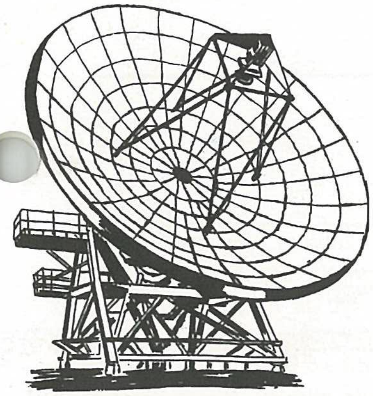

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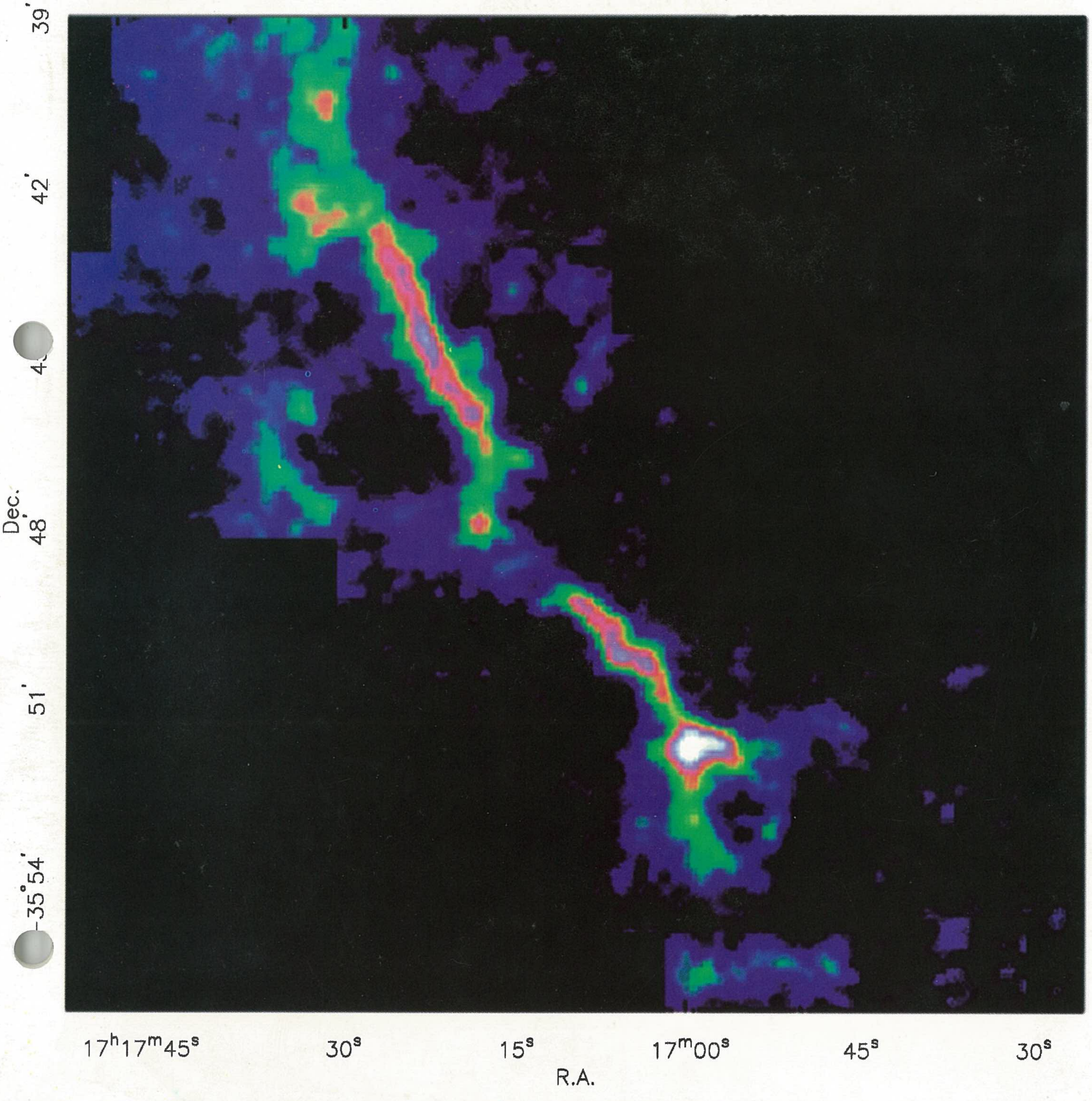

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Front Cover: **The distribution of $C^{18}O$ emission within the large star-forming region NGC 6334. See article in Science section.**

Back Cover: **An image of the ^{12}CO (2 - 1) molecular bipolar outflow in NGC 2264 G. See article in Science section.**

Message from the Director

The last six months have been dominated by reformulating the future instrumentation programme for presentation at the JCMT Advisory Panel and Board autumn meetings in 1995, restructuring the staff in Hawaii with the run-down of ROE involvement in the JCMT, and completing the preparation for the new instruments RxB3, RxW and SCUBA, which although eagerly awaited have all slipped in delivery.

There have been a number of staff changes, and these are documented elsewhere, but Phil Jewell, the new Head of JCMT Instrumentation, arrived in Hawaii to take up post at the beginning of January. We were extremely fortunate in that he agreed to participate in a number of meetings in the autumn, which allowed me to get him involved in the planning of the JCMT future instrumentation programme. He also attended both the Advisory Panel and Board, and so by the time he arrived on-site he was already well up to speed.

We continue to eagerly await the three new instruments, not only for their increase in performance, but also their reliability as the past six months has seen reliability of all our current suite of instruments fall below what I consider acceptable. We now have plans for a fast-track upgrade to RxA2, to deliver increased performance and higher reliability (through better tuning) over the coming six months. The delays to all new receivers continues to cause problems for telescope scheduling and the Allocation Committees as well as being a constant disappointment to users. At the time of writing I anticipate that, barring a major problem, SCUBA will arrive in Hawaii in April. SCUBA is now in its latest laboratory commissioning phase (see later) and looking great. RxB3 and RxW are expected to arrive sometime later, the precise dates are still somewhat unclear, but both receivers are also looking good and have sensitivity figures which exceed their specifications.

Although the lack of a Head of Instrumentation for the best part of a year has had a delitory effect on the progress of the future programme, it was not as bad as it might have been because of the continuing uncertainty of the Development Fund beyond 1999. We are still not in a position to cast in stone the new programme which will see the JCMT as a front-line and first-class facility well into the next Century. Indeed, at the autumn meeting of the Panel and Board I presented a potential ten-year plan for consideration. Which path the JCMT will eventually pursue will depend on a number of factors, the available funding being a critical element. The main elements of the future programme, namely the drive for efficiency improvements (including telescope surface upgrades), the pursuit of sub-arcsecond astronomy through involvement with the Smithsonian Submillimetre Array, and the extended science available through provision of heterodyne focal plane arrays and associated backend.

Nevertheless, the Advisory Panel and Board gave approval for the conversion of RxC2 to a single channel 900 GHz receiver, RxE, as soon as possible. The Rutherford Appleton Laboratory have been contracted to produce RxE, most likely with devices from SRON/RUG. Another contract has been let for a 'proof of concept' study for the MIDAS correlator. At the JAC, work to improve the efficiency of the telescope and data collection was also approved and this is described elsewhere.

Although interferometry with the CSO has regretfully had to be postponed for semester 96A due to the planned commissioning of the three new instruments, it will go ahead in 96B and invitations to participate should be made in the usual manner. The last run, in January 1996, was excellent with spectacular weather and exciting data. Noteworthy is the work at 460 GHz which is described in the later article by Richard Hills.

At the beginning of the year, I presented a project-oriented approach to a number of science projects. Information for users and quality of the facility for users rank high on the objectives for 1996. The use of the World Wide Web will increase further, and in the future, documentation will only be found on the WWW rather than any other medium. This will ensure that the documentation is accurate and up-to-date. Individual staff at the JAC are tasked with the upkeep of various sections. Furthermore, this Newsletter will now appear on the Web long before the hard-copy arrives, and in the continued search for savings, the quantity of the hard copy version of the Newsletter will be reviewed during the year.

The move towards flexible (queue) scheduling is now happening and is described later. I look to user feedback in the area of 'observing templates' to ensure that the support astronomers in Hawaii will be able to carry out the observations required, and with known priorities when decisions are required. I am well aware that this is a topic which is potentially fraught with user-dissatisfaction. I intend to proceed carefully, step by step, and fully intend to keep users 'in-the-loop'. Suggestions, particularly those which are positive and helpful in moving us to the agreed policy of queue flexible scheduling are most welcome.

This coming semester promises (yet again) to be exciting, with the commissioning of SCUBA, RxB3 and RxW. I look forward to be able to report on their progress in the next Newsletter.

Ian Robson,
Director, JCMT

SCUBA Applications for Semester 96B

Although I had hoped to involve the widest possible community at the earliest opportunity in SCUBA observations (see my note in the August 1994 JCMT Newsletter), a new plan has now emerged.

It was clear at the December Telescope Time Allocation meeting that the ITAC wished to determine the scientific prioritization of programmes that would be selected for 'shared risk' observations in the early phases of SCUBA usage.

When we got down to the practicalities of how this would happen, the ITAC felt it to be unworkable within a sensible timescale. It was therefore agreed that there should be a second call for applications for semester 96B, involving SCUBA proposals only. This will be announced on the WWW (via our email exploder - see October 1995 JCMT Newsletter) along with details of SCUBA performance figures and observing templates. The status of SCUBA is expected to be sufficiently well known at the May/June 1996 national TAG and ITAC meetings so that a percentage of time during semester 96B can be set aside for SCUBA observations. The present plans are for the call for SCUBA proposals to be made sometime in July/August 1996, with observations anticipated to take place in November 1996 to January 1997. The manner in which SCUBA programmes will be allocated (small blocks of time for many observers, large programmes, etc) will be made by the individual national TAGs. However, all observations will be priority queue-scheduled and undertaken by JCMT support staff, hence the observing templates (see later article).

Ian Robson,
Director JCMT

Flexible Scheduling for Semester 96B

At the December meeting of the ITAC it was agreed that up to 50% of semester 96B would be allocated to flexibly scheduled,applications, many of these to be conducted via serviced observing.

To this end the PATT3 telescope application form has been redesigned, yet again, and applicants are requested to access and use the new version which can be obtained from the JCMT homepage on the World-Wide Web.

Additional template forms are being constructed for circulation to those Principal Investigators who succeed in getting an award of time for semester 96B but whose observations are to be made via serviced observing by JAC staff. These forms will request more complex details about sources, instrument tunings and observing techniques than the standard PATT3 application form.

In the case of the Netherlands community, the process of flexible scheduling has been in operation for the duration of semester 95B (and is continuing through semester 96A) with only minor problems and difficulties. Most applications are being completed by Remo Tilanus and/or Fred Baas with only the occasional assistance from a visiting observer.

For semester 96B it is the intention to expand this scheme to encompass a large fraction of the Canadian applications and a number of UK applications. Many of the International applications are already completed via serviced mode.

Graeme Watt, JAC, (ITAC Tech Sec)

Use of JAC Vehicles

This is a reminder to visitors, and staff, that the JAC policy does not permit official vehicles to be used for private purposes. Recently vehicles have been spotted in the vicinity of the coast eruption site, which is a round trip of over 100 miles from the JAC. Such jaunts are not only expensive in terms of wear and tear, gas and so on, but the chances of damage to the vehicle or of being involved in an accident are increased. In such cases the JAC will accept no responsibility.

With the prior approval of the Vehicle Scheduler (Carol), visiting observers may use the JAC vehicles for 'work-related' matters (eg: to meet a colleague at the airport or to obtain a meal immediately prior to travelling up Mauna Kea). However, such use must be restricted to the boundaries of Hilo town only. This information is contained in the Guidlines for Visitors.

JAC staff cannot approve use of vehicles for unofficial purposes. All such requests will be refused. Observers should be aware that they will be held fully responsible for any damage or costs arising from any accident or incident occuring through unauthorised use.

Any queries about this note or the policy should be referred to Derek McCall or Ian Midson.

Derek McCall, JAC

Use of the JCMT Apartment

ARRANGEMENTS FOR THE PROVISION OF FACILITIES FOR VISITORS DURING EXTENDED VISITS TO THE JAMES CLERK MAXWELL TELESCOPE

1. Introduction

1.1 Facilities in Hilo will be provided by the Joint Astronomy Centre (JAC) to individuals wishing to undertake extended visits to the James Clerk Maxwell Telescope (JCMT). Although intended mainly for students wishing to undertake visits to the JCMT as part of their training in research or instrument development, these facilities will also be made available to all visitors approved by the Director, JCMT.

1.2 To make this arrangement beneficial for all parties, an 'extended visit' will be considered to last, normally, for a minimum period of one month up to a maximum period of four months. Requests for visits of longer duration may be considered, although the provision of housing may be restricted to the maximum period of four months.

1.3 Students generally will not be accompanied by their supervisor for the whole, or even any, of the extended visit.

1.4 Visitors will be accommodated on a 'first come first served basis' although, normally, preference will be given to students.

2. Provision of housing in Hilo

2.1 Accommodation, in the form of a rented house or apartment, will be provided through the JAC, for visitors from the Partner countries (UK, Canada and the Netherlands) and will be funded from the JCMT Shared Operations budget.

2.2 Normally, students who are not receiving remuneration from JCMT funds, and any other visitors working specifically on JCMT-related projects, which have been approved by the Director, JCMT, will not have to pay for rental of the accommodation, but will be expected to meet the costs of their daily subsistence.

2.3 A rate of $260 per week for rental of the accommodation will be charged for any visitor who is in receipt of a per diem allowance and/or does not fulfill the criteria outlined in paragraph 2.2 above. This charge will cover the costs of accommodation, utilities and cleaning at the end of the visit.

2.4 Visitors will be required to pay for all long-distance telephone calls.

2.5 All visitors must ensure that the accommodation is kept clean and in a good state of repair.

2.6 The JAC does not accept responsibility for loss or damage of personal property of visitors while staying in the accommodation provided.

3. Provision of facilities at the JAC

3.1 Visitors will be provided with working space within the JAC on a best efforts basis.

3.2 Visitors will be provided with a key for the JAC and access for out of hours working.

3.3 Visitors will be provided with usernames and access to computing facilities.

3.4 Visitors will have access to reasonable items of consumables, such as computer output material.

3.5 Visitors will be expected to attend the JAC for a reasonable time each week of the visit to Hawaii.

3.6 At the end of the visit, visitors will be encouraged to present a seminar on his or her work if appropriate.

4. Provision of observing experience at the JCMT

4.1 Visitors will be allowed to accompany JCMT staff during supported observing runs at the JCMT, subject to the prior agreement of the visiting astronomers.

4.2 Subject to the approval of the local supervisor and Director JCMT, experienced students may be allowed to support SERVICE observing programmes of their partner country and/or Director's Discretionary Time (DDT) programmes.

4.3 Subject to the approval of the local supervisor and Director JCMT, students will be allowed to accompany support staff in testing equipment and undertaking Engineering and Commissioning (E&C) work when appropriate.

4.4 Subject to the approval of the local supervisor and Director JCMT, experienced students may be allowed to undertake E&C observations if appropriate.

5. Requirements for Students

5.1 Requests for use of the JCMT facilities must be made to the Director, JCMT. The Head of Department of the student will provide a reference of the suitability of the student and his/her ability to benefit from the extended visit to Hawaii.

5.2 A single individual on the JCMT staff will be appointed as the 'local' supervisor for the student for the duration of the visit. The Director, JCMT must have agreed with the local and remote supervisor about the day-to-day supervisory arrangements and the monitoring of progress prior to the visit by the student.

5.3 At least two months prior to the student's expected arrival date in Hawaii, the home supervisor will agree in writing with the Director JCMT, acting on behalf of the local supervisor, a programme of work which the student is expected to undertake while in Hawaii, and a plan of execution of this work.

6. Requirements for non-Students

6.1 Requests for the use of the JCMT facilities must be made to the Director, JCMT with a supporting case outlining the benefits to be gained from the extended visit.

6.2 Requests from students will be given priority, therefore all requests from non-students will only be considered up to one month in advance of the proposed visit.

7. General

7.1 There is no public transport available within Hilo. Taxis, car hire or any other form of transport will not be provided by the JAC and is the responsibility of the student and/or their funding organisation.

7.2 All visitors will agree to follow the safety rules and all other pertinent rules applying to JAC staff while using the JAC facilities.

7.3 Visitors, or their home institution, will be responsible for all health care costs (including high altitude medical, dental, etc.).

7.4 Any activity engaged upon by the visitor which leads to an unreasonable charge on JCMT Operations, will be levied as a charge against the Partner country concerned.

People & Events

Lorne Avery has been posted to the JAC from HIA to add another Canadian to the Staff Support squad. Lorne has been a frequent user of the the JCMT and his considerable expertise will now be put to the test as he partakes in commissioning tasks and service observing. He will also take on much of the overseeing of the 'quality' project.

Phil Jewell joined the JCMT on January 3rd as the new Head of Instrumentation. Phil was Deputy Director of the 12m millimetre-wave antenna of the NRAO at Tucson and comes with a vast amount of experience in astronomy techniques and instruments.

Richard McCarthy also started at the JAC on January 3rd as the new Senior Electrical/Electronic Engineer. Richard has had extensive project experience working for Westinghouse and NASA.

Alan Aindow has joined the JCMT as a Projects Coordinator. Alan comes from the UK, from an industrial background.

Gerald Moriarty-Schieven joined the JCMT Staff Scientist squad from the DRAO in Canada. Gerald is employed through the RCUH and will greatly assist in the drive toward serviced and flexible observing. In addition to his mountain duties Gerald is interested in public relations and has already taken control of the noticeboard displays and the visiting astronomer seminar programme.

Jamie Scobbie has left the JAC to take up a position with the SEST telescope in Chile.

Denis Urbain resigned his position with the JCMT instrumentation group in mid-January and is off to take up a new post with the Onsala Space Observatory in Sweden.

Gary Welch arrived at the JAC in mid-December for a sabbatical period from St. Marys University, Halifax in Canada.

Tim Jenness has joined the JAC from MRAO. Tim's expertise is in computing, primarily on Unix systems. He will spend about half his time on staff support duties with the remainder developing software.

Rob Cardinal is the latest recruit from the Canadian co-op student project. Rob arrived just after Christmas for a four month period at the JAC working on a variety of software projects for the JCMT.

Congratulations to **Maxine & Phil Daly** on the birth of **Rhiannon Sinead** who arrived on 18th October 1995 weighing in at 6lb 15oz.

Congratulations also to **Gynna & Ron Loper** on the birth of **Lance Kyle** who arrived on 12th November 1995 weighing in at 7lb 2 1/2 oz.

Congratulations to **Yuksel & Ian Pain** on the birth of their daughter **Natasha Arzu** on 17th January 1996 weighing in at 6lb 11oz.

Manuel Martinez retired recently after more than 16 years service to the JAC. Manuel joined UKIRT in 1979 and has watching the progress of UKIRT into a world-class facility. He has also witnessed the construction and commissioning of the JCMT and the move of the Hilo office base from Leilani Street up to its current location within the University Park. We wish Ethel and Manuel a happy retirement.

NEXT ISSUE DEADLINE

The absolute deadline for submission of science and/or technical articles for the next issue of this Newsletter is **30th June 1996**. All communications regarding this Newsletter should be sent via e-mail to **gdw@jach.hawaii.edu**.

PATT Application Deadline

Deadlines for receipt of JCMT applications for semester 96B are:

for Netherlands applications:

15th March

for UK, Canadian and International applications:

31st March

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.

Country paying salary of Principal Investigator		
Canada	**Netherlands**	**UK or Other**
JCMT Time Allocation Group, Herzberg Institute of Astrophysics, 100 Sussex Drive, Ottawa, Ontario K1A 0R6 CANADA	JCMT Program Committee, Leiden Observatory, P O Box 9513, 2300 R A Leiden, NETHERLANDS	PATT Secretariat, PPARC, Polaris House, Swindon, SN2 1ET, UNITED KINGDOM

INSTRUMENTATION

Summary of JCMT Instrumentation for Semester 96B

The current state of the JCMT instrument availability and sensitivities can now be located on the JCMT home page of the World-Wide Web at URL:

http://www.jach.hawaii.edu/JCMT/home.html

Additional details can be found on an e-mail fileserver. This fileserver system exists to provide instrumental data, both archival and current, and other information.

Henry Matthews, JAC

Short Baseline Interferometry in Semester 96B

It is anticipated that there will be an opportunity to schedule an SBI run in the Fall of 1996. The optimum period in which to arrange this 'block' of observations would be around October/November. Technically an SBI run would be a little more complicated than prvious runs because it would involve the use of new JCMT receivers, RxB3 and RxW (hopefully!).

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

Further details on the availability of SBI will be found on the JCMT homepage of the World-Wide Web nearer the event.

Graeme Watt, JAC

RxB3 and RxW in Semester 96A

Unfortunately, the delivery date of RxB3 has slipped from the original estimate of March. The current plan has the commissioning slot scheduled for mid-June.

The most recent information on RxW is that a commissioning slot in August would be appropriate. This releases the slot in April for further PATT applications.

The ITAC gave me a comprehensive list of fallback applications to insert should any of the new instruments not require their night shifts. I will be proceeding with this plan over the next few weeks and will ensure that all PIs are kept informed of changes to the schedule.

Graeme Watt,
JCMT Scheduler

SCUBA: The Final Delivery Date

Yes, SCUBA really is going to be delivered to Hawaii in April 1996 ! At a recent project meeting in Edinburgh it was agreed with the Director, JCMT that, barring some totally unexpected disaster or act of God, SCUBA will leave ROE on April 3rd. After tests in Hilo and mounting on JCMT, first light is expected in early July.

So what is SCUBA anyway? For those readers new to the JCMT or whose head has been firmly buried in the sand for the past few years it is a submillimetre camera and photometer. It has 2 arrays of detectors, one of 37 pixels optimised for 850 μm and one of 91 pixels optimised for 450 μm. These 2 arrays look out simultaneously at the same area of sky with a field-of-view of approximately 2.3 arcminutes. Each pixel is diffraction limited, which corresponds to a resolution of 7 arcseconds at 450 μm and 14 arcseconds at 850 μm. There is a filter mechanism which means that the 850 μm array can also be used at 750 μm or 600 μm and the 450 μm array can be used at 350 μm, with slightly less than optimised sensitivity and resolution. In addition to the arrays there are 3 separate pixels individually optimised for 1100, 1400 and 2000 μm. These pixels look out simultaneously but are offset from each other on the sky. All the detectors in SCUBA will be able to achieve background photon-noise limited sensitivity (it achieves this by cooling the detectors to 0.1K). To enable accurate calibration of data, SCUBA also has a sky transmission calibration system and an internal calibrator to remove variations in detector sensitivity.

Laboratory results: The reason we are all now so confident is that the recent laboratory results are so impressive. Just before Christmas 1995, 93% of the 131 pixels were operating to specification, and have been shown to remain so even with vibration levels on the cryostat 10 times that measured on the Nasmyth platform. Figure 1 shows the noise spectrum of one of the SCUBA 850 μm detectors under three different background conditions, as measured through the SCUBA electronics system. The lowest curve shows the noise measured with the filter drum closed, i.e. system noise, the highest curve shows the noise looking out at the lab, i.e. photon noise from a 300K black-body, and the middle curve shows noise measured with a reflector at the cryostat window so the detectors are looking back at a temperature of approximately 50K, very close to the effective temperature of the sky at Mauna Kea at 850 μm on a good night. The clear separation of these three curves shows that SCUBA is background-limited. The noise performance has also been shown to be completely stable over a 10 hour period. The optical performance has been shown to be very satisfactory. Figure 2 shows a map of a point source with the LW array with contours at 1-10% of the peak.

Remaining work: The remaining laboratory work is predominantly getting the other 7% of the pixels working to spec. These are mainly known faults and errors which are being fixed at time of writing in preparation for a cold run starting mid-February which may be the final laboratory cold run (although we do have enough time to have one more if necessary). There is also still a little work remaining on testing out observing software as far as possible and in completing the overall flatfielding of the arrays.

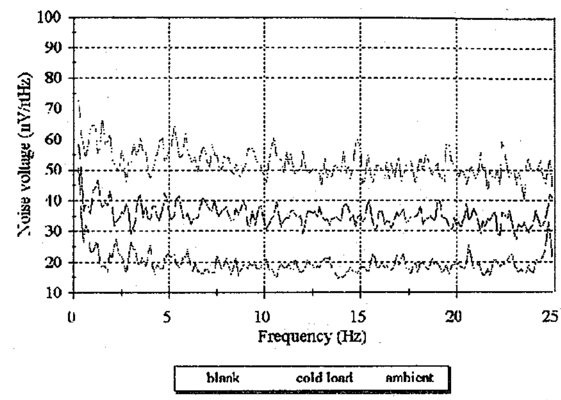

Figure 1: Noise spectrum from one of the 850 micron detectors under 3 different background conditions.

Expected sensitivities: This is all many of you will be interested in no doubt! SCUBA will be background-noise limited, as promised, however until such time as we actually get onto the telescope we do not know whether the background noise will be pure photon-noise or whether systematic sky variation ("sky-noise") will dominate. It seems highly likely that there will be sky-noise, but it is not known at what level. We do have software schemes for using the fact that we have an array to reduce any sky noise that may be present but again until we actually have real data the effectiveness cannot be guaranteed. Nonetheless we can still make some predictions, erring slightly on the conservative side. The following table shows a predicted noise-equivalent flux density (NEFD) at 450 μm, 850 μm and 1100 μm, along with the equivalent 5-sigma detection level in 5 minutes and 1 hour. **However it is essential to bear in mind, that these are only estimates based on very best weather.**

filter	NEFD (mJy/√Hz)	5σ in 5 mins (mJy)	5σ in 1 hour (mJy)
450	500	150	42
850	40	12	3
1100	40	12	3

Table 1.

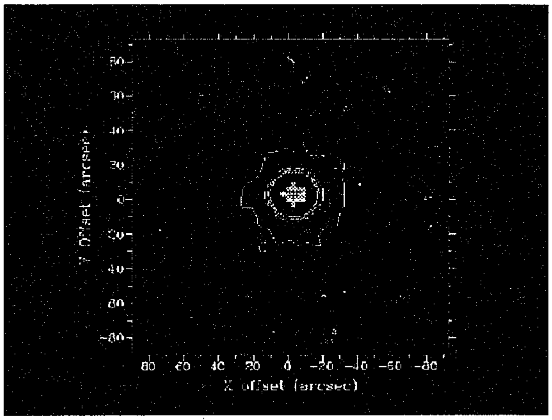

Figure 2: Fully-sampled jiggle map of a point source at 850 microns, aligned on the central pixel of the LW Array. (There are 10 contours, starting at 1% and increasing in 1% increments).

Observing modes: The observing modes for SCUBA were described in some detail in the March 1994 JCMT Newsletter. To recap there are three main modes: a) Point-source photometry , which is pretty much identical to a single-pixel photometer; b) "Jiggle- mapping" where a map of a source smaller than the total field-of-view is made by moving the secondary mirror to obtain a fully-sampled image, as was shown in Figure 4 of the March 1994 issue and; c) "Chop-scan" where a map of a large region is made by scanning the telescope across the sky to obtain a fully-sampled strip as was shown in Figure 5 of the March 1994 issue.

In all three cases data is obtained simultaneously with the long and short-wave arrays. The 1.1, 1.4 and 2.0 mm "photometric" pixels look out at the sky simultaneously but offset from each other. Thus observations of a point or small source the telescope has to be offset from one to the other but for a large source all three could be scanned over the same area with only a slight offset between the maps at the edges.

So wish us luck for the remaining tests and we will post the first telescope results on the Web as soon as we get them. Elsewhere in this issue there are details of the likely timescales and deadlines for applications for SCUBA. There is also a summary of the results of laboratory polarimetry tests with SCUBA.

Walter K. Gear
SCUBA Project Scientist

Results from the First SCUBA Polarimeter Tests

Introduction

Polarimetry tests were recently carried out with SCUBA in the laboratory at ROE using the spare UKT14 polarimeter module. An electrically isolated mounting plate was used to attach the polarimeter directly in front of the SCUBA window after removal of the chopper wheel and laser assembly. The source signal was provided by a chopped blackbody viewed through the JCMT telescope simulator and the polarimeter was operated in the step and integrate mode. The output from two selected pixels were demodulated simultaneously using lock-in amplifiers and sampled with a PC based analogue to digital converter. This same PC was used for data reduction and analysis.

Microphonics tests

The microphonic effects on the bolometers produced by the movement of the waveplate were found to be minimal (much less severe than those experienced with UKT14) with a settling time well within a second. For this trial no special efforts were made to vibrationally isolate the mounting plate from the cryostat. When the waveplate was set to spin continuously, some induced noise was observed during the acceleration stage but was negligible in the constant velocity phase. It is therefore expected that a continuously spinning mode of observation may be possible.

Instrumental polarisation

A chromatic half-waveplate of 70 mm clear aperture was used to measure the IP across the long wavelength array at 850 μm. This caused some beam truncation since it was undersized with respect to the SCUBA window (89 mm). The IPs measured at the central pixel and at four extreme off-axis pixels (in the four cardinal directions) were in the range 0.8 - 1.7% with position angles between 0 and 45°.

Polarisation modulation efficiency

Two prototype achromatic half-waveplates were tested: the short-waveplate usable at all array wavelengths (350 - 850 μm) and the long-waveplate for the photometric wavelengths (1100 - 2000 μm). The measured polarisation modulation efficiencies were greater than 90% at all wavelengths. Reflections accounted for most of the transmission losses occurring at the waveplates (which will be reduced by antireflection coating), except at 350 and 450μm where absorption begins to be significant (5 - 15%). The QMW photolithographic analysers used proved to be perfect polarisers.

Measurement of a simulated faint partially polarised source at 850 μm

A sample of fluorogold (for which the percentage polarisation and position angle at 850 μm were well known from previous laboratory experiments at QMW) was placed in front of a small object plane aperture to simulate a partially polarised source. The blackbody was located some distance behind this aperture. A measurement carried out at high signal level (blackbody temperature 1200K) yielded, after IP correction, the expected percentage polarisation for this fluorogold sample of 2.7 ± 0.2% with position angle 43.5 ± 2.1°. The blackbody temperature was then lowered to its minimum level (~360K with some instability) to give an estimated source flux of ~500mJy which gives a polarised flux of ~14mJy. After an integration time of 80 minutes the polarisation obtained was 2.8 ± 0.8% with position angle 47.5 ± 7.7°, in excellent agreement with the high level value.

Conclusions

Polarimetry will be possible with SCUBA using essentially the same data acquisition and analysis methods used for the current UKT14 polarimeter and will yield a considerable improvement in polarimetric sensitivity.

Sye Murray & Ramón Nartallo, QMW
Wayne Holland & Walter Gear, ROE

Telescope Time Allocations

PATT ITAC Report for Semester 96A

Allocations

The individual partner TAGs hold meetings in their respective countries prior to the PATT session to assess applications 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	46
Canadian status	24
Netherlands status	14
International status	9
University of Hawaii	10
TOTAL:	103

The PATT meeting was held at The Falcon Hotel in Stratford upon Avon, UK on 6 & 7th December 1995.

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 at the ITAC meeting.

Time Available (in 16-hour nights)	
No. of nights in semester 96A	182.0
Engineering & Commissioning	45.0
University of Hawaii (10%)	13.5
Director's discretionary use	4
Available for PATT science:	119.5

The above table indicates the order in which nights are removed from the total available for the semester. Semester 96A covers a summer period from 1st February 1996 through 31st July 1996 inclusive. To complicate the mathematics slightly, 1996 is a leap year so February has 29 days.

Awards (in 16-hour nights)	
UK status	63.25
Canadian status	28.75
Netherlands status	23.0
International status	4.5
University of Hawaii	13.5
TOTAL allocation:	133.0

For those not familiar with the JCMT Board formula, the total time requested is divided amongst the PI and collaborators. 50% of the time is awarded to the country paying the salary of the PI. The remaining 50% is divided equally over **ALL** investigators (including the PI).

Attribute by JCMT Board formula	**nights**
UK	48.9
Canada	30.7
Netherlands	20.4
International	17.3

Instrumentation

The reduction in allocation of time for UKT14 is again due to reduced request as applicants await the arrival of SCUBA to continue their programmes. The Lethbridge Group have again requested to bring their own Fourier Transform Spectrometer (FTS) system. Previously their FTS interfaced with the UKT14 bolometer but they now have a stand-alone instrument with its own bolometer and cryostat. The FTS will be located on the right-hand Nasmyth platform (the other side from the SCUBA platform). No SBI time was allocated for this semester.

Instrument distribution	
UKT14	15%
FTS	3%
SBI	0%
RxA	48%
RxB	23%
RxC	11%

Long-Term Status

L/M/95B/U14 and L/M/95B/U15 were awarded long-term status for 2 semesters with awards of 7 shifts and 4 shifts respectively in 96A. These are the final awards of time for these projects.

L/M/96A/U14 was approved for long-term status for two semesters, given 6 shifts in 96A, with a further 2 shifts in 96B.

Engineering & Commissioning

The E&C time for 96A includes major engineering periods to replace the telescope encoders for 24-bit models and to upgrade the antenna azimuth track. The AZ track work is a continuance of work begun during semester 95B. The installation of new encoders was postponed from semester 95B due to delivery problems from the manufacturer.

In view of the large amount of E&C time set aside for the commissioning of new instrumentation, other E&C tasks have been kept to a minimum for the semester.

Commissioning of the antenna and instrumentation continues with periods required to characterise and improve the surface via metrology and beam map measures, monitor the antenna performance and tracking through pointing and inclinometry runs, measure receiver performances and efficiencies, and increase the catalogue of standard spectra available at the telescope.

Time has been allocated for commissioning of RxB3, 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.

Due to scheduling pressure and constraints there will be no SBI session during semester 96A.

Observatory Backup Programme

The Observatory Backup (M/94B/I09) was not re-submitted for this round. However, it was discussed in view of the requirements for a considerable amount of low-frequency, high quality science for the semester. The ITAC decided that this programme may continue for semester 96A BUT only for CO (2-1) and ^{13}CO (2-1) mapping of the nominated sources. More explicit requests must be made through the ITAC before proceeding to observe any other lines and/or sources.

Fallback Programmes

A number of applications have been approved by the ITAC to be included in the schedule should RxB3 RxW and/or SCUBA fail to meet their 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.

Since the fallback applications do not necessarily fit directly into the scheduled slots for the instruments some changes may be required to the schedule for the second half of the semester. All applicants affected will be informed in advance by the JCMT Scheduler.

Service time

Allocations for this semester are:

CDN	=	6 shifts allocated;
NL	=	0 shifts allocated;
UK	=	10 shifts allocated

Redesign of the JCMT Application form

Some minor revisions to the new version of the PATT3 form will have been made prior to the distribution of this Newsletter as further flexible scheduling and serviced observing is to be implemented for semester 96B. The new form is available on the JCMT homepage of the World Wide Web.

Graeme Watt, JAC
(ITAC Technical Secretary & JCMT Scheduler)

Successful JCMT Applications for Semester 96A

PATT No.	Principal Investigator	Shifts Given	Title of Investigation
C01	Seaquist E R	2	A study of dense molecular gas in M82 from the distribution of HCO^+
C02	Vallée J P	4	Extreme infrared (EIR) polarimetry of elongated molecular clouds
C03	Avery L W	1	Chemical asymmetries in L1157? - What's the real story?
C04	MacLeod J M	3	Identification of the CH_3OH enhancement mechanisms in bipolar outflows
C05	Davis G R	2	Brightness temperature spectrum of Jupiter
C06	Frayer D T	1	CO and C I line and dust continuum observations of a $z = 2.7$ protogalaxy
LT/C08	Matthews H E	3	The evolution of the coma of comet Hale-Bopp
C09	Bastien P	4	Submillimetre polarimetry of protostellar disks
C10	Duley W W	3	Search for TiO in two star-forming regions
C12	Avery L W	2	A study of the kinematic and density structure in Rho Oph C
C15	Wilson C D	3	Probing the interstellar medium on large scales in normal and starburst galaxies
C16	Taylor C L	3	Cold dust emission in starbursting dwarf galaxies
C17	Hasegawa T I	3	Density gradient in Barnard 68
C18	Clark T A	2	Limb distribution and mapping of H I $n = 19 - 20$ emission on the Sun
LT/C19	Hasegawa T I	3	Observations of ground-state transition of HDO
C21	Feldman P A	1	A continuum map of the S233 outflow region associated with a methanol maser
C22	Fich M	2	Dense molecular gas in the NGC 2264 G bipolar outflow
C23	Giannakopoulou J	5.5	Clues to the formation of giant H II regions: The molecular gas content of one normal and two giant H II regions in M101
C24	Naylor D A	4	Search for tropospheric CO absorption in Neptune
H01	Carpenter J	4	An unbiased survey for massive dense cores
H02	Carpenter J	2	Properties of massive dense cores
H04	Senay M C	2	Simultaneous JCMT and CSO observations of CO emission from Comet P/Schwassmann-Wächmann 1
H05	Owen T	3	The stratospheres of Titan, Neptune and Uranus
H06	Owen T	2	HCN observations of Comet P/Hale-Bopp
H07	Jewitt D	6	Long-term monitoring of CO emission from Comet Hale-Bopp
H08	Owen T	2	Post SL9 chemistry of Jupiter's stratosphere
H10	Evans A S	6	Submillimetre spectroscopy of $0.02 < z < 0.1$ powerful radio galaxies
I01	Myers P C	1	Submillimetre continuum from the unusual starless core L1544
I02	Kastner J H	4	Physical conditions in gas orbiting young stars
I05	Ho P T P	2	Study of the high-velocity HCO^+ emission in the NGC 2264 G molecular outflow
I08	Davis C J	2	Jet-driven molecular outflows: Prompt or turbulent entrainment?
N01	van Dishoeck E F	10	Physical and chemical evolution of star-forming regions
N02	Israel F P	6	[C I] and higher CO transitions in galaxy centres
N04	Israel F P	4	Radial distribution of molecular gas in M33
N05	Boogert A C A	8	Physical conditions and carbon budget around YSO's with ice bands
N06	Waters L B F M	6	A CO survey of ISO-selected AGB and post-AGB stars
N07	De Jong T	1	Mapping the C I envelope of IRC + 10216
N08	Burton W B	2	CO $J = 3\text{-}2$ observations of the nuclear disk in Cen A
N09	Israel F P	4	CO excitation of dwarf galaxies
N10	Wesselius P R	1	[C I] in L183

Successful JCMT Applications for Semester 96A

PATT No.	Principal Investigator	Shifts Given	Title of Investigation
N12	Stark R	2	The gas-dust connection in protoplanetary discs
N13	Waters L B F M	2	Millimetre variability of Be stars
95B/U14	Dent W R F	7	Statistics of YSO outflows
95B/U15	Davies J K	4	Molecular content of Comet P/Honda-Mrkos-Pajdusakova
U03	Ward-Thompson D	5	Protostellar collapse
U04	Gray M D	4	A high frequency maser survey of long period variables
U05	Stevens J A	2	Is there a bimodal magnetic field distribution in the cores of BL Lacertae objects
U08	Seta M	8	A molecular and atomic line study of the W44 supernova remnant / GMC interaction
U09	Sato K	2	C I absorption lines in the ISM - A new tool to study cooling?
U13	Saraceno P	4	Complementary mm/submm photometry of Yso's from the ISO LWS guaranteed time programme
LT/U14	Gray M D	2	SiO J = 7-6 masers in R Aqr: Testing the 'clump' model for maser emission
U20	Macdonald G H	7	210 - 280 GHz spectral survey of the hot molecular core in G34.3 + 0.15
U22	Millar T J	3	Deuterium in hot molecular cores
U23	Willacy K	3	High temperature chemistry in the photodissociation region M17 SW
U24	Gibb A G	5	Determining the mass and status of protostellar clumps in L1630
U25	Ivison R J	4	Evidence of star formation in a damped Lyα system at $z = 3.137$?
U26	Green D A	7	The interacting galaxy pair NGC 4490/4485
U27	Griffin M J	3.5	The mm/submm brightness temperatures of Saturn, Venus and Mercury
U30	Holland W S	4	A search for magnetic twisting in the L1448-C bipolar outflow
U31	Greaves J S	6	A magnetic field map of the Galactic Centtre, from line polarization
U33	White G J	6	Sequential star formation and CO isotopomer fractionation in M8
U35	Dahmen G	3	Selected Galactic Centre clouds in $C^{18}O$ and SiO
U37	Davies J K	9	Chemical monitoring of Comet Hale-Bopp
U38	Fuller G A	6	The circumstellar environment of very young stars
U39	McMahon R G	5	The thermal nature of the FIR emission in high redshift QSO's.
U41	Hughes D H	7	Submillimetre and millimetre lightcurves of asteroids - The primary ISOPHOT calibrators

Weather and Fault Statistics for Semester 95B

The following tables present the weather loss and fault loss for semester 95B. Full details are stored on database at the JAC and interested readers are referred there for further information. ***The total clear time lost from primary programmes for semester 95B is 3.2%.***

Semester 95B

Month (1995)	Hours available	extended hours used	primary programme lost to weather (hours)	%	backup programme lost to weather (hours)	%
August	480.0	17.5	8.3	1.7	0.0	0.0
September	480.0	19.5	16.3	3.4	3.3	0.7
October	464.0	13.7	14.9	3.2	12.0	2.6
November	480.0	15.8	97.5	20.3	44.0	9.2
December	480.0	29.1	66.7	13.9	4.0	0.8
January	472.0	13.4	205.4	43.5	110.5	23.4
Total	2856.0	109.0	409.1	14.3	173.8	6.1

Table 1: *JCMT weather statistics.*

Semester 95B

Month (1995)	Hours available	Total	ANT	INS	COMP	SOFT	CAR	OTH
August	480.0	18.7	5.0	9.5	1.6	1.7	0.0	1.1
September	480.0	8.4	2.4	2.6	1.1	2.3	0.0	0.0
October	464.0	11.8	1.5	8.3	0.9	0.6	0.5	0.0
November	480.0	18.4	0.2	8.5	0.3	0.2	0.0	9.3
December	480.0	13.6	1.3	8.1	0.0	2.9	0.0	1.3
January	472.0	7.5	0.0	6.2	0.3	0.0	0.0	1.0
P(hrs)	2856.0	78.4	10.4	43.2	4.2	7.7	0.5	12.7
B(hrs)		0.1	0.0	0.1	0.0	0.0	0.0	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.*

TECHNICAL NEWS

The JCMT E-mail Exploder

The following listing contains the e-mail addresses for all persons who have requested to be included on the JCMT e-mail exploder. Please check your entry for correct syntax.

The purpose of this e-mail exploder is to give rapid notice of changes to the JCMT. This may involve announcements of opportunity to observe with new instrumentation, immediate changes to the schedule, etc. In most cases the e-mail messages will be short and will direct the recipient to access the relevant page(s) of the World Wide Web for further information.

Entries are listed in alphabetic order by username.

If you wish to have your e-mail address included in the distribution list then please send me a brief email.

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v2y-x2y Angle Problem

In January Fred Baas uncovered an obscure bug in the real-time telescope software which has caused GSD data file headers to be incorrect under certain (rare) conditions when V2Y was not equal to 0.0. The cause has now been found and fixed by Firmin Oliveira. The data itself are fortunately correct. From the JCMT database it appears only 4 projects have been affected since 1989 and the affected observer has been notified. If in doubt please check the list of projects NOTaffected but which had V2Y's not equal to 0.0. You can find this list on the World-Wide Web at URL:

http://www.jach.hawaii.edu/~rpt/v2y_not.html.

Although we believe we identified all scans affected, we think a general warning is appropriate. However, given the rare occurance of the situation, I will omit a detailed explanation and just present the conditions under which the error would have happened:

If during your observations you had:

- defined a PA angle for the Y-axis of the CELL (V2Y) of

  90 < V2Y < 180 for a **RA-Dec** cell or
  180 < V2Y < 270 for an **AZ-EL** cell

...and...

- done a fivepoint **AFTER** defining V2Y

...and...

- observed at **offsets positions -not (0,0)-** after the fivepoint

then SPECX will map/locate the part of the observations following the fivepoint at a X grid-point with the opposite sign of what it should be.

The most obvious projects which might be affected are ones which align the Y-axis of the cell with the major axis of a galaxy, strictly following the astronomical conventions by using V2Y of e.g. 120 degrees
instead of -60 or 300 degrees.

Remo Tilanus, JAC

Netherlands Serviced and Flexible Programme

As a precursor for the whole of the JCMT since M95B the Netherlands has switched to a Serviced and Flexible (S&F) observing programme. During the past few semesters we had started asking for the Dutch time to be allocated in 'blocks' whenever possible and last summer I realized that we were in a position to switch to a full S&F programme, provided that a single observer would help out during particularly long runs.

It is a long-term goal of the JCMT to fully switch to S&F scheduling because it maximizes efficiency by matching projects to local current conditions. The experiences gained from the current Netherlands programme will hopefully prove helpful in this respect.

For those who are not clear on what S&F observing means exactly, for M95B we came up with the following rules (which not necessarily will be taken over as such by the JCMT as a whole!):

1. All observations will be carried out by local JAC staff (Fred Baas or myself) or by a designated observer under close supervision of a local staff member. (unless the P.I. explicitly chooses to come out for the observations)

2. On any particular NL night those NL observations which best fit weather, available equipment, etc. will be carried out, irrespective of when they have been scheduled for on paper. (unless again the P.I. has chosen to come out).

3. Projects are deemed completed when they have reached their allocated time or aimed-at goals, whichever comes first. To qualify the latter: if the stated goal is reached at or during the final shift (e.g. because we could use on-the-fly mapping or there are better receivers) the remainder of the project's time will convert to "low-priority" until PATT projects 'competing' for the same LST-range have been finished.

Common sense should prevail: we want to avoid having to fill part-shifts with finished projects simply to reach their allotted PATT time when other unfinished projects are in need of that same time. For each project not more than several hours (up to perhaps one shift for the longest allocations) will be re-assigned to low-priority.

Semester 95B

The general experiences with S&F scheduling during Semester 95B were very positive and observing was quite efficient. A full 100% (!!) of the scheduled low-frequency (A,B) observations was completed and we only lacked in the C-band because of the weather (there were very few CI nights in spite of a reasonable number of CO(4-3) nights). This was true in particular during the latter half of the semester. In January we already started on some 96A A/B-band observations to compensate for the lack of C-band time (the affected 95B project got PATT time for 96A).

Of the approximately 10 projects, 7 participated fully in the S&F scheduling. Three P.I.'s (1 novice, 2 experienced; two flew in from the USA mainland rather than the Netherlands) chose to do their own observations, although all opted to trade time with the flex observations rather than carrying out their backup programme in case of adverse conditions. In addition one observer was asked to come out to assist with a 15 day observing block. In the end, for the majority of the projects the (remote) P.I. was closely involved in 'real-time' during the observations.

One feature of S&F observing that was appreciated was the ability to compensate for pilot/equipment/weather failure by re-scheduling the missed observations at other times (i.e. day-time or time won due to increased efficiency). We managed to recover all clear failures without losing time from other projects. Also, on one occasion we could combine two projects very efficiently reducing the number of tunings and pointings needed.

A number of deficiencies were noticed, though:

- the lack of easy ways for 'remote eaves-dropping', by which I mean that observers in NL look at the observations as they are being carried out by the local staff while providing timely feedback where necessary.

  For us this is the preferred mode of operation for long projects. Not only does it provide another set of eyes to spot problems, it also means of course that the P.I. has real-time control over the project even when not physically present at the telescope.

- clear observation prescriptions. This is mostly for our benefits. If the occasion arises that a quick change of plans is needed, the PATT proposals do not have the correct format to enable easy decisions: LST-range, receiver and observation sequence need to be pieced together from the tables and text and compared with the overall conditions.

  Also, PATT proposals are written to get the observing time, not as recipes for the actual observations and, on occasion, the difference is quite noticeable! Almost always there is a need of one or more communications with the P.I. to clearify details.

We are trying to deal with these two issues during semester 96A. Already during 95B a 'prototyping' log tool was installed which could generate a standard T.O.-type log showing a large number of parameters for each observation (read from the observation file header) and to which the observer could add comments. Even while the implementation was relatively crude, this enabled the remote P.I.('s) to remain quite well informed about the observations without putting too much of a burden on the observer. Since the log entry can be created as soon as a particular observation starts inspection of the listing approximates looking at the real-time displays (which are less easily 'exported').

By the way, we experienced first-hand that the task of

1) directing the observations,
2) keeping an accurate log,
3) inspecting the data,
4) communicating with remote observers

is almost impossible to accomplish by a single person when the observations are a bit more complicated than trivial (to no surprise to the Director). At least (2) has been taken care of and (3) and (4) will hopefully improve soon. Also, a second real-time display (showing the incoming spectra) was installed in the control room the enable the observer to remain in front of main data reduction machine without loosing track of the quality of the spectra.

Work on a html (Netscape) based 'previewing' tool is almost completed by Tim Jenness. This tool will allow remote observers to look at (das-merged) spectra without even having to logon to the summit computers. The basic tool is working and what remains is solving security and access issues. It is my hope that the log tool and this preview tool will develop into an efficient html based 'Remote observing desk' which will show the log as it is being created by the on-site observer and enable the remote observer to 'click' on scans to list and plot them.

Semester 96A

The Netherlands S&F programme was expanded somewhat for the current semester. One additional staff (Göran Sandell) became part-time member of the so-called 'NL-flex team' so that it is no longer necessary to ask observers to come out from the Netherlands. All semester 96A projects are participating in the S&F programme, although two observers will still come out to carry out the bulk of their programme.

For all projects in this semester we have asked the P.I.'s to submit an extensive 'observation' recipe not only giving detailed information on the equipment setup but also on the observing strategy itself. Graeme Watt is preparing a similar form for the future JCMT S&F programme and we hope that between our form and the forms used for the traditional service programmes a well-designed form will result.

During semester 95B the novice observer decided to come out to gain experience and we also hope to be able to better serve that aspect of observing with the Netherlands S&F programme. Rather than coming just for the few days of their project we hope that advanced students will come for a few weeks and participate in all aspects of the S&F observations under supervision of local staff gaining a broader foundation in sub-mm astronomy.

In conclusion:

In spite of its somewhat 'ad hoc' implementation the Netherlands S&F programme is functioning very well. We clearly have gained a higher degree of efficiency in delivering results, while at the same time decreasing the burden on the observers. There is, of course, a larger burden on the local staff but this is in part offset by an increase of the number of support astronomers and the increased flexibility within the flex-team which in practise operates as a single unit. From a personal point of view, I find the much closer involvement in the observations and astronomy much more gratifying than being peripherally present during the first shift only.

Remo Tilanus, JAC

UKSERV in Semester 96A

The UK Service Programme is open to applications from UK and International applicants alike. Canada and the Netherlands run their own service programmes.

Applications are accepted for observations that take no more than 4 hours to complete (half of a standard JCMT shift). Typical applications include those requiring completion of PATT projects that have been partially weathered out or nearly-but-not-quite finished; pilot projects which may lead to full-blown PATT applications; short investigations that would not justify a full PATT application; monitoring programmes; and targets of opportunity.

Currently the UK-TAG allocates about 8 shifts to UKServ per semester which the JCMT Scheduler then attempts to distribute throughout the semester so as to maximise the RA range covered.

All applications are awarded a scientific grading by 2 independent assessors, one of whom is a member of the UK-TAG. In addition the applications are technically assessed by staff at the JAC. The assessment process should take no longer than two weeks after which the applicant is notified whether his project has been added to the service list or whether a rewrite is necessary. The UK Service Programme can be an extremely rapid method of obtaining your data.

Prospective applicants can obtain information about the UK Service Programme from the JCMT home page on the World Wide Web. If you wish to obtain further information then send an e-mail request to:

jcmt@roe.ac.uk

UKServ in semester 96A

There are 10 shifts of UKServ scheduled this semester. The provisional locations for the shifts can be found from the World Wide Web. For semester 96A the UKServ shifts were arranged in a pattern determined by the UK TAG to be optimised for the programmes currently on the waiting list. However, these are subject to change due to the instrument delivery modifications.

Graeme Watt, JAC

The Effect of Releasing On-the-fly Spectral Line Mapping

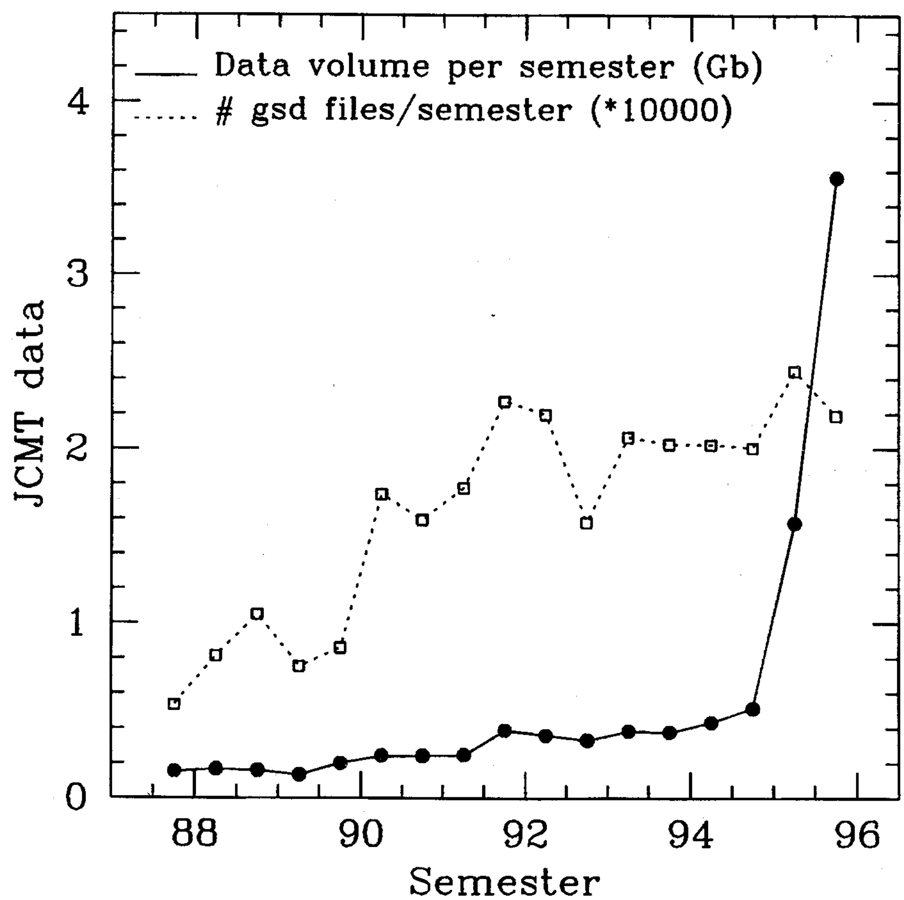

Figure Caption: *This figure speaks for itself. The amount of disk space available at the JCMT is limited. Observers expecting to make vast numbers of on-the-fly maps should warn their staff support in advance so that as much space as possible can be freed on the summit disks.*

Telescope Control System Upgrades

We will be starting work on the design and implementation of a replacement for TEL and TEL_CYCLE in March/April. We plan to use the Web as the mechanism for distributing information about this project, so that the community as a whole will have the opportunity to review and comment on our proposals. Interested readers should therefore look out for a link to this topic from the JCMT home page.

If you would like to have your name added to an e-mail list which we will use to explicitly announce developments as they occur, and to solicit specific feedback, please contact me (rmp@jach.hawaii.edu).

Richard Prestage, JAC

JCMT Software Newsletters

The following sections contain a text version of the 2 recent issues of the new JCMT Software Group Newsletter. Readers are advised that these documents are designed to be viewed using the World-Wide Web. They are reproduced (thanks Tim) in this issue of the JCMT Newsletter so that readers can get a taste of the contents.

The Web pages are accessible from:
http://www.jach.hawaii.edu/jcmt_sw

Graeme Watt, JAC

JCMT Software Newsletter Issue 1

This is the first in a new series of documents designed to make JCMT staff and users aware of new software developments. Initially they will concentrate on the area of UNIX utilities and data reduction packages; as we start to make more significant changes to the online systems, they will be covered also. It is hoped that these documents will be released on a semi-regular basis every two or three weeks.

The World-Wide-Web

The World-Wide-Web (WWW) is becoming increasingly important in the dissemination of information at the JCMT. In view of this a number of software based web pages have now been written. Pages are available on JCMT software[1], Starlink[2], general software and UNIX support[3]. These should be the first place to look if you have a problem or want to know about new software. Feel free to comment on the pages and make suggestions of improvements you think should be made (please note that the User Support pages are maintained by jointly by Tim and Frossie since they are telescope independent). Copies of these newsletters will also be available on the web from the JCMT software page.

New JCMT software

Work is ongoing on the movement of the JCMT utilities to UNIX .

- **Specx 6.7.** Specx 6.7 is now available for UNIX . Unfortunately the VMS version is still at v6.6 - this will be rectified as soon as possible. Information on known Specx bugs and fixes can be found on the JCMT software web page. (contact: RPT or TJ).

- **xsourceplot 0.9b.** The xsourceplot package has now been released to UNIX and tries to give the same functionality as the planets program on the VMS machines. Since it is still in the beta testing phase comments on this implementation are welcomed. A final release is expected in the next few weeks. (author: TJ).

- **jcmtlog.** The jcmtlog program has been released as an alternative to journal. It allows comments to be made to the log as the observations are made so that it is now not necessary to take separate notes. An X front-end will be added shortly. (author: RPT).

Other software releases

It is also our intention to keep staff aware of new software releases not directly related to the JCMT. This list will in essence duplicate that found on the Starlink news[4] or user support[5] web pages and on the minutes of the Computer Services Group meetings. It is felt that this duplication can do no harm and may prove to be useful.

1- Starlink software

In the past month Starlink has released many new packages. The following releases are worth noting:

- **Starlink Figaro 5.** A major update that still includes a bug with GLOBAL.sdf that was present in Figaro 3 (but is not present on AAO Figaro 4[6]). In general this bug is non-fatal but does generate annoying error messages. Contact Frossie if you require more information on the differences between the Starlink and AAO implementations.

- The Starlink cookbook for JCMTdr[7] has now been officially released.

- The Starlink versions of FITSIO and PGPLOT are now at the same release as the JAC versions.

2- General software

- **bibcard version 1.11.** An xwindows tool for entering and manipulating Bibtex bibliographies.

- **ncftp version 2.** An ftp package which allows up-arrow command recall, automatic anonymous login, session recall (so that when you reconnect to a site you end up in the directory you were in last time you were there), a bar graph of the transfer status, commands such as lls and lpwd and automated file transfer sessions.
- **pgperl.** A perl5 PGPLOT module.

- **tcl extensions**

  tcl7.5a2 and **wish4.1a2** The latest alpha releases of tcl/tk. (includes library support).
  version 1.8 Table based widget packer (loads as module in wish4.1).
  expect version 5.18. Utility to run external packages by simulating a typist.
  SpecTcl version 0.1a. GUI designer.
  Sybtcl version 2.3. tcl interface to Sybase.
  tclX version 7.4a. Extended tcl. Also includes an up to date version of tclhelp.

- **xbmbrowser version 5.1.** Small program which displays all the xbm/xpm files in a given directory.

- **xfig version 3.** A more recent version of xfig(1), the software for drawing figures, flow charts etc.

- **xv 3.10a.** The latest release of xv, many new features including the ability to read in FITS files.

- **xvnews version 2.3.** An up-to-date version of the XView newsreader that has now replaced the old version in /usr/local.

- **ytalk version 3.2.** This is a much improved version of talk which has xwindows support and the ability to talk to more than one person at once.

Tim Jenness, JCMT Software group
1st December 1995

1 = http://www.jach.hawaii.edu/user/jcmt_sw/
2 = http://www.jach.hawaii.edu/user/starlink/
3 = http://www.jach.hawaii.edu/user/
4 = http://www.jach.hawaii.edu/news.html
5 = http://www.jach.hawaii.edu/user/other/
6 = http://www.jach.hawaii.edu/user/figaro4
7 = http://www.jach.hawaii.edu/user/jcmt_sw/jcmtdr_cookbook/sc1.html

JCMT Software Newsletter Issue 2

Welcome to the second JCMT software newsletter. The Christmas break has delayed the release of this issue but this does mean that there are plenty of software changes to discuss.

The World-Wide-Web

The world-wide-web pages have not changed much since the last newsletter but remember that the JCMT software page and the unix support pages are there. An emacs[1] help page is currently under construction and will eventually give information on some powerful features which you may find useful.

New JCMT software

- **Specx** has undergone many improvements since the last newsletter to aid in raster mapping:

  — INDEX-FILE and LIST-MAP now support ranges.
  — DAS-MERGE is now a FORTRAN routine rather than a specx script.
  — The READ-GSD-RASTER command has been added. This command will read in all the spectra in a multi-scan GSD file and copy them to a specx data file (with an optional DAS-MERGE).
  — The MERGE-FILES command can merge two specx data files into one and will average spectra which are at the same offset.

  It is hoped that these commands will make raster maps easier to deal with. (contact: RPT or TJ).

- **Standard** is a new tool for searching the spectral line standards database. This program will show you how the strength of a given line has varied in the past. A WWW version has been created and is available[2]. (contact: LWA for standard and TJ for the WWW implementation).

- **Coadd** has been ported to the unix systems and is now available (contact: TJ).

- **GSD access from perl** is now possible. For small software tasks it is much easier to write in an interpreted language than a compiled one. For this reason a GSD module has now been developed so that perl scripts can access GSD data *directly*. For more information on this and an example please see the WWW documentation[3] (contact: TJ).

Telescope control software

Just a reminder to Users about some recent on-line upgrades: the new catalog format, improved handling of source velocities and the ability to perform spectral line fivepoints.

Details about the new catalog format are available in the header of the standard catalog (JCMTDATA_DIR:POINT.DAT). It is now possible for the on-line system to read a source velocity from the catalog, and use this when configuring the frontend. Options are available to always apply the source velocity when slewing to a new source or to only apply the new value on demand (manual entry of velocities is available as before).

It is now also possible to perform five-points with the heterodyne receivers in spectral-line mode. The standard catalog contains a list of sources which have sufficiently strong lines that they are detectable in this mode; the fivepoint routine operates by using channels within the specified velocity range centred around the source velocity.

Tim Jenness, JCMT Software group
18th January 1996

1 = http://www.jach.hawaii.edu/user/emacs/
2 = http://www.jach.hawaii.edu/cgi-bin/standard.csh
3 = http://www.jach.hawaii.edu/jcmt_sw/utils/gsdmod.html

SCIENCE HIGHLIGHTS

First Detection of SiO J=7-6 Maser Emission

All SiO masers involve transitions between rotational states (J) within the same vibrational state (v). SiO masers have previously been identified in transitions up to and including J = 6-5, in the v = 1 and 2 states. There have been conflicting theoretical predictions concerning the J = 7-6 transitions, and our earlier observations (which failed to detect either line towards R Leo or VY CMa - objects chosen because they were sites of J = 6-5 masers) seemed to suggest that the most pessimistic prediction for the J = 7-6 line intensity was correct. Jewell et al. (1987) had suggested that transitions involving J > 6 were unlikely to prove detectable, whereas more recent theoretical work (Doel et al. 1995; Gray et al. 1995) predicted the existence of observable J = 7-6 lines and (possibly) higher-lying lines.

During 1995 June, we devoted several shifts to observing the 321- and 325-GHz water masers in the well-known symbiotic binary, R Aquarii, with the VLA simultaneously monitoring the 22-GHz transition. At these frequencies, even in the best of weather conditions it can feel like you are using JCMT as the world's most expensive water-vapour radiometer, and so during one of the many periods of unsuitable weather, we turned to our umpteenth backup programme: a continuation of our search for J = 7-6, v = 1 and 2 SiO maser emission.

R Aqr is unusual for a symbiotic Mira, in that it exhibits maser emission. In this respect, it resembles isolated Miras: it has been detected as a source of SiO maser emission in the J = 1-0 and J = 2-1 lines of both the v = 1 and 2 states; indeed, the maser is often used as a pointing source by, for example, SEST. It is also one of only two symbiotic systems known to support water masers (Ivison, Seaquist & Hall 1994) hence our primary programme on this occasion. The resemblance of the SiO emission in R Aqr to that in isolated Miras is probably due to the large binary separation and the low luminosity of its hot companion star compared with the other symbiotics observed by Seaquist, Ivison & Hall (1995). In terms of our continuing search for J = 7-6 SiO maser emission, R Aqr seemed as good a target as any, especially since we were already pointing at it.

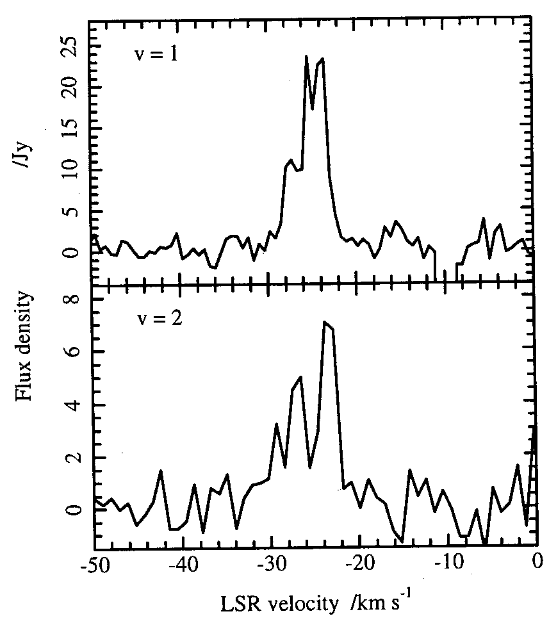

Figure 1: *R Aqr SiO maser transitions: (top) v = 1, J = 7-6 (301.814 GHz) - the highest frequency SiO maser yet detected; four-channel averages are shown; (bottom) v = 2, J = 7-6 (299.704 GHz) - the highest temperature (E/k) SiO maser transition yet detected; six-channel averages are shown.*

The observations were carried out during 1995 June 9.8 UT. The rest frequencies used were 301.814 GHz for v = 1 and 299.704 GHz for v = 2, with a velocity of -25.0 km/s relative to the LSR. The channel spacing was 0.156 MHz (or 0.156 km/s). For each transition, we integrated for 30 min, though the lines were apparent after only a few cycles. The resulting spectra were of excellent quality (Figure 1) and clearly show SiO maser emission from the highest lying rotational transitions detected to date.

The theoretical models used to predict the existence of these masers indicate that they arise from a predominantly collisional pumping mechanism in very dense regions of the circumstellar envelope. Using these models, in conjunction with a pulsation model of a 1-Mo Mira (Bowen 1988), we find a maximum amplification factor of 170.

Assuming that the maser amplifies a black-body background at a typical inner envelope temperature of 1500 K, the amplification factor is around 170, and that the spot size of a 300-GHz maser is about 0.5 mas, we find that the maser beam-angle must be 4.8×10^{-4} sr to match the observed flux - well within the range appropriate for geometrical beaming arising from alignment of small clumps of amplifying gas along the line of sight. Our detection therefore adds credence to the most recent (and optimistic) theoretical work.

It is interesting that the new maser transitions were detected in R Aqr, whilst those in R Leo and VY CMa went undetected. The most likely reason is a strong stellar phase effect on the intensities of the higher rotational state masers. Support for this idea comes from calculations (presently in progress) using a phase-dependent Mira model, and from our non-detection of the J = 6-5 transition in R Leo (the transition was seen at an earlier epoch by Jewell et al. 1987).

It could also be argued that the detection of J = 7-6 SiO masers towards R Aqr has more to do with the influence of the Mira's hot companion than with its pulsational phase, i.e. that the J = 7-6 maser may be pumped in some way by R Aqr's white-dwarf companion. Maybe J = 7-6 SiO masers can only exist in symbiotic Mira systems, where the companion causes temperature and density perturbations in the CS envelope? Comparative observations of a control sample of isolated Miras and a small sample of symbiotic Miras (say, H1-36 and R Aqr, those with known low-J SiO masers) should provide the answer.

It may be that the most interesting consequence of our detection is that it confers the ability to test the 'clump model' for maser emission. Clumps supposedly form through thermal instabilities resulting from infrared band cooling by CO and SiO: a bifurcated envelope structure is the result, with phases which differ in kinetic temperature by typically 200-300 K and in molecular abundance. One phase forms the clumps and the other a hotter background medium.

Models predict that the number of clumps contributing to a SiO maser falls with increasing rotational excitation, and so we would expect clumps emitting in J = 7-6 lines to be much rarer than those emitting in, say, the J = 2-1 lines. Our prediction for the J = 7-6 lines would therefore be for an almost catastrophic form of variability, since the loss of 2 or 3 dominant clumps could eradicate the entire spectrum in these transitions for some fraction of the stellar cycle.

Simultaneous monitoring of J = 7-6 and J = 2-1 SiO transitions would allow comparison of maser-feature lifetimes against those predicted by the model. New spectral features should appear on the cooling time ($< 10^6$ s) and should last until a clump is re-heated by the passage of a shock-wave (i.e. every 2×10^6 to 10^7 s); thus, a study of the changes in SiO maser features from R Aqr over a pulsational period (386 d) will act as a severe test of the clump model.

References

Allen D.A., Hall P.J., Norris R.P., Troup E.R., Wark R.M., Wright A.E., 1989, MNRAS, **236**, 363.
Bowen G.H., 1988, ApJ, **329**, 299.
Doel R.C., Gray M.D., Humphreys E.M.L., Braithwaite M.F., Field D., 1995, A&A, in press.
Gray M.D., Humphreys E.M.L., Field D., 1995, ApSS, **224**, 63.
Ivison R.J., Seaquist E.R., Hall P.J., 1994, MNRAS, **269**, 218.
Jewell P.R., Dickinson D.F., Snyder L.E., Clemens D.P., 1987, ApJ, **323**, 749.
Seaquist E.R., Ivison R.J., Hall P.J., 1995, MNRAS, **276**, 867.

R. J. Ivison, ROE,
J. A. Yates, M. D. Gray, E. M. L. Humphreys & D. Field, University of Bristol &
P. J. Hall, Australia National Telescope Facility

The Bipolar Outflow NGC 2264 G

Detailed observations in CO(2-1) have been obtained of the highly collimated bipolar outflow NGC2264G. A complete map with 20 arcsec resolution shows rich structural detail in both the spatial morphology and the velocity field of the outflow. **Figure 1** (the back outside cover of this Newsletter) shows a position-position image of ^{12}CO(2->1) obtained with the JCMT. The top panel displays blue-shifted lobe while the bottom panel shows the red lobe. Radial velocity is depicted with blue showing the lower velocity gas and red for the most extreme velocity gas. The star in the center of each plot marks the position of the recently discovered central source (Gómez et al, 1994) that is seen in NH_3 and radio continuum with the VLA. The ammonia is centered at 4.6 km/s, which we take to be the central velocity of the outflow, perfectly consistent with observations of the large surrounding ambient cloud. This central source has recently been detected at submillimeter wavelengths using the JCMT (Ward-Thompson, Eiroa, and Casali 1995) and found to have a luminosity of approximately 12 L⊙.

The two lobes exhibit nearly identical extents in space and velocity although there are significant differences in their structure. In particular at low velocities the red lobe shows a bow-shock like appearance far from the central object. No such structure is apparent anywhere in the blue lobe. It is clear that there is a systematic increase in flow velocity and collimation with distance from the central source.

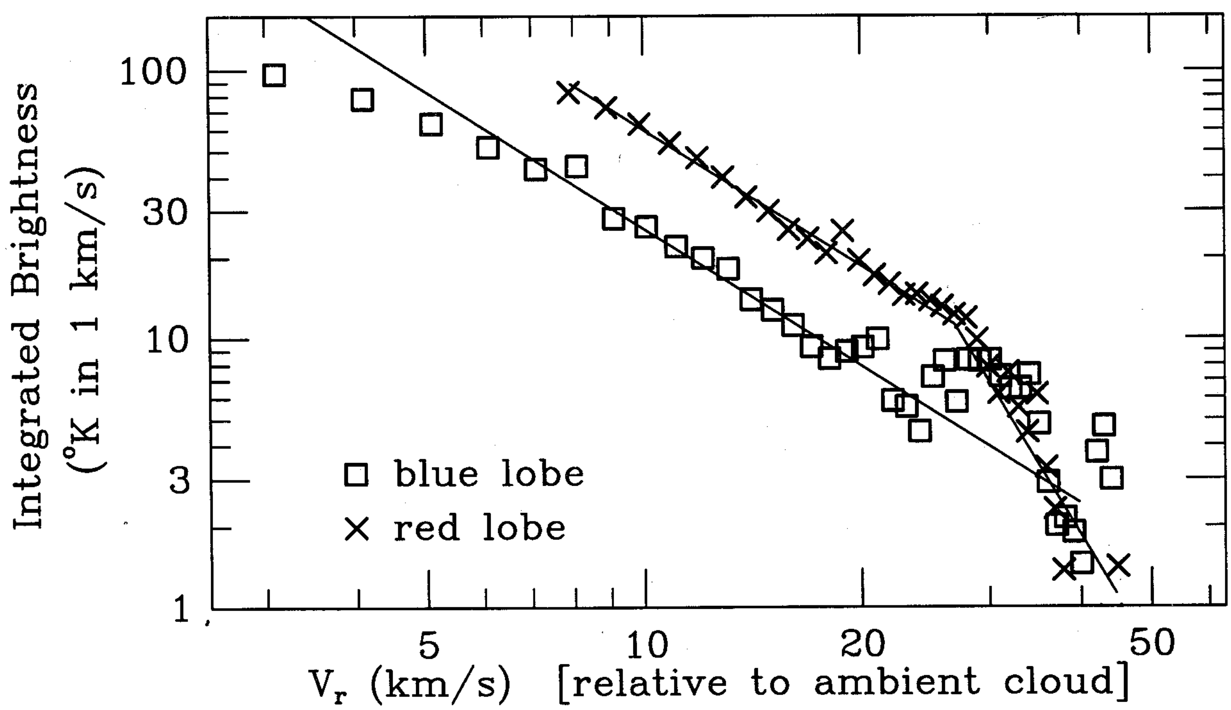

Figure 2: Velocity profiles of each wing. A break in the power law slopes occurs at 28 kms^{-1} in both wings.

Both lobes show an elongated structure at the highest velocities, extending beyond the lower velocity gas and unresolved in the direction perpendicular to the flow direction. These structures may be the molecular component of the jet driving this outflow. Spatially integrated velocity profiles of the outflow gas in each lobe are shown in Figure 2. These profiles, which trace mass of the flow if the gas is optically thin, appear to be well described by a power-law. A line with slope 1.7, similar to what is seen in several other similar outflows, is shown on each lobe's profile. However the highest velocity gas, that looks like a jet in the position-position plots, requires a steeper power law slope ($\gamma \approx 4$) with the identical index in both lobes.

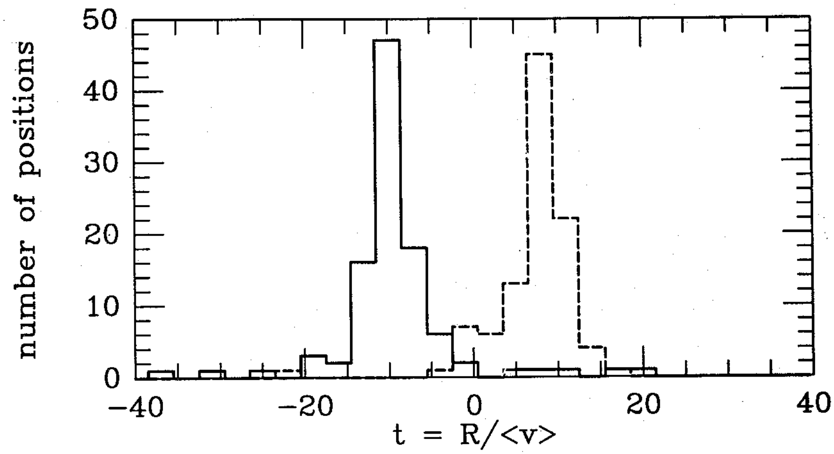

Figure 3: Flow dynamical timescales for the flow determined from each observed position in the outflow and binned in a histogram.

The systematic increase of velocity with distance shown in Figure 1 can be used to estimate a time scale. This can be done for every point in the outflow by estimating the mass-weighted mean velocity at each point <v> and the projected distance from the central source *R*. The time scale is then simply *R* / <v>. The frequency distribution of this timescale is shown in Figure 3. The positions in each lobe are shown separately in solid lines for blue, dashed lines for the red lobe. Both distribution functions are sharply peaked at a timescale corresponding to 3 x 10^4 years!

The mass, momentum, and luminosity of each lobe has been estimated and is shown in Table 1. The mass and momentum estimates are probably the most robust and accurate quantities we have determined. The momentum estimates indicate that that the driving engine of the flow is extremely efficient. In particular, the energy required to drive the molecular outflow is found to be an appreciable fraction of the gravitational accretion energy liberated in the process of forming the central protostellar object. The amount of momentum injection required to account for our observations probably cannot be supplied by a typical optical jet, unless it contains a substantial neutral component.

Mass and Energetics of the Outflow

Lobe	Mass $M_\odot$	Momentum $M_\odot$ kms^{-1}	Mass Flux (10^{-5})$M_\odot$ yr^{-1}	Thrust (10^{-4})$M_\odot$ kms^{-1} yr^{-1}	Lumin. ($L_\odot$)
Red	0.4 (0.5)[a]	6.0 (2)[a]	0.84 (1.2)[a]	1.5 (0.5)[a]	0.52
Blue	0.4	4.2	0.73	1.2	0.44
Total	0.8 (1.3)[a]	10.2 (12.2)[a]	1.67 (2.87)[a]	2.7 (3.2)[a]	0.96

a: Estimated mass and energetic parameters for the lowest velocity (6-12 kms^{-1}) red-shifted gas in the outflow and the totals in these flow quantities including this component. The contribution of this lowest velocity red-shifted gas to the outflow mechanical luminosity is negligible and not included in the Table.

References:

Gómez, J. F., Curiel, S., Torrelles, J. M., Rodríguez, L. F., Anglada, G., & Girart, J. M. 1994, ApJ, **436**, 749.

Ward-Thompson, D., Eiroa, C., & Casali, M. 1995, MNRAS, **273**, L25.

Michel Fich, University of Waterloo & Charles J. Lada, Smithsonian Astrophysical Observatory

Large-scale Mapping of CO Emission in the NGC 6334 Region

The image on the front cover shows the distribution of $C^{18}O$ J=2-1 emission within the large star-forming region NGC6334 in Scorpius (at l = 351.2, b = 0.5) at a distance of about 1700 parsec. The CO emission has been integrated over the narrow velocity range of -3.5 to -1.5 km/sec to show to good effect one particular feature, the narrow ridge of molecular gas running from top left to bottom right.

This map and a number of others were made of NGC6334 with the JCMT using the spectral line raster mapping technique, in which the telescope continuously scans along a line of constant Declination while sampling the data every few seconds. The sample rate was 2 seconds in this case, and there are more than 4000 spectra in this map. These data illustrate the power of the technique, and its value to global investigations of large molecular clouds.

Sections of this complex have been studied previously in some detail in various molecular lines, but this is the first such map of the entire complex with high angular resolution (about 21 arcsec, as indicated by the symbol at the lower left). In the image shown, an unexpected feature is a remarkably narrow ridge of emission, nearly continuous over the entire complex (i.e., about 7.5 pc in length). An 800-micron continuum map made by Sandell and Baas, which covers only the top 40% of this map, shows that the narrow ridge also contains dust emission.

On the basis of a large body of published data, the NGC6334 complex contains five major sites of star formation activity, which are aligned roughly with the molecular ridge. NGC6334 appears also to be a region where sequential star formation has occurred. The sites in the southwest (lower right) appear to be the oldest, and those at the top, the youngest and apparently still ongoing. The active star-forming sites in the north (NGC6334I, I(N), II) lie somewhat to the east of the molecular ridge, while the southernmost (NGC6334V) lies to the west of it. The bright knot of emission at the southern end of the molecular ridge corresponds with NGC6334IV. One of the goals in this project is to study the properties of these sites as seen in their CO and CS emissions.

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W.H. McCutcheon, University of British Columbia,
G.J.White, Queen Mary and Westfield College, London.

Comet Hale-Bopp (C/1995 O1)

The authors are collaborating in the search for supervolatiles in active comets. Supervolatiles (ices more volatile than water ice) have long been suspected as drivers of the activity in distant comets, but only recently has technology advanced to the point where meaningful attempts at direct observation are possible.

They used the JCMT to search for gaseous emissions in the bright, distant comet Hale-Bopp. Emission from the 230 GHz CO[2-1] rotational emission line was first suspected on UT 1995 Sept 5 and 7, but appeared partially confused with galactic CO lines. Subsequent observations on Sept. 19 and 20 and Oct 16 showed the line free of contamination. The discovery was reported (Matthews et al. 1995; see Figure 1) and soon confirmed by observations at IRAM (Rauer et al. 1995). The line appears blue-shifted relative to the instantaneous radial velocity of the comet by about 350 m/s. The blue-shift results from sunward ejection of the carbon monoxide in response to solar heating of the nucleus. The area of the line is variable, and corresponds to a CO production rate in the range 1000 kg/s to 2000 kg/s (1 to 2 tonne/s). Such prodigious outgassing rates are not normally attained by comets until they are much closer to the sun.

The gross properties of the line are very similar to those observed earlier at the JCMT in comet P/Schwassmann-Wachmann 1 (Senay and Jewitt 1994). The activity of both comets, at distances ~6 AU from the sun, is readily explained by the outgassing of CO. At 6 AU, any water ice in the nuclei will be frozen solid, and cannot contribute to the observed cometary activity. Whereas the orbit of P/SW1 is nearly circular, giving no opportunity for the comet to be heated enough for water to ever sublimate, the orbit of Hale-Bopp is highly elliptical. We expect that water ice in Hale-Bopp will begin to sublimate strongly when the comet is 3 to 4 AU from the sun. It will reach this distance early in the summer of 1996. Thereafter, water may rival or surpass CO as the driver of outgassing. Hale-Bopp presents an unprecedented opportunity to study the development of activity in a comet that is still far from the sun. It should provide exciting new constraints on the volatile abundance and outgassing modes of comets.

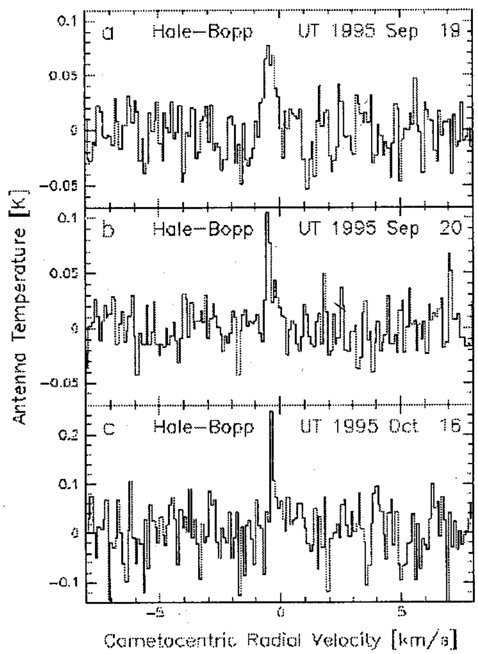

Figure 1: CO spectra from Comet Hale-Bopp.
The spectra were taken at the James Clerk Maxwell Telescope on Mauna Kea, using the RxA2 receiver, and are described in a paper to appear in the February 23 issue of SCIENCE by Jewitt, Senay and Matthews.

References:

D. Jewitt, M. Senay, and H. Matthews (1996), *Observations of Carbon Monoxide in Comet Hale-Bopp*, Science, in press (February 23 issue).

H. Matthews, D. Jewitt, and M. Senay. (1995). IAU Circular 6234 (September 21).

M. Senay and D. Jewitt (1994), *Activity in a Distant Comet: First Detection of Carbon Monoxide*, Nature, **371**, 229-231.

H. Rauer, D. Despois, R. Moreno, G. Paubert, N. Biver, D. Bockelee-Morvan, P. Colom, J. Crovisier, and L. Jorda (1995). IAU Circular 6236 (September 25).

Henry Matthews, JAC,
David Jewitt & Matt Senay, IfA, Univ. of Hawaii.

Magnetic Fields from Molecular Lines - A First for JCMT

In July 1995, the first ever detections of linearly polarized (non-masing) molecular lines were made at the JCMT. In CO J=2-1, polarization levels of 0.4 — 2.5 % were measured, in a variety of cloud cores and near the Galactic Centre. This effect has been sought for 15 years, ever since it was first predicted by Goldreich & Kylafis (1981; ApJ **243**, L74), but has never previously been found. These first results are a tribute to the sensitivity and stability of heterodyne observations at the JCMT.

The line polarization arises in a similar way to that in maser sources, but can in fact occur in **ANY** molecular gas where there is a magnetic field. The direction of the polarization on the sky can be used to infer the direction of magnetic fields in the clouds (see e.g. Kylafis 1983, ApJ **267**, 137).

An example of the results is shown in Figure 1. The upper spectrum is of CO J=2-1 in DR21 (multiplied by a scale factor of 0.01). The two lower spectra are the 'Stokes parameters' Q and U, in polarimetry terminology, which represent orthogonal parts of the polarization vector. The direction of the polarization is 1/2 $\tan^{-1}$ (U/Q), which for this spectrum is approximately 125 degrees. It is clear that the polarization is detected at a good signal-to-noise. Another confirming factor is that the inferred magnetic field direction is only 10 degrees away from the net field in the area as shown by DUST polarimetry (JCMT results at 800 microns by Minchin & Murray 1994, A&A **286**, 579), a difference which is within the errors.

The line polarimetry observations are quite straightforward to do. The polarimeter module, which is generally used with UKT14, is mounted onto the RxA2 frame, with a suitable waveplate for the frequency of the line. We used the 1100 micron waveplate (which has an estimated 94 % polarizing efficiency at 230 GHz), but the 800 micron waveplate could also be used with RxB3i. The installation process is relatively straightforward. Spectra are then observed in the normal way, with an ICL routine used

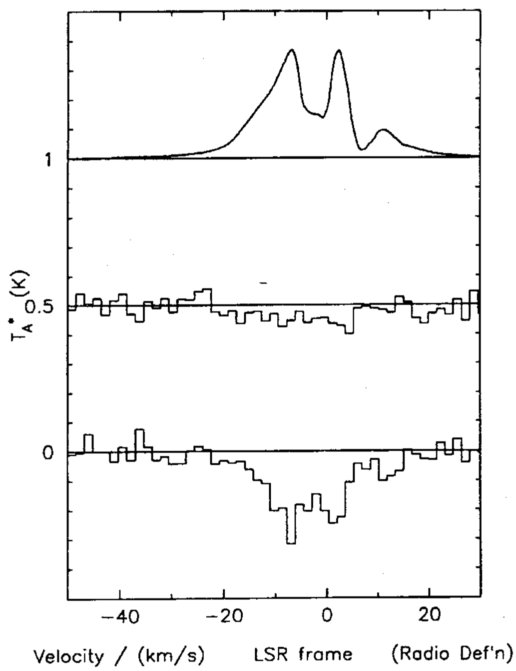

Figure 1. *CO J=2-1 spectra of the DR21 cloud core. (Top:) Total intensity I, multiplied by 0.01; (centre:) Stokes-Q spectrum; (bottom:) Stokes-U spectrum. The polarized components are binned to 1.6 km s^{-1} resolution. All intensities are in T_A^*, and the polarization is about 1 % (this can be seen from the U component being similar in intensity to I x 0.01).*

to move the waveplate between integrations. The data can then be analysed by subtracting pairs of spectra at different waveplate positions to find the polarized components, as in Figure 1.

The data in Figure 1 were obtained in about 30 minutes of integration. We are still investigating the limiting sensitivity of the system, but as an example, polarization has been detected at the 3 sigma level in a dark cloud core where the integrated T_A^*dv was only 50 K km s^{-1}. Polarization levels as low as 0.4 % have been successfully measured in brighter lines. The instrumental polarization level is about 1 %, and has been measured to a 0.1 % error; it appears to be constant across the receiver passband. It is likely to be this accuracy in subtracting off instrumental effects which has made this experiment succeed, in contrast to earlier efforts (e.g. Wannier, Scoville & Barvainis 1983; ApJ **267**, 126 or Lis et al. 1988; ApJ **328**, 304).

This technique is potentially very useful for probing magnetic fields in interstellar clouds. In particular, where the velocity structure of the cloud is fairly well understood (a simple case such as rotation, for example), changes in the polarization across the line profile may give a three-dimensional picture of the magnetic field. This effect is clearly seen in our Galactic Centre data (paper in prep.). This information is not obtainable in any other way, and thus the line technique is both a facility unique to JCMT, and a unique probe of magnetised clouds.

Jane Greaves, Wayne Holland, Per Friberg & Bill Dent, JAC.

Short Baseline Interferometry

The JCMT-CSO interferometry was split into two parts this semester, with one run in October 1995 and one in January 1996. Although there were some patches of poor weather on both runs, we did have a reasonable amount of time when interferometry was possible and in January there were some stretches (regrettably rather short) of really good weather with the 230 GHz τ below 0.04 and the 'CFA seeing' at around 0.2 arcseconds. In October there were no significant technical problems and we were able to carry out a range of programmes at 320 to 356 GHz. As on previous runs the most rewarding sources were bright protostars which give strong fringes and often show a good deal of structure. On this occasion L1448-N and Orion-IRC2 were the prize objects. Finding models to fit these data is proving an interesting challenge. We detected several other ptorostars and found some more Ae-Be stars that have substantial emission from small regions. In most of these cases the visibility did not obviously vary as the baseline projection varied so we can only put limits on the sizes of discs or other structures present. We also observed some double-protostar candidates and made new flux measurements of the compact object in the Galactic Centre Sag A* (which is in too confused a region for single-dish measurements at these wavelengths).

In January the big push was to get the system working properly at 460 GHz for the first time. In addition to the generally more challenging requirements - higher receiver noise, lower antenna efficiencies, much higher atmospheric attenuation, and greater sensitivity to atmospheric and instrumental path length fluctuations - there is an additional complication that the JCMT has a 4 GHz IF system at this frequency whereas CSO's is at 1.5 GHz. We therefore had to introduce additional hardware into the system which offsets the Gunn in the JCMT local oscillator system by 480 MHz. Since the Gunn frequency is then multiplied by 5 this produces an offset of 2.4 GHz at the mixer, which is then removed in the IF system by converting down from 3.9 GHz to 1.5 Ghz. This has all to be accomplished without losing the phase stability.

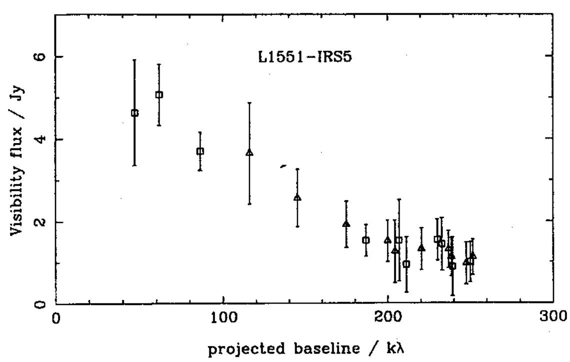

Figure 1a.

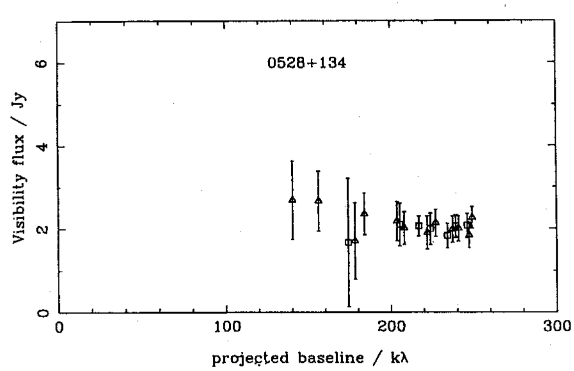

Figure 1b.

We checked out the system by setting up an artificial source at 460 GHz on the roof of the UKIRT control room. We were pleased to see the fringes straight away, but unfortunately instead of one trace on the scope there were three! This was eventually tracked down to two different 10 MHz reference oscillators fighting each other in one of the synthesizers. With that resolved the fringe was clean but subject to nasty phase glitches on timescales of only a few seconds. Another heavy bout of debugging finally traced this to a loose connection on a power supply. We then turned to astronomical sources and were most gratified to see strong fringes immediately from 3C273 (which was conveniently well above its usual 600 micron flux at that time).

Our prime astronomical targets at this frequency were the nearby protostars HL Tau and L1551-IRS5, which both show strong evidence at lower frequencies of having discs about 1 arcsecond across. Both were detected on two nights over a fair range of hour angles. The first diagram shows the visibility of the fringes as a function of projected baseline for L1551-IRS5 (Figure 1a), showing it is well resolved, and also for the quasar 0528+134 (Figure 1b), which is of course unresolved. We hope to use these visibilities to refine our models of the dust discs in these objects. We also found that we could see emission from the CO J = 4-3 line in the evolved star IRC+10216, which poses interesting questions given our 0.8 arcsecond fringe spacing.

The other main technical project on the January run was to try out the prototype 183 GHz radiometer which Martina Wiedner (an MRAO student) had built. The intention is to mount a pair of these on the two telescopes and use them to measure the water vapour content along the paths from the source very accurately so that we can correct the phase fluctuation on timescales down to a second or so. The first one seemed to work well giving reasonable values for the total water and showing the fluctuations at about the level expected.

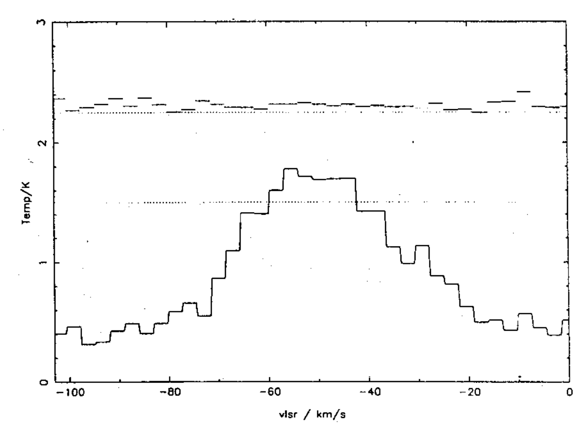

Figure 2.

On the final night we were threatened by a large weather front moving in from the north-west. We spent most of the time working at 346 GHz on NGC 2024 and L1641N but after these were set we tuned to the $H26\alpha$ recombination line frequency (353 GHz) to look at the strong line in Eta Carina recently discovered by Henry Matthews and colleagues. Since the Declination is below -59 degrees this was a challenge, but we timed our attempt so that it was just coming above 10 degrees in elevation. We were amazed to measure a system temperature of 1600K when we arrived at the source and the first 10 second integration showed fringes and a strong line! We then tried to peak up the pointing, but the line seemed to be getting weaker whichever way we went. Another check on the system temperature gave 4000K. The weather front had arrived! In desperation we took a 100 second integration which is shown in Figure 2. (The lower line show the amplitude as a function of frequency and the upper one the phase. Note that there is continuum flux as well as the line.) Obviously the calibration is not very meaningful, but one can say that a lot of the emission is coming from a very small region. A few minutes later the system temperature was above 10,000K, there were clouds overhead and it was time to start taking the system apart and go home.

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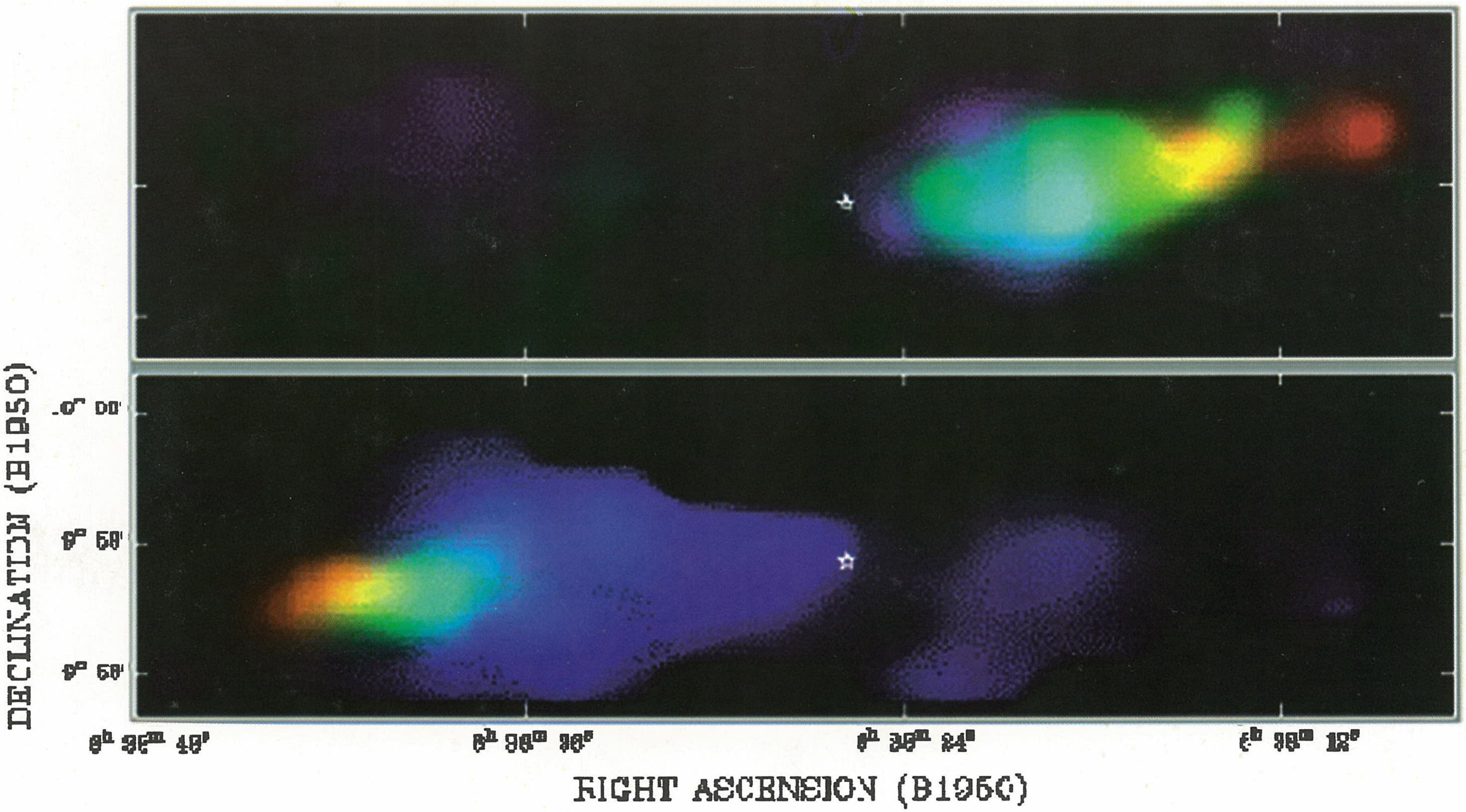
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