

## Engineering Forum Workshop





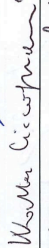


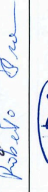






### Report

<b>Title</b>	<b>5th Engineering Forum Workshop</b> <i>Receiver Gain Stability</i>	
	<a href="http://www.radionet-eu.org/fp7wiki/doku.php?id=na:engineering:ew:5thew">http://www.radionet-eu.org/fp7wiki/doku.php?id=na:engineering:ew:5thew</a>	
<b>Date</b>	12 – 13 May 2011	
<b>Location</b>	Cagliari, Italy	
<b>Host institute:</b>	Osservatorio Astronomico de Cagliari - INAF	
<b>Participants</b>		
	<i>Number</i>	31
	<i>Countries</i>	<i>DE, ES, FI, FR, IT, PL, UK, USA, ZA</i>
<b>Attachments:</b>	<i>Participants List</i>	2
	<i>Photo</i>	3
	<i>Agenda</i>	6
	<i>Summary</i>	8
	<i>Financial Report</i>	9

## PARTICIPANTS LIST

	Last Name	First Name	Affiliation	COUNTRY
1.	<b>Artal</b>	Eduardo	Universidad de Cantabria	Spain
2.	<b>Bianchi</b>	Germano	INAF- IRA	Italy
3.	<b>Bolli</b>	Pietro	INAF – OAC	Italy
4.	<b>Bruch</b>	Daniel	IAF	Germany
5.	<b>Ciccognani</b>	Walter	University of Rome Tor Vergata,	Italy
6.	<b>Colangeli</b>	Sergio	University of Rome Tor Vergata	Italy
7.	<b>Cremonini</b>	Andrea	INAF IRA	Italy
8.	<b>Frau</b>	Roberto	Università degli studi di Cagliari	Italy
9.	<b>Gallego Puyol</b>	Juan Daniel	OAN	Spain
10.	<b>Gaudiomonte</b>	Francesco	INAF OAC	Italy
11.	<b>Keller</b>	Reinhard	MPIfR-Bonn	Germany
12.	<b>Kirves</b>	Petri	Metsähovi	Finnland
13.	<b>Lew</b>	Bartosz	Nicolaus Copernicus University	Poland
14.	<b>Limiti</b>	Ernesto	University of Rome Tor Vergata	Italy
15.	<b>Locci</b>	Daniele	Universita di Cagliari	Italy
16.	<b>Mariotti</b>	Sergio	INAF-IRA	Italy
17.	<b>Monni</b>	Marco	INAF – Osservatorio di Cagliari	Italy
18.	<b>Navarrini</b>	Alessandro	INAF-Cagliari Astronomy Observatory	Italy
19.	<b>Orfei</b>	Alessandro	INAF IRA	Italy
20.	<b>Palombini</b>	Diego	University of Rome Tor Vergata	Italy
21.	<b>Pinna</b>	Andrea	Università di Cagliari	Italy
22.	<b>Pisanu</b>	Tonino	INAF – OAC	Italy
23.	<b>Possenti</b>	Andrea	INAF – Osservatorio di Cagliari	Italy
24.	<b>Patrice</b>	Serres	IRAM	France
25.	<b>Serra</b>	Giampaolo	SRT	Italy
26.	<b>Türk</b>	Senner	MPIfR-Bonn	Germany
27.	<b>Valente</b>	Giuseppe	INAF-OAC	Italy
28.	<b>Venkatasubramani</b>	T. L.	SKA-KAT	South Africa
29.	<b>Watts</b>	Galen	NRAO	USA
30.	<b>Wollack</b>	Edward	NAS - Goddard Space Flight Center	USA
31.	<b>Wilkinson</b>	Peter	University of Manchester	UK

Engineering Workshop Report  
12 - 13 May 2011, Cagliari (Italy)

Name	Institute	Signature
1. <b>Artal Eduardo</b>	Universidad de Cantabria, Spain	
2. <del><b>Bergame Miguel</b></del>	<del>Instituto Telecomunicações, Portugal</del>	<del>Cancelled</del>
3. <b>Bianchi Germano</b>	INAF- IRA, Italy	
4. <b>Bolli Pietro</b>	INAF - OAC, Italy	
5. <b>Bruch Daniel</b>	IAF, Germany	
6. <b>Ciccognani Walter</b>	University of Rome Tor Vergata, Italy	
7. <b>Colangeli Sergio</b>	University of Rome Tor Vergata, Italy	
8. <b>Cremonini Andrea</b>	INAF IRA, Italy	
9. <b>Frau Roberto</b>	Università degli studi di Cagliari, Italy	
10. <b>Gallego Puyol Juan Daniel</b>	OAN, Spain	
11. <b>Gaudiomonte Francesco</b>	INAF OAC, Italy	
12. <b>Keller Reinhard</b>	MPfR-Bonn, Germany	
13. <b>Kirves Petri</b>	Metsähovi, Finland	
14. <b>Lew Bartosz</b>	Nicolaus Copernicus University, Poland	
15. <b>Limiti Ernesto</b>	University of Rome Tor Vergata, Italy	



5<sup>th</sup> Engineering Forum Workshop  
Receiver Gain Stability



16.	<b>Locci Daniele</b>	Università di Cagliari, Italy	<i>Daniele Locci</i>
17.	<b>Mariotti Sergio</b>	INAF-IRA, Italy	<i>Sergio Mariotti</i>
18.	<b>Monni Marco</b>	Institute Astronomical Observatory of Cagliari, Italy	<i>Marco Monni</i>
19.	<b>Navarrini Alessandro</b>	INAF-Cagliari-Astronomy Observatory, Italy IRAM	<i>Alessandro Navarrini</i>
20.	<b>Orfei Alessandro</b>	INAF IRA, Italy	<i>Alessandro Orfei</i>
21.	<b>Palombini Diego</b>	University of Rome Tor Vergata, Italy	<i>Diego Palombini</i>
22.	<b>Pinna Andrea</b>	Università di Cagliari, Italy	<i>Andrea Pinna</i>
23.	<b>Pisanu Tonino</b>	INAF - OAC, Italy	<i>i.v. Pisanu</i>
24.	<b>Possenti Andrea</b>	INAF - Osservatorio di Cagliari, Italy	<i>Andrea Possenti</i>
25.	<b>Patrice Serres</b>	IRAM, France	video <i>i.v. Serres</i>
26.	<b>Serra Giampaolo</b>	SRT, Italy	video
27.	<b>Türk Senner</b>	MPIR-Bonn, Germany	<i>Senner Türk</i>
28.	<b>Valente Giuseppe</b>	INAF-OAC, Italy	<i>Giuseppe Valente</i>
29.	<b>T. L. Venkatasubramani</b>	SKA-KAT, South Africa	video
30.	<b>Watts Galen</b>	NRAO, USA	video <i>i.v. Watts</i>
31.	<b>Wollack Edward</b>	NAS - Goddard Space Flight Center, USA	<i>Edward Wollack</i>
32.	<b>Wilkinson Peter</b>	University of Manchester, United Kingdom	<i>Peter Wilkinson</i>

12 - 13 May 2011, Osservatorio Astronomico di Cagliari, Italy

## PHOTO



Participants of the 5<sup>th</sup> Engineering Forum Workshop, 12 – 13 May 2011, Cagliari (Italy)

## AGENDA

### 12<sup>th</sup> May 2011

13.00 – 14:00	<i>Lunch at the Hotel Regina Margherita</i>
14.30 –	<i>Departure of the bus to SRT from the hotel Regina</i>
15.30 – 17.30	<i>Visit at the radio telescope site (SRT)</i>
18.30	<i>Arrival to the hotel</i>
20.00	<i>Dinner</i>

**13<sup>th</sup> May 2011**

<b>09.00 – 09.30</b>	<b>Registration</b>
09.30 – 09.40	<b>Welcome and Introduction</b> <i>R. Keller (MPIfR, DE),</i>
09.40– 10.20	<b>Mechanisms of 1/f noise and Gain Instabilities in metamorphic HEMTS</b> <i>D. Bruch (IAF, DE)</i>
10.30 – 11.00	<b>Gain Fluctuations of Cryogenic Amplifiers</b> <i>J.D. Gallego Puyol (OAN, ES)</i>
<b>11.10 – 11.40</b>	<b>Coffee Break</b>
11.40 – 12:10	<b>Receiver chain: Typical Gain drift and instabilities and their causes</b> <i>S. Mariotti (INAF-IRA, IT)</i>
12.15 – 12.55	<b>Precision Continuum Receivers for Astrophysical Applications</b> <i>E. Wallack (NASA, USA)</i>
<b>13.05 – 14.30</b>	<b>Lunch</b>
14.30 – 15.10	<b>Stability of the IRAM receiver</b> <i>P. Serres (IRAM, FR)</i>
15. 20 – 15.50	<b>Added Phase Noise measurement for Local Oscillator distribution systems</b> <i>G. Bianchi (INAF-IRA, IT)</i>
<b>16.00 – 16.30</b>	<b>Coffee Break</b>
16.30– 17.00	<b>Using High performance LNAs with cost-effective HEMTs in Radio-Astronomy Receivers</b> <i>M. Bergano (Instituto de Telecomunicações, PT)</i>
17.10 – 17.40	<b>Low frequency noise measurements in direct detection radiometers</b> <i>E. Artal (Universidad de Cantabria, ES)</i>
17.50 –18.00	<b>Conclusions</b> <i>R. Keller (MPIfR, DE)</i>

## SUMMARY

Daniel Bruch introduced in the contemporary theories of  $1/f$  noise. There are two of them at the moment, one due to recombination process the other based on solid-state physics. Both describe the effect but none of them really gives an answer on how to overcome this effect. At the end the theories are represented in the well-known transistor model, which is used as design basis for process optimization and circuit description.

Juan Daniel Galliego introduced first into two basic measures for gain fluctuations: Allan variance and power spectrum density. He also pointed out some of the various sources of gain fluctuation, none of the being responsible alone. Impressive measurements of gain fluctuations besides noise measured over frequency were presented.

Sergio Mariotti presented several causes of gain fluctuation in the receiver chain. Beginning with mechanical instabilities due to refrigerator vibrations in the feed ending in the detector all the function blocks in a radiometer were addressed. He also showed the measurement methods used for gain instability measurements.

Edward Wallack stressed a variety of details contributing to  $1/f$  noise of receiver and first of all LNA stability. At the WMAP example he pointed out several reasons for gain instabilities. He also stresses that the dedication of the system decides about specifications, i.e. gain stability for continuum systems, which is no problem for spectral systems. Another interesting point was the influence of passivity of chips and their influence on performance and repeatability.

Patrice Serres introduced the IRAM receivers at Plateau de Bure, Pico Veleta and ALMA. Besides Gain Stability the need for phase stability was pointed out. IRAM receivers are also optimized on that parameter.

Germano Bianchi stressed the problems of distributing a phase and gain stable local oscillator signal to distributed receiver units of receiver arrays. Especially the phase noise problem was discussed in detail including AM to PM conversion.

Eduardo Artal demonstrated  $1/f$  requirements of the ESA Planck low frequency instrument and measurements at the Universidad de Cantabria. The  $1/f$  needs of this instrument were given by the spin frequency of 1rpm and thus very challenging.

At the end of the workshop a summarizing discussion took place where the participants tried to summarize the results in three bullet points:

- Gain Fluctuations are due to fabrication technology of active devices. Passivation is an issue.
- Avoid Gain Fluctuations by avoiding all errors you can control and you know.
- Phase noise has to be understood, don't forget it.

It was clear that this workshop did not resolve our gain instability problems but addresses the many questions to be answered. And there is a need for a successor of this workshop.



## FINANCIAL REPORT

5<sup>th</sup> Engineering Forum Workshop organised in Cagliari (Italy) on 12 – 13 May 2011 was supported by the European Community Framework Programme 7, Advanced Radio Astronomy in Europe, grant agreement no.: 227290.

The organisation costs covered from the RadioNet-FP7 WP3: Engineering Forum were at the level of ~3200€. Additionally travel expenses of several participants were supported from the project in the total range of ~4600€.