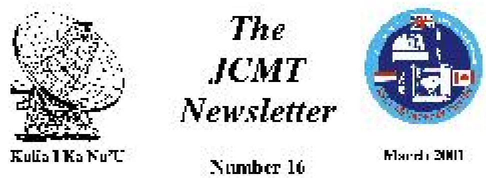
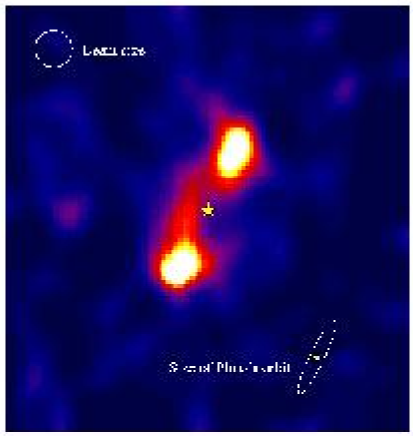
This newsletter was originally published in electronic form by the Joint Astronomy Centre on their web site. This PDF version was created using the web pages still available in August 2014. The most important pages are preserved. The missing pages tend to be administrative in nature and are unlikely to have historical value.

The JCMT Newsletter

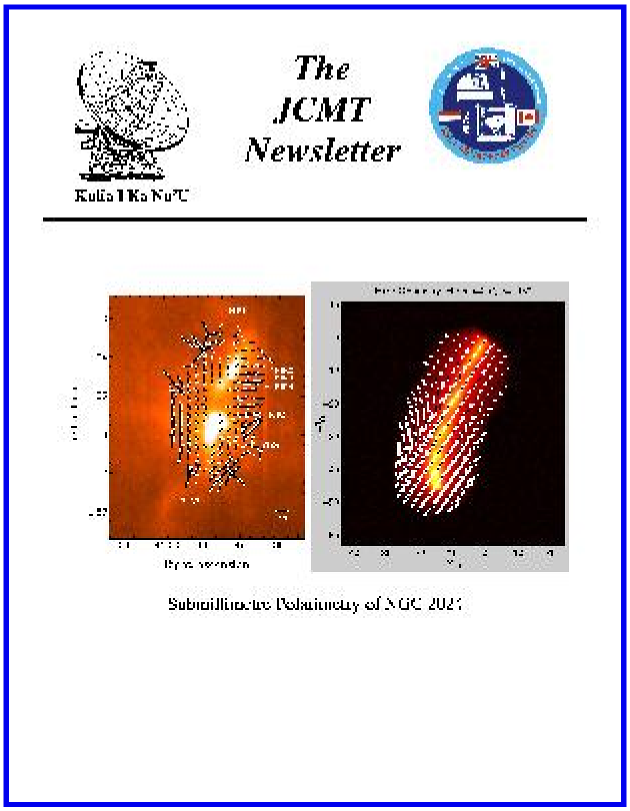




Fomalhaut's Twisted Disk

March 2001 Issue Number 16

Downloadable files containing the majority of the contents will shortly be available in postscript, gzipped postscript, and Adobe Acrobat (pdf) format.



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Gerald Moriarty-Schieven

From the Director's Desk

Ian Robson - Director JCMT

At last the miserable weather of 2000 looks to have changed for the better, and just recently we have seen the best spell of dry weather since El Niño. Hopefully this bodes well for 2001. Since the last Newsletter the main news to report is the cancellation of the `black' time in semester 01A imposed by the 12-hour shifts due to staff shortages. This is excellent news indeed and is a great testimony to the enthusiasm of the TSSs to maintain the facility at full capability (see below).

In November, in the light of a further TSS departure, the JCMT Advisory Panel and Board considered urgent proposals to implement a rapid-action project that would provide a remote, close-up facility for the telescope. This would allow the JCMT to be staffed by a TSS at the summit for all of first shift and some of second shift, the telescope would then be left running while the TSS and observer drove down to HP, where the observer would take over operations. Close-up would take place when the day-crew arrived, or earlier if the weather deteriorated. There would be a number of safety overrides so that in the event of inclement weather, the dome would automatically close. Once the dome was closed it would not be able to be opened again from HP. This project was only possible due to some recent upgrades and the upcoming project to replace the telescope and carousel control consoles. In the first instance this remote close-up would only work with SCUBA, leaving non-SCUBA nights reduced to 12-hours for some fraction of the time. The Panel and Board approved this project in an effort to reduce the `black' time while not increasing staffing.

However, on discussion with the TSSs, Remo Tilanus found there was support to change the shift pattern so that 16-hour nights could be retained. After much intensive work, an agreed solution was found. This has been implemented from early February and will last for the entire semester with a review at the end of May. The Board was supportive of this action. Therefore, observers should now have full 16-hour nights for the entire semester, and should this experiment prove successful, this mode is expected to continue. I cannot speak too highly of the professionalism of the TSSs in working to reach this very satisfactory conclusion.

The only downside to the new pattern is that it removes TSS support from the daytime. This has caused some reorganisation of ETS functions and puts a restriction on extended observing, while not removing it altogether in times of excellent weather. The remote close-up project has not been abandoned, however; it has merely been slowed to a more reasonable pace because this will also allow extended observing to be retained. This is crucial so that we can maximise the observing time during excellent, and in particular, El Niño weather.

Over the last six months the time lost due to faults has improved, which is very welcome in itself. The Associate Director (Per Friberg) has been charged with working with the Chief Engineer and Head of Software to identify and come up with a plan to eliminate many of the niggling faults and to reduce substantially the overall fault-rate. In this light the instruments have been performing reasonably well; RxW suffered a rare failure of the D-band multiplier, while SCUBA went through a period of noisy pixels and dilution fridge problems that were eventually cured by a full warm-up and bake-out. Experience now strongly suggests that this needs to be undertaken about every four months and so in future this one-week downtime will be hard-wired into the schedule. Unfortunately, due to a number of unrelated reasons, the new holography receiver has still not been fully commissioned but as this is being written we should be very close. This will then allow us to move on to the next phase of the surface upgrade project.

Returning to SCUBA, while it continues to produce excellent and world-beating science, those users who want the photometric pixels or the 750/350 channels continue to be disappointed by their unavailability. This was discussed at the ITAC and based on the scientific priorities, time out of service and risk of the fix, the ITAC decided to continue to operate in the 850/450 mode for the coming semester. However, it was agreed that SCUBA should be taken out of service for an extended period in summer 2002 for a thorough overhaul, which will include the return of all filter modes. Observers are hereby given advanced notice of this planned downtime. We are also investigating whether we can obtain a further increase in sensitivity through new feedhorns, which have just become available through a new machining technique. If this proves feasible, then these will also be installed next summer.

I again encourage RxW applications, the dearth of which continues to baffle me given the high demand to build this excellent receiver in the first place. I am working with the ITAC to explore ways to ensure that users who obtain RxW time do get good weather.

The past few months have been very busy ones as far as the new instruments are concerned. HARP had an excellent review meeting at MRAO in late November and is on good track. This was followed by an equally successful Critical Design Review of ACSIS at Penticton in December. It looks as though ACSIS will suffer some further slippage, but will be at the JAC well in time for HARP. For both of these projects, the software interface with the JAC has become a priority and this will be addressed at an extensive meeting in Hilo in early April. SCUBA-2 has just seen the project kick-off-meeting at NIST in February. This went extremely well and it was very encouraging to see how positively the two detector development teams were working together. This project is currently going through the funding cycle in the UK and will be the focus of the JCMT Board in May. The situation for CHAMP-D on the other hand, does not look at all promising as Bonn has not been able to appoint a project manager and so the required design review scheduled for March is unlikely to take place.

Ian Robson - Director JCMT

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The Nightwatchman

Edition 1

Spring 2001

Hilo, March 1

[Regular readers of this newsletter will note that this is the first appearance of an article in the JCMT Newsletter by a Telescope System Specialist. I hope that you find this column to be some combination of enlightenment and entertainment, at least as far as the TSS perspective goes, and I welcome comments, questions, compliments, and criticisms. -JK]

TSS Support

The JCMT TSS corps has undergone several changes since the last newsletter and I thought I'd devote much of this inaugural edition to elaborating on some of those changes and the ramifications that they will have upon observer use of and interaction with the JCMT facility.

As of the last newsletter, Jim Hoge and I had just joined JCMT and begun our training. Since then, we have each become substantially more familiar with the JCMT and its operations an we would each like to thank observers and JCMT staff alike for their patience during our familiarization periods. And, we'd also like to thank current TSSs Ed Lundin and Thomas Lowe, as well as recently-departed but long-serving TSSs Rusty Luthe and Jeff Cox, for their time and patience during the training periods. (Aside: Rusty and Jeff each report that they are enjoying the new challenges they are facing at CFHT and Gemini-South, respectively. For those wishing to keep in touch with them, they can be reached at luthe@cfht.hawaii.edu and jcox@gemini.edu.)

Support scientists Robin Phillips and Nick Jessop have begun a program of taking a few nights each month at the telescope, becoming more familiar with the facility and its nighttime operational mode, and Scott Mikkelson has left the TSS group. The presence of Robin and Nick has also helped augment the support model for nighttime operation, as outlined below.

The JCMT Board considered the TSS staffing issues at their November meeting and it was decided that no additional TSSs would be hired so that funds could be transferred to development, most notably including the support of future instrumentation. Based on this decision, a plan was developed for the covering of the approximately 8% of normal 16-hour operation that was lost due to this staff shortage. This involved the development of a remote-observing plan, to be implemented on a time scale of less then nine months. However, the TSS group subsequently discussed alternative support models and have restructured their support of JCMT operations, most notably the shedding of some of their daytime support duties, to cover the lost time. Therefore, JCMT once again is supporting its full 16-hour operational model, with no expected lost time between now and the implementation of remote observing. The downside to this plan is that extended observing will be a less frequent event. However, this plan has allowed the remote observing team to slow the pace of development somewhat, allowing implementation a bit further down the road than originally anticipated, and hopefully allowing for a more robust system due to the extended and less-hurried development period allowed by the new TSS support model.

Antenna and Instrumentation

The TCS has begun a multi-step migration to UNIX, the first part of which has been successfully tested and implemented. Recent inclinometry and pointing tests with the new TCS demonstrate that the correction for meridian-crossing is working better. A small elevation-dependent focus shift has been discovered in the z-axis and corrected. The dish surface is performing well and will soon be tested again following adjustments to the holography receivers, although additional tests have been somewhat delayed due to a temporary reallocation of staff surface responsibilities.

Receiver A continues to function well following its recommissioning after helium cryostat repairs.

Receiver B is performing satisfactorily, excepting an occasional 200 MHz offset in tunings due to a 50 MHz shift in the Gunn oscillator output frequency. This problem can be worked around either by verification of line positions on calibrators or other sources with strong, known signals, or by a quick slewing of the antenna to the zenith to check a counter in the receiver cabin that monitors the Gunn oscillator output frequency. Also, single-sideband performance has improved recently due to mechanical modifications that improved rejection of the image sideband.

Receiver W is working okay in C-band. However, D-band is currently unavailable due to the off-island repair of the local oscillator source, which has been accomplished and the part is on its way back to Hilo.

The DAS is performing well, as are the IFS, the IFD, and the heterodyne polarimeter.

SCUBA is working somewhat better following a full warm-up of the entire instrument to ambient temperature and a subsequent limited warm-up. Most of the large, migrating noise issues have been solved, although occasional lower-level, apparently-random noise has appeared on occasion. It is substantially less severe than the previous problems and we hope to remedy this soon. This problem has not yet affected the central photometry bolometers in either the long-wavelength or short-wavelength arrays.

The SCUBA polarimeter is functioning once again following a failure and subsequent replacement of two of its cables. Please note that the staff contact and responsibility for this instrument is changing.

Notes for Observers

We would like to remind observers to carefully review their observing templates before submitting them so as to contribute to a more efficient and less error-prone execution of their programs in queue/service mode by the TSS, or the observer if he/she happens to be familiar with the mode of observing. Thoroughness (sans superfluity) and lucidity are welcome sights during early morning template review at altitude. Also, early submission of templates is highly encouraged. Early semester weather that tends excessively towards one end of the spectrum or the other often leaves us having to implement less-suitable programs from other weather bands or member countries or with lower scientific rankings. Prompt filing of templates will possibly increase the likelihood and timeliness of finishing a program.

Observers are also reminded that there are country-specific guidelines on the permitted weather grades in which they can observe their own program when they observe in person. If you are uncertain of these rules, please contact your country's Hilo-based scheduling representative.

As noted above, extended observing will be somewhat curtailed on account of the support changes which have reinstituted full support for the

16-hour operational mode. Also, observers are reminded of the importance of having a safety briefing with their staff contact, and of communicating with the on-duty TSS before commencing transport between Hale Pohaku and the summit.

For those observers who have scheduled, overriding Target-of-Opportunity proposals, we encourage not only the prompt sending of electronic mail to your country's Hilo-based scheduling representative and the TSS group at jcmt_to@jach.hawaii.edu, but also contact by telephone to insure prompt follow-up with time-dependent observations.

Miscellanea

In addition to our TSS-specific web pages which Ed Lundin has worked on for several years and which I will probably soon take over from him, I have developed what I hope to be a concise and centralized set of links useful to both observer and TSS. While this project was delayed during the development of the new JCMT web site by Robin Phillips, now that that site is stable again, I shall to continue work on it and incorporate more of the new web site into it. If you are interested, please visit www.jach.hawaii.edu/~jkemp/links to see the work in progress. Please note that some links are restricted to the JAC network and/or staff. Comments welcome.

Several TSSs received some degree of financial support for attending conferences in the early months of 2001. Thomas Lowe and Jim Hoge attended the Gemini-Subaru Astrophysical Ages and Time Scales conference held here in Hilo and I attended IAU Colloquium 183 - Small Telescope Astronomy on Global Scales.

For those of you reading a hardcopy of this article, or viewing it in any medium besides the world wide web, please note that this article, and its subsequent companions in The Nightwatchman series, appears at www.jach.hawaii.edu/~jkemp/nwm.

La Citation du Semestre

An immense pride was buoying us up, because we felt ourselves alone at that hour, alone, awake, and on our feet, like proud beacons or forward sentinels against an army of hostile stars glaring down at us from their celestial encampments. ... Standing on the world's summit we launch once again our insolent challenge to the stars!

Filippo Tommaso Marinetti, Fondazione e Manifesto del Futurismo, 1909

Happy equinox and African solstice eclipse chasing!

Jonathan Kemp

www.jach.hawaii.edu/~jkemp

j.kemp@jach.hawaii.edu

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PATT Application Deadline

Deadlines for receipt of all JCMT applications for semester 01B is:

31 March 2001

Note that the effective deadline for Canadian proposals is 8am PST April 2 in Victoria, and for UK/International proposals is 8am HST April 2 in Hilo.

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. Frank Briggs,	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

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Modification Author: Gerald Moriarty-Schieven (gms)

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JCMT image here

Weather Statistics for Semester 00A

The following tables present the weather loss for semester 00A. For losses dut to faults see the the Operational Stats. A more detailed description of how these tables are created is also available here.

Month	Available	Extended	Lost to weather		Lost to weather	
			Primary	%	Backup	%
Feb	375.5	14.5	98.5	26.2	36.0	9.6
Mar	263.0	8.2	69.3	26.3	33.7	12.8
Apr	478.0	13.3	105.0	22.0	75.3	15.8
May	472.0	12.6	314.8	66.7	200.0	42.4
Jun	373.0	14.8	119.0	31.9	60.3	16.2
Jul	512.0	5.7	314.8	61.5	210.3	41.1
Totals	2473.5	69.1	1021.4	41.3	615.6	24.9

Iain Coulson

JCMT image here

Weather Statistics for Semester 00B

The following tables present the weather loss for semester 00B. For losses dut to faults see the the Operational Stats. A more detailed description of how these tables are created is also available here.

Month	Available	Extended	Lost to weather		Lost to weather	
			Primary	%	Backup	%
Aug	478.0	21.9	198.3	41.5	83.6	17.5
Sep	480.0	10.6	214.5	44.7	99.3	20.7
Oct	488.0	9.4	254.3	52.1	120.2	24.6
Nov	477.5	31.5	160.1	33.5	121.5	25.4
Dec	468.0	22.1	71.1	15.2	30.9	6.6
Jan	496.0	25.6	69.5	14.2	34.8	7.1
Totals	2887.5	121.1	967.8	33.6	490.3	17.0

Iain Coulson

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JCMT Heterodyne Instrumentation Status

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

Status of current receivers.

RxA3

RxB3

RxW

Heterodyne Polarimetry

DAS Spectrometer guide

DAS "non-standard" configurations

Heterodyne Integration Time Calculator This facility is a web-based and stand-alone perl script for estimating the required integration time (or rms noise) for heterodyne observations.

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Gerald Moriarty-Schieven

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Lethbridge Fourier Transform Spectrometer

It is likely that the Lethbridge FTS will be available for use during semester 01B with increased sensitivity. 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.

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Gerald Moriarty-Schieven

SPIFI: The South Pole Imaging Fabry-Perot Interferometer

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 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.

First light for SPIFI on the JCMT in April 1999. A report on this event was published in the March 2000 JCMT Newsletter.

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.

Gerald Moriarty-Schieven

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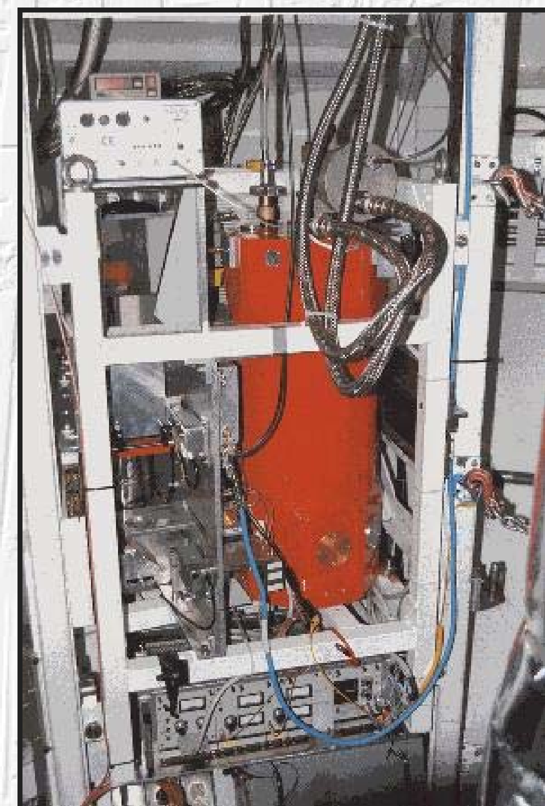
Max-Planck-Institut 800 GHz Instrument



The MPIfR/SRON heterodyne spectrometer (MPIRE) for the 350 micron atmospheric window (E-band) has been successfully installed and commissioned at the JCMT in April 2000. The figure at the top shows the integrated system in the Cassegrain cabin. The spectrometer consists of a single-channel fixed-tuned waveguide mixer with an SIS NbTiN junction fabricated at the University of Groningen. The current tuning range of the mixer is 790-840 GHz. Among the most important lines within this band 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 double-sideband (DSB) receiver temperature is in the range 500 - 800 K, the highest sensitivity is around 800 - 810 GHz. Only DSB operation is possible. The maximum available bandwidth for the DAS is currently 920 MHz. The measured single-sideband system temperatures at the JCMT are around 10,000 K or much less under good submillimetre weather conditions (tau_225 GHz<0.05). Preliminary analysis yields a main beam efficiency eta_mb~0.15.

The system is currently on loan from MPIfR and available in semester 01B for use by the JCMT community on a collaborative basis. Astronomers interested in using it should contact Ronald Stark (stark@mpifr-bonn.mpg.de) to arrange collaborative efforts. The instrument will stay at JCMT for an extended time during which a continuous improvement of its performance is planned.

Further details can be found at:

http://www.mpifr-bonn.mpg.de/div/mm/tech/mpire.html

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

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A Warped dust disk around Fomalhaut - Evidence for planetary perturbations?

Wayne Holland & Jane Greaves (UKATC/JAC)

Cold dust around nearby stars

The discovery of large reservoirs of cold dust around nearby stars in the 1980s provided strong evidence for the existence of planetary systems other than our own. If no planets exist in such systems then the density and brightness of the dust should increase smoothly with drag forces towards the central star. However, if planets do exist interplanetary dust will interact with these larger bodies whilst spiraling in towards the star, resulting in irregular variations in both the density and the corresponding brightness distribution. Although the edge-on disk around b Pictoris had been studied extensively, it was not until 1998 that significant new results emerged (Holland et al. 1998; Jayawardhana et al. 1998; Koerner et al. 1998; Greaves et al. 1998). In particular, submillimetre-wave techniques can circumvent the difficulties of the starlight that dominates at optical and near-IR wavelengths, by imaging the faint thermal emission from cold dust grains. The much hotter star has very little flux at these long wavelengths. The submillimetre images of Vega, Fomalhaut and e Eridani showed dust disks similar in size to the Sun's Kuiper Belt of comets (Holland et al. 1998; Greaves et al. 1998) and revealed evidence of central cavities in the emission near the star possibly cleared-out by the formation of planets.

The need for high resolution imaging?

Although intriguing, these observations lacked sufficient spatial resolution to investigate smaller scale structure, such as the asymmetries and warps that are potential signatures of planetary perturbations. New data at short-submillimetre wavelengths of Fomalhaut shows the presence of a "warp" in the observed dust torus. At 450m m, where the telescope beam-size is equivalent to a resolution of 50 AU at the distance of Fomalhaut, the dust disk appears to have a distinct bend in the connecting emission between the two offset peaks (see Figure 1). The image confirms that we are looking at an almost edge-on dust disk or ring, with a cavity devoid of emission out to approximately 100 AU radius from the star. The two bright peaks result from looking "down the ends" of the ring where the effective column density is largest. The new data clearly benefited from not only some of the best submillimetre weather on Mauna Kea, but are also substantially improved in both sensitivity and calibration accuracy over the previous work (due to the new wide-band filter on the short-wave array, and the calibration work of Archibald et al. *paper in prep* - also see JCMT webpage for details).

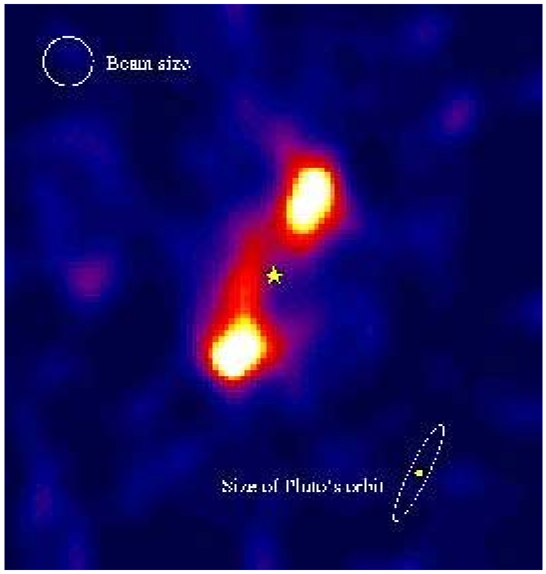

***Figure 1*. 5-hr jiggle-map observation of Fomalhaut at 450m m. North is up and east is to the left and the star position is marked by the "star" system. The telescope beam size is shown for comparison, along with the size of Pluto's orbit for scaling purposes.**

Possible interpretations?

Several possible theories for the origin of the asymmetry are possible. Papers in preparation (Holland et al., Wyatt et al.) will show that no smooth ring model (e.g. pericentre glow) can fit the data, and the asymmetry is unlikely to be explicable by dust generation in planetesimal collisions. *The most plausible model is that the dust is concentrated in orbital resonances with a planet.* A comparison with recent numerical simulations shows that the data can indeed be qualitatively modeled with a Saturn-like object hidden in a gap in the torus. In figure 2 we show a simple de-projection of the 450m m image. This was first rotated for convenience so that the peaks lie in a vertical line, and then stretched by a factor of three along the horizontal axis. This is roughly equivalent to converting the image from an inclination of 19.5 degrees to face-on, although it does not take into account degradation by the finite beam size or a non-zero disk thickness (we are currently investigating ways of doing this?). The result shows a long arc below the star and a shorter one to the upper left. There is a small gap to the left of the star, and a much larger one covers the remainder of the ring.

A unique interpretation is certainly not possible at this stage, but we show for comparison (also in figure 2) a model planetary system from Ozernoy et al. (2000). Here there is a 0.3 M(Jupiter) (roughly Saturn-mass) planet orbiting at the ring radius, and dust is collected into librating orbits about the L4 and L5 Lagrangian points. There is a good resemblance between this model and the Fomalhaut de-projection, after taking into account the large beam size. In particular, the small and large gaps and short and long arcs are clearly present.

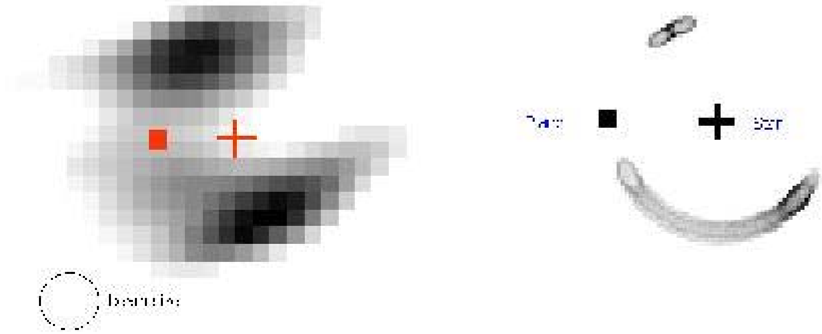

Figure 2. **(left) De-projected (stretched) 450m m image of Fomalhaut with telescope beam, and (right) Ozernoy model.**

There are several possible configurations producing arcs in the models of Ozernoy et al. (2000), depending on the planet mass and the presence or absence of dust in outer resonances as well as along the planet's orbit. Thus this is a hypothesis rather than a solution to the data - observations at different epochs would be a good test to further investigate this theory. However, the most plausible model is that a large planet in reasonably close association with the Fomalhaut dust disk has created very severe perturbations. As in the case of e Eridani, this would be evidence for planetary companions at larger radii from the star, 60- 100 AU, than observed in our own Solar System.

This work is still on-going with data being collected on other systems such as Vega and e Eridani at a wavelength of 450m m. Until the ALMA interferometer comes on-line later this decade, the JCMT and SCUBA offer a unique way to study such systems with unparalleled sensitivity.

Acknowledgements

We thank all our collaborators who have contributed to this research: Bill Dent, Mark Wyatt (UKATC), Ben Zuckerman, Chris McCarthy (UCLA), Rich Webb (NASA Ames), Iain Coulson, Gerald Moriarty-Schieven, Ian Robson (JAC), Dolores Walther (Gemini), Walter Gear (Cardiff), Helen Walker (CCLRC) and Harold Butner (SMTO). This research was supported in part by PPARC funding, and by NSF and NASA grants to UCLA.

References

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2. Jayawardhana et al.1998, ApJ 503, L79

3. Koerner et al. 1998, ApJ 503, L83

4. Greaves et al. 1998, ApJ 506, L133

5. Ozernoy et al. 2000, ApJ 537, L1

LARGE CIRCUMBINARY DUST GRAINS AROUND EVOLVED GIANTS?

M. Jura, R. A. Webb (UCLA) & C. Kahane (Obs. de Grenoble)

INTRODUCTION

The growth of solids into planetesimals in circumstellar disks is a major unsolved astrophysical problem. Almost all investigations of dust disks have concentrated on pre-main sequence stars, but there are some post-main sequence binary stars which possess orbiting circumbinary dust disks. We are studying disks in evolved systems with the goal of learning more about particle growth.

Accretion disks around a mass-receiving star in mass-exchange binary systems such as cataclysmic variables and symbiotics stars have been studied for many years. In an accretion disk, the lifetime of an individual grain may be short even if the system is long-lived. In contrast, in a circumbinary disk, the particles orbit both stars and are not being continuously destroyed. As a result, in circumbinary disks, particles may survive enough orbits to grow by coagulation to sizes as large as 1 mm. With only a few known examples of this phenomenon such as the Red Rectangle and AC Her (see Waters et al. 1993, Jura & Kahane 1999, Jura, Chen & Werner 2000, Molster et al. 2000), we hope to identify more such systems.

Because small spherical grains do not emit efficiently at wavelengths much larger than their size, one way to identify ``big'' particles is to observe at relatively low frequencies. Therefore, we have obtained mm and sub-mm observations of SS Lep (m_V = 5.0 mag, period = 260 days, A1 + M4; Cowley 1967, Welty & Wade 1995) and 3 Pup (m_V = 4.0 mag, period = 161 days, A2I + ?; Plets et al. 1995) because they are A-type stars in the Yale Bright Star Catalog with anomalously and uniquely high IRAS fluxes (Jura & Kleinmann 1990) and we suspected that they may have circumbinary disks. As part of this program, we also obtained data for BM Gem, a highly luminous carbon star with oxygen-rich circumstellar matter which also may possess a long-lived orbiting disk (Kahane et al. 1998).

There are many previous infrared studies of evolved binary stars (for example, Friedemann, Gurtler & Lowe 1996). A system that might have some properties in common with SS Lep and 3 Pup is the binary containing the post-main sequence luminous A-type star, epsilon Aur (M_v <= -6.0 mag) which has a companion of unknown type that is surrounded by a dust disk containing grains larger than 5 um (Lissauer et al. 1996). Here, we consider circumbinary environments where the grains may be more than an order of magnitude larger in size and thus 10^3 times more massive than those found around the companion to epsilon Aur.

In contrast to their infrared properties, little is known about submillimeter dust emission from evolved binary stars. Symbiotic stars have been detected at wavelengths > 100 um (Seaquist & Taylor 1992, Ivison et al. 1995, Corradi et al. 1999), but this emission is probably produced by ionized gas and not dust. In the systems discussed here, thermal emission by dust probably dominates at wavelengths <= 1350 um.

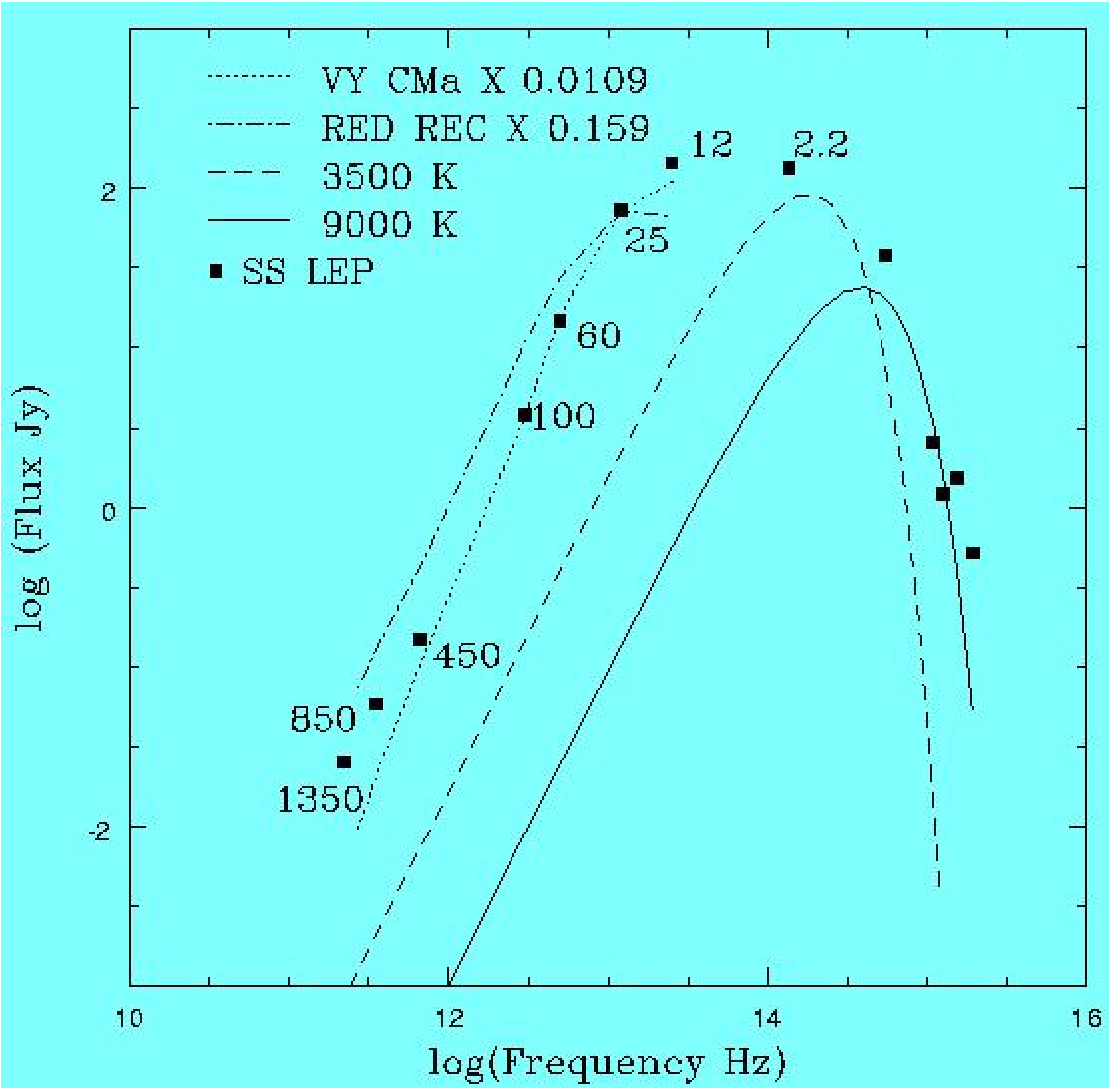

Fig. 1. A plot of the observed spectral energy distribution for SS Lep with the lower-frequency points labeled by their wavelength (um). The mm and sum-mm points are from this paper. We use the IRAS data for the fluxes from 100 um to 12 um, the Two Micron Sky Survey for the flux at 2.2 um, the Hipparcos photometry for B and V magnitudes and the TD-1 satellite photometry for the ultraviolet data. The solid and dashed lines show the fluxes for the two stars in the system assumed to be black bodies. An extinction law that varies as ν^{+1} with A_V = 0.4 mag is assumed. The dotted line shows the IRAS and sub-mm (Knapp, Sandell & Robson 1993) fluxes for VY CMa scaled by a factor of 0.0109. The dot-dashed line shows the IRAS and sub-mm (Jura & Turner 1998, Van der Veen et al. 1994) fluxes for the Red Rectangle scaled by a factor of 0.159. The errors are smaller than the squares.

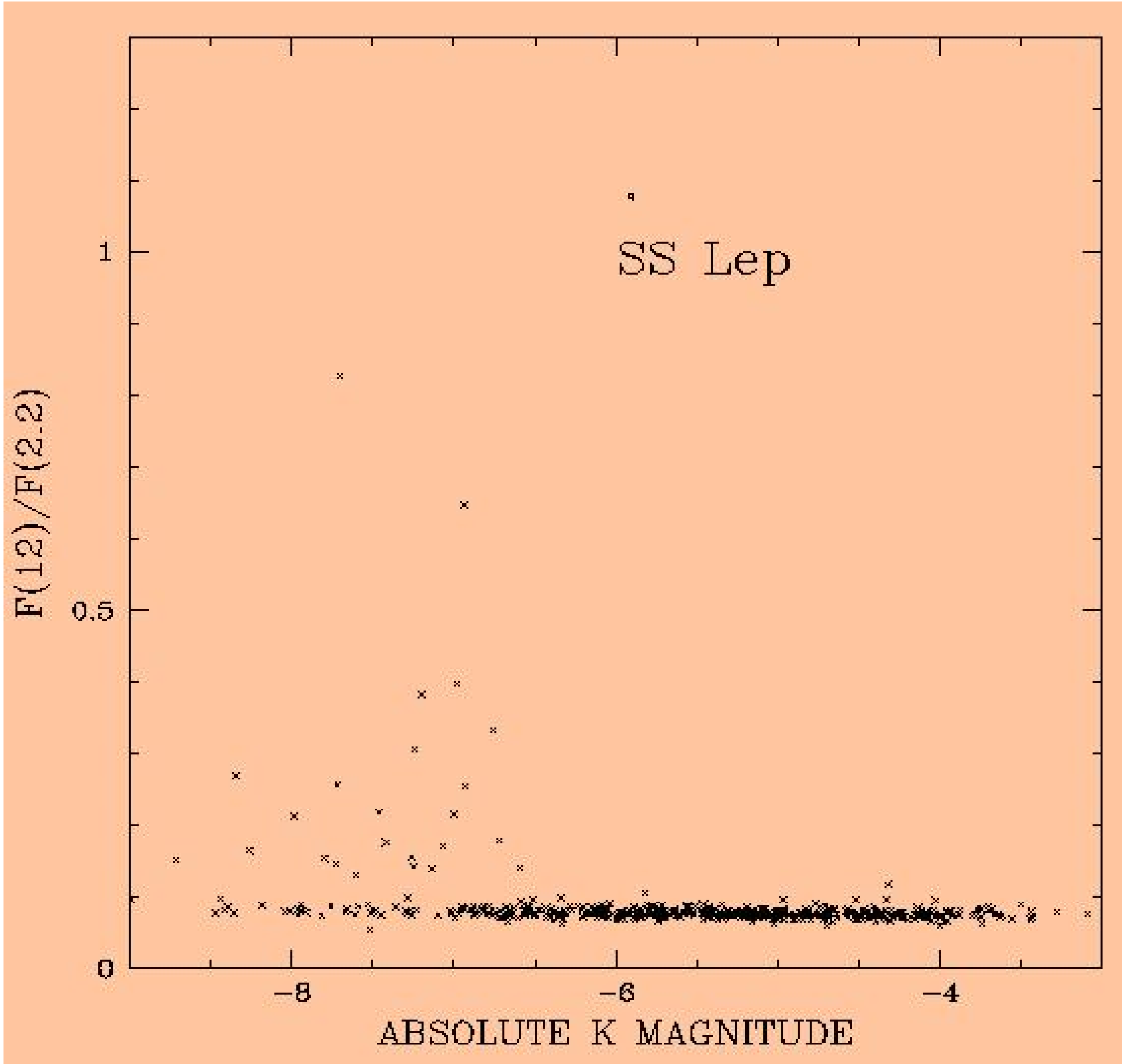

Fig 2. Plot of M_K vs. F_{nu}(12 um)/F_{nu}(2.2 um) for stars in the Bright Star Catalog with (B-V) >= 1.50 mag, parallaxes measured to better than 1sigma with the Hipparchos satellite, 2.2 um fluxes from the Two Micron Sky Survey (Neugebauer & Leighton 1969) and non color-corrected 12 um fluxes from the IRAS survey. Most of the stars exhibit photospheric values of F_{nu}(12 um)/F_{nu}(2.2 um); but some stars with M_K < -6.5 display an excess at 12 um caused by dust emission. The unique position of SS Lep in this diagram for ~500 stars is evident, with its large 12 um flux perhaps arising from a disk wind.

CONCLUSIONS

We have detected mm and sub-mm continuum emission from two evolved binaries, SS Lep and 3 Pup, and also possibly from BM Gem.

1. This continuum is probably produced by emission from dust colder than ~ 70 K lying within 6" of the star and can be explained if the dust particles are at least as large as 0.1 mm in radius.

2. We propose that there are circumbinary orbiting disks of at least 5 x 10^{28} g and that the ``large'' particles have grown by coagulation in this disk. These disks may have winds with mass loss rates of ~ 5 x 1017 g s^{-1} and lifetimes >= 2000 yr.

A preprint of this article is available here.

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Measuring the SCUBA wideband filters using the University of Lethbridge FTS

David Naylor (ULethbridge) & Wayne Holland (JAC/ATC)

Just before Christmas 2000 the University of Lethbridge Fourier Transform Spectrometer (FTS) was used to measure the SCUBA wideband 450/850 micron filter profiles. This was quite a technical challenge! SCUBA's location on the left Nasymth platform, and the limited space in front of the cryostat window (where the re-imaging mirrors are normally located), meant that it was a tricky operation to place the FTS in such a position that we could measure the filter profiles. Moreover, in order to fit the FTS into the limited space available the FTS had to be reconfigured such that the input ports became the output ports and vice-versa. In fact, space was of such a premium that we also had to remove the extremely heavy (160 kg!) optical table that normally supports the mirrors. However, over a Sunday morning we managed to get set up for the measurements.

The data were taken with the FTS viewing a heated blackbody calibration source placed at the input to the FTS. Once optimised, two spectra were taken at the central pixel position and each of its nearest neighbours in both the short and long wavelength arrays. The FTS was operated in its highest resolution mode (0.005 cm-1, scan time 60 seconds) to allow study of the spectral fringing that occurs due to resonant optical cavities within SCUBA. The measured interferograms were digitally filtered before phase correction and subsequent Fourier transformation. The resultant spectra are of very high quality. Figure 1 shows the spectra superimposed on the Mauna Kea atmospheric transmission curve for 1mm PWV. The intensity scale has been arbitrarily scaled to match the atmospheric windows. The narrow band filter profiles (also measured with the FTS) are shown for comparison. Interestingly, the new 850 micron filter is not significantly wider than the old (the so-called "narrow-band") filter, with the measured NEFD improvements of 5-10% mainly due to an improved IR blocking filter. At 450 microns the new filter is twice as wide as the old one, with a measured NEFD per pixel improvement of 30-40% (in good weather) being in line with the wider passband.

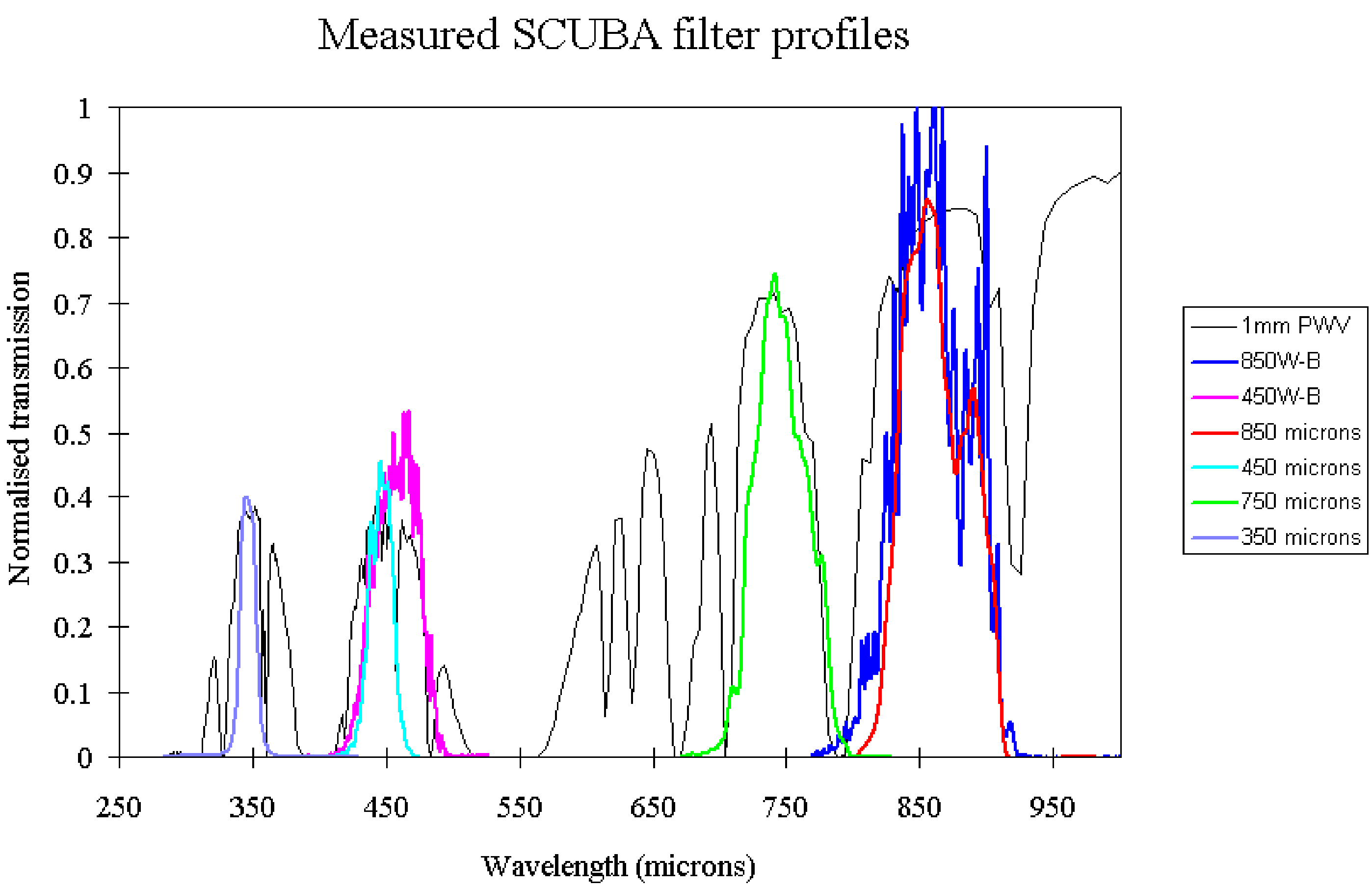

FIGURE 1 : Measured filter profiles The fringing which is visible is both the new traces is believed to be due to interference between the bolometer cavity, feedhorn and the bandpass filter. At the scan speed of the interferometer mains pickup transforms to wavenumber space as 30 cm-1 which lies outside of the spectral bands of interest. Many thanks to Greg Tompkins, Gary Davis, Brigett Hesman and Tom Lowe for help with the tests, as well as Vernon, Nash, Mark, Kevin and NealO for their assistance with the mechanical set up.

David Naylor & Wayne Holland

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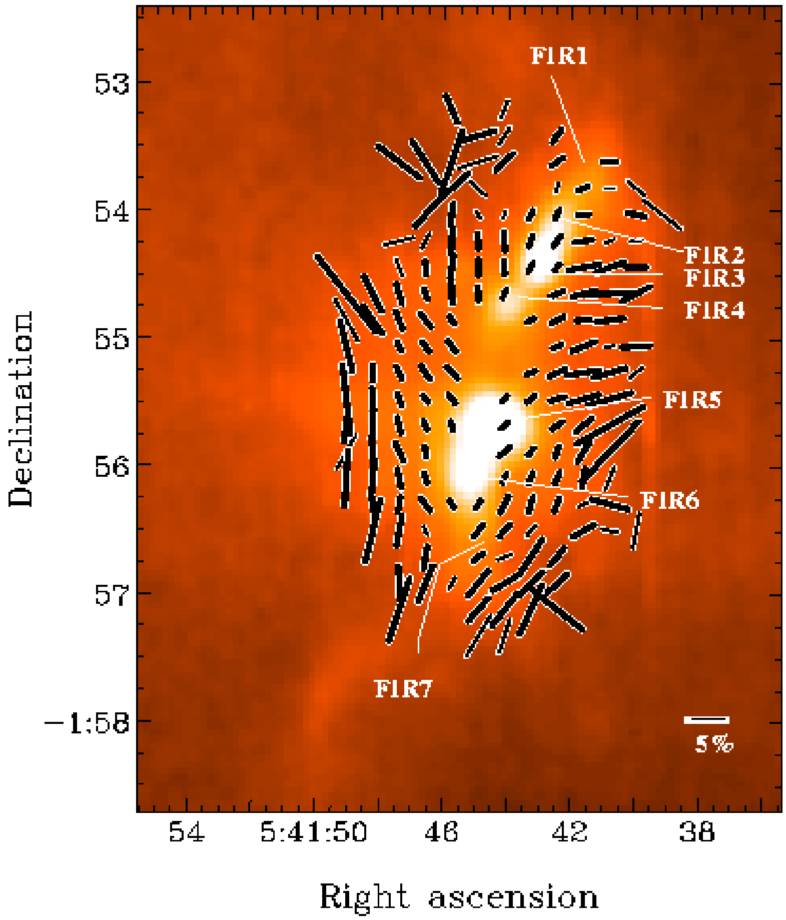
Submillimetre Polarimetry of NGC 2024

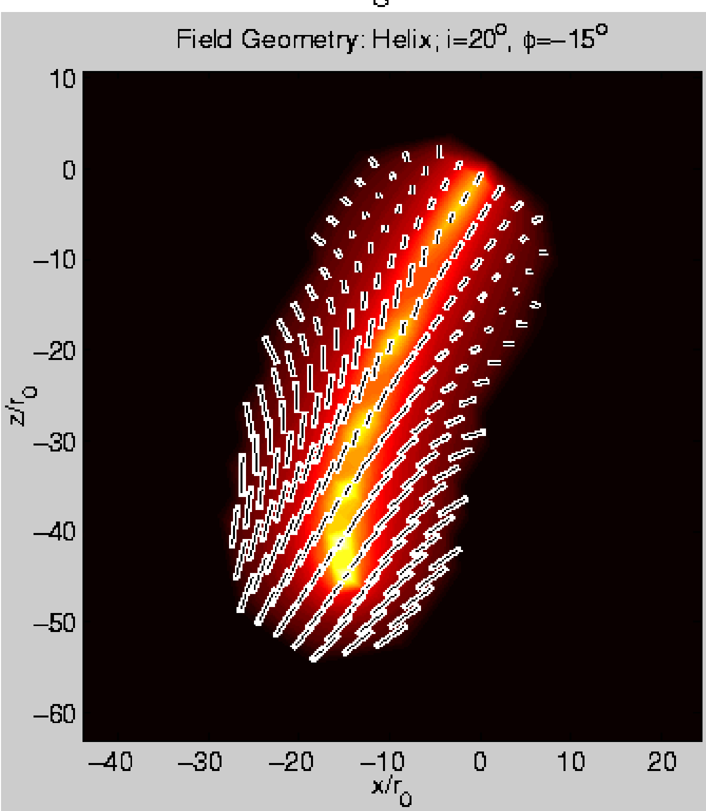
Brenda C. Matthews (McMaster U), Jason D. Fiege (CITA), & Gerald H. Moriarty-Schieven (NRC/JAC)

Magnetic fields play a significant, even crucial role in the process of star formation (Heiles 1993), through magnetic support of molecular clouds, dissipation of angular momentum in accretion disks, and the generation of jets and outflows. Polarized thermal emission at submillimeter wavelengths from aligned dust grains directly traces the magnetic field structure projected onto the plane of the sky (Hildebrand 1988). With the recent development of focal plane bolometer arrays equipped with polarimeters, sensitive imaging polarimetry in the submillimeter is now possible.

The Orion B (L1630) molecular cloud, at ~415 pc (Anthony-Twarg 1982), is one of the nearest giant molecular clouds and is an active site of low- to high-mass star formation. It was one of the first to be systematically studied for dense cores by Lada et al. (1991), who found that massive star formation took place only in the five largest clumps, which together make up more than 50% of the mass of dense gas Lada et al. (1991).

NGC 2024 is an HII region and the most prominent star formation region in Orion B, associated with a massive cluster, ionizing B stars, and stars at all phases of evolution (Mezger et al. 1988; Lada et al. 1991; Chandler et al. 1996). The submillimeter emission, discovered by Mezger et al. (1988) & Mezger et al. (1992), is located behind the HII region (see cartoon in Barnes (1989)) and consists of at least seven sources aligned along a ridge, similar to OMC-3 in Orion A (Johnstone & Bally 1999; Matthews & Wilson 2000). Two of these cores are the origins of unipolar molecular outflows, one of which is very highly collimated and very extended (Chandler & Carlstrom 1996; Sanders & Wilner 1985; Richer, Hills & Padman 1992), while another core contains a water maser (Genzel & Downes 1977), indicating intermediate-mass protostars. The rest of the cores show no sign of star formation activity (Visser et al. 1998).





(Figure 1 left) Using the imaging polarimeter for the Submillimeter Common User Bolometric Array at the James Clerk Maxwell Telescope, we have detected polarized thermal emission at 850 um from dust toward the NGC 2024 star-forming core system. Here we show the 850 um dust emission as a ``grey''-scale, on which are plotted the 12''-binned polarization vectors. Vectors are plotted where I>0.001 V, p>1%, dp<1.5% and p/dp>4. Bold vectors show those where *p*/dp>7. The polarization patterns are not indicative of those expected for the case of uniform fields, and exhibit depolarization toward the highest intensity peaks. NGC 2024 exhibits an organized polarization pattern which is structured consistently along the length of a chain of 7 far-infrared sources and may be dominated by the filamentary structure rather than the cores.

(Figure 2 right) We've modelled the polarization pattern of NGC 2024 with a ``bent filament" model of Fiege & Pudritz (2000). The length of the filament is 6 times the radius and the ends have been rounded. We have bent the entire filament into a circular arc perpendicular to the plane of the sky and toward the observer, keeping the top of the filament parallel to the original orientation. The radius of the arc is 3 times the filament length. We then rotated the entire structure by 20deg and inclined it relative to the plane of the sky by -15deg. The magnetic field threading the region in this model is helical and the ratio of ``toroidal" to ``poloidal" magnetic flux is about 2. Although this model is not unique, in that other field geometries could duplicate the observed polarization pattern, the excellence of the fit supports a helical field surrounding a bent filament.

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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 **15 August 2001**. *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**).

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THE LAST WORD

This is my third attempt as Newsletter Editor. Many thanks to those who made suggestions for its improvement. I've tried to incorporate these, for example a "printable" version of most pages, sans background images/colours.

The number of science articles has, alas, decreased in this issue compared to the profusion in the previous two issues, but the calibre remains high. Don't miss this opportunity to show off your pretty pictures in the next issue!

I've had only one response from someone interested in resuming publication of a hardcopy edition of the newsletter. Hence we will continue to publish this electronic version, and provide downloadable postscript/pdf versions.

Mahalo nui loa!

Gerald Moriarty-Schieven

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