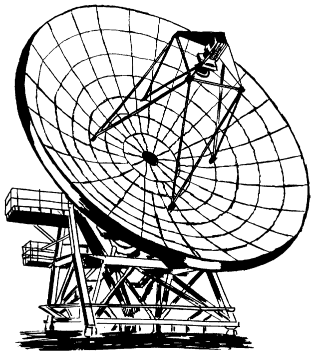
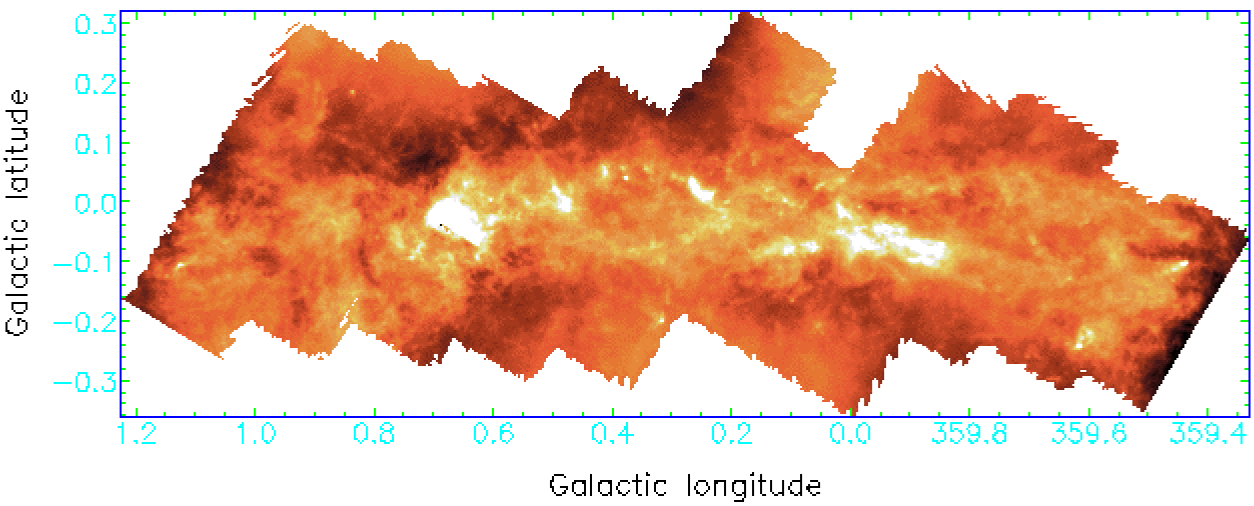


The JCMT Newsletter

Kulia I Ka Nu'U

Number 14

March 2000



March 2000
Issue Number 14

GENERAL ANNOUNCEMENTS

From the Director's Desk

Yet another hectic and eventful six months with some huge successes, strong support from the Board and agencies for the new instrument programme, mixed performance from the facility instruments, some sad losses of staff of the JCMT and a welcome for new staff members. Overall scientific output has been very good, although a lengthy spell of poor weather on Mauna Kea blighted the impact that even flexible scheduling can achieve.

Staff are the heart of most service organisations and the JCMT is no exception and so it was with regret that two of our long-standing Telescope System Support (TSS) staff (see *People*), Jim Pomeroy and Kimberly Pisciotta resigned in the autumn. We were grateful for both staff giving extensive notice of departure, thereby minimising delays through recruitment. Indeed, one new TSS, Scott Mikkelson, is already in post and recruitment is underway for a second TSS. In the meantime, as users are aware, we have been unable to offer 16-hour observing shifts at all times and some slots have been reduced to 12-hours. This situation was known to the JCMT Board and the ITAC and while regretted, cannot be helped. However, this is only a temporary measure, which will be rectified as soon as we are up to full strength. We also lost Rob Christensen, our senior heterodyne instrument support technician, who resigned in December to further his career with the Smithsonian Submillimetre Array (SMA). On the positive side, Brad Gom was recruited in September to provide instrumentation technical support for SCUBA along with Peter Oshiro, an electronic technician for JCMT instrumentation. Elese Archibald arrived to take up her PPARC-funded fellowship working with SCUBA, and will also undertake some SCUBA support plus a small amount of outreach. Robin Phillips, a new support astronomer, joined us in October. Robin will focus on heterodyne instrument support and software utilities and web pages. Nick Jessop, our second new support astronomer, will arrive at the end of March.

Last autumn was a key time in defining the future development programme of the JCMT and involved extensive consultation with the user community through announcements via email exploders and input through their representatives. The JCMT Board meeting in November produced an exciting outcome of strong support for the new programme. Users have been informed of the outcome already (see Board Report on the JCMT Home Page, http://www.jach.hawaii.edu/JACpublic/JCMT/news/nov99-board.html) but the highlights are reproduced here for the general reader. The Board reinforced its enthusiasm for interferometric operation with the SMA and approved a draft MOU that is currently with the SMA for comment. Following the recommendations from the JCMT Advisory Panel, the Board approved the heterodyne camera, HARP-B, which is being constructed by MRAO, the UKATC and HIA (Victoria). There was also tremendous scientific enthusiasm for the new wide-field submillimetre camera, SCUBA-2, and following its successful Conceptual Design Review (CoDR) in late October, was approved for its proof-of-concept construction phase. A proposal for a high frequency heterodyne camera was also received and the scientific potential was strongly appreciated. This project is a collaboration by SRON and MPIfR and is a D-band (600 GHz) version of the CHAMP camera. This is expected to return to the Board in May following a CoDR.

The JCMT Board made other pronouncements on policy issues regarding ‘key’ observing programmes; rules regarding release of data from the archive; and guaranteed time for instrument builders. These were also guided by input from the user community and the full text of the announcements was given in a note to users in January. While mentioning the JCMT archive, excellent progress has been made and the first tranche of SCUBA data has now been released to the CADC. The article by Remo Tilanus in this Newsletter illustrates the strong interest in the existing heterodyne-only data in the archive and the extent to which it has been polled and files extracted.

At the JAC, the surface project continues to make good progress, however, the commissioning of the new holography receiver was delayed, principally through unavailability of software provided by ourselves. In fact progress on software in a number of projects became critical in the autumn and a full review of the JCMT software requirements and capabilities was undertaken by the Head of JAC Software and Computer Services, Nick Rees. Some of the recommendations have already been enacted but there have been inevitable delays to some projects. Returning to the surface project, this should be electrically and mechanically complete in the early summer and testing in the fully active mode will then commence. The new spectrometer for the array receivers, ACSIS, is making excellent progress towards its CDR this summer.

Over the past few months, responsibilities amongst the support scientists have been rearranged following the appointment of Wayne Holland to replace Richard Prestage as Telescope Manager. Remo Tilanus is now line manager for the TSSs. Gerald Moriarty-Schieven takes charge of editing the Newsletter and I take this opportunity to thank Graeme Watt for his excellent work as editor since its inception. As part of this overall rearrangement I am very keen that we produce more and better utilities for the users and make better progress on the observers ‘wish lists’. A recent example of this is the heterodyne integration time calculator (see article this newsletter) produced by Robin Phillips. One of Wayne Holland's key tasks will be to address the scientific quality issues regarding the operation of the facility and to oversee the subsequent improvements.

The telescope itself has just opened following a planned close-down for over a week to undertake the replacement of the carousel motor drives. The ETS group worked their usual miracles and the project has gone extremely successfully, being completed two days ahead of schedule. The final system tests have just been completed and the new carousel drive system has been declared operational. Hopefully, this is the last of the major systems on the JCMT that will require replacement and the Chief Engineer is preparing a roster of preventative maintenance for the facility to reduce downtime in the future through breakages.

Finally, in terms of instrumentation, while SCUBA and its polarimeter has performed excellently, albeit in the fixed 850/450 micron mode, the status of the heterodyne suite of instruments has recently fallen below that acceptable for a facility of the class of the JCMT. Bad luck has dogged the team attempting almost heroic attempts to repair the 230 GHz receiver, RxA3, and this is now out of service while its dewar is repaired by the cryostat manufacturers. The key facility instrument, the 345 GHz receiver RxB3, has suffered a number of problems and their resolution has sapped a huge amount of effort from staff both at the JAC and HIA. However, the recent downtime for repair should now leave this highly competitive receiver operating well and hopefully reliably. The 450/600 GHz receiver (RxW) has just had the high frequency mixers replaced by SRON and now has a very competitive performance at this band. This is excellent news for users and RxW now provides a very potent high frequency capability, which, with flexible scheduling, should allow high quality and competitive science to be undertaken.

Overall, the JCMT operations continue to be extremely tightly funded and I welcome the opportunity to present a series of scenarios of funding requirements to the Board in May. I also welcome the increase in budget by three partner agencies for this current year, and for FY2000/01. Following the May Board meeting, the future development and operation of the JCMT for the next five years should be determined, and I am confident that this will bring a very positive and exciting future indeed.

Ian Robson
16th March 2000

Applying for Time in Semester 00B

Submission Dates:

For telescope time in Semester 00B (1st August 2000 - 31st January 2001) the closing date for ALL JCMT applications is:

31st March 2000

The actual closure of the collection system at the JAC is around 9am local time the following day.

Electronic Submission of PATT Applications:

Canadian & Netherlands applicants should refer to local information about submission procedures and formats, which may contain more current details than those given below.
Complete information is available in the article: *Electronic Submission Update* in this issue.

Paper Copy Submission:

UK and International applicants may still submit hard copies through the usual route to the JAC collecting point, or to Swindon office. However, you are strongly discouraged from using this form of submission. Usually you generate a postscript image anyway so it is much simpler to email that in instead of printing/copying/posting.
If you submit paper copies to Swindon then please **DO NOT** send the same application as an electronic application. This makes extra work for the JCMT and Swindon staff and often leads to confusion.
The appropriate number of copies of each application should be submitted to the collecting point of the appropriate national partner. Applications MUST reach their destination prior to the deadline given above -

Canadian & Netherlands applications **MUST** be electronically submitted (no paper posting please!)
UK or International should be sent to PATT Secretariat, Swindon, UK

There were no paper submissions for semester 00A, and it is hoped that the trend will continue.
For an up-to-the-minute synopsis on the status of each instrument, please consult the JCMT web pages at http://www.jach.hawaii.edu/JACpublic/JCMT/rx/status.html **.**

Status of Instrumentation:

SCUBA: SCUBA will be available for use during the semester. Further information is available on the SCUBA web page at http://www.jach.hawaii.edu/JACpublic/JCMT/scuba/alloc/call.html.

SCUBA Polarimeter: This instrument will be available for use during the semester, in full imaging and in single-pixel modes. Imaging polarimetry is available at 850 to 350 microns and single-pixel polarimetry can be done at any SCUBA wavelength. Scan-map polarimetry can be used, although it has not yet been fully commissioned. More information is given on the polarimeter web page, at http://www.jach.hawaii.edu/JACpublic/JCMT/scuba/scupol/.

Heterodyne Instrumentation: It is expected that RxA3, RxB3 and RxW (both C- and D-band) will be available for use during the semester. Further details and the current status of each instrument are available on the receiver page at http://www.jach.hawaii.edu/JACpublic/JCMT/rx/status.html.

DAS: The DAS continues as the working backend instrument. All published modes of operation should be available (see http://www.jach.hawaii.edu/JACpublic/JCMT/rx/das/das-guide/das-guide.html). Non-standard configuration information is available at http://www.jach.hawaii.edu/JACpublic/JCMT/rx/das/nsfiles.txt.

Visiting Instruments:

Short Baseline Interferometry: The series of experiments using the JCMT-CSO link has been concluded. There will not be any further SBI runs until the JCMT is linked to the SMA antennae.

FTS: The Lethbridge FTS may be available for use during this semester. Tentative planning is under way for a run in December, and possibly one in early August. Further information is available at http://home.uleth.ca/phy/naylor/FTS.html. The Lethbridge group welcomes scientific collaborations with other JCMT users. Please contact Prof. D.A. Naylor (naylor@uleth.ca) to arrange collaborative efforts.

SPIFI: The South Pole Imaging Fabry-perot Interferometer may be available for use during the semester. Current best estimates of sensitivities and other parameters will be posted on the web page at the Cornell Astronomy Department Site at http://astrosun.tn.cornell.edu/research/projects/spifi.html. The Cornell group welcomes scientific collaborations with other JCMT users. Please contact Prof. G.J. Stacey at Cornell University (stacey@astrosun.tn.cornell.edu) to arrange collaborative efforts.

MPI: The Max-Planck-Institut 795-880 GHz heterodyne receiver may be available for use during this semester. Further information is available on the web page at http://www.mpifr-bonn.mpg.de/div/mm/tech/rxe.html. The MPI group welcomes scientific collaborations with other JCMT users. Please contact Dr. R. Stark (stark@mpifr-bonn.mpg.de) to arrange collaborative efforts.

The JCMT e-mail exploder:

There are now instructions accessible from the JCMT homepage detailing how to subscribe/unsubscribe and/or modify your entry in the automatic e-mail distribution system. To subscribe/unsubscribe, etc., link to http://www.jach.hawaii.edu/JACpublic/JCMT/general/majordomo-help.html.

The JCMT Annual Report 1999:

This report is under construction, and must be available in draft form for the JCMT Board meeting in mid-May. Please send any science articles produced using data obtained during 1999 (Semesters 99A & 99B) to the Editor, Graeme Watt, as soon as possible for inclusion in the report.

The 'Progress Reports' web page:

A new page has been linked to the sidebar of the JCMT homepage. This page is primarily for providing applicants (allocated and fallback) with information concerning the status of their proposals. If you have and allocated or fallback proposal active during semester 00A then please check this page frequently. The URL is http://www.jach.hawaii.edu/JACpublic/JCMT/schedules/progress.html.

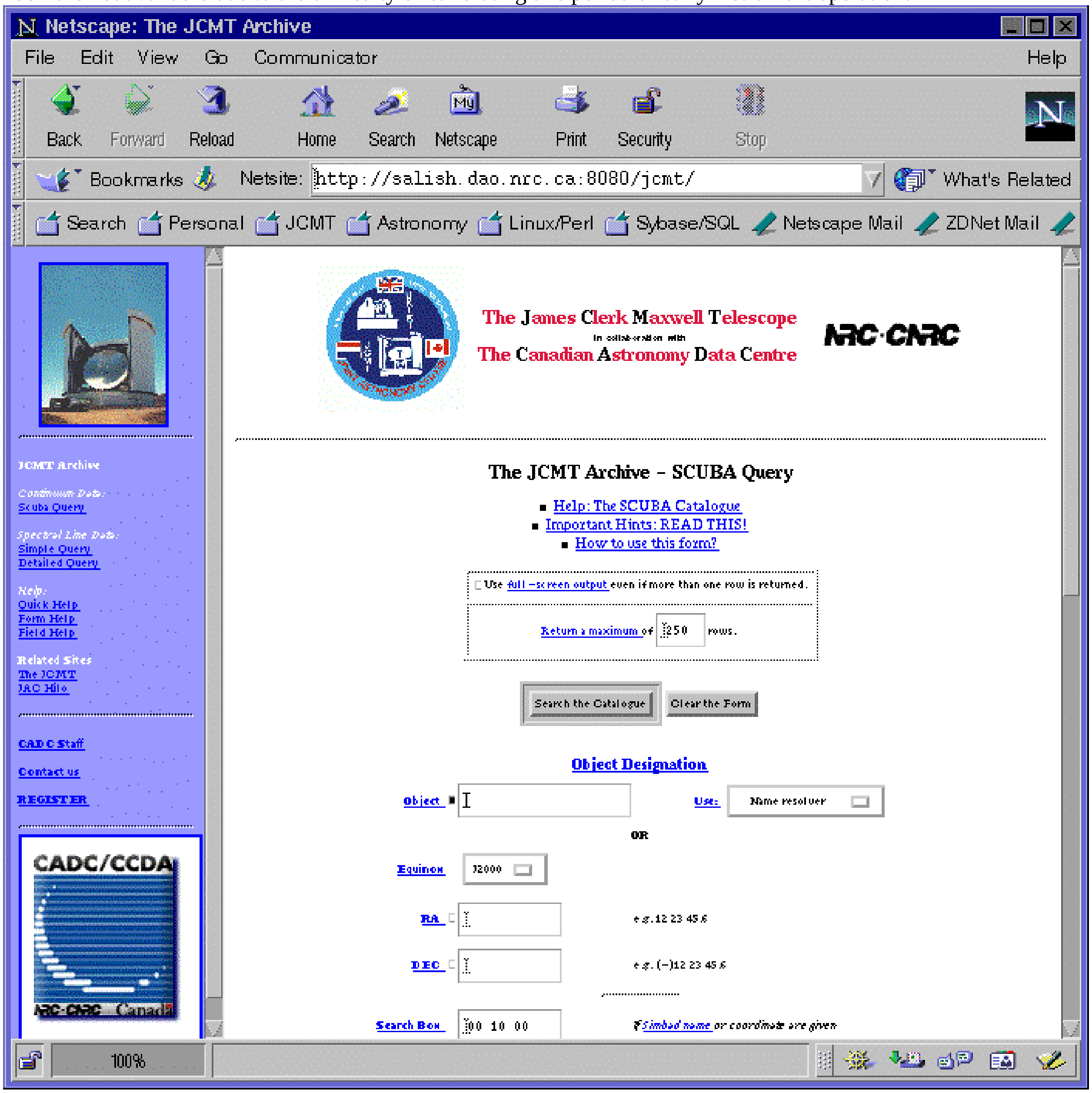
And Finally:

If you have any comments about the scheduling, the submission deadlines and procedures, etc - please contact me at 808-969-6516 or via email at g.watt@jach.hawaii.edu.
Graeme Watt (JCMT Scheduler)

THE JCMT ARCHIVE: SCUBA OBSERVATIONS AVAILABLE

For a number of years the JCMT spectral line Archive has been available to the general public through the Canadian Astronomy Data Centre (cadcwww.dao.nrc.ca) located at the Dominion Astrophysical Observatory in Victoria. By the end of March observations using the Submm Common User Bolometer Array (SCUBA) should also be available from the Archive. The image below shows a part of the prototype SCUBA Archive access page which enables users to select observations e.g. by object name or coordinates.

To date, all SCUBA observations through M99A have been uploaded to CADC and can be `browsed' from the SCUBA page. The default proprietary period is 1 year after the *close* of the semester in which the data were taken, i.e. october 1999 data (M99B) will not become available until the close of semester M00B (midnight Feb 2, 2001). Proprietary data will be listed but the object name and position fields will have been blanked and the observations cannot be downloaded. The *release date* column can be activated to show when proprietary observations will (automatically) become available for general use. A P.I. can file a request with the Director of the JCMT to extend the proprietary period for his or her data in case of a thesis project or a project with long-term status. Data prior to May 22, 1997 are not available due to the difficulty of calibrating this period of early instrument operation.

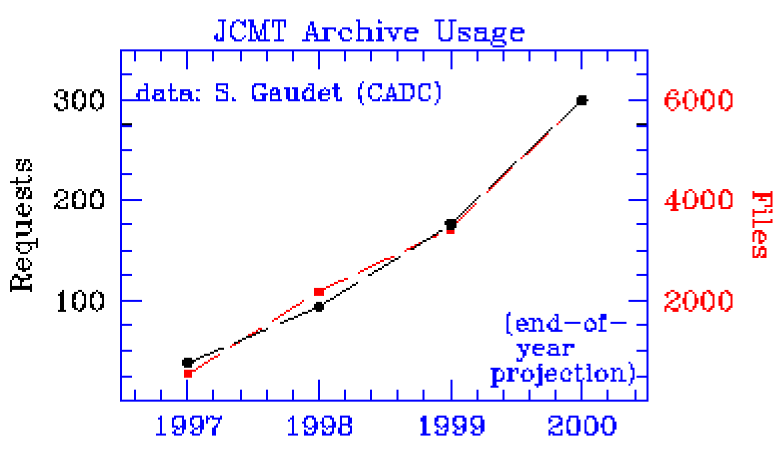


While the SCUBA observation catalogue can be browsed and data be downloaded, *preview* images are not yet available. To reduce the observations users will need to install the SCUBA User Reduction Facility (SURF) software package plus a number of supporting Starlink packages (KAPPA, CONVERT). SCUBA data files are non-FITS. SURF is the SCUBA off-line data reduction package, developed at the Joint Astronomy Centre, and is used to convert SCUBA raw (demodulated) data to calibrated observations. For further information on how to get SURF and its installation, please consult www.jach.hawaii.edu/JCMT/software/scuba/surf.

The JCMT Archive is a collaboration between the JCMT and CADC, and behind the scenes some hard work is being undertaken to make this archive a world-class facility. CADC selected the JCMT data to be the first to be converted to their new DVD-R storage media as highlighted in the weekly publication of HIA, reprinted on the left. The next step will be to try to push the envelope of scientific usability of archival data by installing the SCUBA reduction pipeline (ORAC-DR: www.jach.hawaii.edu/stardocs/sun231.htx/sun231.html) at CADC. The pipeline will initially be used to generate on-the-fly preview images for single observations, optionally in FITS format. However, ultimately we would like to be able to combine any compatible observations, i.e. of the same object or the same region on the sky, and produce a result with the best possible calibration for an automatic process. I am a bit cautious here since we don't know at present how good this calibration will be in general. A lot of work has been done using the pipeline to look at the stability of SCUBA and calibration for photometry by Jeff Wagg (UVic), Tim Jenness (JAC) and Ian Robson (JAC). A subsequent investigation of SCUBA calibration characteristics and optimal calibration procedures by Jeff, Elese Archibald (JAC), and Iain Coulson (JAC) is nearing completion. The results look promising. Their conclusions will be used to derive representative SCUBA calibration parameters for each night which in turn will reduce the overhead of a pipeline reduction sufficiently to make it feasible to start combining data from one or more nights.

Whether or not the resulting images will be reliable enough for scientific use without the need for the archive user to re-reduce the data, remains to be seen. The interactive nature of ground-based astronomy with limited centralized control over the observations may prove to be too much of a challenge resulting in too many images with systematic problems. Regardless, any investigator using archival data in this fashion will be faced with a learning curve on how to guard against errors. Standard quality checks will have to become an accepted practice, i.e. comparing the results of logical subsets of the observations. It will be interesting where these initiatives will lead to in the end.

Since becoming available at CADC in 1997, the JCMT spectral line Archive has enjoyed a continuously increasing popularity. To date there have been about 400 requests for data from users in 11 different countries who have downloaded a total of about 7,500 observations from the Archive (after correcting for the 10,000 files downloaded by a single user this year!). The figure below shows a breakdown per year. On average each user has downloaded 20 files. The usage of the JCMT Archive is especially remarkable given that the spectral line data files have a non-FITS data format and require the use of the Specx software package (http://www.jach.hawaii.edu/JACpublic/JCMT/software/specx/) for their reduction. The expectation is that with the release of the SCUBA observations the usage of the JCMT Archive at CADC will increase markedly.



Acknowledgement: with thanks to the hardworking staff at CADC, especially David Bohlender and Séverin Gaudet, for their efforts in support of the JCMT Archive. The use of the CADC astronomical archives is free: there is no charge to browse through the different catalogues, to use the preview system, or to retrieve data. However, prior to retrieving archive data, users must register.

CADC ARCHIVE SUCCESS STORY

*Reprinted by permission of **HIA Lights**, the weekly internal newsletter of the Herzberg Institute of Astrophysics.*

The Canadian Astronomy Data Center (CADC) has successfully written data to a 4.3 Gigabyte DVD-R (recordable Digital Versatile Disc). The DVD-R that was written contains 261107 files of radio astronomy data from the James Clark Maxwell Telescope. This contents of the DVD-R constitutes the data generated by the James Clark Maxwell Telescope from August 1987 to August 1995.

The data that were written onto this first DVD-R came from six CD-Rs thus, the storage space required to store these data has been reduced by a factor of six.

The file format used to store these date is the Universal Disk Format (UDF) which is a relatively new file system which is expected to be the industry standard for DVD-Rs. This file system differs from the file system commonly used on CD-R (recordable CD) which is the ISO 9660 standard available from American National Standards Institute (ANSI).

The Archive Storage (ASTO) software, which was developed by the CADC, was used to create the DVD-R. This software, in-turn, uses software from Tracer Technologies (www.tracertech.com) to do the actually burning (writing) of the DVD-R with a Pioneer (www.pioneerusa.com) DVD-R writer. Software from Tracer Technologies is also being used to manage our Pioneer DVD-R jukebox where our first DVD-R created currently resides. This DVD-R has already been joined by two others, and more are expected to join it soon.

We at the CADC are very excited by this achievement. Moving our data to DVD-R will greatly reduce the storage space needed to keep all of the data we currently have in the archive. It also provides a solution to the storing of large data files (approx. 210 Megabytes each) that are being produced by the Canada France Hawaii Telescope.

The People Page

Since the last newsletter we've had quite a number of staff changes at the JCMT/JAC. Most notable from the standpoint of visiting astronomers (see article from the Desk of the Director) was the departure of telescope system specialists Jim Pomeroy (noted in Newsletter #13), who left to take a job nearer his family in Utah, and Kimberly Prisciotta, who left to persue full time her interests in Hawaiian affairs. Scott Mikkelson arrived in January, and is nearly ready to take on the full responsibilities of being a T.S.S. We are still recruiting for the second T.S.S. position.

We also said farewell recently to Rob Christensen, our Senior Instrumentation Technician, who left to take a position with the Smithsonian Sub-Millimeter Array. Rob was instrumental in keeping our heterodyne receivers working.

Since the last newsletter we also welcomed Felisa Teramoto, who works in Accounts Payable/Receivable.

Congratulations are also in order to Wayne Holland, who took over the duties of Telescope Manager in the fall.

gms

INSTRUMENTATION UPDATE

Status of Heterodyne Instrumentation

This page offers a summary of the basic characteristics of the current heterodyne (spectral line) instrumentation of the JCMT, with a forward look to the next semester. Links are provided to other pages, where more detailed information can be found regarding performance and operational details. It is very likely that the present page will be more up-to-date than the detailed pages. For a more general introduction and other information about the heterodyne instrumentation, please see the *Guide for Prospective Users* at http://www.jach.hawaii.edu/JACpublic/JCMT/userguide/guide/guide.html.

The JCMT operates facility heterodyne instruments in four bands, known as A, B, C and D in order of increasing frequency. The basic characteristics of these systems are given below.

Receiver system	**A**	**B**	**C**	**D**
Tuning range (GHz)	215 - 275	318 - 373	430 - 510	630 - 710
Beamwidth (HPBW, arcsec)	20	14	11	8
Beam Efficiency	0.69	0.63	0.52	0.30

Receiver A3 - 230 GHz

This receiver provides spectral coverage from about 215 to 275GHz, the lowest frequency band in which the JCMT operates for spectral line observations. A3 has a single channel with a low-noise SIS mixer having a typical noise temperature Trec(DSB) of about 70K over most of its range. A hump in the noise temperatures occurs between local oscillator frequencies of 245 and 260GHz, with a peak of 120K. Although A3 does not have a single-sideband filter, one can avoid the side effects of this feature for almost all common spectral lines with a suitable choice of sideband.

Current Status

A3 is not in service while repairs are being carried out on the helium cryostat. This is expected to take three months or so.

Anticipated for semester 00B

Current (uncertain) estimates indicate that A3 should be back in service for semester 00B.

Receiver B3 - 345 GHz

B3 has two low-noise SIS mixers which are tuned to the same frequency using a common local oscillator. Both mixers have been replaced with tunerless versions in the past year. The receiver tunes between LO frequencies of 319 to 369 GHz; i.e. sky frequencies from 315 to 373 GHz should be accessible with one or both mixers.

Both channels of B3 are capable of observing a spectral window up to 920 MHz wide simultaneously. Using a single channel allows one to observe with the spectrometer maximum of 1.8 GHz instantaneous bandwidth.

Current Status

The receiver is undergoing an overhaul in Hilo, where it is connected in a standalone mode to a VMS workstation. Current effort is focused on making a number of repairs and operational improvements. We expect that B3 should be back in service on the JCMT around the beginning of April.

Anticipated for semester 00B

B3 should be available with normal performance: typical DSB Trec values of between 100 and 150 K can be expected, except at the extremes of the frequency range (outside about 320 - 365 GHz), where only one mixer may be useful. For additional information, refer to the B3 Web pages (http://www.jach.hawaii.edu/JACpublic/JCMT/rx/b3/rxbman.html), and/or the User's Guide (http://www.jach.hawaii.edu/JACpublic/JCMT/userguide/guide/guide.html).

Receiver W - 460 and 690 GHz

This receiver consists of four mixers, two for use around 460 GHz ("C" band), and two designed for use over the 660-690 GHz region ("D" band). All are mounted within a single cryostat. The two C-band channels, or the two D-band channels are normally used simultaneously to achieve improved sensitivity. It is not configured to allow simultaneous operation with C and D bands, however.

Current Status

Receiver W is presently in the laboratory at the JCMT, where it is undergoing some improvements and operational maintenance. The major improvement is the replacement of the D-band mixers with tunerless versions having considerably improved sensitivity. W is expected to be ready for use again by the end of March, although considerable effort will be required to recommission the D-band spectral coverage; this may take some time as it is strongly dependent on sky conditions.

Anticipated for semester 00B

The C-band mixers are expected to be unchanged with a typical DSB Trec value of about 150K over the operating range of about 430 to 510GHz. The D-band mixers should be improved by the current upgrades to provide a Trec of typically 350K.

Spectrometer backend ("DAS")

The DAS is an autocorrelating spectrometer which provides the signal processing for all heterodyne instruments at the JCMT. Possible sampled bandwidths are 125, 250, 500, or 920MHz wide with one or two inputs (i.e. one or two mixers), or 1800 MHz with one input channel. The narrowest bands correspond to a spectral resolution of 95kHz (190kHz using two input channels). At 1.8GHz bandwidth the spectral resolution is about 1.5MHz. Some special configurations can be used to allow more than one line to be observed at the same time if the lines are suitably situated in frequency space. 1MHz corresponds to 0.87km/s at 345GHz

Current Status

The DAS is operating in all normal modes.

Anticipated for semester 00B

We expect the DAS to be operating normally.

Henry Matthews

Applying for SCUBA observing time in Semester 00B

The next deadline for JCMT applications is 31st March 2000. This is for semester 00B, which runs from 1st August 2000 until 31st January 2001. This note describes some of the technical considerations applicants should be aware of when applying for SCUBA time.

1. New wideband filters (450w:850w) were installed during the upgrades in October 1999. Preliminary Flux Conversion Factors (FCFs, or 'gains') and Noise Equivalent Flux Densities (NEFDs) have been calculated for the 450w and 850w filters only. The figures in this document are sufficiently accurate to allow the preparation of proposals, although it may transpire that more precise NEFD estimates may differ from those described here by a few percent at 850 microns and perhaps 15% at 450 microns. These figures will be updated here as soon as possible. At this time, only pre-upgrade FCFs and NEFDs are available for the other filters, although it is likely that all the NEFDs have improved as a result of the new blocking filters .

2. **General information**
   As for previous semesters there are again no time restrictions either per source or per proposal. Accepted proposals will most likely be flexibly scheduled in blocks, with designated observers performing the observations. Short programmes, requiring less than a shift (8 hours) will be probably be done in service mode, although, depending on resources, the observations may not be done by JCMT staff but by astronomers from the user's country. International proposals in this category will normally be undertaken by staff astronomers.

3. **The SCUBA Upgrade Project** was completed in October 1999.
   There were three major changes :
   1. New blocking filters were installed, which have somewhat better transmission than the old ones. As before they are designed to cut out extraneous infrared radiation that would otherwise be detected by the bolometers. The sensitivity of all filters will have been affected by this change, although, as noted below, only the new wideband filters have been properly characterized since these upgrades.
   2. Two new wideband filters centred at 450 microns and 850 microns (450w:850w) were installed and have been in almost continuous use since. The transmission profiles were measured in the lab whilst the older profiles were measured *in situ* using the Lethbridge FTS . They have provided significant improvements in sensitivity over their pre-upgrade narrowband predecessors. At 850 microns the new blocking filter is mainly the source of the improved sensitivity, while at 450 microns the new wideband filter is also more sensitive than the post-upgrade narrowband filter.
   3. Installation of new ribbon cables allows the fridge to run colder. This has generally reduced the number of noisy pixels and has also stabilized the noise on the arrays.

   On the debit side
   - the 1100 micron photometric pixel again failed to respond, and it is again unavailable during Sem 00B,

- the 2000 micron photometric pixel also failed unfortunately,
- and despite general low noise levels on the arrays, one pixel on the long-wavelength array, G9, has become essentially too noisy to use and has been disabled almost continuously since the upgrades.

4. **Filter Drum Problems and Filter Availability**
   Problems with the filter drum mechanism during Sem 99b prevented the selection of the full range of filters and the drum was left in the 450w:850w position while we considered how to repair it. An attempt to repair the drum on March 07 failed. Another attempt to repair the drum and the 1100 and 2000 micron pixels will most likely be made during August or September 2000.
   Therefore :
   - Applications will be accepted for the 450w:850w filters.
   - Applications will also be accepted for 350, 750, 1350, 2000 micron work, but these filters will not be available until August/September 2000 at the earliest.

5. **Which observing modes are available?**
   There will still be four basic observing modes available for semester 00B. Where the multiplicity of filters is mentioned, please bear in mind the possibility that only one drum position, probably that holding 450w & 850w, may be available.
   - Photometry
   - Jiggle-mapping
   - Scan-mapping
   - Polarimetry

   For observations with the arrays, applications will be accepted for photometry at 450:850 microns simultaneously, 350:750 microns simultaneously, or any combination **separately**. Mapping applications (both jiggle and scan-map) will be accepted for 450:850 or 350:750 simultaneously. There is no advantage in asking for maps at individual wavelengths separately since the data at the other wavelength comes automatically. It should be noted that, because of the NEFDs, observations at 350:750 are generally much more time consuming than those at 450:850.
   Applications will also be accepted for photometry or mapping with the 2000 and 1350 microns photometric pixels. The 2000 micron pixel is expected to be restored to full use later in the year, but the 1100 micron pixel is much less likely to be available. The photometric pixels look out simultaneously but are offset from each other on the sky, so simultaneous photometry is not possible. Mapping is obviously very inefficient with the photometric pixels compared with the arrays, and should be restricted to small areas (i.e. less than about 2 arcminutes square for jiggle-map, and 3-4 arcminutes for scan-map).

6. **Current system sensitivities**
   The wideband filters (450w:850w) have been in use for about 4 months, providing sufficient data to allow estimates of the system sensitivities with these filters. Such estimates have not been possible for the other filters because of the filter drum problems mentioned above . The new 450w:850w flux conversion factors (FCFs, or *gains*, as we used to say) and sensitivities (NEFDs) are summarized in the table below :

Filter	**Average FCF** *	**Best NEFD**	**Average NEFD**
microns	**Jy/volt**	**mJy/sqrt(Hz)**	**mJy/sqrt(Hz)**
850w	197 $\pm$ 13	75	90
450w	384 $\pm$ 97	600	1400

* - FCFs calculated using the SAMPLES option in SCUPHOT.

   - **FCFs**
     The uncertainty in the FCF at 850 micron is approximately 7%, while that at 450 microns is approximately 25%. This latter figure is due in part to the averaging of data from many nights, including data taken when the dish efficiency is less than optimal. It probably substantially overestimates the calibration error that would result from reasonably rigourous calibration observations taken on any single night. Plots of
     - the FCF for the 850w filter -vs- tau_850 and airmass
     - the FCF for the 450w filter -vs- tau_450 and airmass ,

     derived from a sample of nights with suitable calibrations, show no strong dependencies of the FCFs against either parameter. These average FCF values will be updated as soon as the other filters become accessible and appropriate data is available for similar analysis.
   - **NEFDs**
     Sensitivity (NEFD), particularly at the shorter wavelengths, depends very strongly upon the weather, but also upon the elevation of the source. The table shows the *best* sensitivity achieved in each filter, i.e. under very good conditions and close to zenith, as well as figures that we believe are more representative of *average* conditions. In

calculating integration times it is therefore necessary to take into account the average elevation of the source during the proposed observation. The NEFD varies with sky transmission , where transmission = $e^{-tau.airmass}$, so observing at low elevations on a good night is equivalent to observing at high elevations on a poor night.
The variation of NEFD for 750 microns is likely to be similar to that for 850 microns, and likewise 350 to 450, although confirmation is pending. For the photometric pixels (1350 and 2000 microns) the variation is essentially ignored, except under very poor conditions. The older table of NEFDs may help proposals for observations at 350, 750, 1300 and 2000 microns.

We have provided a Web-based observing tool - the Integration Time Calculator - to assist with the calculation of integration times. This has been updated during March 2000 to take into account the new 450w:850w characteristics.

7. **Which observing mode to use?**
It may seem an obvious statement, but the observing mode you choose depends on precisely what you want to do!

- **Photometry**
  If you have a completely isolated point source, with a known accurate position, then the **photometry** mode is your best bet. If you want 850 micron photometry then 450 comes for free (even if you don't detect it at 450), and similarly, 350 microns comes for free with 750. However, if you suspect your source might be slightly extended, OR you are interested in the field around your source, OR your position isn't very reliable, then you should almost certainly take a map.
  Notet hat because of a small (1 arcsecond) offset between the centres of the LONG and SHORT arrays photometry is taken using a small (2 arcsecond step, 3x3) 9-point jiggle pattern in order to ensure that the peak signal from the source is achieved at some point in the jiggle. Provided both calibrators and target sources are observed in this way the validity of the calibration is maintained.

- **Jiggle mapping**
  When it comes to mapping there are two basic options: jiggle-mapping and scan- (or raster) mapping. **Jiggle mapping** is the preferred mode for sources that are smaller than the array field-of-view. Limited mosaicing of jiggle maps is also possible, although care must be taken to avoid chopping onto extended emission. To obtain a fully-sampled map using the jiggle method requires taking data at 16 positions . Therefore, the sensitivity per sampled point is 1/4 that of a point-source observation for the same integration time. However, this is only true if you wish to retain the full spatial resolution of the map. On many occasions you are most likely interested in the total flux of an object (eg. an unresolved core in a map), and in such cases you can afford to bin pixels (i.e. degrade the resolution) in order to gain signal-to-noise. For example, for a perfectly pointed observation a calculation using the measured SCUBA beam profiles suggests that if you add together the signals measured on a point source over the 16 positions (1 second at each) of a jiggle-map, we would get a S/N approximately 3 times worse that if we'd simply sat on the peak for 16 seconds. In reality, there is always a residual pointing error for stare photometry, plus the effects of seeing to take into account, and tests during commissioning have shown that under good conditions the S/N on a point source is 2 - 2.3 times lower with a jiggle map than with photometry. If the seeing is poor, OR if the source is slightly extended, then the difference is smaller, and the two modes may even be comparable. In such circumstances it may be better to take a fully-sampled map rather than photometry. **However, it should be pointed out that by binning pixels together you are degrading the resolution of your map.**

- **Scan mapping**
  The **scan-map** mode is the preferred mode for sources that are bigger than the array, and works particularly well for sources in confused regions. This mode works in a similar way to the old "on-the-fly" raster mapping with UKT14, but, of course, we have an array rather than a single pixel. The telescope moves the array in a raster pattern across the source, and as with jiggle-mapping, integrations can be coadded to improve the S/N. As the telescope is scanning the secondary mirror is also chopping and measures the difference in signal between two points a short distance apart (typically 30-60 arcseconds). Full image sampling along the scan direction is achieved by adjusting the scan rate and sampling frequency. One demodulated data sample is obtained for each cycle of the secondary chopper, so if the chop frequency is 7.8 Hz (as currently used for scan map), a 3 arcseconds spacing (to produce fully-sampled maps at 450 and 850 microns) will be produced by a scan rate of 24 arcsec/second. The direction of the scan is such that the bolometers sample the map area fully in a single scan. The black dots represent the bolometer positions for the Long-Wave array, and the slight distortion from a true hexagon shape is because of field curvature caused by the SCUBA optics. This technique has the disadvantage that it fixes the angle of the scan on the sky, so we cannot expect to scan in azimuth. Although sky rotation has a minimal effect on the sampling for each scan across the map area, it may cause the edges of successive maps not to butt together correctly. There is no real cure for this in the current system, so we allow an substantial overlap of the array between scans and between maps.

In semester 98A we adopted a new method for acquiring scan map data, known (locally) as the "Emerson II" technique. This method is described in detail by Jenness et al. (SPIE Vol. 3357, 1998). The technique reduces the severity of some of the problems associated with the traditonal EKH restoration, and results in a significant improvement in S/N. It is not necessary to know exactly how this new method works to write your proposals, but if you are interested please click here. The maximum length of any one scan is limited to 52 secs by the transputer data acquisition system. So, in principle, an area of about 20 x 20 arcmin can be mapped, scanning at 24 arcsec/sec, IF the scan direction is maintained parallel to one side of the scan area. In practice, this is very tricky, and we normally restrict areas to around 10 x 10 arcmins. There is also the question of when, and how often, to calibrate, and the EMII method is somewhat restrictive in terms of integration time, and hence the achievable S/N in the final map (please see the section on Calculating Integration Times for more information). However, it is also possible to scan the telescope faster and maintain Nyquist sampling at 850 microns, but at a cost of producing an undersampled map at 450 microns. This has a number of possible uses, such as very large scale surveys. Individual scan maps with dimensions of 25 x 25 armin and 40 x 10 arcmin have very recently been carried out successfully.
One obvious question that one may ask concerns the relative merits of jiggle and scan map for particular types of observation. If you have a source smaller than the array field of view, and are confident of chopping onto "blank" sky, then jiggle map is almost always the preferred mode. It is fair to say (and we have proven this empirically) that if you used both observing modes to map, say, a 8 arcminute long edge-on galaxy (where the width of the galaxy is

- **Polarimetry**
  The SCUBA polarimeter will be available in Semester 00B. Observations can be made at all SCUBA wavelengths, using either the 'array' waveplate (350-850 microns) or the 'photometric' waveplate (1350,2000). Full-imaging polarimetry in jiggle-map mode is available at a primary wavelength of 850 microns, with some limited mapping at 750, 450 and 350 microns available. Observers interested in making polarization maps of very large sources should consult the instrument scientist (Jane Greaves). For more details, including some of the latest results, please go to the SCUBA Polarimeter WebPage, or see the specific instruction for applying for polarimeter time .

8. **Calculating integration times**
Calculating integration times for the various SCUBA observing modes has never been easier! We now have an Integration Time Calculator (ITC) for use in writing proposals. The following sections detail the calculations included in the ITC, as well as containing some examples.
   1. **Photometry**
   For photometry the rms noise (in mJy) after t seconds is NEFD/sqrt(t).
   As an example, consider we have a point-like source that we think is around 50mJy at 850 microns (the flux estimate may have come from an extrapolation from other wavelengths). We would like, say a 10-sigma detection on this source, and so the integration time required is :

$$t = \left[\frac{NEFD}{F}\right]^2 \sigma^2$$

   where F is the estimated source flux (in mJy) and sigma is the signal-to-noise ratio . So, using the "average NEFD" of 90 mJy at 850 microns (the ITC will allow a more accurate value to be used), means that we would require 324 seconds to give a 10-sigma detection.
   Similarly we can invert the above equation, and find that in one-hour integration time we should reach a rms noise level (1-sigma) of 1.5 mJy/pixel. In 8 hours (i.e. one-shift of telescope time) we can expect to achieve close to 0.5 mJy. A table of the sensitivity limits (1-sigma) for the average achievable NEFDs is given here.
   2. **Jiggle mapping**
   As mentioned above jiggle mapping requires taking data at 16 positions to produce a fully-sampled map. Therefore, in this case the time estimate for a fully-sampled map is:

$$t = 16\left[\frac{NEFD}{F}\right]^2 \sigma^2$$

   When we use both arrays simultaneously we adopt a 64 position jiggle pattern . This is usually split into 4 sets of 16, and after each 16 jiggles (each jiggle takes one second) the telescope is nodded. However, the integration time calculation is still the same, since we sample at around 3 arcsecs. This ensures that we cover the same area between

the LW array bolometers, at the resolution required by the SW array (since the spacing of the SW bolometers is about half that of the LW). So at 850 microns we are effectively oversampling by a factor of 4.
As an example, consider a map of say a 1 arcminute core, which we again estimate has a peak flux of about 50 mJy. We would again like 10-sigma on the peak and so using the above equation we would require an integration time of 1.44 hrs, or obviously 16 times longer than our point-source photometry. Again, as mentioned in section 3, if you are intending to bin pixels (i.e. degrade resolution) then the factor of 16 in the above equation can be dropped to around 4-5.

3. **Scan mapping**
Scan mapping is a relatively new mode for SCUBA, and we are continually improving the efficiency (eg. by cutting down on the overheads). The following equation has been found to work satisfactorily for estimating scan map integration times:

$$t = \frac{(x+L)W}{d^2N}\left(\frac{NEFD}{F}\right)^2\sigma^2$$

where L is the length of the map in the scan direction (in arcseconds), W is the width (arcseconds), d is the pixel resolution required (arcseconds), and N is the number of array elements. To ensure that we produce a fully-sampled map of the selected area we conservatively allow an overlap of half the array diameter at the beginning and end of each scan. Hence there is a factor, x (equal to 138 arcseconds) which needs to be added to the length of a scan.
Consider an example: Suppose we wish to scan-map a 10 x 10 arcminute region, with the default 3 arcsecond sampling. The brightest source in the image is estimated to be about 300mJy at 850 microns, and we would like at least 10-sigma on this peak. Using an NEFD of 90 mJy/rtHz, the above equation gives an integration time of 3.3hr. However, sampling at 3 arcseconds in order to fully sample at 450 microns means oversampling by a factor of 4 at 850 microns. A scan map to produce an rms noise level of 30 mJy at 850 microns will therefore take about 0.8hr (plus overheads, as discussed below). Depending on the spectrum of your source you might do better or worse (usually worse!) at 450 microns. For example, if the source described above had a nu-squared spectrum the signal-to-noise at 450 microns (assuming NEFD of 700 mJy) would only be around 3.5 for the same integration time.
N.B. The Emerson II scan-map technique requires a number of maps of the same region with different chop configurations. The default is that 6 chop configurations are used. This means that the time for a map and the resulting rms noise (in a certain weather band) are somewhat fixed. For example, a 10 x 10 arcminute map is the most popular size, and one coverage for one chop configuration takes about 10 mins (including software and telescope overheads). For all six chop configs the final map will take about 1 hour (which is a reasonable time in stable weather). Because of the necessity of performing 6 maps (for the EM II restoration to work), the resulting rms is also fixed (e.g. in band 1 weather we have shown that an rms of about 25-35 mJy/beam is achieveable at 850 microns at airmass of around 1.5). Although the ITC gives time estimates based on a required rms noise level, the potential applicant is also asked to be aware of the restriction of using this method.

4. **Polarimetry**
The default mode for carrying out polarimetry observations will be the "step-and-integrate" technique (similar to the way that the UKT14 polarimeter used to operate).
To obtain a polarization signal-to-noise, sigma_pol, for a source of flux, F, it is necessary to integrate for the following time:

$$t = 18\left[\frac{NEFD.\sigma_{pol}}{p.F}\right]^2$$

where p is the expected percentage polarization level. This equation assumes that 16 waveplate positions will be used in the data acquisition, which was generally the preferred mode of taking data with the old UKT14 polarimeter. The equation also includes losses in transmission due to the wire grid and waveplate itself. A full derivation of this expression is available here.
Consider a couple of examples: Suppose we have a 1 Jy protostar, for which we estimate a polarization level of about 2%. To obtain a 5-sigma detection, at 850 microns, under average conditions would take about 2.5 hrs. Now consider a 0.2 Jy blazar, which may be typically 5% polarized. To obtain a 5-sigma detection at 1350 microns would take about 4.5hrs.

9. **Estimating overheads**
Although we have made significant progress in reducing some software overheads, there are still substantial overheads to be added to the above integration times for *all observing modes*. There are two types of overheads: "observational overheads"

which are associated with the setup and carrying out of a particular observation, and "calibration overheads", which includes pointing, focussing, slewing, skydips and other calibration (eg. beam maps). The ITC now calculates the observational overheads **BUT DOES NOT CALCULATE CALIBRATION OVERHEADS** .
Examples follow :

- **Photometry** : a 10 minute on-source photometry observation takes about 15 minutes, i.e. observational overheads of 50%. Calibration overheads are a further 50%, giving total overheads of closer to 100%.

- **Jiggle mapping** : A 64-point jiggle map with n_integrations=20 suggests an on-source time of 20x64x2 seconds = 43 minutes, but typically takes about 52 minutes in elapsed time; *i.e.* the observational overheads are about 20%. This is less than in photometry mode mainly because nods are performed less frequently. With calibration overheads of a further 50% total overheads are about 70%.

- **Scan mapping** still has large observational overheads which we hope to improve. Currently these are something like 50%, with an additional 50% needed for calibration, giving total overheads of approximately 100%.

- **Polarimetry** : observational overheads are dominated by moving the waveplate. Calibration is not so critical in polarimetry (unless you are trying to measure the source flux as well as the polarization level!), but overall overheads are around 100%.

Elese N. Archibald, Iain M. Coulson

Applying for Polarimetry Observations in 00B

The SCUBA Polarimeter will be offered again in Semester 00B. Observations can be made at all SCUBA wavelengths, using either the `array' waveplate (350-850 microns) or the `photometric' waveplate (1350, 2000 microns). Note that changing the waveplate takes about 20 minutes, so it is inefficient to do this during an observing shift.

Imaging polarimetry using the full field-of-view of the arrays has been released. The primary observing wavelength is 850 microns (with 450 micron data obtained simultaneously) but you could use 750/350 if you wish. *Note* There is a complete set of instrumental polarization measurements for all 37 bolometers of the long-wave array, at 850 microns, to a typical accuracy of +/- 0.25%. Thus polarizations as low as 1% can be detected to 4-sigma accuracy. The instrumental dataset is much less complete at the other wavelengths, so you should only plan to use these if accuracies of +/- 0.5-0.75% are acceptable.

Single-pixel polarimetry observations can be made routinely at all SCUBA wavelengths, to accuracies of +/- 0.1-0.2%. This mode is preferable for point-like sources, as more time is spent on-source than with mapping.

Scan map polarimetry was tested in late 1999 (at 850 microns only). Initial maps of the Crab Nebula are very promising, but this is not a typical source (high polarization and low flux, rather than low polarization and high flux, the conditions that are more likely to occur in star-forming complexes). Observers interested in making polarization maps of very large sources should consult the instrument scientist for more details. Using the standard jiggle-map mode, sources larger than 3 arcmin across the minor axis are difficult to do properly (as this is the largest chop throw currently available), but e.g. long thin filaments can be done very successfully with mosaicing.

Data reduction: A stand-alone package is used for single-pixel reduction, and final answers are produced (apart from small add-on corrections for the absolute polarization angles). For imaging polarimetry, the ORACDR automatic pipeline can be used, and generally very good final results are obtained with no tweaking. Minor modifications can easily be made to reduce different wavelengths, or to choose particular bolometers for sky-noise removal. To improve the S/N of the data, offline reduction options include binning and changing selection criteria.

Integration times: The SCUBA Integration Time Calculator (at http://www.jach.hawaii.edu/JACpublic/JCMT/software/bin/propitc.pl) is set up for polarimetry in single-pixel mode, and you should enter the rms polarized-flux (e.g. for 5-sigma on a 2% polarized / 1 Jy source, the rms is 1000 x 0.02 /5 = 4 mJy). Note that the overhead in the calculator is not correct!!! and you should add around 100-150% to the integration time for single-pixel observing (most if doing many sources with short integrations). Finally add 1 hour per shift for startup, pointing checks etc. For imaging polarimetry, multiply the per-pixel integration times by 4 (for beam-width resolution) or 16 (for half-beam resolution) and then add overheads of 50%, plus 1 hour per shift as above.

*Sensitivity limits:*At 850 microns, the minimum detectable POLARIZED flux is ~ 5 mJy (e.g. 1 % polarized, 0.5 Jy source OR 5% polarized, 0.1 Jy source), in 1-2 shifts of observing and with some binning in the imaging mode. For dust polarization, 850 microns is the most sensitive wavelength, but synchrotron polarization may be best observed at 1350 microns, due to rising fluxes.

Jane Greaves

The Lethbridge Fourier Transform Spectrometer (FTS)

It is likely that the Lethbridge FTS will be available for use during semester 00B. Further information is available at: http://home.uleth.ca/phy/naylor/FTS.html.

The Lethbridge group welcomes scientific collaborations with other JCMT users. Please contact Prof. D.A. Naylor (naylor@uleth.ca) to arrange collaborative efforts.

gms

The Cornell South Pole Imaging Fabry-Perot Interferometer (SPIFI)

SPIFI is a direct detection, imaging Fabry-Perot interferometer designed for use in the submillimeter band (200 to 650 microns), especially the 350 and 450 micron windows available to the JCMT. SPIFI's detector is a 5 x 5 element monolithic silicon bolometer array cooled to 60 mK in an adiabatic demagnetization refrigerator. SPIFI uses free standing metal mesh Fabry-Perot interferometers to deliver spectroscopic images at velocity resolutions up to 30 km/s over the entire array. The velocity resolution is continuously adjustable from 300 to 30 km/s in a few minutes time at the telescope. Higher velocity resolutions (better than 15 km/s) are possible for the inner 9 pixels. The Winston cones coupling radiation to SPIFI's bolometers have 6.1" (~ lambda/D at 450 microns) circular entrance apertures and are arranged on a 7.0' square grid, so that SPIFI images a 35" x 35" field of view at the diffraction limit of the JCMT telescope.

SPIFI is expected to be available for use during the semester. Current best estimates of sensitivities and other parameters will be posted on the web page at the Cornell Astronomy Department Site (http://astrosun.tn.cornell.edu/research/projects/spifi.html).

The Cornell group welcomes scientific collaborations with other JCMT users. Please contact Prof. G.J. Stacey at Cornell University (stacey@astrosun.tn.cornell.edu) to arrange collaborative efforts.

gms

Max-Planck-Institut 800 GHz Receiver (RxE)

RxE is a single-channel quasi-optical SIS receiver for operation in the 350 micron atmospheric window (E-band). Among the most important lines available in this window are the transitions of CO J=7-6 [807 GHz], [CI] 3P2-3P1 [809 GHz], HCO+ J=9-8 [802 GHz], and HCN J=9-8 [797 GHz].

The receiver has been designed and constructed at the MPIfR in Bonn. The SIS mixer employs a Nb-(Al-oxide)-Nb junction produced in collaboration with IRAM in 1994. The LO system consists of an InP Gunn-oscillator followed by a doubler and a tripler stage which covers the frequency range 795 - 880 GHz. The cooled IF section consists of a 3 stage 2.5 - 4 GHz HEMT amplifier.

The receiver was successfully tested in the winters 1997/1998 at the 10m HHT on Mt. Graham. A DSB receiver noise temperature of 680 K was measured at 809 GHz. Continuum scans across Mars yielded a FWHP main beam width of 9" which is well matched to the diffraction limit. No evidence for side lobes or broad pedestal structure was found at a level of 10 - 13 dB.

The heterodyne response was demonstrated using the CO J=7-6 transition measured toward IRC+10216. The resulting spectrum is shown on the web page. The integration time was 180 sec, the data was taken under poor and unstable atmospheric conditions.

The system is currently being upgraded in Bonn and is scheduled for installation and commissioning at the JCMT in April 2000. After successful commissioning the instrument will be on loan from Prof. Rolf Gusten and his group at MPIfR and available for use by the JCMT community on a collaborative basis.

Further details can be found at http://www.mpifr-bonn.mpg.de/div/mm/tech/rxe.html.

Observers interested in using it should contact Dr. Ronald Stark (stark@mpifr-bonn.mpg.de) to arrange collaborative efforts.

The double sideband (DSB) receiver temperature over the E-band is expected to be in the range 700 - 800 K. Only DSB operation will be possible. The maximum available bandwidth for the DAS is currently 920 MHz. The single-sideband system temperatures are expected to be around 10,000 K or less under good submillimetre weather conditions (weather band 1 = CSO(tau) < 0.05). Observers are advised to use these numbers to estimate required observing times.

The performance at the JCMT will only be known after the commissioning, but before the TAGS meet. Therefore, the actual numbers can be retro-fitted in the proposals prior to the final allocation meeting at ITAC in early December.

gms

PATT INFORMATION

PATT Application Deadline

Deadlines for receipt of all JCMT applications for semester 00B is:

31th March 2000

Please read the next article - *Electronic Submission Update* **before filling in your application forms for the forth-coming semester. In particular Canada requests electronic applications only, no paper submissions.**

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

Graeme Watt

Electronic Submission Update

Status of Applications

The JCMT Board have defined rules which determine how to categorise each application.

1 - If the PI is funded by a partner country (UK, Canada, or Netherlands), then that application should be submitted to that country's collection system.

2 - if the PI is not from any partner country, then the application should be submitted to the collection system of the country from the first named collaborator who is funded from a partner country.

3 - if neither the PI nor any of the collaborators are funded from a partner country then the application is treated as International and should be submitted through the JAC collection system.

4 - it should be noted that if the PI on an application is a JCMT staff member based in Hilo, then the application should be submitted to their national collection system.

5 - however, if the PI is not from any partner country, and the only collaborator from a partner country is a member of the JCMT staff based in Hilo, then the application remains as International and should be submitted through the JAC collection system.

6 - if you are in any doubt about where to submit, then please e-mail Graeme Watt (g.watt@jach.hawaii.edu) as soon as possible and he will point you in the appropriate direction.

PATT3 Templates

All JCMT applications must be submitted on the standard PATT3 form.
To obtain the most recent version of these templates and associated files, send e-mail to:

jcmtprop@jach.hawaii.edu

with the phrase '**request templates**' in the 'Subject' line of the e-mail. Any text following the header information will be ignored. All necessary files will be e-mailed back to you.

Alternatively, you can download the current files from http://www.jach.hawaii.edu/JACpublic/JCMT/applications.html.
PLEASE ENSURE YOU OBTAIN A NEW TEMPLATE FOR EACH SEMESTER. Submission of an older version may result in delay, or even rejection, of your application.
Do not change the font sizes or the page margins.

Canadian Applications

(Note that local information at http://www.hia.nrc.ca/dgo/reports/ctag/instruc/index.html *about submission and formats may be more current than that given below)*
1 - The Canadian system uses the same PATT3 template but only requires the postscript files to be submitted.
2 - Proposals (postscript files only) must be sent electronically via e-mail to:

jcmtscience@hia.nrc.ca

to arrive a few days before the deadline (to allow for problems with format or printing to be resolved).
3 - **Paper copies submitted by post are no longer accepted.**

Netherlands Applications

(Note that local information http://www.astro.rug.nl/~nfra_pc/jcmt.html *about submission and formats may be more current than that given below)*
1 - The Netherlands uses an identical collection system as that based at the JAC. The standard PATT3 template must be used and both the Latex code and the postscript must be submitted. Templates can be obtained either from the 'nfra_pc' account or from the 'jcmtprop' account a the JAC. However, it is preferred that Netherlands submissions are made through the 'proposal' account at the NFRA. Proposal templates can be obtained from anonymous ftp at:

ftp.astro.rug.nl

(in sub-directory: nfra_pc/JCMT-forms).
In case of problems or questions contact Thijs van der Hulst at vdhulst@astro.rug.nl.
PLEASE ENSURE YOU OBTAIN A NEW TEMPLATE FOR EACH SEMESTER. Submission of an older version may result in delay, or even rejection, of your application.
2 - Proposals to the Netherlands **MUST** be submitted electronically.
3 - For e-mail submissions, complete the latex template (do **NOT** change the fontsize !!), generate a postscript file (complete with figures, if any), concatenate the two files into one long file (with the latex template at the top of the file) and send the concatenated file to:

nfra_pc@nfra.nl

to arrive by the deadline. Please **DO NOT** use e-mail attachments.
4 - The 'Subject' line of the e-mail **MUST** contain the phrase '**NEW SUBMISSION NL**'.
5 - If you later submit a revised version of the same application please ensure that you put '**REVISED PROPOSAL M00Bxxx**' (where 'xxx' is the assigned proposal number) in the 'Subject' line of the e-mail message. You may submit as many revised applications as you wish prior to the deadline. After the deadline any revised applications will only be accepted if they have been requested (usually as a cure for formatting or printing problems).

UK and International Applications

1 - complete the Latex template as instructed in the header section. You are required to submit a Postscript version of your complete application. Please append the Postscript to the end of the Latex making a single file for transmission.
2 - UK or International proposals may be submitted electronically or as hardcopies to the Swindon address listed on the proposal.
3 - e-mail the completed Latex+Postscript file back to:

jcmtprop@jach.hawaii.edu

to arrive by the deadline. Please **DO NOT** use e-mail attachments.
4 - In the 'Subject' line you **MUST** specify either '**NEW APPLICATION UK**' or '**NEW APPLICATION INT**'. Please read the 'Status' section above for details on which heading to use.
5 - each submission will be automatically numbered and acknowledged. *If you do not receive any acknowledgement within 24 hours, then please contact* Gerald at g.moriarty-schieven@jach.hawaii.edu *or* Graeme at g.watt@jach.hawaii *as soon as possible*. Your application will be processed as soon as possible and you will only be contacted if difficulties are encountered with the printing or format. The most common problems arise with embedded Postscript figures.
6 - if you later submit a revised version of the same application please ensure that you put '**REVISED PROPOSAL M00Bxxx**' (where 'xxx' is the assigned proposal number) in the 'Subject' line of the e-mail message. You may submit as many revised applications as you wish prior to the deadline. After the deadline any revised applications will only be accepted if they have been requested (usually as a cure for formatting or printing problems).
7 - UK-based observers must also fill out and obtain signatures on the separate 'UKsignatures.ps' file and return that document to the Swindon by regular mail or courier. This document should arrive in Swindon within a few days after the proposal deadline. Make sure you include the proposal number assigned by the automatic proposal handler so that the signature page can be correctly assigned to your application.

Graeme Watt

PATT ITAC Report for Semester 00A

1. Introduction

This document details the allocations for telescope time made by the ITAC for the semester 00A (1 February 2000 - 31 July 2000).

2. Allocations

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

Applications considered	
UK status#	74
Canadian status#	35
Netherlands status	22
International status	19
University of Hawaii	10
TOTAL:	160

10 UK starred applications & 1 Canadian carry-overs have been included in this total.

The PATT meeting was held at PPARC, Swindon on 6 & 7 December 1999.

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 national TAG where appropriate. However, by Board rule, International status is given to any application where the only named collaborator from any partner country is a JCMT staff member. International applications are assessed by the ITAC members at their meeting.

Time Available (in 16-hour nights)	
No. of nights in semester 00A	182.0
Engineering & Commissioning	33.0
University of Hawaii (10%)	14.5
Director's discretionary use	4.0
Available for PATT science:	130.5

The above table indicates the order in which nights are removed from the total available for the semester. The table below indicates the allocations using the JCMT Board formula for attributing applications to countries.

Awards (in 16-hour nights)	
UK status	68.0
Canadian status	31.0
Netherlands status	25.0
International status	6.5
University of Hawaii	14.5
TOTAL allocation:	145.0

3. Designated Service and/or Fallback time

Allocations for this semester are:

CDN = 4.0 shifts allocated for Canserv;
NL= no free allocation remaining;
UK = up to 27 shifts in the Ukflex fallback program;
INT = 0,25 shifts allocated for Intflex.

4. Non-standard Instrumentation

SPIFI (South Pole Imaging Fabry-Perot Interferometer), the visiting instrument from the Cornell group, is scheduled for installation in mid-May with several astronomical runs flexibly arranged over the following two weeks. SPIFI will be located on the right-hand Nasmyth (opposite SCUBA).

The Max Planck Institut fur Radioastronomie (Bonn) intend to bring their 800 GHz heterodyne instrument out for observations during the semester. It is likely that this will be scheduled around mid-April.

5. Instrument allocation statistics

Instrument distribution	
A-band (& polarimeter)	8%
B-band	9%
C-band	7%
D-band	3%
MPI (800 GHz)	2%
SPIFI	6%
SCUBA polarimeter	7%
SCUBA	58

6. Applications with Long-Term Status

M/99A/C19(B.Matthews) was extended for a further allocation of 2 shifts in 00A to continue polarisation studies of molecular cloud cores and young stellar objects. This application has Canadian student thesis project status and continues to be re-allocated until observations are completed.

M/99A/U01(Holland) was given a further 4 shifts to continue the dusty disk observations. In addition, 2.5 shifts were carried over, as starred, from their 99B allocation. **M/99A/U42(Richer)**, mapping of the star formation in the Perseus molecular cloud, was given a further 6 shifts. In addition, 1 shift was carried over, as starred, from their 99B allocation. **M/99A/U45(Rowan-Robinson)**, the UK 8mJy SCUBA/ISO survey, was given a further 8 shifts in 00A with a final 8 shifts for semester 00B conditional on source identifications. In addition, 8 shifts were carried over, as starred, from their 99B allocation. **M/99B/U43(Thommes)** was given a further 4 shifts in semester 00A to complete observations to investigate the role of dust in extremely red galaxies. **M/99B/U68(Holland)** was given a further 4 shifts in semester 00A to study the Vega phenomenon around nearby stars. In addition, 2 shift were carried over, as starred, from their 99B allocation. All of the above extensions are subject to satisfactory progress reports to the relevant TAGs from earlier observations.

7. Engineering & Commissioning

A two-week period of heavy engineering (no observing possible) has been scheduled for March to replace the carousel drive motors and their associated electrical systems, drive cubicles, and electronic systems. A contingency period of one week has been set aside for extended work. If not required for carousel repair, this contingency time will be used for other urgent engineering or commissioning work, or returned for PATT use as appropriate.

Two shifts were kept for further TCS/OCS testing and the remaining 12 shifts were included in the allocation tables for semester 99B.

Some shifts have been set aside for further commissioning of the heterodyne instruments.

RxA3 was scheduled for a new tuner-less mixer which may be available for installation this semester. However, a faulty liquid helium transfer in December has resulted in a vacuum leak in the cryostat and, as a result, RxA3 is unavailable for an undefined period of time until repairs can be effected.

RxB3 was also scheduled for a mixer upgrade to the tuner-less variety which has now been completed (in January).

Poor weather continues to plague the commissioning of the high-frequency instrument RxW and further shifts are required for that purpose.

Both the SPIFI and the MPI (800 GHz) instruments require setup shifts to enable installation, alignment, and system checks to be performed. SPIFI is located on the Nasmyth platform opposite from SCUBA. The MPI instrument goes into a receiver bay in the Cassegrain cabin.

The MPI group was again offered 4 engineering shifts plus 2 DDT shifts to install and commission their single mixer 800 GHz system (E-band) and have accepted the offer. They have been scheduled a flexible block of observing time in mid-April.

In addition there is commissioning time scheduled for SCUBA.

The two shifts from the previous semester, critical for complete 450 micron commissioning of the SCUBA polarimeter, were lost due to poor weather, but time has been scheduled to complete this work in semester 00A.

8. Fallback Programmes

A number of applications have been approved by the ITAC to be included in the schedule should the weather not be appropriate for the primary observations on any night. All applicants (allocated and fallback) have been requested to submit a completed template by the end of the first month of the semester, February 29, so their observations can be included on the queue system. Failure to submit a working template by February 29 may result in the ITAC removing the allocation of time. Applicants will be reminded in mid-February. Templates can be updated at any time, but it is necessary to have a working draft in the system.

9. The Flex Systems

There remains an outstanding 22.5 shifts of starred applications from semester 99B carried over into this semester. In addition, **M/99B/U17(Crutcher)** was given a 2 shift allocation deferred to 00A due to lack of RxA3 in semester 99B. The UK TAG again set aside a total of 24 shifts designated as UKflex. The intention is that each high-frequency allocation be extended by typically 20% using UKflex time, thus increasing the chance of obtaining suitable weather to complete the high-frequency program. Under weather conditions unsuitable for the high-frequency observing, the current observers would undertake observations from the UKflex list in a serviced mode and in the scientific priority ordering given by the UK TAG. Successful applicants on the UKflex fallback list have been informed that they have to submit complete templates for their observations but that there is no guarantee that any part of their program will be done during the semester.

A flexible system is now in operation for all partner communities, and for UH. Wherever possible the International projects are included flexibly with other partner projects. This appears to work extremely effectively with all allocated projects being placed in scientifically prioritised queues and flexed against all other projects in those queues.

10. Weather Bands

Each allocation has been placed into a select weather band, defined by a range of values of the CSO tau meter (water vapour content). It is imperative that observers make their observations within their prescribed weather bands and turn to other queued projects once the weather changes. Note that it is possible for the weather to improve out of a prescribed weather band as well as deteriorate.

From the start of semester 99B, due to staff pressures at the JAC, support staff no longer conduct serviced observing except for some very short (usually single shift) projects. The fallback queues will therefore continue to be handled by the TSS group and by visiting observers. It is now even more imperative that applicants make travel arrangements to provide observing cover for their scheduled shifts.

11. Other Business

There were three main items of policy that resulted from the previous JCMT Board meeting. These all had to do with telescope time and so were taken by the Director JCMT to the ITAC meeting in December for further discussion. The ITAC approved all of the new policy with one or two clarifications that have been incorporated in what follows.

(a) The JCMT Board approved a new policy for awarding guaranteed observing time for common user instrumentation building teams. This time would be linked to the complexity of the project with different awards depending on whether the instrument was defined as small, medium, or large. This would result in allocations of 5, 10 and 15 shifts of guaranteed time in appropriate weather for the science undertaken by the instrument concerned. The time should be scheduled over a minimum of two semesters and would be top-sliced in the same manner as Engineering and Commissioning time. A scientific case would have to be submitted, to be adjudicated by the ITAC, and the scientific objectives must come from a subset of the original science case for the instrument (where appropriate).

Instruments would be considered on a case by case basis but it was agreed that ACSIS, HARP-B, and Champ-D and SCUBA2 would all be considered to be large projects.

The Board had also endorsed the Director JCMT's proposals concerning large observing programmes, which were distilled from the response of the community and the Advisory panel. These are listed below.

(b) Large programmes are those that have the potential to produce the highest quality, highest impact science, and if needed they should be awarded large blocks of time when required, even at the expense of other (lesser quality) programmes. The TAGs should be cognisant of the strategic needs of the JCMT and the Board will support them in allocating large slots of time to such challenging programmes. Scientific excellence should remain the sole determining factor for time allocation and this is definitely not to suggest that only large programmes can deliver scientific excellence.

These large programmes should either have long-term, or starred status and it is a requirement for continuation that they must report back to the TAG and ITAC in some detail at the end of each semester. The TAGs need to be made very aware of what precise progress has been made, what observations remain, and when the results are expected to be submitted for publication. This information will be closely monitored. Furthermore, to strengthen the link between the scientific progress of these programmes using the JCMT and the JCMT Board, the ITAC report to the Board will highlight these programmes and describe them and their progress in much more detail than is the current case. In terms of allocation, the large programmes would be split over not less than two consecutive semesters so as not to monopolise most, or all, of the high-frequency weather during any given semester.

Regarding the issue of 'Key Programmes' for the JCMT, there is strong user resistance to the 'top-down' approach. The current allocation system has the potential to deliver the aims of Key Programmes, they have had a chequered history at other facilities and should not be pursued further for the JCMT.

(c) The Board had agreed that the default for release of astronomical data for open access from all observing programmes should be one year following the end of the semester in which the observations were taken. However, users would be given the option of requesting this be withheld in special cases. Examples of special cases are programmes that are continuing and release of a subset would have a significant impact on the outcomes of the overall prgramme, and student thesis material.

This policy comes into effect beginning semester 00A. Therefore, in principle, on 1 February 2000 ALL data from projects up to, and including, semester 98B will become accessible to the public from the CADC data archive. However, due to the short notice of this change, the date will be delayed by one month to 29 February. Any request for an exception to this rule must be given as a written case by the Principal Investigator and submitted to the Director JCMT before 21 February in order to give us time to withhold the data. For future semesters, PIs will be reminded approximately one month prior to the end of the semester that their previous data will be released. While this particular announcement is aimed primarily at SCUBA data, none of which has so far been released, nevertheless, the policy applies to all data taken at the JCMT, including visiting instruments where the data resides on our archive.

Unfortunately, due to constraints on support staff, the JAC cannot offer support for users of the archive. Users should in the first instance contact the PI for information regarding the data.

12. Electronic Submission

The were only minor improvements to the current scheme which did not affect applicants, but smoothed the collection system at the JAC. All applications were received electronically using the software systems at either Groningen, Victoria, or the JAC. All postscript applications were collated and a top copy printed at the JAC within 3-4 days of the PATT deadline. No major problems were observed. Minor problems persist with the formatting and printing of the various types of postscript files, but these can always be worked around.

The UH applications do not conform to the electronic system and continue to be collected at the UH and posted to the JAC as hardcopy.

13. Procedures for Semester 00B

The deadline for semester 00B (1 August 2000 through 31 January 2001) applications is 31 March 2000 for ALL applicants. This deadline encompasses applications for all available facility instrumentation on the JCMT (RxA3, RxB3, the heterodyne polarimeter, RxW, SCUBA, and the SCUBA imaging polarimeter) and the visiting instruments SPIFI and the MPI (800 GHz) receiver.

14. Composition of ITAC

It should be noted that there have been significant changes to the membership of ITAC for this round. The two UK representatives, Dr. Jim Dunlop and Dr. John Richer, have been rotated off the committee and replaced by Dr. Jonathan Rawlings (Chairman) and Dr. Rob Ivison. The Canadian representative, Dr. Mike Fich, has been succeeded by Dr. Henry Matthews. Dr. Thijs van der Hulst remains as the Netherlands representative. A belated thanks to the retiring members for their sterlings efforts over recent semesters.

Graeme Watt

QUEUE-BASED FLEXIBLE SCHEDULING GUIDELINES

*The following note was sent out with UK feedback letters commencing with semester 98A. It is however appropriate for **ALL** applicants from all countries, since these guidelines now form the basis of all JCMT queue-based operations. The original text has been updated by the JCMT Scheduler.*

WEATHER GUIDELINES

In order to maximise the productivity of the JCMT, and in particular to ensure that the science performed at the telescope is best suited to the observing conditions, the ITAC has endeavoured to move some way towards flexible scheduling. To facilitate this it has decided to attempt to identify the range of weather conditions within which each programme allocated time should be pursued. The weather categories adopted, in liason with the Director JCMT are as follows

Weather Grade	*Definition*	*CSO Tau*	*Prime Instrument(s)*
1	very dry	t < 0.05	SCUBA, RxW
2	dry	0.05 < 0.08	SCUBA, RxW
3	medium	0.08 < 0.12	SCUBA, RxW, RxB3
4	wet	0.12 < 0.2	RxB3, RxA2
5	very wet	0.2 < t	RxA2

To achieve a more realistic match to the weather statistics it has also been decided to formally allocate only a fraction of the actual number of available UK shifts, and only half of that allocated time to proposals requiring very good weather (1-2 weather band). Proposals allocated time will therefore, where possible, be placed within somewhat expanded time slots in the schedule. During these blocks, proposers who have been allocated time will be permitted to spend all of the time during which the weather coincides with their assigned weather band, up to a maximum time equal to their actual formal allocation. In return for this increased chance of completing/advancing their programmes, scheduled observers will also be expected **NOT** to pursue their programme when the weather is either better or worse than their assigned band (or if by good luck they get their full allocation of appropriate weather before the block is finished) and instead to implement an appropriate proposal from the appropriate-weather backup/flex queue as directed by the JCMT scheduler (basically the highest ranked proposal on the appropriate queue for which targets within the appropriate RA range are available).

The Netherlands and Canadian communities are working towards a similar flexible scheme although not using designated flex shifts from their allocations as yet. The details below specifically apply to UK applications but may well be used as guidance for other partner propjects

Three backup queues have thus been created, and many applicants who have not been awarded a formal allocation of time will find that their proposals have been placed on these queues, especially if they do not require very dry weather (and were not sufficiently highly rated for a formal allocation). These queues are:

1. *The Grade-3 weather backup queue* - `easy' SCUBA work and heterodyne observing at moderate frquencies

2. *The Grade 4-5 weather backup queue* - basically A-band work

3. *The 'If SCUBA breaks' queue* - basically high-freq heterodyne work which could make good use of conditions if SCUBA failed, but which was not sufficiently highly rated for a formal allocation

EXAMPLE OF HOW THIS IS MEANT TO WORK IN PRACTICE

Suppose you have been awarded 3 shifts of grade 1-2 weather. Where possible this will be scheduled within a 4 shift block, and if the first 2 nights were dryer than grade 3 weather you would be able to pursue your programme. However, if the weather deteriorated to grade 3 weather on night 3 you would be expected to implement the highest rated appropriate proposal from the Grade-3 weather backup queue. If on night 4 the weather deteriorated further to grade 4 conditions, you would be expected to implement the highest rated appropriate proposal from the Grade 4-5 weather backup queue.

All applicants with formally allocated time and all applicants with backup time will be notified of these facts via e-mail from the JCMT Scheduler shortly after each ITAC meeting. Observing templates are required to be submitted for **ALL** these applications by the end of the first month of each semester - whether applicants intend to come to the telescope or not (because it is useful for a template for every PATT-approved programme to be held at the JACH to facilitate flexible observing).

NOTE FOR APPLICANTS ALLOCATED SCHEDULED TIME

If you have been awarded a formal allocation of more than 1 shift or so, the ITAC would like to encourage you to travel to the telescope and staff the whole of your expanded run. In return for this flexible block the ITAC expects disciplined observing, in terms of moving to the backup queues if appropriate. The ITAC, and national TAGs, will not look kindly on observers who continue to pursue their own programmes in inappropriate conditions, and, to encourage a disciplined attitude, the UK TAG has decided to `star' all proposals requiring very good (1-2) weather ('starred' applications are indicated on the web schedule by having a '*' placed after the PATT number). This star acknowledges that programmes requiring 1-2 weather are on average least likely to obtain the necessary full quota of appropriate weather to be completed, and indicates that applicants can have a reasonable expectation that that payback time will be made available in the following semester, always subject to final approval of their case by the UK TAG.

NOTE FOR APPLICANTS ALLOCATED TIME ON THE BACKUP QUEUES

With the reduction in the number of shifts formally allocated for the UK, proposers who have their proposals placed on these backup queues should have a somewhat higher expectation that their proposals will be implemented than was perhaps the case in previous semesters. You are encouraged to complete templates for your backup proposals as soon as possible (before the end of the first month of each semester), to enable your proposal to be implemented whenever a suitable situation should occur. The ITAC's intention is that many of these backup programmes should be completed or at least significantly advanced during the coming semester.

NOTE FOR APPLICANTS NOT ALLOCATED TIME

The ITAC would like to encourage you to be patient if you have not been awarded time. The long-awaited advent of SCUBA, combined with the TAG's efforts to move towards flexible scheduling have resulted in high-frequency (good weather) time being oversubscribed by a factor above or about 3 each semester. By allocating sensible amounts of time to the most highly rated proposals at this stage, the ITAC aims to get some major new programmes completed fairly rapidly which should clear the way for other programmes in future semesters.

NOTE FOR ALL HETERODYNE APPLICANTS

The ITAC would also like to assure heterodyne applicants that any perceived SCUBA bias in the TAG allocations is an illusion. All proposals are assessed together for scientific merit, and heterodyne proposals which are sufficiently highly ranked are given a formal allocation. Heterodyne proposals inevitably make up a large fraction of the proposals in the backup queues because they often provide the only sensible use of low-frequency weather. Indeed *the ITAC wish to encourage **MORE** A-band heterodyne proposals*. Since all heterodyne proposals in the backup queues have by definition failed to achieve a sufficiently high grade to merit a formal allocation, their presence on the backup queues should be regarded as a bonus. Most SCUBA proposals which fail to make the grade for a formal allocation simply get no time at all, simply because SCUBA proposals are rarely suitable for low frequency backup work.

Graeme Watt

JCMT ALLOCATIONS FOR SEMESTER 00A

The following are the complete allocations made by the ITAC for Semester 00A. Further details may be supplied by national TAGs. The telescope schedule is available on the Web at http://www.jach.hawaii.edu/JACpublic/JCMT/schedules/schedule.html.
As usual, please address all queries about JCMT scheduling to g.watt@jach.hawaii.edu.

Semester 00A Allocations **Updated:2-February-2000**

UK allocation:

PATT Number	PI on Application	Shifts Allocated		Title of Application
U01	Macdonald G H	3	S	Methanol masers and hot molecular clouds - towards an evolutionary sequence for massive star form'n
U03*	Barvainis R	2	S	Completing a SCUBA survey of lensed quasars
U06	Dent W R F	3	S	A search for evidence of evolution of the dust around Vega-excess stars
LT/U09*	Ivison R J	6	S	Star formation in high-density environments in the early Universe
U12	Cawthorne T V	0	Sp	Low radio polarization quasars and high rotation lines of sight

				(2 shifts deferred till semester 00B)
U13	Greaves J S	2	Sp	The evolution of magnetic fields around Class 0/I/II protostars
U19	Gibb A G	3	A	A survey of SiO emission towards outflows from massive YSOs
U20	Edge A C	1	B/C	Search for C I in cooling flow clusters
U21	Eales S A	3	S	The SCUBA local universe and galaxy survey
U24	Unger S	3	SPIFI	SPIFI investigations of ultraluminous galaxies
U27	Fuller G A	2	S	SCUBA imaging of candidate high mass protostars
U32*	Andre Ph	3	S	Probing the origin of the initial mass function: wide-field SCUBA imaging of the L1689 dark cloud
U33	Serjeant S	2	S	Dust-shrouded star formation at intermediate Z: sub-mm photometry of ELIAS/FIRBACK galaxies
U37*	McMahon R G	3	S	Submillimetre studies of high-redshift quasars and their host spheroids
U41*	Friberg P	2	B/C	Towards a better understanding of SWAS and Odin results?
U43	Stevens J A	3	Sp	A SCUBA/VLBA polarization study of the inner jets of compact radio sources
U56	Stacey G J	2	SPIFI	SPIFI observations of NGC 253: characterising the starburst
U61	Fuller G A	3	A/B	Comparing the gas and dust in the Perseus cloud
U63	Pooley G G	0	Sp	Polarimetry of jets from x-ray binaries (1 shift deferred till semester 00B)
U64*	Holland W S	2	S	Completion of SCUBA Galactic Centre survey
U65	Dunlop J S	3	S	Dust in the host galaxies of radio-loud and radio-quiet AGN
U66	Isaak K G	2	SPIFI	Mapping star formation in the Antennae: CO(7-6) and [C I] observations with SPIFI
U67	Isaak K G	1.5	D	CO(6-5) emission: the warm, dense gas in local luminous infrared galaxies
U68*	Gao Y	4	S	Dust, gas and starbursts along a merger sequence

Starred carries:

99A/U01	Holland W S	2.5	S	The dust-planet connection: A search for dust around the parent stars of extrasolar planets
99A/U42	Richer J S	1	S	A SCUBA survey of star formation in the Perseus molecular cloud complex
99A/U45	Rowan-Robinson	8	S	The UK 8-mJy SCUBA/ISO survey: determining the cosmological evolution of starburst activity
99B/U17	Crutcher R	2	Hp	A detailed look at magnetic fields in the OMC1 core
99B/U28	Adamson A J	1	Sp	Emission and absorption polarizations in Heiles 2
99B/U36	Kramer C	3	S	The dust grain opacity at submm wavelengths
99B/U44	Rawlings J M C	3	S	The true nature of class I sources
99B/U68	Holland W S	2	S	The Vega phenomenon around nearby stars

Long-term allocations:

LT/99A/U01	Holland W S	4	S	The dust-planet connection: A search for dust around the parent stars of extrasolar planets
LT/99A/U42	Richer J S	6	S	A SCUBA survey of star formation in the Perseus molecular cloud complex
LT/99A/U45	Rowan-Robinson	8	S	The UK 8-mJy SCUBA/ISO survey: determining the cosmological evolution of starburst activity
LT/99B/U43	Thommes E	4	S	The role of dust in extremely red galaxies
LT/99B/U68	Holland W S	4	S	The Vega phenomenon around nearby stars
	Ukflex	29	A/B	

Netherlands allocation:

PATT Number	PI on Application	Shifts Allocated		Title of Application
N01	van der Werf P	7	A/B/C	Mapping of warm, dense molecular gas in the Antennae system
N03	Israel F P	0.75	S	Dust emission from NGC 1569
N05	Henning Th	6	Sp	Magnetic fields and star formation: Bok globules as a case study
N06	Stark R	4	MPI	Physical properties of warm gas in the inner envelopes of YSOs
N08	Rottgering H	3	S	Star formation in high-density environments in the early Universe
N09	Kemper F	4.5	S/B/C/D	Mass loss history of oxygen-rich AGB stars
N13	Barthel P D	3.125	S	The fraction of starbursts in the FIRST survey
N14	Stark R	2.5	B	Deuterium chemistry in young stellar objects
N15	Boonman A M S	3.125	D/MPI	Physical and chemical structure of the inner regions of massive protostars
N16	Smith I A	3	S	SCUBA observations of gamma-ray burster counterparts (t-o-o)
N22	Best P	8	S	Star forming galaxies in clusters at redshift one
N23	Pickering T E	5	S	Dust properties of disk galaxies as a function of surface brightness

Canadian allocation:

PATT Number	PI on Application	Shifts Allocated		Title of Application
C02	Matthews H E	2	C/D	H2S in dense cold clouds; the ortho-para ratio
C03	Matthews H E	2	S	A pilot 'unbiased' SCUBA survey of the Galactic Plane: comparison with the mid-IR MSX database
C04	Seaquist E R	2	D	Mapping of M82 in 13CO J=6-5
C05	Kwok S	2	C/D	Carbon chemistry in post-AGB evolution
C06	Fich M	4	S	Dust in M101
C07	Demers S	1	S	The enigma in the heart of Ursa Minor
C09	Petitpas G R	4	A	Do gas properties determine the nuclear structure of barred galaxies?
C10	Redman R O	3	Sp	Magnetic field structures in MSX infrared-dark clouds
C13	Vallee J P	3	B/Sp	Fast rotating Bok globules - differential rotation?
C15	Redman R O	1	Sp	Polarization of the thermal emission from large asteroids
C16	Chapman S C	4	S	Submm counterparts to Lyman-break galaxies
C17	Madden S	3	S	Dust properties in low-metallicity environments
C19	Scott D	4	S	SCUBA follow-up of FIRBACK 175 micron ISO sources
C20	Volk K	2	S/B/C/D	Sub-mm continuum and CO imaging of NGC 6302
C21	Chapman S C	2	S	Highly lensed radio sources - a key to the nature of SCUBA-selected galaxies
C22	Goodman A A	2	Sp	The role of magnetic field structure in YSO outflows
C24	Naylor D A	1	B	A spectral survey of Orion A molecular cloud sources
C25	Lewis G F	2	S	Dusty broad absorption line quasars and unified models of AGN
C26	Bolatto A D	2	SPIFI	A survey for warm, dense, gas in galactic star

				forming regions
C27	Feldman P A	1	S	Search for cool dust in globular clusters
LT/C28	Lilly S	2	S	Completion of deep sub-mm survey
C29	McCutcheon W H	2	A/B	Star formation in NGC 6334
C31	Hasegawa T I	2	A/B	Chemistry in IRAS 21282+5050
C33	Frail D A	1	S	Gamma-ray bursts: the signposts of star formation in the early Universe (t-o-o)
C34	Nikola T	2	SPIFI	Probing the ISM in the interacting galaxy M51
99A/C19	Matthews B	2	Sp	A continuing polarization study of molecular cloud cores and young stellar objects
	Canserv	4	S/A/B/C/D	

International allocation:

PATT Number	PI on Application	Shifts Allocated		Title of Application
I02	Jura M	0.5	S	Continuum emission from stars
I04	Stern A	2	S	Submillimeter brightness temperature measurements of Triton with applications to both Pluto and Triton
I05	Coulson I M	2	S/A/B	The temperature of the CO gas around the Vega-type star SAO 112630
I07	Emmanuel D	0.5	C/D	Deuterium enrichment in the massive protostar RAFGL 7009S
I12	Hirano N	2	B/C/D	Search for high-velocity gas towards the L1157 outflow
I13	Clancy R T	0	B	Atmospheric temperature and chemistry above the Venus cloud tops (3 x 5hr daytime periods reserved)
I15	Estalella R	0.25	S	The distribution of dust around the exciting sources of the double H2 bipolar jet in L1634
I20	Bradford C M	5	SPIFI	SPIFI investigations of the circumstellar ring
I23	Goodman A A	0.5	S	Coherence and depletion in TMC-1C
	Intflex	0.25	A/B	

UH allocation:

PATT Number	PI on Application	Shifts Allocated		Title of Application
H02	Biver N	3	B/C/D	Interstellar and cometary ices: comparison with L1157 and hot cores
H04	Biver N	2	A/B	Distantly active comets: C/1999 J2 (Skiff)
H05	Jewitt D	3	S	Albedos of distant planetary bodies
H06	Cowie L L	6	S	Studying the evolution of galaxy formation in the Hawaii deep survey field SSA13
H07	Barger A	6	S	Targeted submm observations of optically faint micro-Jansky radio sources
H08	Magnier E	1	S	The spectral energy distributions of transitional young stellar objects
H09	Sanders D B	5	S	SCUBA templates: observations of the most distant ULIGs in the IRAS FSC
H10	Sanders D B	3	S	Identification of ISOPHOT 175 micron deep field sources

E&C	66
DDT	8
TOTAL =	364
Total UK =	136
Total CN =	62
Total NL =	50
Total Int =	13
Total UH =	29

Graeme Watt

STATISTICS

Weather and Fault Statistics for Semester 99A

The following tables present the weather loss and fault loss for semester 99A.

Month	**Available**	**Extended**	**---- Lost to weather ----**			
			Primary	**%**	**Backup**	**%**
February	438.5	29.6	104.4	23.8	80.4	18.3
March	464.0	18.0	134.9	28.6	52.9	11.2
April	464.0	15.3	107.4	23.2	47.9	10.3
May	344.0	5.8	120.0	34.9	57.0	16.6
June	464.0	23.8	46.5	10.0	4.0	0.9
July	472.0	34.6	28.8	6.1	12.3	2.6
Totals	**2646.5**	**127.1**	**542.0**	**20.5**	**254.5**	**9.6**

Table 1: *JCMT weather statistics.*

Month	**Available**	**Lost**	**ANT**	**INS**	**COM**	**SOF**	**CAR**	**OTH**
February	438.5	38.9	3.9	23.7	6.9	0.0	3.4	1.1
March	464.0	24.7	1.3	10.7	7.5	2.3	1.0	2.0
April	464.0	18.4	0.7	7.8	2.3	1.9	0.4	5.5
May	344.0	18.5	0.0	15.6	0.5	0.4	0.0	2.0
June	464.0	177.8	22.0	8.6	1.5	0.6	143.7	1.5
July	472.0	42.1	8.5	16.9	0.6	0.1	8.0	8.0
P(hrs)	**2646.5**	**320.4**	36.4	83.3	19.3	5.3	156.5	20.1
B(hrs)		37.7	4.9	11.3	0.8	0.2	20.0	0.5

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.*

Graeme Watt

Weather and Fault Statistics for Semester 99B

The following tables present the weather loss and fault loss for semester 99B

Month	Available	Extended	---- Lost to weather ---- Primary	%	Backup	%
August	504.0	26.1	166.1	33.0	150.6	29.9
September	477.0	12.1	71.0	14.9	40.3	8.4
October	474.8	16.2	110.5	23.3	70.5	14.8
November	471.5	12.4	205.3	43.5	151.8	32.2
December	394.0	15.8	194.2	49.3	172.5	43.8
January '00	429.0	28.9	138.5	33.0	96.9	23.1
Totals	**2741.3**	**111.7**	**885.6**	**32.3**	**682.6**	**24.9**

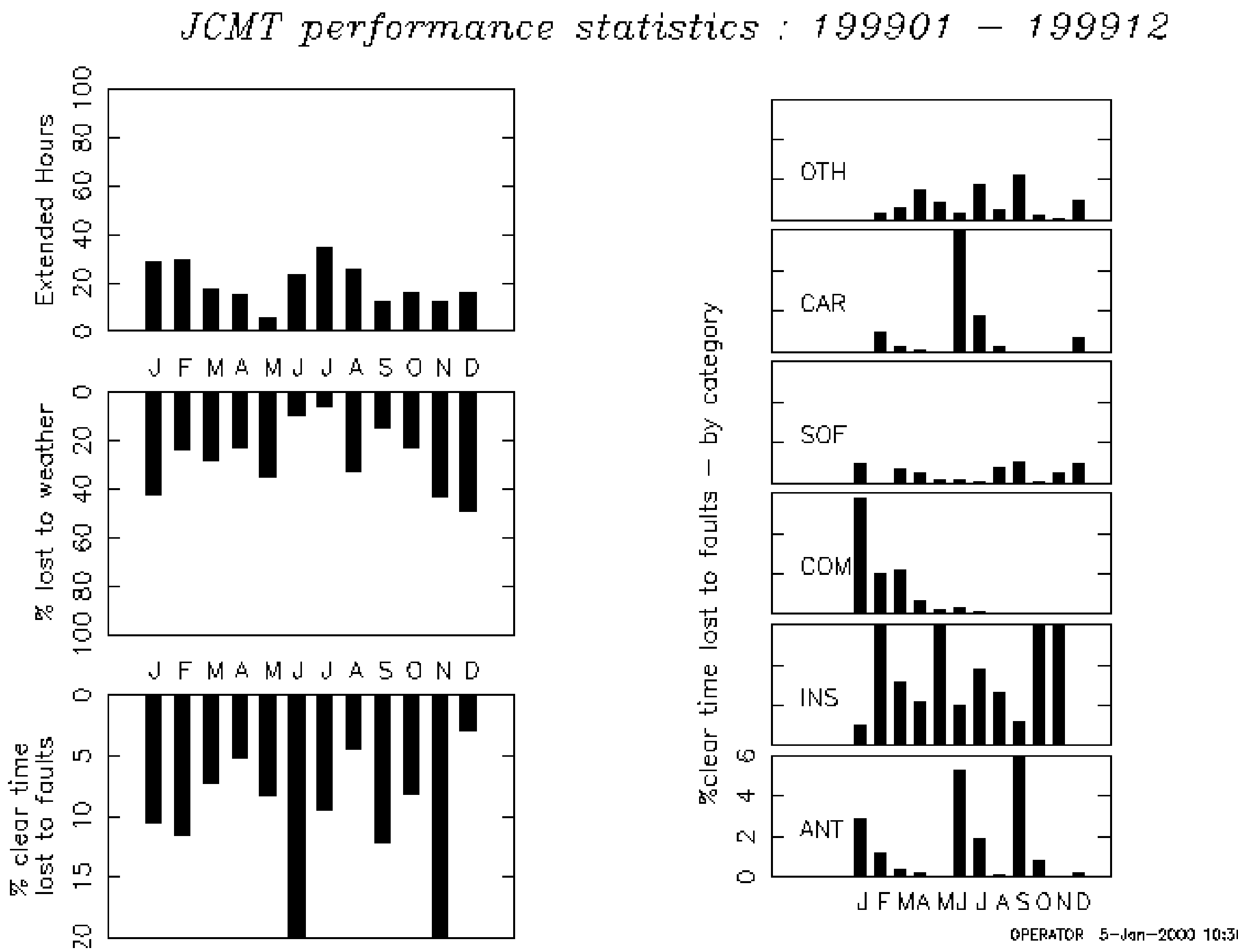
Table 1: *JCMT weather statistics.*

Month	Available	Lost	ANT	INS	COM	SOF	CAR	OTH
August	504.0	15.9	0.5	8.8	0.0	2.8	1.0	1.9
September	477.0	49.4	31.0	4.9	0.2	4.4	0.0	9.0
October	474.8	29.9	3.0	25.7	0.0	0.2	0.0	1.0
November	471.5	65.4	0.0	63.9	0.0	1.4	0.0	0.2
December	394.0	5.9	0.5	0.0	0.0	1.9	1.5	2.0
January'00	420.0	14.0	0.3	8.6	2.4	0.9	0.3	1.0
P(hrs)	**2741.3**	**179.6**	35.3	111.9	2.6	11.6	2.8	15.1
B(hrs)		18.5	0.5	14.1	0.5	0.9	0.0	2.5

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.*

Graeme Watt

Operational Statistics for 1999



Iain Coulson

NEW FEATURES

A HETERODYNE INTEGRATION TIME CALCULATOR (*HITEC*)

When the Integration Time Calculator (ITC) for scuba observations was released, the response was immediate and enthusiastic. Calculating required integration times for any observation technique under whatever sky conditions was simple, repeatable, and accurate. A similar facility for observing with heterodyne instruments was much more difficult to develop, because of the plethora of instruments/configurations/sky conditions, coupled with non-uniform instrument sensitivies within each bandwidth and the presence of atmospheric "features".

Now a Heterodyne Integration TimE Calculator (HITEC) is in place! Designed by Robin Phillips, HITEC is a stand alone application (i.e. not yet web based) and needs to be downloaded from from the JCMT home page under http://www.jach.hawaii.edu/JACpublic/JCMT/Apply_time/ITC/heterodyne_itc.html. It's a perl script, and can be run on any platform which has perl/TK installed. Complete instalation instructions are available from the web page.

gms

Current Status of Observing Projects

You wrote the proposal, you were awarded the time, and you dutifully submitted an observing template. Now you're waiting around wondering if anything has been done on your project. Now there's a site you can check to see whether data were taken for your project, when those data were obtained, and how much time remains of your allocation. This page is updated weekly, and is based on the nightly observing reports submitted by the observers. These Progress Reports can be accessed from the JCMT Home Page, at http://www.jach.hawaii.edu/JACpublic/JCMT/schedules/progress.html.

Note that despite this new page, we will continue to strive to get all data acquired in service mode to the PI in as timely a manner as possible, usually within a week or less.

gms

SCIENCE HIGHLIGHTS

JAC Internal Science Seminars

Coming to the JCMT to observe? We'd love to hear about your current research. The JAC and Gemini now operate a joint seminar series, and with visitors from Subaru, the CSO, the IfA and other facilities you can be assured of a varied and interested audience. The average attendance at JAC/Gemini seminars over the past year was about 15+/-6 people.

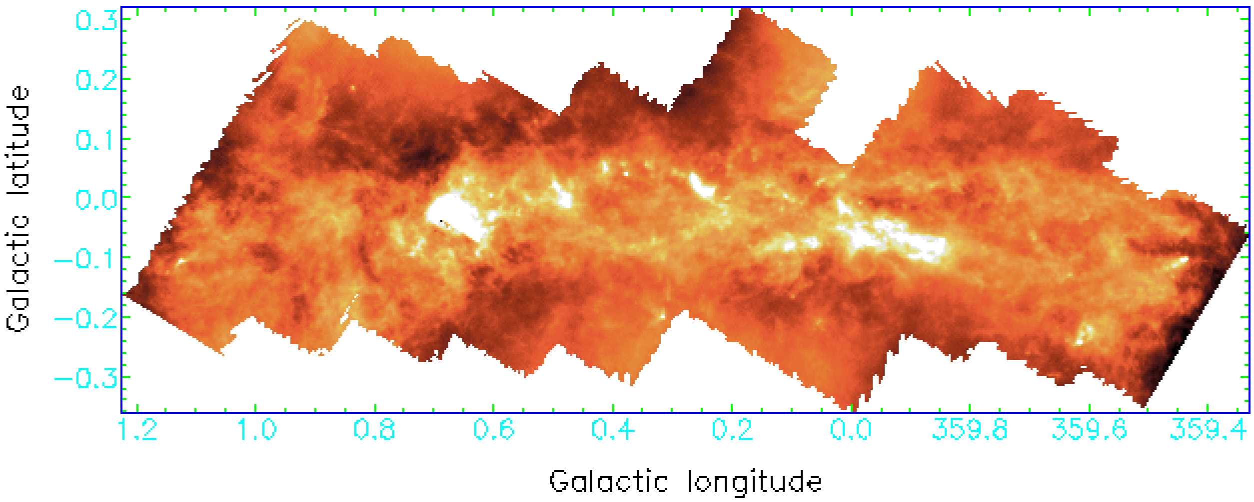
If you'd like to volunteer to give a seminar, or would like to put on the seminar emailing list, please contact Gerald Moriarty-Schieven at g.moriarty-schieven@jach.hawaii.edu.

Have a look at our seminar web page at http://www.jach.hawaii.edu/~gms/seminars/.

gms

A SCUBA SUB-MM SURVEY OF THE GALACTIC CENTRE

D. Pierce-Price, J.S. Richer (MRAO), J.S. Greaves, W.S. Holland, T. Jenness (JAC), A.N. Lasenby (MRAO), H.E. Matthews (JAC), G.J. White (QMW), D. Ward-Thompson (Cardiff), W.R.F. Dent (UK ATC), R. Zylka, P. Mezger (MPIfR Bonn), T. Hasegawa and T. Oka (Tokyo)



This figure shows part of a submillimetre continuum survey of the Galactic Centre, made with SCUBA on the JCMT. SCUBA's on-the-fly scan-map mode has allowed us to make extremely wide-field maps of thermal dust emission with unprecedented speed and sensitivity. The Galactic Centre is of great interest, being both an extreme region of our own galaxy - containing much active star formation - and the nearest example of a galactic nucleus.

Our ultimate aim is to map as much as possible of the `Central Molecular Zone', which contains up to 10% of the Galaxy's molecular ISM. Thermal dust continuum emission allows us to make an unbiased map of the temperature weighted column-density of material, and hence derive the total masses of the molecular clouds, find regions of star formation, and investigate cloud structures.

This new survey covers a significantly greater area than previous maps (cf. the 800 micron map made at the CSO by Lis & Carlstrom 1994, ApJ, 424:189-199) and we are also able to make spectral index maps using the simultaneously observed 450 micron and 850 micron data.

The current reduced map has a total size of approximately 100 x 30 arcmin. It covers the SgrA region - including SgrA*, the circumnuclear disc, and the 20km/s and 50km/s clouds; the area around the Pistol; SgrB2 - the brightest feature on the map; and at its Galactic Eastern and Western edges, the Sgr D and Sgr C regions. The images reveal many rich, striking features such as filaments and shell-like structures, as well as point sources such as SgrA* itself and a set of methanol maser sites.

The survey has resolutions of 8 arcsec at 450 micron and 14 arcsec at 850 microns, corresponding to distances of 0.33 pc and 0.58 pc at a distance of 8.5 kpc. The sensitivities per beam are approximately 30 mJy and 300 mJy at 850 and 450 microns respectively, or ~3 M_{suns} per beam. The total mass detected in the current region is 1 x 10^7 M_{sun}, assuming a dust temperature of 30 K.

We have derived fluxes and mass estimates for the prominent features in the survey area, and have used the 450 and 850 micron data to produce a spectral index map, and hence a point-to-point map of the dust opacity index (assuming knowledge of the dust temperature). For example, assuming a dust temperature of 30K, we estimate the masses of the 20km/s and 50km/s clouds (M-0.13-0.08 and M-0.02-0.07, near SgrA) as 150,000 M_{sun} and 80,000 M_{sun} respectively. The total mass in the vicinity of these two clouds is ~500,000 M_{sun}.

The maps have also been used to calculate sub-millimetre fluxes of the point-source SgrA*, complementing SCUBA polarimeter jiggle-map observations of the same source. The 450-2000 micron spectrum of SgrA*, together with its polarisation, is discussed by Aitken et al. (ApJL, submitted).

We have also investigated many issues related to the reduction of SCUBA scan-map data. As scan-map is a relatively new observing mode for SCUBA, its data reduction - particularly for wide-field mosaiced surveys - has presented some problems. Due to chopping of the JCMT secondary mirror, scan-maps produce dual-beam convolved images with no spatial-frequency information at the inverse chop throw and its harmonics. The total power level is also not observed. To improve coverage in frequency space we have used the `Emerson 2' algorithm (Jenness et al. Proc SPIE 3357, 548, 1998), combining observations made of the same field using different chop throws and orthogonal chop position angles.

Many of the difficulties of scan-map reduction have now been solved, including uncertainties about how to mosaic many multiple fields. Furthermore, many scan maps previously had unphysical negative holes around regions of bright emission (with depths ~10-20% of the peak object brightness). Standard baselining tended to overestimate the zero-level on individual scans which observed mostly bright emission, thus producing negative artefacts after baseline removal. With more careful baselining, considering entire observations rather than individual scans, we have succeeded in essentially eliminating these artefacts.

Optimum Image Reconstruction From Chop Measurements

Gerald Moriarty-Schieven (JAC), Doug Johnstone (Univ. of Toronto), Christine Wilson (McMaster U.), Jean Giannakopoulou-Creighton (IPAC), & Eric Gregersen (McMaster U.)

Technological improvements in submm instrumentation over the last few years have enabled astronomers to map large (hundreds of square arcminutes) areas of star-forming regions (Motte, Andre and Neri (1998, A&A, 336, 150); Johnstone and Bally (1999, ApJ, 510, L49); Wilson et al. (1999, ApJ, 513, L139)) with reasonable resolution (8-14" beams) and high sensitivity (rms noise ~0.01 Jy/beam). While the capability of submm instruments has improved dramatically, e.g. SCUBA, removing the interference produced at submm wavelengths by the rapidly varying atmosphere of the Earth still requires complex chopping procedures during the measurement process at the telescope. Instead of taking individual flux measurements at each position on the sky, difference measurements are taken between two locations separated by a chop distance and direction. By taking these difference measurements quickly, usually at a rate of several Hertz, the foreground atmosphere is effectively frozen in time and the signal provides a direct measure of the difference in flux between the two locations within the molecular cloud. Producing a flux map of the molecular cloud from a set of difference measurements requires deconvolving the chop beam, careful consideration of the sources of noise during the observations, and an understanding of the propagation of these errors through the reconstruction technique.

Many techniques for reconstructing an image of the sky from such chop maps have been proposed including the Emerson Fourier deconvolution method in common use at the JCMT, and maximum entropy techniques. Cosmologists, anticipating significant advances in satellite observations of the Cosmic Microwave Background have also considered matrix inversion solutions to reconstruct images from chop maps (Wright et al. (1996, ApJ, 458, L53). However, only a limited number of comparative tests have been performed to analyze the strengths and weaknesses of each individual technique (see for example Richer (1992, MNRAS, 254, 165) for a discussion on maximum entropy techniques, and Jenness et al. (1998, Proc. SPIE 3357, 548 (astro-ph/9809120); and Jenness et al. (2000, ASP conf. series, in press) who talks about the merits of the Emerson fourier deconvolution method compared to the classical Emerson-Klein-Haslam technique). We have recently analyzed several techniques for making maps: in particular the Emerson Fourier deconvolution, and matrix inversion techniques.

The matrix inversion technique reconstructs the image as follows. The set of difference (chop) measurements can be represented by a matrix $\mathbf{D} = \mathbf{CS} + \mathbf{N}$, where **D** is the set of chop measurements, **C** is the chop configuration, **S** is the sky brightness, and **N** is the noise. Cosmologists, in preparing for data sets with similar sized matrices, have spent considerable effort in obtaining methods for determining **S**, and have found that an iterative scheme works extremely well and converges quickly (Wright et al. 1996). For a map of size 256x256, approximately 100 iterations are needed. The technique is very computer intensive compared to the Emerson Fourier method, requiring several minutes on a Pentium III Linux computer compared to a fraction of a minute for the latter method. However, the matrix inversion technique has the advantage in that it uses all available information (e.g. the noise properties of each bolometer, etc.).

Using an artificial data set with known noise properties, we analyzed the two principal techniques for constructing images of the sky from the chop data. The best image reconstructions were produced using the matrix inversion technique, especially when the noise was variable across the image and/or there is structure near the edge of the map. The Emerson Fourier deconvolution technique is an efficient algorithm but suffers edge effects and diffusion when the noise is non-uniform.

This work has been submitted to the Astrophysical Journal (Johnstone et al. 2000a).

Observations of MSX Infrared-Dark Clouds

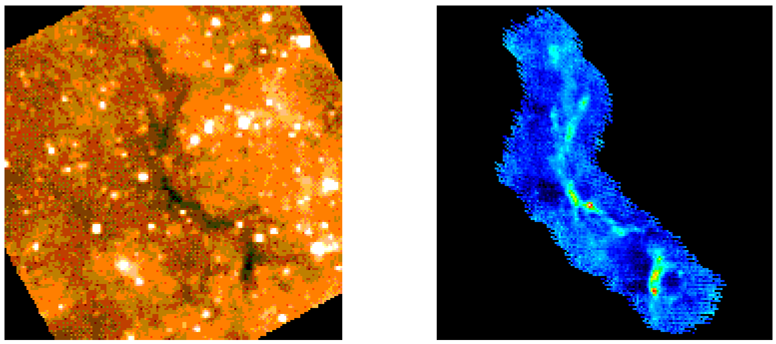


Figure 1: G11.11-012 at 8um and 850um

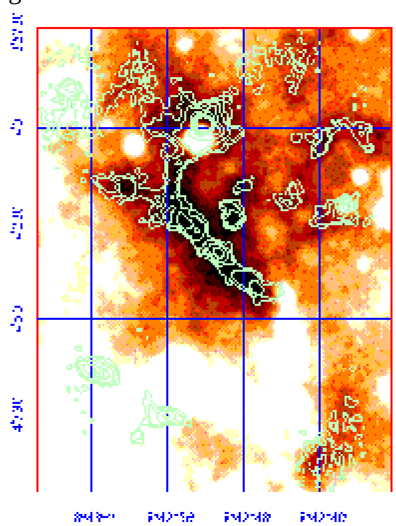


Figure 2: MSX 8um image of G28.34+0.06 with SCUBA 850um contours

Redman, Feldman (NRC Canada), Carey (Boston College), & Egan (AFRL)

Redman, Feldman (NRC Canada), Carey (Boston College) and Egan (AFRL) observed dust and gas in a selection of MSX infrared-dark clouds. These clouds are identified by their substantial mid-infrared (8-25 um) extinctions in MSX Galactic Plane survey images (Egan et al., *ApJL*, ***494***, *L199*, *1998*). From their high mid-infrared opacities and lack of emission between 8 and 100 um, Egan et al. concluded that the IRDCs exhibit hundreds of magnitudes of visual extinction, contain large column densities of cold dust, and are dense molecular cores.

Subsequent observations (Carey et al., *ApJ*, ***508***, *721*, *1998*) of millimeter transitions of H_2CO toward ten IRDCs confirmed that these objects contain dense molecular gas. Large Velocity Gradient (LVG) modeling of several transitions of H_2CO indicate that IRDCs have kinetic temperatures of 10-20 K, H_2 number densities ~10^6 cm^{-3}, and H_2 column densities ranging up to 10^{23} cm^{-2}. The available data strongly suggest that the gas and dust are in thermal equilibrium.

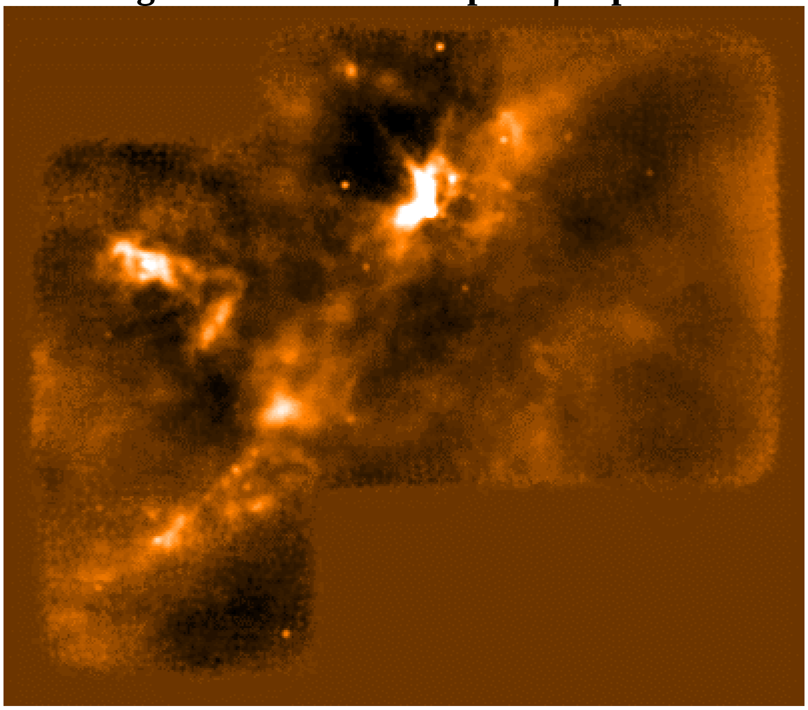
SCUBA was used to map a number of IRDCs and revealed filamentary/flocculent clouds in emission at 850 and 450 um, with bright, compact sources along the filaments. Many of these compact sources are prolate, extending along the direction of the filament (see Figure 1). These cores appear to be in a variety of early stages of star formation. Some of them contain bright infrared sources, while others are completely dark in the MSX 8 um images, suggesting that they are Class 0 or earlier. In addition, molecular line data taken with receivers A3 and B3 show evidence for outflow from all of the cores observed, and for infall in several cases.

The SCUBA polarimeter was also used to observe several bright filamentary regions; all showed high degrees of linear polarization. The magnetic fields derived from the polarization vectors tend to run along the filaments except near the brightest compact sources where the fields often switch direction to be perpendicular to the filaments. The observed high-percentage polarization and large-scale organization of the linear polarization imply that magnetic fields in the filaments are well organized on the 14" scale of the SCUBA beamsize at 850 um.

From the molecular line and SCUBA observations, the estimated masses of the IRDCs are comparable to those of the largest star-forming cores. The individual compact sources have masses that range from tens to hundreds of solar masses. It is interesting to note that the bright IRAS source 18402-0403, immediately adjacent to the bright SCUBA source P2 in G28.34+0.06 (Figure 2), has a bolometric luminosity of about 10^3 solar luminosities. If this luminosity is due to accretion onto a protostar, the central mass would be that of a typical OB star. It is plausible that massive IRDCs may be sites where high-mass star formation is occurring.

These results were presented at the 33rd ESLAB Symposium, "Star Formation from the Small to the Large Scale" and are in press in the Proceedings (eds. F. Favata, A. A. Kaas, and A. Wilson).

Large-Scale SCUBA Maps of ρ Ophiuchi



G. Moriarty-Schieven (NRC/JAC), D. Johnstone (UToronto), C. Wilson (McMasterU), G. Joncas (ULaval), G. Smith (UToronto), E. Gregersen (McMasterU), & M. Fich (UWaterloo)

The process by which stars form out of a molecular cloud is still uncertain. Isolated collapse has been well studied (see Shu, Adams & Lizano (1987, ARA&A, 25, 23 for a review) but has not led to a definitive theory for the distribution of stellar masses. One suggested mechanism invokes energetic feedback from the forming protostar to provide a range of possible stellar masses during the collapse of the clump (Adams & Fatuzzo 1996, ApJ, 464, 256). Under this scenario, the initial physical attributes of the clump do not uniquely determine the stellar mass and there is no requirement that the clump mass distribution have any relationship with the Stellar IMF. A competing mechanism for producing stars relies on fragmentation during the collapse of a large molecular core, which produces a range of coump masses (Myers 1998, ApJ, 507, L157; Klessen et al 1998, ApJ, 501, L205). These clumps eventually form into stars and therefore should have a mass distribution similar to the Stellar IMF. Another method for producing a range of steellar masses, suggested by Bonnell et al (1997, MNRAS, 285, 201), allows the forming stars to accrete material from the molecular cloud, with a range in stellar masses produced by competitive accretion. Rigorous determination of the properties of clumps in molecular clouds provides an important constraint on the validity of each of these mechanisms for producing the stellar IMF. The quality of the data now obtained using submm instruments, coupled with the efficiency with which cold dust in molecular clouds radiates in the submm, allows for unprecedented analysis of the small scale, clumped structure with combined dust and gas masses down the M<0.01 Mo. With such precision, the process of star formation has become directly observable; both the mass and the size of the clumps from which stars form are directly measurable within the reconstructed images.

We have recently completed a survey of the central 700 square arcmin region of the Rho Ophiuchi molecular cloud at 850um using SCUBA. Figure 1 shows the mapped region. Using the Williams clump-finding algorithm, we have identified 55 independent objects and computed the size, flux, and degree of central condensation. Comparison of these clumps with isothermal, pressure-confined, self-gravitating Bonner-Ebert spheres implies that the clumps have internal temperatures of 10-30K and surface pressures (P/k) between 10^6 and 10^7, consistent with the expected average pressure in the Rho Ophiuchi central region, log(P/k)~7.3. The clump masses span 0.02-6.3 Mo assuming a dust temperature Td~20K. The distribution of clump masses is well characterized by a broken power-law N(M) ~ M^{-alpha} with alpha=1-1.5 for M less than 0.6 Mo, and alpha=0.5 for M less than about 0.6 Mo, although significant incompleteness may affect the slope at the lower mass end. This mass function is in general agreement with the Rho Ophiuchi clump mass function derived at 1.3mm by Motte et al. (1998, A&A, 336, 150), and is similar to the stellar IMF (Salpeter, 1955, ApJ, 121, 161)

This work has been submitted to the Astrophysical Journal (Johnstone et al. 2000b).

FIRST LIGHT WITH SPIFI ON THE JCMT

We report the results of our first light with the South Pole Imaging Fabry-Perot Interferometer (SPIFI) on the JCMT. SPIFI is a direct detection imaging spectrometer designed for use on the 15 m JCMT and on the 1.7m AST/RO at the South Pole in the 350, and 450 μm submillimeter windows. SPIFI's detector is a 5 × 5 square array of silicon bolometers held at 60 mK in an adiabatic demagnetization refrigerator (ADR). The bolometers are fed by an array of Winston cones, yielding a beamsize of 7", and field of view is 35" × 35" on the JCMT. Three cryogenic Fabry-Perot interferometers (FPIs) in series deliver resolving powers, $R \equiv \lambda/\Delta\lambda \sim$ 500 to 10,000 ($\Delta v \sim$ 600 to 30 km s^{-1}) over the entire field of view. SPIFI mounts at the f/16 right Nasmyth platform of the JCMT. The full field of view is delivered through the elevation arm by a polyethylene lens relay system.
First light with SPIFI was on the JCMT in April, 1999. We focussed on mapping the CO(7→6) rotational line in the Galactic Center and external galaxies. Despite rather mediocre weather, we mapped the entire circumnuclear ring (200 spectra) at 7" spatial, and 67 km s^{-1} velocity resolution (Figure 3). We also mapped the inner regions of M82 and NGC 253 in their CO(7→6) line emission (Figure 4) -- to our knowledge, the first detections of the CO(7→6) line from external galaxies. The scientific implications of these results are discussed below. SPIFI performed up to our expectations. At $R \equiv \lambda/\Delta\lambda = 4500$ ($\Delta v = 67$ km s^{-1}), the front end system noise equivalent power (NEP) was ~ 9×10^{-16} W $Hz^{-1/2}$ - within a factor of two of the background limit given the (measured) system throughput (~25%), and detector quantum efficiencies (~50%). This NEP corresponds to a receiver temperature < 100 K(DSB), so that SPIFI is very competitive on a ***per pixel basis*** with the best heterodyne receivers for spectroscopy of broadline ($\Delta v > 30$ km s^{-1}) Galactic and extragalactic sources. For mapping projects, SPIFI's 25 pixel imaging array provides a factor of 25 gain in mapping speed over a single pixel system.

1. SCIENCE WITH SPIFI

1.1 Background. In its current configuration, SPIFI can access any line in the 350 μm telluric window. In the near future, we hope to upgrade SPIFI so that we can access the 450 window on the JCMT and the 200 μm window at the South Pole. For the Mauna Kea windows, the primary lines are the $^3P_2 \rightarrow {}^3P_1$ [CI] 370 μm fine structure line and the CO (J=7→6) and (J=6→5) rotational transitions. JCMT goals include mapping the Galactic Center, nearby external galaxies, and ultraluminous IRAS galaxies in these lines, and (hopefully someday!) detecting redshifted fine-structure line emission at cosmologically significant distances (e.g. [CII] 158 μm @ z > 1.2, [OIII] 88 μm @ z > 3, and [OI] 63 μm @ z > 4.5).
The mid-J rotational lines of CO probe the warm dense gas associated with photodissociation regions (PDRs) and molecular shocks. They are important probes, as warm, dense molecular gas is common in Galactic star forming regions, the Galactic Center, and external galaxies (cf. Harris et al.1991). For PDR gas, the CO(6 → 5) and (7 → 6)/CO(1 → 0) line intensity ratios are sensitive indicators of the strength of the far-UV radiation field, and the gas density, n (Kaufman et al. 1999). The mid-J lines indicate that much (>35%) of the total molecular gas mass is both warm (T > 50 K), and dense ($n(H_2) > 10^4 cm^{-3}$) in both Galactic star forming regions and starburst nuclei. Since the warm gas is an important component, its study is critical to understanding the interplay between star formation and the natal molecular clouds on galactic scales.

Neutral carbon is abundant in the ISM, amounting to 10% of CO in the Milky Way (MW) and up to 50% in starburst nuclei (cf. Keene et al. 1985). The [CI] lines are easily excited, and are therefore important coolants of PDRs, and perhaps cloud interiors as well. In dense clouds, the line ratio is temperature sensitive, while for more diffuse regions, there is a density dependence as well. Both [CI] lines are normally optically thin, thus tracing mass. The [CI] 370.415 μm and CO(7→6) (371.651 μm) lines are only 1000 km s^{-1} apart, so they both can be included in a single spectral scan. SPIFI can therefore map in the two lines at once, saving time, and resulting in "perfect" spatial registration and excellent flux calibration between the maps. We demonstrated this mode of operation during our September 1999 observing run at the JCMT (see Figure 1). Note that the line separation plus typical extragalactic linewidths (~ 300 km s^{-1}) and sufficient baseline (± 100 km s^{-1}) for a good spectrum, corresponds to >4 GHz at 370 μm, so these experiments are very difficult using heterodyne receivers with typical (1 GHz wide) backends.

Figure 1: [CI] and CO(7→6) spectrum of the BN-KL outflow taken with SPIFI in Sept. 1999 - velocity reslultion = 150 km s^{-1}. Figure not shown. See http://www.jach.hawaii.edu/JACpublic/JCMT/newsletters/n14/spifirept.html .

1.2 First Light Results. During our first observing run with SPIFI, we were somewhat conservative with the instrument. For the first half of the run, we focused on observations in the CO(7 → 6) line since the instrument is easier to set up at this wavelength. We chose a velocity resolution of 70 km s^{-1} so that we could resolve the major velocity features in the Galactic Center, as well as the lines in bright galaxies. This was the lowest velocity resolution we could obtain for this run, so that it was not possible to scan far enough to include both the CO(7→6) (372 μm) and the [CI] 371 μm lines. After mapping the entire Galactic Center Circumnuclear Ring (CNR) in CO(7→6), we made the switch to the [CI] line with four nights remaining in the run, but, unfortunately, the skies were Band 3 or worse for these nights, so that we were not able to take [CI] spectra. During our second run in September 1999, we set up at a lower velocity resolution, since we were focused on extragalactic science. Unfortunately, the weather was quite poor during this run so that we obtained very little data. However, we obtained a small map of M82 in CO(7→6), weakly detected the [CI] line in M82, and obtained a few spectra of Orion that contain both the CO(7 →6) and [CI] lines demonstrating our large bandwidth.

Galactic Center Circumnuclear Ring (CNR). The CNR is an inclined ring of cloudlets at r > 1.5 pc that orbits the dynamical center of the Galaxy, Sgr A^*. We imaged the CNR at 5" resolution in the 31.5 and 37.7 μm continuum with our imaging Fabry-Perot, KWIC on the Kuiper Airborne Observatory (Latvakoski et al. 1999, Figure 1). Prominent in these images are the complete inner edge of the CNR, and each of the mini-spiral features (the northern arm, eastern arm/bar, and western arc). The observed far-IR emission arises from warm dust in photodissociation regions (PDRs). These images trace the deposition of far-UV flux (energetics), trace the morphology, and give hints of clumpy structures. However, spectral lines are required for kinematics, and are much better tracers of clumps. We therefore plan to map the entire CNR in the [CI] and CO(7→6) lines with SPIFI on the JCMT. These JCMT maps will have spatial resolution comparable to our far-IR images, so that we expect many of the same features as in the KWIC images, but *velocity resolved*.

We began this project on our first (April 1999) run with a partially filled (12/25 pixel) array, focussing on the CO(7→6) line. Despite rather mediocre weather, we mapped the inner 1' by 2' regions (> 200 spectra!, Figure 2 and 3) in the CO(7→6) line at R ~ 4500 (Δv ~ 67 km s^{-1}). The spectra cover a velocity range of V_{LSR} -200 to + 400 km s^{-1}. This is the first large-scale mapping of the CNR in the CO(7→6) line. The circumnuclear ring and streamer velocities are quite evident in the spectra and in map. The high-J CO line traces the excitation of the ring, delineating clumps, shocks from clump-clump collisions, and shocks formed where streamers entering the central cavity collide with the ring. These data were obtained during 2 shifts of Band 2 (~ 5 to 7% transmission towards the source) weather, and one shift of marginally Band 1 weather (~ 11% transmission towards the source).

Figure 2. (left) SPIFI/JCMT footprints (4x4 array) superposed on our 37.7 μm image (L4). Shown is the 7" circular beam, and the 48"x48" footprint of the 16x16 pixel SPUD array, together with a 3"x3" pixel. (top) CO(7→6) first light spectrum of the Western Arc. These 12 spectra were obtained simultaneously in an integration time of 12 minutes. Pixels are separated by 7". Velocity resolution is 67 km s^{-1}, and the telluric transmission to the source was ~7%. . Figure not shown. See http://www.jach.hawaii.edu/JACpublic/JCMT/newsletters/n14/spifirept.html .

We are planning to continue this project in our May 2000 JCMT run. We plan to lower the velocity resolution, so that we can map the entire ring in both the CO (7→6) and [CI] 370 μm lines simultaneously. The [CI] line will deliver a complete rotation curve for the ring unfettered by foreground absorptions, and give for the first time good measurements of the overall ring dimensions and mass, and when combined with the $^3P_1 \rightarrow ^3P_0$ 609 μm [CI] maps in the literature, yield cloud temperature, and mass. The CO(7→6) line is sensitive to density enhancements, the local UV radiation fields, and shocks. We expect enhanced CO(7→6)/[CI] line ratios from the

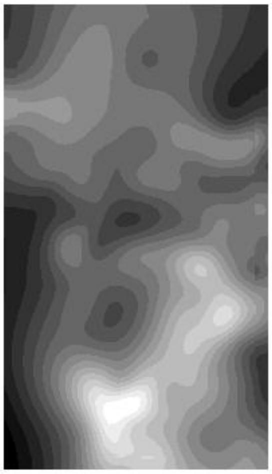


Figure 3. SPIFI CO(7→6) contour map of the Galactic Center circumnuclear ring.

shocks of clump-clump collisions in the ring, or where the gas from the northern arm crosses the CNR. Morphological and kinematic information from both lines may link the streamers that cross the ring to the infalling gas. The imaging array yields near perfect registration and relative calibration between pixels and spectral lines in a map, greatly facilitating the analysis

GALAXIES: NGC 253 NGC 253 is the best example of a nearby (D ~ 2.5 Mpc) spiral galaxy with a starburst nucleus. It is very dusty and highly inclined (*i* ~78°). The inner 500 pc contain a massive molecular bar which hosts much of the starburst activity. The far-infrared luminosity of the starburst region is $\sim 1.6 \times 10^{10}\ L_{\odot}$ so that the average far-UV interstellar radiation field, G_o, is very high, heating and disrupting the ambient molecular clouds

During one shift in April, we had fairly good transmission (10% or better towards the source) for about half an hour on NGC 253 before the sun began to influence the pointing. However, in this time, we clearly detected CO(7→6) line emission in all 12 of the pixels in the array (Figure 4). The main beam brightness temperature was typically ~ 3 K.

Comparing our CO(7→6) map with low-J maps from the literature characterizes the physical conditions of the molecular ISM. The CO(7→6) line, when compared with lower J CO transitions in an LVG model constrain both the gas temperature and pressure. From our measured value at the nucleus we derive: T(gas) ~ 120 K, $n_{gas} \sim 4 \times 10^4$ cm^{-3}. By itself, the CO(7→6)/CO(1→0) line intensity ratio, is a sensitive indicator of G_o and n (Kaufmann et al. 1999). Comparing our CO(7→6) data to the OVRO CO(1→0) line (similar sized beam), we estimate $G_o \sim 3 \times 10^4$ times the local interstellar radiation field. These physical conditions are similar to those obtained from the far-IR fine-structure lines (Carrol et al. 1994), but the area filling factor of the CO(7→6) emitting molecular gas is much lower (~ 0.10) than that of the PDR emitting gas (~ 1.4 -- more than one PDR along the line of sight) indicating that the molecular cores of the clouds in NGC 253 are small relative to their PDR envelopes.

Figure 4. First light spectrum (single footprint of the array) of CO7(7→6) line from NGC 253. Velocity resolution is ~100 km s^{-1}, total integration time is 25 minutes, and telluric transmission towards the source was 8.5%.. Figure not shown. See http://www.jach.hawaii.edu/JACpublic/JCMT/newsletters/n14/spifirept.html .

2. A FEW NOTES ON THE INSTRUMENT

Array. For first light, we ran with 12 working pixels in the array. During our September 1999 run, we had all 25 pixels installed, and 22 were working reasonably well. We have made some repairs, and are hopeful that the full array will be operational for our May run.
Velocity Resolution. When warm, SPIFI can be set up at any velocity resolution between 300 km s^{-1}, and 30 km s^{-1}. For any given cooldown of the spectrometer, the range of velocity resolutions available is limited by our translation stage travel, so that the complete selection of velocity resolutions is not available. For a typical set up, we should be able to change velocity resolution from Δv ~ 150 km s^{-1} to 40 km s^{-1}.
Scan Length. Our maximum scan length is determined by the stretch of the scanning PZT, and is typically 15 resolution elements. For example, if we operated at a velocity resolution appropriate for galaxies (100 km s^{-1}), SPIFI can obtain a spectrum that covers about 1500 km s^{-1}. For narrow line sources, (Δv = 30 km s^{-1}), the maximum spectrum would cover 450 km s^{-1}. To obtain a spectrum with a proper baseline, the minimum scan length is about 5 resolution elements.
Sensitivity. Our best estimates for SPIFI's current sensitivity are tabulated below.

Resolving Power	Velocity Resolution	ΔT_{MB}
1000	300 km s^{-1}	11 mK
1500	200 km s^{-1}	16 mK
2000	150 km s^{-1}	22 mK
5000	60 km s^{-1}	50 mK
10000	30 km s^{-1}	100 mK

These noise estimates assume a 5 spectral resolution element scan, (so that for Δv = 200 km s^{-1}, the resulting spectrum will be 1000 km s^{-1} wide), and assume a very good night, 40% zenith transmission at 370 um. These numbers are for the zenith, so they must be adjusted for airmass. Our measurements in April indicated that the total coupling of the telescope to a point source at 370 μm is 20%, consistent with $\eta_{fss} = 0.65$ and $\eta_{MB} = 0.3$.

3. ACKNOWLEDGEMENTS

Many people contibuted to the success of our first run. We are extremely grateful to the management and staff of the JCMT for giving us the opportunity to bring a complicated new instrument onto the superb JCMT telescope, and for their help with logistics, emergency repairs to components of the instrument and mount, software and interfacing, and shipping and packing. We thank the Director, Ian Robson for his continued support and enthusiasm for the SPIFI project. Perhaps most important is the wonderful support we received from Wayne Holland, and Richard Prestage at the telescope during the first nights of observing.

The SPIFI instrument and the science called out above is the result of much hard work, and writing a few good proposals. Personnel involved include Gordon Stacey, Matt Bradford, Thomas Nikola, Jim Jackson, Alberto Bolatto, Mark Swain, Jackie Davidson, Maureen Savage, Sarah Unger, Peter Ade, and Frank Israel. We are eternally grateful for Peter Ade's filters which made our lives a whole lot easier.

More information on SPIFI can be found at: URL address: http://.astrosun.tn.cornell.edu/research/projects/spifi.html, and in Stacey et al. 1998, Swain et al. 1998, and Bradford et al. 2000.

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NEXT ISSUE DEADLINE

The deadline for submission of science and/or technical articles for the next issue of this Newsletter is **1 August 2000**. *Please consider submitting a short article/figure of your latest result from the JCMT!* All communications regarding this Newsletter should be sent via email to Gerald Moriarty-Schieven (g.moriarty-schieven@jach.hawaii.edu).

gms

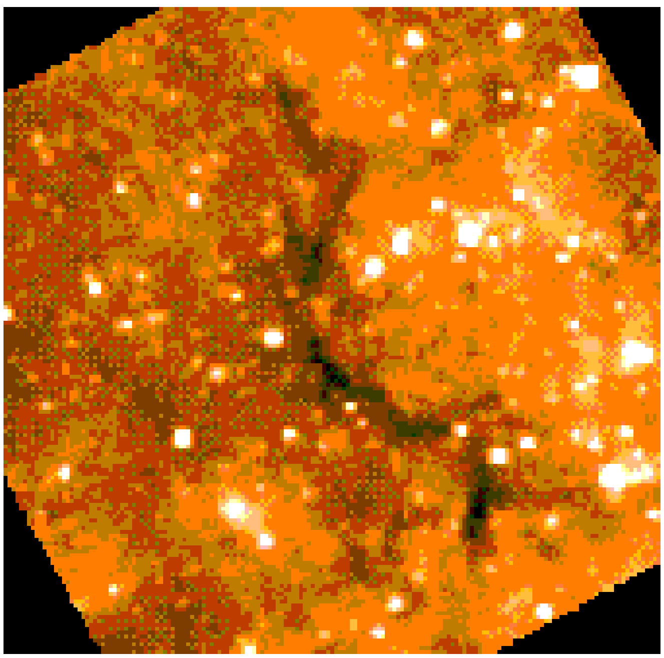
THE LAST WORD

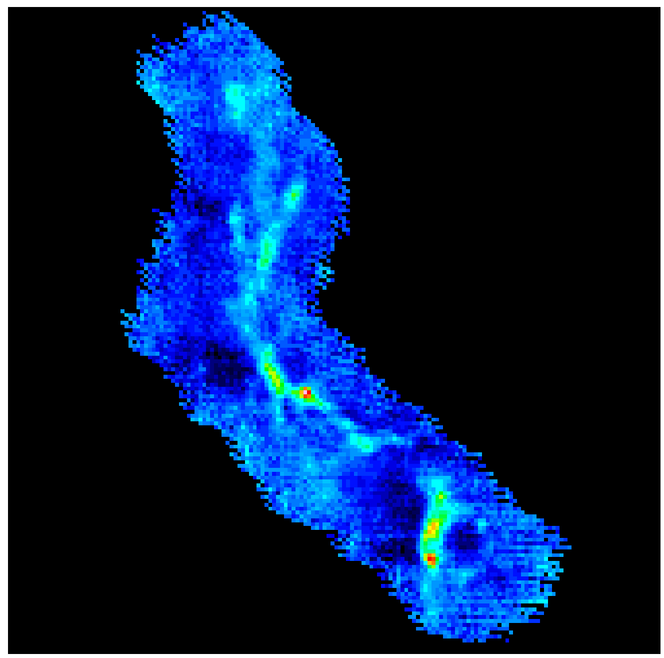
This issue marks my debut as editor of the JCMT Newsletter, which had been most ably edited by Graeme Watt. His editing style and skill made it easy for me to take over (indeed all I had to do for many of the features in this newsletter was update the text a little!), and has made the newsletter the useful, informative, and attractive document that it has become. I hope I can continue to make it so. My thanks and salutations to you, Graeme!

We are looking into the possiblility of resuming publication of a hardcopy edition of the newsletter, possibly for the next issue. If this appeals to you (or repels you!), or you have any comments or suggestions, or would like to volunteer to contribute to the next newsletter, ***please let me know!!!!!***

Gerald Moriarty-Schieven (gms)

March 2000





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