Progress report on the AMSTAR+ activities presented at the Grenoble May 20th, 2009 meeting held at IRAM headquarters.

Participants: Daniel Bruch and Matthias Seelmann (IAF), Frank Schefer (MPIfR), Teun Klappwijk (TuDelft), Beatriz Aja (UniCan), Alessandro Navarrini (INAF/OAC), Ghassan Yassin (OxfordUni), Roland Lefevre and Martina Wiedner (Obs Paris), Netty Honingh (KOSMA), Andrey Baryshev (SRON), Peter Wilkinson (Uni Manchester), Victor Belitsky (Chalmers), Riccardo I. Amils and Juan-Daniel Gallego (OAN), Pierre Cox, Michel Guélin, Bernard Lazareff, Doris Maier, François Mattiocco, Karl Schuster and Patrice Serres (IRAM). Minutes by MG.

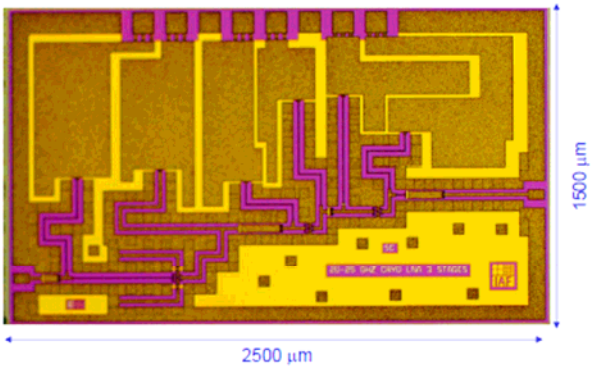
Agenda

8:15-8:45	**Welcome & Organizational questions**; Report on the RadioNet Kickoff&Board Meetings of March 30th&31st. FP6 Final Report. *(P. Cox, M. Guélin).*
8:45-9:45	**Task 1:** W-band array module using metamorphic HEMT technology Presentation of the Task (*F. Schaefer*) Other presentations and discussion
9:45-10:45	**Task 2:** Advanced receiver pixels and LOs for Large FPAs in the near mm domain Presentation of the Task *(D. Maier)* Other presentations and discussion
11:00-12:00	**Task 3:** Sub-mm Focal plane arrays Presentation of the Task (*A. Baryshev?*) Other presentations and discussion
12:00-13:00	**Task 4:** Low-noise mixers for FPAs in the 1-2 THz range Presentation of the Task (*N. Honingh*) Other presentations and discussion
13:50-15:20	**Technical Discussions**
15:20-16:00	*Visit of the IRAM labs*

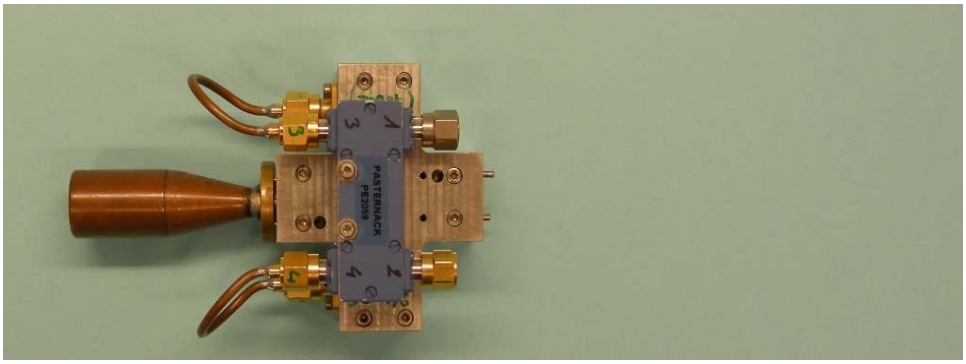
The AMSTAR+ kickoff meeting was held on May 20th, 2009 at the IRAM headquarters near Grenoble, France. It was attended by 20 scientists and engineers from 13 laboratories participating to AMSTAR+ . Peter Wilkinson, Principal Investigator of the RadioNet JRA APRICOT, a JRA which aims like AMSTAR+ at developing focal plane array receivers, although at longer wavelengths, also attended the meeting.

The morning session was devoted to a brief report on the RadioNet kickoff and Board meetings and to the presentation of the 4 main tasks of AMSTAR+ and to reports on the advancement of the work on these tasks since January 2009. A non-exhaustive review of the work of interest for AMSTAR+ currently in progress in the participating laboratories is indicated below.

Task 1: The collaboration IAF/IRAM/MPIfR started with the characterization at cryogenic temperatures of 25 GHz low noise amplifiers (LNA) with GaAs devices fabricated with the IAF metamorphic technology. S parameters of the cooled LNAs were measured up to 50 GHz. The device gate length turned out to be a critical parameter. Oscillations appeared upon cooling 100 nm gate length devices, but fortunately, not with 50 nm devices. It has been decided to switch to 50 nm gate length.

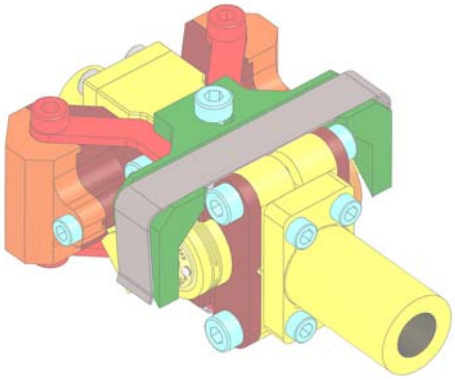


Task 2: The goal is to develop sideband-separating (2SB) SIS mixers with a wide IF bandwidth, that are fully integrated from horn to LNA and have a reduced footprint (25mmx25mm per pixel) and length (30 mm), so that they could be incorporated first in a prototype 3 pixel block, then in a 7x7 element array that would fit in the focal plane of the IRAM 30-m telescope. The mixers of one 3-pixel block would be driven by a photonic LO under development at RAL.



During the first semester of 2009 months, a design was made of a compact pixel with a sideband-separating mixer making use of proven technologies. The sideband-separating mixer consists of waveguide couplers, DSB SIS mixers, and an IF coupler. The DSB SIS mixer has been designed for RF frequencies from 200 to 280 GHz with an IF band of 4-12 GHz. It will also serve for the study of direct coupling with the LNA.

Task 3: A mechanical concept of a compact 2SB mixer block suitable for FPA at 650 GHz has been developed at SRON. Detailed drawings are produced to make a test fit set and verify the produce ability. A new junction design involving high current density with an AlN barrier is being developed at TuDelft and SRON taking into account magnetic field dependent losses in tuning structures.



Task 4: Developments towards low-noise THz mixers fit for FPA applications.
Current status on HEB mixers: up to 5 THz: 1140 K at 5.25 THz, or twice the quantum noise (see AMSTAR). Obs Paris wants to develop a demonstrator with 4 pixels operating at in the 1-2 THz in the frame of AMSTAR+ . Studies were made of planar antennae. 4 HEB devices on membrane operating at 600 GHz were realized. So far only DC measurements were made; they look promising. Single pixel on substrate in mixer gave Rc= 2000 K and bandwidth of 500 MHz. The question of whether the deposition of multi-layers on membranes (i.e. on amorphic material) reduces the IF bandwidth was discussed. The answer may become clearer after AMSTAR+.

TuDelft develops SiS devices based on AlN technology for applications at near THz wavelengths. The latter allows much higher current densities 78 kA/cm^2 than AlOx technology. Works is advancing well and looks very promising. It also yields a wider frequency band. For future FPA applications it will important to increase reproducibility of devices. KOSMA started to work on THz waveguide mixers based on HEB devices in membranes.

The afternoon discussions mainly addressed the following points:

a) Why are IAF 100 nm gate length devices oscillating when cooled down?

b) What is the maximum of pixels that can be foreseen in a single cryostat at the different wavelengths**.** Limiting factor are optics, as thicker window and more thermal losses and power dissipated by the cryogenic amplifier, magnetic field and the local oscillator (case of photonic mixer). Fully integrated mixers with flow-flux LO can now be locked, as demonstrated by the Moscow group.

c) LNA design; Integrated/balanced amplifiers.
Balanced adds complexity: chips must be absolutely identical; twice as many devices. A model should be developed.

d) magnetic field and Josephson current suppression**.** Josephson currents can be disastrous in an array due to cross talk between the different pixels (this was overlooked in the CHAMPs array). Solution may be a permanent magnet as used by UBerkeley (Plambeck) . A Microwave Studio program allows to calculate cross-talks, but the material is not so well defined, so the results may not be reliable.