REVIEW ON THE ITALIAN RADIO TELESCOPE RECEIVERS

SUMMARY

M. Burgay - INAF OACagliari

Rome, March 21st, 2017

WORKSHOP MATERIAL & INFO

- http://rx2017.inaf.it/RX2017/ review document and talk slides
- https://www.youtube.com/watch?v=wpcV8YdV6HQ video of the workshop
- rx2017@oa-cagliari.inaf.it working group e-mail address

AIMS

From the Terms of Reference: "Section II (Radio Astronomy) of the Scientific Directorate is starting a process aimed at harmonizing and coordinating efforts and resources in radio astronomy. […] This process includes a **review of the existing and future radio astronomical front-end receivers for the INAF radio telescope facilities**: 64-m SRT; 32-m Noto; 32-m Medicina; and Northern Cross.

A specific **Working Group** (WG) to pursue this topic has been nominated by the Head of Section II of the Scientific Directorate.

	OAA	OAC	IRA-BO	IRA-MED	IRA-NOTO	Section II
Technologist	P. Bolli	T. Pisanu	A. Orfei			
Astronomer	M. Beltran	M. Burgay	A. Zanichelli C. Stanghellini[1]			
Technician		P. Marongiu		G. Zacchiroli	C. Contavalle	
Manager						S. Tingay

The activities of the review include the production of:

1. a comprehensive **list of all receiver developments currently underway within INAF,** including their status, the people working on the developments, the science goals that they are addressing, and the estimated cost to complete;
2. a **priority list of work to undertake on existing receiver systems** that require maintenance/repair, identifying the people to do the work, and initial estimates of cost and time. This list should be driven by science priorities and practical considerations such as the RFI environment at the different telescopes or other factors at play at the different sites;
3. a **roadmap for future receiver developments at INAF.** This should be a **science-driven** set of developments, but should also be relatively **challenging and ambitious on the engineering front,** coupled (where possible) with developments in other directions, such as the SKA."

IMPLEMENTATION

From the Executive Summary:

1. first WG initiative was to **survey the status of receivers in Italy**
2. survey the **status** and future plans of receivers at several **International radio astronomical observatories**
3. we examined also **three projects of future receivers where INAF was involved but which were not developed for the Italian radio telescopes**. These projects were PHAROS, BRAND and ALMA band 2+3,
4. evaluation of the productivity in terms of **scientific publications** in the last five years
5. the issue of a **call for ideas for future receivers**, which has been open for one month around November 2016
6. draw the **final recommendations,** which represent the conclusion of this review process

RECEIVERS FOR RADIO ASTRONOMY: CURRENT STATUS AND FUTURE DEVELOPMENTS AT THE ITALIAN RADIO TELESCOPES

P. Bolli, M. Beltran, M. Burgay, C. Contavalle, P. Marongiu, A. Orfei, T. Pisanu, C. Stanghellini, G. Zacchiroli, A. Zanichelli

Sponsored by S. Tingay

Section II of Science Directorate - INAF

PART I
INFRASTRUCTURES

- MAIN CHARACTERISTICS AND STATUS OF THE ITALIAN RADIO TELESCOPES
- BACK–ENDS, OPACITY AND RADIO FREQUENCY INTERFERENCES
- INAF RECEIVER GROUPS
- NORTHERN CROSS
- SRT FOR SPACE APPLICATIONS

Talk by Giampaolo Zacchiroli

PART II
ITALIAN RECEIVERS AND THE INTERNATIONAL CONTEXT

- RECEIVERS AT THE ITALIAN RADIO TELESCOPES
- INTERNATIONAL FRONT–END PROJECTS: POSSIBLE LINKS WITH THE ITALIAN RADIO TELESCOPES

Talks by:
Tonino Pisanu, Alessandro Orfei, Maite Beltran

PART III
SCIENTIFIC PERSPECTIVE OF THE ITALIAN RADIO TELESCOPES

- SCIENTIFIC CASES FOR RECEIVERS UNDER DEVELOPMENT
- CALL FOR IDEAS

Talk by
Carlo Stanghellini, Alessandra Zanichelli

PART IV
RECOMMENDATIONS

Talk by Pietro Bolli

RECEIVERS UNDER DEVELOPMENT

SRT
- S-band receiver 7 feeds, @3 GHz, Δν = 1.5GHz
- Clow-band receiver 1 feed, @5 GHz, Δν = 1.4GHz
- Q-band receiver 19 feeds, @43 GHz, Δν = 17GHz

Medicina
- Ku-band receiver 2 feeds, @15 GHz, Δν = 4.5 GHz

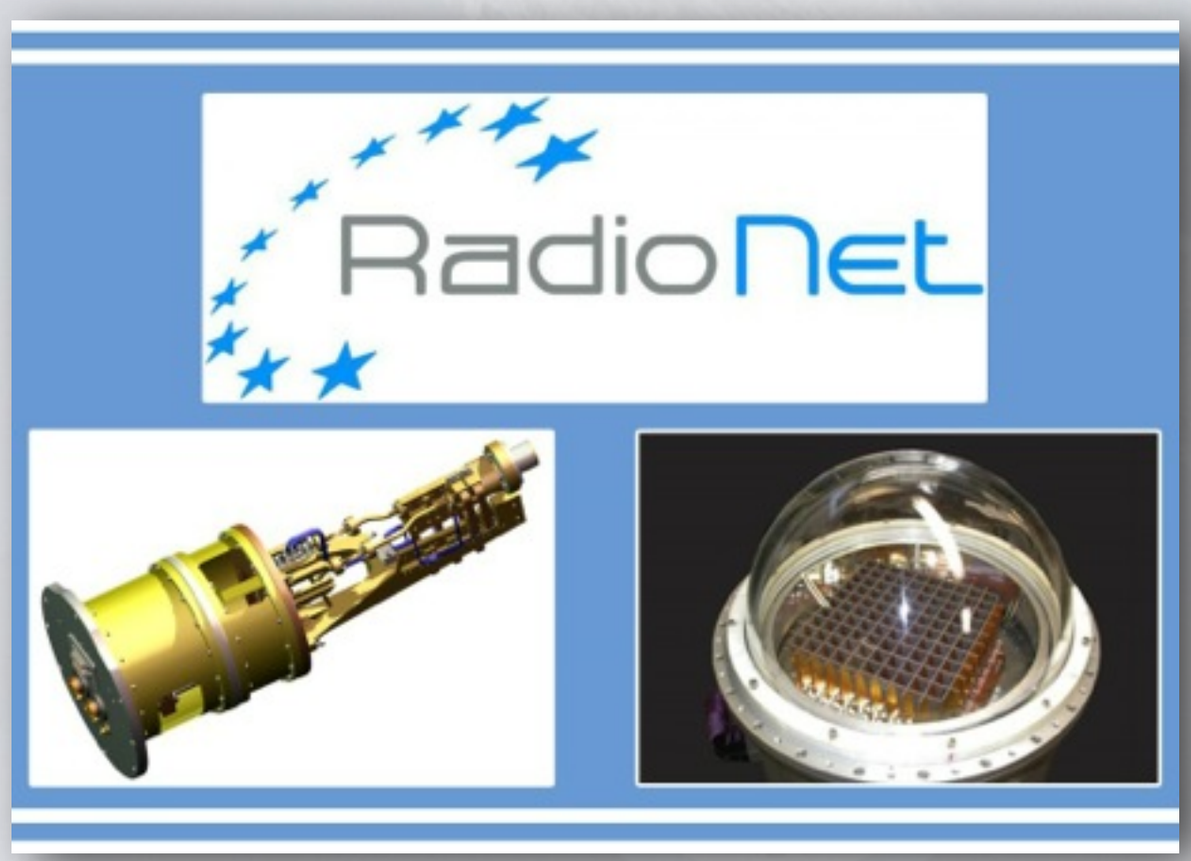
Noto
- L + S/X band receiver

SRT and Noto W-band receivers
- Ex-IRAM (1 at SRT, 2 at Noto)1 feed, @86-116 GHz, cooled, Δν = 0.5 GHz
- Ex-MPIfR (Noto only) 1 feed, @86 GHz, cooled, Δν = 0.1 GHz

INTERNATIONAL PROJECTS

➢ BRAND

BRoad-bAND EVN (BRAND) 1.5 to 15 GHz , RadioNet4 (INAF – Gino Tuccari)



➢ ALMA Band 2+3

67 GHz to 116 GHz prototype, > 8 GHz bandwidth

European Institutes under the coordination of ESO (IASF-BO + OAA)

➢ PHAROS / PHAROS2

C-band cryogenically cooled PAF demonstrator.

INAF participation in SKA Phased Array Feed (PAF) Advanced Instrumentation Program (AIP)

CALL FOR IDEAS

Low-mid frequency band

- Receiver for SRT at 1.4 GHz Δν=750 MHz
- Receiver for SRT at 5 GHz Δν=1.4 GHz
- 3 x PA for SRT (Med, Noto) at 6 GHz Δν=4 GHz
- Receiver for SRT at 2.3/8.4 GHz Δν=136/800 MHz
- Receiver for SRT at 10 GHz Δν=4 GHz
- Receiver for SRT, Med, Noto Δν=1.5-15 GHz

High frequency bands

- Receiver for SRT at 8.4 / 32 GHz Δν=2 MHz
- Receiver dual-beam for Noto at 43 GHz Δν= 10 GHz
- Receiver for all 3 at 22/43/90 GHz Δν= 8/17/30 GHz
- 2 x Receiver for SRT at 100 GHz Δν≤ 30 GHz
- Bolometer dual-frequency or SRT at 90 GHz Δν= 20 GHz,

RECOMMENDATIONS

	RT	Receiver	2017	2018	2019	2020	2021
Under construction	SRT	Q	IRA/OAC	IRA			
	SRT	ALMA2+3	IASF	IASF			
	SRT	Clow	IRA/OAC/OAA				
	SRT	S	OAC	OAC			
	MED	Ku	IRA/OAA	IRA			
	NOTO	S/X/L	IRA				
	NOTO	W (ex-MPFRI)		IRA			
New	SRT	Multi-feed W			OAC	OAC	OAC
	SRT	C-band PAF			OAC	OAC	OAC
	MED	Simultaneous frequency K/Q/W			IRA	IRA	IRA

	2017-2018	2019 and beyond
Q-band Mfeed 19	600,000	0
ALMA 2+3	80,000	0
S/X/L completion	80,000	0
Sim. Freq.	0	3,000,000 (*with AS*) 2,200,000 (*w/o AS*)
W-band Mfeed 19	0	1,700,000
PAF		2,700,000
TOTAL	**860,000**	**7,400,000 (with AS)** **6,600,000 (w/o AS)**