

Engineering Forum Workshop

Report

Title	1st Engineering Forum Workshop Low Noise Figure Measurements at Cryogenic and Room Temperature	
	http://www.radionet-eu.org/fp7wiki/doku.php?id=na:engineering:ew:1stew	
Date	23.-24. June 2009	
Location	Gothenburg, Sweden	
Host institute:	Chalmers University of Technology Onsala Space Observatory (OSO)	
Participants		
	<i>Number</i>	54
	<i>Countries</i>	DE, FI, FR, IT, NL, SE, SP, UK, USA, ZA
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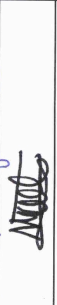




















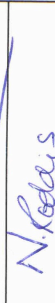






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PHOTO



Participants of the 1st Engineering Forum Workshop, 23-24. June 2009.

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AGENDA

23 June 2009

- 08.00 - 08.20 *Registration*
- 08.20 – 08.30 **Welcome and Introduction**
Reinhard Keller
- 08.30 - 09.30 **Fundamentals of Noisy Networks**
Sander Weinreb
- 09.50 - 10.10 **Cryogenic low-noise amplifiers: From InGaAs channel to hybrid module**
Per-Åke Nilsson
- 10.15 - 10.35 **Characterization of FhG-IAF low-noise mHEMTs at cryogenic temperatures : DC, S-Parameters and Noise**
Frank Schäfer
- 10.40 - 10.55 *Coffee Break*
- 10.55 - 11.25 **Noise Parameters of FET's: Measurement, Modeling and Use in Amplifier Design**
Marian Pospieszalski
- 11.35 - 11.55 **Estimation of Uncertainty in Noise Measurements Using Monte Carlo Analysis**
Juan Daniel Gallego
- 12.00 - 12.20 **Practical aspects on noise figure measurements**
Sergio Mariotti
- 12.25 - 12.45 ***Cryogenic LNA Characterization: GARD Experience***
Erik Sundin
- 12:50 – 13:10 **LNA Performance Optimisation Using Post-production Noise Characterisation**
Andrea Cremonini
- 13:15 - 14.00 *Lunch*
- 14:00 – 15:00 *Labs Visit*
- 15.00 – 18.00 *Trip To Onsala Space Observatory*
- 19.30 - *Social Dinner*

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24 June 2009

- 08.00 – 08.10 *Administrative Issues*
Izabela Rottmann
- 08.10 – 08.40 **The IAF mHEMT Low-Noise Technology and its Extension to Cryogenic Applications**
Matthias Seelmann-Eggebert
- 08:50 – 09.10 **Millimeter HEMT amplifier measurements at cryogenic temperatures**
Francois Mattiocco
- 09.15 - 09.35 **Measurement Setup for ALMA Band 5 Prototype Cartridge**
Magnus Strandberg
- 09.40 - 09.55 **A Measurement Test Set for ALMA Band 9 Amplifiers**
Isaac Lopez-Fernandez
- 10.00 - 10.15 *Coffee Break*
- 10.15 - 10.45 **Cryogenic Measurements of CMB Polarimeters**
Pekka Kangaslathi
- 10.55 - 11.15 **Progress on FPA LNA developments and LNA characterization**
Laurens Bakker
- 11.20 - 11.40 **Noise measurements for the SKA**
Neil Roddis
- 11.45 - 12.05 **Active antenna design and characterization for the mid-SKA**
Jan Geralt Bij de Vaate
- 12.10 – 13.00 **FORUM: FETs for Low Noise Amplification: Reasons of success, limits and potential for improvements in cryo-LNAs"**
Moderator: Matthias Seelmann-Eggebert
- 13.00 - 13.15 *Concluding remarks*
- 13.15 – 14.00 *Lunch*

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SUMMARY

For the first time in the RadioNet Engineering Forum we have established a videoconference talk, which was given from USA. It was great to have Sander Weinreb (CalTech), one the noise characterisation gurus, giving a very fundamental talk on this topic. He first gave this topic in the 60s and refers back to these old but still valid techniques to transfer it from the classical analogue domain to the microwave regime of nowadays. Some impressive examples illustrate the validity of these characterisation theories, especially with SiGe transistors.

Jan Grahn (Chalmers/GARD) showed how to optimize transistors behaviour with the help sophisticated measurement. Measurements were shown in a final LNA module compared to other available InP references, as Cryo 3 from NGC.

Frank Schäfer (MPIfR) presented the attempts of MPIfR to establish a F50 cryo measurement station. Concepts of appropriate hot/cold noise diode loads have been presented and measurement results demonstrated the usability of these electrically heatable devices in the dewar.

In the second session Marian Pospieszalski (NRAO) gave another fundamental talk on low noise components characterization. He resumed HEMT Modelling over the last decades and showed its validity until today. Many examples of LNA were shown while pointing out the hints of the sophistic measurements setup at the CDL of NRAO.

Sergio Mariotti (INAF-IRA) showed a LNA as a standard for the exchange under different labs, an attempt that is contra dictionary to standard measurement thinking. The system is designed to be easy to handle and to minimize measurement uncertainties.

Eric Sundin (GARDO/OSO) proposes a SIS tunnel junction for a precision shot noise source. The in house facilities at Chalmers provide this opportunity of producing a DC controlled hot / cold load at cryogenic temperatures. Due to its physical properties it has the potential to a powerful broadband measurement utility.

Andrea Cremonini (INAF-IRA) presented a theoretical regard on uncertainties of noise measurements and set up some formulas for low noise amplifier characterisation.

Matthias Seelmann-Eggebert (FhG-IAF) presents the very high sophisticated high frequency InGaAs processes at 100nm down to 35nm. Examples for MMICs as well as highly integrated sensor modules were presented. Going fairly intensive into the model description, he described the basic principals of mHEMT physics and the influence of ambient temperature on gain and noise performance. Measurements verify a modified model with temperature dependencies for cryogenic temperatures.

Francois Mattiocco from (IRAM) showed measurements concerning the IRAM developments on 3mm receiver developments with the LNA at 4K. A sophistic measurement procedure was presented for saturation measurements.

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Magnus Strandberg (GARD/OSO) described a measurement setup for the ALMA band 5 cartridges for noise measurements as well as for antenna beam measurement. To do this at sea level a closed measurement chamber filled with dry nitrogen was built to get rid of the 185GHz line in the middle of the band.

Isaac Lopez-Fernandez (OAN) described the Yebes test setup for the ALMA band 9 IF amplifiers from 4 to 12GHz. In a test cryostat 3 amplifiers can be automatically measured for noise figure and scattering parameters in parallel. By careful calibrations of all components in the system a total noise error of less than 1.5K is expected.

Pekka Kangaslathi (JPL) introduced the technology of Quiet, a CMB polarisation measurement instrument at 90GHz and 40GHz. For such high volume production of modules besides a compact design a sophisticated assembly station was developed. He addresses the difficulties of measurement of these highly integrated modules. To measure polarisation capabilities a rotatable polarised cold load was built up for the whole array.

Laurens Bakker (ASTRON) showed the developments of the focal plane array APPERTIVE made at ASTRON. A prototype of this uncooled system for the Westerbork array was demonstrated including measurements of single LNA and the whole system. Their main goal now is to understand measurements and get real repeatable with measurements.

Neil Roddis (SPDO) presents some thoughts about figures of merits and their influence on performance and cost on SKA antenna designs. On this background he shows some developments going on in the world on low cost high volume LNA and antennas.

Jan Gerald Bij de Vaate (ASTRON) presented the development of a big team of people working in Dwingeloo and Madrid on the development on planar array antennas for SKA. A hot/cold noise measurement facility was built up with a hot load under a tent roof and the sky as a cold load; the latter temperature was determined through atmosphere models.

A forum on "FETs for Low Noise Amplification: reasons of success, limits and potential for improvements in cryo-LNAs" was scheduled at the end of the workshop. For the first time in the suite of the engineering workshop an open forum discussion was introduced. Matthias Seelmann-Eggebert from the Fraunhofer Institute for Applied Solid State Physics volunteered to moderate this forum and he was clearly the right person for this with his profound knowledge of noise measurement and characterisation as well as component technology. After recapitulation of the model used for noise characterisation a discussion on how to improve noise through technology modifications rose up. Some explanations for the gain in noise by cooling were addressed and possibilities how to use this for better cryo components were addressed. Over all this was an interesting way to discuss and communicate this topic amongst the attendants and should be continued. This workshop was a great opportunity to gather all kind of information about low noise measurements. It was a unique chance to meet people with all kind of experience and it was a perfect place to talk to people from the same regime, especially our colleagues from overseas. Presenting fundamentals together with recent research results turned out to be very attractive especially to younger engineers. The forum discussion was also very well accepted and will be continued on future RadioNet-FP7 Engineering Forum workshops.

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FINANCIAL REPORT

1st Engineering Forum Workshop organised in Gothenburg (Sweden) on 23-24 June 2009 was supported by the European Community Framework Programme 7, Advanced Radio Astronomy in Europe, grant agreement no.: 227290.

The Chalmers University Technology & Onsala Space Observatory hosted the meeting. The local organisation costs were mostly covered from the RadioNet-FP7 WP3: Engineering Forum at the level of ~4100€. Additionally travel expenses of several participants were supported from the project in the total range of ~4700€.