REVIEW ON THE ITALIAN RADIO TELESCOPE RECEIVERS

SECTION II

Chapter 7 – The International context

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17 TELESCOPE; 10 INSTITUTION; 8 NATION

Radio telescope (diameter)	Abbreviation	Class	Nation
Green Bank Telecope (100m)	GBT	Large	USA
Effelsberg (100m)	Effelsberg	Large	Germany
Onsala (20m)	Onsala20	Medium	Sweden
Onsala (25m)	Onsala25	Medium	Sweden
Yebes (40m)	Yebes	Medium	Spain
Pico Veleta (30m)	Pico Veleta	Medium	Spain
Tianma (65m)	Tianma	Large	China
Korean VLBI Network (21m)	KVN	Medium	Korea
VLBI Exploration of Radio Astrometry (20m)	VERA	Medium	Japan
Nobeyama (45m)	Nobeyama	Medium	Japan
Parkes (64m)	Parkes	Large	Australia
Mopra (22m)	Mopra	Medium	Australia
Sardinia Radio Telescope (64m)	SRT	Large	Italy
Medicina (32m)	MED	Medium	Italy
Noto (32m)	NOTO	Medium	Italy

ASKED TO EACH TELESCOPE

TECHNICAL DATA

Radio Telescope
Feed system
Focus (F/D)
Frequency coverage [GHz]
Instantaneous BW per polarization per feed [GHz]
Pixels per polarization (Linear / Circular)
HPBW at mid band (arcmin)
Cryo-cooled
Frequency agility
Expected or measured Trx [K]
Expected or measured Tsys at zenith [K]
Expected or measured maximum gain [K/Jy]
RFI in Rx band

SCIENTIFIC DATA

Main scientific applications
Percentage of the RT observing time allocated to the Rx (average since 2010)
Participation to International network or projects (since 2012)

MANAGEMENT

In operation since or expected to be installed
Maintance and upgrade required to the existing receiver and remaining parts of the under-development receivers
Constraints posed to the RT / infrastructure

IN THE TEXT FOR EACH TELESCOPE
DIAMETER
ALTITUDE
FREQUENCY COVERAGE
OPERATIONAL and UNDER DVPT. RX
FEED and POLARIZATION USED
FOCUS LOCATION of RX
FREQUENCY AGILITY
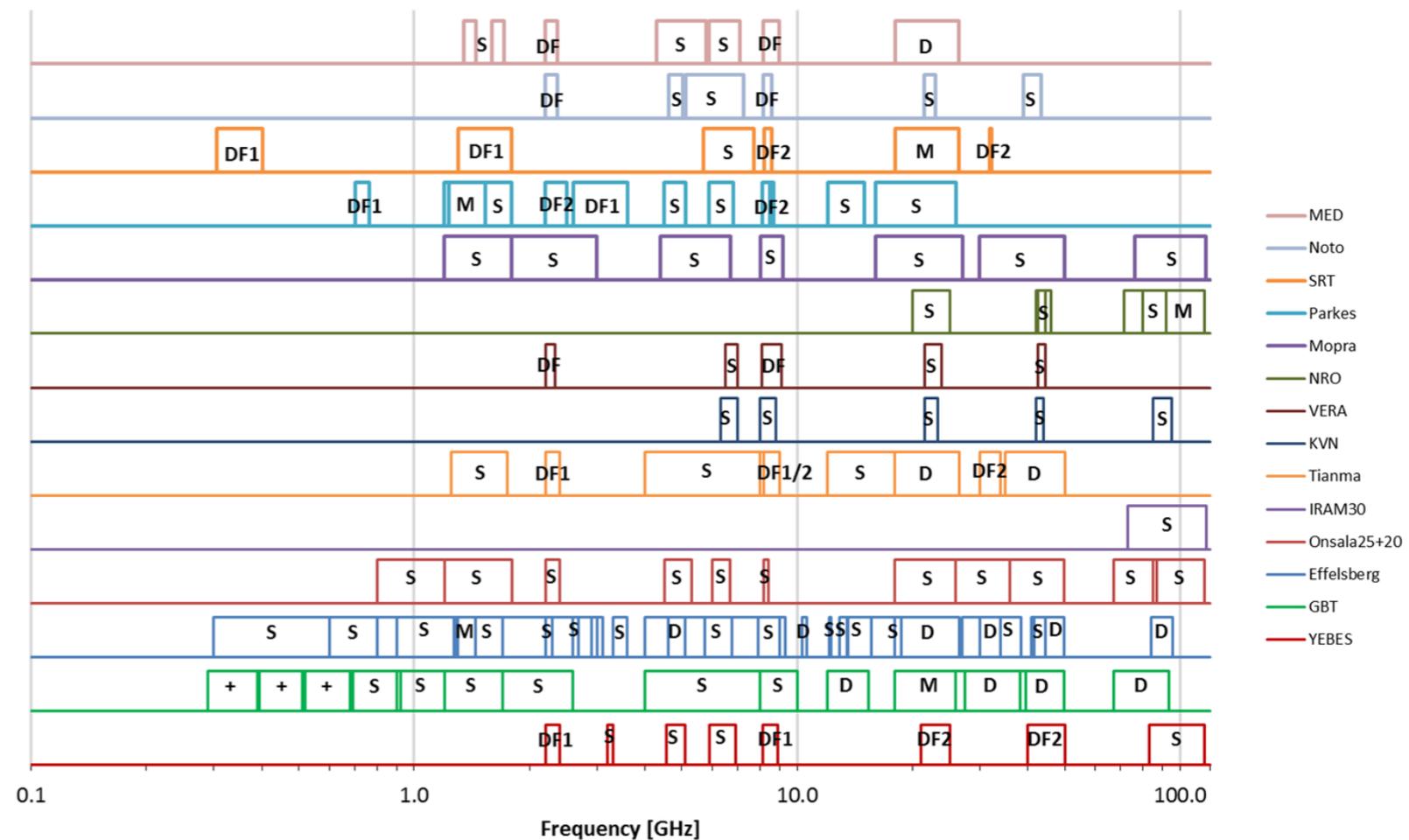STATUS of RFI at the SITE
PERFORMANCE
% of RX USAGE
AGE of RX

Rome, March 21st, 2017

FREQUENCY COVERAGE: OPERATIONAL RX

Number of in operation bands				
TELESCOPES	f ≤ 1GHz	f= 1÷18 GHz	f= 18÷100 GHz	Total at the telescope
SRT	1	3	2	6
MED	0	5	1	6
NOTO	0	4	2	6
TOTAL Italian	1	12	5	18
GBT	5	6	4	15
Effelsberg	3	15	6	24
Tianma	0	6	3	9
Yebes	0	5	3	8
KVN	0	2	4	6
VERA	0	3	2	5
Onsala25 + Onsala20	0	6	5	11
Nobeyama	0	0	6	6
Pico Veleta	0	0	1	1
Mopra	0	4	3	7
Parkes	1	10	1	12
TOTAL bands	10	69	43	122

in operation		
Mono-feed	77
Dual-feed	13
Dualfreq	11
Multi-feed	5
Dipoles	3
Total	109

S = mono-feed; D = dual-feed; M = multi-feed; DF = dual frequency; + = crossed dipoles

International Survey, FREQUENCY COVERAGE: in operation

FREQUENCY AGILITY

TELESCOPE	Switching time from Primary to Secondary focus receivers	Switching time within Primary focus receivers	Switching time within Secondary focus receivers
MED	4 min	≤ 45 sec	≤ 14 sec
NOTO	4 min	10 sec	4 Hours (manual change)
SRT	4 min	2 min	2 min
GBT	10 min	2 hours	1 min; manual change in specific cases
Effelsberg	30 min	1 min; manual change between multi-receiver boxes	30 sec
Tianma	Not applicable	Not applicable	seconds
Yebes	Not applicable	Not applicable	No data
KVN	Not applicable	Not applicable	Simultaneity
VERA	Not applicable	Not applicable	No agility
Onsala20	Not applicable	Not applicable	seconds to 30 min
Onsala 25	Not applicable	Not applicable	seconds to 1 hour
Pico Veleta	Not applicable	Not applicable	2-bands simultaneous
Nobeyama	Not applicable	Not applicable	1 min
Parkes	Not applicable	2 min; manual change between multi-receiver boxes	Not applicable
Mopra	Not applicable	Not applicable	Some min for high frequency receivers

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PERFORMANCE: OVERALL (_OPERATIONAL RX_)

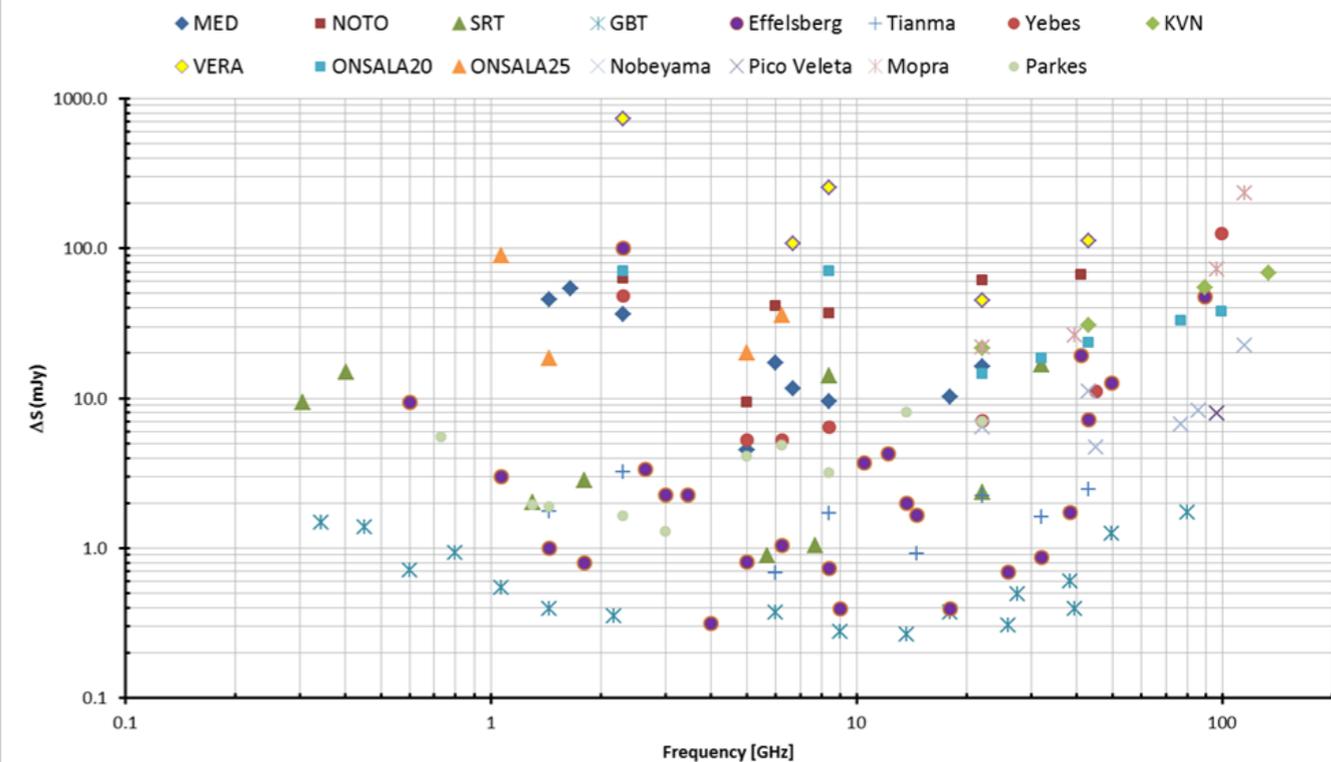SEFD of receivers in operation: **overall**
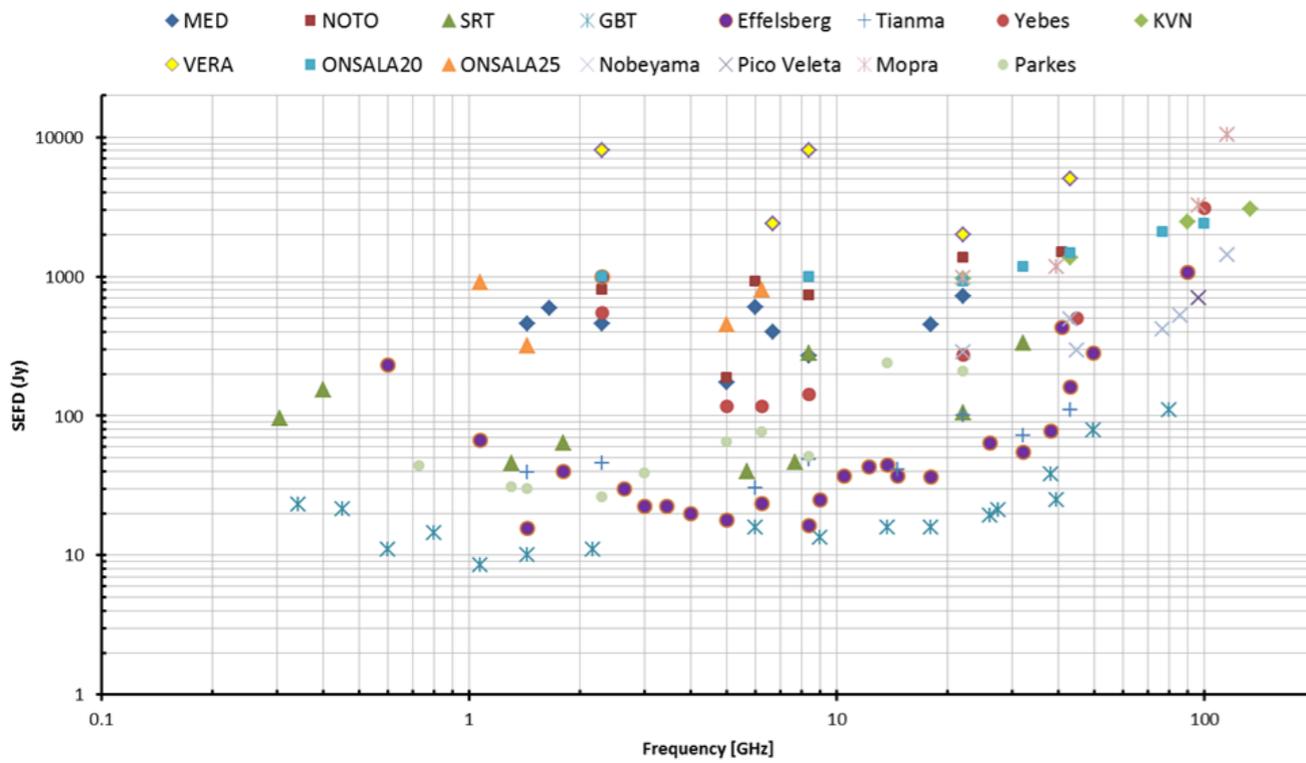
$$SEFD = \frac{Tsys}{G}$$

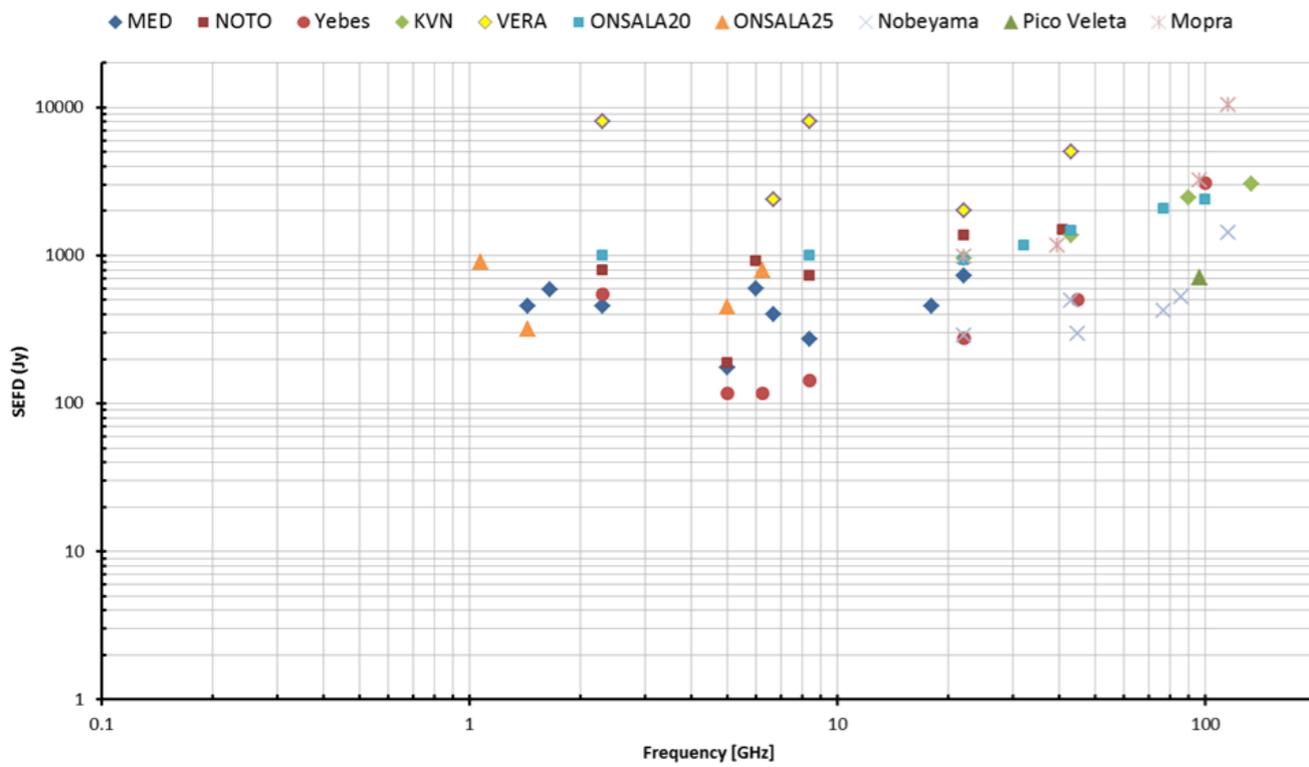$$\Delta S = \frac{SEFD}{\sqrt{B * 1}}$$

1 sec. INTEGRATION TIME

TELESCOPE	Altitude (m)
Pico Veleta	2850
Nobeyama	1349
Yebes	931
Mopra	860
GBT	807
SRT	600
Parkes	415
Effelsberg	319
KVN	120; 260; 320
NOTO	78
VERA	60
MED	25
Onsala25 + Onsala20	20
Tianma	7

Sensitivity of receivers in operation: **overall**

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PERFORMANCE: MEDIUM AND LARGE SIZE ANTENNAS (*OPERATIONAL RX*)

SEFD of receivers in operation: medium class antennas

MED ■ NOTO ● Yebes ◆ KVN ◆ VERA ■ ONSALA20 ▲ ONSALA25 ✕ Nobeyama ▲ Pico Veleta ✳ Mopra

SEFD of receivers in operation: large class antennas

▲ SRT ✳ GBT ● Effelsberg + Tianma ● Parkes

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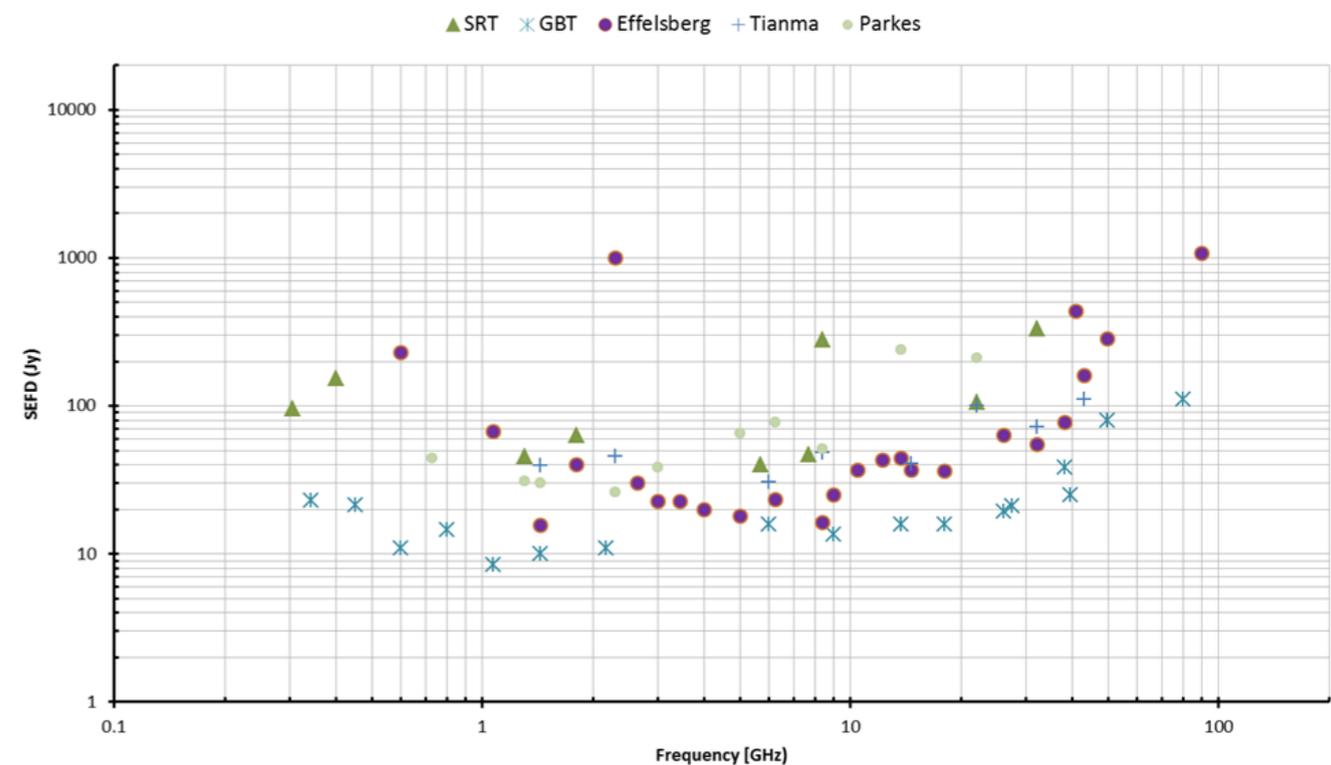
PERFORMANCE: NORMALIZED SEFD (_OPERATIONAL RX_)

Normalized SEFD of receivers in operation: medium class antennas
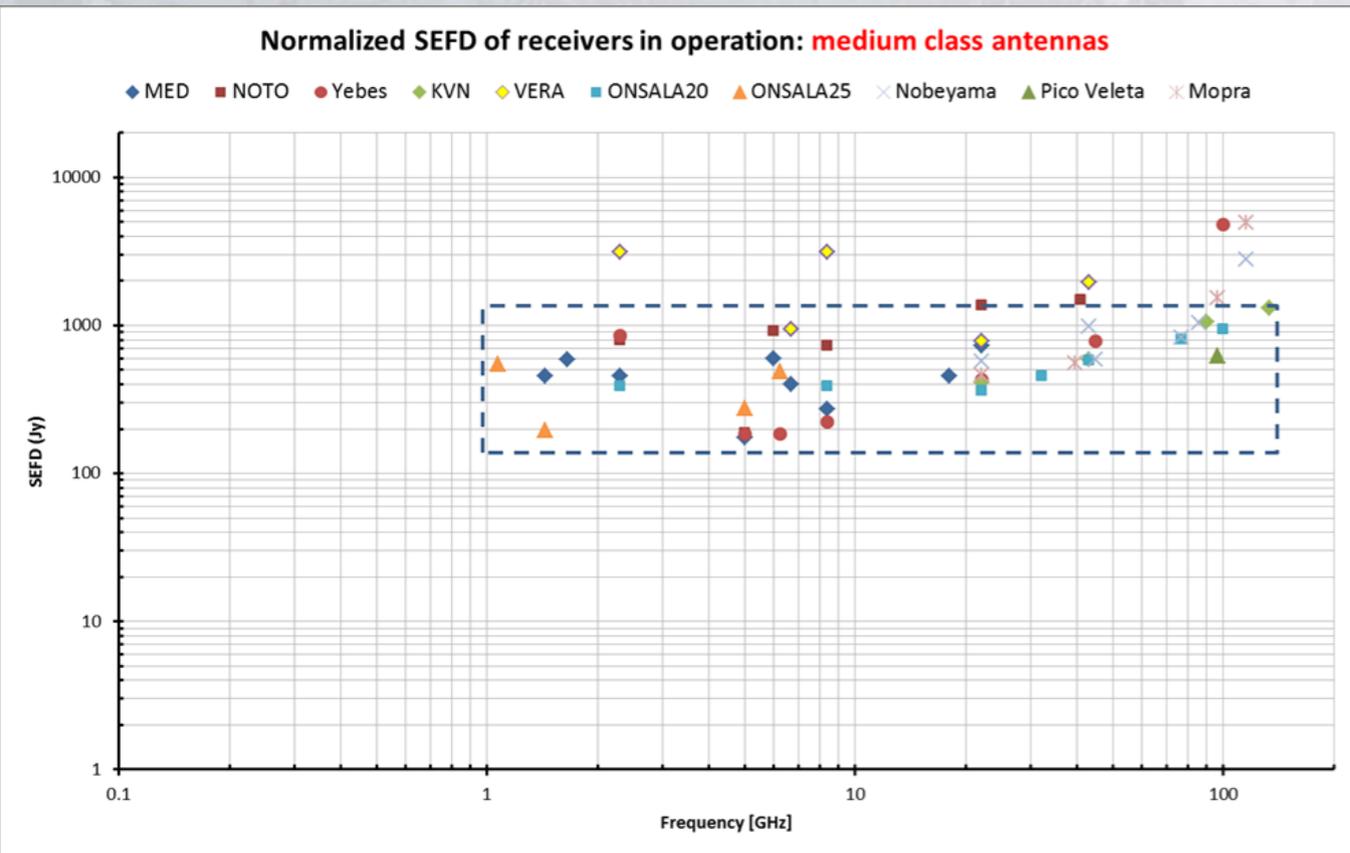
$$\left(\frac{DIAMETER}{32}\right)^2 = NORMALIZATION\ FACTOR$$

$$SEFD' = SEFD * N$$

Normalized SEFD of receivers in operation: large class antennas

RESIDUAL EFFECTS:
- ❏ surface accuracy
- ❏ offset antenna
- ❏ RX noise
- ❏ Tsys measure
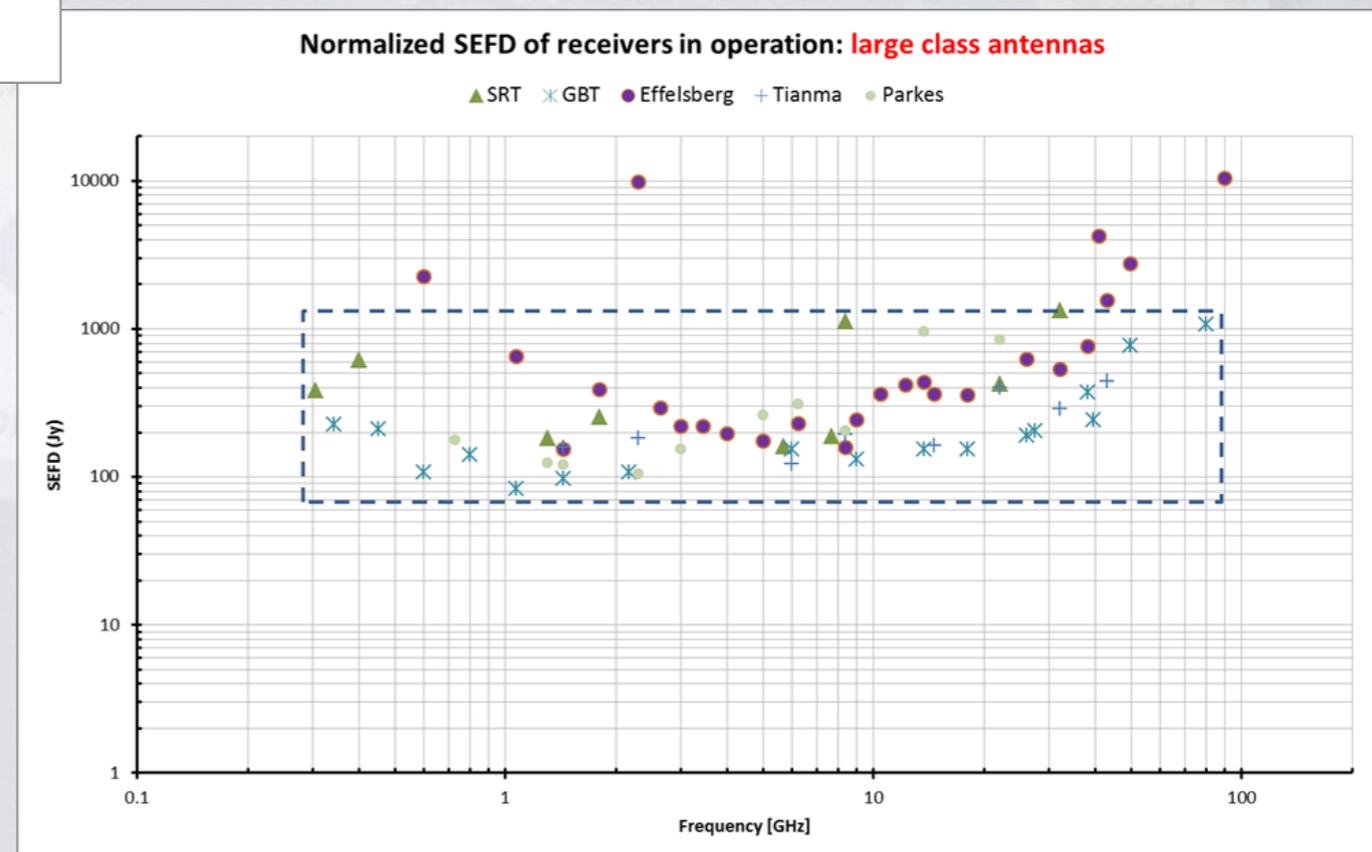
FREQUENCY COVERAGE: UNDER DEVPT. RX

Number of under development bands

TELESCOPES	f ≤ 1GHz	f= 1÷18 GHz	f= 18÷100 GHz	Total at the telescope
SRT	0	2	2	4
MED	0	1	0	1
TOTAL Italians	0	3	2	5
GBT	1	3	2	6
Effelsberg	0	1	1	2
Tianma	0	0	1	1
Yebes	0	0	3	3
KVN	0	0	0	0
VERA	0	0	0	0
Onsala25 + Onsala20	0	1	0	1
Nobeyama	0	0	0	0
Pico Veleta	0	0	0	0
Mopra	0	0	0	0
Parkes	1	4	0	5
TOTAL bands	2	12	9	23

under dvpt.		
	Mono-feed	12
	Dual-feed	4
	Dualfreq	0
	Multi-feed	3
	Dipoles	0
	PAF	2
	Total	21

TREND:
- ❑ Enlarge the bandwidth
- ❑ Allow both polarizations
- ❑ Fill frequency coverage gaps
- ❑ Make available specific multi-pixel RX

S = mono-feed; D = dual-feed; M = multi-feed; PAF = phased array feed
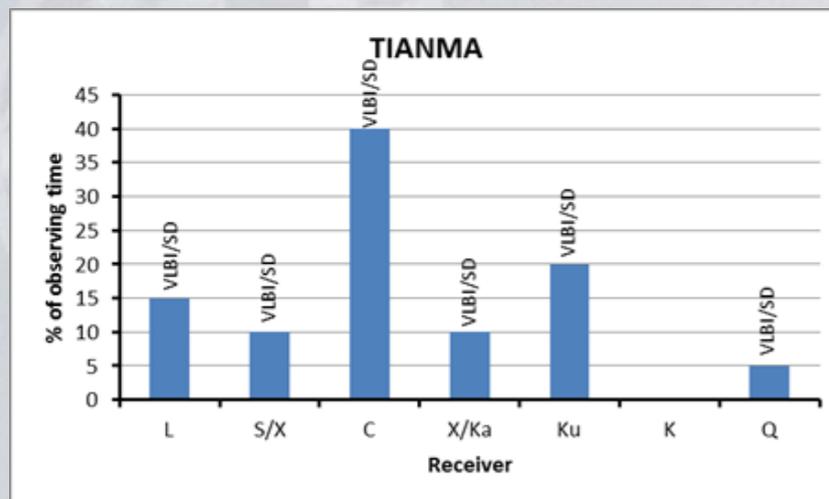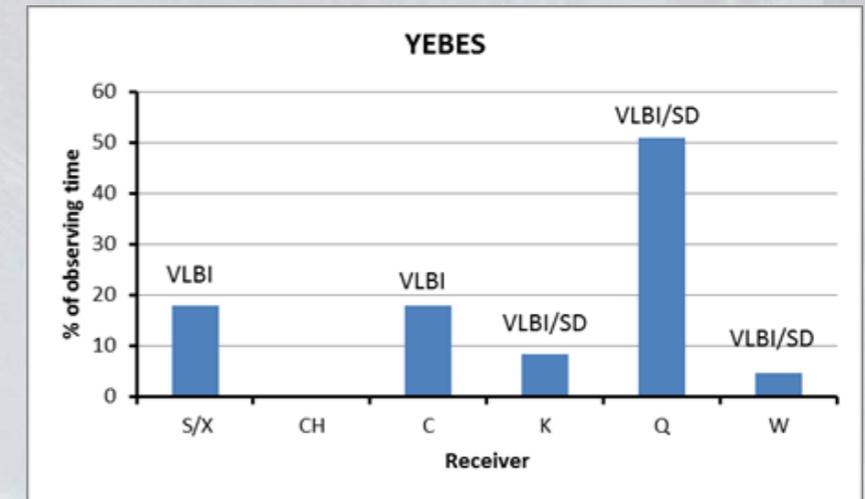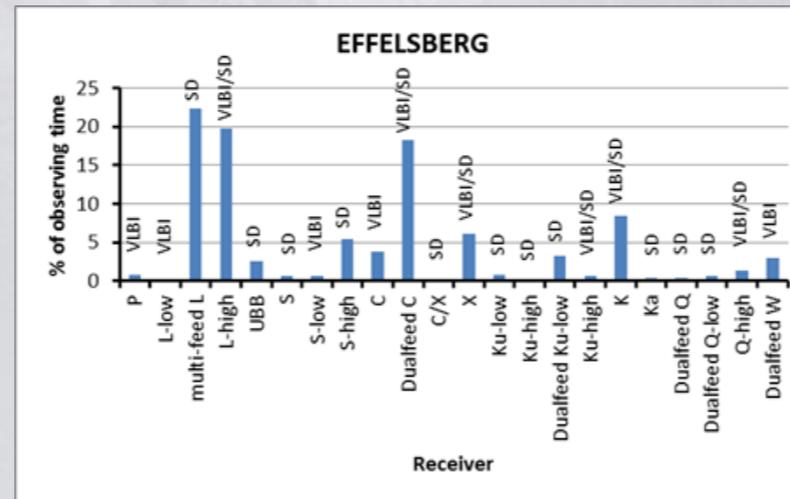
International Survey, **FREQUENCY COVERAGE: under development**

PERFORMANCE: SEFD (*UNDER DVPT. RX*)

1 sec. INTEGRATION TIME

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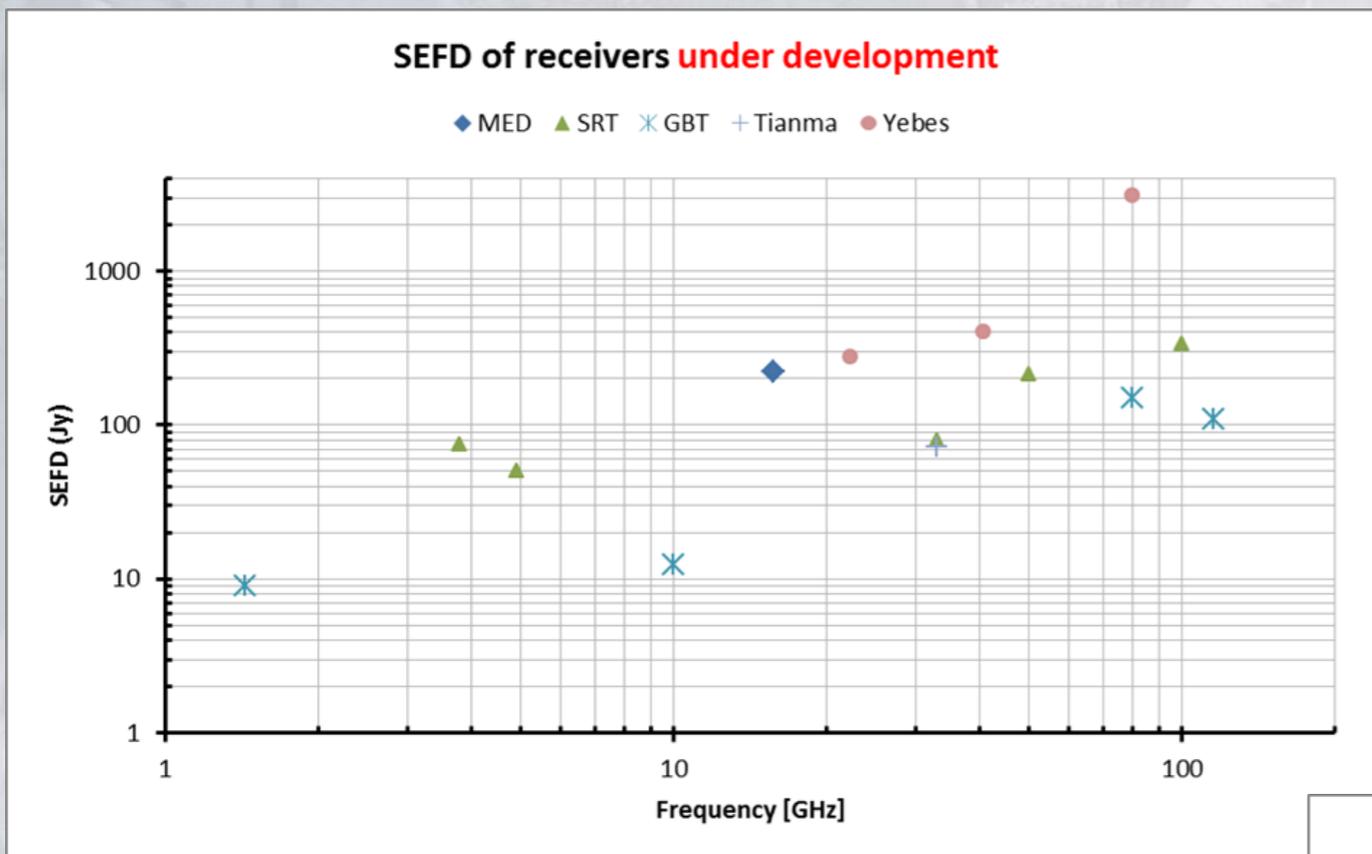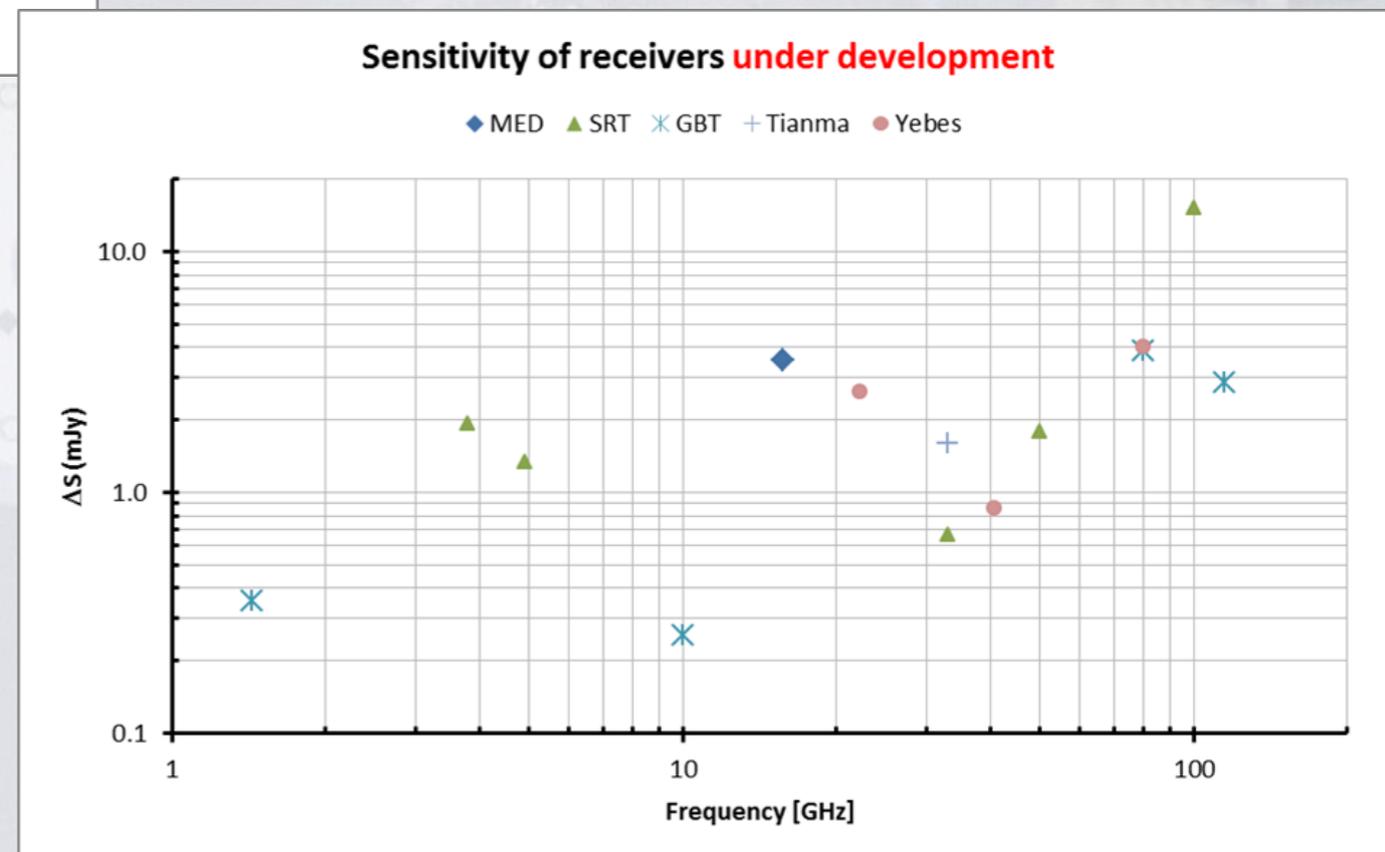
OBSERVING TIME
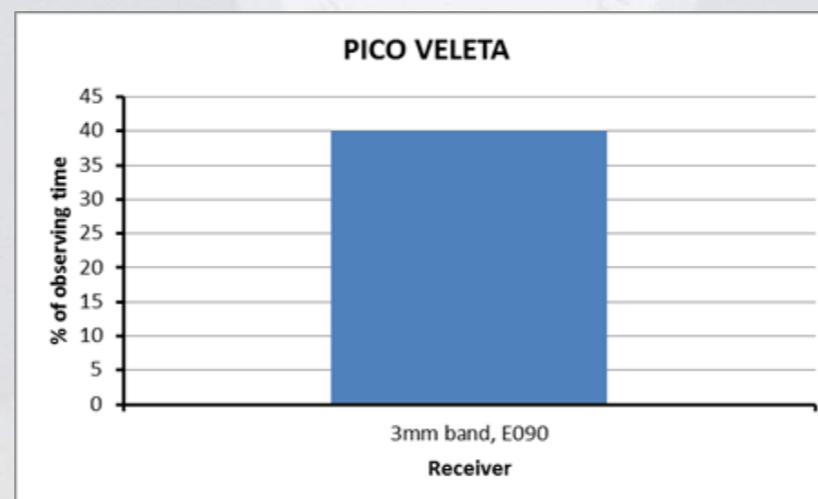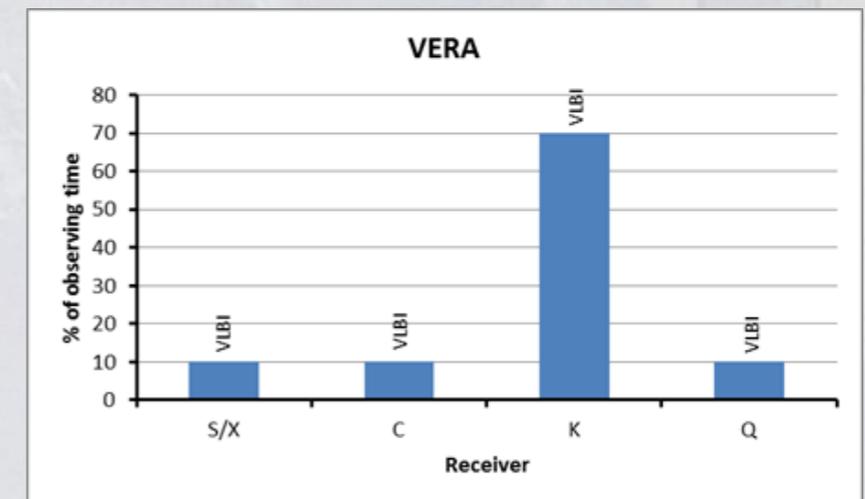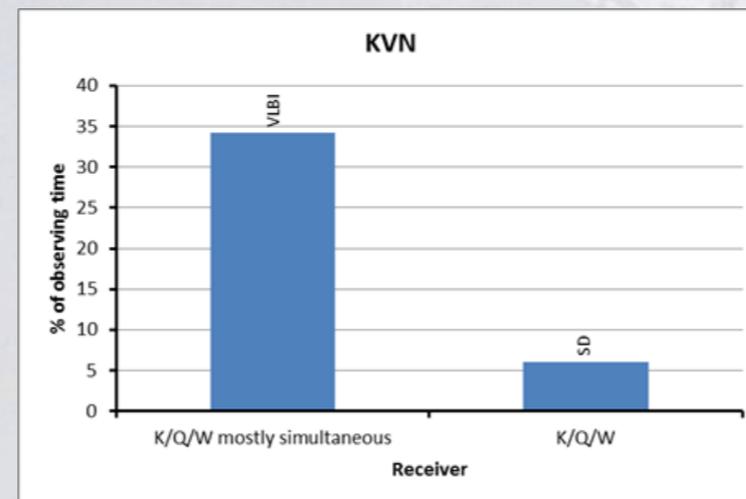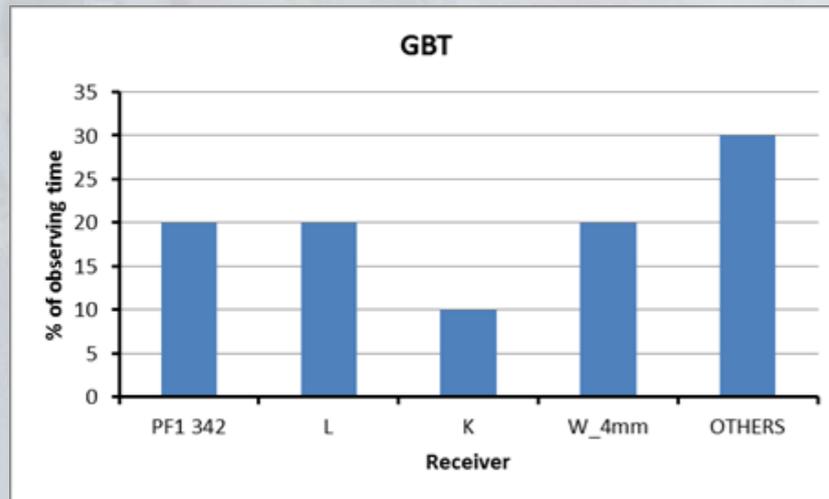
AGE OF OPERATIONAL RECEIVERS

Buona Lettura!

Rome, March 21st, 2017