

# **The Status of SHAO-MWA Ph3 Receiver**

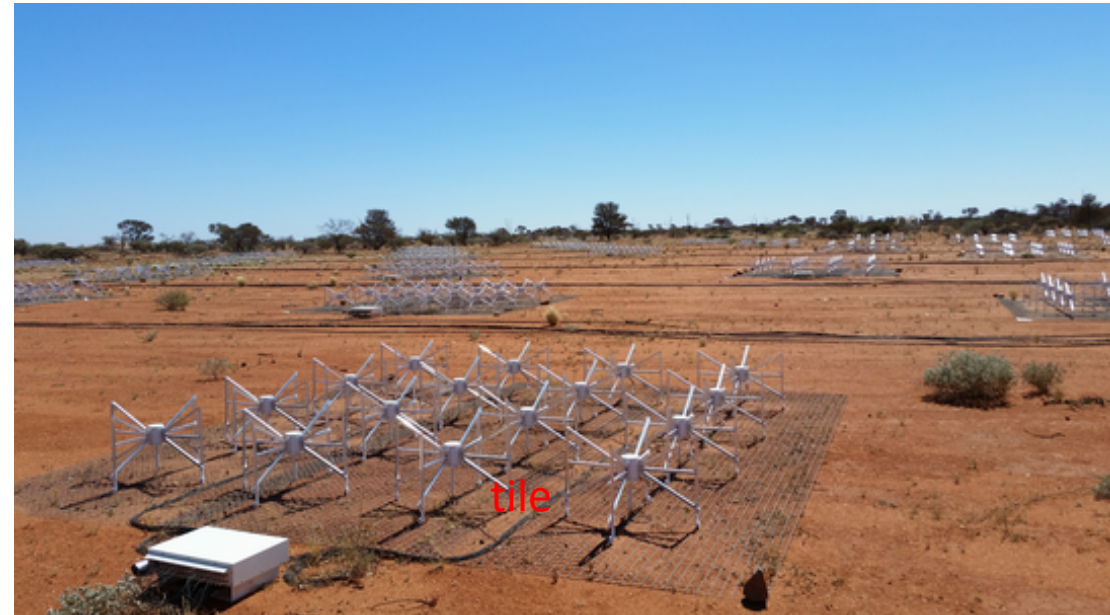
**Yajun Wu**

**Shanghai Astronomical Observatory(SHAO, CAS)**

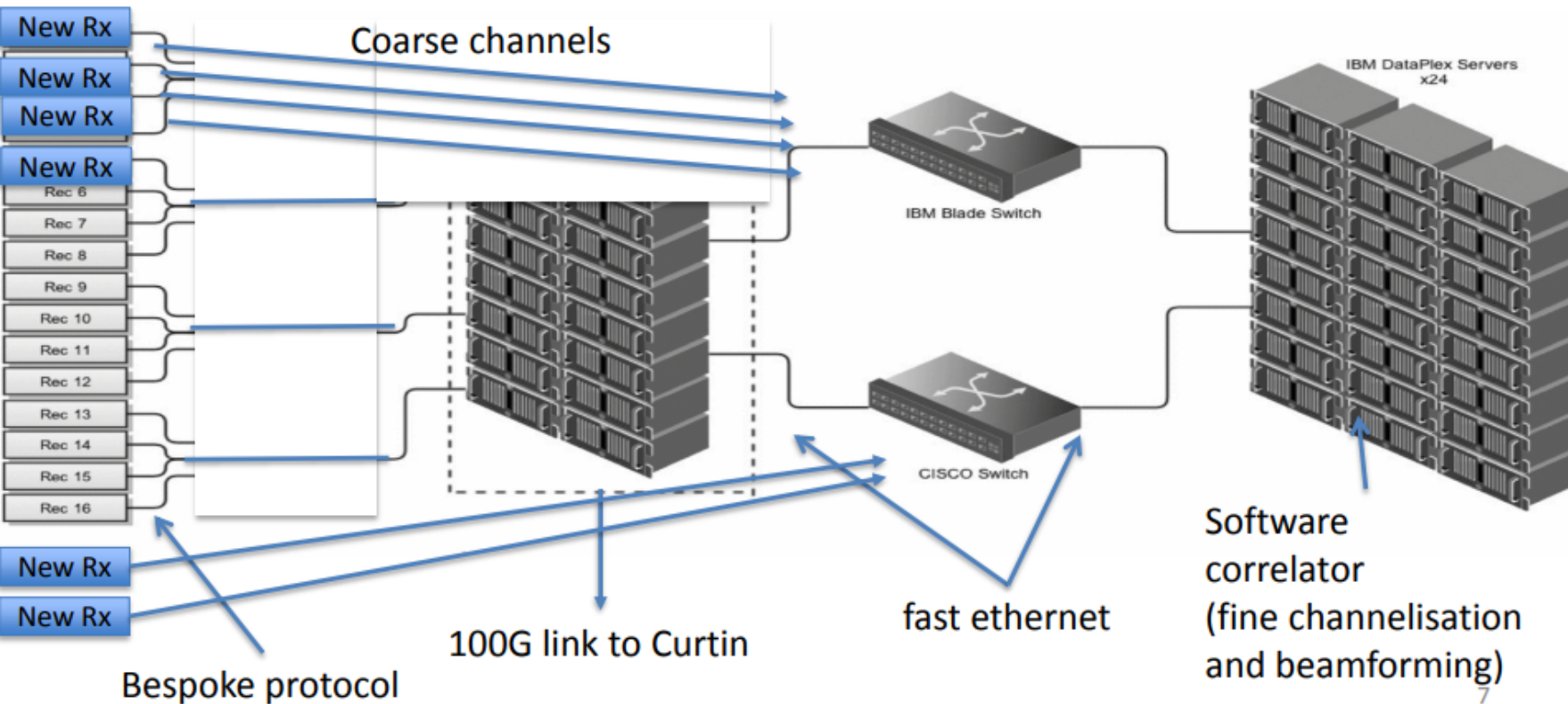
# Background

- **The MWA Ph2: SHAO**
- **The MWA Ph3: SHAO supply 16 Receivers as the contribution;**
- **SHAO: funded by the SKA pre-study project;**

- ✓ **MWA 256 tiles; 128 tiles working at Ph2;**
- ✓ **16 antennas(Low frequency) as a tile;**
- ✓ **16 receivers receiving signals from 128 tiles;**



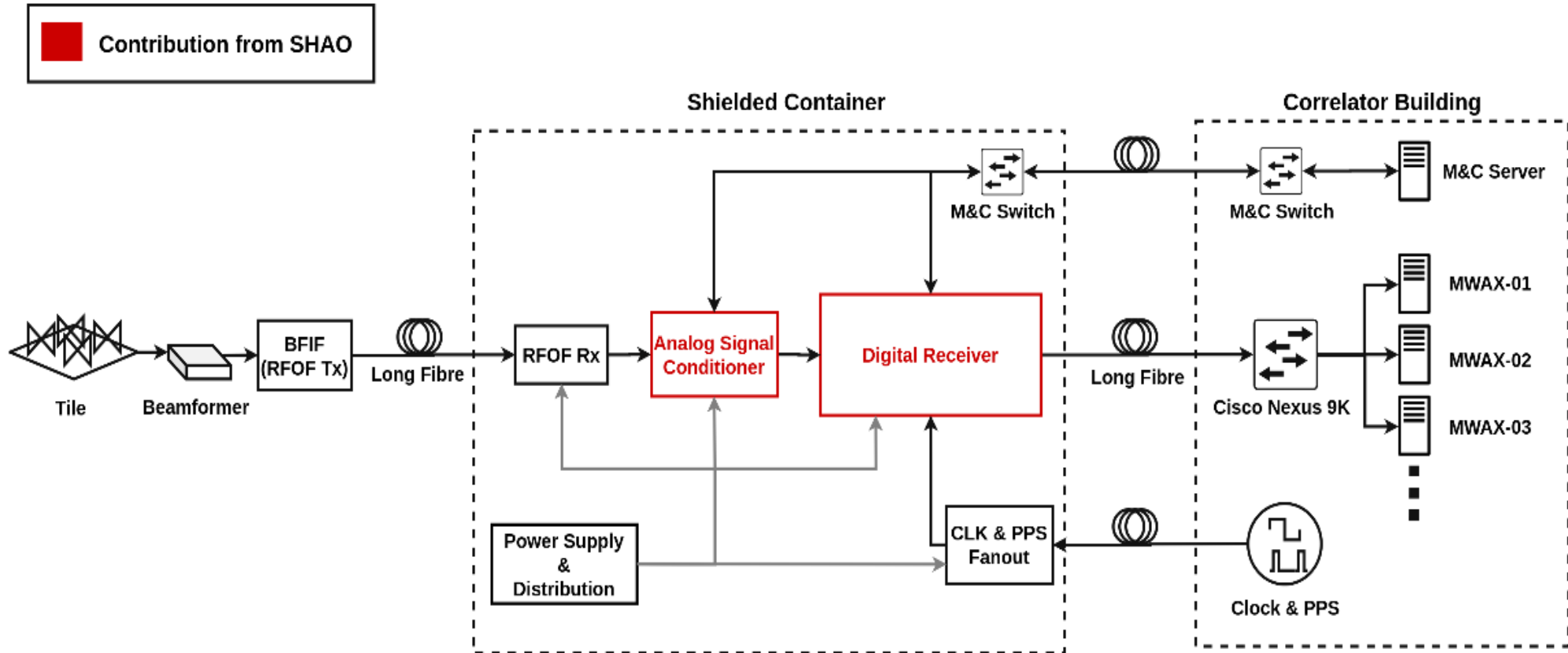
# The MWA Ph3 upgrade plan



## • Receiver Requirements

- ✓ More ADC bits:12
- ✓ Oversampled PFB  
Critical PFB;
- ✓ Standard network packet;
- ✓ Raw voltage capture;
- ✓ Flat spectral response;

# The Signal Path



# The Specifications of the receiver

M/C

OS/Driver

function

Hardware

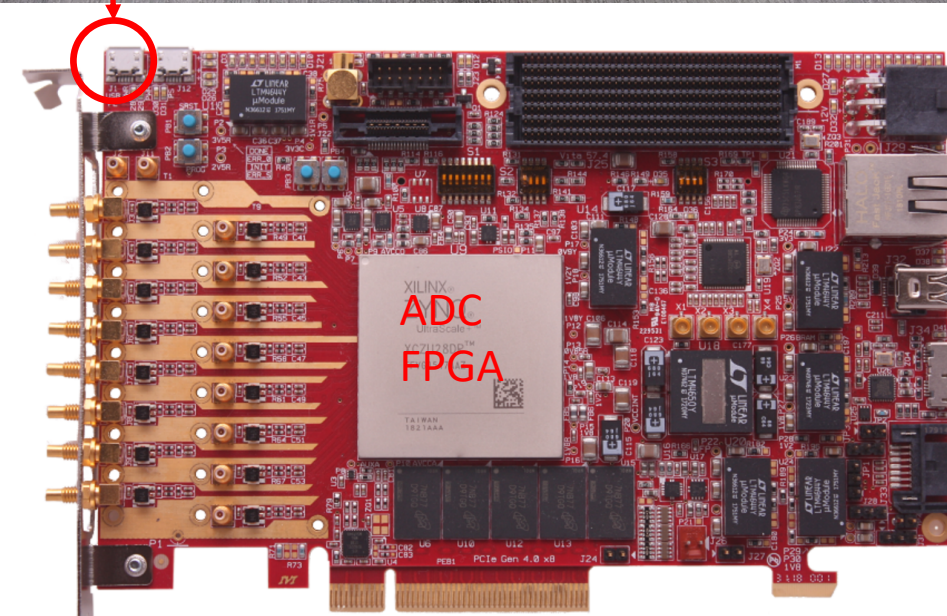
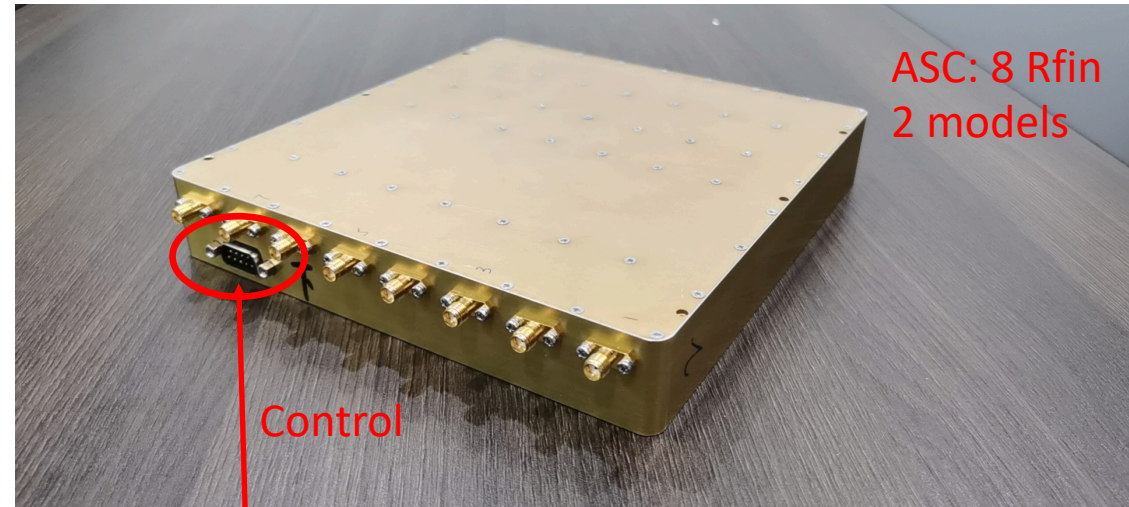
- M/C: software, communication and configuration;
- OS/Driver: Linux OS, configure the gunction model;
- Function: models to implement the functions of the receiver;
- Hardware: analog amplifier, ADC sampler, FPGA processor, 10GbE

Specifications:

- ✓ 16 RF input, for 8 tiles with 2 pols;
- ✓ ASC: -40 ~ 10 dB for RFoF or Cable;
- ✓ PFB: 1.28MHz/channel;
- ✓ Output: 24 channels; UDP; 10GbE port;
- ✓ Ringbuffer: raw voltage cache for 1s;

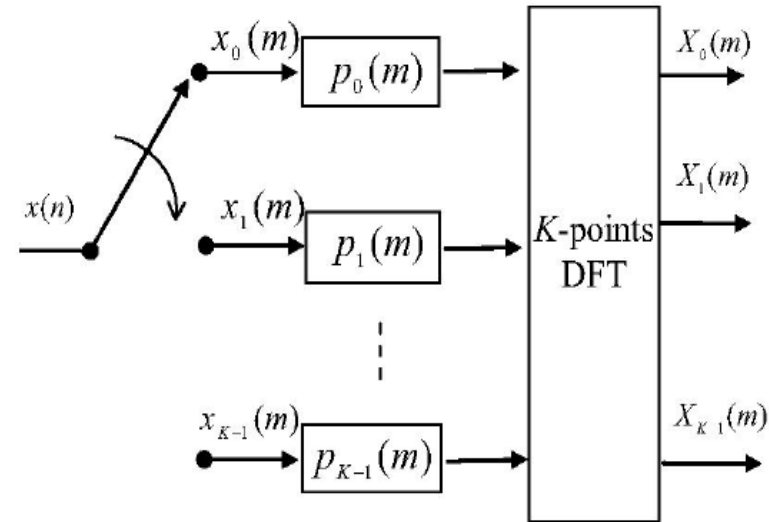
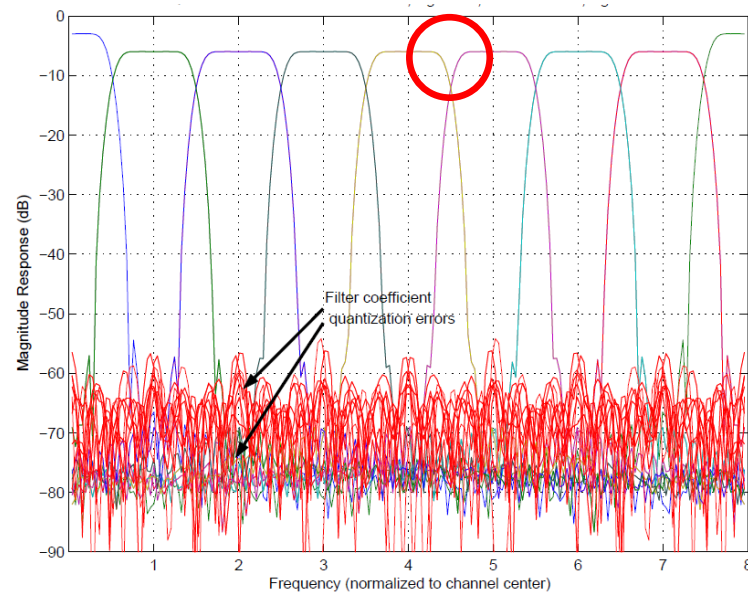
# The Hardware

- ASC:
- ADC/FPGA board:
- PPS/10MHz splitter:
- Power supply:
- Fan and Airflow:



# The function logic-PFB(Ph2 mode)

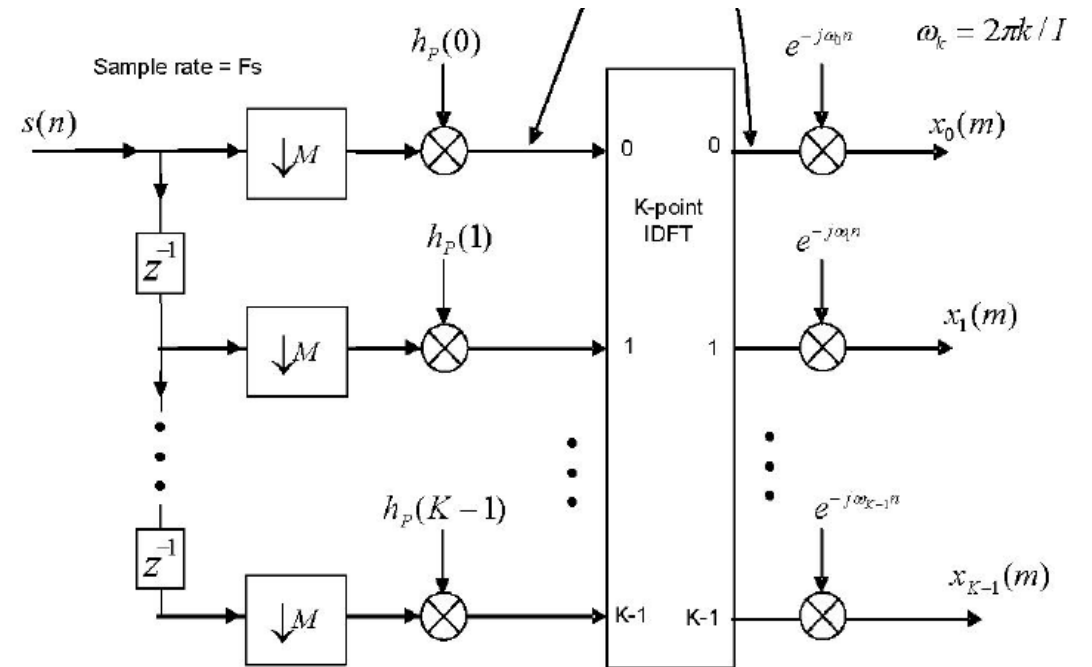
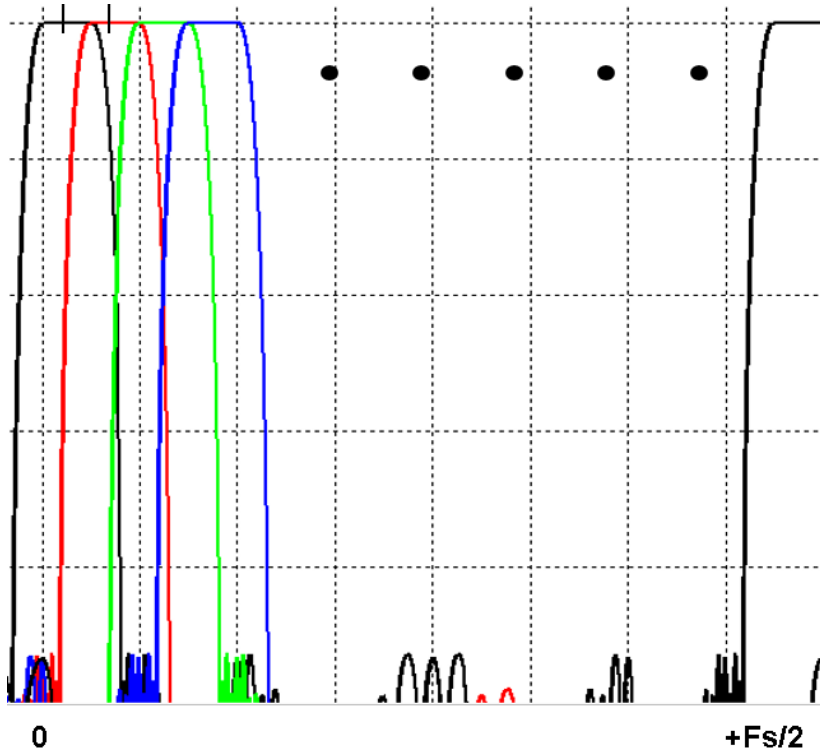
- Compatible mode with MWA Ph2;



- 1.28MHz channel bandwidth;
- Frequency loss at sides of channels;

# The function logic-OVPFB(Ph3 mode)

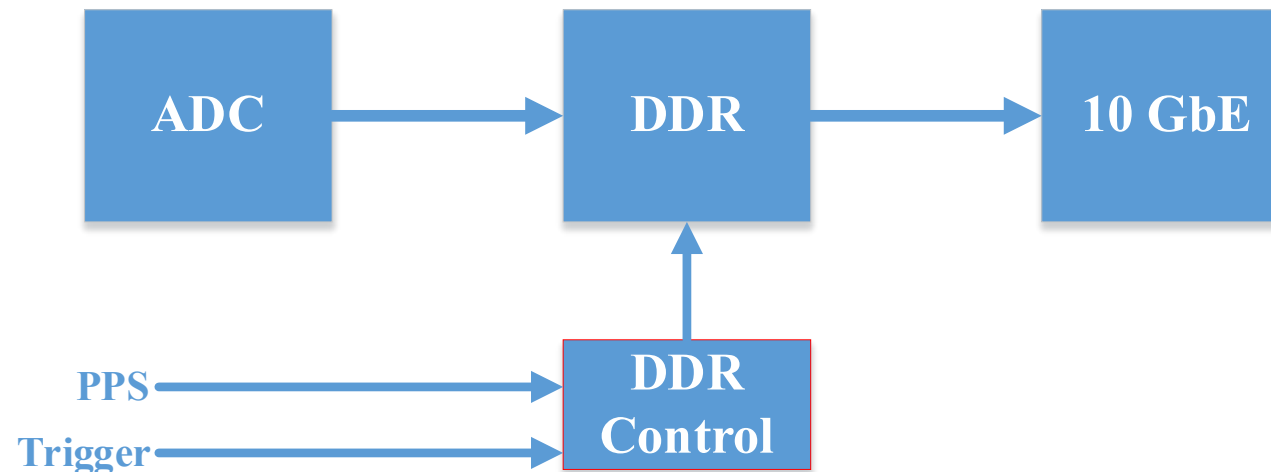
- Like SKA;  $K/M=32/25$
- Data rate higher;





# The function logic-raw voltage capture

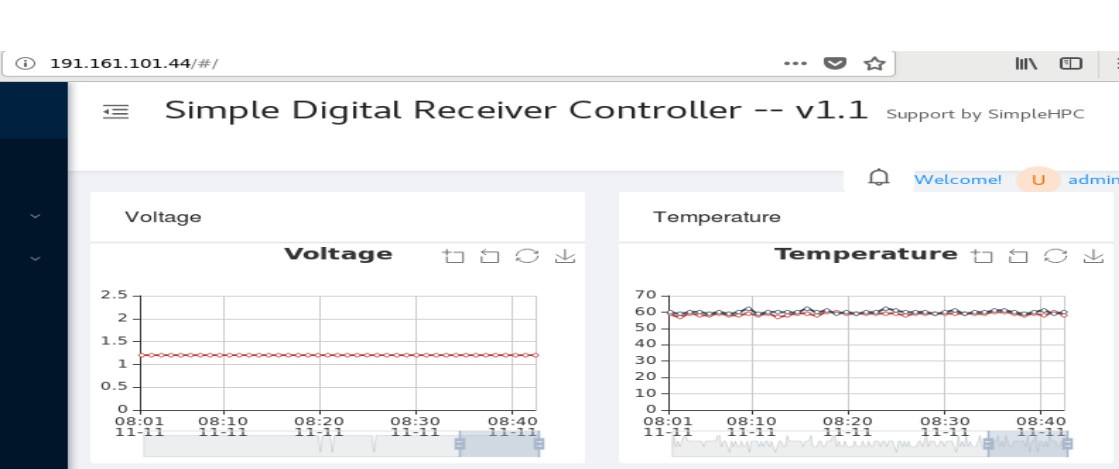
- New function in MWA Ph3 receiver;
- 16 RF, 8-bit raw voltage, about 84 Gbps;
- When triggered, data cached in DDR will transamitted by 2 10GbE port;



# The M/C software-Webserver

- A webserver for remote controlling based on Linux OS running by ARM processor;
- Access by IE browser or Client;

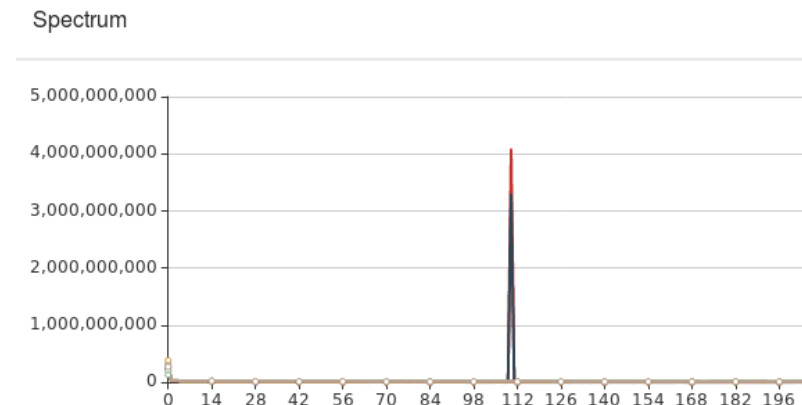
Monitor



Histogram

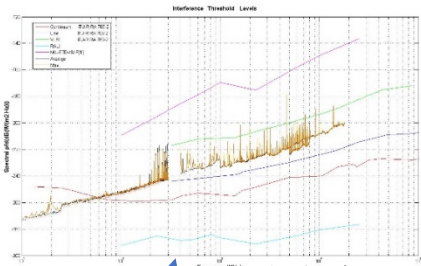


Spectrum

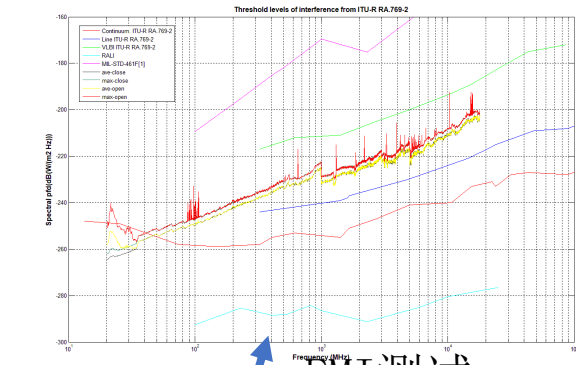
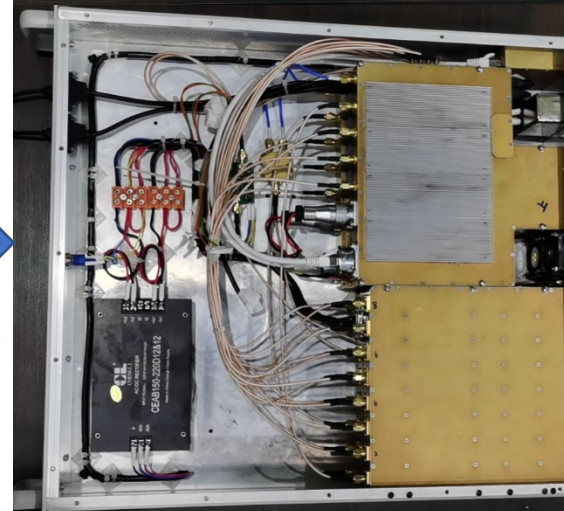
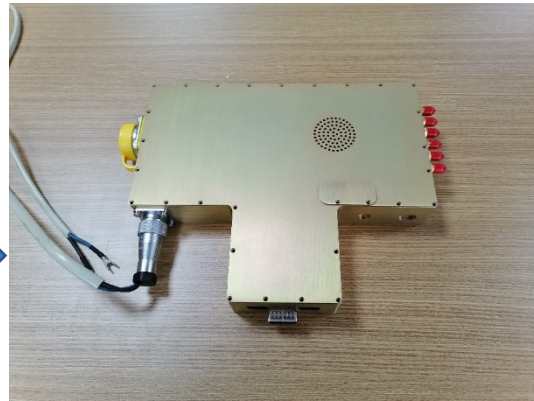


# The EMI

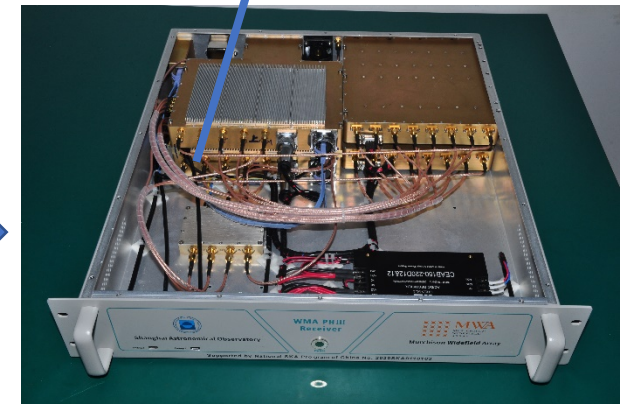
Measure the EMI of the components, design the shielded box and airflow



EMI测试

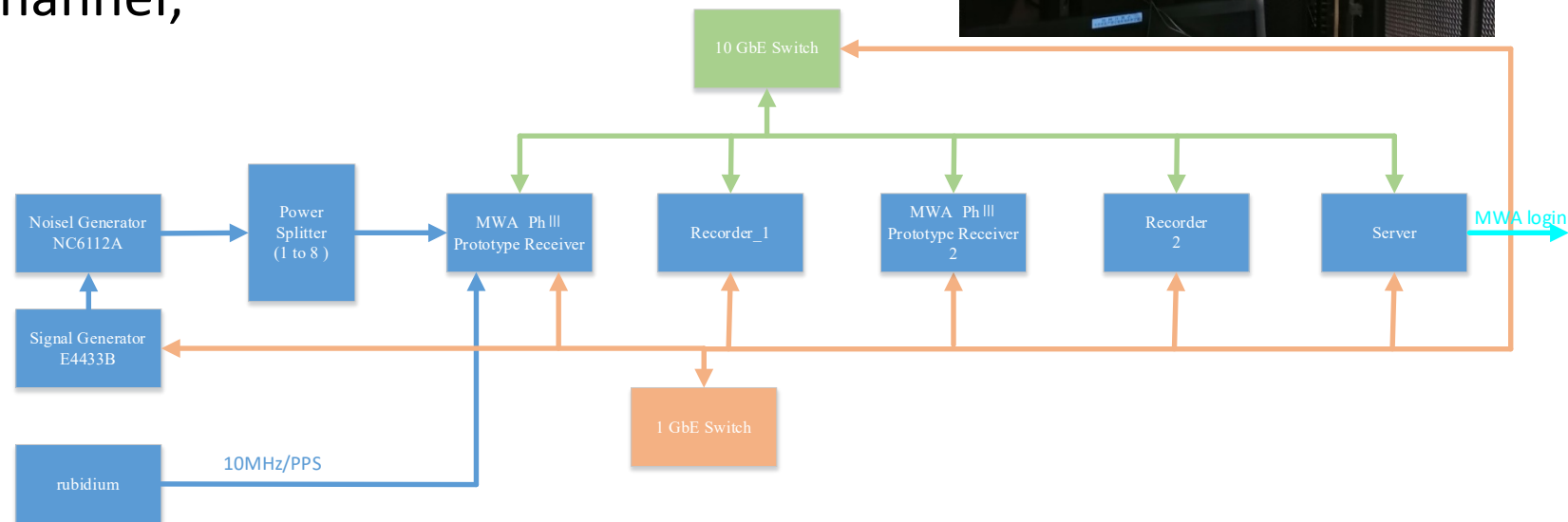
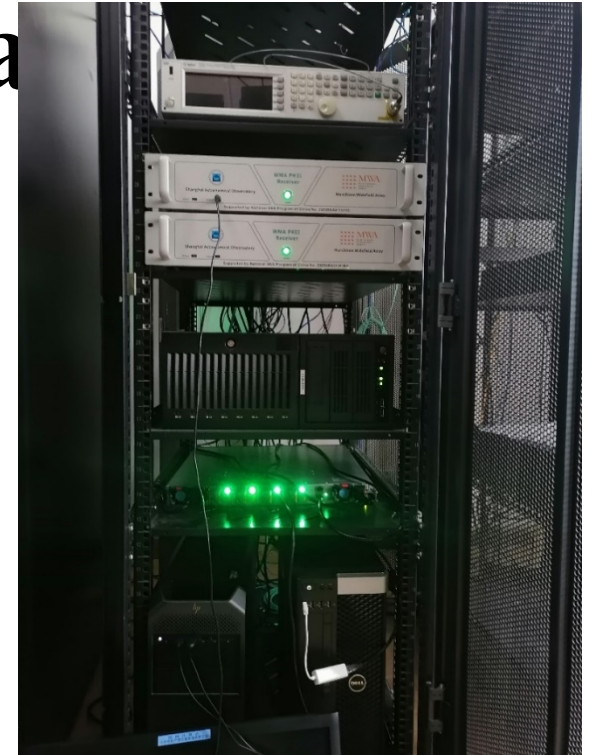


EMI测试

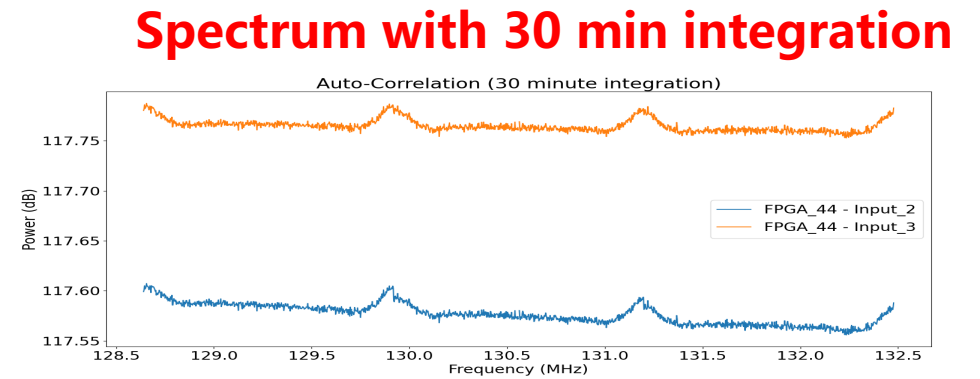
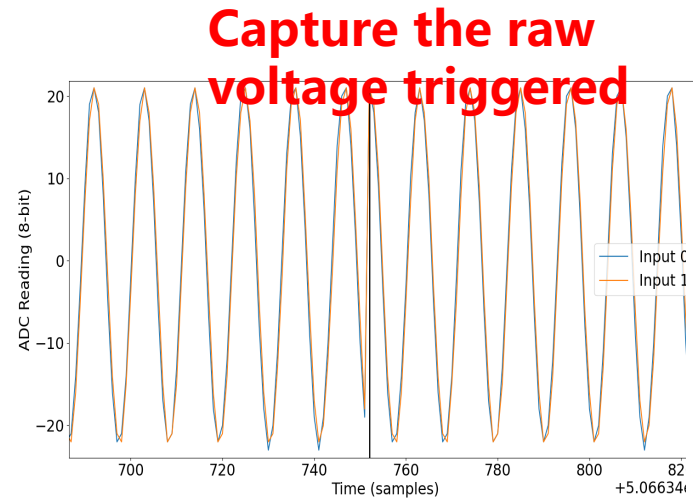
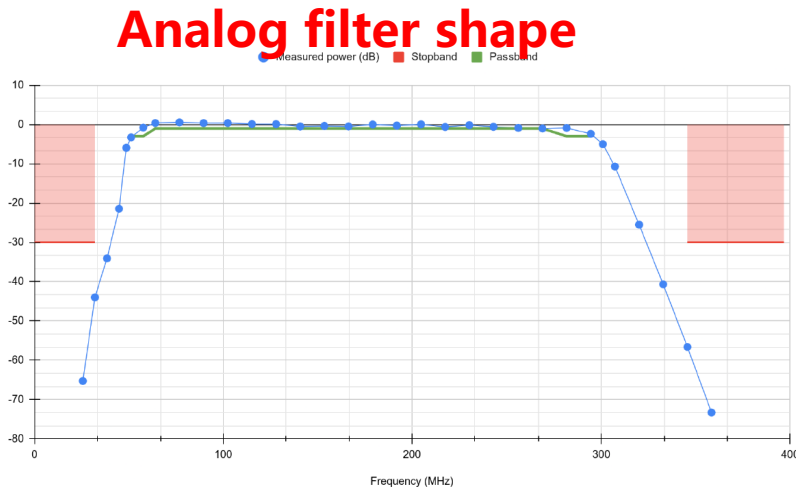
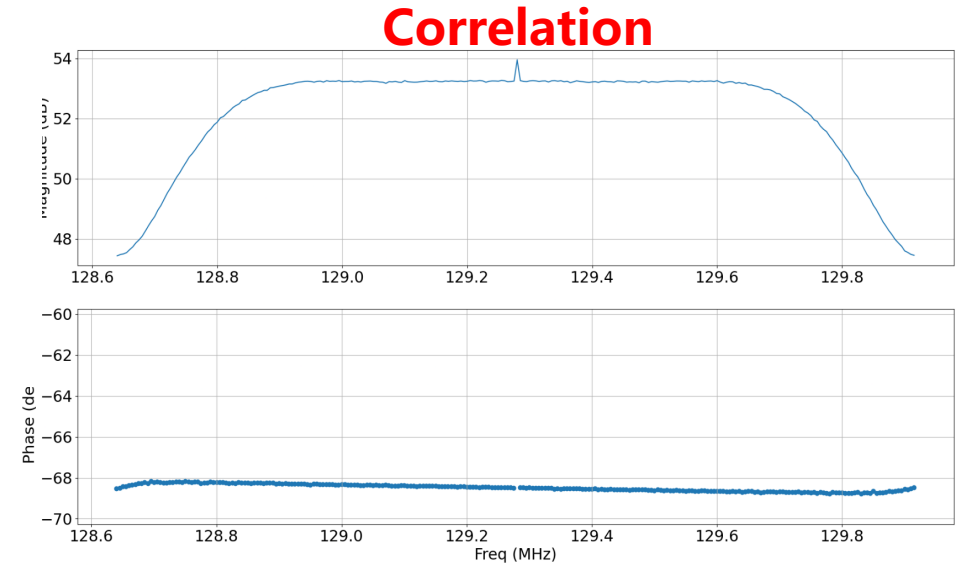
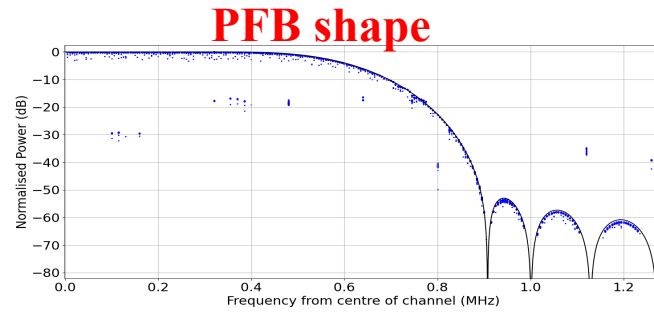
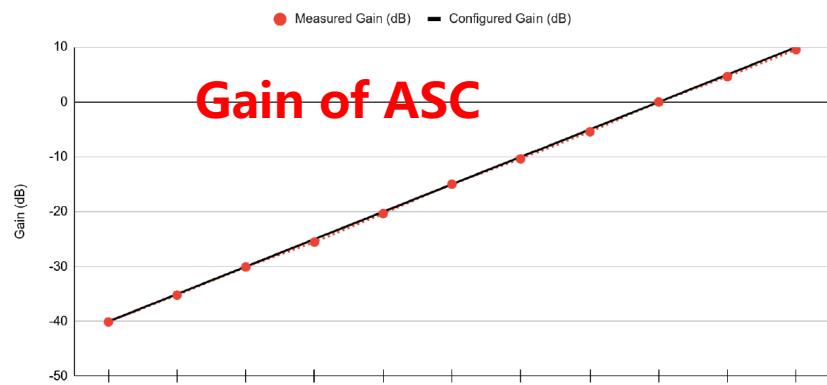


# The prototype testing at SHAO Lab

- The remote test by MWA and SHAO;
- Test:
  - ✓ M/C interface;
  - ✓ Self-configuration;
  - ✓ UDP packets: format and payload;
  - ✓ Performance of PFB channel;
  - ✓ Correlations;
  - ✓ Raw voltage capture;
  - ✓ ASC;

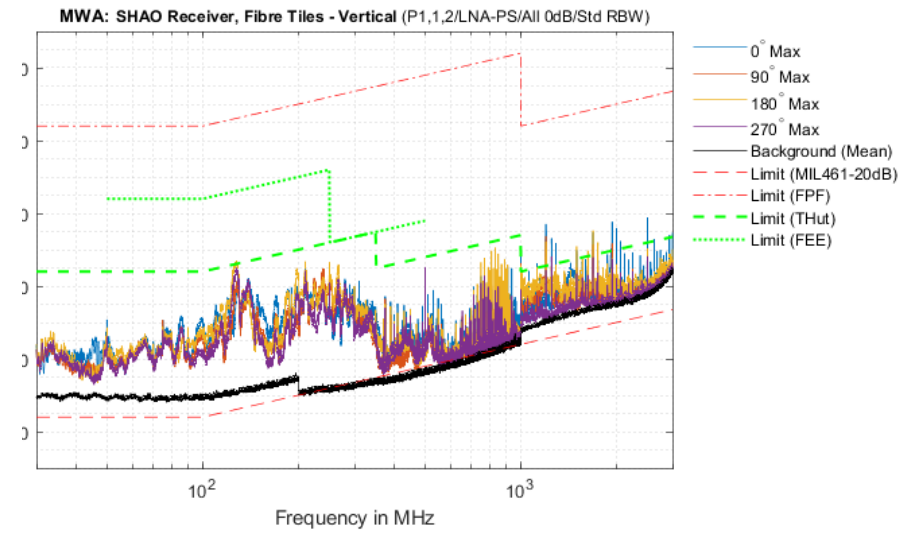
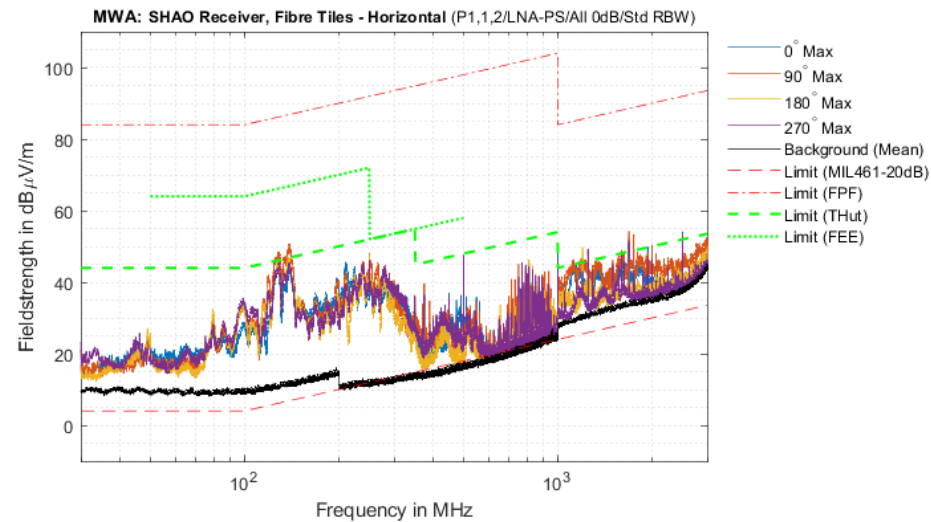
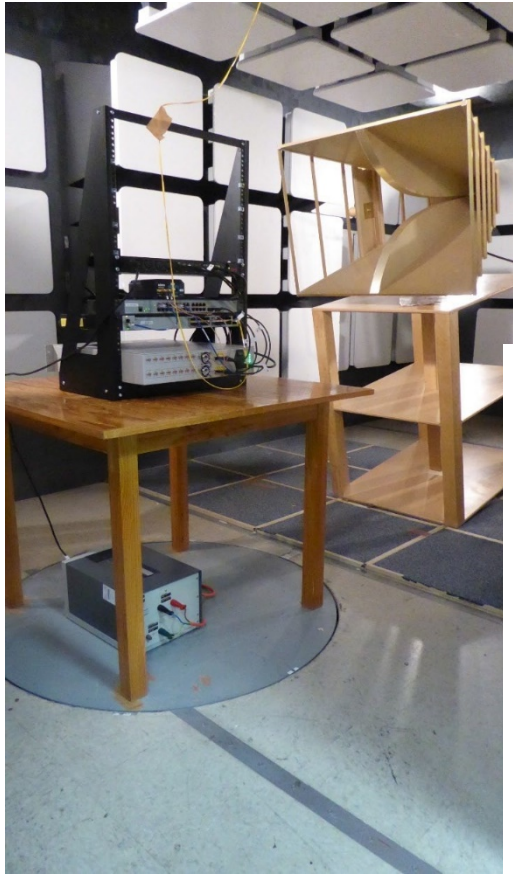


# Test Results in SHAO Lab



# EMI test at Curtin

The results show that, tested with supporting power, network and timing hardware, the shielding offered by the FPF (where the NI system is located) is sufficient to shield the SHAO MWA Phase III Receiver and hence with existing approved hardware, the SHAO Receiver System. Signals from fibre tiles are used for this test system.

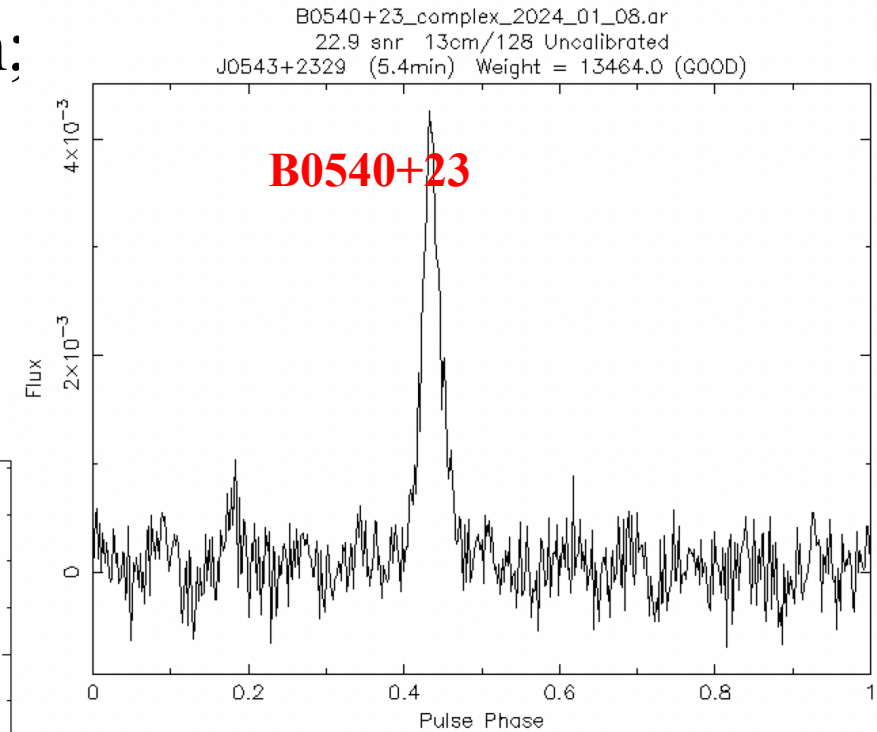
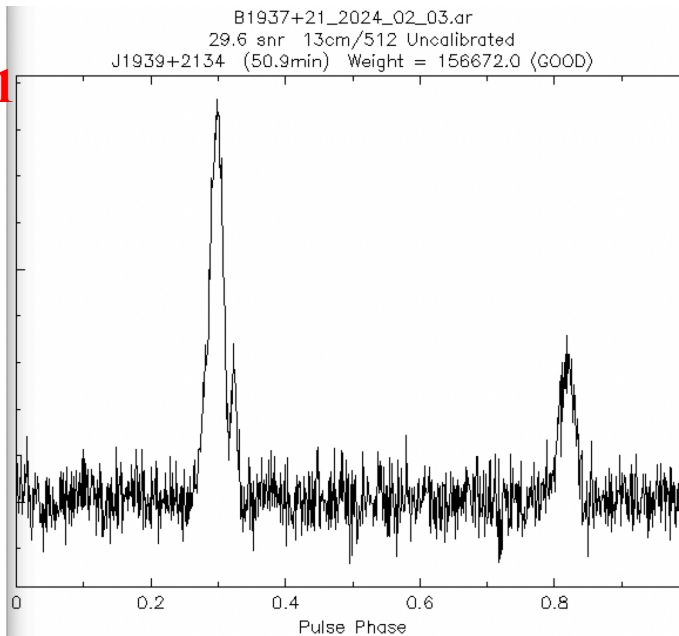
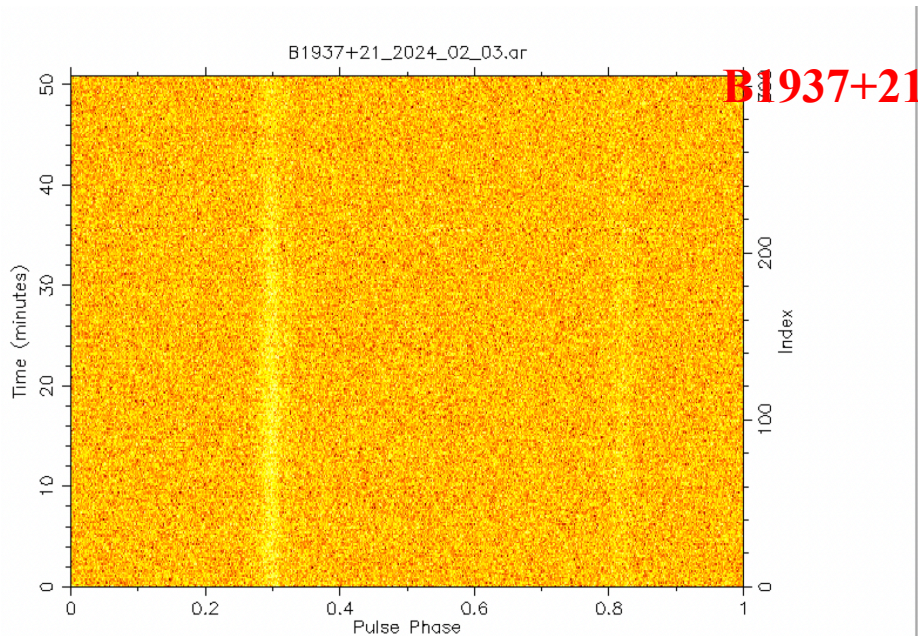


# **The SHAO-MWA Ph3 receiver delivery**

- **2022/12, the prototype delivered to Curtin;**
- **2022/4-6, the prototype installed at MWA;**
- **2022/7, the 15 receivers delivered to Curtin;**

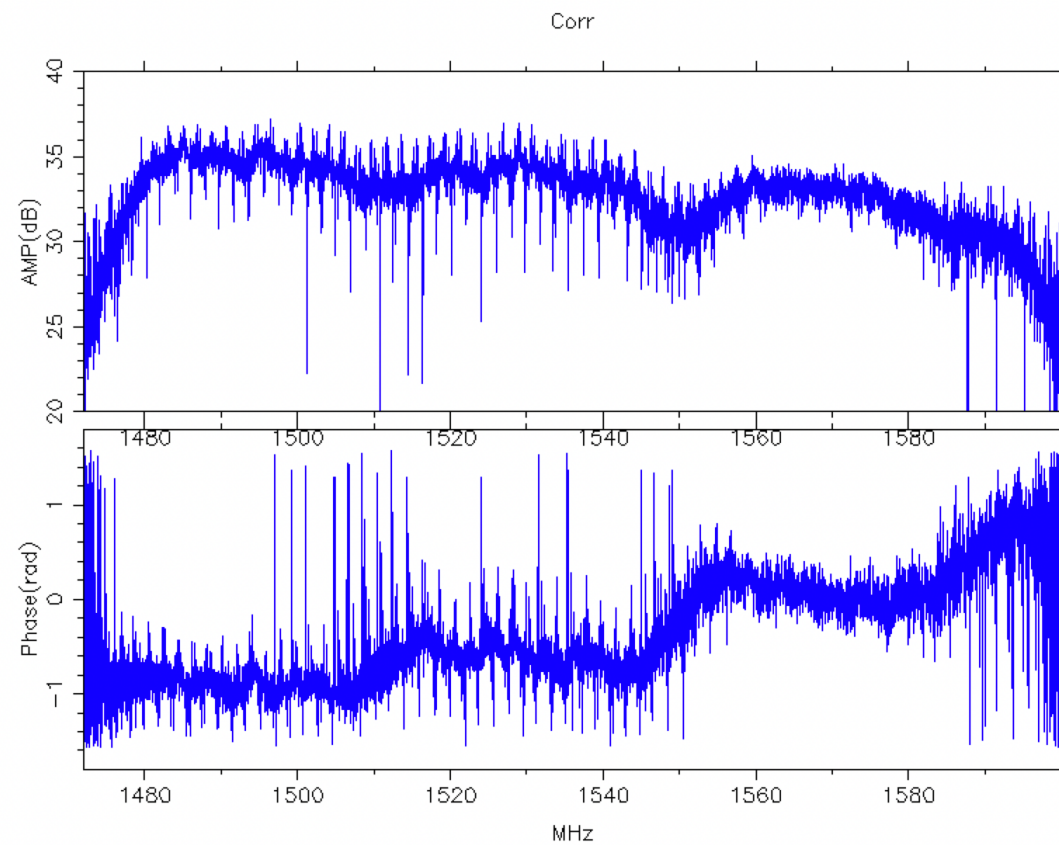
# Related work-Pulsar backend

- The Pulsar backend for single dish observation;
- The baseband data, using dspsr (GPU);





# Related work-array



*Thanks to MWA teams!*  
*Thanks for Attentions!*