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FAST: on-going commissioning



Yogesh Chandola

On behalf of

The FAST Team

NAOC, Beijing

FAST construction



Construction completed 2016-09-25

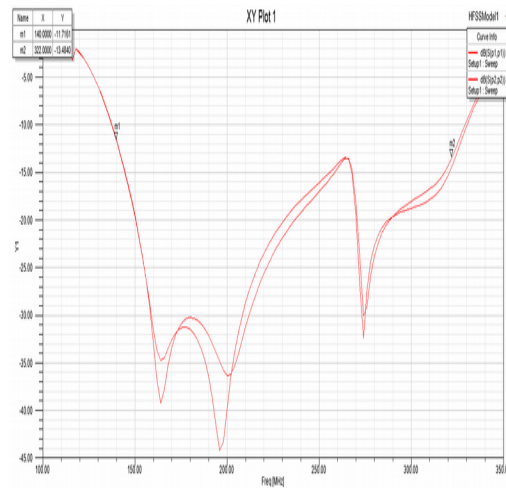
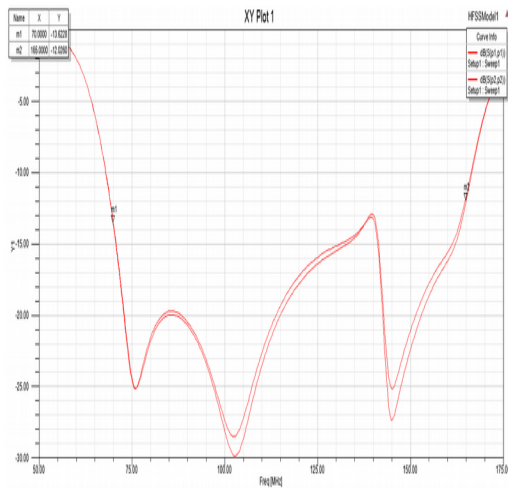
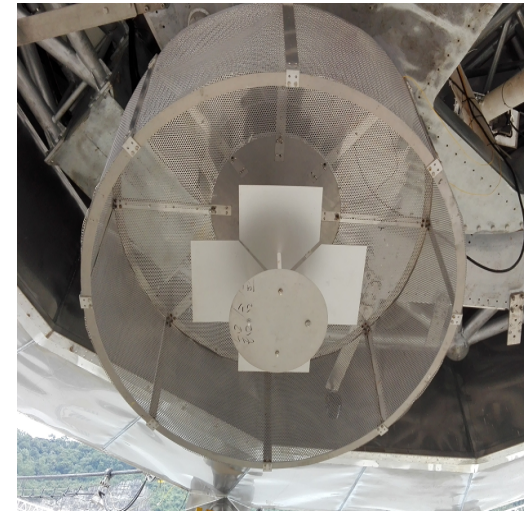
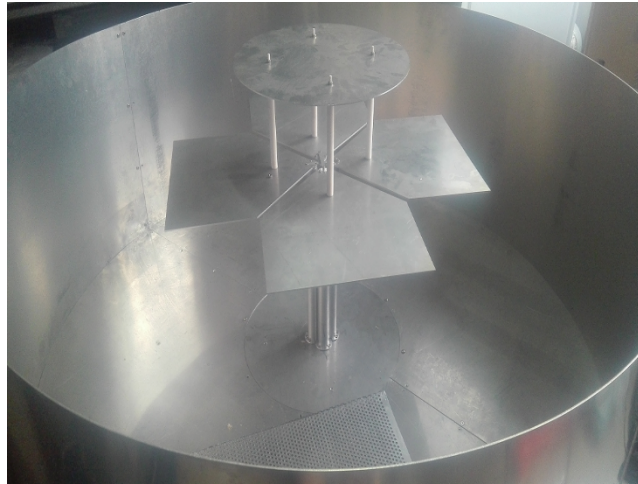
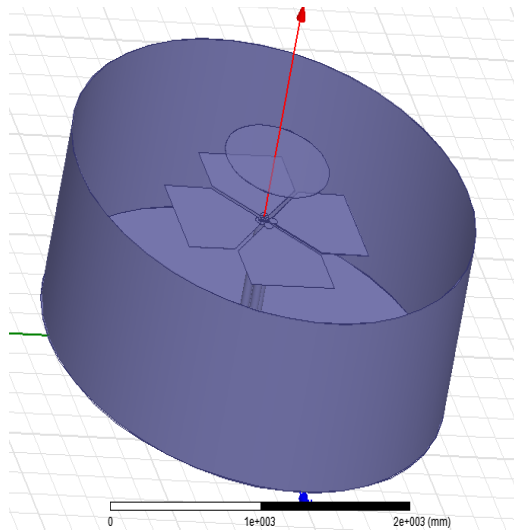


2 times the collecting area than the Arecibo, raw sensitivity (1-2 GHz) $2000 \text{ m}^2 \text{ K}^{-1}$
Wide coverage (70 MHz-3 GHz), 19 beam feed (to be commissioned soon)
good for survey, slew time $<10 \text{ min}$, good survey instrument.

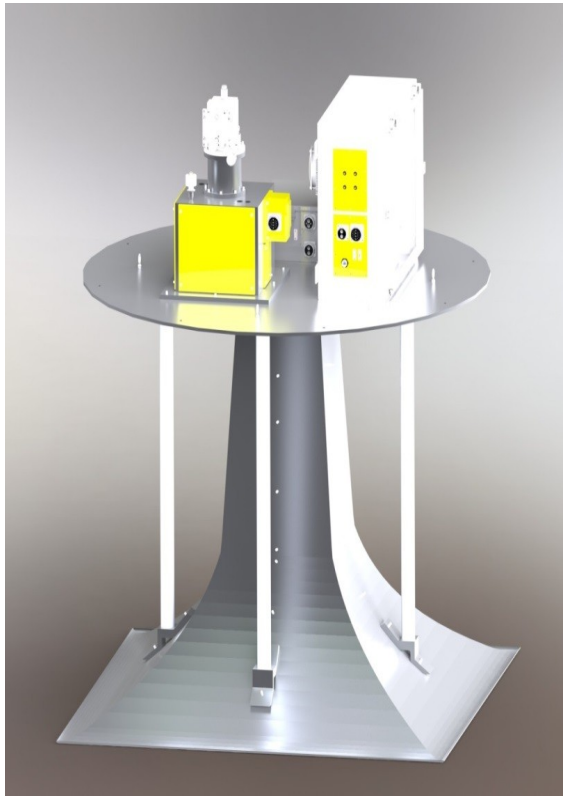
Commissioning

- **Receiver system developments**
- **EMC and RFI**
- **Measurement and control system**
- **Surface adjustment**

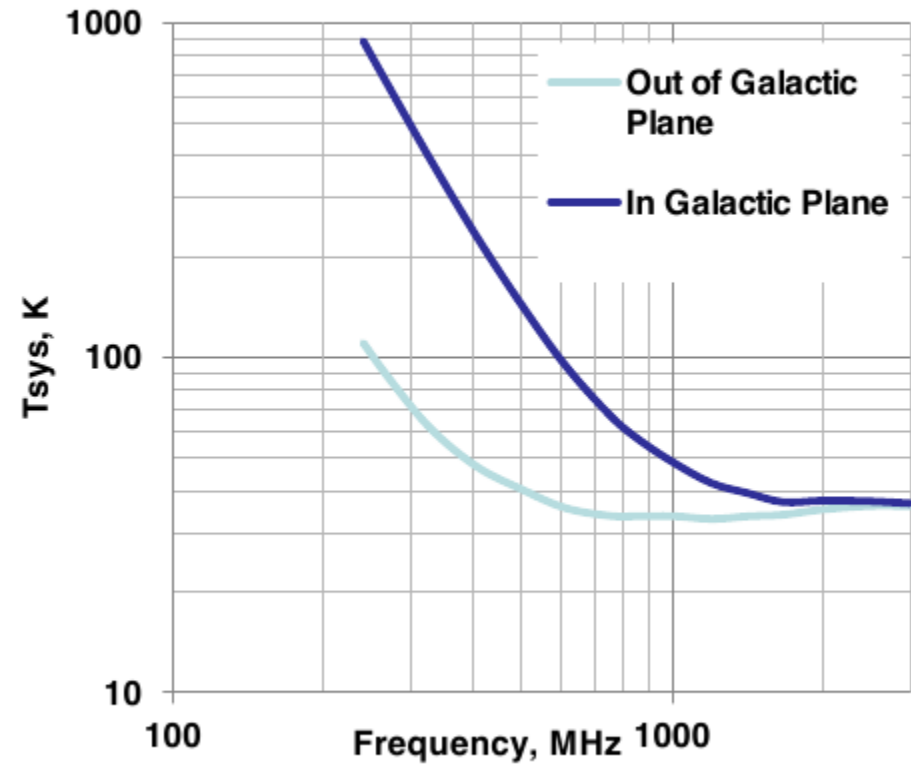
140 - 280MHz Receiver



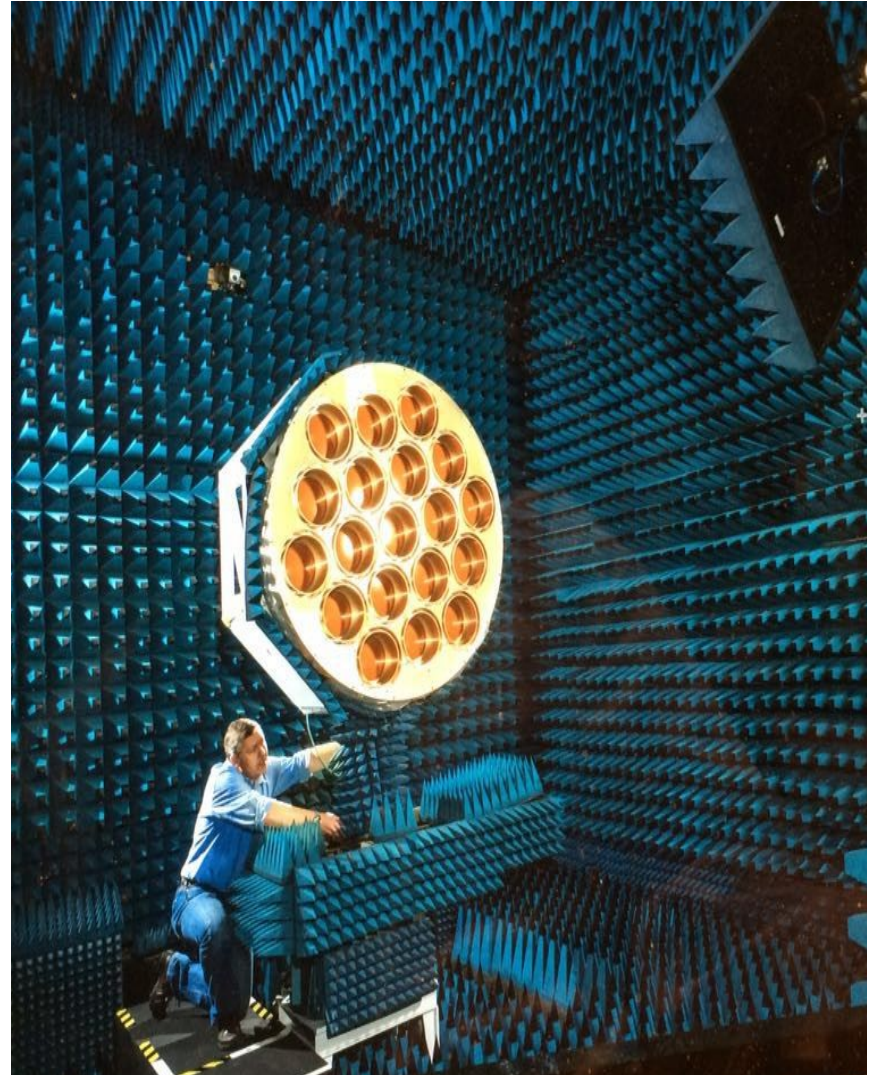
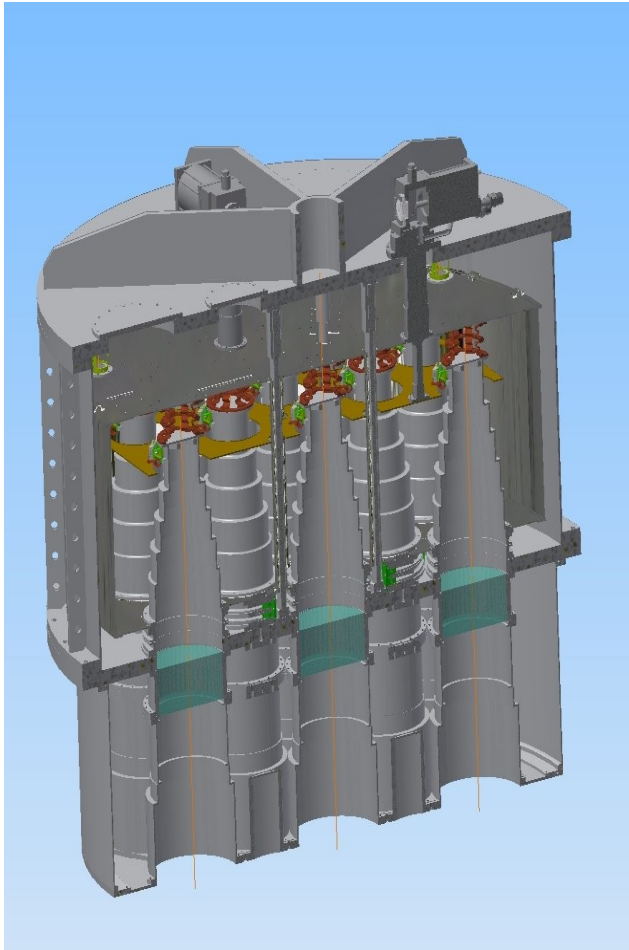
270-1620MHz Wideband Receiver



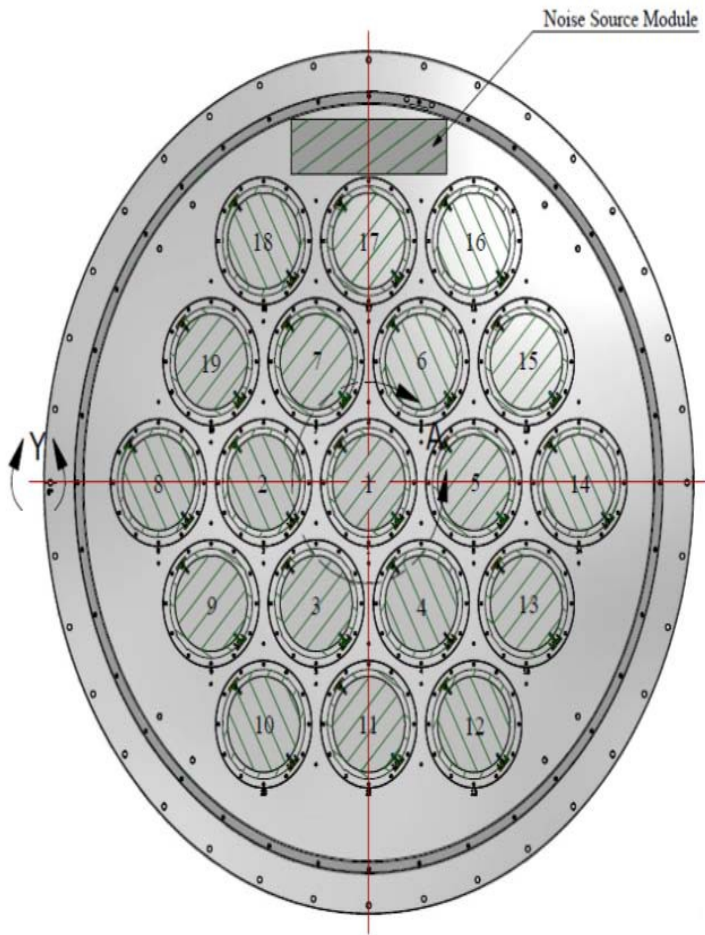
FAST Tsys for 20K Receiver



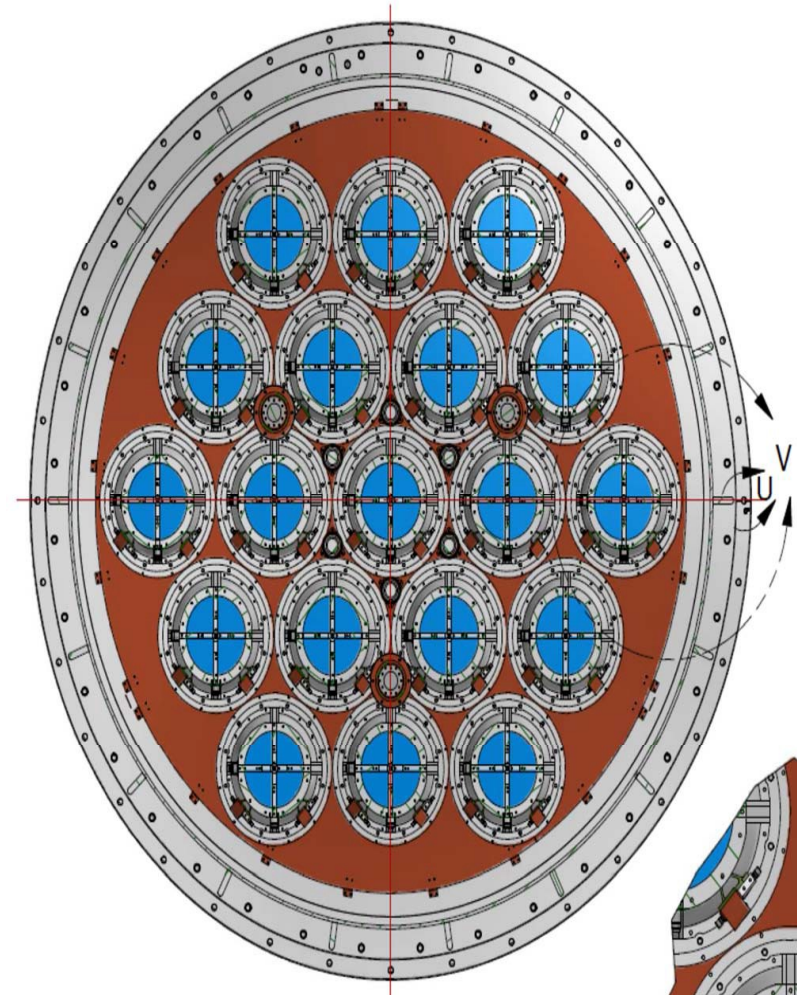
1050 - 1450MHz Multibeam



19-Beam Array



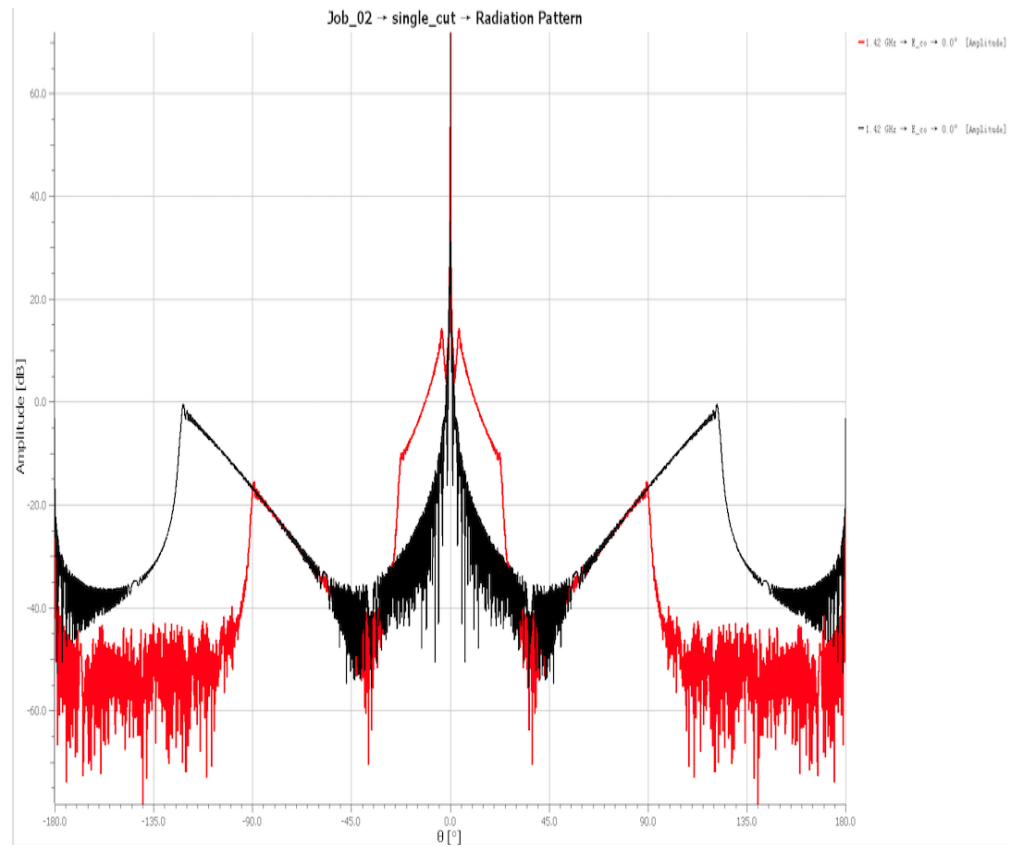
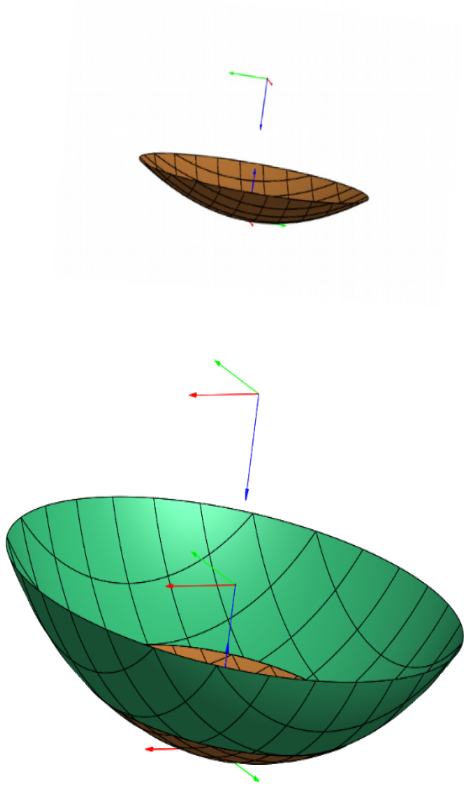
SECTION W-W



19-Beam Assembly at CSI R0

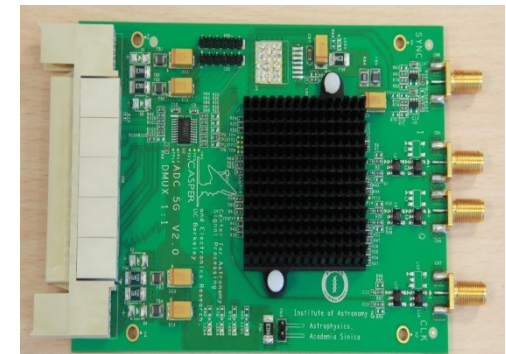
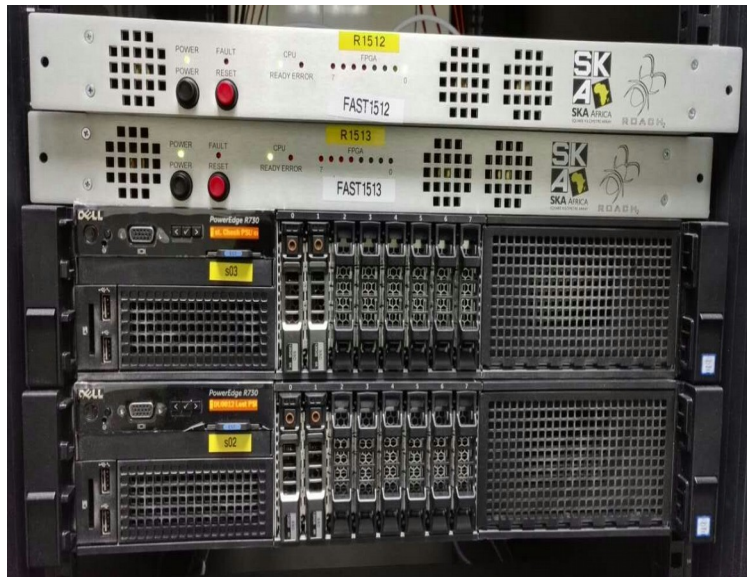


300m paraboloid vs. 300m paraboloid + sp herical skirt



Digital Backend (single beam)

- 4xROACH2, each with 5Gbps ADC sampling card+2 Quad SFP+ Mezzanine
- 4 DELL PowerEdge R730
- Chelsio T580-LP-CR and 2 Nvidia GeForce Titan X GPU board



↑ 5Gbps ADC

← GeForce TITIAN X

EMC and RFI

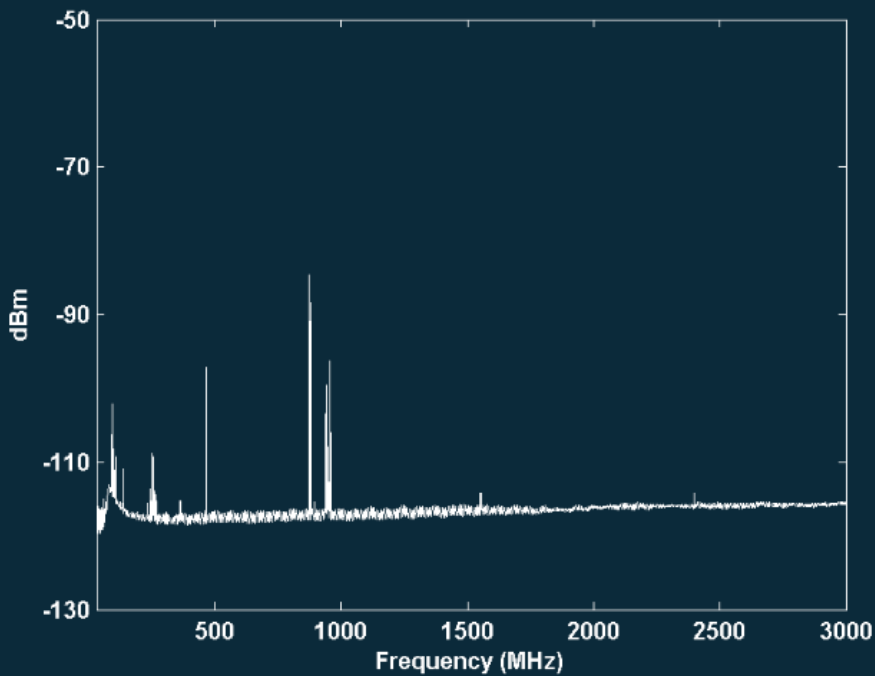


电磁干扰监测

Radio Frequency Interference Monitor

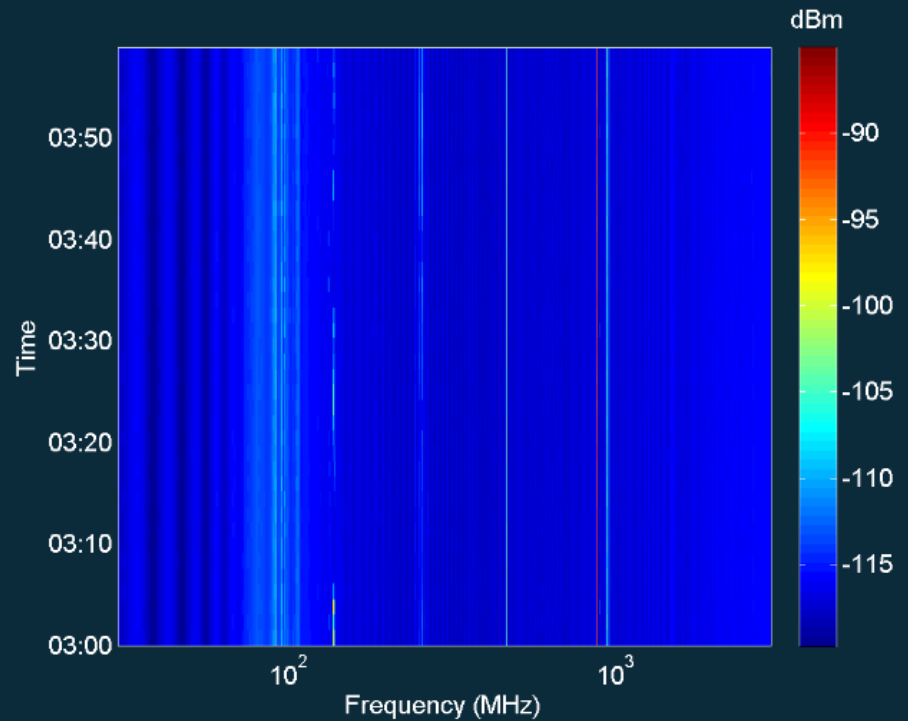
RFI 频谱

RFI Spectra



RFI 时变

RFI Waterfall

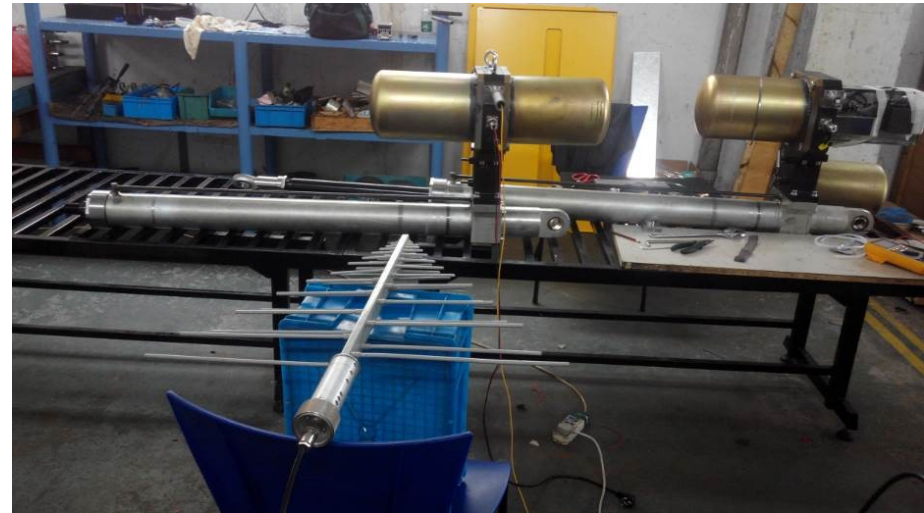


EMC control



- Actuator testing and shielding

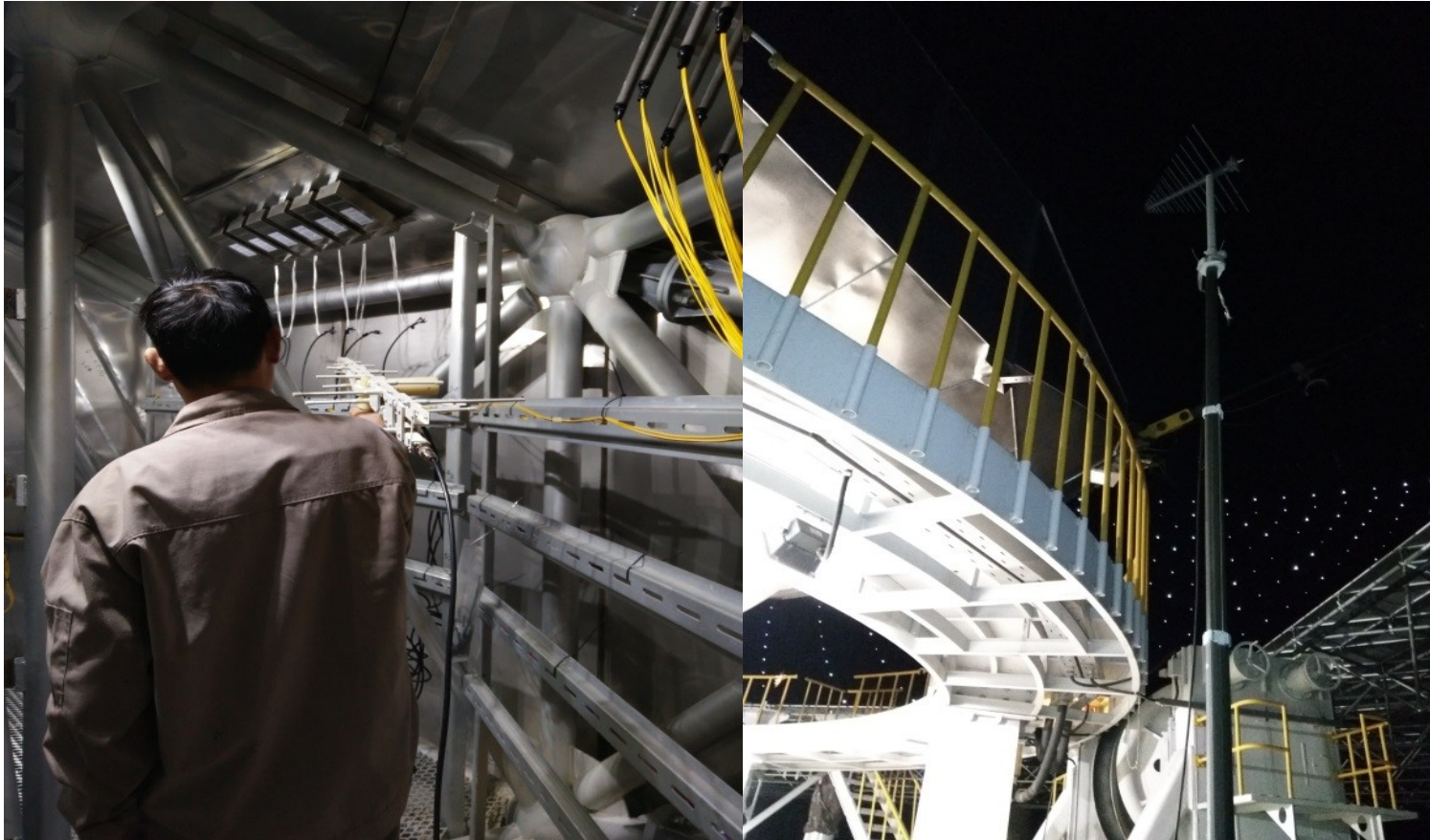
✓ Shielding 80dB



EMC control



FAST receiver cabin shielding



Total station shielding



EMI test

EMI testing



EMC control

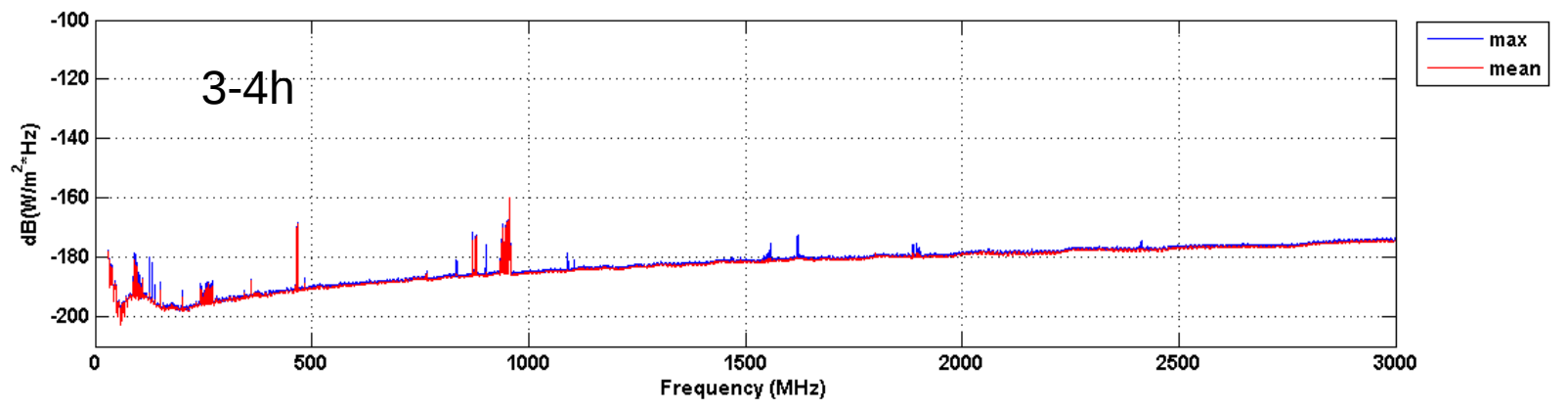
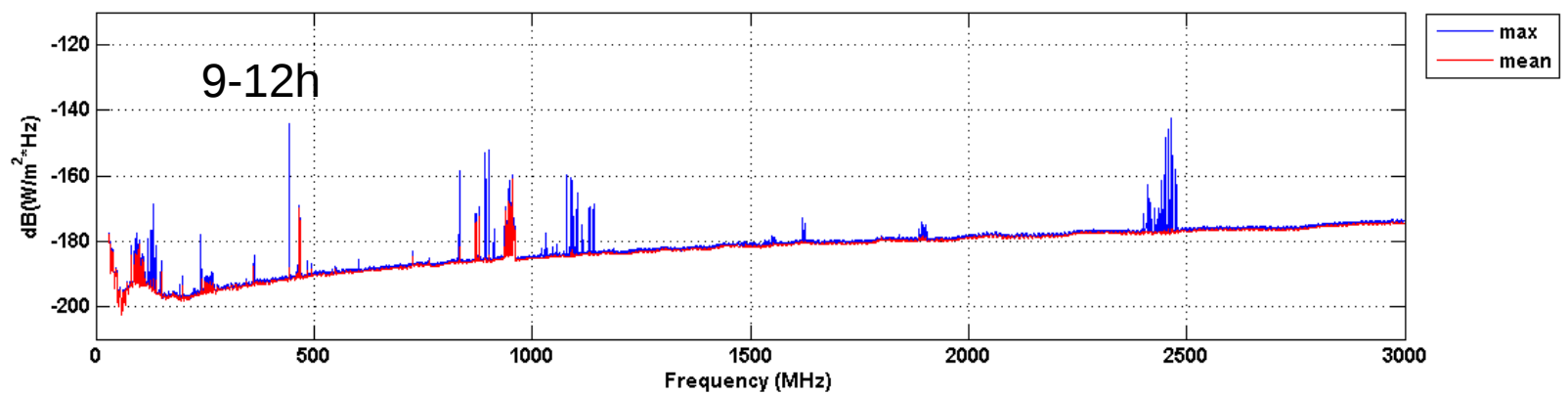


RFI environment monitoring



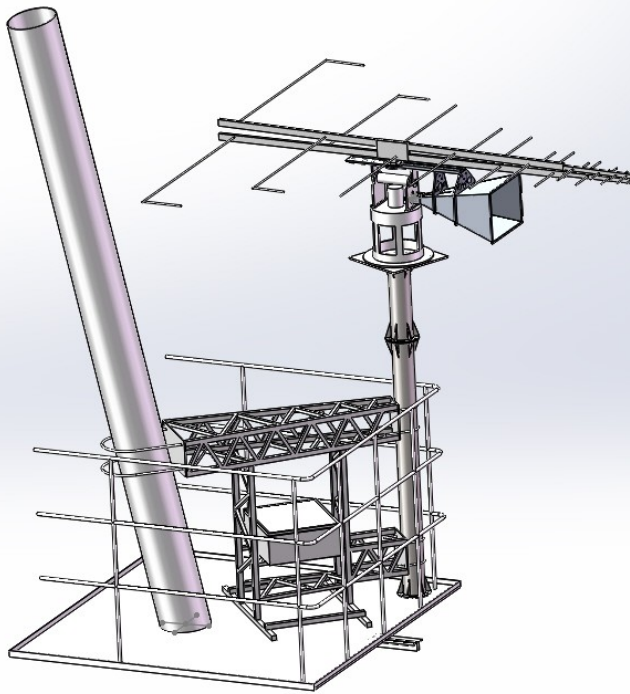


2016-11-08 RFI testing results



Set up the RFI monitoring station

Freq: 0.07-2GHz, 1.5-5GHz





Reflector surface

- Surface Accuracy target <1.5mm

Date	Start time	End time	Measuring points	RMSE (mm)
10.25	19:56:45	21:12:07	2256	1.1595
10.26	09:07:11	10:23:39	2256	1.2366
10.26	16:24:56	17:35:15	2256	1.4851

- Measurement efficiency < 180 min

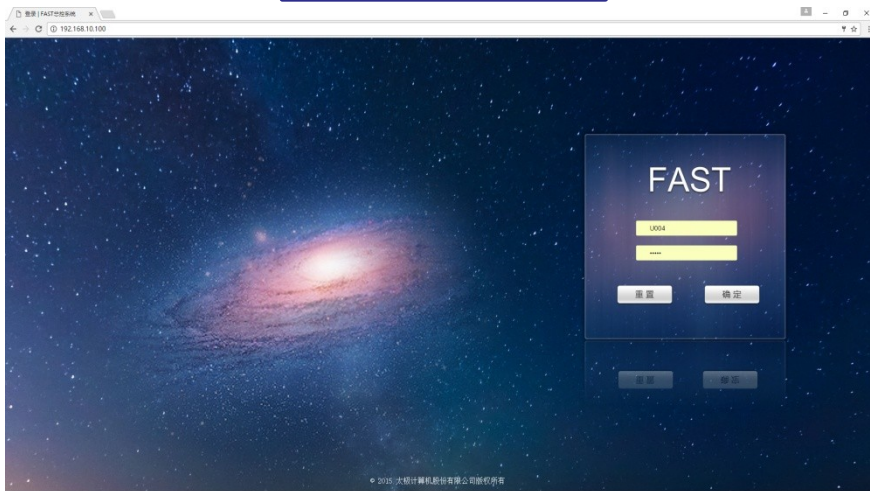
Date	Start time	End time	Measuring points	Time used (min)
10.25	17:27:43	18:40:38	2221	73
10.25	21:51:15	23:03:57	2221	73



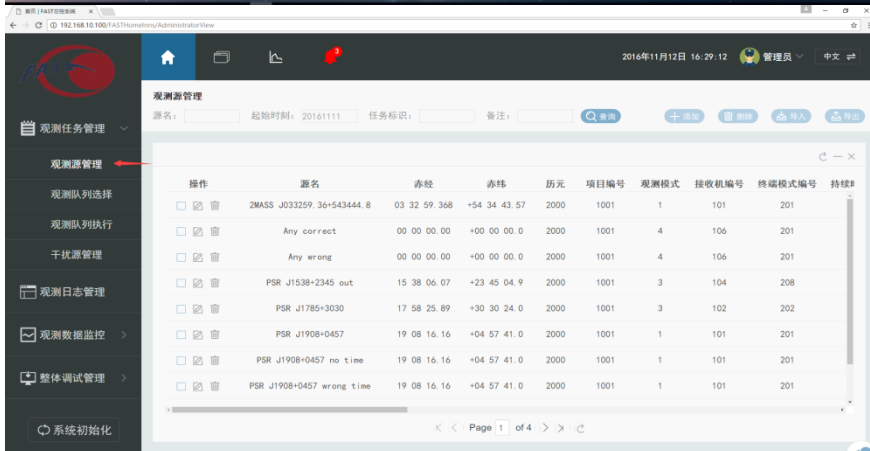
Telescope Control system

Interface

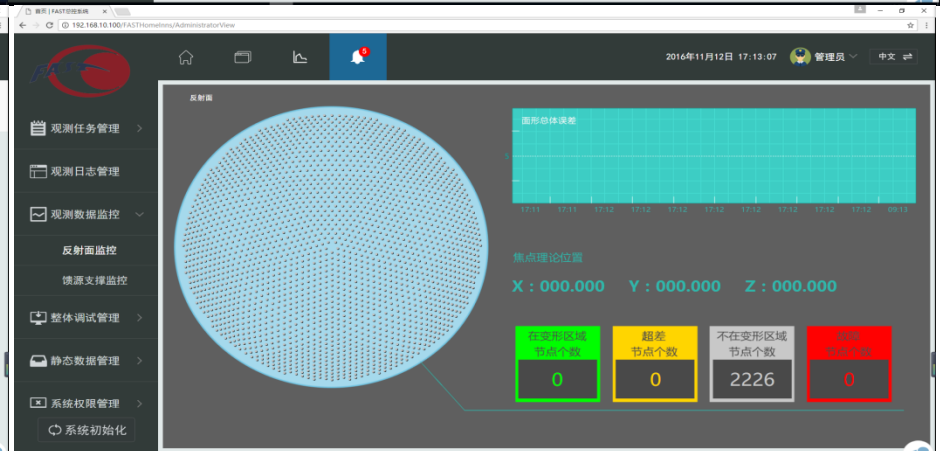
Login panel



Control panel



Observation task monitor



System data monitor

1.6PB on site and 1.4PB at GNU



Data center



Early Science and test observations

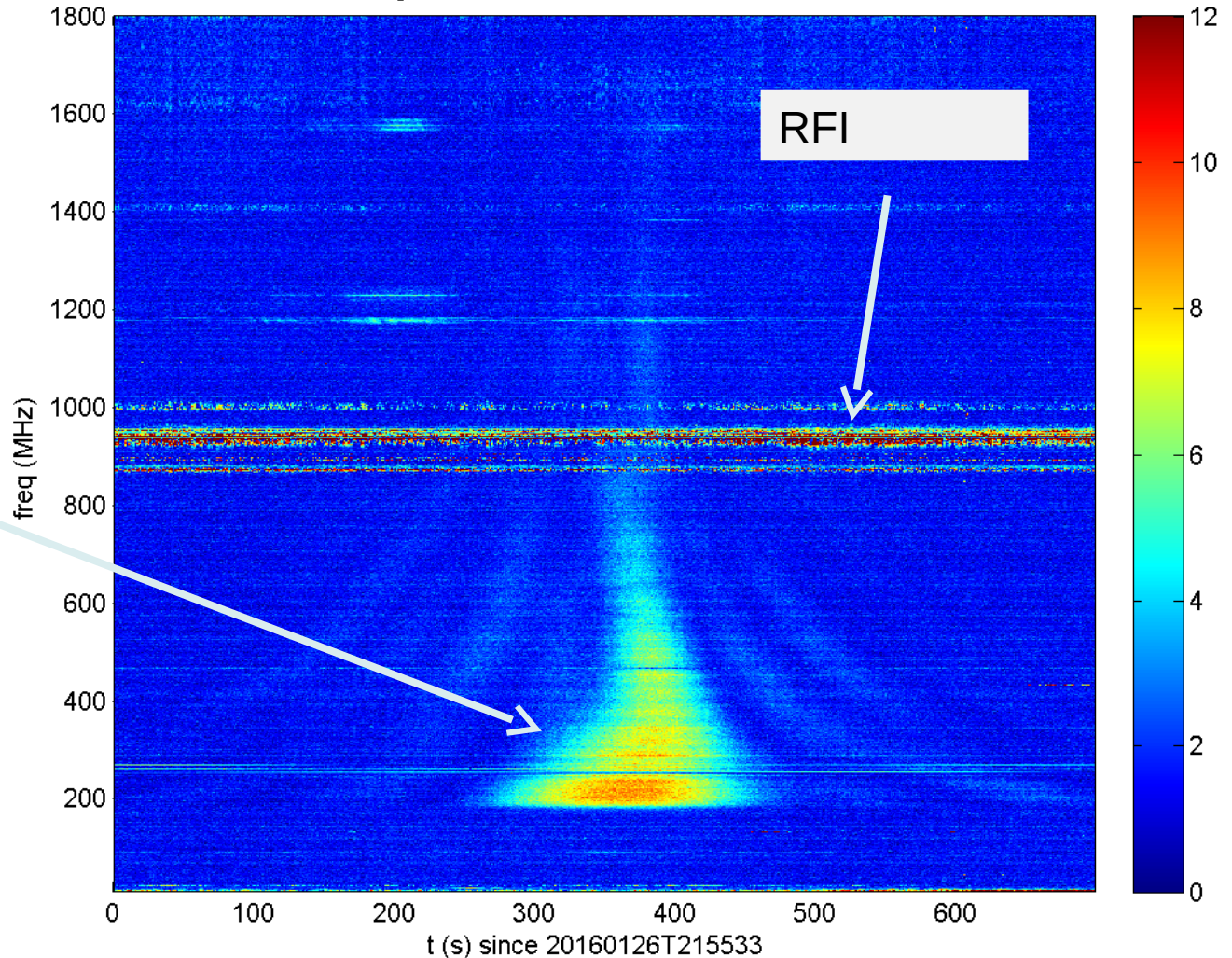


- **Pulsar observations**
- **Continuum sources**
- **Pointing and focus calibrations**
- **Flux calibrations**
- **Commensal observations**

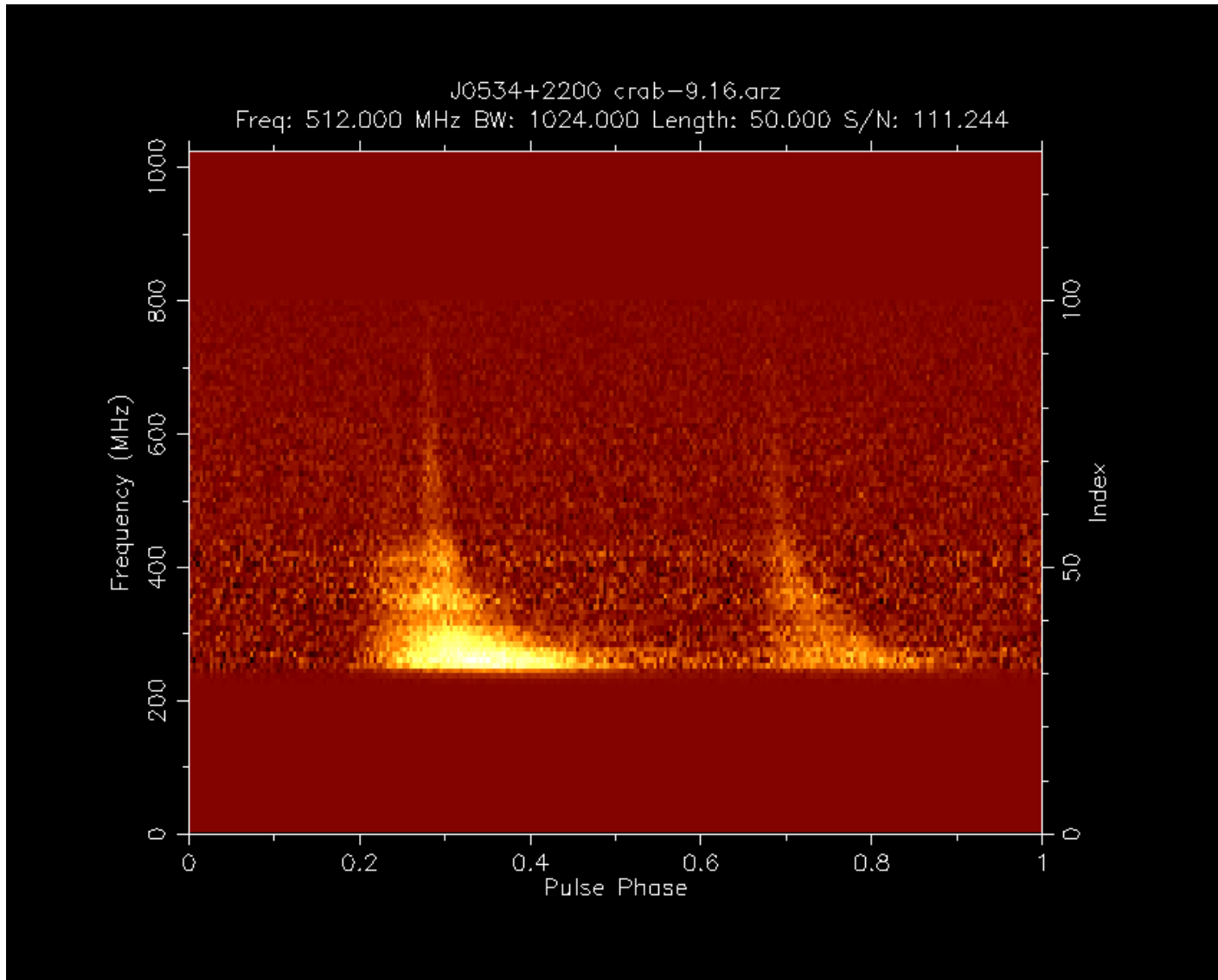
Crab Nebula and pulsar

background subtracted, colorbar in dB scale

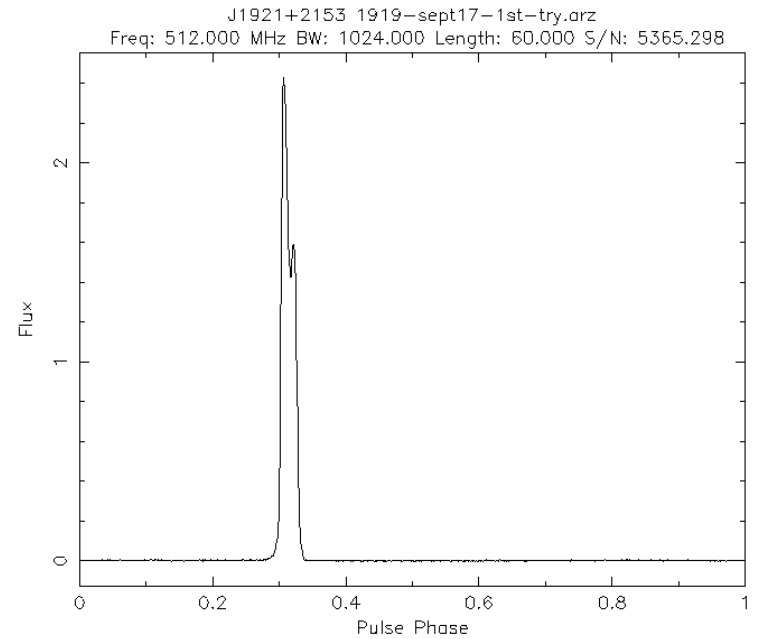
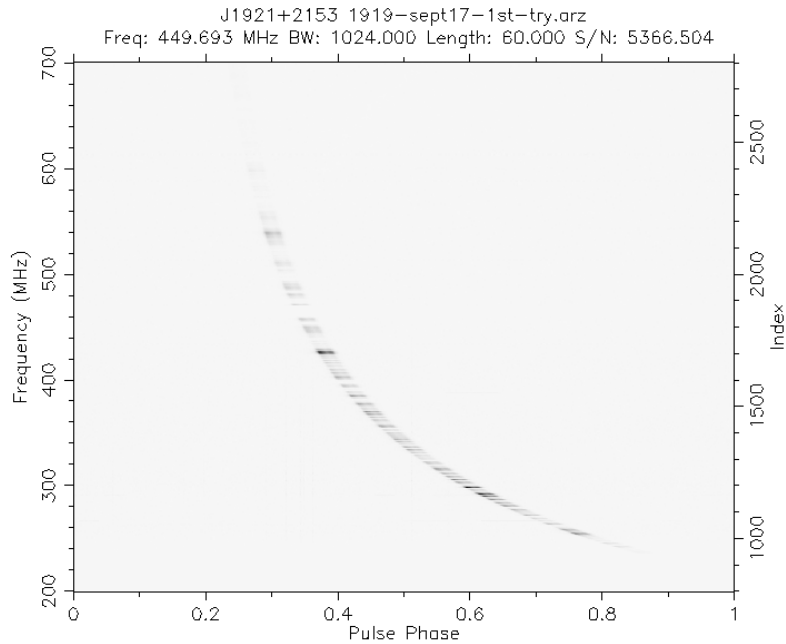
20160126
crab
nebula
continuum
emission



B0531+21 Crab

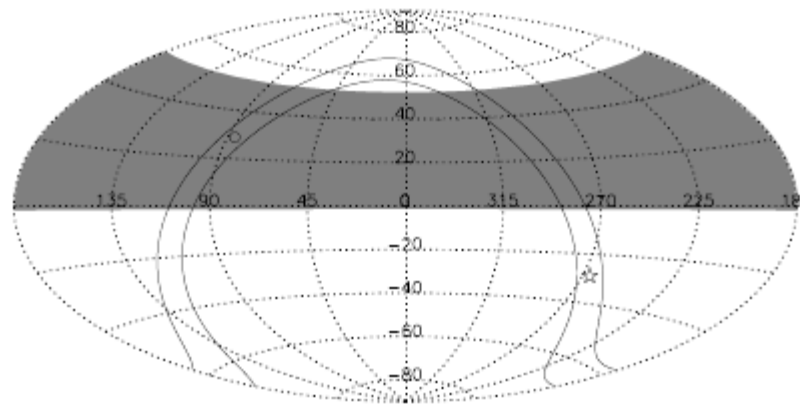


Pulsar B1919+21



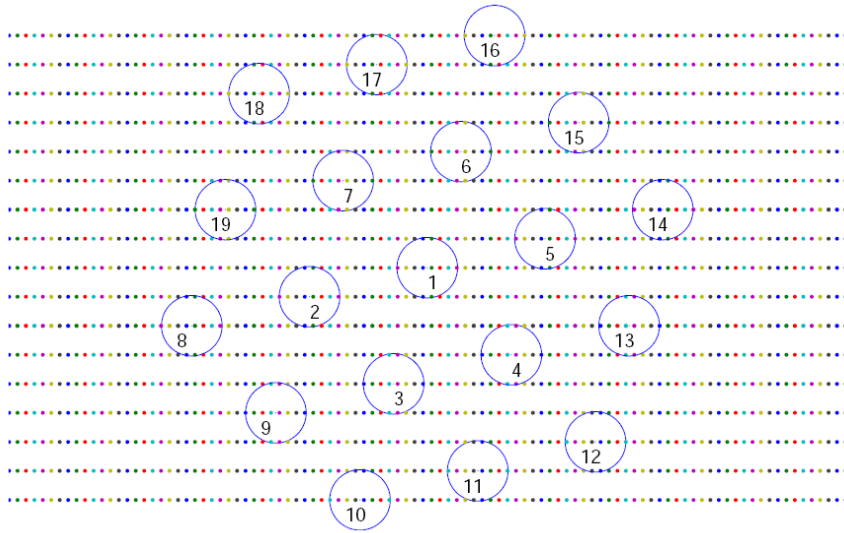
FAST drift scan configuration (Qian Lei et al. in prep.)

- Drift scan survey: telescope fixed and scans the sky within the FOV
- Precursors: Arecibo ALFALFA (Giovanelli et al. 2015) , sensitivity ~ 1.8 mJy for 10 km s^{-1} , around 30000 sources expected from full survey
- FAST drift scan :
Effective integration time 10 s at 1.4 GHz
- Science goals: searching pulsars, Galactic and extragalactic HI observations

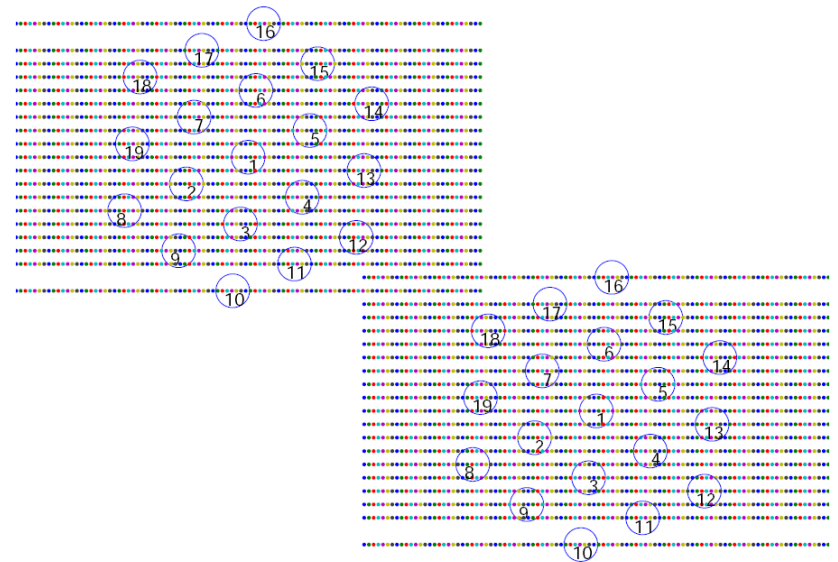


Sky coverage of FAST
corresponding to opening angle of
26.5 deg (Qian Lei et al., in prep)

FAST drift scan configuration (Qian Lei, et al. in prep.)



Single pass mode:
rotation angle 13.9 deg.
Total time for survey ~ 187 days
Sensitivity: ~ 1mJy/10 kms⁻¹



Two pass mode:
Rotation angle: 23.41 deg
Total time for survey ~ 201 days

FAST drift scan survey and HI absorption

- **Wu et al. (2015):**
From ALFALFA 40 % survey, 10 detections
- Upper limits on $T_s/f_c < 500$ for damped Ly-alpha systems.
- Predicted full ALFALFA survey ~ 25 detections.
- **Yu et al. 2017:** Prediction for FAST ~ 200 absorption system/month

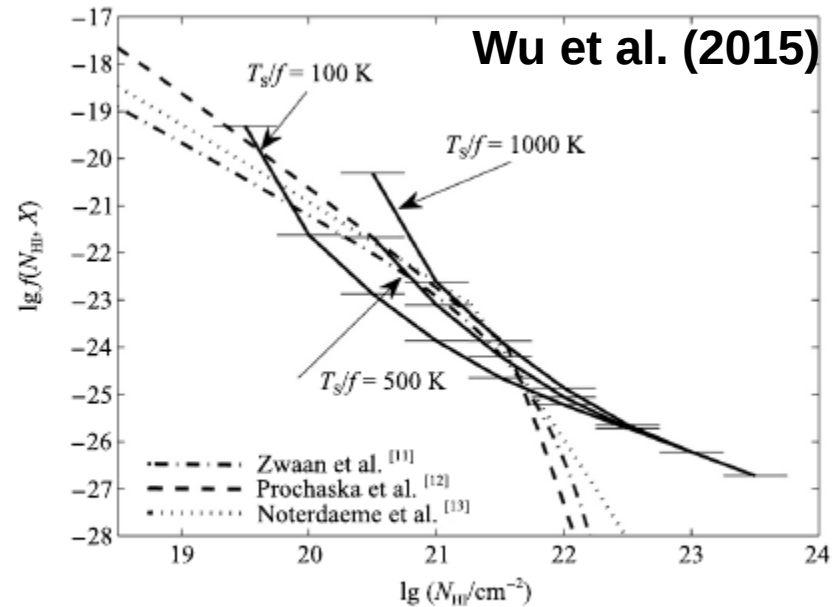


Fig. 2 The frequency distribution of HI column density

Summary

FAST Commissioning

- Intensive work for at least 1yr
- Still need major developments of the Receiver systems, Data reduction pipeline and control software systems, etc.

Early Science with FAST

- Pulsar and FRB searching
- Commensal observations setup
- FAST drift scan observations