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THE JCMT NEWSLETTER

March 1997 Issue Number 8

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Last Modification Date 1997/03/12 - Last Modification Author: Graeme Watt (gdw)

Message from the Director

An interesting semester of good news/bad news. On the positive front the JCMT Board approved the long-term development plan put to it at the November Board. This was the result of a huge amount of work by staff at the JAC and elsewhere, in preparing detailed and costed design studies of a range of possible options.

The approved plan sees the JCMT embarking on the construction of a focal plane 345 GHz heterodyne array receiver and a brand-new digital correlator to go with it. This development will serve the JCMT well in terms of its scientific output and standing well into the next Century. The possibility of becoming involved with the Smithsonian Submillimeter Array continues to excite the community and expenditure is approved to convert JCMT IF systems to match those of the SMA. When this is complete, the JCMT should just look like another antenna to the SMA control system. These are the major thrusts of the funded development plans over the next five years.

One of the major drivers of the development plan is to improve efficiency of collecting data. This ranges from a new observatory and telescope control system to improving the surface accuracy. Both have been funded. The latter, in the first instance, will see the replacement of the panel adjuster electronics so that the surface that can be better set and subsequently adjusted for temperature variations. The next step would be to look for panel refurbishments or new panels and this is one of the possibilities vying for the unallocated funds. The JCMT Board agreed that this will be decided in two-year's time and competing projects include a new 230 GHz receiver, more pixels for the heterodyne array, a high frequency heterodyne camera, and more channels for the correlator.

In terms of new instruments, the current 230 GHz A-band receiver (which was upgraded last year with a new mixer) will be replaced by a new receiver, the conversion of the now-replaced 345 GHz receiver (RxB3i). This will give improved performance and much better operational efficiency and reliability. For completeness it should be remembered that new instruments previously approved include a new 800-900 GHz receiver (the conversion of the current 450 GHz receiver RxC2) and a SCUBA polarimeter. Both of these are under construction.

The new 345 GHz receiver (RxB3) has had a chequered life at the telescope - when it works it has been excellent (giving up to a 5-fold increase in observing speed-up over its predecessor - RxB3i). However, it has not yet demonstrated the reliability that we expect and require for a facility instrument. RxB3 was a casualty of the move of labs of HIA from Ottawa to Victoria and we accepted delivery at a time when we were knowingly aware this receiver was not as mature as we would have preferred. We have worked very closely with the receiver builders and I am delighted to say that as of the past couple of weeks, this receiver now looks to be well on the way to being extremely reliable, as well as very sensitive with its dual-polarization set-up. Indeed, when I was at the telescope yesterday it had just been used for an 'on-the-fly' map of the central arcminute of comet Hale-Bopp in CO.

Our new dual-band (450 GHz and 600 GHz), and dual-polarization receiver, RxW, has suffered further delays and it's delivery is not yet known, although a May-June delivery remains a possibility. The receiver builders at MRAO now have all four mixers installed in the main cryostat and have reported excellent noise temperatures. We await its arrival with considerable excitement.

And now to SCUBA. As I noted in my last Newsletter message, SCUBA was having problems in its commissioning. I'm afraid to say that these have continued. We eventually got on top of most of the problems of the sensitivity, traced to faulty filters and a mis-match of the bolometer cavity to the incoming radiation field. Unfortunately, since the December cool-down, progress has been very disappointing due to two unexpected problems, neither of which had occurred previously. The cryogenic stability deteriorated markedly, accompanied by a very large increase in the noise from the detectors. Two further cool-downs failed to cure these problems and the approved astronomical observations for the community had to be postponed.

Where are we now? New filters have been built and tested by Peter Ade at Queen Mary College and we are all now confident that this particular problem is solved. We also believe we have a good handle on the bolometer mis-match and expect that the next cool-down should see very significant improvements in sensitivity. Unfortunately, the cool-down last week (March 10th) failed to reach base temperature, and we are now in the process of another cool-down. If the cryogenic stability and noise problems have been cured, then we will complete the astronomical commissioning (including determining new flat-fields) and then commence immediately on the astronomical programme for users.

I should stress that the news is not all bad. Early-on we obtained some very spectacular images that have been shown on the web or at the AAS meeting. The improvement over a single-pixel device is incredible (as you would expect) and this is just the very beginning. We have also managed to get 'on-the-fly' scan-mapping almost working, and this will open up an entirely new field of submillimetre studies and will help SCUBA realise its potential as an imaging instrument. The SCUBA news page is being updated (at least) on a monthly basis, so this is where to stay tuned for new information.

For general operations, once again, the projects described above have consumed the majority of the efforts of JAC staff, although some time has been devoted to other areas. After a marked deterioration in reliability, the whole JCMT telephone system was replaced in February. Also in February, a severe pointing problem was noticed which manifested itself as large (~10") variations in azimuth pointing at specific values of azimuth. This has been diagnosed as a problem with the antenna central bearing. The effect is being compensated for by an extra term in the pointing look-up tables; we now need to decide whether to replace the bearing (at considerable cost and effort).

Because of the SCUBA commissioning and potential astronomical serviced observing, the JCMT schedule has been in a state of constant flux, and Graeme Watt is to be congratulated on his efforts to keep everything afloat, so as to speak. However, because of the SCUBA serviced mode and the serviced SCUBA heterodyne back-ups, it has meant that we have had very few observers visiting the JCMT. In my mind, far too few. Because of this, and the additional cost of undertaking the observations using JAC staff, we will not undertake another semester like the last one. Despite the continuing need to commission SCUBA and RxW, we will definitely undertake to schedule-in observers programmes with the observers coming out to Hawaii. Hopefully, these runs can be flexibly scheduled within a defined window so that the observer can be present for an extended time in Hawaii, and perhaps will be able to undertake the back-up programmes in lieu of their own. Careful work remains to be done before we embark on a full implementation of this, and discussions with the user community, time allocation communities and funding agencies will be undertaken over the coming months.

Finally I should move on to two domestic aspects, staffing and Prior Options. The former has seen some notable changes, especially in the recruitment of new staff, and we are already seeing the benefit of their expertise. Prior Options has, unfortunately, sapped effort at the JAC and some of the work that we had intended to do has slipped. It is to be hoped that the uncertainty surrounding this process will be soon removed and we can get back to concentrating on delivering high quality and cost effective science.

Ian Robson,

Director, JCMT

March 17th, 1997.

The People Page

Cameron Mayor joined the JAC as a JCMT Instrument Engineer. Cam comes from Canada where he was working as a digital design engineer for Broadband Networks, Inc. His main design work was in digital television compression, decompression, and transmission systems. Now, at a slightly higher frequency, he gets to look after A-band, B-band, C-band, etc cryogenic heterodyne instrumentation.

Bill Dent returned to the UK in early March after many years at the JAC working as a Telescope operator and then as an Instrument Support Scientist for the JCMT. Bill will remain involved with the JCMT instrumentation, since he will shortly be sent off to Penticton to work on the correlator upgrade project.

Congratulations to **Clayton** and **Karyl Ah Hee** on the birth of a 'bouncing baby boy', **Austin**, in November 1996.

Congratulations also to **Ian** and **Liz Smith** on the birth of their 'bouncing baby boy', **Callum Arnott Macintosh**, in January 1997.

Web Access to JCMT Instrumentation Status

The current state of the JCMT instruments, their availability on the telescope and their sensitivities and other observational parameters can always be located on the relevant pages within the JCMT World-Wide Web site:

RxA2

RxB3

RxC2

SCUBA

Short Baseline Interferometry

It is anticipated that there will be an opportunity to participate in an SBI run during the Fall of 1997. The optimum period in which to arrange this 'block' of obsevations has not yet been decided. Further details on the availability of SBI will be found on the JCMT homepage, and via the e-mail exploder, nearer the event.

Interested applicants are requested to submit their applications by the appropriate deadlines for either JCMT or for CSO. The allocation of a block of time for SBI does depend on scientifically competitive proposals being approved by the time allocation groups for the two telescopes.

RxW

Progress:

Progress on RxW was slow during the autumn owing to a difficulty in achieving adequate cryogenic temperatures at the mixer. That problem was eventually solved and since New Year's progress has been very good. The MRAO staff have installed and cooled all four mixers in the main RxW cryostat. The receiver noise temperatures of the 450-500 GHz mixers (C-Band) are about 100 K (DSB) and the 630-710 GHz (D-Band) mixers yield about 500 K (DSB). RxW is essentially complete now with the optics assembly, the control electronics, and the mixers installed and functional. Some work remains in the software area.

The MRAO staff are now testing and characterising the receiver in the laboratory commissioning phase. The tests include measurements of beam patterns, tuning parameters, noise temperatures across the tuning bands, sideband rejection characteristics, and computer control of the instrument. Pending the results of the first phase of lab commissioning, we have not yet set a firm date for shipping the receiver to Hawaii. If no serious difficulties develop, the lab commissioning should proceed for about another two months and the receiver should be available for telescope commissioning by the early summer.

P. R. Jewell

18th March 1997

for Semester 97B

The commissioning dates for RxW are provisionally set for late in semester 97A. Unfortunately, the dates will be after the regular PATT deadline and after the ITAC meeting which will be awarding time during semester 97B. It will not be possible to accept applications which specifically require the features and sensitivities of the RxW instrument. Therefore the D-band (690 GHz) section is not available for semester 97B. C-band observations can be applied for assuming that the project can be completed using the existing RxC2. If, and when, RxW is commissioned, all outstanding C-band applications will be transferred to use the new instrument.

Last Modification Date 1997/03/18 - Last Modification Author: Graeme Watt (gdw)

SCUBA

SCUBA will be undergoing further commissioning during semester 97A. In addition to this work it is hoped that there will be some opportunity for observations.

See also the SCUBA Technical Page later in this Newsletter.

Those applicants who were awarded time during the SCUBA 2nd round, scheduled to begin in early December 1996 and continue through to the end of semester 96B, will be notified once the instrument is available for observing. At that time applicants will be invited to modify their original applications/templates (within limits) to allow for the change in source availability and instrument performance.

The most up-to-date information on SCUBA can be found on the SCUBA home page

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Last Modification Date 1996/08/14 - Last Modification Author: Graeme Watt (gdw)

PATT Application Deadline

Deadlines for receipt of JCMT applications for semester 97B are:

for UK, Canadian, Netherlands and International applications:

31st March 1997

Note the change of date and that **ALL** applications have the same deadline for this semester.

Please read the next article - Special Notes for Sem97B before filling in your application forms for the forth-coming semester.

To ensure prompt processing, please ensure that your applications are sent to the correct establishment. Applications for JCMT time should be submitted to the national TAG of the Principal Investigator (PI) or, if the PI is not from one of the 3 partners, to the national TAG of the first named co- investigator on the application who is from one of the partners. International applications (those with no applicants from one of the partners) should be submitted to the PATT Secretariat at PPARC, Swindon. Members of the JAC staff in Hawaii count as International unless they are the PI on an application, when it should be forwarded to the appropriate national TAG.

NOTE: New address for Canadian applications effective immediately.

Country paying salary of Principal Investigator

Canada	Netherlands	UK or International
Director-General's Office, National Research Council of Canada, 5071 West Saanich Road, Victoria, BC, CANADA V8X 4M6	Dr. J. M. van der Hulst, Kapteyn Astronomical Institute, Postbus 800, NL-9700 AV Groningen, NETHERLANDS	PATT Secretariat, PPARC, Polaris House, Swindon, SN2 1ET, UNITED KINGDOM

Previous: SCUBA | **Up:** The JCMT Newsletter Index | **Next:** Special Notes for Sem97B

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Information for Applicants Requesting Time on JCMT for Semester 97B

The deadline for HETERODYNE applications only for semester 97B (August 1st 1997 through January 31st 1998) is **31st March 1997**. It has been decided **NOT** to invite SCUBA applications for this deadline because revised NEFDs etc will not be properly known until mid-late March at the earliest (following the current cool-down - see below), but rather to delay the the call for semester 97B SCUBA proposals until reliable figures have been established. Those SCUBA applicants who were successful in obtaining SCUBA time in the first `24-hour' SCUBA call last Autumn can be assured that it is still planned to implement these `pilot' proposals as soon as SCUBA is performing with the required reliability; Principal Investigators will be contacted when this occurs, and will be offered the opportunity to modify their observing template as appropriate.

All HETERODYNE applications must arrive at their appropriate collection point by March 31st. These will be processed for the ITAC meeting to be held with the other PATT facilities in late May.

Note that the deadline for Netherlands applications is now the same as for the UK, Canadian and International applications. The Latex template application form can be downloaded from the JCMT homepage on the Web. An explanation of how to classify applications into UK, Canadian, Netherlands or International, the correct number of copies required, and the correct addresses of the collecting points can also be found on the Web. Electronic submissions will be most welcome in the case of Netherlands and Canadian applications. This facility is not yet available for UK or International applications. See the JCMT home page for further details.

INSTRUMENTS AVAILABLE

The current status of RxA2, RxB3 and RxC2 can be found on the Web. These instruments will be available throughout the semester.

RxW is scheduled to be commissioned on the telescope in July. This is too late to be able to provide any parameters prior to the ITAC meeting and therefore applications should not request RxW. More specifically, any C-band applications allocated time for RxC2 will automatically be given RxW time should the C-band commissioning proceed successfully. There cannot be any D-band requests for semester 97B.

It is anticipated that there will be an SBI run around October or November. Applications should be sent in as normal by the appropriate JCMT and CSO deadlines. The instruments available will be only RxA2, RxB3 and RxC2, not RxW.

SCUBA

At this moment it is not possible to give any further details about SCUBA since the instrument is warm and undergoing repairs. Should these repairs and upgrades result in significantly improved observing capabilities then an information update will be released later this month (March). This may result in a late call for CONTINUUM observing applications for semester 97B with a deadline around the end of April. If this is the case, then the ITAC meeting will be delayed for the regular PATT date to sometime in late June so that both heterodyne and continuum applications can be considered together.

PATT ITAC Report for Semester 96B(SCUBA)

Allocations

The SCUBA applications were processed via the normal procedures, with nominal allocation being made by the partner TAG's. The final allocations were made by the ITAC. The figures below are in addition to the 95 applications requesting heterodyne observations that were processed for the first half of the semester.

Applications to be considered

UK status	81
Canadian status	34
Netherlands status	26
International status	25
University of Hawaii	16
TOTAL:	182

The PATT ITAC meeting was held at the ROE, Edinburgh, UK on 29th October 1996.

Status of Applications

The range of science requested in these applications was clearly indicative of the immense interest of the astronomical community in making observations with SCUBA. The objects to be studied range from studies of solar-system objects such as Pluto/Charon, comet Hale-Bopp, asteroids; galactic objects such as pre-protostellar cores, T Tauri sources, molecular outflows, AGB stars, Vega-type stars, planetary nebulae; and extragalactic objects such as normal spirals and ellipticals, starburst galaxies, radio-quiet & radio-loud objects, quasars & blazars, studies of the Sunyaev-Zel'dovich effect.

The applicants included many PIs familiar to the JCMT community from past applications using UKT14. In addition there were several applications from observers more normally associated with heterodyne observations. In addition, there were a number of proposals from PIs who have not been regular users of the JCMT. A small number of non-regular applicants submitted through the Canadian and International channels, with slightly higher numbers using the UK routing, but the most significant number of first-time applicants resulted in an almost doubling of the Netherlands applications.

Time Available (in 16-hour nights)

No. of night set aside in semester 96B	78.0
Engineering & Commissioning	5.0
Other PATT usage	13.0

University of Hawaii (10%)	6.0
Available for PATT science:	**54.0**

The above table indicates the order in which nights are removed from the total available. This winter period covers from 12th December 1996 through 28th February 1997 inclusive. A number of nights during this period have previously been scheduled for heterodyne observation.

Some time has already been allocated out of the original 78 nights for the delayed commissioning of RxB3, and for some previously allocated programmes requiring A-band observations which were unable to proceed due to the unavailability of RxA2.

The SCUBA allocations were actually made in hours of observing time (including overheads) and have been converted to 16-hour nights to allow consistency with other reports. There were 43 hours (2.69 nights) left unallocated. It was understood that it would be extremely unlikely that there would be sufficient good weather to enable the queues to be completed and therefore the unallocated time would be absorbed into weather loss or unscheduled E&C time. The time allocated will be scheduled into partner 'blocks', of 3-4 shifts in length, for ease of scheduling, flexibility, and simplification of the accounting.

Awards (in 16-hour nights)

UK status	26.50
Canadian status	11.75
Netherlands status	10.00
International status	3.06
University of Hawaii	6.0
TOTAL allocation:	**57.31**

The panel felt that they had treated the International applications fairly and had given allocations of time to those that were deemed practical and doable with the currently available parameters for SCUBA observing. Although a considerable number of hours (49hrs) were awarded to International applications, this does not translate into a large number of 16-hour nights, as shown in the table above.

Use of the Allocated Time

The allocations made by the ITAC for this period are to be observed in serviced mode. There will be no visiting observers, nor will there be any opportunity for PIs to eavesdrop on the observations. The Director, however, requested whether the communities could provide experienced continuum observers to both assist with the observations and also to begin SCUBA experience for the communities. The UK have already offered two observers and we await the reply from Canada and the Netherlands. The ITAC have delivered two ordered queues (one for high-frequency observations - 450 microns or very sensitive 850 microns, the other for lower-frequency observations - typically 850 microns) graded by scientific merit.

The SCUBA personnel will decide which queue to operate at any time. Facilities are in place to insert low-frequency (A-band and some B-band) fallback applications should the weather not be appropriate for continuum obserations. In addition, some of the designated shifts may be used for necesary SCUBA commisisioning or other tests. If SCUBA is not in a fully commissioned state to begin with the highest ranked proposal, the list will be scanned until the highest doable proposal is found.

Use of Daytime Periods

It was noted that Comet Hale-Bopp was a day period object during this observing period. The ITAC recommendations for day period allocations were noted and will be accepted by the Director JCMT and scheduled if possible.

Engineering & Commissioning

The general quota of E&C time for Semester 96B was discussed and allocated at the previous ITAC meeting. This time was completely scheduled during the first half of the semester and it is only for exceptional reasons that further time has been sought.

Six extended days (equivalent to 3 shifts) have been set aside for re-grouting and welding the remaining 5 joints on the antenna azimuth track.

A further 7 shifts have nominally been set aside for other, non-SCUBA E&C requirements that may be neccessary during the period. Should these shifts not be required then they will be returned to the SCUBA 2nd round observing queues.

Fallback Programmes

A number of applications, requesting A-band and some B-band observations, have been approved by the ITAC to be included in the schedule should the weather or the status of the SCUBA instrumentation be inappropriate for continuum observations. These inserted programmes will be apportioned according to the partner funding ratio after 10% has been given to the University of Hawaii. Applicants on these fallback programmes have been informed by the JCMT Scheduler that their time may be scheduled and the PIs have been requested to complete and submit serviced observing templates. These fallbacks will be done in serviced mode by JCMT staff.

Modification of the Semester 97A Application Submission Date

SCUBA will be warmed up in mid-November with the aim of installing modified versions of the 450 micron and 850 micron filters in the slots currently occupied by the 350 micron and 750 micron filters, and making minor repairs to other aspects of the instrument (such as correctly aligning the two arrays with respect to each other). The 350/750 combination is not being offered at present. It is hoped that the modified filters will improve the NEFD sensitivities at both frequencies.

RxB3 is scheduled for commissioning in early December. This instrument replaces (it goes in the same bay in the receiver cabin) the current workhorse, RxB3i, and offers several more observing features in addition to a likely improvement in sensitivity for all B-band observations.

In order to accommodate the possible significant improvement with the sensitivities of the SCUBA filters, and to be able to offer the facilities of RxB3, the Director JCMT has decided, after consultation and approval from the PATT Chairperson and Secretariat, the ITAC members and their respective TAG's and the UH representative, to postpone the submission deadline for applications requesting time in Semester 97A from 30th November 1996 until early in 1997.

Semester 97A will be a 5-month semester, beginning on 1st March 1997 and ending on 31st July 1997. The closing date for applications for this semester is now 10th January 1997 (for ALL applications). The national TAGS will meet in mid-February with an ITAC meeting towards the end of that month.

The Allocations Table

Listings in the following table reflect the allocations made by the ITAC.

Graeme Watt, JAC

(ITAC Technical Secretary & JCMT Scheduler)

PATT ITAC Report for Semester 97A

Allocations

The individual partner TAGs hold meetings in their respective countries prior to the PATT session to assess applications deemed by the JCMT Board rule to be from their own country. At these meetings informal numbers of shifts are nominated for each application in a priority order. The Chairpersons of each TAG bring their respective lists to the PATT where the ITAC combine the awards, include discussion of the engineering and commissioning requirements, and assess the International applications. The final allocations of shifts are made by the ITAC.

Applications to be considered

UK status	40
Canadian status	18
Netherlands status	10
International status	14
University of Hawaii	7
TOTAL:	**89**

The PATT meeting was held at the ROE, Edinburgh, UK on 27th February 1997.

It should be noted that if the PI on an application is a JCMT staff member based in Hilo, then the application is assessed by the appropriate national TAG. However, by Board rule, International status is given to any application where the only named collaborator from any partner country is such a JCMT staff member. International applications are assessed by the ITAC members at their meeting.

Time Available (in 16-hour nights)

No. of nights in semester 96B	153.00
Engineering & Commissioning	42.00
Set aside for SCUBA 2nd round	30.00

University of Hawaii (10%)	7.75
Director's discretionary use	4.00
Available for PATT science:	**69.25**

The above table indicates the order in which nights are removed from the total available for the semester. Semester 97A covers a summer period from 1st March 1997 through 31st July 1997 inclusive. This is a shortened semester due to the inclusion by ITAC of February 1997 into the accounting for semester 96B.

Awards (in 16-hour nights)

UK status	32.00
Canadian status	14.50
Netherlands status	11.50
International status	11.25
University of Hawaii	7.75
TOTAL allocation:	**77.00**

Designated Service time

Allocations for this semester are:

CDN	=	3.5 shifts allocated;
NL	=	0 shifts allocated (but all Netherlands time is flexibly scheduled);
UK	=	2.5 shifts allocated.

Non-standard Instrumentation

The Lethbridge Group have again requested to bring their own Fourier Transform Spectrometer (FTS) system which will be located on the right-hand Nasmyth platform (the other side from SCUBA).

Instrument distribution:

RxA	35%
RxB	39%

RxC	14%
SBI	10%
FTS	2%

Applications with Long-Term Status

L/M/96A/C08 was given a further 3 night shifts and 9 day periods in 97A.

Use of Daytime Periods

There was considerable discussion about how to account for day period usage during the semester. This was prompted by the large amount of time requested by the comet Hale-Bopp observing groups, since the comet is basically a daytime object for the entire semester. Morning half-shifts are appropriate in March and July. It was decided that the ITAC can only allocate observations during the night periods from 17:30 through 09:30. They can recommend to the Director JCMT that certain applications should be considered for daytime observing. Any allocation of time thus given, at the Director's discretion, would not come from the national quotas. The ITAC recommendations for day period allocations were noted and accepted by the Director JCMT.

Engineering & Commissioning

In view of the large amount of time set aside for SCUBA 2nd round observing and for the commissioning of instrumentation (SCUBA and RxW), other E&C tasks have been kept to a minimum for the semester.

Commissioning of the antenna and instrumentation continues, with periods required a) to characterise and improve the surface via metrology and beam map measures, b) to monitor the antenna performance and tracking through pointing and inclinometry runs, and c) to measure receiver performances and efficiencies.

A period of extended days separated at fixed intervals has been set aside for re-grouting and welding the remaining joints on the antenna azimuth track.

Time has been allocated for commissioning of RxW and for SCUBA according to the commissioning plans made available by the instrument builders. There is a non-standard instrument configuration schedule for the new FTS system which requires set-up and calibration time on the right-hand Nasmyth platform. In addition, a single shift has been requested to ensure that the UKT14 polarimeter is setup correctly for use with RxA2.

A short-baseline interferometry session (SBI) has been arranged with the CSO to be run in early May 1997.

SCUBA 2nd Round

A total of 60 shifts have been set aside to be allocated for continuum observations pending the successful commissioning of SCUBA. The applications that had been awarded time at the previous ITAC meeting would remain in the queue. Once SCUBA was available for observing, the applicants would be able to revise their templates in view of the different source avalability and oberving parameters. It is anticipated that the distribution of these shifts will be according to the partner percentages.

It is likely that only the bright photometry applications will be acheivable this semester. All observations will be done in serviced mode with no facilities for remote eavesdropping being provided. The outstanding SCUBA applications will be carried over into semester 97B.

Fallback Programmes

A number of applications have been approved by the ITAC to be included in the schedule should RxW fail to meet the delivery schedules. The commissioning time set aside for these instruments will be apportioned according to the partner funding ratio after 10% has been given to the University of Hawaii. Applicants on these fallback programmes will be informed by the JCMT Scheduler when/if their time is to be scheduled.

In addition, there are numerous heterodyne applications set aside to be included as fallback for the SCUBA 2nd round. These fallbacks will continue to be done in serviced mode by JCMT staff.

Procedures for Semester 97B

The deadline for for semester 97B (August 1st 1997 through January 31st 1998) applications is 31st March 1997. The ITAC have decided that this is to be a HETERODYNE ONLY deadline. It has been decided NOT to invite SCUBA applications for this deadline because revised NEFDs etc will not be properly known until mid-late March at the earliest (following the current cool-down). They felt it better to delay the call for semester 97B SCUBA proposals until reliable figures have been established. Those SCUBA applicants who were successful in obtaining SCUBA time in the first '24-hour' SCUBA call last Autumn would be assured that it is still planned to implement these 'pilot' proposals as soon as SCUBA is performing with the required reliability.

The Allocations Table

Listings in the following table reflect the allocations made by the ITAC. Subsequent re-scheduling may already have modified some of these awards and added others.

Graeme Watt, JAC

(ITAC Technical Secretary & JCMT Scheduler)

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Last Modification Date 1997/03/12 - Last Modification Author: Graeme Watt (gdw)

Successful Applications for Semester 96B(SCUBA)

Semester 96B SCUBA 2nd round Allocations

PATT Number	PI on Application	*HOURS* Allocated	Title of Application
U40	Chandler C J	8	Tests of star formation models - the density structure of protostellar envelopes
U41	Richer J S	8	Evolution of dust grains in protostars and young stellar objects
U42	Eales S A	3	A pilot project for a UK-Canada survey of high-redshift galaxies
U43	Alton P B	9	Dust outflows alnog the minor axis of starburst galaxies
U44	Ivison R J	12	Follow-up observations of dusty radio galaxies at high redshift
U45	Smail I	3	SCUBA imaging of giant arcs: a new probe of star formation in distant galaxies
U47	Minchin N R	2	Mapping the 450 and 850 micron dust emission from S140
U48	Macdonald G H	15	The dust environment of hot molecular cores
U49	Penny A J	3	A search for dust in globular clusters
U54	Ivison R J	15	Continuum observations of symbiotic stars: testing the standard models and the reality of cold dust components
U55	Dey A	6	SCUBA observations of the reddest objects in the Universe
U56	Ward-Thompson D	20	The formation and evolution of pre-stellar cores
U57	Launhardt R	12	Protostellar cores in Bok globules
U58	Motte F	10	Dust properties of starless clumps and protostellar envelopes in Rho Oph
U59	Dunlop J S	24	Probing elliptical galaxy evolution via SCUBA observations of high-redshift galaxies
U60	Unger S	6	Pulsar powered synchrotron nebulae
U63	Fabian A C	6	Self-absorbed emission from hot ion tori: nearby dead quasars
U64	Tothill N F H	2	Searching for recent triggered star formation in Sharpless 283
U67	Gibb A G	9	Determining the mass and status of protostellar clumps in L1630
U69	Fuller G A	9	A search for embedded binary protostar systems
U70	Doyle J G	6	The nature of the far-infrared excess emission in evolved C- and O-rich stars
U71	Tothill N F H	4	The evolution of high-mass star forming regions
U73	Bridges T J	3	The dust distribution in the cooling flow galaxy, NGC 1275
U76	Hughes D H	15	An investigation of the emission mechanism dominating the FIR lumiosity in radio-quiet quasars
U78	Eales S A	15	First measurements of the submillimetre luminosity function and dust function of galaxies
U79	Mathieu R D	9	A deep photometric search for disks in pre-main-sequence binaries
U82	Rawlings J M C	3.5	Density structure of the pre-collapse protostellar core L1498
U83	Dent W R F	4	The heating of dust by outflows
U85	Dent W R F	15	Variations in the dust characteristics across circumstellar disks
U87	Gear W K	12	A search for compact flat-spectrum cores in compact steep-spectrum sources
U88	Gear W K	18	Are X-ray selected BL Lacs different objects frm radio-selected ones?
U89	Holland W S	3	Continuum mapping of proto-brown dwarfs
U90	Holland W S	15	The "Vega Phenomenon" around nearby stars
U91	Holland W S	15	A search for proto-planetary disks around pulsars
U93	Stevens J A	12	The nature of the far-infrared to millimetre continuum emission from Fanaroff-Riley radio galaxies
U94	Richer J S	18	Star formation in Lynds class 6 clouds: a pilot study
U95	McHardy I M	14	Shocked jet models for blazars: coordiinated SCUBA/GRO/XTE/ROSAT/UKIRT monitoring of 3C279
U98	Rowan-Robinson G	3	UK sub-mm survey consortium pilot proposal: a search for sub-millimetre emission from Hubble deep field galaxies
U100	Hatchell J	6	Hot dust in high-mass star formation regions
U101	Mathieu R D	2	Sensitive imaging of submillimetre emission from the GG Tau multiple system
U102	Roche P D	3	Probing the conditions in the outer circumstellar envelope of X Persei
U103	Withington S	12	The thermal nature of the FIR emission in high redshift QSOs
U104	Isaak K G	15	Dust and gas masses in infrared luminous galaxies
U108	Smith K W	3	Mapping the structure of binary forming envelopes: NGC 1333/IRAS 4
U114	Blain A W	3	Submillimetre observations of a hyperluminous star-forming galaxy
U116	Blain A W	3	SCUBA observations of the spectacular cluster 0024+1654
U118	Sylvester R J	8.5	SCUBA photometry of fainter Vega-like stars
U119	Schuster K F S	2	Dust to gas ratio in the envelope of T Tau

TOTAL UK = 424 hours = 53 shifts

N11	van der Hulst J	14	Cold dust in low surface brightness galaxies
N12	Israel F P	3	FIR continuum of dwarf galaxies
N13	Israel F P	3	FIR continuum of extragalactic HII regions
N14	Jaffe W J	3	Nuclear disks in E/S0 galaxies
N15	Jaffe W J	6	Sub-mm dust emission from central galaxies in cooling flow clusters
N16	Hogerheijde M R	14	SCUBA mapping of 450 micron dust emission of the envelopes around embedded, low-mass YSOs in Taurus
N17	Rottgering H J	14	Dust in high redshift radio galaxies
N18	Cimatti A	3	The nature of high-z red galaxies: old or dusty?
N19	van Breugel W	3	Dust in high redshift ultraluminous IRAS galaxies
N20	Snellen I A G	3	The role of dust in Giaghertz peaked spectrum radio sources
N21	Waters L B F M	6	Structure and variability of Be star discs
N22	Dominik C	15	Submillimetre fluxes of Vega-type stars and candidates
N23	Barthel P D	6	The radio to infrared spectral transition in 3CR quasars
N24	Israel F P	3	Submillimetre mapping of the circumstellar disk of Centaurus A
N26	Lehnert M D	8	The cold dust distributions of bright IR-selected starburst galaxies
N27	Molster F J	15	Submillimetre imaging of post-AGB stars
N28	Pottasch S R	1	Submillimetre measurements of planetary nebulae
N29	van den Ancker M	14	Continuum mapping of the environment of Young Stellar Objects
N31	Verheijen M A W	9	The dust content of Ursa Major spirals
N32	Rottgering H J A	3	Dust in candidate proto-galaxies
N35	Israel F P	8	Cool dust in nearby galaxies
N36	Smith I A	6	SCUBA observations of soft gamma-ray repeaters

TOTAL NL = 160 hours = 20 shifts

C30	Mitchell G F	6	Changing grain properties through a PDR
C31	Volk K	8	Sub-millimetre observations of detached dust shells
C32	Taylor C L	8	SCUBA observations of cold dust in starbursting dwarf galaxies
C33	Petitpas G	6	Dust temperature and gas-to-dust ratio of molecular clouds in IC10
C34	Wilson C D	6	The dust temperature and gas-to-dust ratio in nearby normal galaxies
C35	Seaquist E R	12	Cold dust in IRAS galaxies
C36	Frayer D T	12	Accurately defining the dust content of QSOs, radio galaxies, and IRAS galaxies at high redshift
C37	Zhang C Y	8	Circumnebular cool dust shells of compact planetary nebulae
C38	Zhang C Y	3	Submillimetre mapping of the bipolar nebula OH231.8+4.2
C39	Kwok S	12	SCUBA submillimetre observations of proto-planetary nebulae with the 21 micron feature
C40	Avery L W	3	Shock-modified dust grains in compact outflows
C41	Pollanen M D	8	Pre-protostellar/protostellar dust cores associated with methanol masers
C42	Hasegawa T I	3	Far-infrared continuum observations of Barnard 1
C43	Seaquist E R	3	A search for cold dust in M82 and NGC 253
C44	Redman R O	10	Metal content and heterogeneity of the M-type asteroids 16 Psyche and 22 Kalliope
C45	Redman R O	12	Spectra and sampled lightcurves of 3 bright asteroids
C46	Fich M	2	The central source of the bipolar molecular outflow NGC2264G
C47/48	Fich M/Welch G	18	First survey for dust clouds in elliptical galaxies Diffuse dust in elliptical galaxies
C52	Giannakopoulou J	8	Hot dust near giant HII regions in M101
C53	Wilson C D	8	The extended envelope structure of class 0 protostars
C54	Kneller T D	2	Search for possible class 0 sources driving four molecular outflows
C56	Welch G A	6	Cool dust in normal, late-type spiral galaxies
C57	McCutcheon W H	8	Luminosities, temperatures, and structures of IRAS pre-main sequence objects and their environs
C58	Matthews H E	2	Dust in an evaporating globule in a galactic chimney
C61	Matthews H E	8	Thermal dust emission from Centaurus A
C62	Volk K	2	Sub-millimetre observations of extreme carbon stars
C63	Hajjar R	4	Dust properties and distribution of some YSOs

TOTAL CN = 188 hours = 23.5 shifts

I11	Clements D L	6	Are high redshift LIBALs ultraluminous IR sources?
I12	Jura M	3	A protoplanet in the Red Rectangle?
I13	Jura M	3	A long-lived dust disk around RAFGL 3068?
I17	Greaves J S	6	Dust formation in detached circumstellar shells
I19	Moriarty-Sch.G H	6	Density distributions of starless cores in Taurus
I20	Moriarty-Sch.G H	3	Mm/submm properties of proplyds
I21	Sandell G	6	Dust emissivity in elephant trunks and cometary globules
I26	Bourke T L	1	Submillimetre mapping of the compact HII region S88B
I27	Tafalla M	2	Submillimetre emission from two kinematic infall candidates
I28	Huard T L	6	Cold IRAS sources associated with Bok globules: a submillimetre survey of protostellar candidates using SCUBA
I30	Weintraub D A	3	SCUBA mapping of T Tauri and HL Tauri: how big are the thermal emission source regions?
I32	Jackson J M	4	Cool dust in a metal-poor environment

TOTAL INT = 49 hours = 6.1 shifts

H07	Wynn-Williams G	8	SCUBA/JCMT mapping of thermal dust in elliptical galaxies
H08	Jewitt D	16	Rotational lightcurve of Pluto
H09	Jewitt D	0	(22 hrs daytime) Dust in Comet Hale-Bopp
H10	Greene T	8	Systematic investigation of circumstellar envelopes around YSOs in the NGC 1333 cluster
H12	Greene T	6	Physical properties of dust in cold dense cores
H13	Wynn-Williams G	8	Search for hidden AGN in the ultraluminous galaxy IRAS 08572+3915
H14	Wynn-Williams G	0.5	Submillimetre map of W3
H15	Carpenter J	11	Submillimetre continuum observations of clumps in Orion
H17	Jewitt D	15	Dusty main-sequence stars
H19	Ishida C	7.5	Determination of the submillimetre spectral energy distribution and the distribution of dust and luminosity sources in a complete sample of luminous infrared galaxies
H20	Sanders D B	16	Submillimetre continuum observations of high-z powerful radio galaxies

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TOTAL UH = 96 hours = 12 shifts

```
SCUBA 2nd round total 917 hours
Unallocated time       43 hours
E&C requirements       80 hours = 10 shifts
                    -----
TOTAL SHIFTS         1040 hours = 130 shifts
```

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Last Modification Date 1997/03/12 - Last Modification Author: Graeme Watt (gdw)

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Successful Applications for Semester 97A

Semester 97A Allocations

PATT Number	PI on Application	Shifts Allocated	Title of Application
U01	Davis C J	4	Entrainment of molecular outflows in regions of high-mass star formation
U03	Coulson I M	1	Gas temperature in the Vega-excess star SAO 206462
U05	Millar T J	2	Deuterium in hot molecular cores
U06	Hatchell J	4	Excitation in protostellar outflows
U07	Hatchell J	3	Outflows associated with hot cores
U09	Hatchell J	2	Probing the inner regions of hot cores
U12	Collins C A	3**	Molecular line absorption in lensing galaxies
U13	White G J	5	Spectral survey of the highly excited clump CO+0.024-0.28 - the dominant molecular clump at the Galactic Centre
U14	Gibb A G	3	The electron abundance in the molecular cloud G34.3+0.2
U16	Gibb A G	4	Excitation structure of the bipolar outflow from G35.2-0.7N
U21	Harrison A P	2	Single-dish observations of CO and C I in NGC 6240
U22	Smail I	4	CO in giant arcs: mol. gas in a normal spiral galaxy at z=0.7
U26	Evans A	4	A search for molecular gas in metal rich globular clusters
U36	Sakamoto S	3	A search for interstellar MgH absorption towards Galactic continuum sources
U37	Macdonald G H	6	210-280 GHz spectral survey of the hot mol. core G34.3+0.15
U39	Holland W S	3	Magnetic field map of the Galactic Centre, from line polarization
U40	Holland W S	3	A 3-D picture of the magnetic field structure in S140
	UKSERV	2.5	

** = U12 has 1 shift allocated, other 2 are conditional on results, otherwise they are returned to UKSERV.

N03	van der Werf P P	2	A deep search for redshifted [C II] 158 micron emission from the dusty, mol-gas-rich z=4.7 QSO BR1202
N05	Israel F P	4	[C I] and CO in galaxy centres
N06	van der Werf P P	4	A new and more precise measurement of the microwave background temperature at z=0.886
N07	Rottgering H J A	3	A search for C+ emission in the most distant radio galaxies
N09	Boogert A C A	2	Physical conditions & C budget around YSOs with ice bands
N10	van Dishoeck E F	8	Physical and chemical evolution of star-forming regions

C01	Seaquist E R	1	Distribution of HCN(4-3) in M82
C03	Matthews H E	1 (+3 days)	Interstellar and cometary ices: searches in C/Hale-Bopp
C04	Clark T A	0 (4x2hrs solar)	Limb distribution and mapping of HI radio recombination lines & continuum emission across the Sun
C07	Frail D A	4	Shocked molecular gas in supernova remnants
C10	McCutcheon W H	2	Excitation conditions in NGC 6334
C11	Chapman S C	2	The fueling structure of Seyfert galaxy nuclei
C12	Naylor D A	3	Search for tropospheric CO absorption in Neptune
C15	Avery L W	3	Cosmological chemistry - sens. searches in distant galaxies
C17	Jackson J M	4	Low metallicity photodissociation regions: IC 10
96A/C08	Matthews H E	3 (+9 days)	The evolution of the coma of comet Hale-Bopp

	CANSERV	3.5	

I01	Clancy R T	1.5	Mars and Earth atmospheric studies
I02	Davis C J	1	How do stellar jets from young, low-mass stars drive massive CO outflows?
I04	Matsushita S	2	Determining the physical condition of molecular gas around a LLAGN in M51
I05	Tatematsu K	3	Observations of the Gamma Cygni SNR and W28: search for evidence of interaction with molecular cloud
I06	Kamazaki T	2	Searching for the pre-protostellar cores in the Rho-Ophiuchus star forming region
I09	Olofsson H	5	CO(4-3) observations of detached shells around carbon stars

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H01	Eisloffel J	2	The remarkable outflow of the class 0 source Cep E
H02	Eisloffel J	2	A detailed study of molecular outflows from FU Orionis stars
H03	Owen T	2	Enrichment of 15N in Titan's atmosphere?
H04	Meier R	0 (+5 days)	Comet C/1996 O1 (Hale-Bopp), isotopes and search for new molecular species
H05	Sanders D B	6	An unbiased CO & 13CO J=3-2 survey of the Galactic Plane
H06	Jewitt D	1 (+9 days)	Hale-Bopp spectroscopy program
H07	Carpenter J	2.5	Molecular depletion in dense clumps

SBI Applications

U20	Hills R E	2	Interferometric observations of CO in NGC 6240
U27	Chandler C J	1.5	The formation and evolution of protostellar disks and the detection of infall in Serpens
U33	Ward-Thompson D	2	The growth of protostellar accretion disks
C08	Wilson C D	1.5	The disk properties of nearby class 0 protostars: three isolated sources, plus an unusual cluster in Serpens
C09	Wilson C D	1	Molecular gas and dust in Arp 220
#641	Zuckerman B	1.5	The circumstellar environment of TW Hydra
#643	Narayanan G	1.5	Detection of a protostar accretion disk around IRAS 16293
#645	Carlstrom J	3.5	CSO-JCMT Interferometry
#651	Wright M	1.5	Cygnus A at 345 GHz

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SCUBA 2nd round        60      to be divided amongst all parties in the correct proportions
E&C requirements       84
DDT                     8
                    -----
TOTAL SHIFTS IN 97A = 306
```

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Weather and Fault Statistics

The following tables present the weather loss and fault loss for semester 96B. Although semester 96B was extended to include February 1997, these tables only use the standard August through January statistics for compatibility with earlier tables. A hard disk crash in December meant that the December statistics are not available. Full details are stored on database at the JAC. A more detailed description of how these tables are created is also available here.

Month	Avail	Extend	Primary	%	Backup	%
	Hrs	Hrs	Loss		Loss	
August	422.5	17.8	19.5	4.6	11.5	2.7
September	464.0	28.4	19.4	4.2	18.2	3.9
October	448.0	13.2	73.2	16.3	63.7	14.2
November	456.0	9.5	196.5	43.1	177.0	38.8
December	488.0	6.8	198.0	40.6	199.5	40.9
January	464.0	14.5	134.7	29.0	126.7	27.3
Total	**2742.5**	**90.2**	**641.3**	**23.4**	**596.6**	**21.8**

Table 1: *JCMT weather statistics.*

Month	Avail	Total	ANT	INS	COMP	SOFT	CAR	OTH
August	422.5	60.8	0.3	55.5	1.4	2.4	0.8	0.5
September	464.0	14.7	0.0	9.7	1.5	2.9	0.0	0.6
October	448.0	6.8	0.0	1.4	3.5	0.9	0.0	1.0
November	456.0	7.6	2.1	2.5	2.2	0.2	0.3	0.3

December	488.0	20.1	0.1	0.4	0.8	10.5	8.0	0.3
January	456.0	7.1	0.4	5.3	0.3	0.9	0.0	0.3
P(hrs)	**2742.5**	**117.1**	2.9	74.8	9.7	17.8	9.1	3.0
B(hrs)		0.6	0.0	0.3	0.0	0.0	0.3	0.0

Table 2: *JCMT fault statistics. Wherever possible the faults are categorised into ANT = antenna; INS = instrument; COMP = computer hardware; SOFT = software; CAR = carousel; with the remainder going to OTH = other. The figures in the table may not appear to add up correctly due to rounding in the original program. P defines the time lost from Primary projects. The category B(hrs) is the time lost to Backup projects.*

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Derivation of Statistical Information

This note provides some explanation on the method of production of the weather and fault statistical summary for the performance of the JCMT. There is very little manual intervention in the generation of these tables, other than to correct obvious errors, mis-labelled categories, or to complete missing entries (where they can be found from other sources).

o The data are extracted from the reports completed by the telescope operators at the end of their shift, one report for each shift (evening or morning); the shifts are normally of 8 hours duration. Because the change-over of TOs does not occur on the shift boundaries, the shift information is handed over to the following operator who will file the report at the end of shift.

o A completely separate fault reporting system is used by the TOs and other staff to record time lost to faults (including problems which have zero-time lost). This system is used by the staff to identify, trouble-shoot and solve the faults. Each fault should then have an appropriate solve report attached for future reference. This system is not used for generating statistics.

o Input from the TO reports comprises

- \- the actual time scheduled (normally 8 hours);
- \- any extension of this (normally due to good weather and lack of pressing daywork);
- \- loss of time on primary and backup programs due to the weather.;

  (**NB** : in flexible observing mode, the move from a high-frequency primary program to a low-frequency primary program because of a deterioration of the weather conditions does not result in any entry in the 'loss to the primary program' category.
- \- loss of time to primary and backup programs due to faults, divided into 6 categories : ANTenna, CARousel, INStruments, COMputer, SOFtware, and OTHer. These categorizations are performed by the TO at the time of filing and persist in the analysis, although suggested changes in categories are suggested by the notes to the analysis.

  (**NB** : faults are defined as being in respect of subsystems that have been commissioned are therefore expected to work flawlessly. If the instrument under commissioning has a fault, this is not recorded in the log.

  (**NB** : previous correlations between faults as reported in these TO reports and via the separate fault reporting system show high levels of completeness. A similar correlation is also found between the TO reports and any completed Observer Reports for the period.
- \- automated retrieval of weather conditions for the shift in question. These are not analysed further and are not further correlated with the reported conditions.

o Electronic submission of each report automatically triggers the summary analysis program (AUTO_STATS) for the month and semester to date, and the statistics reported to the JCMT Board and in the Annual Report are essentially these results.

o The analysis performed by AUTO_STATS may be repeated following identification and correction of spurious entries, or significant errors in categorization.

o Occasionally reports are not filed on time, and missing reports can seldom be reconstructed. For example, the reporting for Semester 96B apparently misses about 8% of shifts, although this incompleteness may be a result of the incomplete reconstruction of the database following the reported disk crash of 25th December 1996.

Fallback Serviced Observations

During the latter part of semester 96B there was a considerable amount of time set aside for the commissioning of SCUBA and for observations with SCUBA (where the time had been allocated by the ITAC in October). For most of the period the weather was barely useable by the SCUBA commissioning team although a considerable amount of commissioning was undertaken. There were no opportunities to begin the SCUBA 2nd round observing programme.

The ITAC had nominated a significant number of 'fallback' applications for use either when the weather was not suitable for commissioning or when the instrument was in need of repair. These applications were to be completed in serviced mode by members of the JCMT support team.

In addition to the applications above, there were several additional applications that had been awarded time in semester 96A that merited further work. These were primarily A-band requests which could not be fulfilled during semester 96A due to the lack of a working RxA2 for most of the semester. These applications were combined with the semester 96B fallback nominations to form what has now become known as the 'heterodyne fallback queue'.

Each applicant was requested to complete a detailed template for their observations and submit it promptly to the JCMT staff (either to the designated staff support member or directly to Graeme Watt) so that sufficient details were available on the summit for whichever staff member was 'on duty' that night to proceed with whatever application appeared to be most appropriate for the weather conditions at that time and the instrument available.

An approximate value for the percentage completion of each fallback application can be found in the status table. Applicants should note these are only guideline figures. For more detailed infomration on the data obtained, applicants should contact Gerald Moriarty-Schieven (gms@jach.hawaii.edu).

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Prompt entrainment in the `wiggling' molecular jet from RNO 15-FIR

Introduction

How are massive, molecular (CO) outflows driven by collimated jets from young stars? In recent years there has been considerable attention given to this question. Theoretical studies suggest that ambient gas may be accelerated, either in a turbulent mixing layer along the length of the jet, or through the bow shock at the head of the jet. Both models have their advantages: in the turbulent, "steady-state" model, the mixing layer that developes across the interface between the supersonic jet and its surroundings thickens with distance from the source, as jet material and ambient gas is pulled into the layer. Eventually the jet will be completely pinched off and the flow will become fully turbulent and subsonic. Conversely, entrainment in the bow shock or "prompt" model is more localised. Here, the ambient, molecular gas swept up through each bow shock cools rapidly, and although some of the gas may spill down the sides of the jet, a high-velocity "clump" will develop just behind each shock front.

In an effort to distinguish between entrainment models, Chernin & Masson (1995, ApJ **455**, 182) recently measured the distribution of momentum in a number of outflows. They point out that, in the turbulent entrainment model, the momentum per unit length should increase with distance from the source, as more and more of the jet momentum is transfered to the swept up molecular gas. Conversely, in the prompt entrainment model, the momentum decreases with distance from the source as the flow "accelerates" into the lower density regions further out from the embedded outflow source. However, their results proved inconclusive in that the momentum profiles along the six outflows considered peaked roughly in the centre of each flow lobe.

Motivated by these ideas, and unswayed by this disappointing result, we have since mapped, at JCMT in CO J=3-2, the outflow driven by RNO 15-FIR. Early CO maps of this region had insufficient resolution to separate the RNO 15-FIR outflow from other, neighbouring systems. However, in a recent H_2 image of the region, Davis et al. (1997, A&A, in press) discovered a sequence of compact line emission features which imply the presence of a highly-collimated, bipolar outflow driven by RNO 15-FIR. The new CO data confirm the existence of this bipolar flow, and furthermore allow us to distinguish between entrainment models. We achieve this by comparing the submillimetre data with the near-IR observations, and by measuring the distribution of momentum along the flow lobes. We also find remarkable evidence of directional variability along this outflow.

Prompt or turbulent entrainment?

In Fig.1 we present an integrated-intensity map showing the blue-shifted and red-shifted CO outflow lobes superimposed onto a near-IR image of the region. The H_2 line-emission features in this image, labelled A, B and C, are thought to be molecular shocks along the flow axis. The high degree of collimation apparent in the RNO 15-FIR CO outflow and the close association between the CO outflow and the H_2 knots (A, B and C) indicate that the outflow is driven by a collimated jet. Indeed, the spatial coincidence between the 3 peaks in the CO map and the 3 molecular shocks traced in H_2 suggest that (1) these H_2 shocks are those which entrain much of the ambient gas to form the CO outflow, and that (2) the prompt entrainment mechanism dominates over turbulent entrainment.

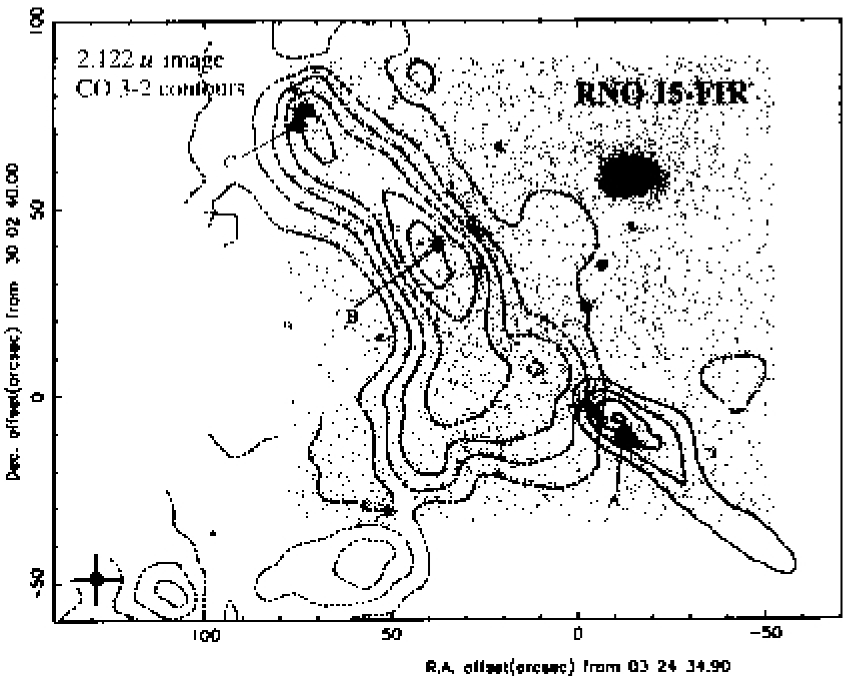

Figure 1: *A 2.122 micron image of the RNO 15-FIR outflow region with, overlayed, contours of the high-velocity CO 3-2 emission. The cross marks the IRAS position of the outflow source RNO 15-FIR; the neighbouring source, RNO 15, which also drives a CO outflow (in a northwest-southeast direction) is offset by (108" , -58") from RNO 15-FIR. Note how the red-shifted flow lobe from RNO 15 encroaches on the red lobe from RNO 15-FIR.*

In Fig.2 we plot the mass per unit length (dM/dR), momentum per unit length (dP/dR), and mean velocity per unit length (d/dR = [dP/dR]/[dM/dR]) along the outflow axis, integrated across the width of the flow and over the high-velocity blue-shifted and red-shifted line wings. In both the northeastern, red-shifted flow lobe, and the southwestern, blue-shifted flow lobe, the mass and momentum decrease with distance from the source. This decrease is most dramatic in the blue-shifted lobe (at negative offsets in Fig.2). The mean velocity, on the other hand, appears to be relatively constant along both flow lobes.

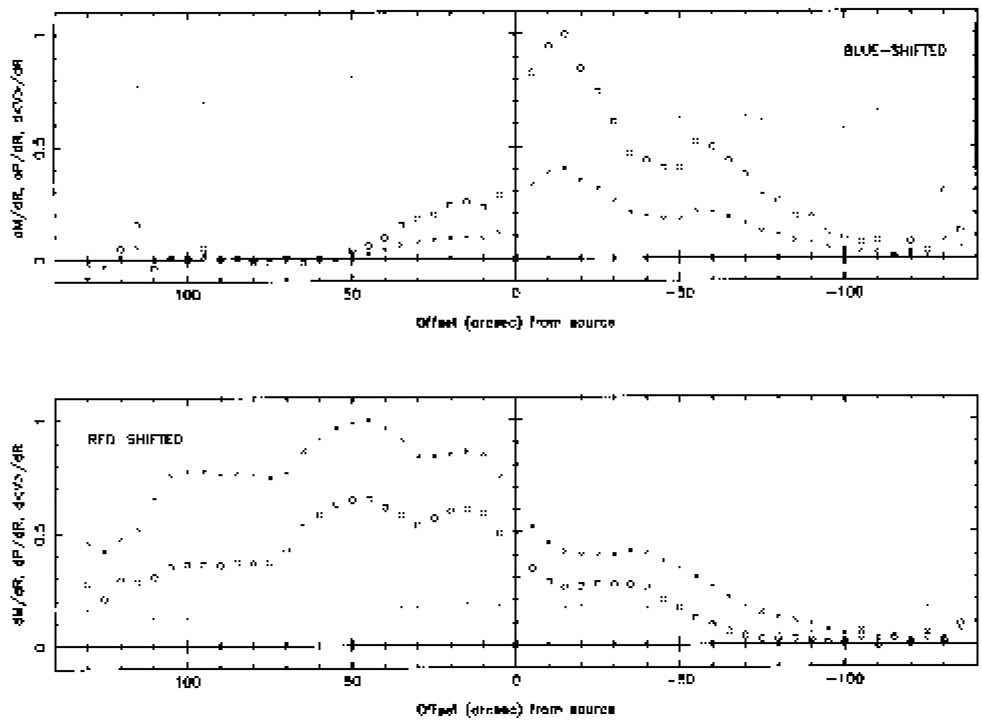

Figure 2: *Distribution of mass (integral T_b.dv -- crosses), momentum (integral T_b.v.dv -- dots+circles), and mean velocity (dots) along the RNO 15-FIR outflow axis. Profiles for the blue-shifted (v < 2.0 km/s) and red-shifted (v > 7.4 km/s) high-velocity gas are plotted, measured at 5" intervals, from the sum of spectra in strips perpendicular to, though centred on, the outflow axis. dM/dR, dP/dR and d/dR are normalised to the maximum measured values. The offsets are in arcseconds from RNO 15-FIR (positive `x' is towards the northeast).*

Opacity at low outflow velocities is likely to have the most severe effect on the mass and momentum estimates in Fig.2. However, these errors have little influence on the {emphasise distribution} of mass and momentum, since the mass and momentum profiles have the same overall shape in spite of the fact that the momentum is weighted to higher velocities. Consequently, the profiles in Fig.2 are believed to be an accurate representation of the true distributions. The {emphasise decreasing momentum profiles}, in both the blue-shifted and red-shifted flow lobes, therefore add considerable weight to the idea that {emphasise the prompt entrainment mechanism dominates in RNO 15-FIR}.

Variability in the RNO 15-FIR molecular jet

Curving molecular outflows have been observed in a number of star-forming regions. However, a ``wiggling'' molecular outflow has, to our knowledge, so far not been reported. Variability in jets is seemingly a common occurance so it seems reasonable that jet-driven molecular outflows might also show signs of directional variability.

The high-velocity flow lobes in Fig.1 hint at regular deviations in the outflow direction from the nominal flow axis. To examine this possibility, we have fit a gaussian profile to the integrated intensity contours in Fig.1, at 5" intervals along the RNO 15-FIR outflow axis, each gaussian being perpendicular to the flow axis. A straight line fit through these points leads to a more precise measure of the orientation of the outflow axis, which we find to be 47.2 degrees E of N.

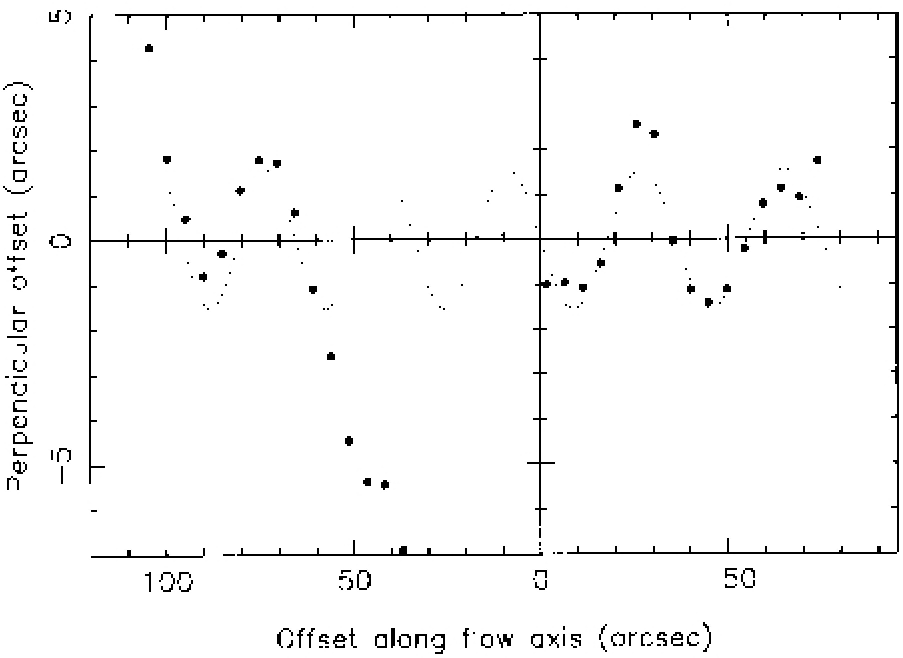

Figure 3: *Plot of high-velocity emission centriods (thick dots) along the outflow axis. A sinusoidal least-squares fit is also plotted.*

The centroid of each gausian fit is plotted in Fig.3; here, the nominal outflow axis is orientated along the x-axis. The deviation of each point from this x-axis we therefore consider as being due to the wiggling of the molecular flow. The plot in Fig.3 suggests a sinusoidal distribution, so we fit these data with a function of the form y = Asin(2.pi/B)sin(2.pi.x/(lambda - xC), where x is measured (in arcseconds) along the outflow axis. We have excluded from this least-squares fit data points in the range 0" -- 55" , because here the RNO 15-FIR outflow overlaps the red-shifted outflow lobe from another, nearby source, RNO 15 (the end of the red lobe from RNO 15 is evident to the southeast of RNO 15-FIR in Fig.1). To the remaining points we obtain a good fit, which indicates that the outflow is indeed wiggling, with an amplitude A = 2.4" and wavelength lambda = 35.0". We also find that B = 9.0" and C = 0.03, and that the function is point symmetric.

Chris Davis & Tom Ray, Dublin Institute for Advanced Studies

Jochen Eisloffel, Thuringer Landessternwarte, Tautenburg

Tim Jenness, Joint Astronomy Centre

Observations of Comet Hale-Bopp

Introduction

Comet 1995 O1 (Hale-Bopp) was first reported during 1995 July while still well beyond the orbit of Jupiter. Although comets are notoriously fickle, coma activity in Hale-Bopp presently continues to be strong, suggesting that Marsden's prediction (1995), comparing it to the Great Comets of the 19th Century, remains valid. Hale-Bopp therefore seems to present an extremely rare opportunity, and the first such in the modern era of mm/submm telescopes, to investigate a bright long-period comet through all the stages of its development during its passage through the inner solar system.

We made the first mm-wave detection of Hale-Bopp with the JCMT in the CO 2-1 transition in early September 1995 when the comet was still at a distance of 6.7 a.u. from the Sun (Matthews *et al* , 1995). At this distance comets are too cold for the formation of the coma to be driven by the sublimation of water ice, and the detection of CO in Hale-Bopp was further vindication of the idea (suggested by observations of P/Schwassmann-Wachmann 1 by Senay & Jewitt, 1994 and Crovisier *et al* , 1995) that at such large distances the sublimation of more volatile ices such as molecular nitrogen or carbon monoxide drive the coma.

On the basis of these results, subsequently confirmed at IRAM (Rauer *et al*. 1995), and the exceptional promise of Hale-Bopp as a major comet, we submitted a request jointly to the CTAG and the UH TAG for observations covering four semesters beginning in February 1996. The Canadian program was awarded long-term status. The UH companion programs continue to gain time each semester. In the latter part of 1996 (and also throughout 1997) Hale-Bopp is largely a daytime object, and we have benefitted from a special arrangement by the Director, JCMT allowing such observations.

Observations so far

Using observations made during daytime `override' time in 1995 September through November we showed (Jewitt *et al* , 1996a; see also Biver *et al* , 1996a, and Weaver, 1996) that Hale-Bopp was undergoing an extremely rapid increase in its CO production rate Q(CO), such that the relationship Q(CO) proportional to R(-9.4) provided a good fit to the data. In retrospect it would appear that this was a surge in outgassing in response to increasing insolation, since subsequently the CO output dropped significantly before recovering. Some models suggest (eg: Prialnik, 1997) that such bursts are to be expected at the onset of early outgassing at large distances from the Sun, perhaps due to a runaway transition from amorphous to crystalline ice in the outer layer of the comet nucleus.

CO is easily released from the water-ice matrix, but its vaporization behaviour is quite different from that of other, more complex, trace constituents of cometary ices. One of the goals of our program was therefore to catch the onset of outgassing of different molecules. On 1996 April 8 we detected HCN 4-3 for the first time (Jewitt *et al* , 1996b), and subsequently CH3OH was detected (Womack *et al* , 1996; Biver *et al* , 1996b) in two different pairs of transitions.

We have continued to monitor both CO and HCN output intermittently as the telescope schedule, instrument availability, and weather has allowed. Except for the earliest work reported in Jewitt *et al* (1996a) we have used almost exclusively the CO 3-2 and HCN 4-3 transitions for this work. Recent CO 3-2 line strengths are about 0.8K Ta* (as compared to 0.1K Ta* at discovery in the CO 2-1 transition), while the HCN 4-3 line is now typically 3-4K Ta* . Some of our spectra illustrating the development of the line emission are shown below in Figure 1.

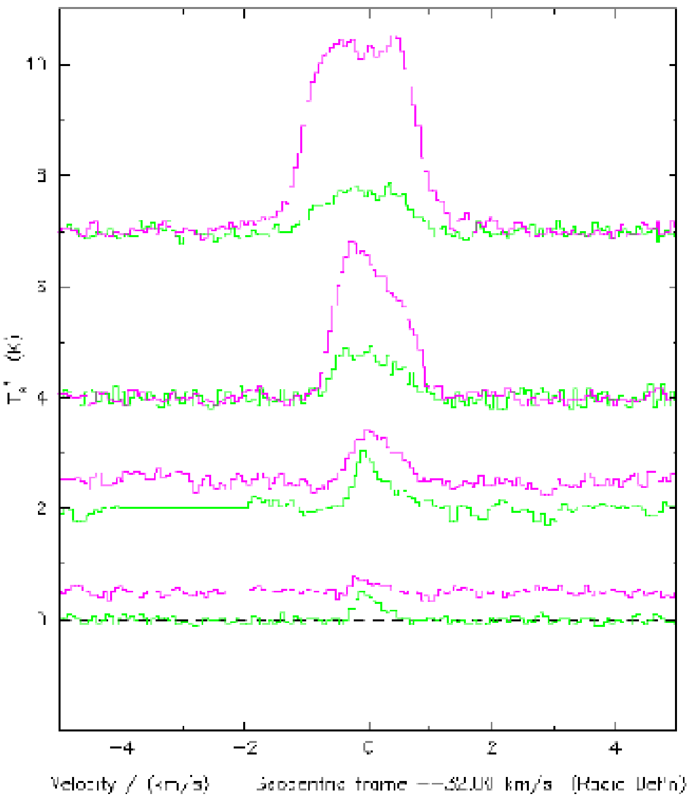

Figure 1: *Spectra of CO (in green) and HCN (purple) observed on four epochs (from bottom to top, UT 1996 May 17, August 11, and November 30, and 1997 January 18). Spectra are offset vertically from one another for clarity, as appropriate, and aligned on a common velocity scale. The 1996 May 17 HCN spectrum is the discovery spectrum of HCN. The telluric CO line has been removed from the 1996 August 11 spectrum, resulting in the flat section of the spectrum. All observations were made in frequency-switched mode. The first three were obtained with the interim receiver B3i. The last was taken with the new receiver B3 using both polarization channels, and a double-sideband configuration which permits the simultaneous observation of CO 3-2 and HCN 4-3, now possible due to the change of the IF from 1.5 GHz with B3i to 4 GHz with B3.*

In Table 1 we give outgassing rates for CO and HCN (*Q*(CO) and *Q*(HCN)) for each of the spectra in Figure 1. R and Delta are the comet-Sun and comet-Earth distances respectively, T(ex) the estimated excitation temperature, and V(exp) the coma expansion velocity.

UT Date	R	Delta	T(ex)	V(exp)	Q(CO)	Q(HCN)
	a.u.	a.u.	K	m/sec	mol/sec	mol/sec
17-May-1996	4.38	3.75	15	400	3.3 x 10(28)	9.9 x 10(25)
11-Aug-1996	3.48	2.74	20	470	5.6 x 10(28)	3.5 x 10(26)
30-Nov-1996	2.14	2.93	40	600	1.1 x 10(29)	1.4 x 10(27)
18-Jan-1997	1.53	2.26	45	750	1.3 x 10(29)	2.7 x 10(27)

Table 1: Hale-Bopp: observed outgassing rates for CO and HCN

As is apparent even in Figure 1 the original dramatic increase in CO outgassing has slowed considerably, presumably as the near-surface supply of CO is depleted. At the same time the HCN line has become very much stronger. As Hale-Bopp approaches the Sun there is also a major increase in the widths of both lines. This effect was also seen in Comet Hyakutake during the campaign in Spring 1996.

As shown in Figure 1 the more recent HCN (and to a lesser extent CO and CH3OH) spectra show the development of a central dip in the profile, as was also seen in Hyakutake in March 1996. Earlier spectra show clear asymmetry in the line shape which results from anisotropy in the emission of gas from the nucleus. Shown in Figure 2 is the result of a fit to one clearly assymetric line profile in which a free parameter is the ratio of outgassing rates from the day- and night-sides of the comet nucleus. Within the baseline uncertainties the data and the model agree rather well.

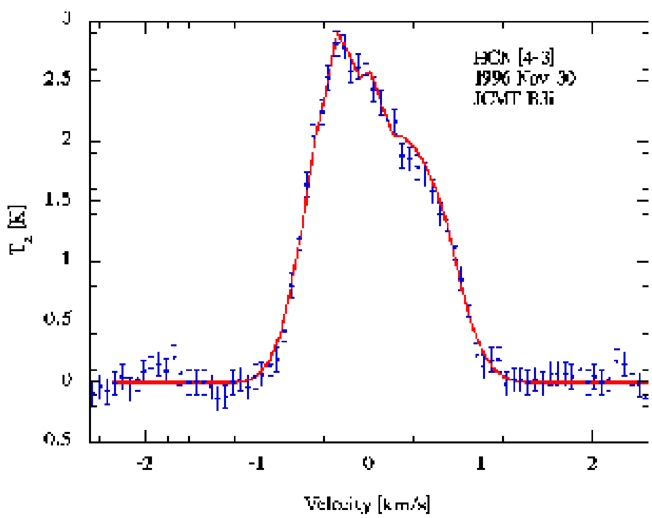

Figure 2: **A model of the HCN 4-3 line compared with observations from 1996 November 30. This shows the fit of an outgassing model in which the ratio of day to night emission rates is 3:1.**

The HCN 4-3 line in Hale-Bopp is so bright that it is possible to carry out mapping observations with very short integration times. A test observation of this type is shown in Figure 3; although somewhat of a curiosity at this point, having been taken under relatively poor conditions, it nevertheless shows that such observations are within our capability and should allow for detailed mapping of the coma out to several beamwidths.

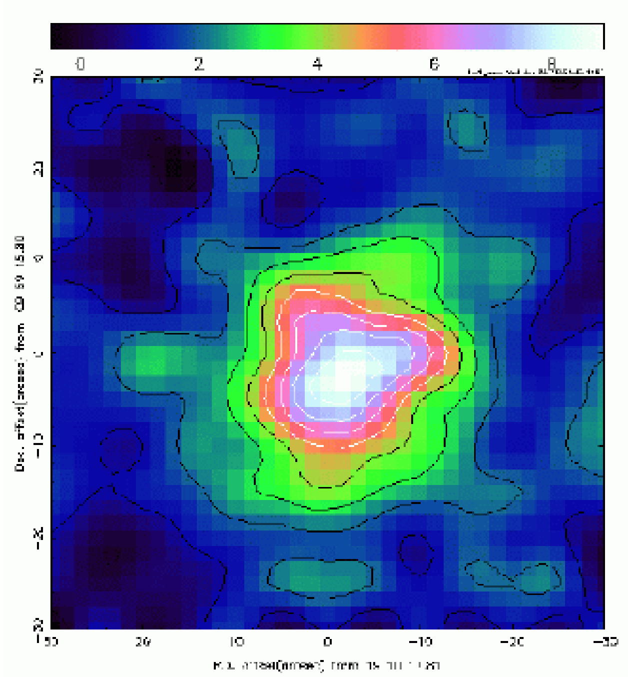

Figure 3: **HCN 4-3 map of Hale-Bopp obtained on UT 1997 January 18 using receiver B3 under marginal conditions. In this "on-the-fly" (raster) map the integration time was 5 seconds per point and the sampling interval 5 arcsec. The total time used to obtain this map was about 17 minutes.**

It is possible to observe the HCN and HNC lines simultaneously with the new receiver B3. One example of these data is shown in Figure 4. The HNC 4-3 line was first detected in Hale-Bopp using B3i on UT 1996 December 1 (Matthews, Jewitt & Irvine, 1996), and, as in Hyakutake (see Irvine *et al* , 1996) the ratio R = [HNC]/[HCN] is typically 6% or 7% when optical depth effects are taken into consideration. This argues for a origin at a temperature of a few tens of degrees, if the molecular abundances are primordial, consistent with an interstellar origin. Since comets are believed to be fragments of the protosolar nebula it is important to attempt to rule out significant photo-processing of HNC during close approaches to the Sun by measuring R as a function of heliocentric distance. So long as the HCN line remains at present levels of a few K Ta* this would appear to be a straightforward task.

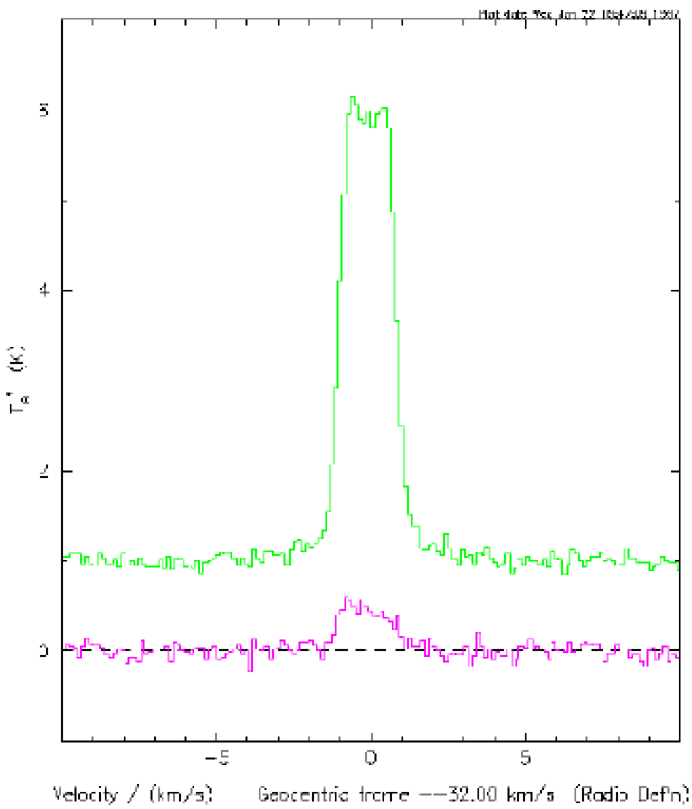

Figure 4: **HCN (upper spectrum) and HNC 4-3 observed in Hale-Bopp on UT 1997 January 18. These data were taken with the new receiver B3 in single-channel mode, using frequency-switching. Both lines were observed simultaneously using a double-sideband configuration. The calibration of these particular data is not yet complete; since the ratio of HCN to HNC and its variation with heliocentric distance is a key question in settling whether the HNC abundance is primordial, this matter needs to be settled rather carefully.**

Lessons from Comet 1996/B2 (Hyakutake)

Comet Hyakutake, discovered only in 1996 February, made a spectacular passage close by the Earth in March 1996 and provided an excellent "dress rehearsal" for the Hale-Bopp program. HCN and CO were both first detected (Matthews *et al* , 1996a; Senay *et al* , 1996b) at the JCMT in this object shortly after its discovery. Subsequently, in collaboration with other members of a JCMT target-of-opportunity consortium, we were able to map Hyakutake during close approach (about 0.1 a.u.) in the CO 3-2 and HCN 4-3 lines. We obtained the first detection ever in a comet of HNC, and the first sub-mm detection of CS in a comet (Matthews *et al* , 1996b). We were able to use two transitions of CH3OH to monitor the temperature of the coma, and we detected H2CO also. Finally, we obtained for the first time ever the mm/sub-mm dust spectrum and rudimentary mapping of a comet on two separate nights (Matthews *et al* , 1996c; Jewitt & Matthews, 1997).

There are some useful experiences gained from the Hyakutake campaign which can be applied to the next phases of our Hale-Bopp program. On the other hand, there are two major differences which should indicate caution in making such a comparison:

1. Hyakutake was a small comet (its nucleus less was than 3 km in size) whose close approach to Earth happily made mapping observations possible. Hale-Bopp is much larger (40 km, give or take a factor of two), but will never come closer to Earth than about 1.4 a.u. However, the considerable coma activity of Hale-Bopp is more than likely to compensate for the increased distance. Present line strengths in Hale-Bopp at more than 2 a.u. from the Earth are similar to those from Hyakutake at a geocentric distance of 0.2 a.u.

2. Hyakutake showed a wealth of mm/sub-mm spectral lines while in the vicinity of Earth's orbit, but once subjected to more extreme temperatures close to the Sun, most of the emission faded away. The molecules were being either pushed into higher excitation levels (with a corresponding increase in the partition function), or destroyed. In the case of Hale-Bopp there is the more favourable situation that it never gets closer to the Sun than about 0.9 a.u., and for this reason excitation temperatures should remain moderate, and Hale-Bopp should be a strong source of mm/submm spectral line emission throughout the course of the long-term program.

Continued observations of Hale-Bopp through 1997

During the early part of 1997, Hale-Bopp moves inbound from *R* = 1.4 a.u., through perihelion, to *R* = 2.0 a.u. Within this interval the predominant driver for coma formation is H2O (see for example Jewitt *et al* , 1996a).

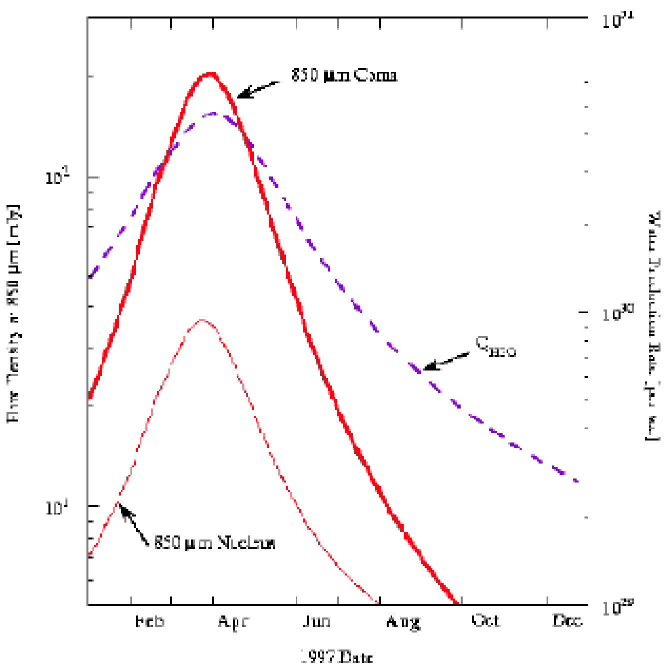

Figure 5: *Hale-Bopp in 1997: predicted H2O outgassing Q(H2O) and 850-micron continuum flux densities from the coma and nucleus, as a function of time. This figure uses recent outgassing rates, and assumes that the diameter of the nucleus is 40 km. Recent observations by Kreysa et al (1997) indicate that the flux density from the coma may be considerably greater than in this model.*

In Figure 5 we show the predicted H2O sublimation rate as a function of time, together with the flux densities at 850 micron from the coma and nucleus. The behaviour of CO outgassing is perhaps less predictable, particularly after perihelion, since it will depend on the amount of CO in the surface layers of the nucleus.

For one thing it is to be expected that this model is simplistic in predicting smooth changes with time in the coma. A detailed model recently advanced by Prialnik (1997) makes specific predictions about the behaviour of CO, H2O and dust release rates from the nucleus of Hale-Bopp, which we should be able to test with our program of observations at the JCMT. In this model a runaway conversion of surface amorphous ice to a crystalline form drives a series of outbursts of CO (carrying dust to form the coma and to build a dust mantle on the surface of the nucleus) which begins when the inbound comet reaches heliocentric distances of around 6 or 7 a.u. That such outbursts mimic rather well that seen by Jewitt *et al*. (1996a) when Hale-Bopp was first detected lends support to Prialnik's model.

The amorphous/crystalline phase change boundary proceeds inward from the surface of the nucleus quickly at first, leading to a very porous outer layer. However, the process is self-limiting, and eventually the boundary essentially stalls at a few metres below the surface, by which time a porous dust mantle perhaps 10cm thick has formed and which serves to dramatically raise the temperature. From this time on, changes are more gentle; the CO (and dust) outgassing rate tends to flatten out. Beyond perihelion the CO output is predicted to remain fairly steady, and then slowly decline, at a somewhat lower level than the pre-perihelion rate, while the H2O outgassing continues to decline more rapidly. Around the same time the dust (and thus coma) output shows a sharp decrease. It is very likely that at this time a fairly thick and relatively impenetrable layer of crystalline ice has built up just below the surface of the nucleus.

The program proposed here consists of three main sections, aimed at testing models such as that discussed above. In this we take into account also our experiences in the Hyakutake campaign. We aim to (1) monitor the line emission characteristics of key constituents of the coma, (2) assess the chemical composition of the coma and its provenance via isotope ratios, and (3) determine the dust properties of the coma.

1. Monitoring key tracers of the physical and chemical state of Hale-Bopp.

HCN 4-3 (354.5 GHz);

CO 3-2 (345.8 GHz);

CH3OH and H2CO (to obtain temperature estimates)

With Hale-Bopp we have a unique opportunity to monitor the development of activity in a major comet from before water sublimation begins to perihelion and beyond. Systematic observations should show the transition from CO-dominated outgassing to H2O-dominated outgassing and back, and give greater insight into the complex physical phenomena which control the coma development of comets in the inner solar system. The total CO outgassing rate is itself a measure of the area of CO exposed to solar heating. Systematic observations will show how the CO is depleted by prolonged solar heating, and give clues concerning the sizes and lifetimes of active vents on the cometary nucleus. Further, variations in line shape, if observed with a suitable time increment (eg: 1 hour) can reveal the nuclear rotation rate and the development of active vents on the nucleus.

HCN is the most probable parent of CN, which gives rise to the strongest features in cometary optical spectra. We hope to be able to compare simultaneous observations of the HCN 4-3 transition with optical images in the CN lines taken at the UH 88-inch telescope in order to understand the connection between the two species.

2. Chemistry within the coma.

In particular, isotope abundances are of key importance to cosmogonical questions. The early detection of abundant CO shows immediately that Hale-Bopp formed at the low temperatures (< 50 K) characteristic of the solar nebula beyond 30 a.u.

a) We should be able to determine both 12C/13C and 14N/15N from observations of isotopomers of CO and HCN. Typically line temperatures of 2-3K Ta* are required in the main isotope lines for this to be feasible, and these have already been achieved, at least for HCN. Hence at present H13CN and HC15N offer the best possibilities, but require exceptional conditions.

b) Sulfur-bearing molecules such as SO and SO2, H2S and CS (both known in Hyakutake), H2CS.

c) Methyl group molecules such as CH3CN and CH3OH, both already known in Hale-Bopp , provide routes to the determination of excitation temperature.

d) Deuterium molecules, in particular HDO and DCN. HDO were detected at CSO at 464 GHz (Lis *et al* , 1996) in Hyakutake and provides an important route to the H2O abundance. It is likely only a matter of time before it is detected in Hale-Bopp . A second transition of HDO at 490 GHz should be considerably stronger and offers another way to determine the excitation temperature. We have recently attempted DCN 5-4, but we have not yet had the excellent conditions required to achieve a useful sensitivity.

e) Ions such as CO^+ and H_2O^+ are known from optical spectra and are important targets. Also H_3O^+ and HCO^+ present interesting possibilities.

3. Characterising the dust coma

Observations using UKT14, in particular our work on Hyakutake (Jewitt & Matthews, 1996), show that cometary dust masses are much greater than expected. Submillimetre observations are sensitive to particles of typical size around 1 mm, and these contain a large part of the dust mass. The specific goals we have are:

a) Determination of the dust mass and dust mass loss rate as a function of heliocentric distance. These data will be used to determine the physics of the dust ejection from the nucleus. We would expect a significant difference also in these quantities on opposite sides of perihelion; a recent detailed model (Prialnik, 1997) shows a fairly precipitous decline beginning immediately following perihelion, in contrast to the gas output.

b) Determination of the plane-of-sky morphology of the dust coma at 850/450 microns. The morphology places strong constraints on the dust particle size, as a result of sorting imposed by solar radiation pressure.

c) Determination of the frequency dependence of the opacity, which in turn informs us about the grain size. In Hyakutake we found that the opacity index was Beta = 0.84 +/- 0.11, typical of that found for dust envelopes around young stars. There are three key issues to be resolved in the case of cometary comae: (1) do all comets show the same value of Beta? (2) If not, can Beta be used to characterize origins in different parts of the protosolar cloud? (3) Does Beta vary with heliocentric distance? The last of these points can be answered to some degree in Hale-Bopp by time-resolved observations using SCUBA.

As shown in Figure 5 we have used recent outgassing rates to estimate the 850-micron continuum flux density of Hale-Bopp. Continuum observations were omitted from the original submission since SCUBA was not being offered in semester 96A. Although there are considerable uncertainties involved, by the beginning of March 1997 we find that the emission from dust in the coma should reach 100 mJy, and peaks at around 200 mJy at perihelion. The nucleus should be detectable also, peaking at around 40 mJy. This assumes that the size of the nucleus is 40 km, although there is a factor of about two uncertainty in this number.

Very recently (February 5) however, Kreysa *et al* (1997) have reported the first detection of continuum emission with a flux density of about 100 mJy from the coma of Hale-Bopp at 250 GHz with the IRAM telescope. Extrapolation to 850 microns using the value of Beta we found for Hyakutake indicates a flux density of about 250 mJy would be seen at this wavelength at present. This suggests that our model of Hale-Bopp considerably underestimates the dust mass in the coma. If this detection is confirmed then we might expect the 850-micron flux density at perihelion to be about 2 Jy.

References

Biver, N., *et al* , 1996a; Nature, **380**, 137

Biver, N., *et al* , 1996b; IAUC 6386

Crovisier, J., *et al* , 1995; Icarus, **115**, 213

Irvine, W.M., *et al* , 1996, Nature, **383**, 418

Jewitt, D., Matthews, H.E., 1997; A. J., in press (for March)

Jewitt, D., Senay, M.C., Matthews, H.E., 1996a; Science, **271**, 1110

Jewitt, D., Senay, M.C., Matthews, H.E., 1996b; IAUC 6377

Kreysa, E., Altenhoff, W., Haslam, C.G.T., 1997; IAUC 6555

Lis, D., *et al* ,1996; IAUC 6362

Marsden, B.G., 1995; Science News, **148**, 103

Matthews, H.E., Jewitt, D., Senay, M.C., 1995; IAUC 6234

Matthews, H.E., Senay, M.C., Jewitt, D., 1996a; IAUC 6318

Matthews, H.E., *et al* , 1996b; IAUC 6353

Matthews, H.E., *et al* , 1996c; IAUC 6363

Matthews, H.E., Jewitt, D., Irvine, W.M., 1996, IAUC 6515

Prialnik, D., 1997, preprint

Rauer, H., *et al* , 1995; IAUC 6236

Senay, M.C., Jewitt, D., 1994; Nature, **371**, 229

Senay, M.C., Matthews, H.E., Jewitt, D., 1996a; IAUC 6312

Senay, M.C., Matthews, H.E., Jewitt, D., 1996b; IAUC 6335

Weaver, H.A., 1996; Nature, **380**, 107

Womack, M., *et al* , 1996; IAUC 6382

H.E. Matthews (JAC/HIA), D. Jewitt (IfA, Honolulu), & M.C. Senay (U.Mass).

For further information and observations of comet Hale-Bopp, Dave Jewitt has an excellent homepage HERE

Hot Starbirth in The Lagoon Nebula

Astronomers today announced the discovery of a very bright region at the centre of the famous Lagoon Nebula, where stars are being born.

The intense radiation was discovered at the centre of the Lagoon Nebula by an international team of British, Canadian, Swedish and German astronomers. Here, the embryonic stirrings of newly forming stars interact with their placental material, producing the exceptionally intense emission.

The Figure shows optical and infrared pictures of the Lagoon Nebula, and a map of the submillimetre wavelength light of the carbon monoxide (CO) molecule. The bright spot on the CO molecules map shows the location of the region where the new stars are forming. Star Formation is one of the key topics in modern astronomical research, and is fundamentally important as a precursor to the birth of Planetary Systems and the origins of life.

The Lagoon Nebula, which lies some 5,000 light years away in the constellation Sagittarius, is a region where stars are currently being born. The optical and infrared radiation shows the location of ionised gas and hot dust, which is illuminated by the light of generations of stars formed millions of years ago. By contrast, the bright spot on the CO molecular image shows just where the new stars are about to be born. The spectrum at the bottom shows the unusually intense CO emission is almost 130 degrees above abolute zero, some 10 times greater than typical of similar star forming regions in our Galaxy.

The present day star formation in The Lagoon Nebula occurs inside a dense clump of gas weighing more than 30 times the mass of our Sun, and which has a diameter of about 1 light year. This stellar factory is heated by the radiation from the newly forming star(s), which are just a few thousand years old, and by the nearby hot star Herschel 36, at the centre of The Lagoon Nebula, which is responsible for much of its striking optical appearance.

The Lagoon Nebula, and similar objects such as the well known Orion Nebula (the only place known in our Galaxy where CO molecules are found to be hotter, and the radiation is more intense than towards The Lagoon Nebula), are now being studied in great detail to give clues as to how stars are born.

The discovery of a source of CO emission this bright came as a total surprise, since this molecule was first detected in space some 27 years ago, and observatories around the world are regularly able to detect it. It's rather like a naked eye astronomer, who previously only was aware of the bright Sun and the much fainter stars, suddenly noticing something new in the sky as bright as the moon. This discovery has been made possible using a submillimetre wavelength telescope, the 15 metre diameter James Clerk Maxwell Telescope in Hawaii. This telescope gives much clearer views of the earliest phases of star formation, and has enabled this important discovery to be made. Studies like this pave the way for the coming generation of sub-millimetre wavelength array telescopes and large infrared wavelength optimised telescopes such as Gemini which will be able to probe more deeply into the material surrounding star formation regions which obscures the escape of optical wavelength emission.

This work is based on observations at the James Clerk Maxwell Telscope in Hawaii, the Anglo-Australian Telescope, the ESO/MPG 2.2 m Telescope in Chile and public data retrieved from the HST Archive. The data were collected by a team consisting of Glenn White and Nick Tothill (Queen Mary and Westfield College, London University), Henry Matthews (Joint Astronomy Centre, Hilo and National Research Council of Canada), Bill McCutcheon (University of British Columbia), Monica Huldtgren (Stockholm Observatory) and Mark McCaughrean (MPI fur Radioastronomie, Bonn).

For further information, visit the QMW Web site.

Last Modification Date 1997/03/12 - Last Modification Author: gdw
Graeme Watt (gdw)

JAC Internal Science Seminars

All visiting astronomers are encouraged to give scientific presentations to the JAC staff after their observing run. In addition, many of the JAC staff give presentation on their current research topics.

The seminars are organised by Gerald Moriarty-Schieven. A list of those given during 1996 can be viewed here

A list of those given to date and arranged for the future during 1997 can be viewed here

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Distribution:

The **JCMT Newsletter** is now no longer distributed in paper form. Information about new issues is circulated to the community via the electronic distribution list held at the JAC, and also via the Canadian listserver. Anybody wishing to be placed on this mailing list should contact the Editor.

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On-line Documentation:

All up-to-date information on the JCMT and instrumentation is maintained through links from the JCMT homepage on the World Wide Web.

The JCMT homepage has URL:

/JCMT/home.html

Service Observing:

Applications should be sent by e-mail to the following:

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Netherlands             vdhulst@astro.rug.nl

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NEXT ISSUE DEADLINE

The absolute deadline for submission of science and/or technical articles for the next issue of this Newsletter is **31st July 1997**. All communications regarding this Newsletter should be sent via email to **gdw@jach.hawaii.edu**.

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Acknowledgements

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The JCMT Newsletter is the official publication of the James Clerk Maxwell Telescope. This issue (number 8) is the first that is ONLY available in html format on the World Wide Web. ***There is no paper magazine that corresponds to these pages.*** *This is taken to be a sign of the times, where most, if not all, of the readership has access to an internet terminal. It means that the information presented can be made more up-to-date. Notice that several of the articles now refer directly to other links on the Web both internal to JCMT and on the odd occasion to external sites. It also means that the rapidly dwindling cash supply available for printing booklets can be channeled into other worthy causes.*

The cover picture is a photograph taken by Wayne Holland of some strange lenticular clouds that were seen on several days over the summit of Mauna Kea (and Mauna Loa) during December 1996. One of these photographs was reproduced on the front page of the Hawaii Tribune Herald. Wayne has this photograph and a few others stored here

Contributions are solicited from recent observers, instrument builders and from the staff at the Joint Astronomy Centre.

Articles for The JCMT Newsletter may be submitted to me at any time. Please take note of deadlines for specific issues. If you wish to make any comments on the articles, please contact the authors. If you have any comments concerning the Newsletter itself, format and/or content, then please contact me.

The JCMT Newsletter is ***NOT*** *a refereed journal but remains as the voice of the JCMT User community. It is appropriate that the content clearly reflect the state of the observatory, the availability of the instrumentation, and the quality of scientific output obtained. The former two features can be completed by the JCMT staff whilst the latter is primarily up to the user (and reader). Please contribute to your newsletter.*

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Thank you for taking the time to read this Newsletter.

Graeme Watt