

Engineering Forum Workshop

Report

Title	2nd Engineering Forum Workshop Multi-Pixel Camera Receivers	
	http://www.radionet-eu.org/fp7wiki/doku.php?id=na:engineering:ew:2ndew	
Date	16 – 17 November 2009	
Location	Bonn, Germany	
Host institute:	Max-Planck-Institut für Radioastronomie	
Participants		
	<i>Number</i>	46
	<i>Countries</i>	<i>AU, DE, DK, FI, FR, IT, NL, PL, PT, SP, UK, USA</i>
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13.	Gallego Puyol Juan Daniel	OAN	Spain
14.	Gough Russell	CSIRO Australia Telescope	Australia
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21.	Kotiranta Mikko	MPIfR & Technical University of Denmark	Germany / Denmark
22.	Lew Bartosz	TCfA	Poland
23.	Mariotti Sergio	INAF IRA	Italy

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47.	Wyrowski Friedrich	MPIfR-Bonn	Germany



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32.	Pisano Giampaolo	The University of Manchester, United Kingdom	

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PHOTO



Participants of the 2nd Engineering Forum Workshop, 16-17 November 2010, Bonn (Germany)

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AGENDA

16 November 2009

<i>08.30 – 09.00</i>	<i>Registration</i>
09.00 – 09.10	Welcome and Introduction <i>Reinhard Keller / Izabela Rottmann</i>
09.10 – 09.40	Centimeter and (Sub)millimeter Wavelength Multi-beam Spectral Line Astronomy <i>Karl M. Menten (MPIfR)</i>
09.50 – 10.10	The K-Band Focal Plane Array Project <i>Steven White (NRAO)</i>
10.20 – 10.40	The K-Band Focal Plane Array (KFPA) <i>Matthew Morgan (NRAO)</i>
<i>10.50 – 11.10</i>	<i>Coffee Break</i>
11.10 – 11.30	A Monitor and Control System for the GBT K-Band Focal Plane Array <i>Galen Watts (NRAO)</i>
11.40 – 12.10	Phased Array Feed Receiver Development for the Australia SKA Pathfinder <i>Russell Gough (CSIRO)</i>
12:20 – 12:40	Cosmic Microwave Background Polarization Receivers: QUIJOTE experiment <i>Eduardo Artal (Uni. De Cantabria)</i>
12:50 – 13:10	Development of Waveguide and Quasi-optical Devices for mm-wave multi-pixel astronomical instruments <i>Giampaolo Pisano (University of Manchester)</i>
<i>13:20 – 14.30</i>	<i>Lunch</i>

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14.30 – 15.00	The Q/U Imaging Experiment (QUIET) receivers: Coherent polarimeter arrays at 40 and 90 GHz <i>Dorothea Samtleben (MPIfR)</i>
15.10 – 15.30	MPIfR sub-millimeter heterodyne arrays <i>Stefan Heyminck (MPIfR)</i>
15.40 – 16.00	AMSTAR+, Large Format FPAs of Heterodyne Receivers at mm/sub-mm Wavelengths <i>Frank Schäfer (MPIfR)</i>
<i>16.10 – 16.30</i>	<i>Coffee Break</i>
16:30 – 17:00	APERTIF: Focal Plane Arrays for the Westerbork Synthesis Radio Telescope enabling wide-field radio astronomy <i>Laurens Bakker (ASTRON)</i>
17:10 – 17:30	FARADAY - A Multifeed Receiver in the 18-26.5 GHz Band <i>Andrea Cremonini (INAF-IRA)</i>
17:40 – 18:00	Faraday and Pharos Cooled Receivers Arrays: Cryogenic solutions for large dewars <i>Sergio Mariotti (INAF-IRA)</i>
18:10 – 18:40	OCRA-F: an 8-beam One Centimeter Receiver Array <i>Michael Peel (UMAN)</i>
18:50 – 19:20	APRICOT, the European effort for a multi pixel camera at Q-Band <i>Reinhard Keller, Peter Wilkinson</i>
19:20 – 19:30	Conclusions <i>Reinhard Keller / Izabela Rottmann</i>
<i>20.00 -</i>	<i>Social Dinner</i>

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17 November 2009

<i>09.00 –</i>	<i>Departure from</i>
09.45 – 12.30	Visit at the Observatory in Effelsberg <i>Guiding Tour</i>
<i>12:35 –</i>	<i>Departure from Effelsberg</i>
<i>13.00 – 14.00</i>	<i>Lunch</i>

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SUMMARY

Karl Menten (MPIfR) gave a comprehensive overview on the ongoing scientific projects with multi pixel receivers. Big Surveys on different single dishes show an impressive outcome, which is documented through high citation rates in scientific papers. He stressed the need on high frequency, high bandwidth multi beam receivers. Especially the K- and W-bands offer many new possibilities for spectral line observations. Examples for existing receiver arrays with really high bandwidth and appropriate backends were given.

Steven White (NRAO) introduced the K-band Focal Plane array project at the GBT (USA). He stressed the need of an integrated project management including not only the receiver frontend but also the backend and software issues. This project comprised a complete system delivering a full image file at the output, which was a main difference to other receiver projects.

Matthew Morgan (NRAO) stepped into details of the receiver and the horn array. The existing infrastructure limits the bandwidth of the system at Green Bank: IF transmission and digital backends restrict the instantaneous bandwidth from 1.8GHz to a maximum of 800MHz in the backend. Many important multi pixel issues were addressed, i.e. a bus based DC control for all electronics including cryo cooled components. A sophisticated investigation on commensurate tuning was performed to avoid LO leakage spurs in the second down conversion.

After a coffee break with many interesting discussions and new contacts Galen Watts (NRAO) started the second session with his talk on the monitor and control system at NRAO. This digital control system is a critical item for a really multi pixel system in a very RFI sensitive environment of a cryo cooled radiometer. With this Ethernet controlled system a multiple of thousands of voltages can be controlled.

Russel Gough (CSIRO) introduces the CSIRO attempts to build a FPA for the ASKAP demonstrator in Western Australia. The so-called "Checkerboard Array" will have a 12x12 array of planar dual polarisation patch antennas with a more than octave bandwidth at L-band. First measurements show promising results on noise behaviour and beam forming.

Eduardo Artal (Uni. de Cantabria) presented the first European cooperation project of the day. The QUIJOTE instrument will have multi channel receivers from 11 to 30GHz providing Stokes Parameters for measurements of the cosmic microwave background properties. The different receiver horns are arranged in the focal plane, there will be a mechanical polarisation rotator in the cryostat to overcome $1/f$ noise and gain instabilities.

Giampaolo Pisano (Uni. of Manchester) gave an overview of passive components for mm wave multi pixel receivers from corrugated horns over polarisation rotators to OMT. A major issue is manufacturability of the components, which was stressed at the example of a 3mm wavelength turnstile OMT. At the example of CLOVER 'mass' production of about 100 horns with OMTs was shown at a reasonable yield.

Dorothea Samtleben (MPIfR) introduced other international joint project for imaging polarimetric parameters of the CMB. The project QUIT comprises fully integrated polarimeter modules. The receiver scheme is a phase switched pseudo correlation system with dual phase switching to minimize the gain instabilities and the phase error due to single-phase switch. Correlating different polarisation of two feeds each the polarization temperature difference can be measured.

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Stefan Heyminck (MPIfR) gave an overview of the activities of the MPIfR mm-wave receiver group. Since more than 15 years multiple pixel arrays have been built for various telescopes, most of them now working in APEX. Frequencies from 345GHz up to the THz regime with bandwidths up to 8 GHz are covered. Due to the excellent performance of the SIS mixers system noise temperatures down to 300K at 600GHz can be reached.

Frank Schäfer (MPIfR) outlined the aims of the RadioNet-FP7 Joint Research Activity - AMSTAR+. This project investigates technologies for mm and sub-mm radiometers with a larger number of pixels. It is extension to FP6 AMSTAR project and connects 12 partners out of 7 countries. A prototype pixel at 3mm wavelength for highly integrated multi pixel receivers has to be built. The technology of metamorphic HEMT amplifiers, provided by the Fraunhofer Institute for Applied Physics, has to be proofed for application at cryogenic temperatures thus providing a second and European source for cryogenically cooled receivers.

Laurens Bakker (ASTRON) presented first results of the APERTIV project at the Westerbork array. A prototype (DIGESTIF) was built and is installed in one of the telescopes. Data of all the 7+8+2 channels are stored for 5.6sec and is then processed off line. Investigations on maximum efficiency or optimal beam pattern were carried out, resulting beams show impressive improvements on the combined beam pattern with respect to single beam patterns.

Andrea Cremonini (INAF-IRA) presented a 7-beam K-band receiver to be installed in the Sardinia telescope. As the horns are cooled a big thermal load on the first stage of the cryocooler had to be suppressed by multilayer infrared filters and the foam window. In addition a special phosphoric bronze wires helped to reduce the thermal load.

Sergio Mariotti (INAF-IRA) stressed the challenges to get big cryostats for multi pixel receivers cooled. Dewars for FARADAY and PHAROS have large windows for the cryo cooled horns. A dome shaped window as well as a flat foam supported window has been realized. Infrastructure boundary conditions in the SRT require the use of a single CTI 350 refrigerator machine, making the cooling a challenge. Sophisticated IR windows have been investigated as well as low thermal conductivity DC cables.

Mike Peel (Uni. of Manchester) presented experiences made with the OCRA receivers in the Torun 32m telescope. While the OCRA-p is a two horn receiver with discrete HEMT components in the LNA, the OCRA-f has MMICs in the first LNA. The system temperature slightly decreases with these components but is more than compensated due to the larger bandwidth. Test with a Styrofoam 11cm thick window showed an increase of 25° for the system temperature. A flat plastic window showed sufficient performance, however it shows some deformation due to the atmospheric pressure.

Peter Wilkinson (Uni. of Manchester) and Reinhard Keller (MPIfR) introduced science background, project structure and technical issues as well as very first results of the APRICOT project under the RadioNet-FP7 umbrella. The goal of this project is a study how to build a multi pixel camera at Q-band with moderate effort and best performance.

The workshop was a full success, invoking many discussions and contacts between people of different institutes. Dedicated inputs to other RadioNet-FP7 JRAs were collected, i.e. the APRICOT project, where many of the reported issues found input.

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FINANCIAL REPORT

2nd Engineering Forum Workshop organised in Bonn (Germany) on 16-17 November 2009 was supported by the European Community Framework Programme 7, Advanced Radio Astronomy in Europe, grant agreement no.: 227290.

The Max-Planck-Institut für Radioastronomie hosted the meeting. The local organisation costs were mostly covered from the RadioNet-FP7 WP3: Engineering Forum at the level of ~2.500€. Additionally travel expenses of several participants were supported from the project in the total range of ~4.700€.