

LOFAR Tied-Array All Sky Survey

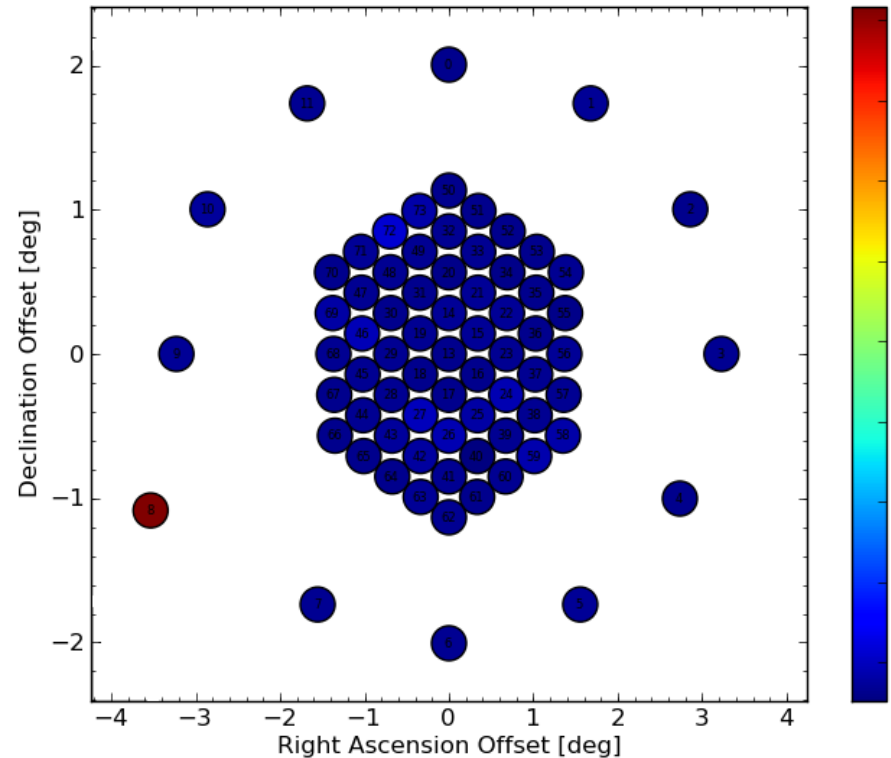
Update on the Pulsar and Fast
Transient Survey

Sally Cooper

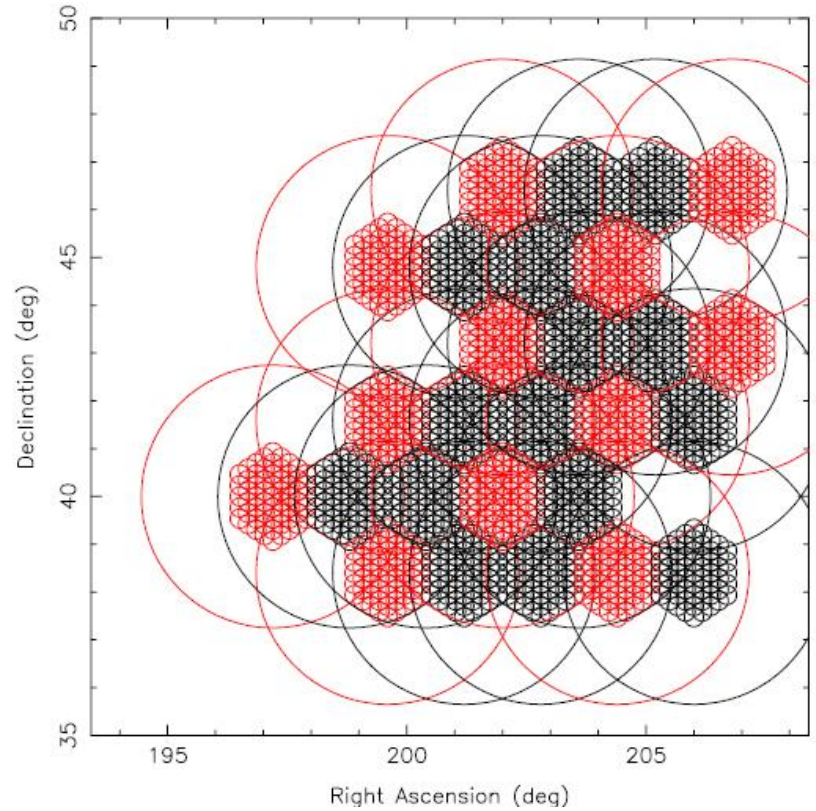
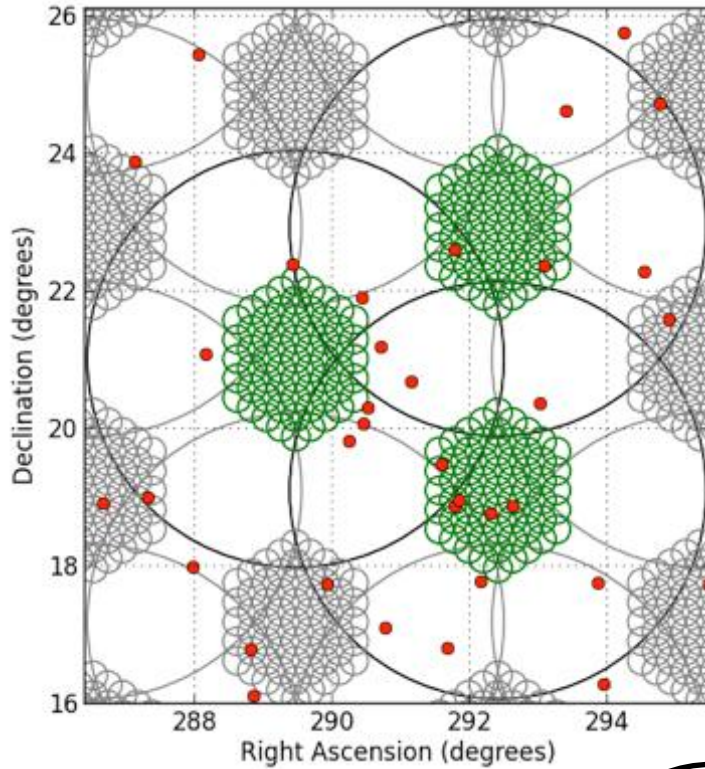
The University of Manchester

LOFAR Tied-Array All Sky Survey (LOTAAS)

- Superterp **HBA** stations
- All Northern sky
- **3** incoherent beams (SAP)
- **67** tied-array beams per SAP
- **12** additional TABs on known sources
- **119 – 151** MHz
- **1** hour observations
- **0.49** ms sampling time
- **32** MHz bandwidth per SAP



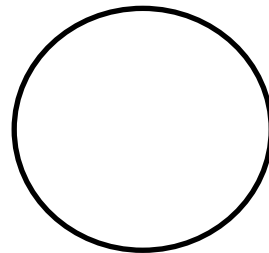
LOTAAS Survey



[Credit: Jason Hessels]

● Known pulsars

○ Tied-Array Beam



○ Incoherent Beam

Processing

- 225 completed pointings
- 4TB of 8-bit data per pointing
- Original processing at Manchester: Hydra 15 hours per beam (24hr per pointing)

Since November 2013:

- Granted 10,000,000 CPU hours on Cartesius
- 4 hours (on single node with 24 CPUs) to process a beam
- Periodic and single pulse searching

DATA TRANSFER

Stage data directly from Grid to Cartesius.

Download 1 beam in ~2mins

Download full pointing takes ~7hours

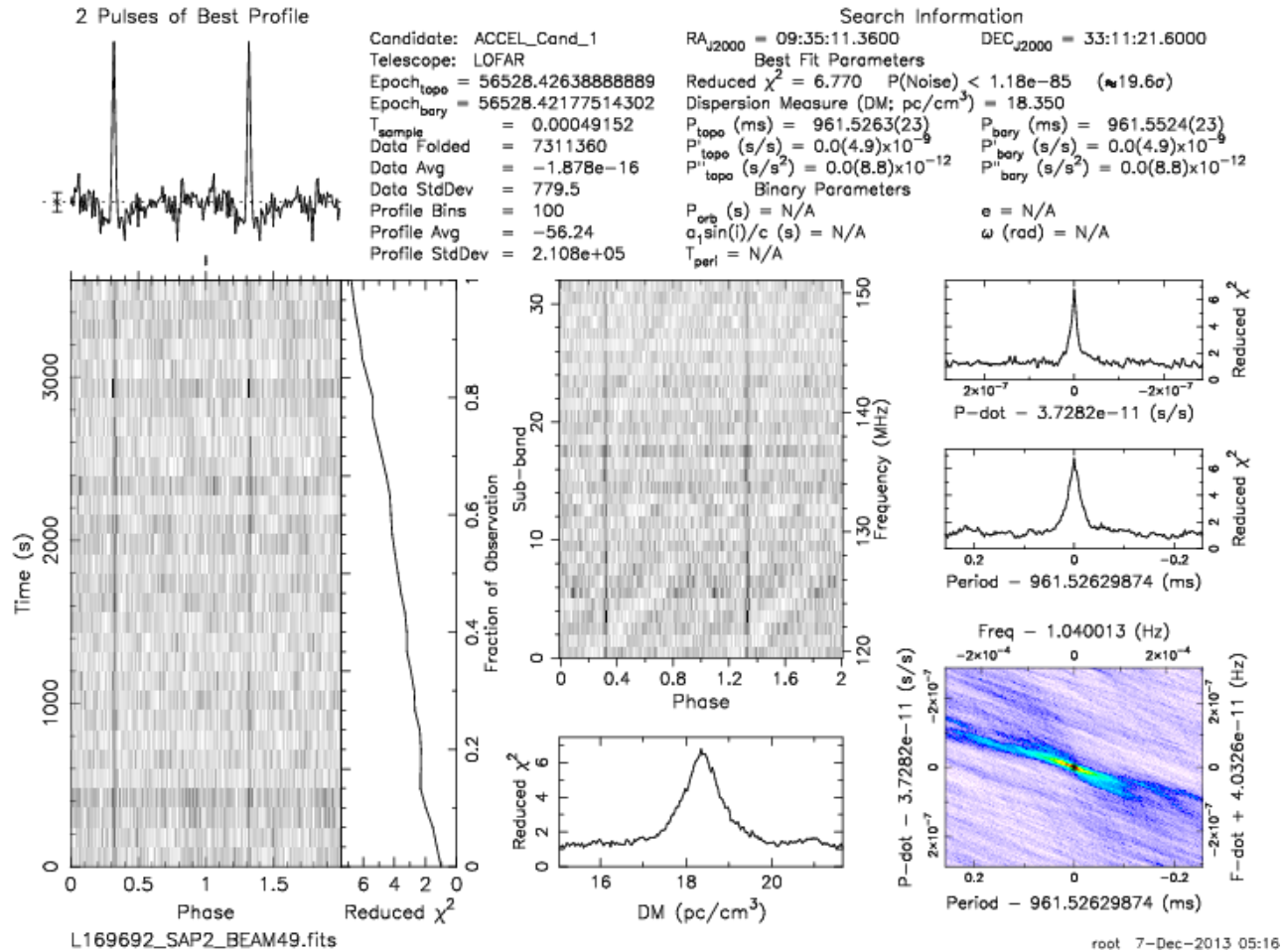
Can run multiple downloads simultaneously

Current Status

- Processed 100 pointings (80 with Cartesius)
- Period and single pulse searching
- Total number of candidates = 2 million (Hydra + Cartesius)
- Cuts made on basic candidate criteria: DM, period, SNR
- Only shallow search: 2% of all candidates
- Known pulsars blind detected = 50
- Redetection of GBNCC pulsar J1815+55

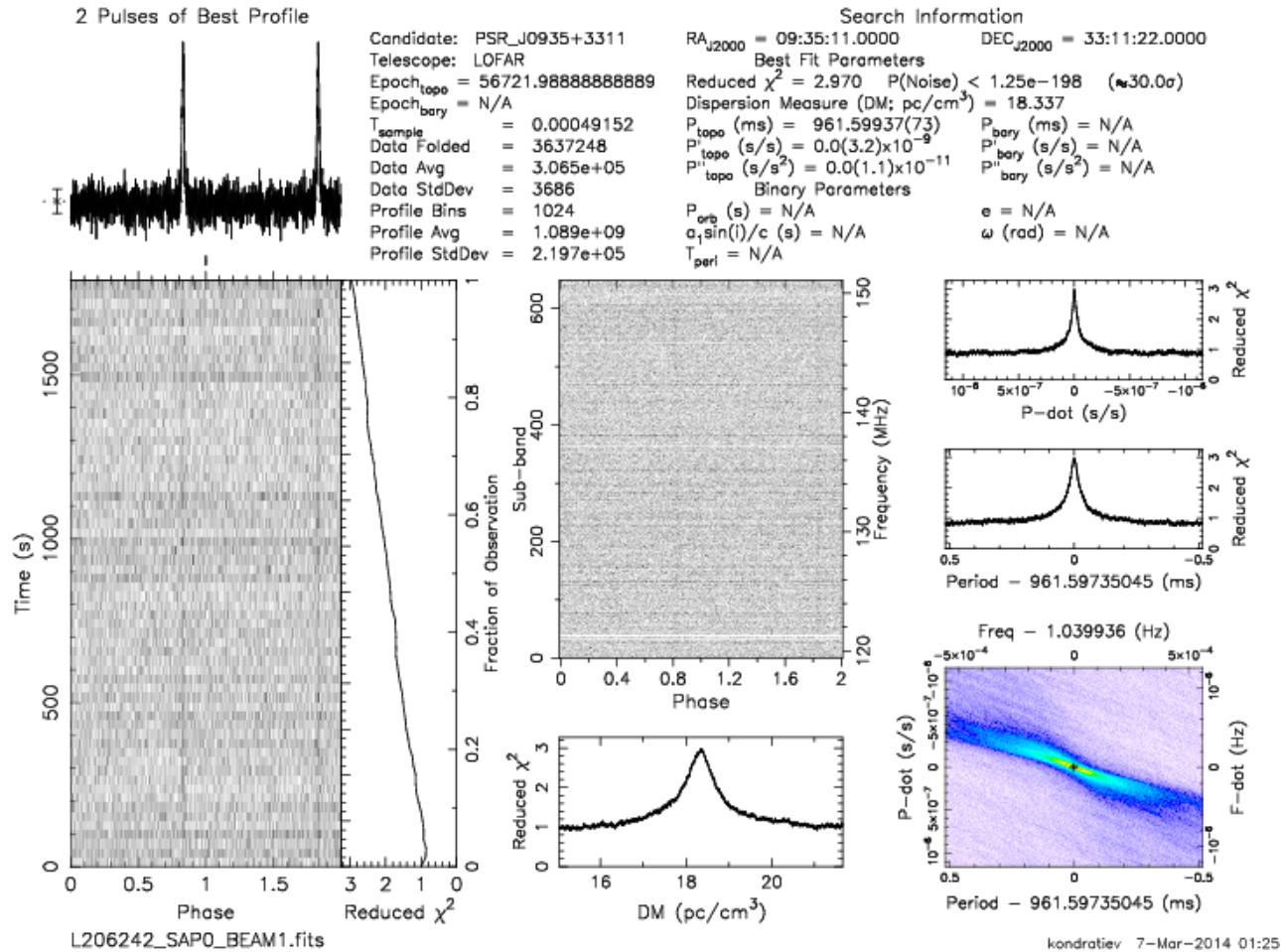
Discovered 2 new pulsars

J0935+3311 Discovery



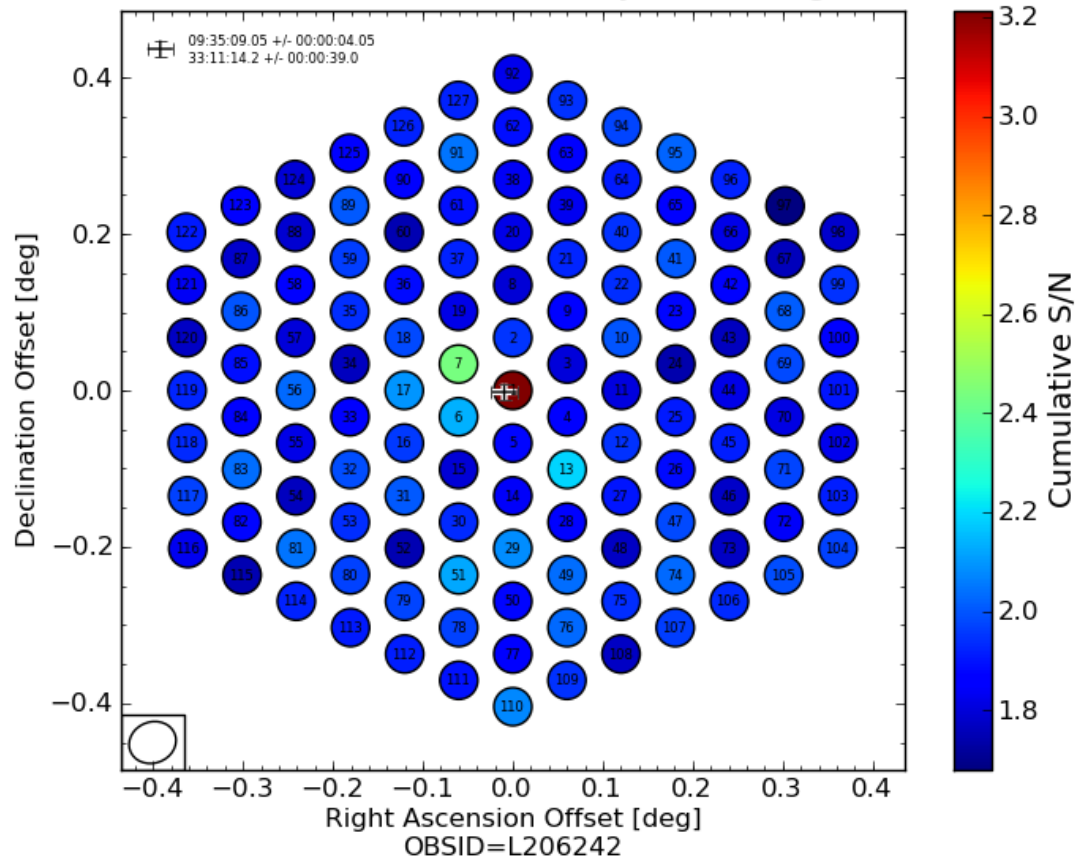
Only seen in one beam

J0935+3311 Confirmation

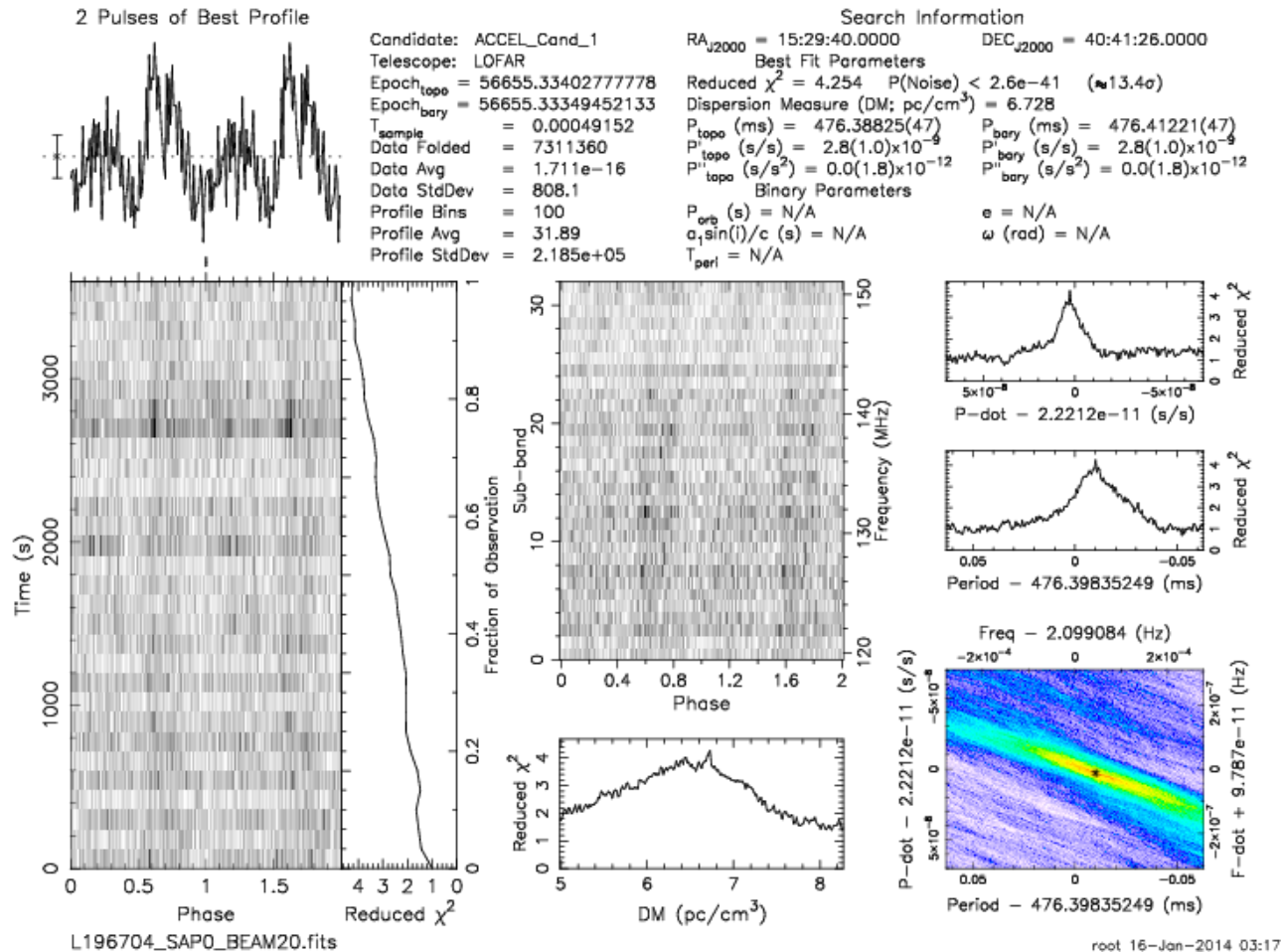


Full Core Heat Map

SAP #0. Cumulative S/N of PSR J0935+3311 in 127 (out of 127) Simultaneous Tied-Array Beams [Log Scale]

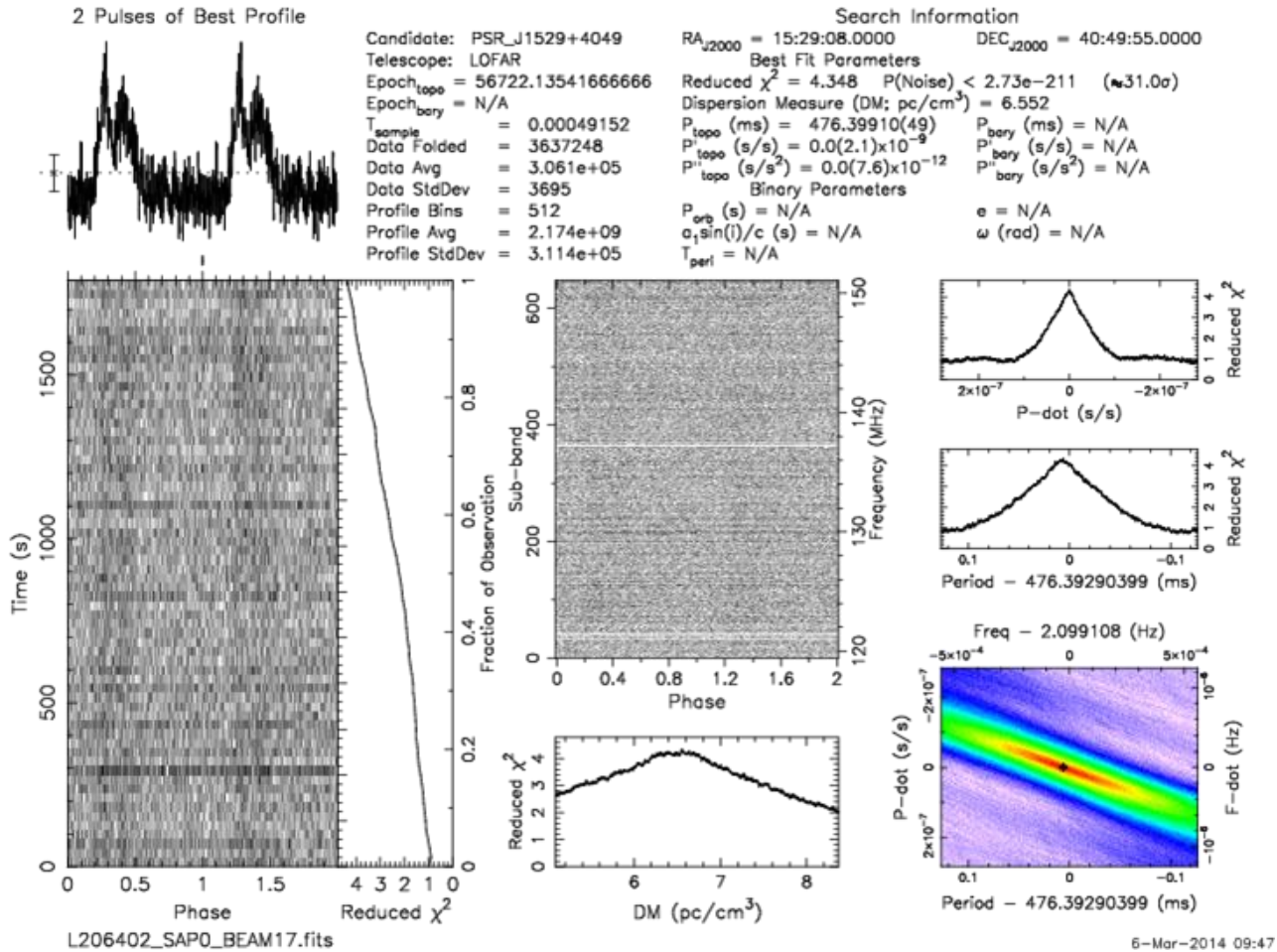


J1529+4049 Discovery



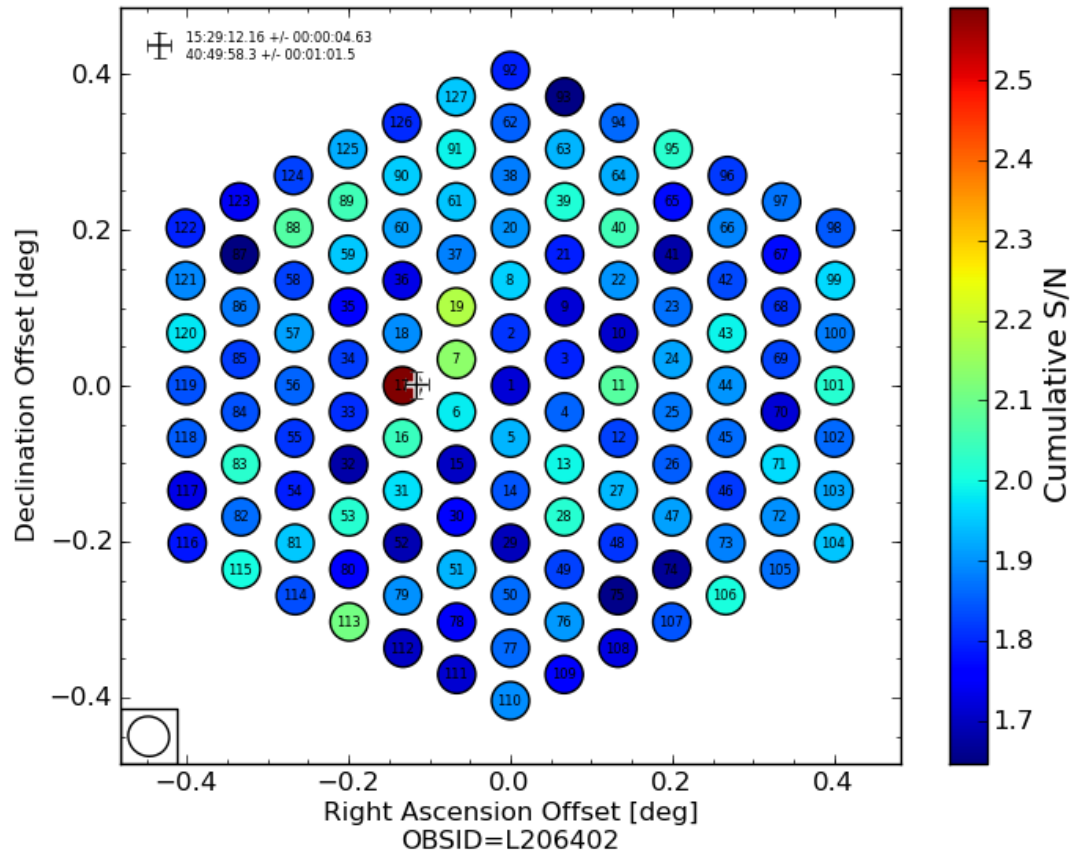
Originally found in 2 neighbouring beams

J1529+4049 Confirmation



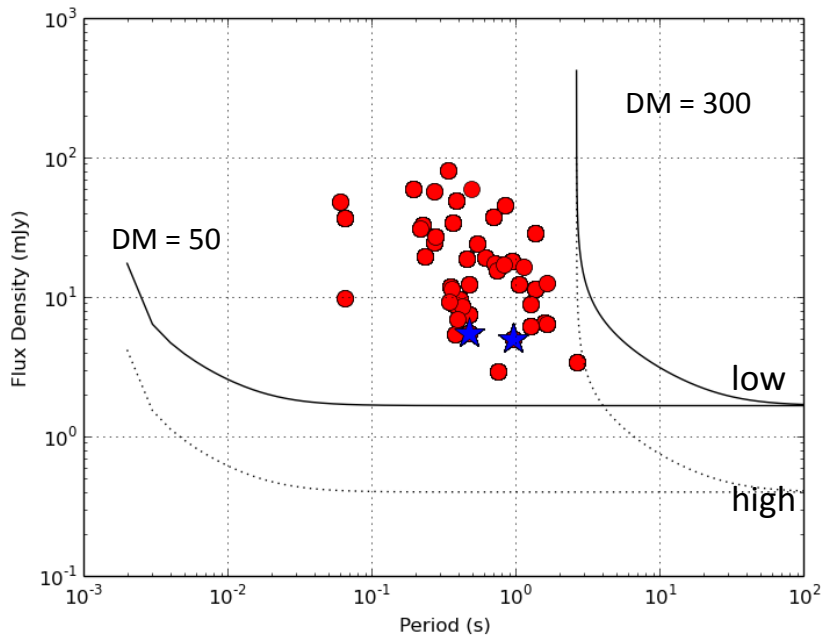
Full Core Heat Map

SAP #0. Cumulative S/N of PSR J1529+4049 in 127 (out of 127) Simultaneous Tied-Array Beams [Log Scale]

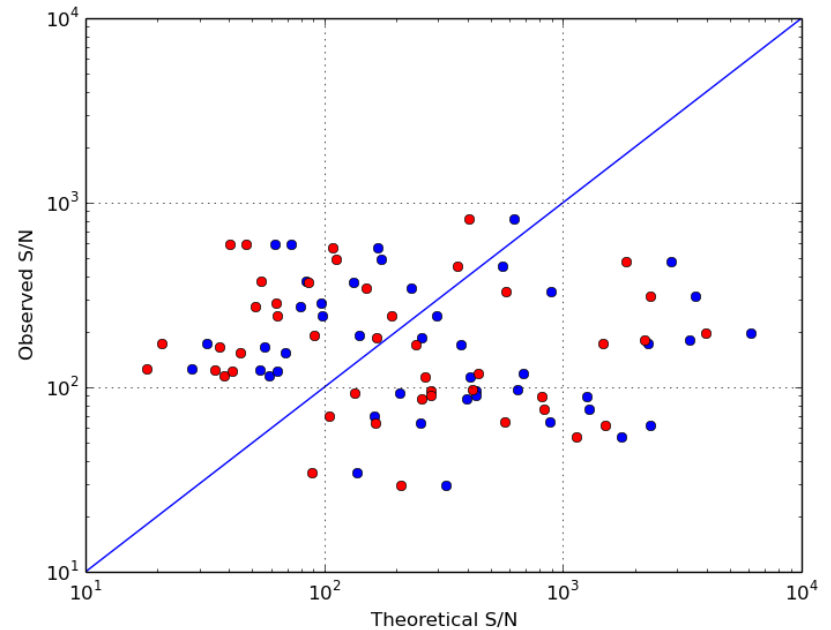


Sensitivity

$$S_{min} = \frac{(S/N_{min}) 2k T_{sys}}{A_{eff} \sqrt{n_p t_{obs} \delta\nu}} \sqrt{\frac{W_{eff}}{P - W_{eff}}}$$



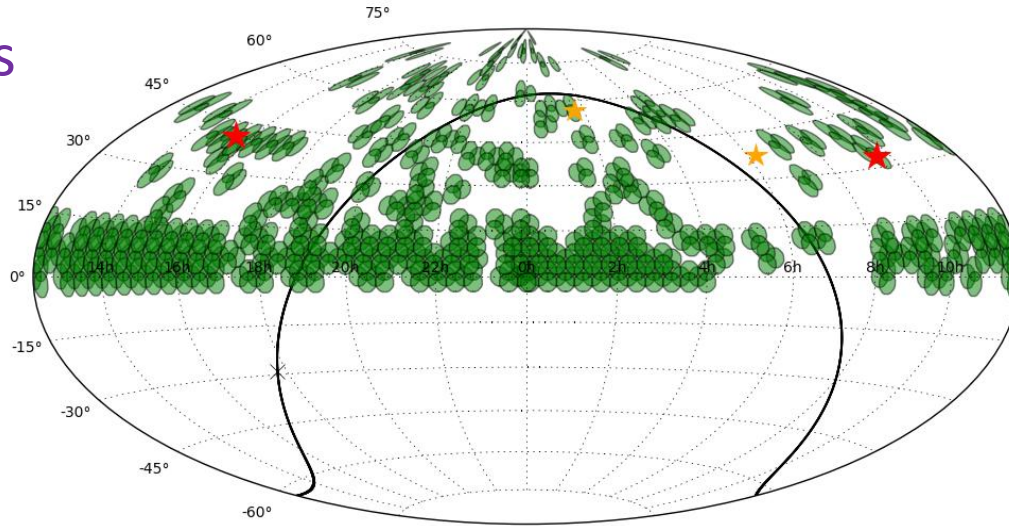
Assumed Bhat 2004 scattering



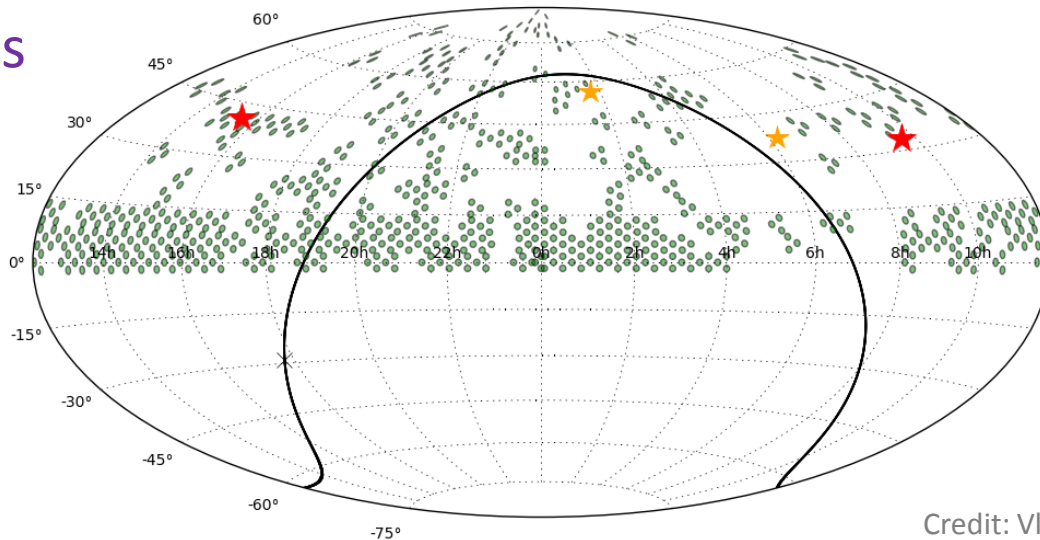
Theoretical value extrapolated from 400 MHz using spectral index of -1.8 (blue) and -1.4 (red)



Completed Pointings

Incoherent Beams

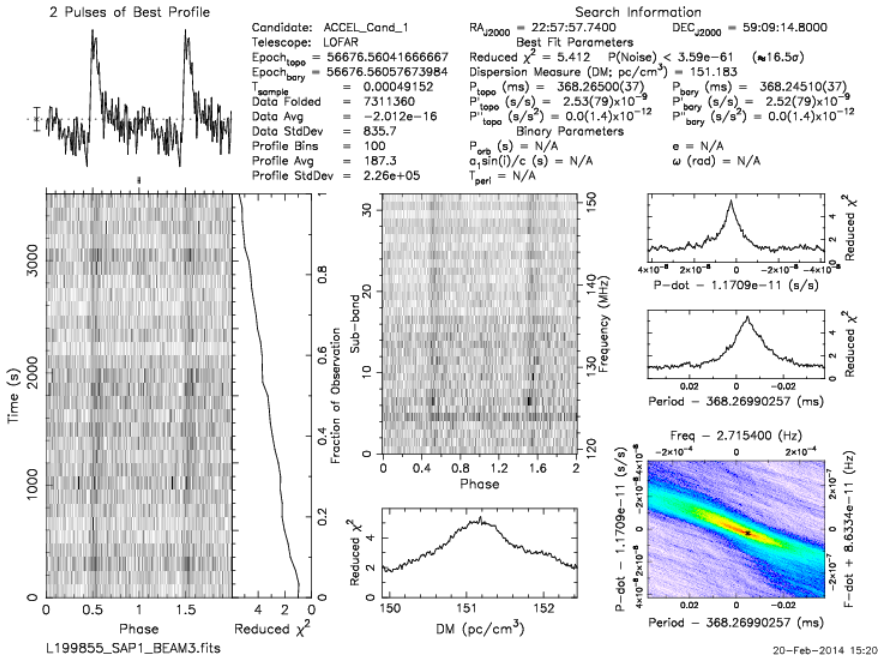


Tied-Array Beams

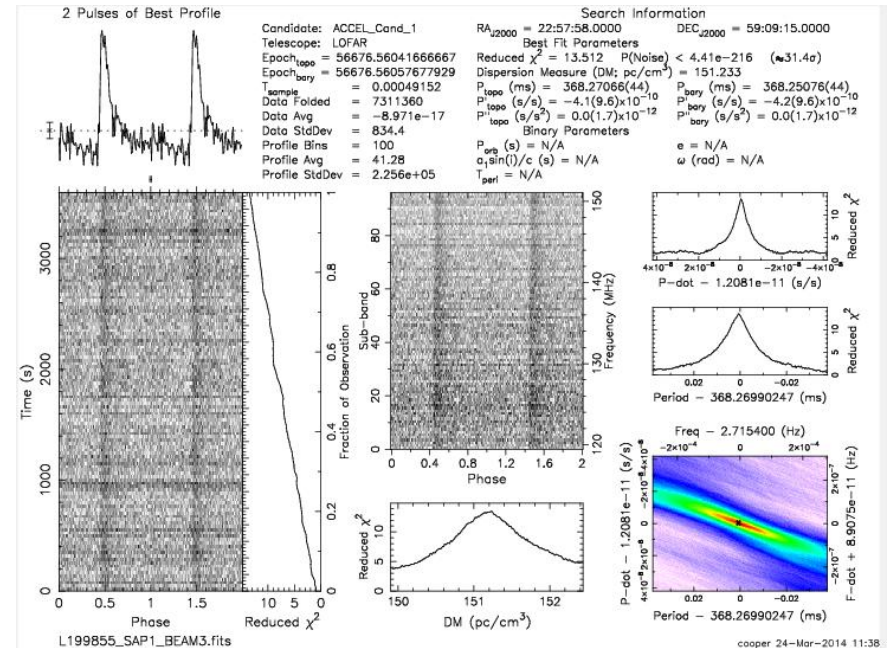


-  LOTAAS pulsars
-  LOTAS pulsars

Prepfold Problem



High DM known pulsar
 folded using 32 sub-bands:



Same known pulsar folded
 using 96 sub-bands:

Ongoing and Future

- Fixed most data processing issues
 - **prepfold**
- Candidates: 2 million – only *creamed* the surface
- Expect to make most discoveries close to our sensitivity limit
- Machine learning
 - original score system has been revised
 - 50 known pulsars to make training set
- Analyse single pulse search output
- Observations with Lovell at L-band of J1529+4049
- Long term proposal submitted cycle 2-5 for 1001 hours
- Our discovery webpage <http://www.astron.nl/lotaas>