Minutes of the Cologne AMSTAR meeting of November 30th, 2005

The Cologne meeting was attended by 20 engineers and scientists directly involved in AMSTAR, and by 5 SRON/ASTRON engineers and scientists working on related topics. Most of the meeting was devoted to the presentations of the progress made in the different AMSTAR work packages and to the discussion of the results. A special session dealt with organizational matters, in particular with the forms and documents need for the 2005 AMSTAR Annual Report. Finally, a short discussion took place on the prospects for R&D within the frame of FP7(I3).

Agenda of the AMSTAR 2005 end of the year meeting

November 30th, 2005, KOSMA (University of Cologne / Institute of Physics I)

1. **Welcome** J. Stutzki, K. Jacobs (KOSMA)	*08h30-08h40*
2. Report on the RadioNet Board Meeting in Bonn M. Guélin (IRAM)	*08h40-09h10*
3. **Progress report on the Work packages: Results& Prospects**	*09h10-15h30*
3.1 Wide-band SIS mixer development	
B. Lazareff (IRAM)	*09h10-09h30*
V.Belitsky (Chalmers)	*09h30-09h50*
A.Baryshev/Ludkov (SRON)	*09h50-10h10*
J.D. Gallego (FG-IGN)	*10h10-10h30*
Coffee Break (10.30-10.50)	
3.2 2SB SIS mixer development	
P. Mena (SRON)	*10h50-11h10*
N. Honingh/T.Tils/M.Justen (KOSMA)	*11h10-11h30*
Lunch Break (11.30-12.45)	
Laboratory Tour (12.45-13.30) N. Honingh (KOSMA)	
3.3 FPA receivers and detectors	
A-L Fontana (IRAM)/P. Huggard (RAL)	*13h30-13h50*
T.M. Klapwijk (TuDelft)	*13h50-14h10*
3.4 HEB mixer development	
T.M. Klapwijk (TuDelft)	*14h10-14h30*
J. Baubert (OBSPM)	*14h30-14h50*
D. Medelin (Chalmers)	*14h50-15h10*
T. Scherer (IRAM)	*15h10-15h30*
Coffee Break (15.30-15.50)	
4. **Preparation of the Annual Report** M. Guélin (IRAM)	*15h50-16h30*
5. Preparation of FP7 the above, plus W. Wild (SRON), B. Ellison (RAL), J-M. Krieg (OBSPM), K. Schuster (IRAM)	*16h30-16h55*
6. Future meetings: dates, location	*16h55-17h00*
END of Meeting(17:00)	

Progress reports on workpackages

The research activities have progressed fast. Impressive results were achieved as concerns the prototyping of wide-band SIS mixers and HEMT amplifiers, the physics and fabrication of Hot Electron Bolometers, and the pumping of HEBs and SIS mixers with quantum cascade laser (QCL) and photonic local oscillators.

Researchers from IRAM, Chalmers and SRON presented the results on the first SIS mixer prototypes built within the AMSTAR JRA. These mixers operate at 3 mm, 0.8 mm

and 0.5 mm wavelength, and have wide IF bandwidths (4 or 8 GHz) and very low noise (2-3 times the quantum limit). The first mixer prototypes will be iterated in 2006-7 to increase even more the IF bandwidth, to raise the operating frequency, or to lower the mixer noise. FG-IGN has delivered two 4-8 GHz band low-noise HEMT amplifiers that will serve as pre-amplifier with the IRAM and SRON mixers. A wide band low-noise amplifier, operating in the band 4-12 GHz is being developed by the same group and a first prototype has been built.

Following fabrication problems mainly linked to the machining and alignment accuracy of crucial components, KOSMA has postponed the construction of a 9-pixel array prototype operating at 0.8 mm and equipped with 2SB SIS mixers. It will temporarily focalize its work on the realization of a single pixel receiver chain. An innovative layout of the array optics has nevertheless been prototyped; it was shown during the visit of the KOSMA laboratories.

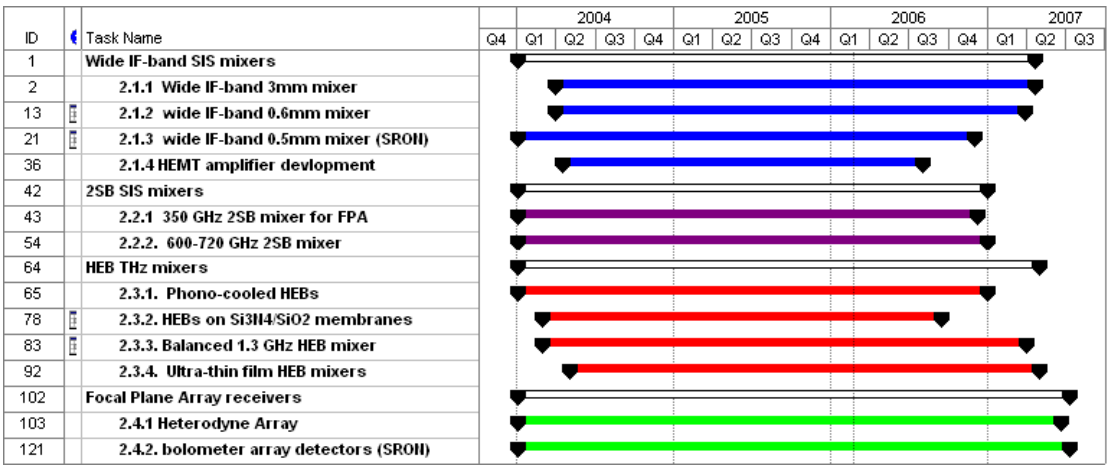
Impressive results were obtained by all the groups working on HEBs, most particularly by the SRON team who succeeded for the first time to drive an all solid-state heterodyne THz receiver by a QCL local oscillator, and by the IRAM scientists, who imaged for the first time a hot spot and investigated the structure of ultra thin NbN films with small angle X-ray scattering at the European Synchrotron (ESRF) in Grenoble. The work on HEBs at Chalmers and OBSPM is also progressing.

Finally, two batches of Kinetic Inductance Detectors (KIDs), based on superconducting Nb on Si, were fabricated at TuD, and an IRAM-built 2-mm SIS mixer has been successfully pumped with a photonic LO built at RAL.

The experience of the different groups on the techniques used to realize high frequency components, such as hybrid couplers and planar supraconducting circuits was compared. Innovative work was made in this respect at KOSMA and Chalmers.

The presentations and full Progress Reports can be found on the AMSTAR WIKI pages (http://www.radionet-eu.org/rnwiki/AmstarMeetings).

The calendar of several workpackages has been extended in order to iterate some of the mixer designs, either to circumvent unexpected problems, or to reach better performances (e.g. as concerns the instantaneous bandwidth or the frequency of operation). All 12 AMSTAR workpackages should nevertheless be completed by Q2, 2007.



Preparation of Annual Report 2005

The calendar will be very tight in January as concerns the Annual Report. New forms or templates need to be filled: Justification of Resources, Form C, and 18-month Implementation plan template. The 18-month Implementation Plan concerns the period Jan 1st, 2006--June 30th, 2007. There should be a description of the activities projected (with milestones), a Gantt chart, and a projected cost table per workpackage. Caution should be taken that the projected costs announced in the Plan do not exceed the budget allocated to each workpackage. All institutes that have received EU money in 2004 and/or 2005 in the frame of AMSTAR need to have an audit of their expenditures for these two years. A copy of the above documents should be sent to RadioNet and to the AMSTAR PI before Jan 20th.

In addition, for each workpackage, a copy of the 2005 Progress Report should be sent to the AMSTAR PI by Jan 16th. These reports will be put on the AMSTAR WIKI site (http://www.radionet-eu.org/rnwiki/AmstarReports).

There was a request to extend by 6-12 months the calendar of 3 of the AMSTAR workpackages. The workpackage leaders that are concerned must write a formal request to the AMSTAR PI and to RadioNet. These extension are understood within a constant budget.

Prospects for R&D on mm/submm receivers in the frame of FP7

The discussions at the AMSTAR meetings of Groningen and Koeln have shown a large interest of the groups involved in AMSTAR to continue their research on millimeter and submillimeter techniques for radio astronomical receivers in the frame of FP7/I3. Despite the requirement to fund at least 50% of this research costs on the laboratory's own resources, all groups expressed their wish to increase their R&D effort.

The progresses realized during the past years call for further developments of compact, low-noise receiver elements that could be fabricated at low cost and integrated into large focal plane arrays. For heterodyne observations these elements would be based on SIS mixers or on HEMT pre-amplifiers. For bolometric observations, they would be based on compact thermometer arrays based on semi-conductor, TES or KID technologies. Finally, the opening of the THz domain to space, airplane and ground-based observations motivates R&D on HEBs receivers with instantaneous bandwidths of several GHz and noise of a few hundred K.

The R&D should bear in particular on the following topics:

- Wideband SIS mixers with integrated HEMT amplifiers & balanced amplifiers
- LOs
- FP arrays of SIS mixer receivers
- FP arrays of MMIC amplifiers in the mm range & FPAs
- Large bolometer arrays

- Wider band and more sensitive HEBs
- THz components (isolators, waveguides,…)

Several questions need to be discussed in this context:

- Is a research on MMICs /InP transistor HEMT amplifiers affordable in the frame of a JRA proposal?
- Shouldn't the development wide-band receiver arrays be coupled to a development of spectrometers?
- What type of bolometer technology should be used after SCUBA-2?

Preliminary answers to these questions were given. The technology for the fabrication of InP transistors for mm HEMTs must be further developed in Europe, but this can only be done in the frame of University groups with limited resources, as there seems to be no real interest for these devices in the industry. The cost of such a development is probably very large, over 1 Meuro, and exceeds the possibilities of a JRA like AMSTAR. Coordination with ESO and/or other JRAs must be sought. Similarly, backend developments were felt to be outside the frame of a JRA on mm receivers and will probably be largely carried out, in the future, by the industry. Wide band receiver arrays and backends will require complex IF processors. Some thoughts should be made on standards in relation with the industry.

Next AMSTAR Meeting: in Chalmers (Goeteborg) on the week starting on June 19th (after MTT symposium, which ends on June 16th).