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Max-Planck-Institut
für Radioastronomie

Effelsberg, den 10.07.2013

An:
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Summary of external funds in the Electronics Departments at 01/07/2013

1. RadioNet3:

Coordinator Anton Zensus, Project Manager Izabela Rottmann, Project Scientist Franco Mantovani; MPIfR

RadioNet is an Integrated Infrastructure Initiative (I3) that coordinates all of Europe's leading radio astronomy facilities in an integrated cooperation to achieve transformational improvement in the quality and quantity of the scientific research of European astronomers. RadioNet3 includes 25 partners operating world-class radio telescopes and/or performing cutting-edge R&D in a wide range of technology fields important for radio astronomy.

RadioNet3 proposes a work plan that is structured into 7 NAs, 9 TNAs and 4 JRAs with the aim to integrate and optimise the use and development of European radio astronomy infrastructures. The general goals of RadioNet3 are to:

- facilitate, for a growing community of European researchers, access to the complete range of Europe's
- world-leading radio-astronomical facilities, including the ALMA telescope;
- secure a long-term perspective on scientific and technical developments in radio astronomy, pooling resources
- and expertise that exist among the partners;
- stimulate new R&D activities for the existing radio infrastructures in synergy with ALMA and the SKA;
- contribute to the implementation of the vision of the ASTRONET Strategic Plan for European Astronomy by
- building a sustainable and world leading radio astronomical research community.

RadioNet3 builds on the success of two preceeding I3s under FP6 and FP7, but it also takes a leap forward as it includes facilitation of research with ALMA via a dedicated NA, and 4 pathfinders for the SKA in its TNA Program. It has a transparent and efficient management structure designed to optimally support the implementation of the project.

RadioNet is now recognized by funding agencies and international project consortia as the European entity representing radio astronomy and facilitating the access to and exploitation of excellent facilities in this field. This is of paramount importance, as a dedicated, formal European radio astronomy organisation to coordinate and serve the needs of this community does not yet exist.

1.1. ERATec:

Chair: Reinhard Keller; MPIfR

The main activity of the RadioNet3 European Radio Astronomy Technical Forum will be to organise and support meetings and workshops of European radio astronomical staff, directly involved in the technical development of the observing facilities and their application. These meetings will help to identify synergies and develop complementary capabilities at the observatories, to determine how the pooling of resources might lead to common solutions for common problems and to share best practice. In short, this activity aims at preventing each observatory from 'reinventing the wheel' for all the problems encountered in the rapidly evolving context of modern radio astronomy, which now includes LOFAR, ALMA and the precursors and pathfinders of the SKA. Furthermore, the training of young people will also

form a crucial part of the work programme as well as the dissemination of expertise in special sessions at large international conferences.

1.1.1. TWS: Technical Work Shops:

Responsible: Karl-Heinz Mack; INAF (Budget 4.323EUR/WS, 6 WS)

Topic related technical workshops to bring engineers and instrument oriented scientists together.

1.1.2. TOG: Technical Operation Group:

Responsible: Michael Lindqvist; OSO/Chalmers (Budget 4.323EUR/WS, 7 WS)

The TOG is the origin of this activity. Here VLBI operational staff meets to discuss topics related to VLBI technology such as new backends, known problems and others.

1.1.3. ESS: Engineering Shared Sessions:

Responsible: Reinhard Keller; MPIfR (Budget 4.323EUR/WS, 4 WS)

In this activity radio astronomy related sessions in bigger conferences are sponsored or even organized. As the budget is limited own radio astronomy dedicated sessions are difficult to organize and up to now co-sponsoring was done.

1.2. Uniboard2:

UniBoard2 will create an FPGA-based, generic, scalable, high-performance computing platform for radio-astronomical applications. This WP consolidates and builds upon the experience obtained through the UniBoard project to create a completely re-designed platform with several innovative features, that will be ready for the next generation of astronomical instruments (notably the SKA), at the end of 2015.

1.2.1. Beamformer

Responsible: Günther Knittel, MPIfR (Budget 11.5 man months)

MPG will develop a system that will utilize the UniBoard2 hardware as a beam forming system. The aim is to derive a generic, modular design that is capable of providing a beam forming solution for a variety of front ends and telescope applications. In particular, the aim is to derive a prototype to be deployed at the 100-m telescope in Effelsberg to serve as test bed.

1.3. DIVA: Developments In VLBI Astronomy:

In DIVA key technology building blocks will be developed to consolidate the role of European VLBI and European radio astronomy in general as a leading competitor with respect to developments in the USA and Asia. It is a conglomerate of several former RadioNet activities on hardware development.

1.3.1. Task 1: Low-noise wide-band integrated amplifiers for VLBI reflectors

Chair: Jan Gerald by de Vaate; ASTRON, Responsible at MPIfR: Frank Schäfer (Budget 7 man months)

In this task key components for future receiver front ends will be developed (LNA, feed). This work is strongly correlated with our works for SKA. It was agreed that the design goals for DIVA were extended to meet the specs of SKA. MPIfRs part is MMIC design and packaging of a MMIC LNA.

1.4. AETHER: Advanced European Terahertz HEterodyne Receivers

Chair: Michel Guelin; IRAM, Responsible at MPIfR: Frank Schäfer (Budget 5.6 man months)

The current ALMA project does not take full advantage of its vast size and excellent site location, due to time and budget constraints. The most critical technologies, those which concern front-end receivers, were frozen at a relatively early stage in the project development. Thus, there exists considerable opportunity for future enhancement of the array capability in terms of performance and, correspondingly, in science output. The primary objective will be to develop a new generation of instrumentation to significantly extend the performance and scope of ALMA and of large existing European mm/sub-mm facilities in terms of operational frequency and sensitivity

1.4.1. 67-116 GHz extremely wide RF-band heterodyne module

Develop a single detector possessing a much larger IF bandwidth than the current ALMA Band 3 cartridge. MPIfRs role is to develop and characterize MMIC components for this band in cooperation with FhG/IAF. This task will continue the exploration of Fraunhofer IAF's metamorphic HEMT process on GaAs. Technology demonstrator will be an extremely large bandwidth heterodyne receiver module (67-116 GHz) competitive to the current InP-based HEMT technology.

Subtask 1.1: Cryogenic characterization of single HEMT devices and design of cryogenic MMIC's [MPG, Fraunhofer, FG, IRAM].
Measurement capabilities used for device characterization in AMSTAR+ will be extended to update the cryogenic MMIC model to the 67-116 GHz band. In parallel cryogenic characterization of the entire MMIC LNA will be carried out in prompt response to the production runs at all participating laboratories. This allows an evaluation of the entire design process (HEMT model plus circuit design) based on a large statistics of cryogenic data. MMIC design candidates for W-band include the current IAF cascode - and a single ended LNA design. Design of the 4-12GHz IF amplifier will build on a successful current design.

Subtask 1.2: Manufacturing runs of MMIC's in IAF's clean room [Fraunhofer].
There will be a minimum of 2 runs in 2011 and 2012 using space on IAF wafers dedicated for cryogenic device fabrication (min. 40% of reticle area per run). There will be shared wafer space available on IAF's current process for room temperature devices (min. of 2 runs min. 9% of reticle area per run). The latter wafer space is intended for realization of structures for noise testing of the devices.

2. Cryo mHEMT:

Responsible at MPIfR: Frank Schäfer (Budget 450kEUR).

Cryo mHEMT is a FhG / MPG bilateral cooperation program to benefit of the advantages of both the basic research of MPG with the industrial orientation of FhG. In this study an existing metamorphic HEMT semiconductor process at FhG/IAF will be further developed for cryogenic applications. The goal of this work is to provide a competitive European source for high performance, ultra-low noise cryogenic components for radio astronomy to minimize the dependency from overseas suppliers.

MPIfRs role in this work is measurement of single components, modules and production wafers pieces at cryogenic temperatures typically at 15K or above. For this purpose a cryogenic wafer mapping facility was built to measure and select MMICs on quarter pieces of 4" wafers for further packaging and use in astronomical systems. This work was clearly dedicated to the needs of SKA where thousands of cryogenic LNAs will be needed. For such quantities it is almost impossible to measure every single packaged device in cryogenic environment.

3. Biosterling:

Responsible for MPIfR: Reinhard Keller (Budget: 140kEUR)

The BIOSTIRLING-4SKA project aims to develop and validate a new concentrator for a 10 kW Stirling dish, reducing operation and maintenance costs. The average efficiency in the conversion of solar irradiance into electric power will overcome the 22%; the production costs are estimated to be under ONE(1) EUR per watt and per unit, with a total operation cost of the complete system (including motor) under TWO (2) EUR per watt and per unit.

To achieve this, the BIOSTIRLING-4SKA project will do intensive research for the development of a new, more efficient and economically viable Stirling Dish System. To test its proper performance, a pilot plant will be developed at an industrial scale (about 150kW), and will be installed in Moura (Portugal) as green energy supplier of a scientific installations. The operation will be monitored and controlled to allow subsequently improvements.

MPIfR is involved in most of the subtasks for RFI measurements and mitigation consulting. All electronic equipment involved will be checked on unwanted emissions according to ITU-R RA769. Measurements will mostly take place at the institutes promises in Bonn and partly at the partners and in the field in Moura, Portugal.

4. SKA Preparatory Phase:

Responsible for MPIfR: Reinhard Keller (no external budget allocated!)

In response to the Request for Proposals from the SKA office MPIfR applied as a partner in 5 different consortia, three of them will involve the Electronics Department:

1.5. SKA Dish Consortium:

MPIfR together with FhG/IAF, INAF, UniRoma and UNIMIB (Univ. Milano) will deliver the design and a prototype of the LNA for Band 3 (1.65-3.5 GHz) of the baseline design. The manpower involvement promised for this is 3FTE which will be provided by the MW-Group.

1.6. WBSPF; wide Band Single Pixel Feed:

MPIfR together with FhG/IAFwill deliver design and prototype of wide band LNAs for 1.7-12 GHz following the baseline design. Different designs will be developed for different feed types. This task benefits from the work done in DIVA. The manpower involvement promised for this task is 3FTE which will be provided by the MW-Group.

1.7. SKA Infrastructure:

MPIfR is involved in RFI measurements and mitigation consulting on power electronics for ‘green energy’. All electronic equipment involved will be checked on unwanted emissions according to ITU-R RA769. Measurements will mostly take place at the institutes promises in Bonn and partly in the field in South Africa.

5. ASKAP II Power Study:

Responsible at MPIfR: Reinhard Keller (Budget 20kEUR).

For the second stage of the Australian SKA Pathfinder the target of a 100 % renewable power supply of ASKAP is defined. Within this study Fraunhofer ISE works out an appropriate system design, which uses as a basis the power supply system of stage 1. Furthermore a concept for the technical implementation will be developed. Amongst others this concept includes also the necessary measures to avoid RFI problems. Therefore specialists from the MPIfR will be involved in this study via a subcontract.

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Financial table of all project benefits:

Nr.	*Project Name*	*Manpower*	*Travel*	*Material*	*Total*
1.1	ERATec	-	17.000,00 €		17.000,00 €
1.2	Uniboard2	11,5			129.000,00 €
1.3	DIVA	7,0	2.000,00 €	50.000,00 €	107.000,00 €
1.4	AETHER	5,6	2.000,00 €	5.000,00 €	71.000,00 €
2	Cryo mHEMT				450.000,00 €
3	Biosterling	12,0	7.000,00 €	10.000,00 €	140.000,00 €
4	SKA	-	- €	- €	- €
5	ASKAP II Power				20.000,00 €
Totals		**36,1**	**28.000,00 €**	**65.000,00 €**	**934.000,00 €**