21 may 2013

Pulsar timing perspectives at SRT

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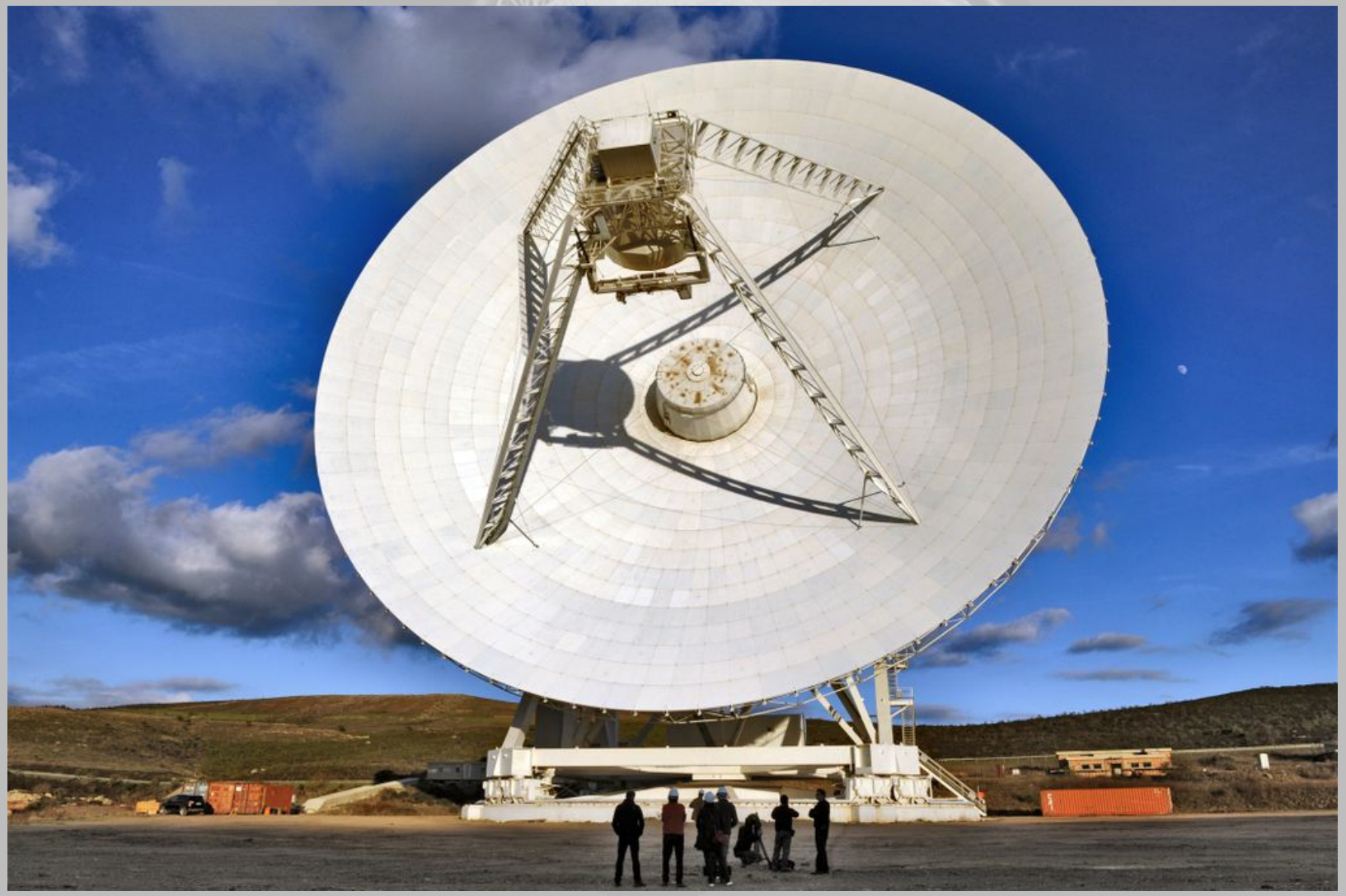
Sardinia Radio Telescope



64 m dish designed for maximum efficiency at all the frequencies btw 300 MHz and 110 GHz

Observing up to high frequencies

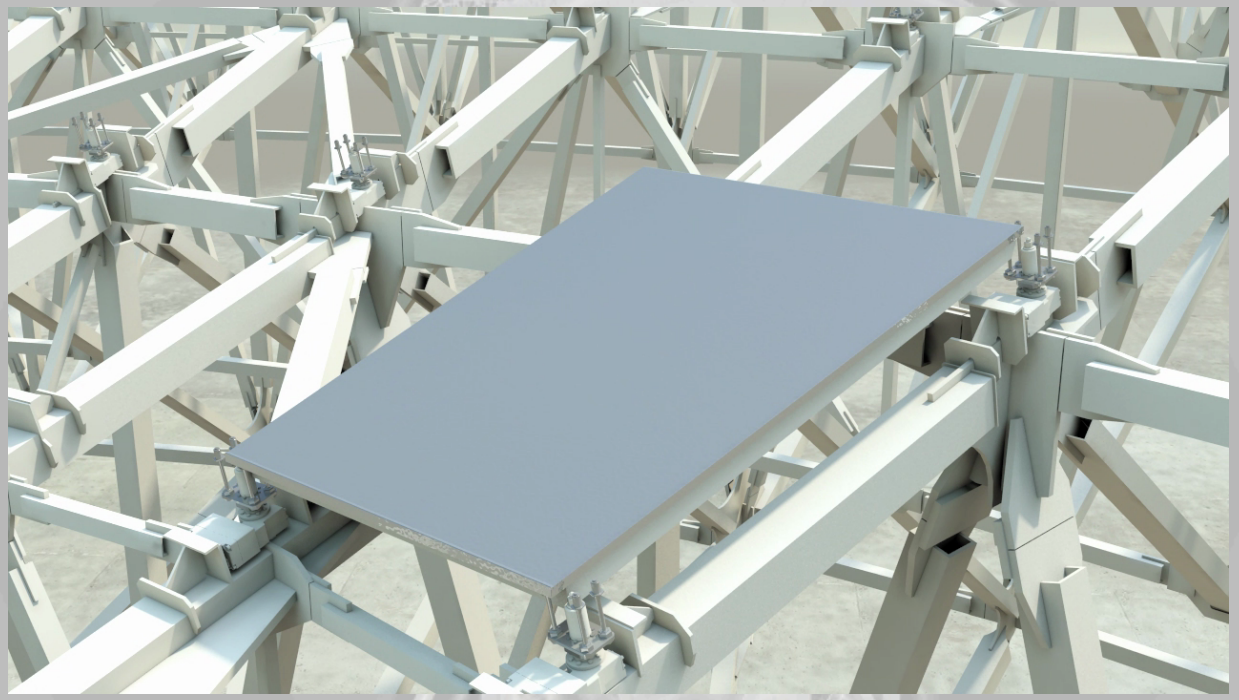
~100 GHz → λ ~ 3 mm

...implies...

an overall accuracy of the reflecting surfaces

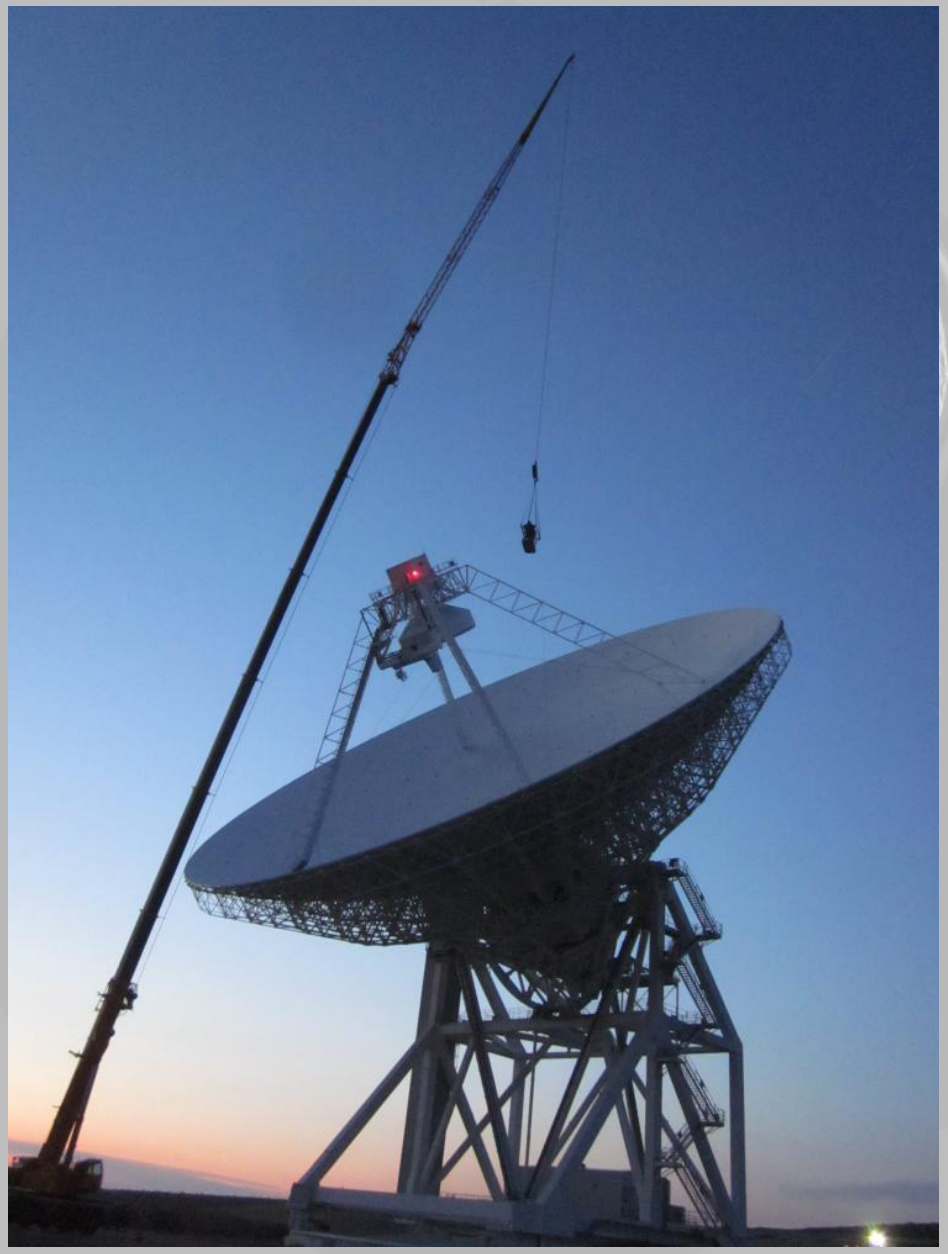
RMS << λ/10 << 300 μm

The main reflector “Active Surface”



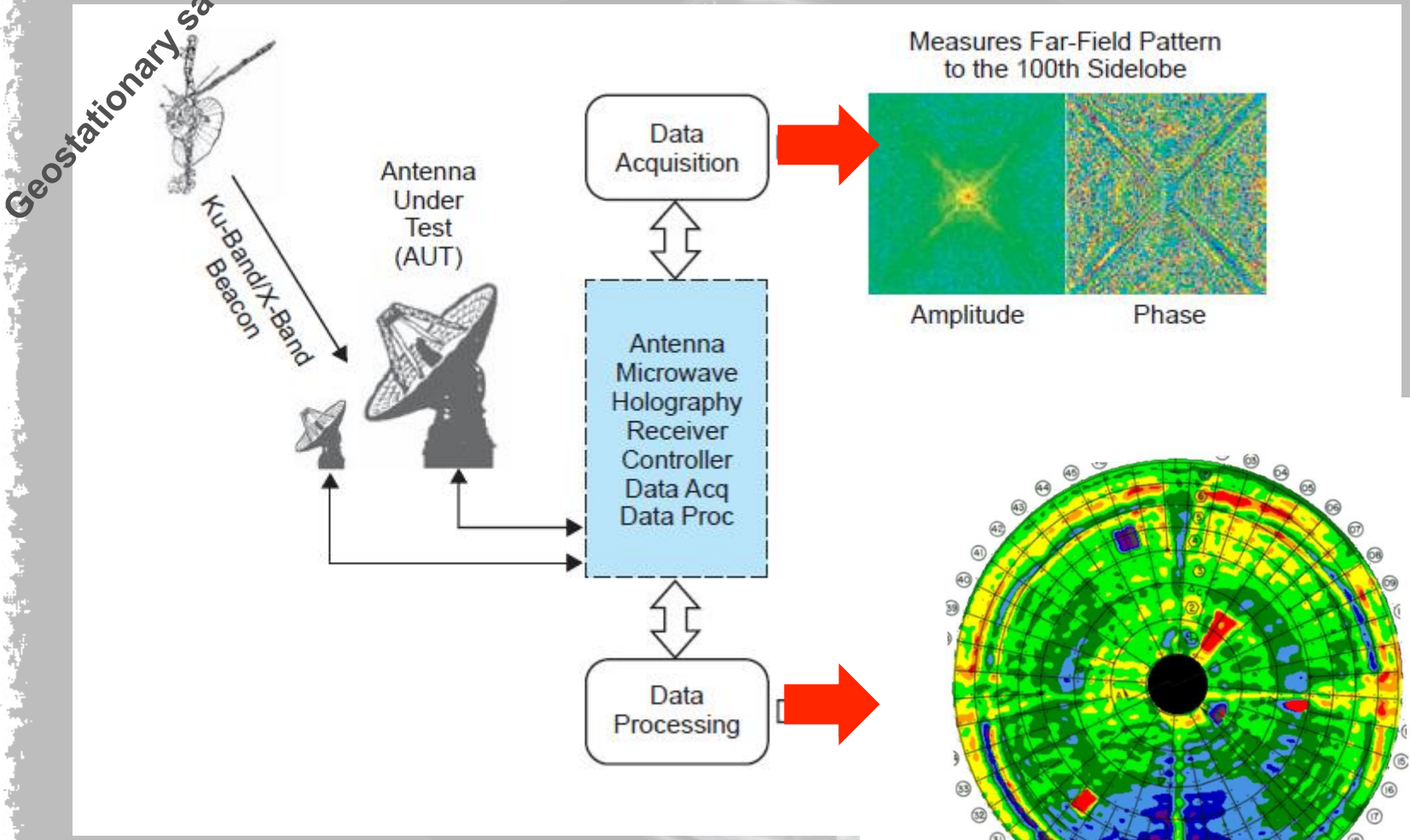
the “active” surface is made of 1008 panels + 1116 mechanical actuators

Photogrammetry measurements are taken at 15°, 30°, 45°, 60°, 75°, 90° elevation angles in order to provide a look-up table for actuators.



...achieved RMS ≈ 290 μm at 45 ° elevation

Doing better with Holography



Capability to measure
RMS ~150 µm

SRT Initial Receivers

Four Receivers are commissioned to test all focal positions

Focal position	Receiver type	Frequency band
Primary	Coaxial, dual frequency	*P-band*: 305-425 MHz *L-band*: 1.3-1.8 GHz
Gregorian	Multibeam	*K-band*: 18-26 GHz
Beam Waveguide	Monofeed	*C-band*: 5.7-7.7 GHz

Bandwidth

≈ 23% of the central frequency at P band

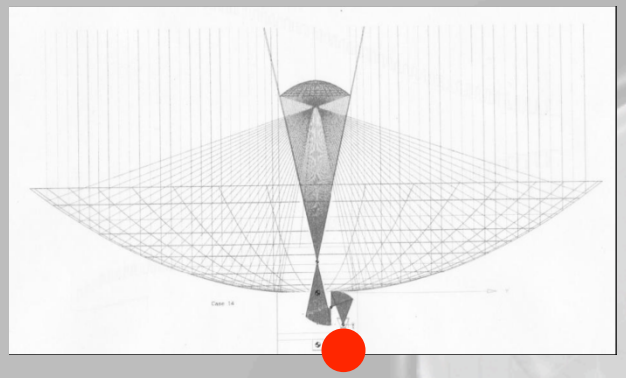
≈ 26% of the central frequency at L band

≈ 25% of the central frequency at K-band

SRT 6-7 GHz Receiver

1 beam with 2 GHz bandwidth

6-7 GHz receiver in Beam Wave Guide focus




...this receiver has led
to the first scientific
investigation with SRT

esent Time: 13 May 2013; 22:19 UT

[Previous | Next]

Detection by Sardinia Radio Telescope of radio pulses at 7 GHz from the Magnetar PSR J1745-2900 in the Galactic center region

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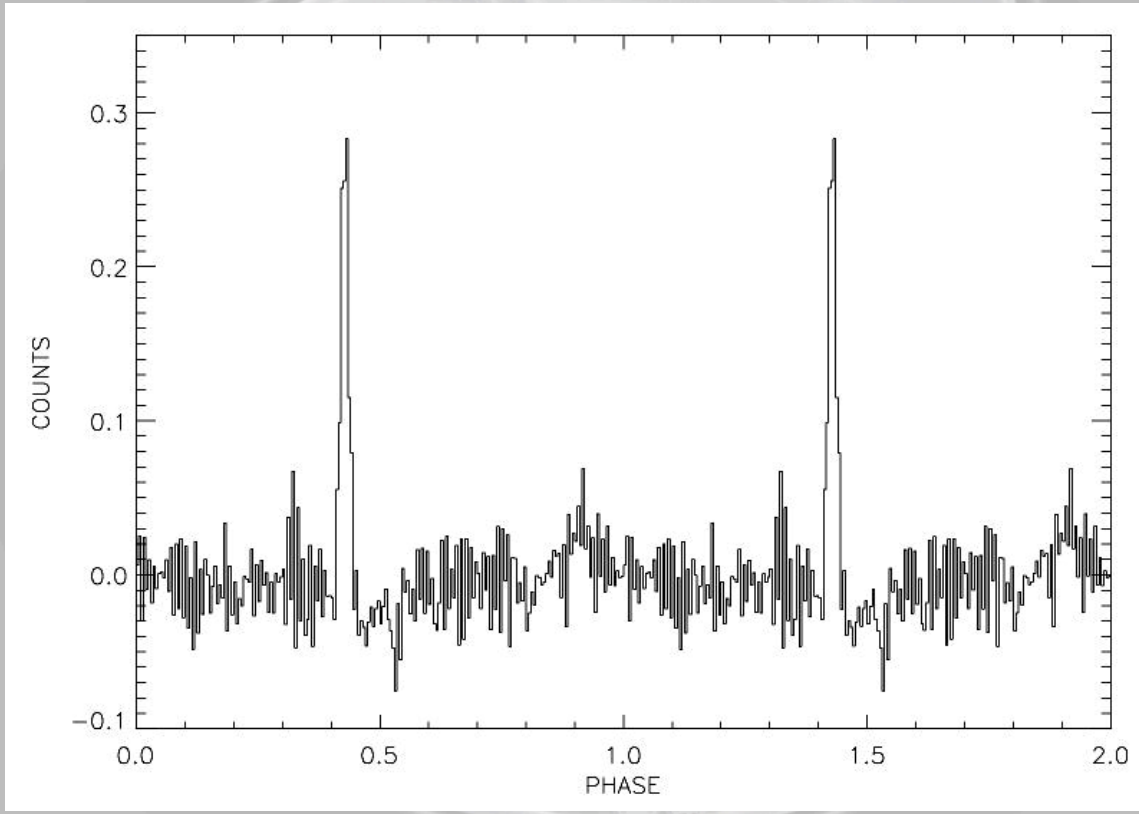
on 7 May 2013; 19:19 UT
Credential Certification: Marta Burgay (burgay@oa-cagliari.inaf.it)

Subjects: Radio, Neutron Star, Soft Gamma-ray Repeater, Pulsar

Referred to by ATel #: 5058

During the Sardinia Radio Telescope (SRT) science verification phase, we observed PSR J1745-2900, firstly detected as an X-ray flare from Sgr A* by Swift and then identified as a

Detection of a magnetar close to the Galactic centre

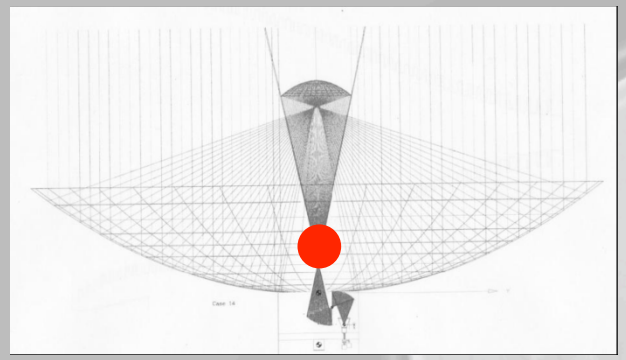


PSR J1745-2900: a 3.7 sec magnetar at 3” from the position of SgrA*

SRT Multi-beam Receiver

7 beams operating btw 18 and 26 GHz

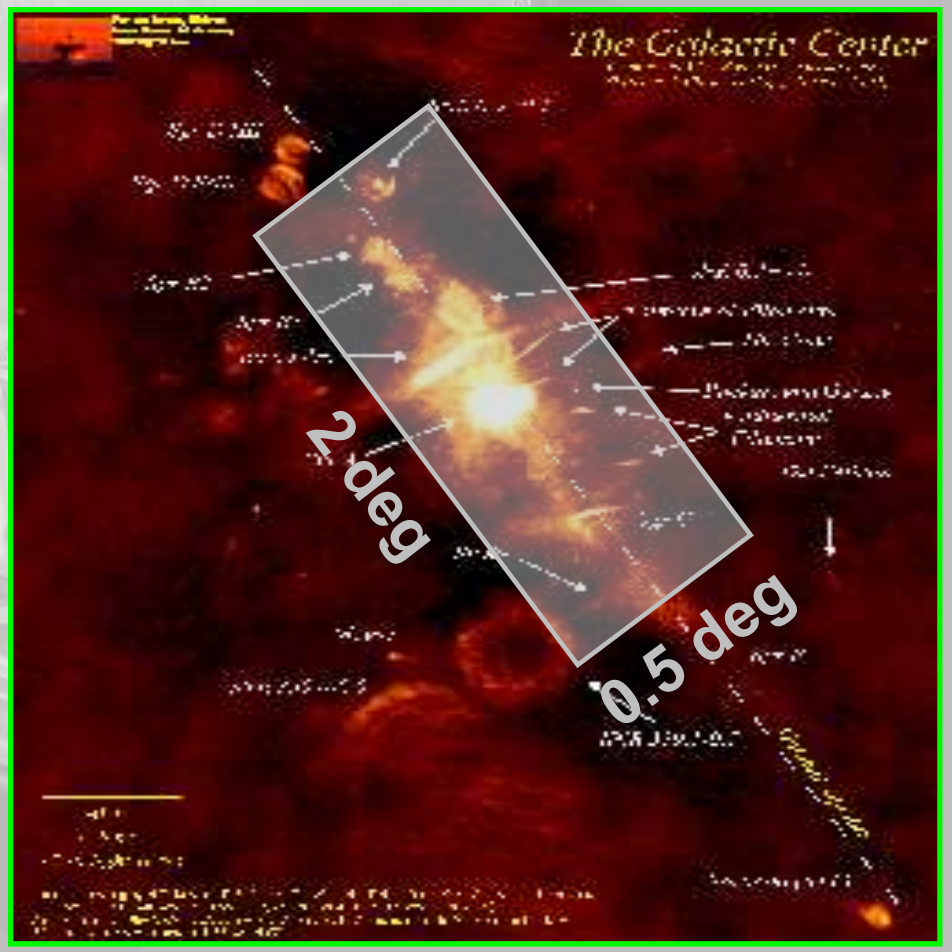
Multibeam 22 GHz receiver in Gregorian focus



Searching a pulsar orbiting SGR A*

PSR22 : a Galactic Center survey for Pulsars at 22 GHz

The availability of a multi-feed receiver at 22 GHz open the possibility of performing a deep survey ever for recycled pulsars in the Galactic Center



Instruments for exploiting SRT in the search for GWs

GW detection from coalescing black-holes

LEAP : Large European Array for Pulsars
(funded by EU grant for 5 years: PI M.Kramer)

Combining "coherently" all the 5 major european telescopes, SRT will be part of the best available telescope at 20cm-band for timing before SKA era…

+

…unique capability of SRT in removing interstellar medium effects, thanks to the dual band 20+90 cm receiver

Pulsar Front-ends

Dual Band receiver

(L-Band: 1.3-1.8 GHz ; P-Band: 305-425 MHz)

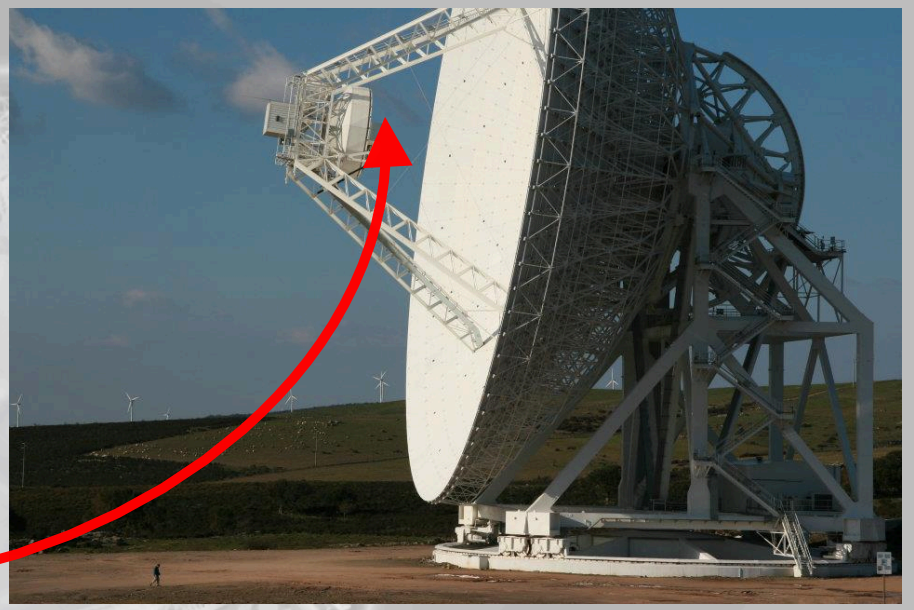
Pulsar Front-ends

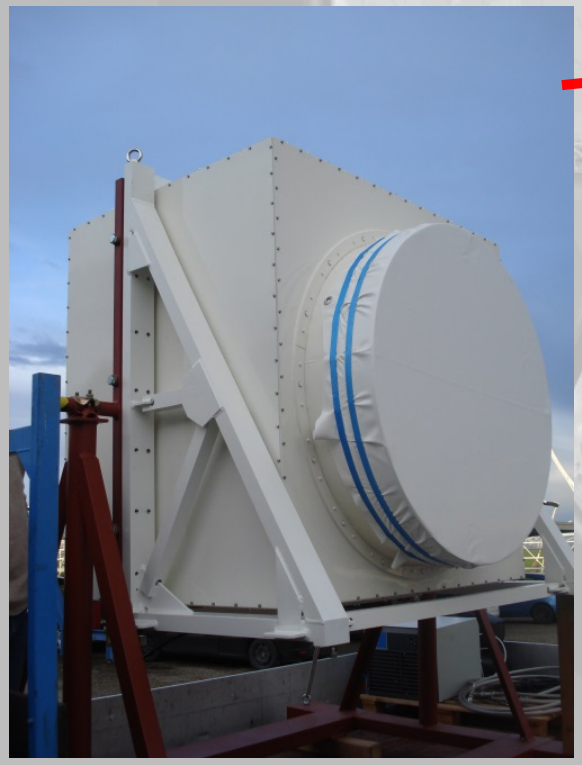
Dual Band receiver

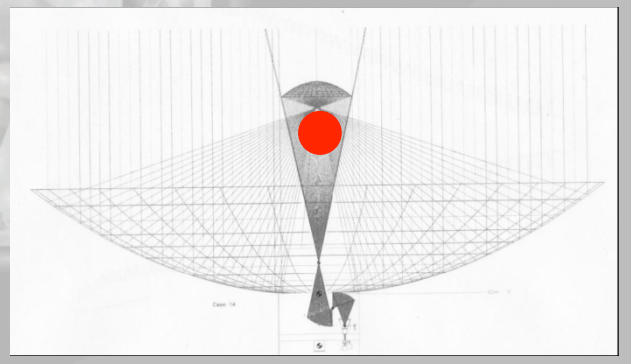
Receiver tested on the ground at mid april
and in primary focus since two weeks

L-P receiver

in primary focus







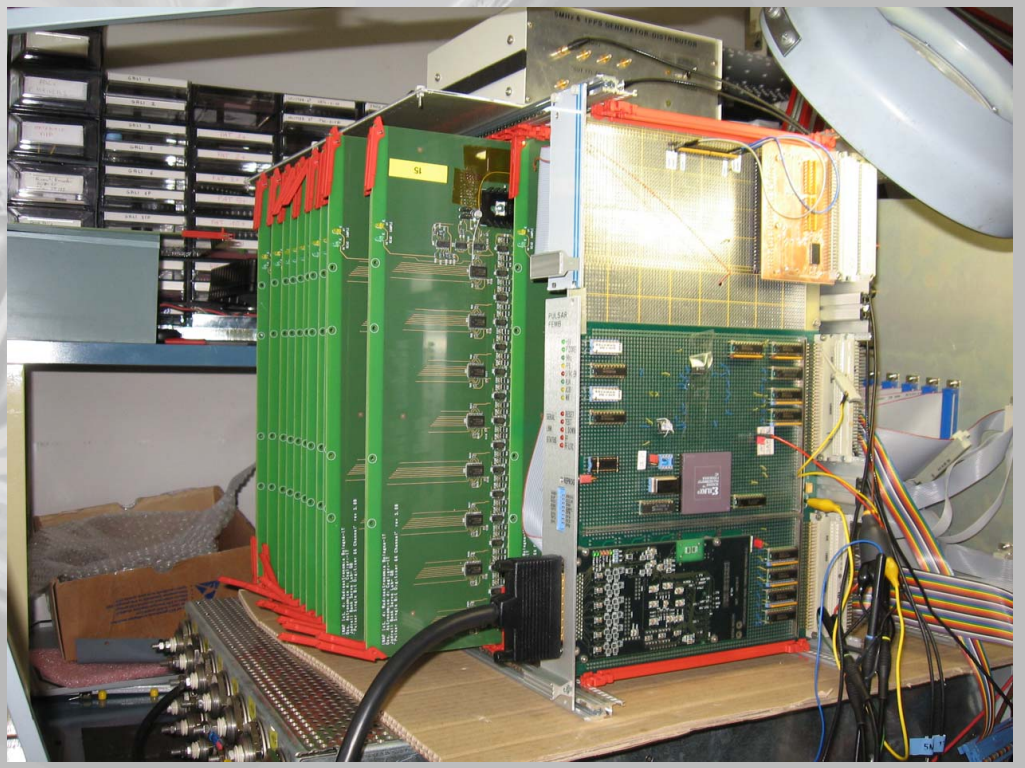
Pulsar Backend # 1

The analogue filter-bank: incoherent de-dispersion

- 512MHz BW, dual polarization
- Analog filter bank 2X1024 channel 512KHz bw/channel
- 1 bit digitizer 1024 channel (the 2 polarizations are added at input)
- Max Sample rate 10 microseconds

Filter bank rack

Digitizer bank test



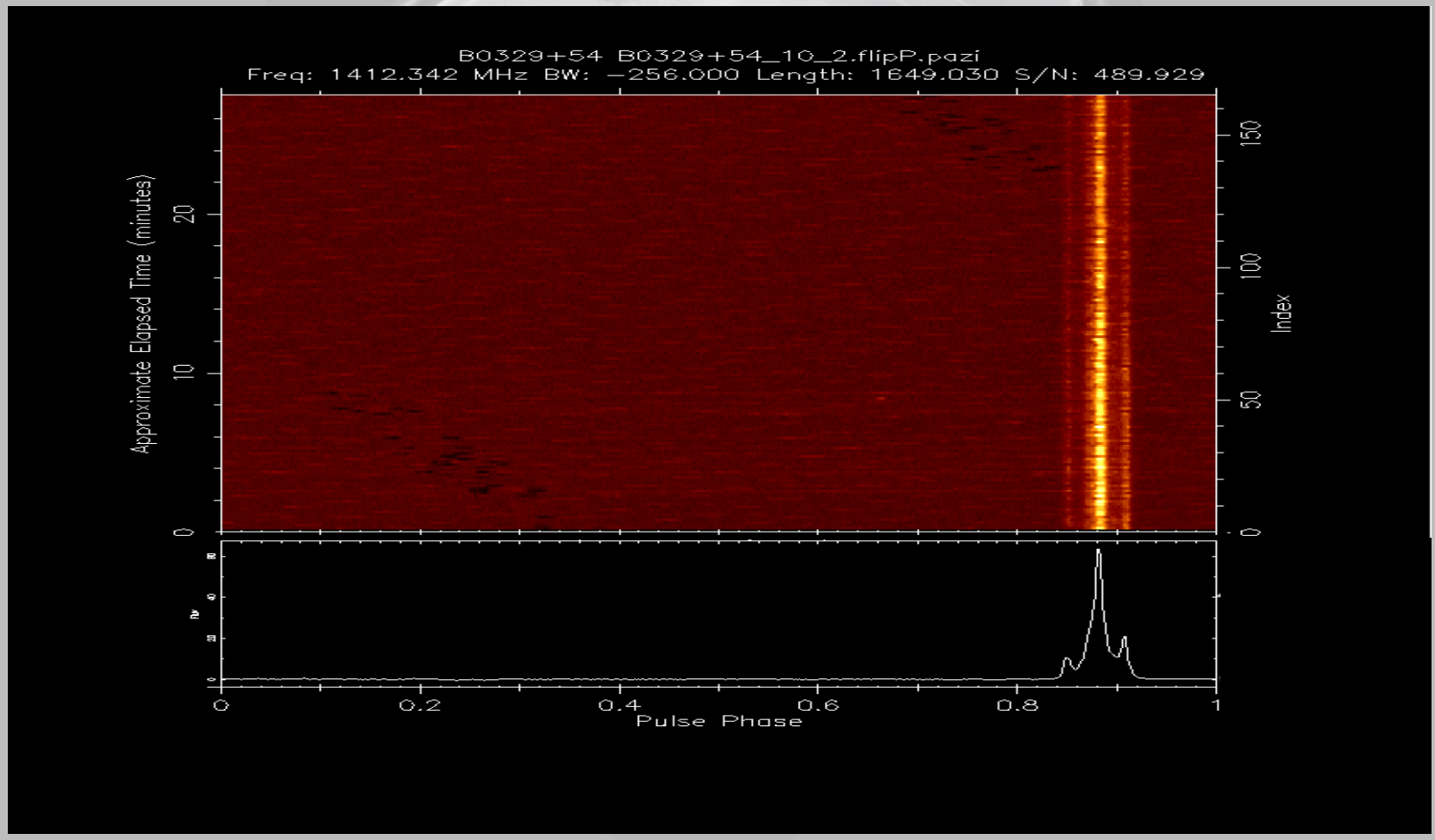
Pulsar Backend # 2

Dual Band DFB from ATNF

Pulsar Backend # 2

Dual Band DFB from ATNF

tests at Medicina (P=714 ms, DM=27)



PSR B0329+54

Pulsar Backend # 2

Incoherent de-dispersion and folding over 2 bands:

≈ 400 MHz btw 1300-1700 MHz

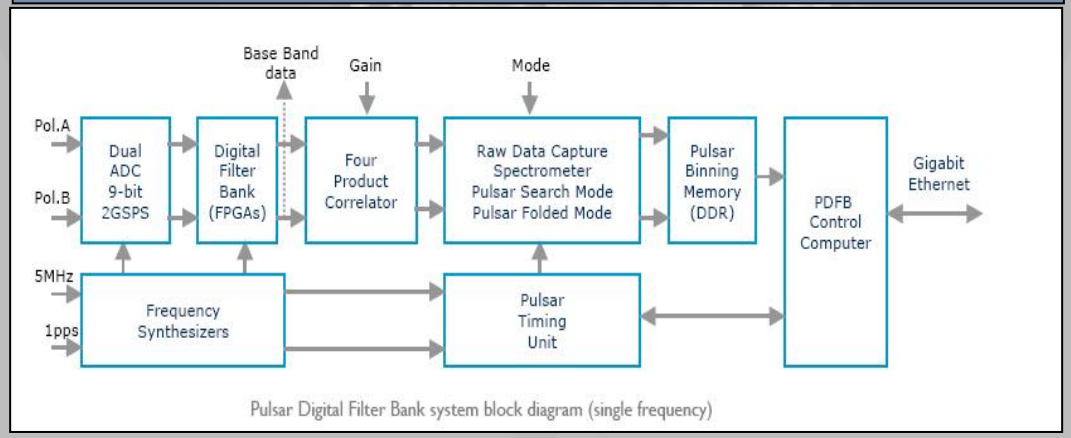
+

≈ 80 MHz btw 320-400 MHz

CSIRO

Pulsar Digital Filter Bank

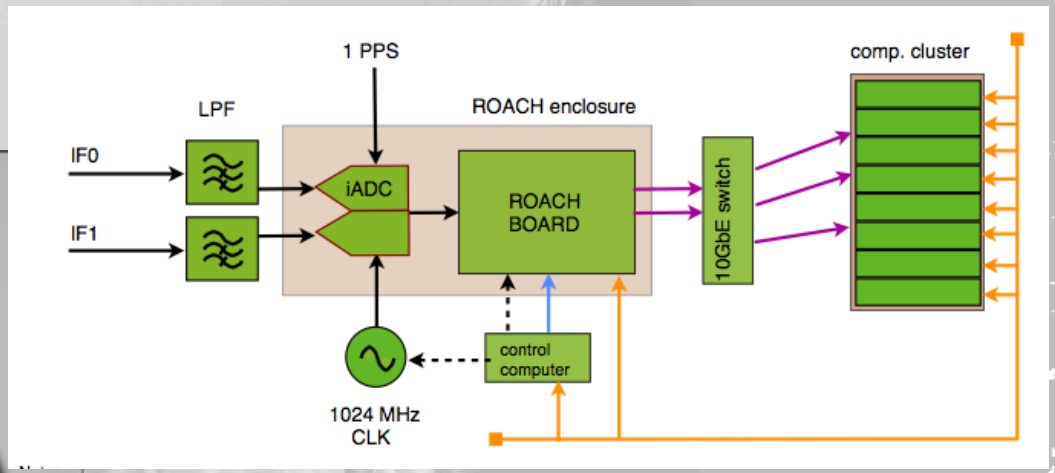
CSIRO ATNF is developing a Pulsar Digital Filter Bank capable of processing up to 1GHz of bandwidth.



Pulsar Digital Filter Bank system block diagram (single frequency)

Pulsar Back-end # 3

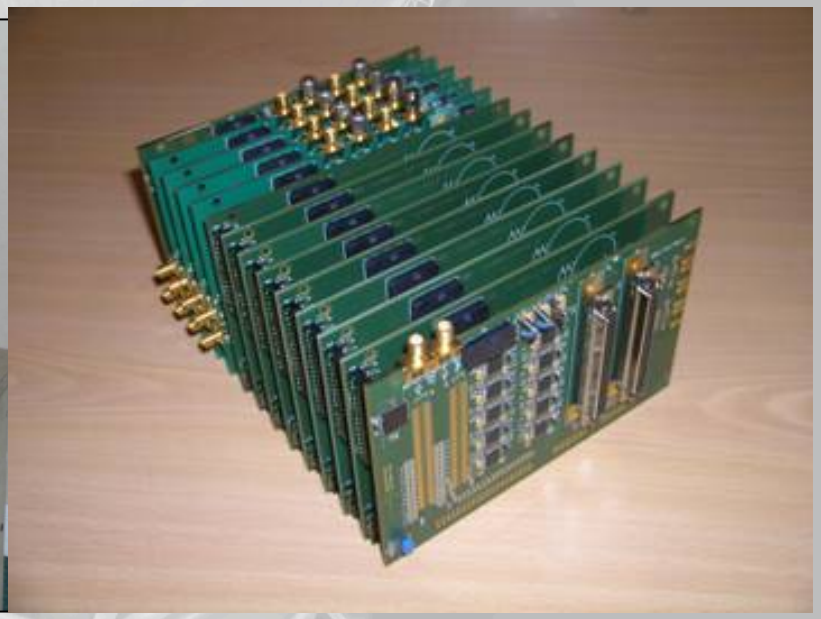
Roach 1: base-band recording for LEAP and coherent de-dispersion over up to ≈ 400 MHz



ROACH 1 tested in the laboratory with a fake injected pulsar signal: all ok

Pulsar Back-end # 4

DBBC: VLBI base-band converter, usable for and (in)coherent de-dispersion



DBBC tested in the laboratory and at Medicina site

Pulsar Back-ends location

Temporary location of the DFB3, ROACH1, DBBC and AFB systems

SRT timeline

- Technical commissioning DONE
- Science validation will run until ≈ 30 november 2013
- Early science shared-risk mode will likely run until late (??) 2014


Thank you!