

Minutes of the AMSTAR meeting in Freiburg (Sep 18th, 2008)

Participants: M. Seelman-E, M. Schlechtweg, S. Chartier (IAF); M. Guélin, B. Lazareff, D. Maier, A-L. Fontana, K. Schuster (IRAM); B. Ellison (SFTC-RAL); A. Navarrini (NIA-Cagliari); M. Baryshev (SRON); V. Belitsky (Chalmers), A. Barcia-C., J-D. Gallego-P. (FGIGN-OAN); J-M. Krieg (ObsParis); G. Yassin (OxU); N. Honingh (KOSMA); F. Schefer (MPIfR); J-R Gao (TuD-SRON). Minutes by MG.

Agenda

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| 1. Welcome M. Seelmann-Eggebert | 8h45-09h00 |
| 2. Progress Report on the AMSTAR Work Packages: Final Results | 9h00-12h30 |
| 2.1 Wide-band SIS mixer development | |
| WP 2.1.1 D. Maier (IRAM) | 9h00-9h20 |
| WP 2.1.2 V. Belitsky (Chalmers) | 9h20-9h40 |
| WP 2.1.3 A. Baryshev (SRON/NOVA) | 9h40-10h00 |
| 2.2 2SB SIS mixer development | |
| WP 2.2.1 A. Baryshev (SRON/NOVA) | 10h00-10h20 |
| WP 2.2.2 N. Honingh (KOSMA) | 10h20-10h40 |
| Coffee Break | 10h40-11h00 |
| 2.4 FPA receivers and detectors | |
| 2.4.1 A-L Fontana (IRAM)/ B. Ellison (RAL) | 11h00-11h20 |
| AMSTAR FP6 results: General Discussion | 11h20-12h00 |
| 3. Report on the EC evaluation and the RadioNet Board Meeting in Rome M. Guélin | 12h00-12h30 |
| Lunch Break (12.30-13.15) | IAF- Cafeteria |
| Visit of IAF laboratories (HF) | 13h15-14h00 |
| 4. FP7 AMSTAR+ Proposal | 14h00-17h00 |
| 4.1 Task 1- W-band heterodyne MMIC array: F. Schaefer | 14h00-14h30 |
| 4.2 Task2- Integrated pixel and photonic LO for FPA: B. Lazareff | 14h30-15h00 |
| 4.3 Task 3- Submm heterodyne FPAs: A. Baryshev | 15h00-15h30 |
| 4.4 Task 4: Mixers for 1-2 THz FPAs: N. Honingh | 15h30-16h00 |
| AMSTAR+: Organization & General Discussion | 16h00-17h00 |
| End of the Meeting (17h00) | |

The closing AMSTAR FP6 meeting was held at the IAF laboratories in Freiburg, Germany. It was attended by 20 engineers and scientists from the groups which have participated to the AMSTAR program. or that will join follow up developments in the frame of AMSTAR+ FP7.

The morning session was devoted to the progress reports on the 5 work packages still active in 2008, to budgetary questions and to the question of the AMSTAR final Report. Most of the 12 work packages (WPs) carried on during the 5 year-long AMSTAR activity period have been quite successful. Some have led to exceptionally good results with the construction of prototype detectors with world record performances. More details about those results can be found in the AMSTAR 2007 Annual Report or below.

The afternoon session dealt with presentations and discussions of the 4 main Tasks that will be pursued in the frame of AMSTAR+ FP7, as well as on organizational matters related to the new JRA. It was stressed that in spite of the fact that the AMSTAR+ work will be largely rely on the experience gained and on results obtained within the AMSTAR FP6 JRA, the FP7 JRA will be essentially oriented toward the development of Focal Plane Arrays of heterodyne detectors and will require to seek novel solutions leading to miniaturized and more reliable devices. Assets and drawbacks of some of those solutions were discussed. The question of the LO distribution, power dissipation, suppression of Josephson current, as well as device micromachining and wiring were more particularly evoked.

A visit of the IAF laboratories that will take part to the AMSTAR+ developments was organized between the two sessions.

As concerns the WPs active in 2008, remarkable results were presented by D. Maier on the wide-band 3-mm SIS mixers (WP 2.1.1) and by A. Baryshev on the development of the AlN technology for the fabrication of high frequency SiS junctions (WP 2.1.3).

WP 2.1.1: A sideband-separating (2SB) mixer with a 2x8 GHz wide instantaneous bandwidth was assembled, connected to the 4-12 GHz low-noise amplifiers developed by FG-IGN in AMSTAR WP 2.1.4 and tested (see Fig. 1).

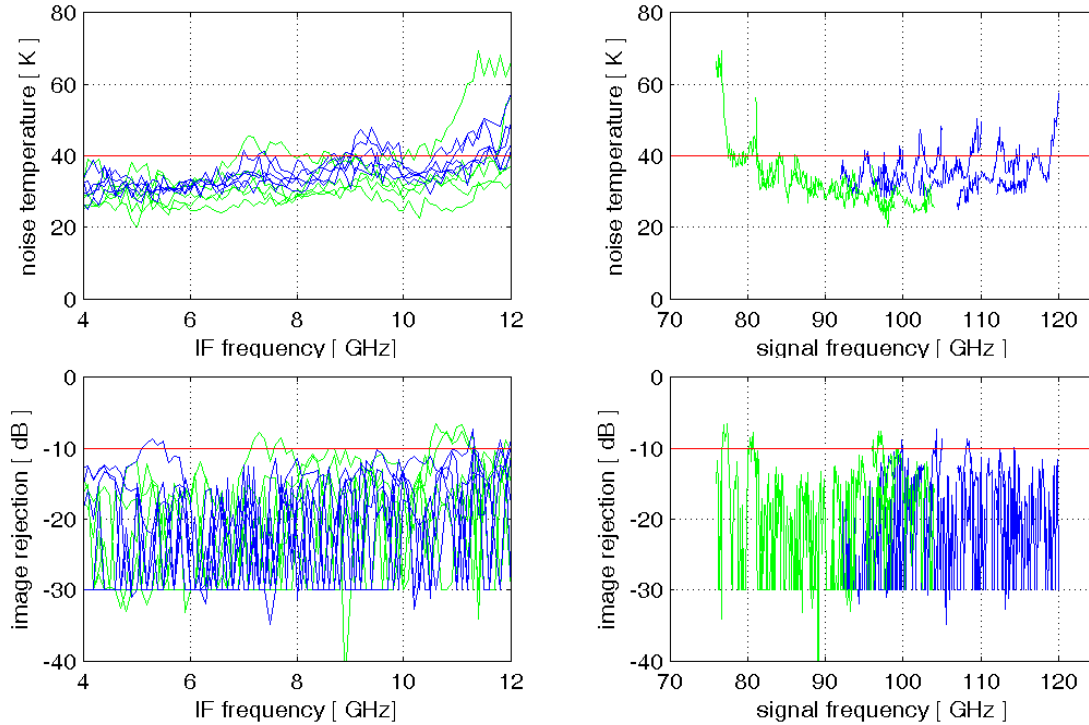


Figure 1: Above: Noise measurements of the sideband separating mixer No.1 as function of the IF frequency (left) and over the RF signal band (right). Below: Image rejection as function of the IF frequency (left) and over the RF signal band (right). Measurements made in LSB mode are shown in green; USB measurements are plotted in blue.

The RF frequency range of the mixer covers the intended range of 80 to 116 GHz (see upper plot on the right in Figure 1). The IF response of the mixer is quite flat over the whole band and only rises a bit between 11 and 12 GHz (see upper plot on the left in Figure 1). The measured image rejection shown in the lower plots of Figure 1 is better than -10 dB except for a few points.

Thus the goal of the work package, consisting of the development of a sideband-separating mixer for the RF frequency range of 80 to 116 GHz with 4 to 12 GHz IF band is achieved. The useful IF bandwidth (2x8 GHz) is twice larger than that achieved for the ALMA receivers, while the receiver noise temperature is similar.

The 2SB mixer developed in WP 2.1.1 will be used for the 3-mm channels of the new receiver that is being constructed for the IRAM Pico Veleta telescope. It was pointed out during the discussion that whereas a rejection of -10 dB is largely sufficient for an interferometer, it may be a bit critical for a single dish telescope. Ways to increase the rejection were briefly discussed. They include the replacement of the commercial coupler.

WP 2.1.2: The goal of this WP was to develop the SIS mixer for the 385-500 GHz receiver (band III) of the MPG-ESO-OSO telescope APEX. The sideband separation mixer consists of 2 back pieces attached to a common block that hosts an LO in-phase power divider and a 90-degree waveguide RF hybrid. While the mixer block was fabricated using Copper-Tellurium alloy, the coupler/hybrid block was fabricated in

house using micromachining with a novel technique. This technique combines photolithography with electroplating to fabricate the tiny waveguide structures and provides very low surface roughness (measured: 0.25 micro-m) and an rms accuracy better than 1 micro-m (Fig. 2).

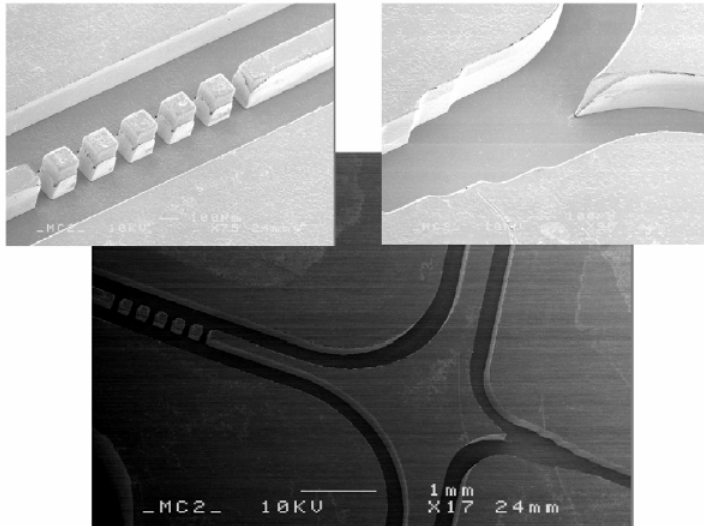


Figure 2:
LO Coupler and RF
hybrid

One of the two IF hybrid outputs could be completed and its performance measured. The SSB noise temperature reaches 200 K at 400 GHz, but rises steeply at the upper edge of the band. The sideband rejection is around or above 7 dB. The mixer, which demonstrates for the first time an on-chip LO injection, was not installed on the telescope because of the relatively high noise.

WP 2.1.3:

After the successful development, construction and delivery of SIS mixers based on AlO_x junction technology (incorporated in the APEX-CHAMP+ multibeam receiver and in the ALMA Band 9 front-end cartridges), the participants have started to investigate the interest of AlN SIS junctions for high frequency applications.

New batches of devices in 600-720 GHz range have been realized in 2008 at TuD. The devices use new SIS technology-based on AlN barrier SIS junctions. The devices were measured extensively in the lab at SRON and a thorough comparison with classical AlO_x barrier technology junctions was made. Measurements include not only RF band coverage but also IF coverage, total power stability, suppression of Josephson effect by magnetic field, and receiver linearity. AlN junctions appears to have a much better IF coverage and shows essentially a flat noise temperature between 4 and 12 GHz, due to a reduced overlap capacitance in the design layout. RF band coverage is also improved without sacrificing the receiver performance. The AlN technology seems also to provide much more fiable and reproducible results. The receiver noise temperature obtained around 694 GHz was excellent, about 100 K.