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M E M O R A N D U M

To: Addressee  
From: R. L. Brown  
Subject: SEST Users Meeting and ESO Workshop  
on Millimeter-wave Interferometry

On May 22-23, I attended the SEST Users Committee meeting and Workshop on Millimeter-wave Interferometry. A copy of the agendas and list of participants is attached.

I. SEST USERS COMMITTEE MEETING

Harry van der Laan, Director General of ESO, opened the meeting and noted that he saw two issues facing SEST. The first involved planning for the move of SEST to Paranal (site of the VLT) in the second half of 1994. He's assuming the astronomers would like to do this, wanted it confirmed, and wanted to know the ramifications. Second, he was concerned about the instrumentation on SEST being incomplete and/or inadequate. He suggested a model in which ESO would fund instrumentation development at universities and institutes, with the instruments so developed becoming common user facilities at SEST.

Following the welcome, the meeting continued with a half day of science talks from users. This was a very effective touch, got people thinking about the telescope as a tool for science, and served to eliminate the us/them distinction right from the start. We should consider this for our Users Committee meetings.

The second half of the day was taken up with SEST technical issues.

Pointing: With model fits and frequent pointings can expect 3"-4" rms. Subject to occasional jumps of 10"-20". Inclometers (4) have been installed to investigate the source of pointing problems. The inclinometers show tilts of 6" with a diurnal signature.

IRAM interferometer antennas show all the same pointing problems. Some suggestion this is due to thermal changes in the azimuth bearing (a very open structure). Wind also has a pronounced effect on pointing, which J. Baars says is a design fault in the backstructure.

Holography: The surface was measured and reset twice recently using holography and the LES-8 satellite. The surface error, determined from radiometric observations following these two resettings, is:

May 1990:	60 $\mu\text{m}$
October 1990:	75 $\mu\text{m}$

They have no explanation as to why things got worse in the most recent effort. The plan was to repeat the exercise in May 1991, but LES-8 is no longer available in Europe (the orbit was moved). No plans now for further work, although it is recognized that the present condition is unacceptable.

Receivers: Present Status: The two receivers at 3 mm and 1 mm are both Schottky receivers.

3 mm T(Rx) =	250- 300 K (90-115 GHz)
1 mm T(Rx) =	700-1700 K (220-260 GHz)

Recent problems with phase lock loops (broadening narrow spectral lines and creating wide line wings, plateaus) and with standing waves in the spectral baselines.

Receivers: Plans:

- Have built a 350 GHz SIS receiver with Cambridge University junctions. Telescope tests gave 3000-5000 K SSB receiver temperature (330-355 GHz). Receiver being returned to Sweden for new (Cambridge) devices; expected to be returned to the telescope in October.
- Ray Blundell has offered a long-term loan of a SAO 230 GHz SIS receiver (single channel, 200 K DSB) which they hope to install on the telescope in October.
- Kreysa has built a 1.3 mm bolometer for SEST which will be installed in August. It uses a focal plane chopper, which Kreysa says is inappropriate; he favors a chopping secondary. There is no analysis software at SEST to support bolometer mapping applications.
- Support the collaboration with a Moscow institute where Nb SIS junctions are being built. Prototype device from Moscow gave T(Rx) = 100 K DSB at 3 mm.

Spectrometers: There is both a wideband, 500 GHz AOS (2), and a narrowband, 86 MHz, AOS (2). Some problems relating pixel number to frequency (nonlinear). Also problem with the diode laser flipping modes. Need to temperature control the laser diode itself.

Calibration: SEST intensities of spectral lines from extended sources are low by a factor of 1.5 to 1.8 relative to other telescopes. Not clear what is the cause.

Optics: Users request simultaneous observations with 115 and 230 GHz. This is being worked on with high priority.

Telescope Statistics:

1990 Observations

Number of Projects	237
Hours scheduled	6288
Hours maintenance	2240
Hours unscheduled	232

Telescope observing "efficiency," 72%  
(fraction of total time observing)

Oversubscription: Swedish Time

Number of proposals	86
Hours requested	8825
Hours scheduled	2919
Oversubscription = $8825/2919 = 3.0$	

Oversubscription: ESO Time

Number of proposals	96
Hours requested	5798
Hours scheduled	3048
Oversubscription = $5798/3048 = 1.9$	

Publications in Refereed Journals (A&A; Ap.J.)

<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991*</u>	<u>Total</u>
2	6	19	(5)	32

\* to date

Data Reduction:

Options

DRP (POPS)	A900
CLASS	VAX
COMB	Unix WS
DRAWSPEC	PC

Lots of support for DRAWSPEC. It easily creates data cubes for AIPS, MIDAS. Strong desire for the single dish FITS to converge (what is the status?).

Future Plans:

- Sensitive receivers at 115, 230 GHz "workhorse" frequencies;
- Improve surface figure;
- Improve the pointing;
- Investigate the possibility of a nutating subreflector;
- Build a SIS 2 mm receiver;
- Encourage outsiders to bring 460 GHz receiver and VLBI equipment.

II. WORKSHOP ON MILLIMETER-WAVE INTERFEROMETRY

Many of the presentations were on material that we have seen in other forms recently. The following developments I was not aware of.

IRAM Interferometer:

- Accurate bandpass calibration (less than 1 degree of phase) is achieved by periodically injecting a common signal into all the IF's just ahead of the correlation. This is done while the antennas are slewing so no time is lost.
- User interface to the array control looks like the 30-m interface, few differences.
- Software, control and analysis, all done in-house. Doing imaging simulations and working on deconvolution algorithms and self-cal algorithms with groups in Nice and Toulouse.
- Observing 30 percent of the time now.
- Upgrade plans.

1991 T(Rx) = 60-90 K, all antennas at 3 mm.

1992 New correlator - BW 160 MHz, 80, 40, 20

1993 4th Antenna  
Dual frequency receivers on all antennas  
80-115 GHz T(Rx) = 50 K SSB  
205-250 GHz T(Rx) = 100 K SSB  
Closed cycle cryogenics

1994 Extend maximum baseline by 50 percent  
Dual polarization receivers  
(4 mixers per cryostat)

1995-97      Expand to 6 antennas (65 MFF)

NRO Interferometer

Upgrade plan 1991-1993:

- New antenna (No. 6)  
    Surface accuracy 40  $\mu$ m  
    Honeycomb aluminum panels
- New SIS receivers  
    110/150/230 GHz in one cryostat
- Ultra-wideband correlator  
    500 MHz x 4   XF, or  
    250 MHz x 8   XF

Large Millimeter Array Project

Antennas	30 of 10 m diameter
Baselines	greater than 435 m
Frequencies	80-230 GHz

Funding to follow large optical telescope in 1995-96.

ESO/Swedish Southern Hemisphere Array

Roy Booth presented plans for an array to be built near the Paranal VLT site. He suggested 12 fixed antennas of 8-m diameter on baselines of a few hundred meters and a Y-configuration. Rough estimate of the cost is \$30 M. Much discussion followed; little enthusiasm for such a "modest" project.

Van der Laan ended the discussion, and the meeting, by saying that if ESO was to be involved in such a project it should be every bit on a par with the MMA. Pointless to do any less for the southern sky than is being done in the north. Booth was given the task of organizing a study group for a major southern hemisphere millimeter-wave array.

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SEST Users' Meeting  
and  
Workshop on Millimetre-Wave Interferometry

ESO, Garching, 22 - 23 May 1991

PROGRAMME

SEST Users' Meeting, MAY 22 - 09:00-18:00

08:30 BUS LEAVES FROM GARCHING (MAIBAUM SQUARE)

08:40 Registration

09:00-09:05 Welcome

H. van der Laan

SOME SCIENTIFIC RESULTS FROM SEST

09:05-09:20 Key Programme: CO in the Magellanic Clouds - LMC

F. Israel

09:25-09:35 - SMC

J. Lequeux

09:40-09:55 CO Rotation Curves of Galaxies

R. Wielebinski

10:00-10:15 CO in Centaurus A

A. Eckart

10:20-10:35 Spectral Scan of Sgr *A02*

Å. Hjalmarsson

10:40-11:10 COFFEE

11:10-11:25 Observations of Planetary Nebulae

R. Sahai

11:30-11:45 CO Survey of IRAS Stars

L.-Å. Nyman

TECHNICAL PROGRESS AND PLANS

11:50-12:15 Overview of Progress

R. Booth

12:20-13:30 LUNCH

Discussion of SEST's Performance:

13:30-13:45 Telescope - Pointing

L.-Å. Nyman

13:50-14:05 - Holography

N. Whyborn

14:10-14:25 Receivers - Present Status

N. Whyborn

14:30-14:45 Receiver Plans - Heterodyne

N. Whyborn

14:50-15:05 - Bolometer

E. Kreysa

15:10-15:25 Spectrometers

L.-Å. Nyman

15:30-15:45 Observations - Proposals, Efficiency, Calibration, Publications

L.-Å. Nyman

15:50-16:05 Data Reduction

M. Olberg

16:10-16:40 COFFEE

16:40-16:55 Future Plans

R. Booth

17:00-18:00 Further Discussion and Suggestions

18:00-19:30 RECEPTION

19:30 BUS LEAVES FOR HOTELS

**Workshop on Millimetre-Wave Interferometry, MAY 23 - 09:00-17:30**

08:45 *BUS LEAVES FROM GARCHING (MAIBAUM SQUARE)*

**EXISTING MM-INTERFEROMETERS AND THEIR PERFORMANCE**

09:00-09:20 The IRAM Interferometer on Plateau de Bure - Operation and Performance S. Guilloteau

09:25-09:45 The Berkeley Interferometer and Its Upgrade

Given by C. Masson ~~TBD~~

09:50-10:10 The Caltech Millimetre Interferometer Upgrade

N. Scoville

10:15-10:35 The Nobeyama Interferometer

K.-I. Morita

10:40-11:10 *COFFEE*

11:10-11:30 Millimetre VLBI

L.B. Bååth

**PLANNED AND FUTURE DEVELOPMENTS**

11:35-11:55 The Australia Telescope at Millimetre Wavelengths

L. Stavelly-Smith

12:00-12:20 The Smithsonian Sub-millimetre Array

C. Masson

12:25-14:00 *LUNCH*

14:00-14:20 Plans for Interferometry between JCMT and the Caltech 10m Antenna

R. Hills

14:25-14:45 The Proposed NRAO Millimetre Array

R. Brown

**A MILLIMETRE ARRAY NEAR PARANAL**

14:50-15:10 Site Measurements on Cerro Paranal

M. Sarazin

15:15-15:35 Water Vapour Measurements

R. Martin

15:40-16:10 *COFFEE*

16:10-16:30 A Possible Interferometer for the Southern Hemisphere

R. Booth

16:35-17:30 Discussion on an Interferometer Near Paranal

17:45 *BUS LEAVES FOR HOTELS*



**SEST Users' Meeting  
and  
Workshop on Millimetre-Wave Interferometry**

ESO, Garching, 22 - 23 May 1991

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