PSR@PKU

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2. NAOC, CAS

PSR@PKU

Pulsar group at PKU:

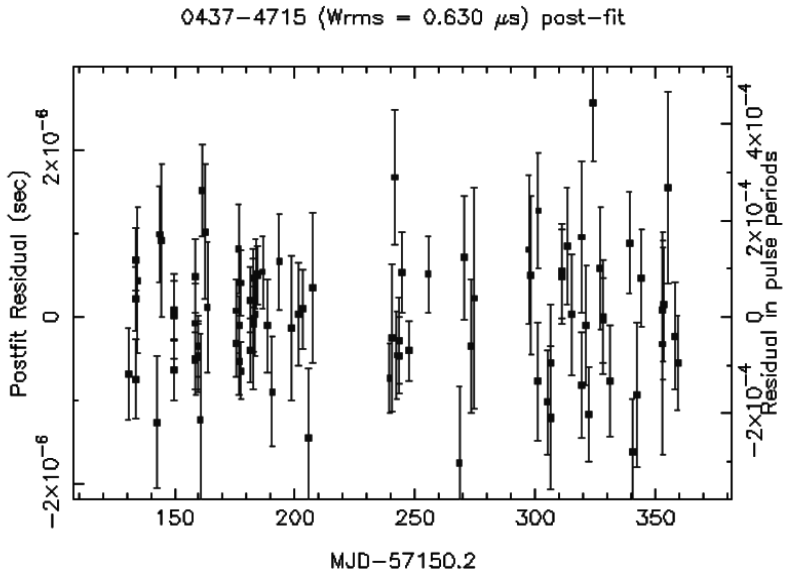
- Http://psr.pku.edu.cn
- Initialized by
  Xinji Wu, Guojun Qiao
- Currently
  Renxin Xu, Kejia Lee
- About 6 PhD students
- Focus on education

- We are working on
- Every thing pulsar related:
- **Internal structure**
- **Pulsar timing, searching**
- **FRB**
- **GW**
- **Pulsar instrumentation**

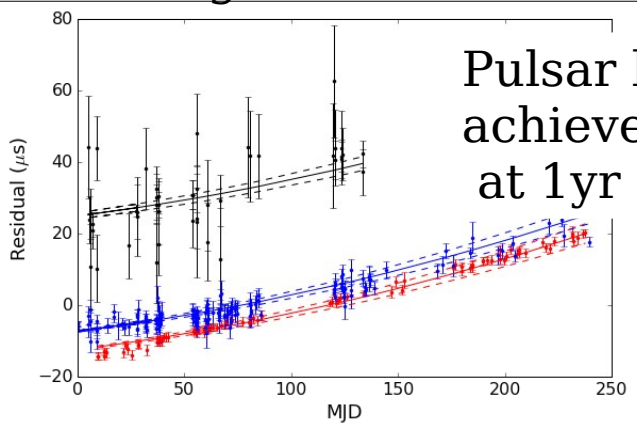
We received significant amount of help from **Yunnan, Xinjiang, NAOC, Shanghai observatory.**

Pulsar observations

Utilize the Chinese telescopes resource we can access to start high precision pulsar timing



Best Chinese timing precision using **Yunnan 40m**



Pulsar based clock achieve 1e-13 stabili at 1yr

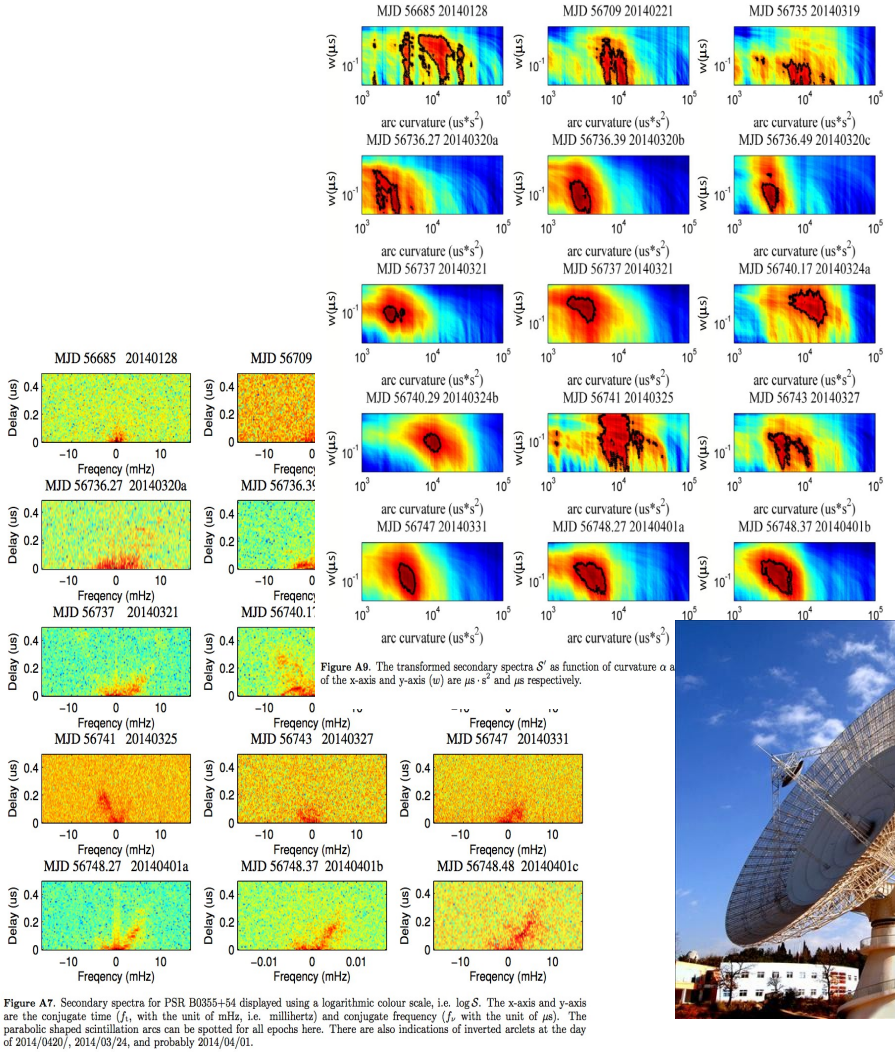


Figure A9. The transformed secondary spectra $\mathcal{S}'$ as function of curvature α a of the x-axis and y-axis (w) are $\mu s \cdot s^2$ and μs respectively.

Figure A7. Secondary spectra for PSR B0355+54 displayed using a logarithmic colour scale, i.e. $\log \mathcal{S}$. The x-axis and y-axis are the conjugate time (f_t, with the unit of mHz, i.e. millihertz) and conjugate frequency (f_ν with the unit of μs). The parabolic shaped scintillation arcs can be spotted for all epochs here. There are also indications of inverted arclets at the day of 2014/0420/, 2014/03/24, and probably 2014/04/01.

Detected scintillation arc and its variati for the first time.

Xu et al., submitted

The real-time FRB searching Progress in PKU, XAO and YNAO

- Supported by NSFC U1531243 funded since 2016 June
- PKU
  - K. J. Lee KIAA (theory, data processing, instrumentation)
  - R. X. Xu DOA (theory)
  - R. Luo DOA PhD (theory, data processing)
  - Y. P. Men DOA PhD (data processing, instrumentation)
  - J.J. Wu EE (microwave measurements and tests)
- XAO
  - X. Pei (data processing, instrumentation, observation)
  - Z. Y. Liu (instrumentation)
  - Z. G. Wen (data processing, observation)
  - J. P. Yuan (Data, observation)
- YNAO
  - L.F. Hao (observation, data processing, instrumentation)
  - Y.H. Xu PhD (observation, data processing)

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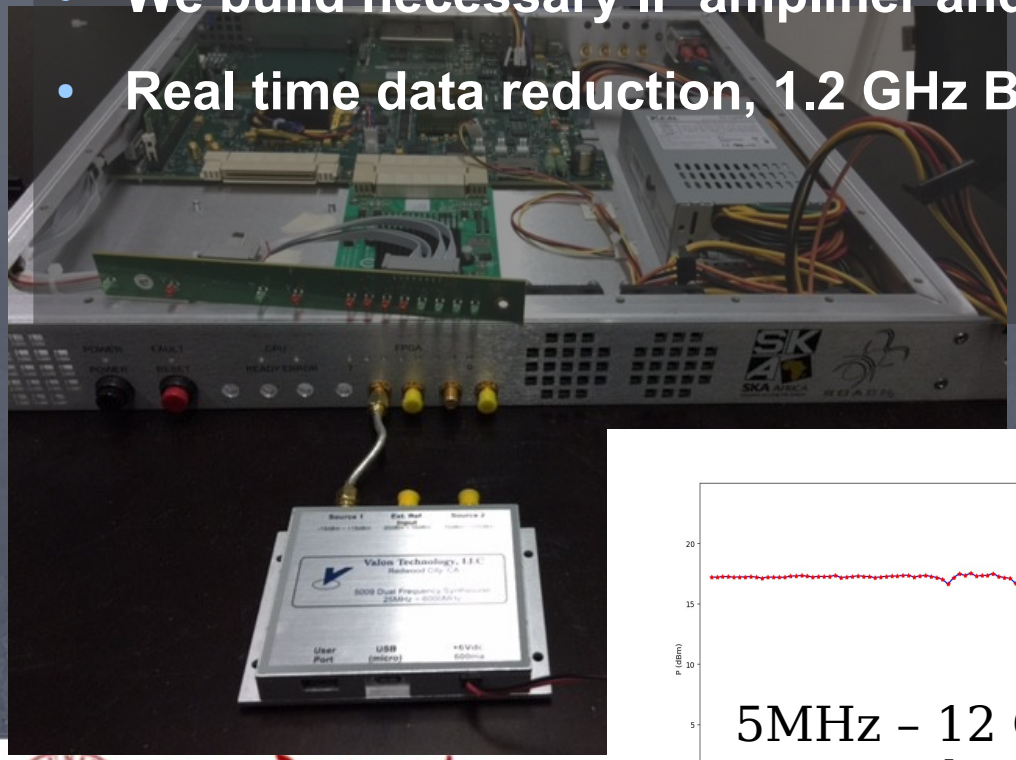
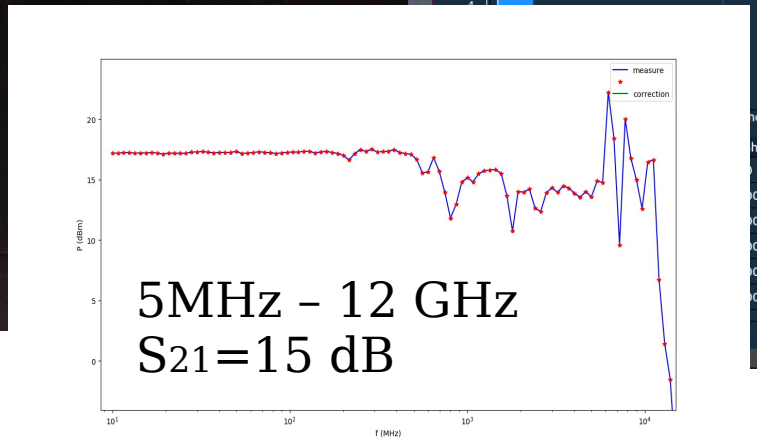
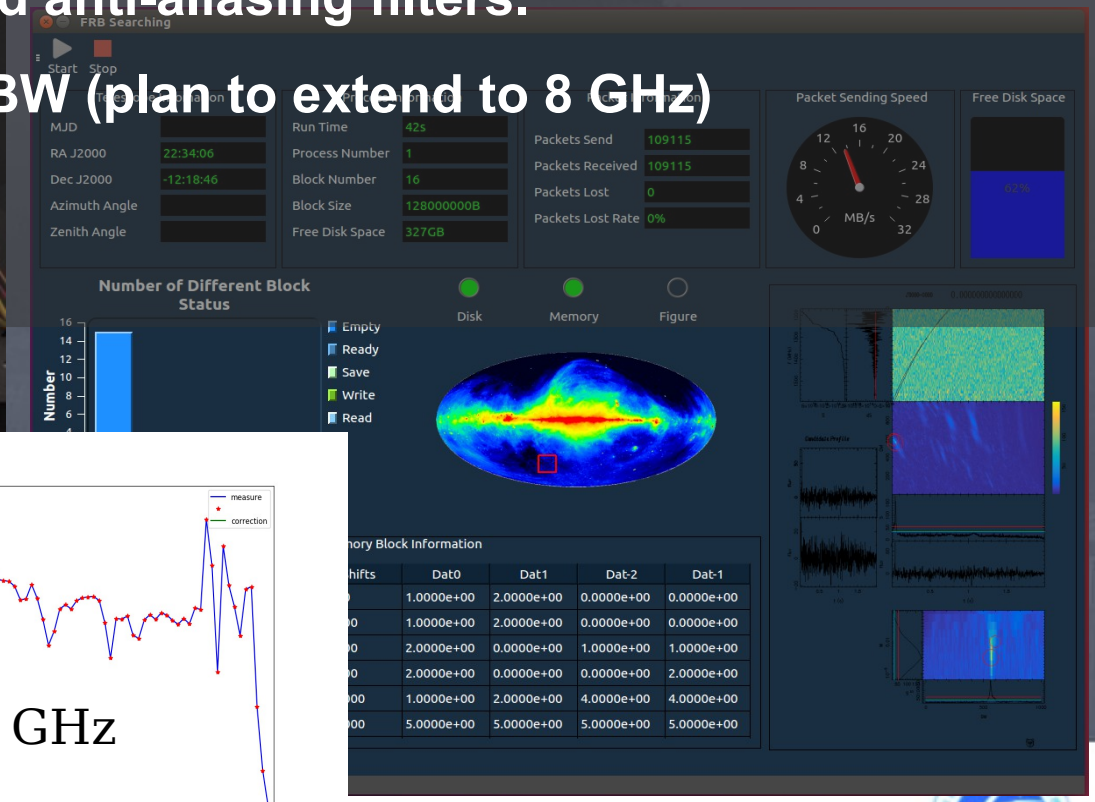
Hardware developing

- The digital hardware is Roach 2+thin server.
- We developed the BEAR, Burst Emission Automatic Roger, and control frontends
- Firmware developed at PKU, baseband recording+ filterbank
  - Real time bandwidth 1.25 GHz
- We build necessary IF amplifier and anti-aliasing filters.
- Real time data reduction, 1.2 GHz BW (plan to extend to 8 GHz)







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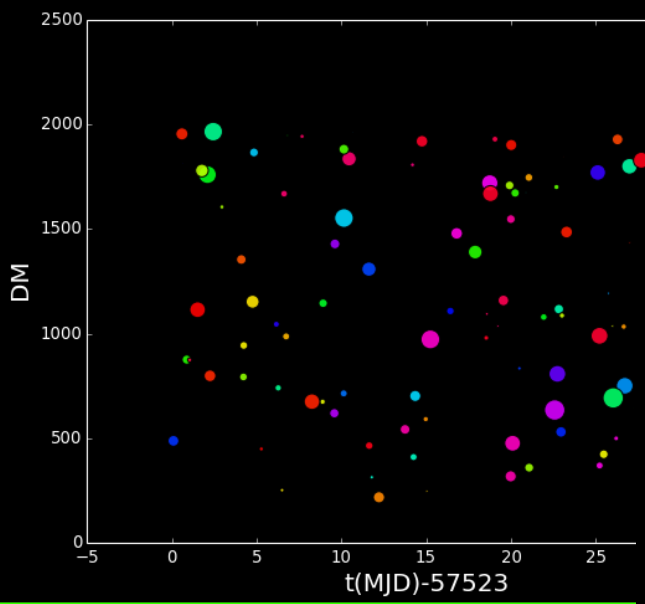
Web-based post analysis with artificial intelligence

file:///home/random/shared/html/stat_view.html

Statistics of FRB candidates

Size parameter:
DM Width SNR MJD RA DEC AZ AL Score Time of Day



Color Parameter:

Y parameters:
DM
Width
SNR
MJD
RA
DEC
AZ
AL
Score
Time of Day

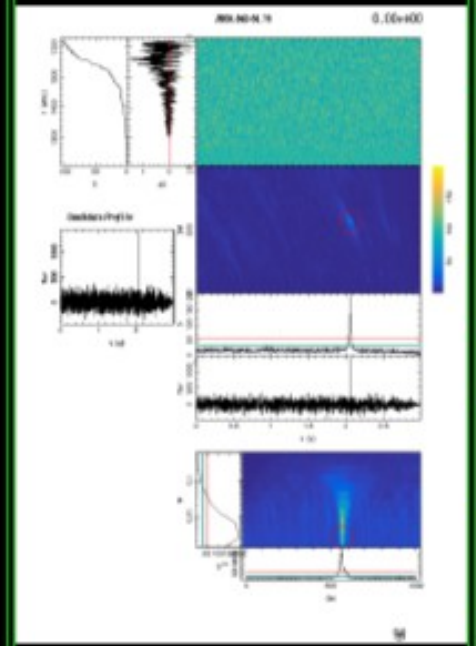
X parameter:
DM Width SNR MJD RA DEC AZ AL Score

SQL quary command: SELECT dm, mjd, width, snr, ra, dec, az, al, score, TOD, FROM cands WHERE dm>100

Examples: SELECT dm, mjd, width, snr FI

FRB candidate viewer

Index 2073



MJD
55704.628078703703

DM 623

Tau 2.5

S 12

Machine Ranking 0.374

YP Ranked as level 1

KJ Ranked as level 2

RL Ranked as level 4

<Prev | Next>

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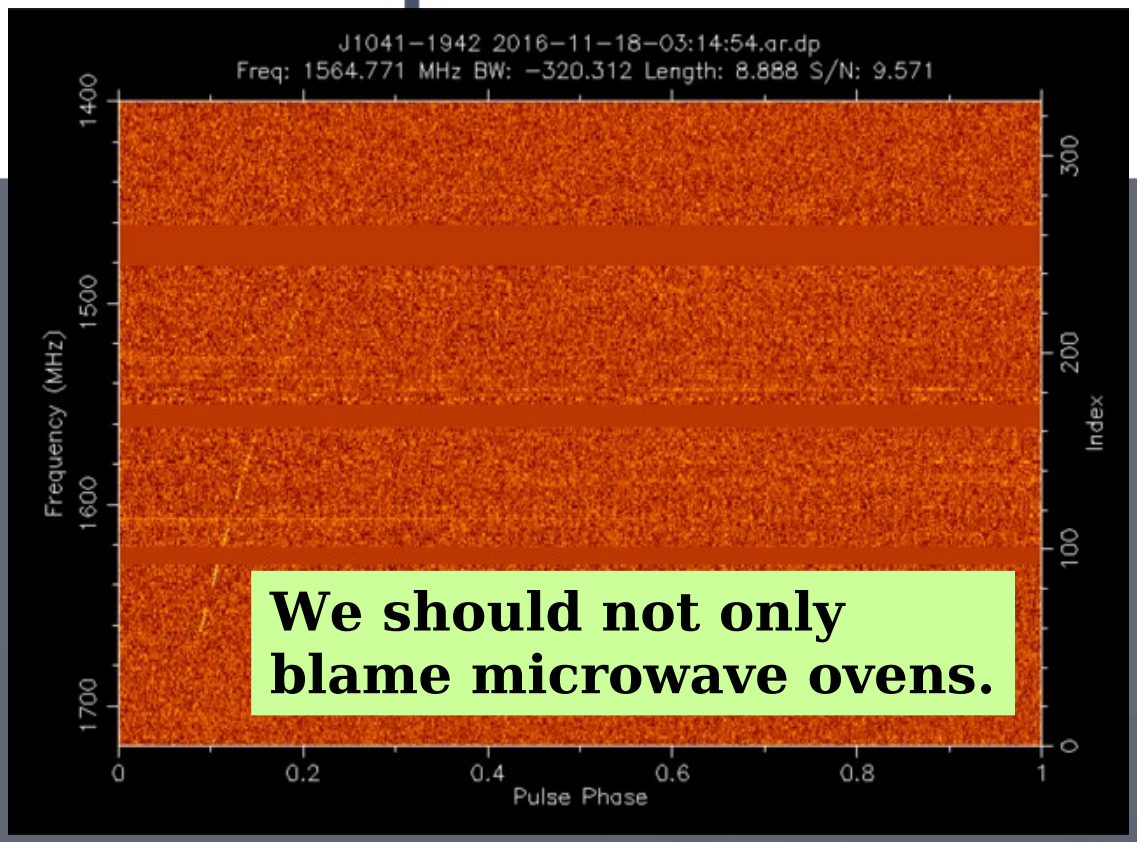
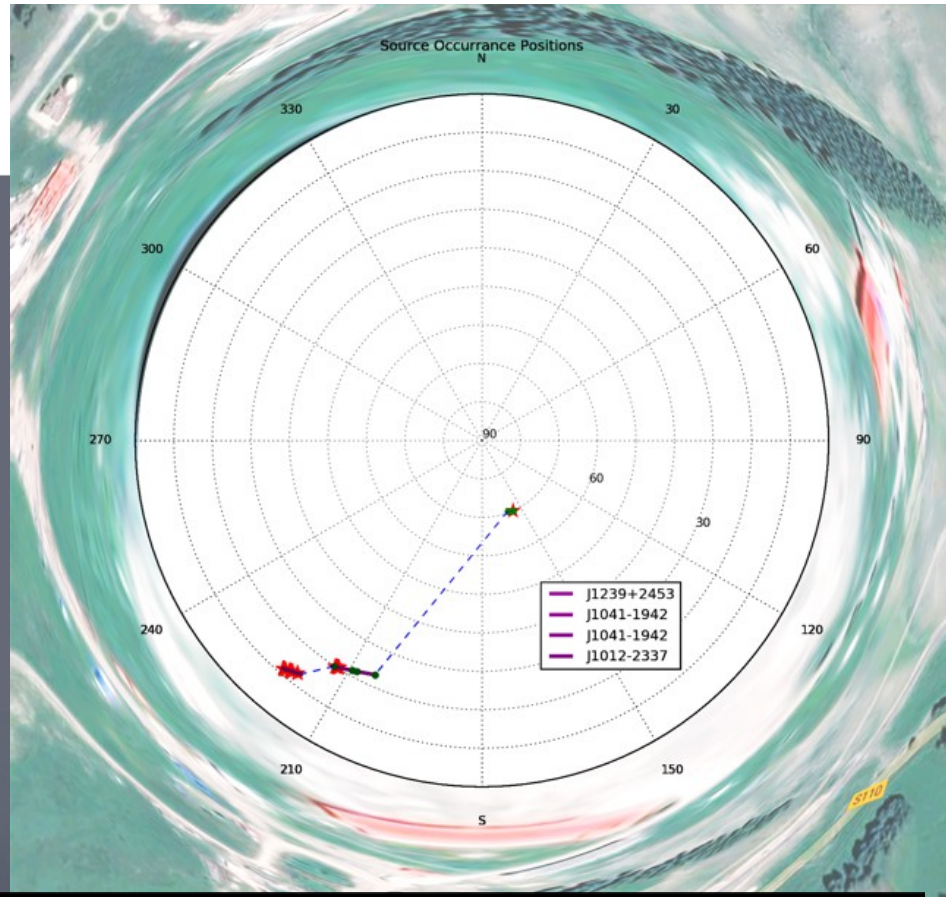
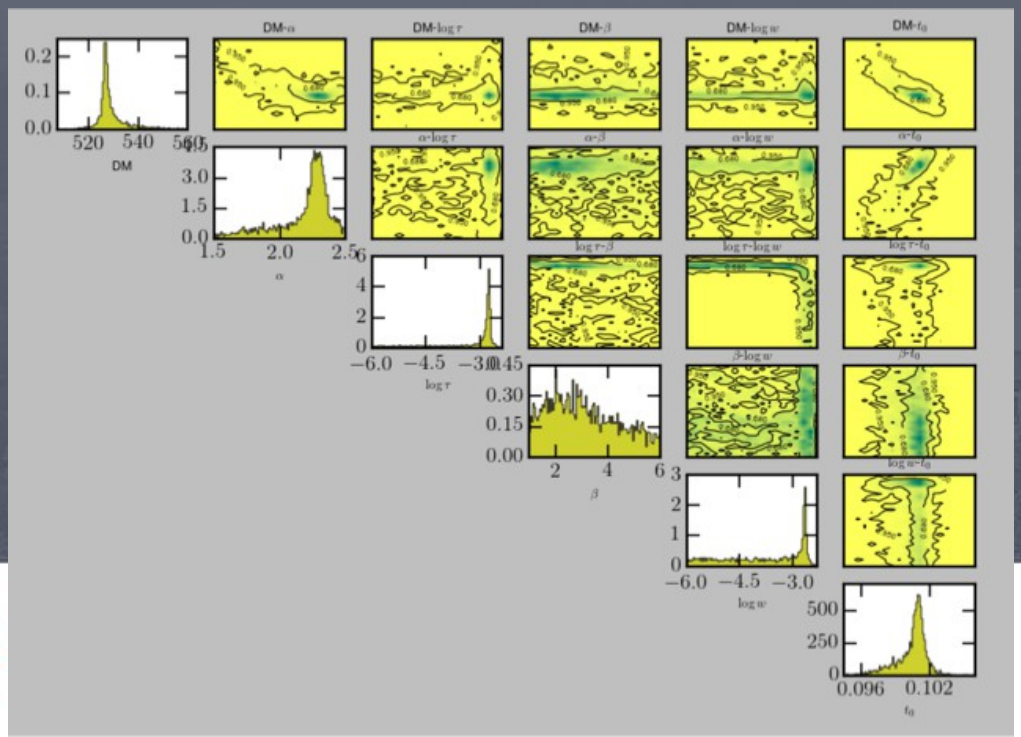
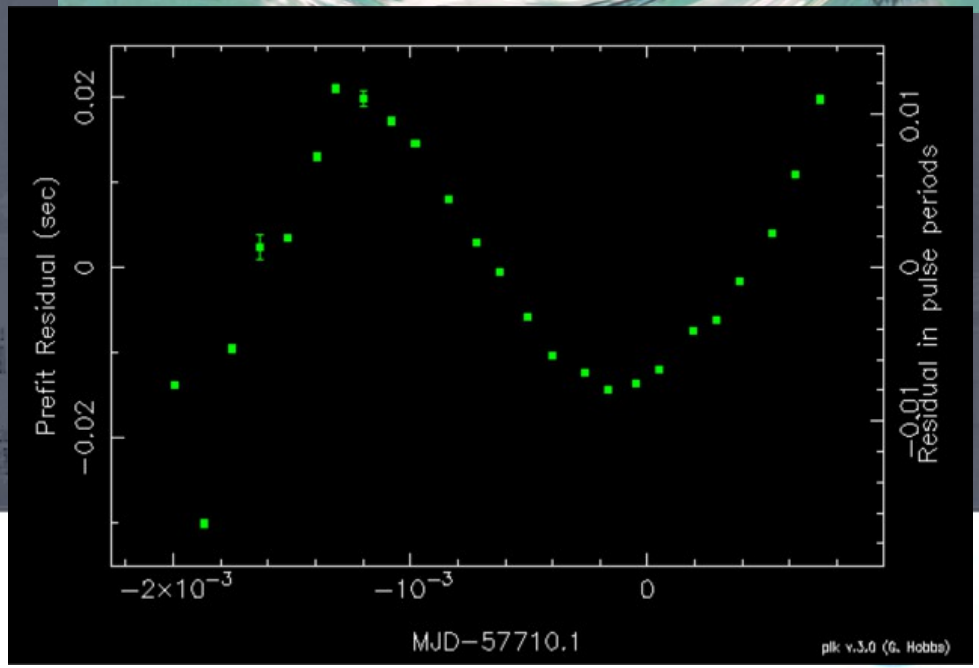

J1041−1942 2016−11−18−03:14:54.ar.dp
Freq: 1564.771 MHz BW: −320.312 Length: 8.888 S/N: 9.571
Frequency (MHz)
Pulse Phase
Index
We should not only blame microwave ovens.


Source Occurrance Positions
N
S
J1239+2453
J1041-1942
J1041-1942
J1012-2337


DM
α
log r
β
log w
t_0


Prefit Residual (sec)
Residual in pulse periods
MJD−57710.1
plk v.3.0 (G. Hobbs)

Projection in the next 3 years

- Key topic: Student education
- EPTA and IPTA data analysis
- Phase array searching of FRBs
- New digital backends with BW of 8 GHz
- Experiment with new designed adaptive filter before the mixer to beat RFI
- Deploy Ps precision TDR for cable and IF distributor.
- Developing the PKU psr service for PTA in China
  - 400 CPU at 2.8 GHz, 4TB memory, 512 TB storage
- Get PTA analysis pipeline ready on Tianhe II

Possible collaboration cases

- We have long collaboration with Dutch colleges at ASTRON via EPTA and LEAP collaboration aiming at detect GWs.
  - EPTA, European pulsar timing array
  - Pulsar timing array using EPTA telescope with phase array method
- Short term
  - Visiting research staffs
  - Strengthen the current collaboration with EPTA
    - Data analysis and student education
  - Strengthen the current collaboration with LEAP
    - Correlator development
- Long term
  - Extend the LEAP to Chinese telescopes
  - Mutliband observation using WSRT, LOFAR, and Chinese telescope at higher frequency simultaneously to study the ISM effects

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