type galaxies with luminous X-ray halos	115, 230	Henkel, Braine, Wiklind

Aug 30 - Sep 13

Ident.	Title	Freq. (GHz)	Authors
71.94	The Moon: brightness at mm-wavelengths	86,150,230	Greve
25.94	High velocity jets and FLIERs in planetary nebulae	115,230	Huggins, Bachiller, Cox, Forveille
24.94	Molecular gas in the halos of planetary nebulae	115,230	Bachiller, Huggins, Cox, Forveille
13.94	Methanol abundance enhancement around young stellar objects	94,109,145,241	Colomer, Bachiller, Walmsley
89.94	A molecular study of the TMC1 filament	97,135,237,85	Cox, Cernicharo

Sep 13 - 27

Ident.	Title	Freq. (GHz)	Authors
24.94	Molecular gas in the halos of planetary nebulae	115, 230	Bachiller, Huggins, Cox, Forveille
89.94	A molecular study of the TMC1 filament	97,135,237,85	Cox, Cernicharo
71.94	The Moon: brightness at mm-wavelengths	86,150,230	Greve
55.94	Separation of infall and outflow motions in L1527 and L483	115,220,230,140	Myers, Bachiller, Fuller, Mardones
29.94	Isotopic variations and physical parameters in OMC-1 north and NGC 2024 determined from CN, ^{13}CN and C^{13}N observations	109,217,219	Simon, Stutzki, Graf, Winnewisser
30.94	CN, HCN and its isotopomers as tracers of the physical conditions and the UV field in the cores of S140, S255, S106	88,109,144,259	Simon, Stutzki, Winnewisser
80.94	CO emission from 6 far-infrared detected blue-compact dwarf galaxies	115,230	Krishna, Petrosian, Henkel, Wielebinski
58.94	CO abundances in the far outer Galaxy	104,109,115,230	Brand, Wouterloot

Sep 27 - Oct 11

Ident.	Title	Freq. (GHz)	Authors
71.94	The Moon: brightness at mm-wavelengths	86,150,230	Greve
76.94	Zeeman effect observations with the 113GHz CN lines	113	Crutcher, Kazes, Troland, Lazareff
16.94	CO observations of a sample of high redshift radio galaxies	86,90,102,137,164	Van Ojik, van der Werf, Miley, Roettgering
12.94	A pilot study of the shock in G9.62+0.19	89,138,217	Hofner, Churchwell, Henning
79.94	Observation of CO in P/Schwassmann-Wachmann1 and other distant comets	115, 145, 168, 230	Crovisier, Biver, Bockelee-Morvan, Colom, Jorda, Despois, Paubert
49.94	Mapping the cold molecular gas toward 2013+370	115, 230	Wilson, Solomon, Mauersberger
50.94	Molecular gas toward Cassiopeia A	93, 86, 110	Wilson, Mauersberger
94.94	Gaseous counterparts of low-mass protostellar dust envelopes	86,96,109,216,224,260	André, Despois

Oct 11 - Oct 25

Ident.	Title	Freq. (GHz)	Authors
94.94	Gaseous counterparts of low-mass protostellar dust envelopes	86,96,109,216,224,260	André, Despois
71.94	The Moon : brightness at mm-wavelengths	86,150,230	Greve
95.94	A CO survey of metal-defient blue compact galaxies	113,114,226,228,229	Thuan, Sauvage, André
35.94	Observations of the gas in the most distant known galaxy	96,144,216	Mirabel, Eales, Hammer, Dunlop, Hughes, Rawlings
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