

New results from LOFAR



Vlad Kondratiev *on behalf of*

*Ben Stappers, Jason Hessels, Michael Kramer,
Joeri van Leeuwen, Anastasia Alexov, Tom Hassall,
Aris Karastergiou, Maciej Serylak, and other
members of **LOFAR Pulsar Working Group***



LOFAR Pulsar Working Group



Anastasia Alexov

UvA

Thijs Coenen

UvA

Jean-Mathias Grießmeier

CNRS/Université d'Orléans

Tom Hassall

University of Southampton

Jason Hessels

ASTRON/UvA

Aris Karastergiou

University of Oxford

Evan Keane

MPIfR

Vlad Kondratiev

ASTRON

Michael Kramer

MPIfR

Masaya Kuniyoshi

MPIfR

Joeri van Leeuwen

ASTRON/UvA

Aris Noutsos

MPIfR

Maura Pilia

ASTRON

Maciej Serylak

Nançay, CNRS/Université d'Orléans

Charlotte Sobey

MPIfR

Ben Stappers

University of Manchester

Joris Verbiest

MPIfR

Patrick Weltevrede

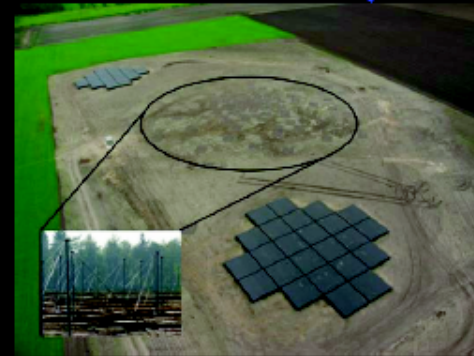
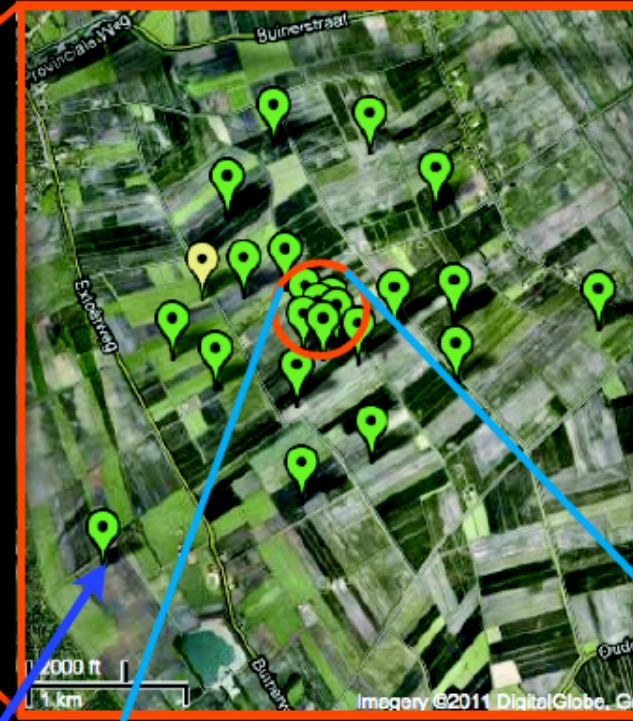
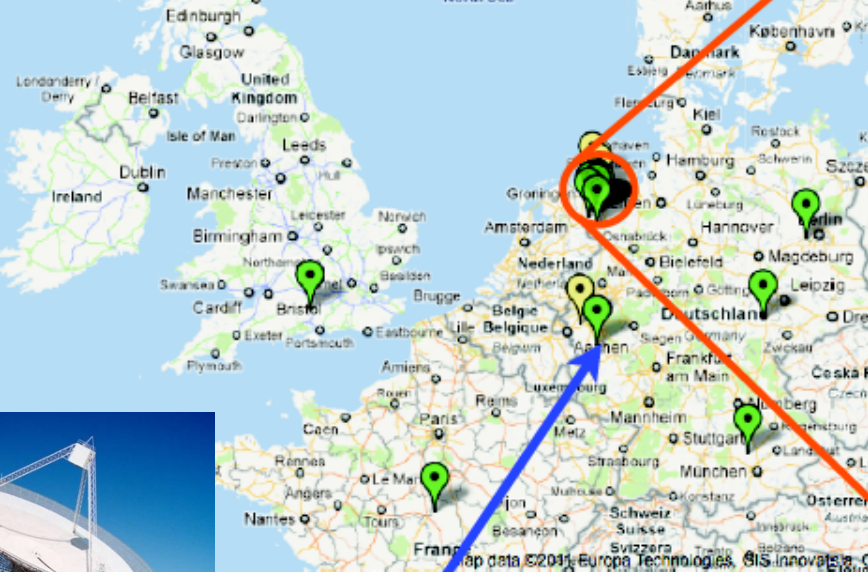
University of Manchester

Kimón Zagkouris

University of Oxford

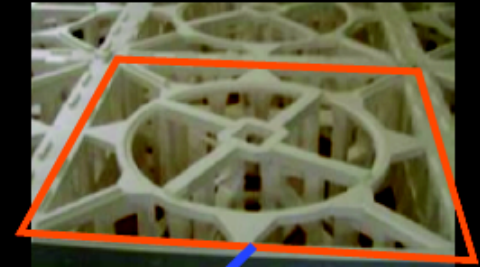
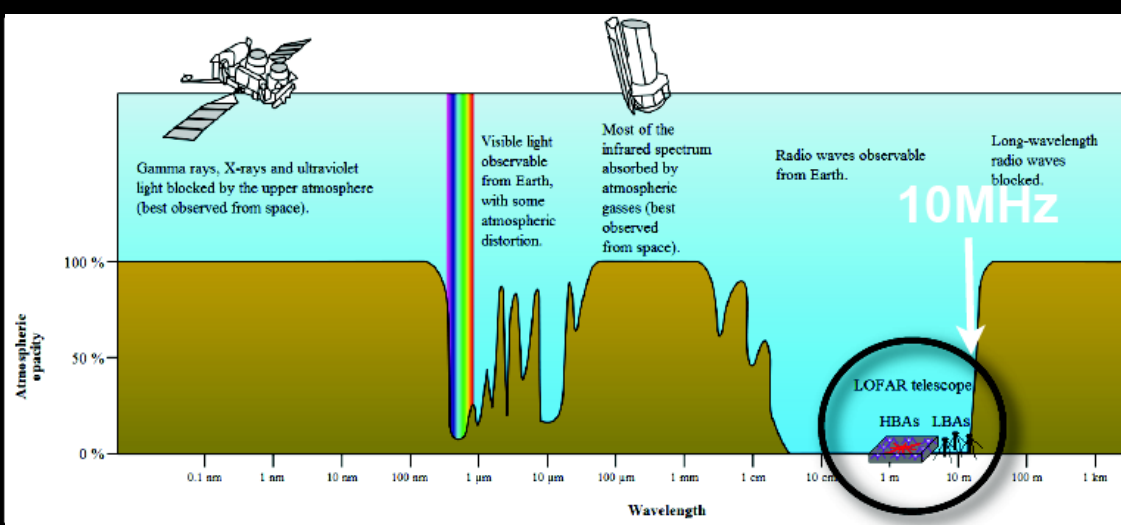
Outline

- About LOFAR
- LOFAR capabilities
- Latest pulsar results
- What is coming...



<http://www.astron.nl/~heald/lofarStatusMap.html>

LOFAR Antennas

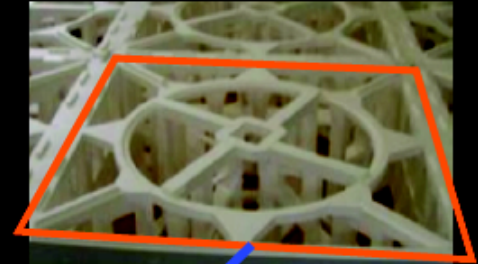
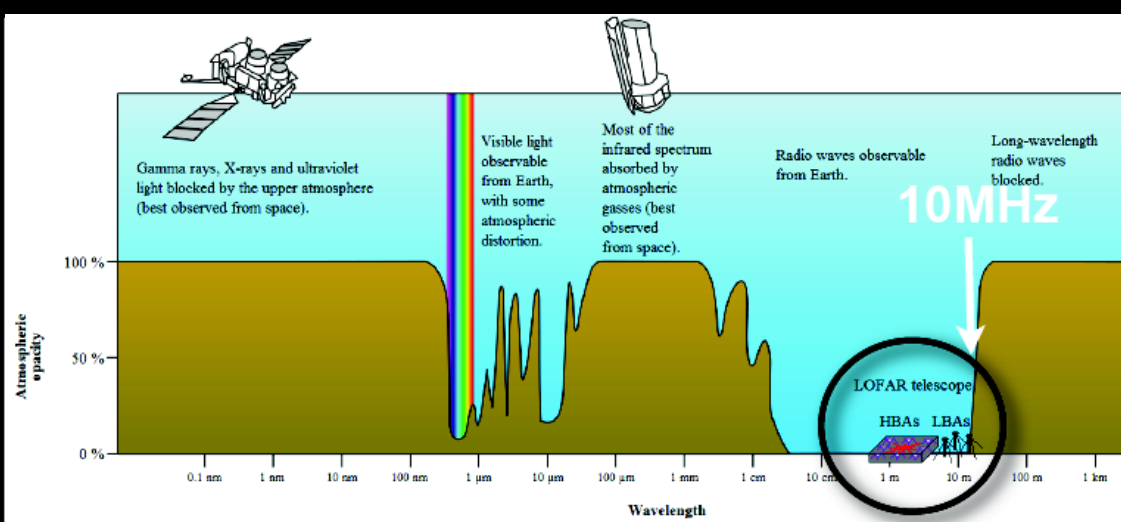


Low-band antennas (LBAs)
 $\nu = 10\text{-}90\text{MHz}$ $\lambda = 4\text{-}30\text{m}$



High-band antennas (HBAs)
 $\nu = 110\text{-}240\text{MHz}$ $\lambda = 1\text{-}3\text{m}$

LOFAR Antennas



LOFAR covers the lowest 4 octaves of the ``radio window''

Low-band antennas (LBAs)
 $\nu = 10\text{-}90\text{MHz}$ $\lambda = 4\text{-}30\text{m}$

High-band antennas (HBAs)
 $\nu = 110\text{-}240\text{MHz}$ $\lambda = 1\text{-}3\text{m}$

Highlights

- **Thijs Coenen** – LOFAR commissioning pulsar surveys (talk, Thu)
- **Heino Falcke** – FRATs: Searching for fast radio transients in real-time with LOFAR (talk, Thu)
- **Joeri van Leeuwen** – "An X-Raydio Switcheroo" - Detection of correlated mode changes in radio and X-ray (talk, Fri)
- **Vlad Kondratiev** – Pulsar Emission at the Bottom-End of the Electromagnetic Spectrum (talk, Fri)
- **Maciej Serylak** – Observations of transients and pulsars with LOFAR international stations (poster IAUS291-1-0254)

Multiple, widely separated FOVs

@28MHz
BW=8MHz

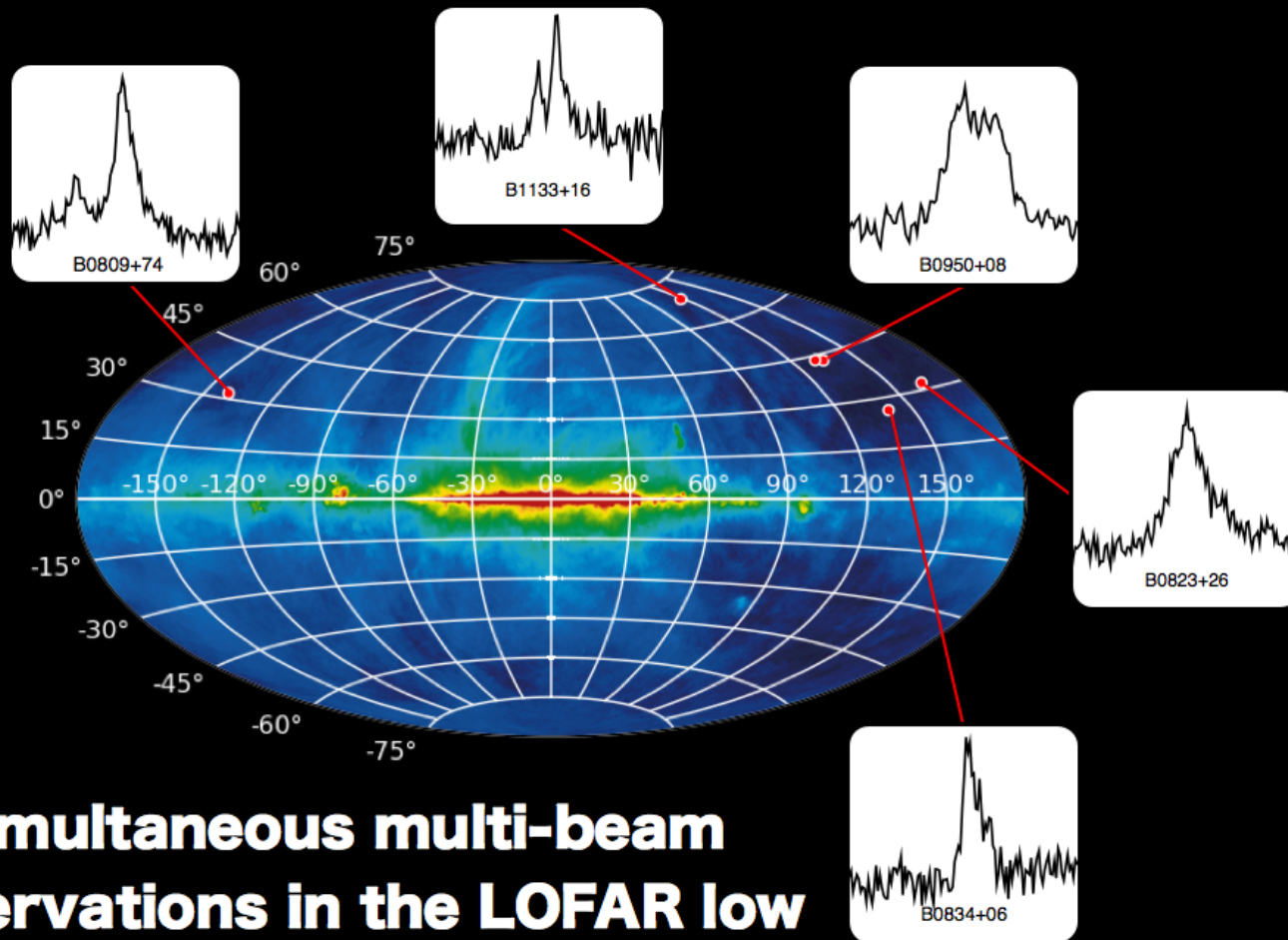


Image credit:
Hassall
Hessels
Stappers

LOFAR Tied-Array Multi-Beam

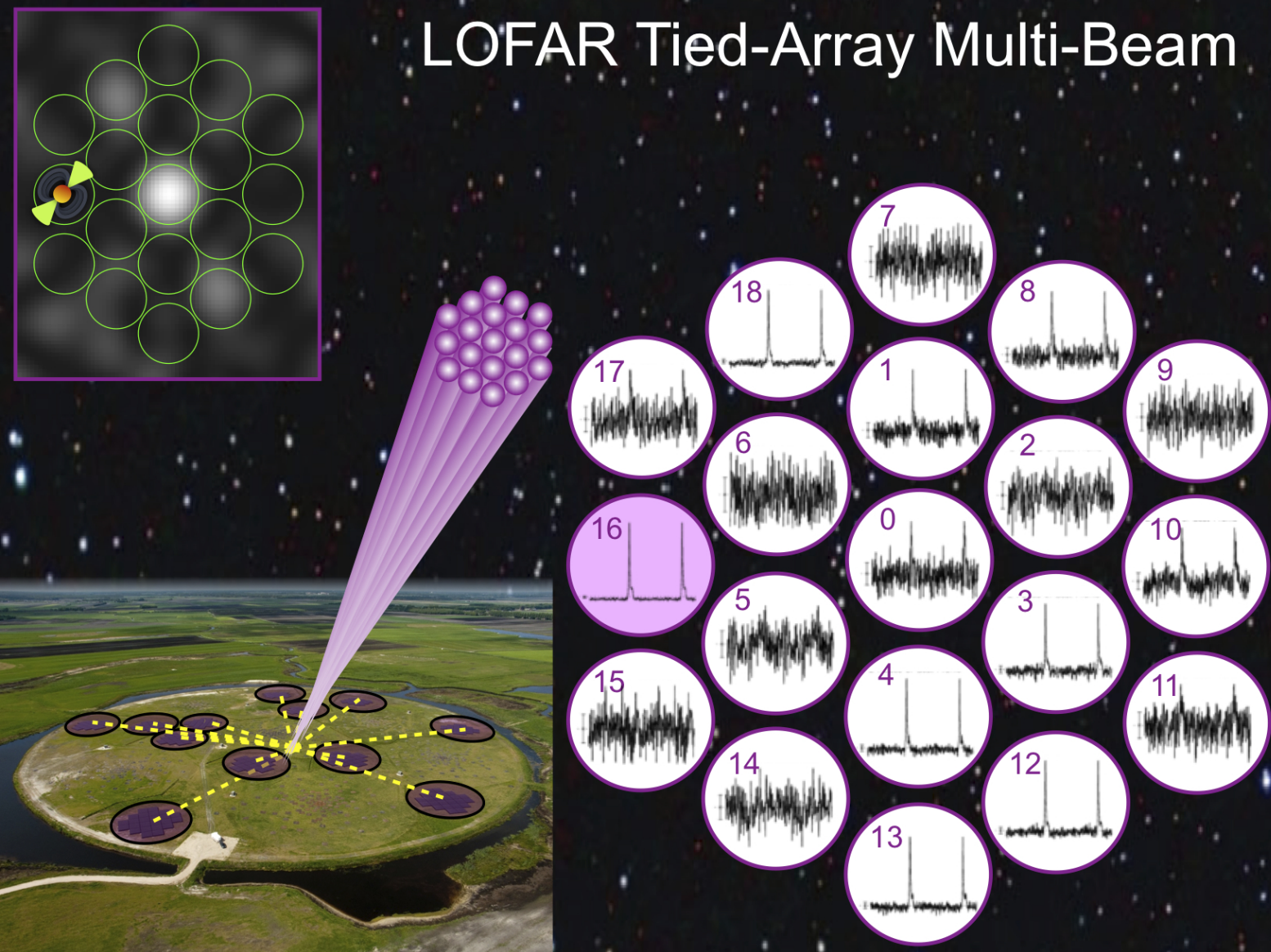


Image credit:
Hessels
Stappers
Scaife

See Mol & Romein 2011 for multi-beam tied-array benchmarking results

LOFAR 127-beam Tied-Array

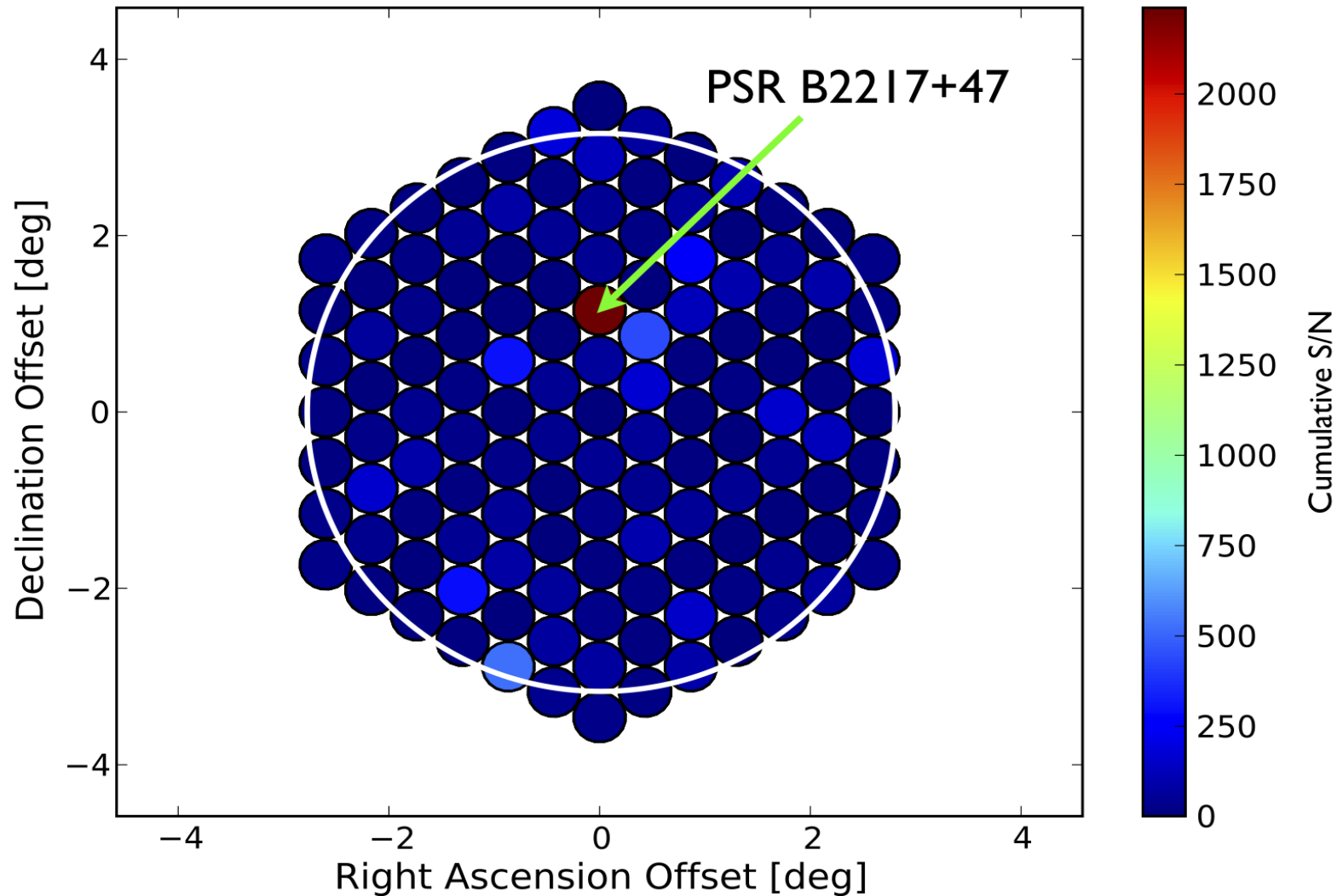
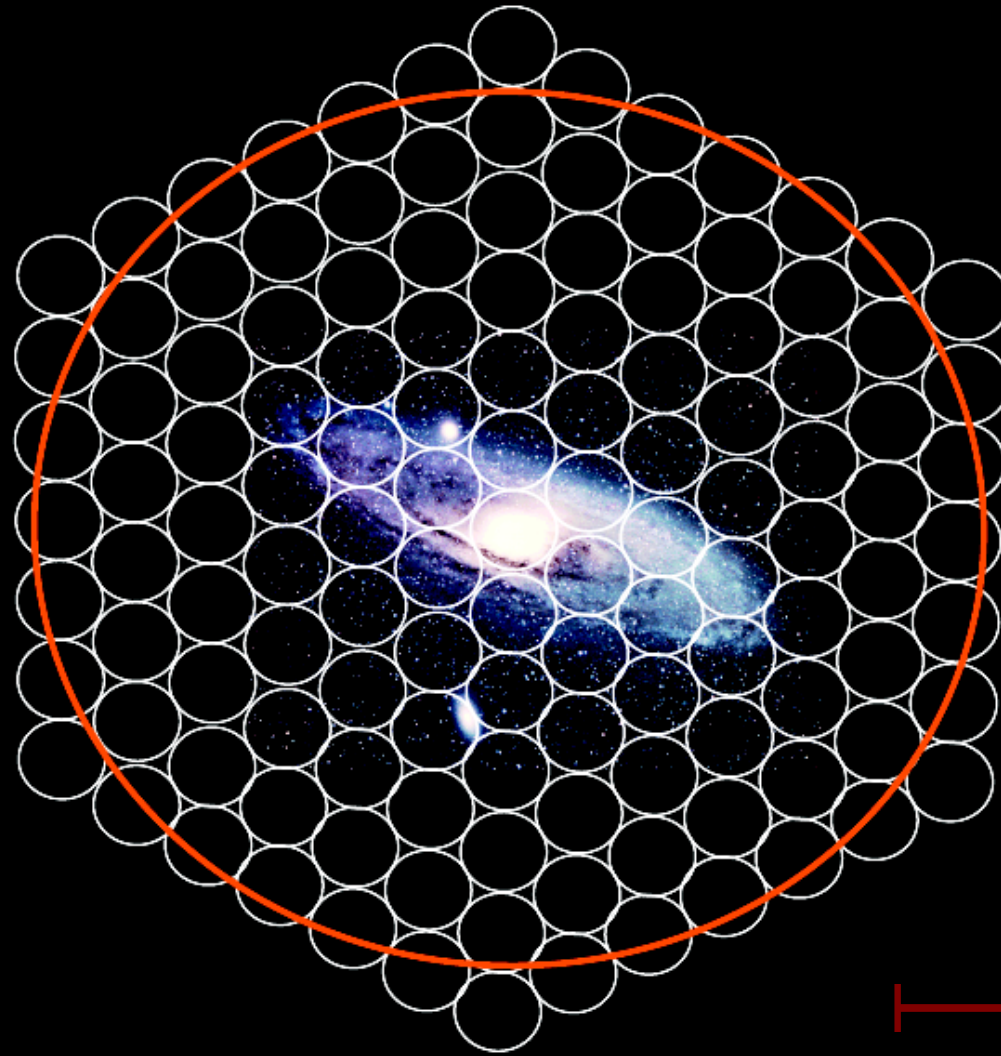
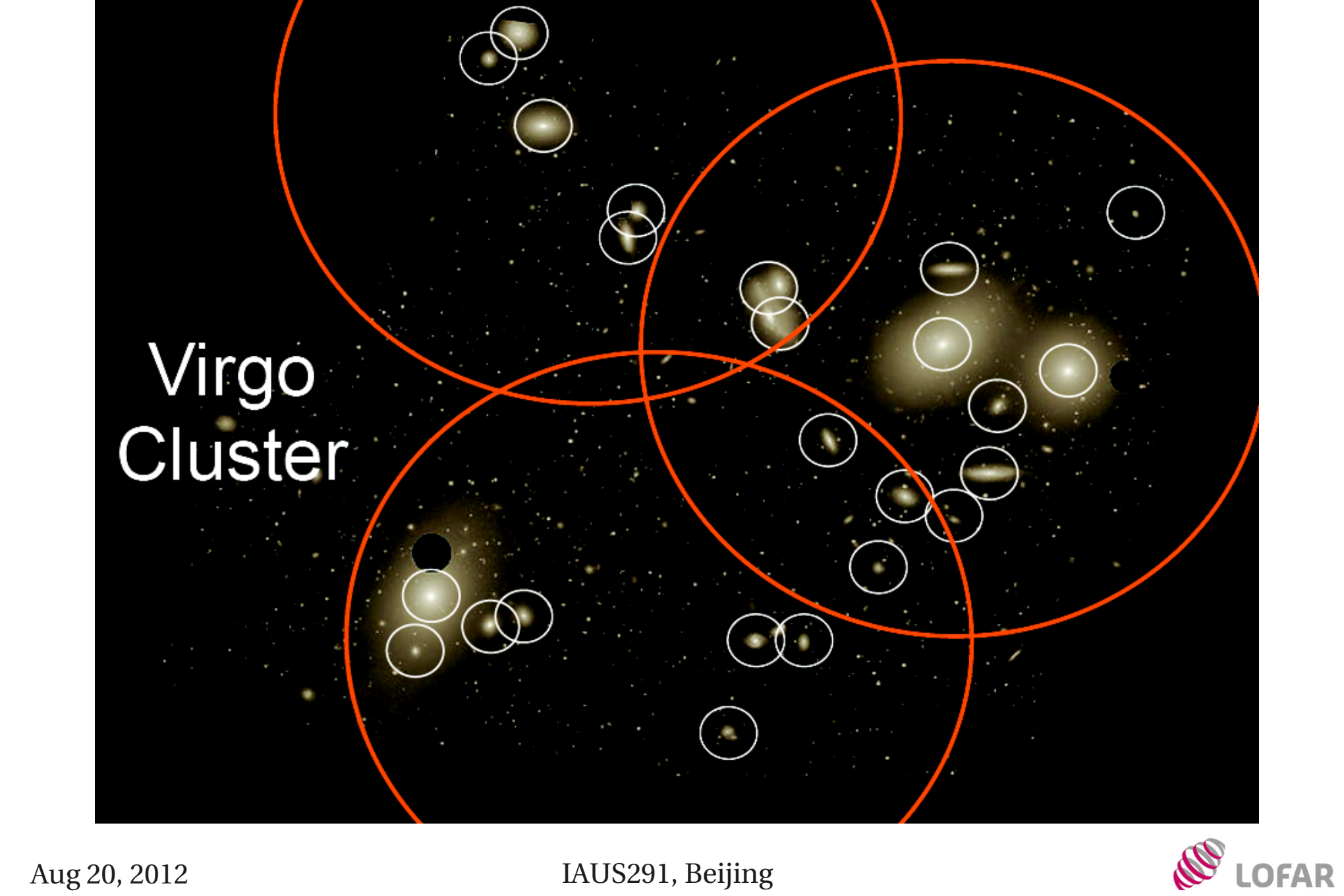


Image credit:
Hessels
Alexov

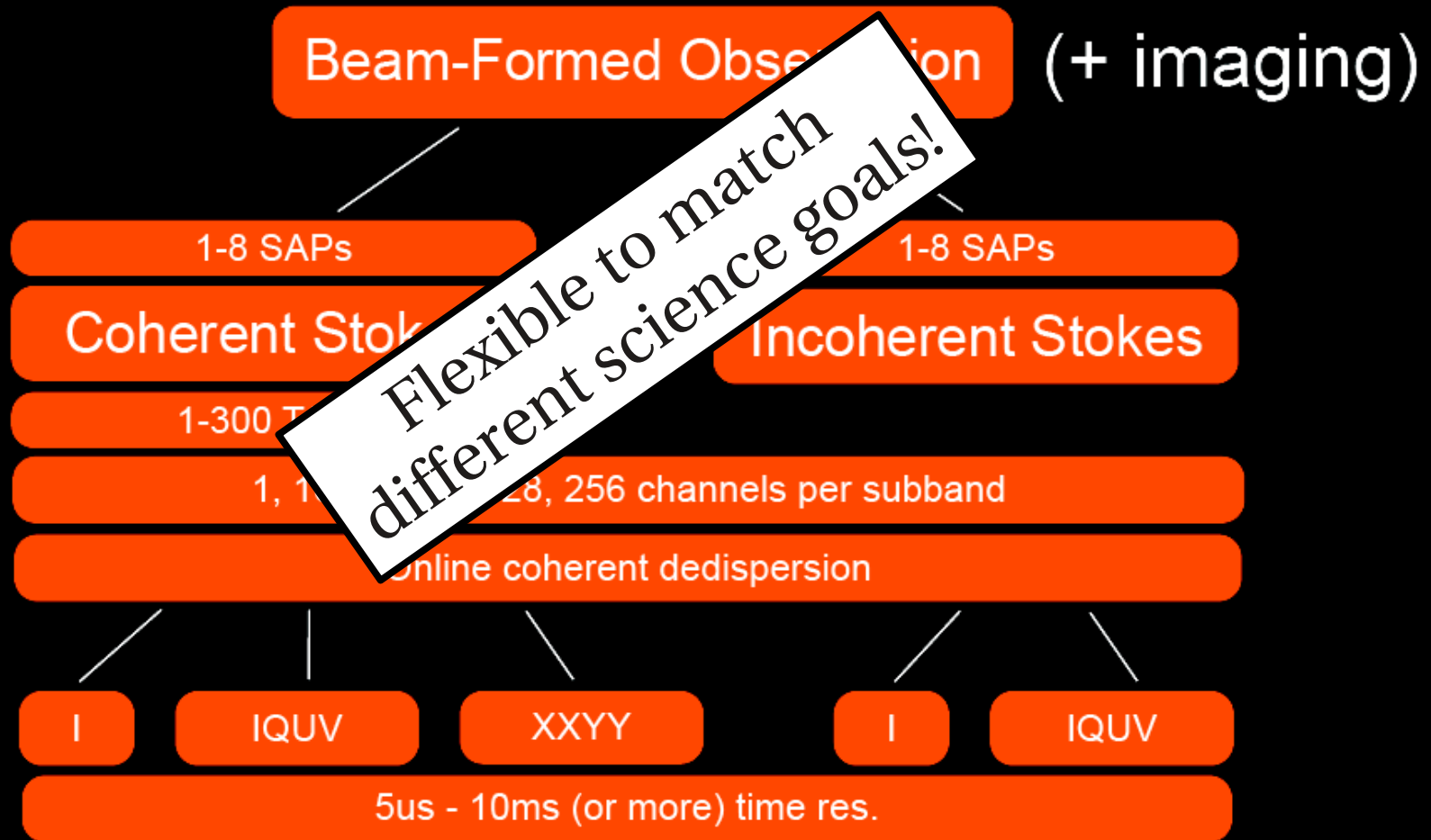
Andromeda



Virgo Cluster



LOFAR v1.0: Beam-Formed Modes



All written to HDF5 with metadata

Simultaneous Imaging + Pulsar observations

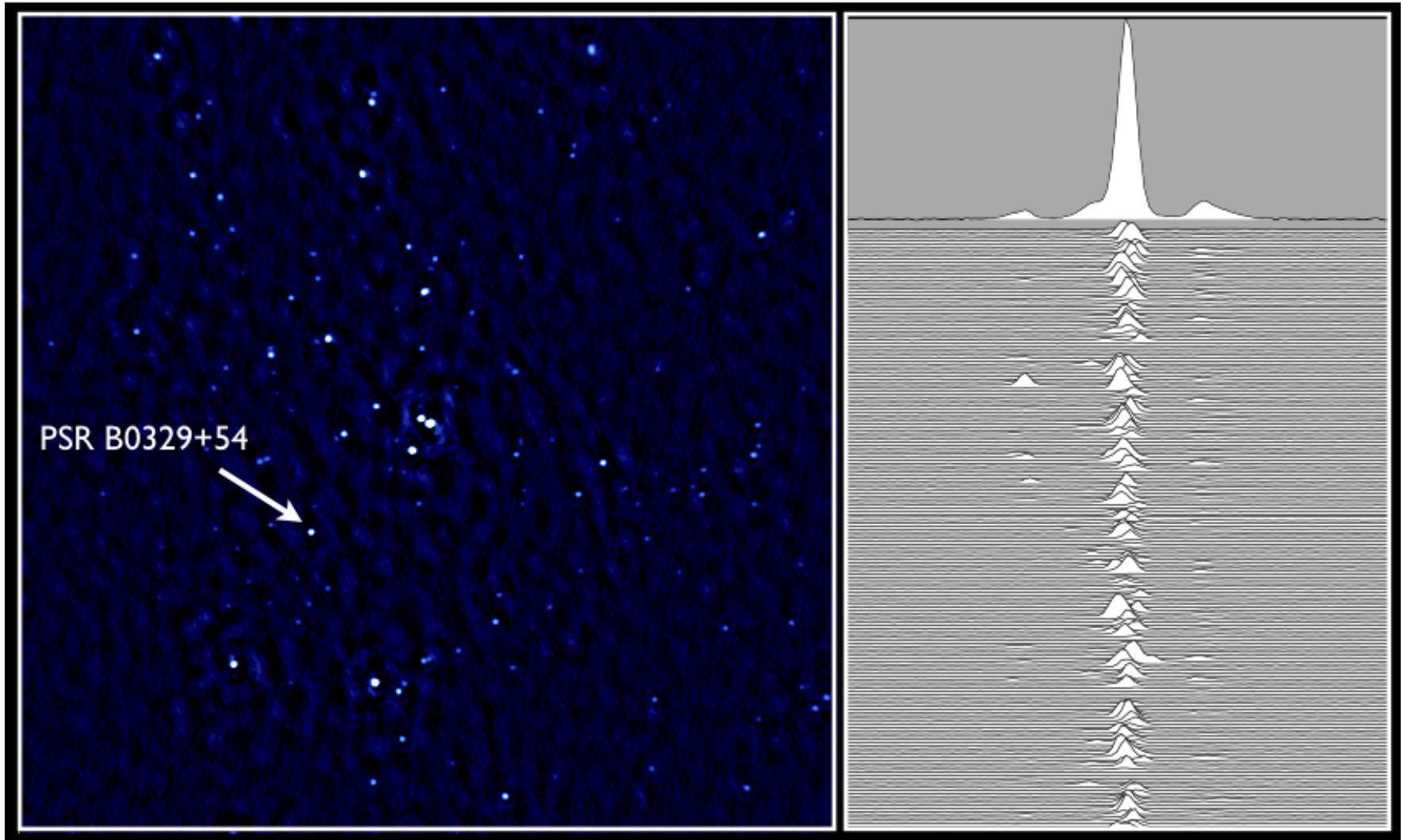
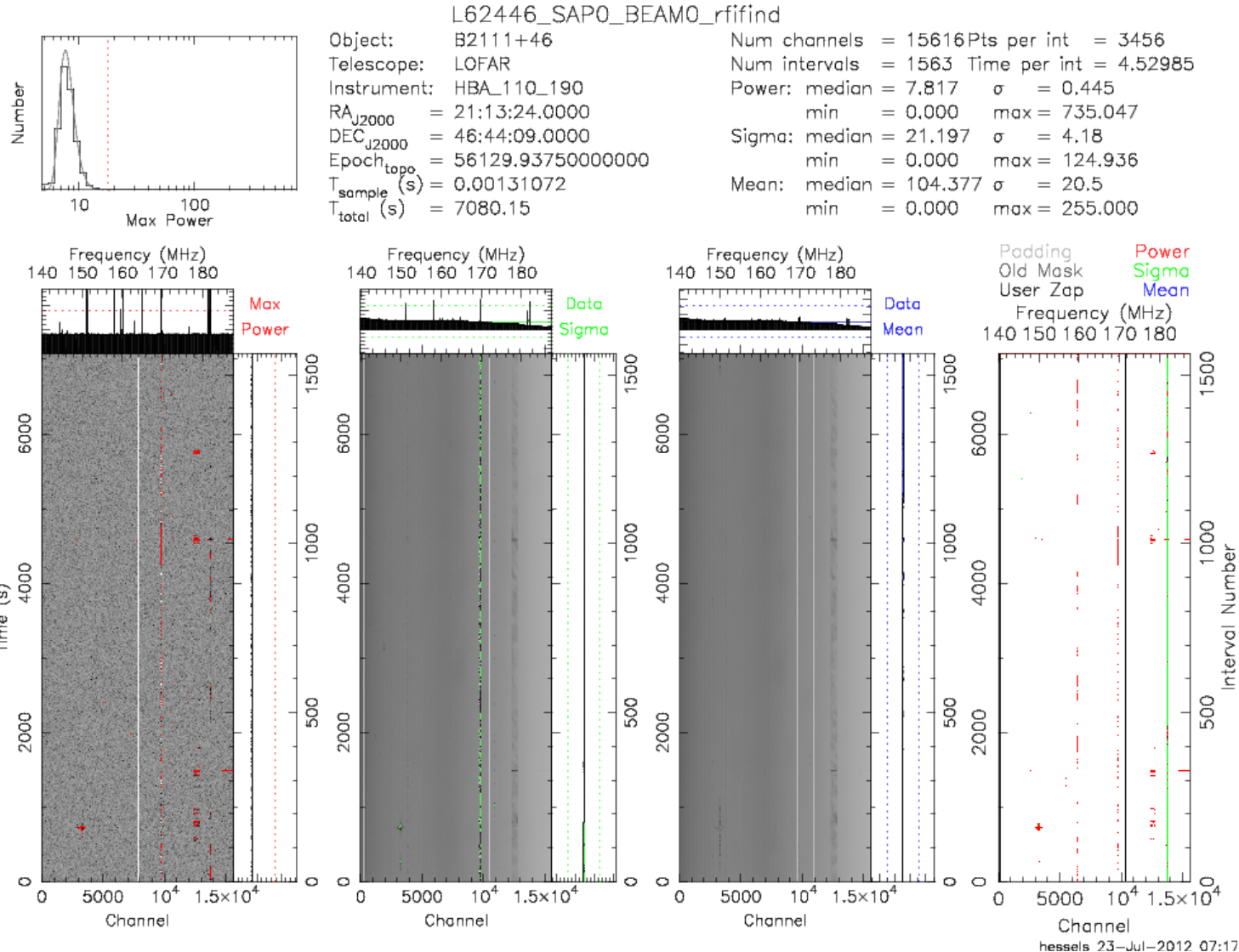


Image credit:
Heald
Alexov
Hessels

RFI environment

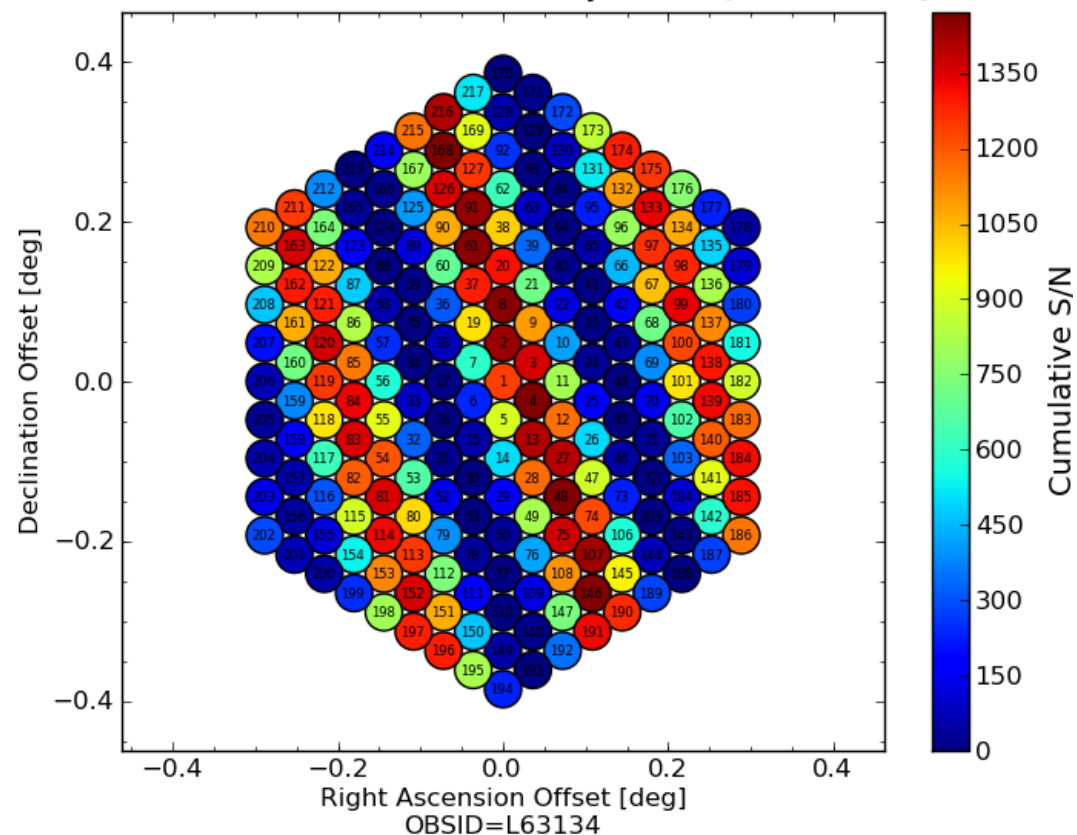


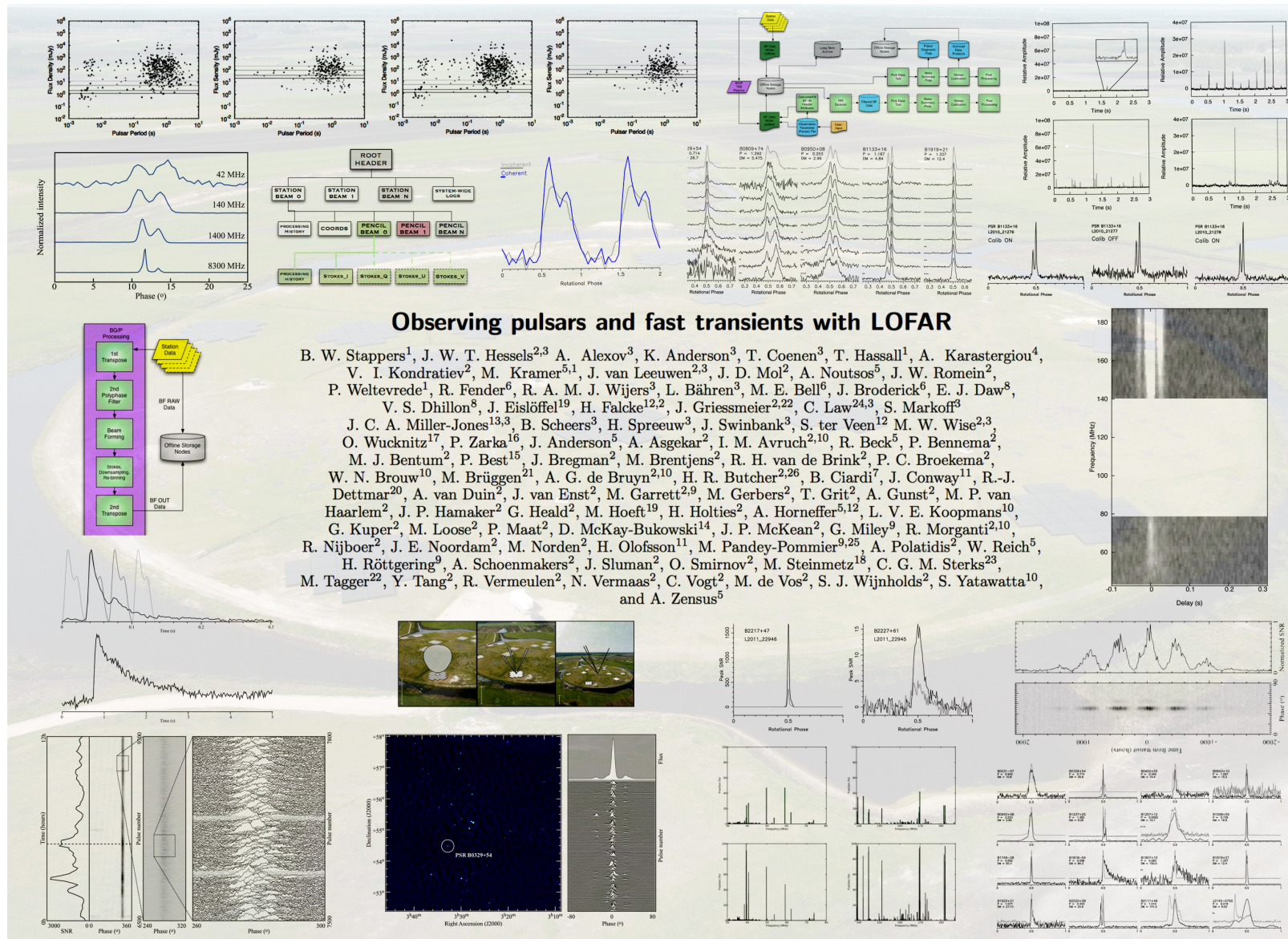
Towards Full-Core Single Clock

Image credit:
Hessels
Kondratiev
Brentjens

B0329+54 transit

Cumulative S/N of PSR B0329+54 in 217
Simultaneous Tied-Array Beams [Linear Scale]





Stappers et al. 2011, A&A, 530, 80

Some Highlights



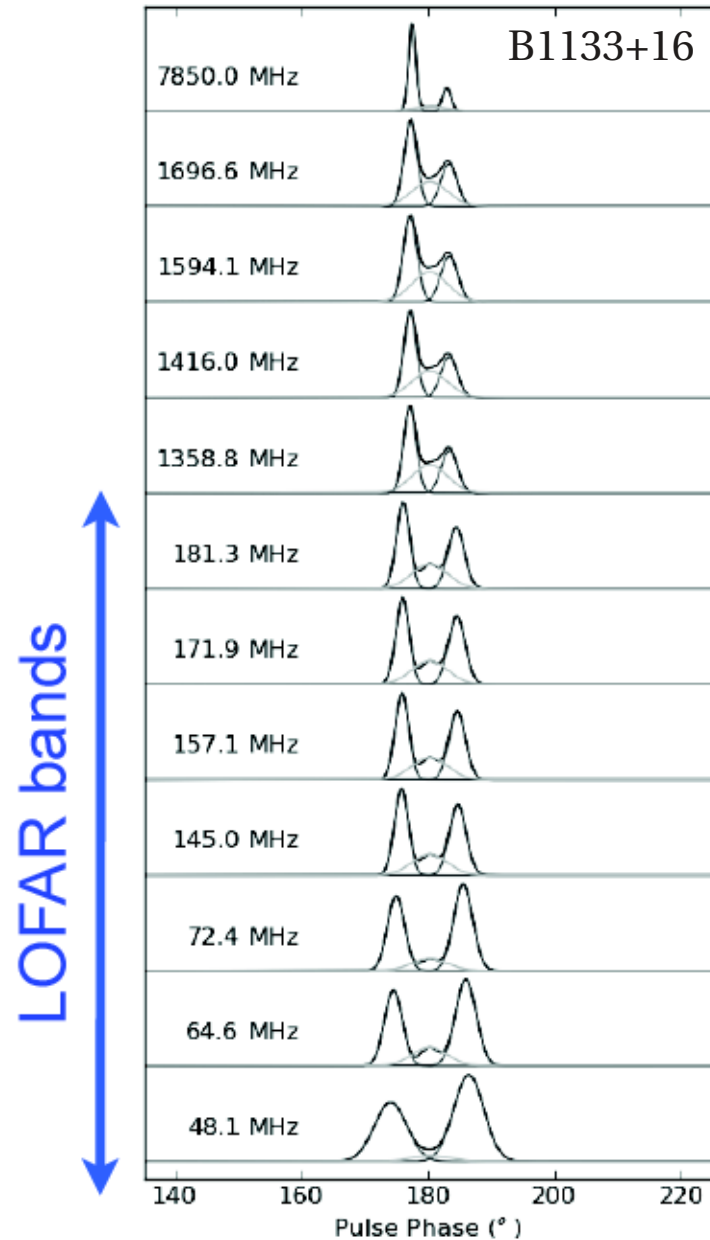
Aug 20, 2012

IAUS291, Beijing

DM vs. Profile variations

- Cold-dispersion law good to $1/100,000$
- For PSR B1133+16 all radio frequencies come from a region $\Delta R < 59$ km in altitude below 110 km from NS surface (0.2% of the light cylinder)

Hassall et al. 2012, A&A, 543, 66



LOFAR pulsar profiles

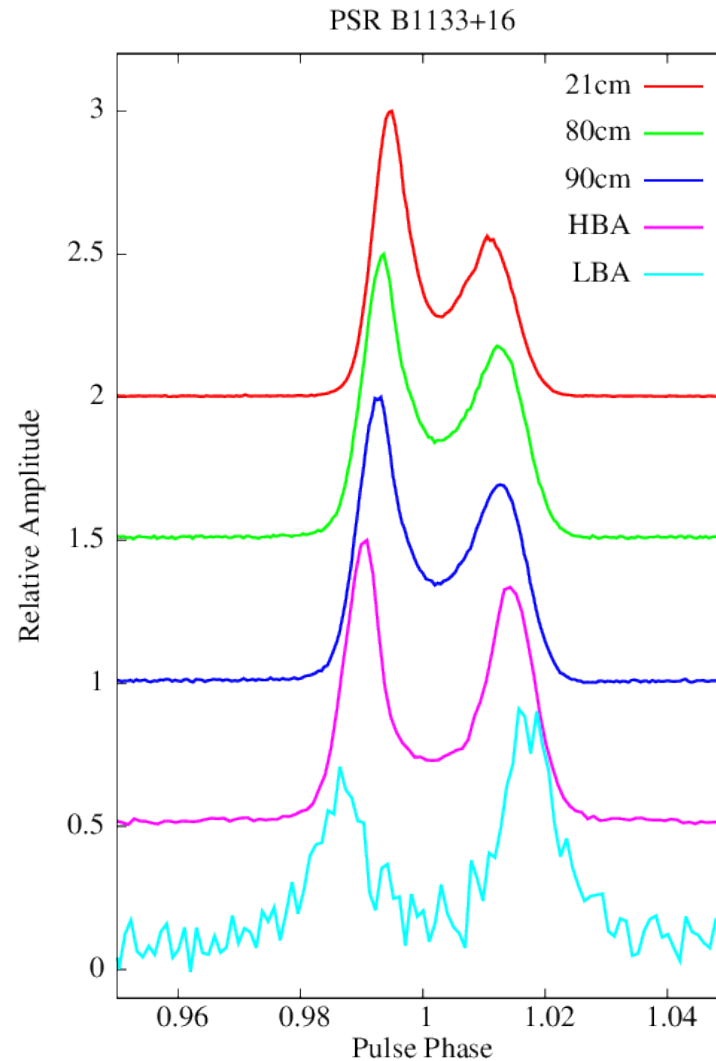
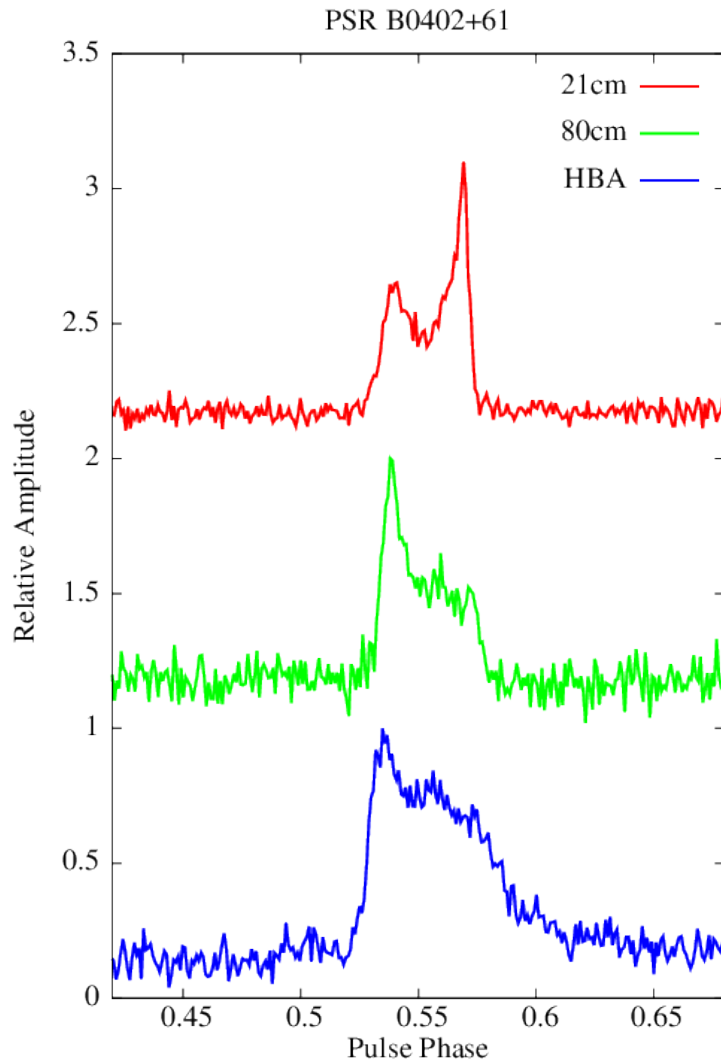


Image credit:
Stappers
Hessels
Pilia

Millisecond Pulsars

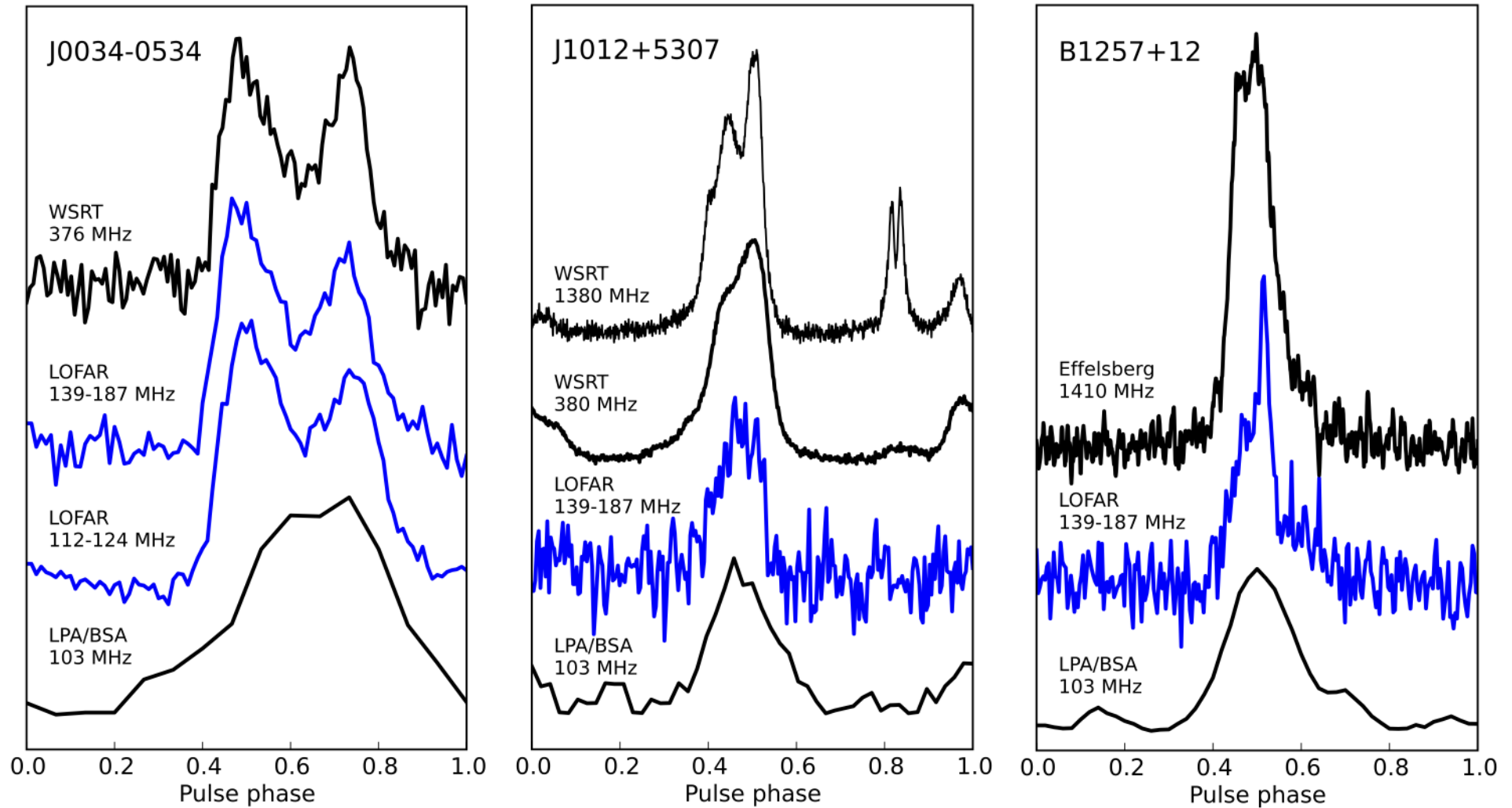


Image credit: Kondratiev & Hessels

Phase-Coherent timing of a Millisecond Pulsar

J0034-0534 (rms = 11.576 μ s) pre-fit

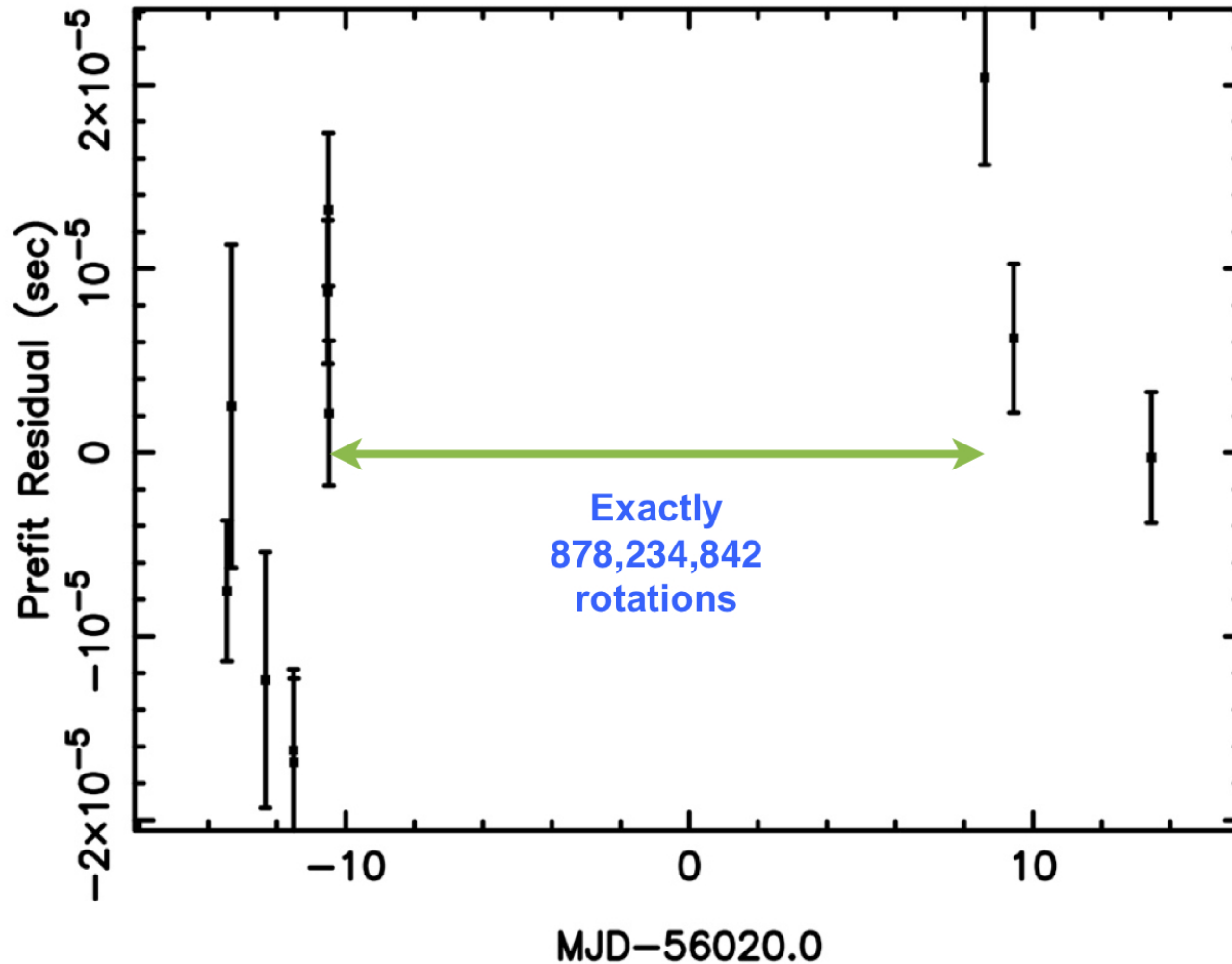
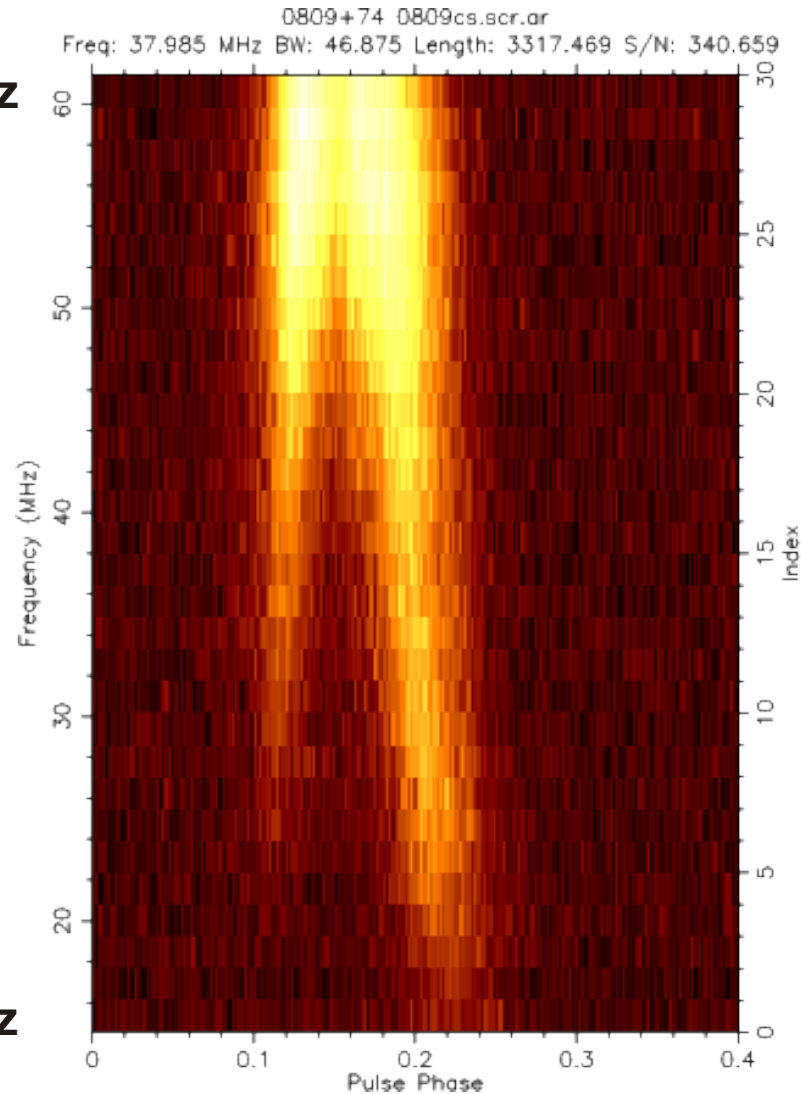


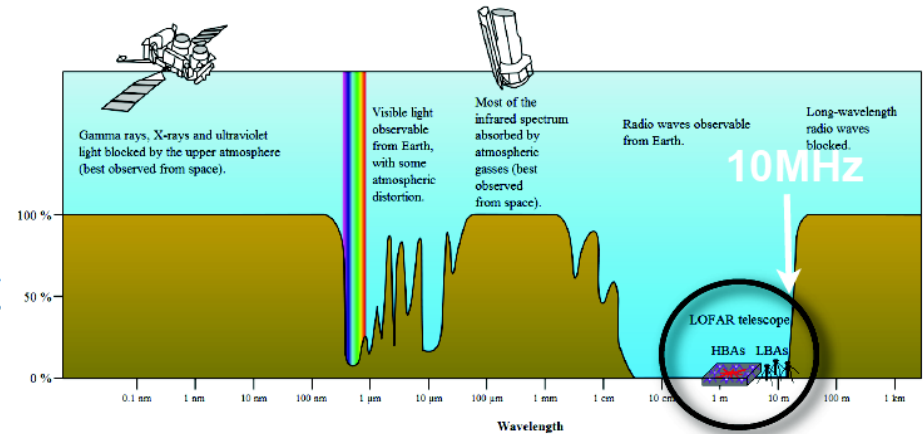
Image credit:
Verbiest
Hessels

Low-frequency studies

62 MHz



15 MHz



10 – 240 MHz

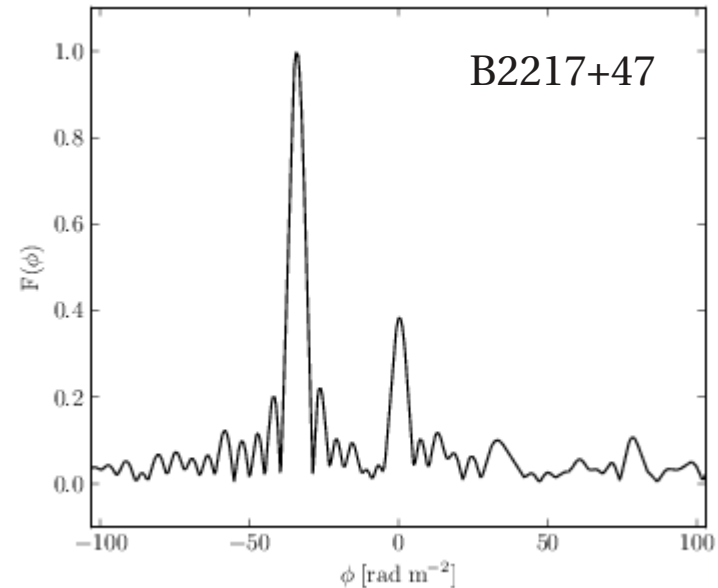
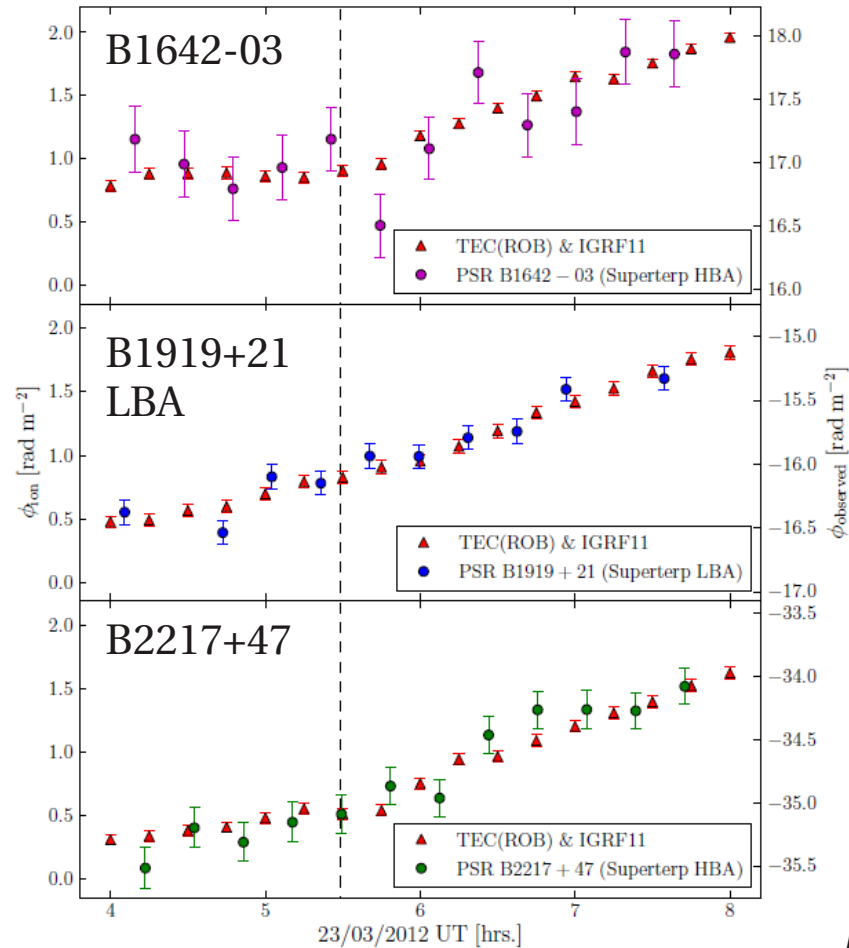
Image credit:

Kondratiev

Hassall

Hessels

Ionospheric RM calibration



$$\text{RM} = -35.58 \pm 0.14 \text{ rad m}^{-2}$$

12 3-min observations combined:

$$\text{RM} = -35.6 \pm 0.1 \text{ rad m}^{-2}$$

Image credit: Sobey, Hessels, Sotomayor

Scattering studies

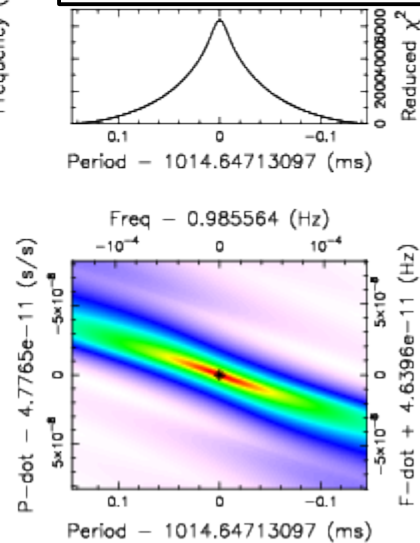
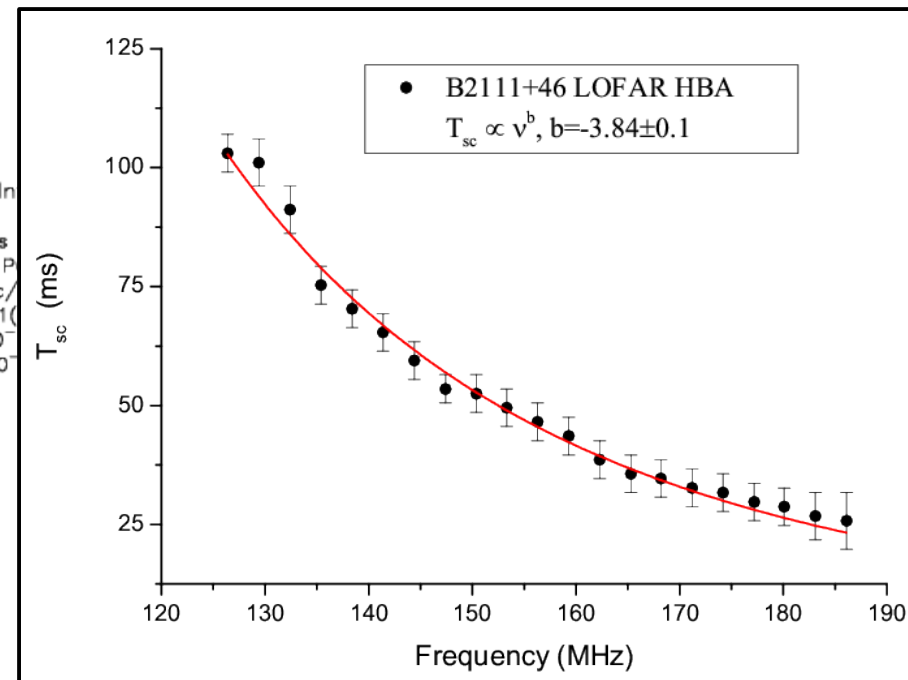
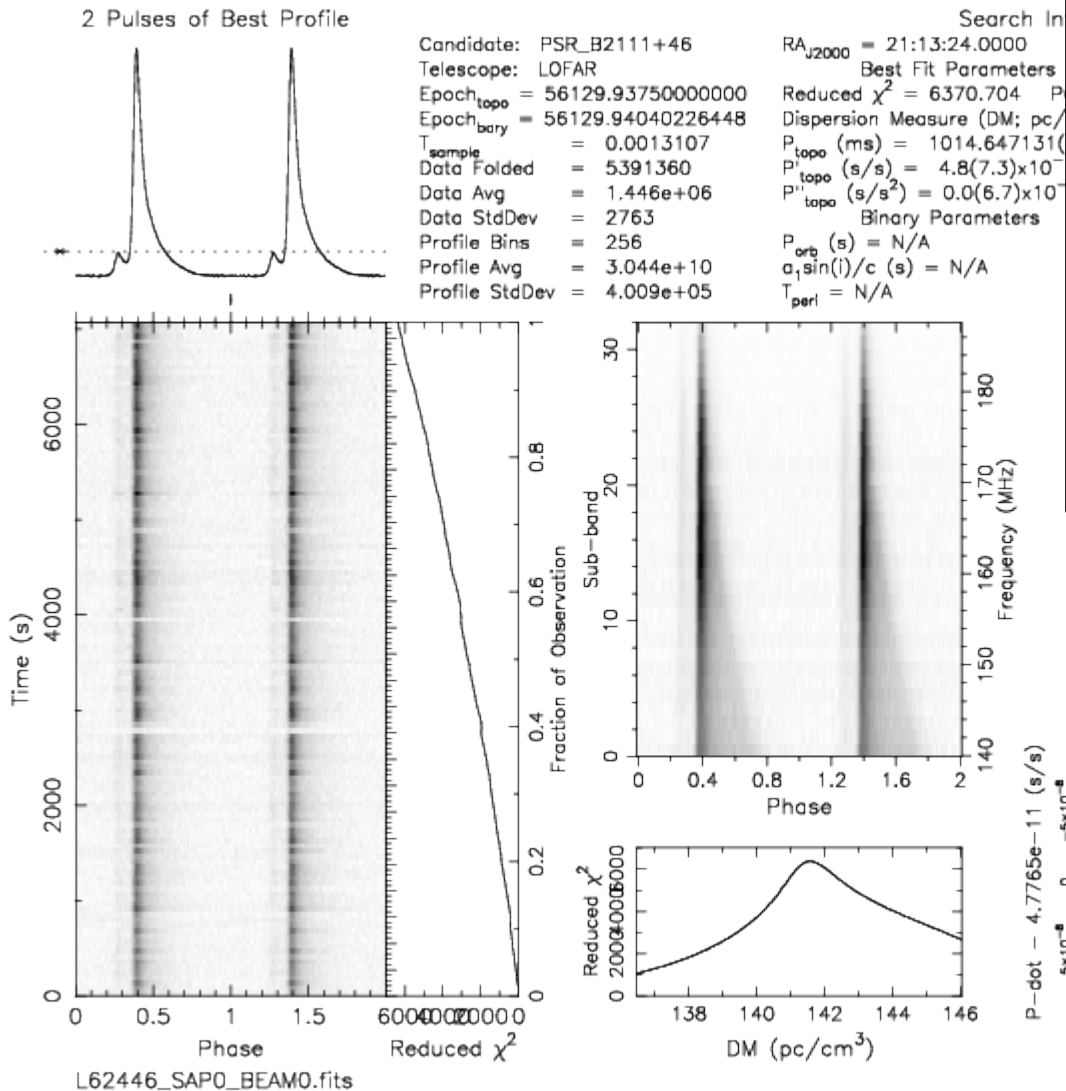
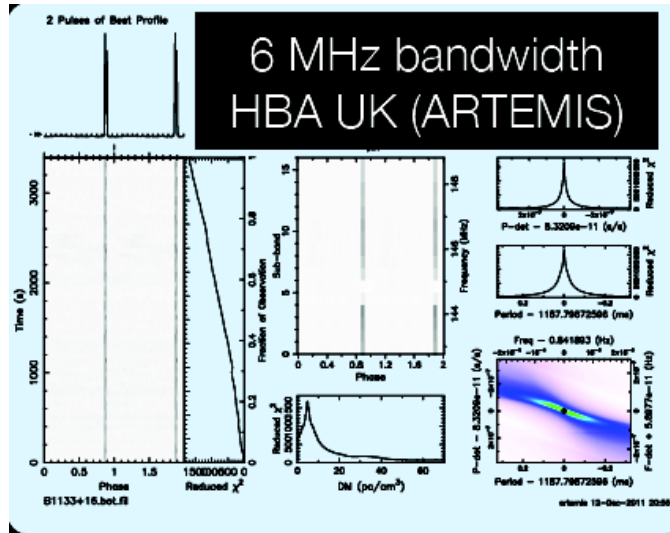


Image credit:
 Zagkouris
 Karastergiou
 Hessels

hessels 23-Jul-2012 09:21

Single stations / ARTEMIS –

software/hardware backend
to process streaming data

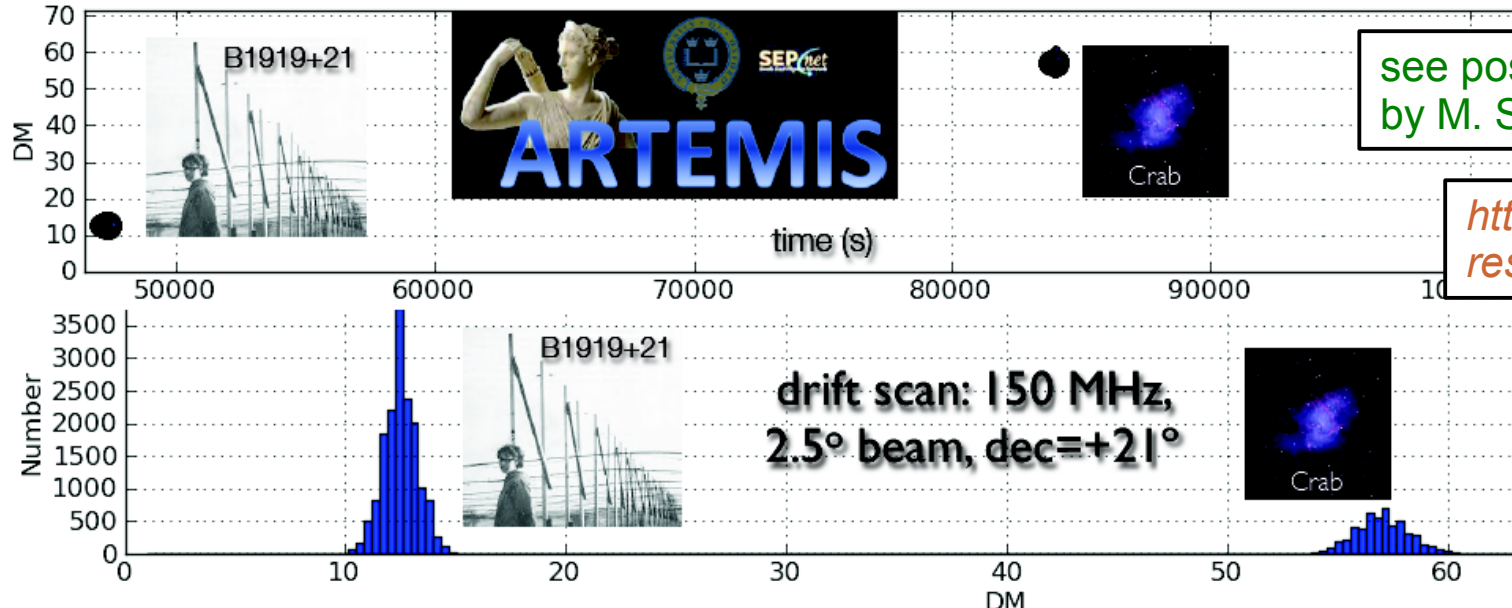


- Real time detection system to detect RRATs and Lorimer burst-type events as they happen.
- Affordable and scalable hardware
- Fastest incoherent dedispersion code on NVIDIA GPU
- RFI rejection in very contaminated environment

Aris Karastergiou (aris@astro.ox.ac.uk)

Stations:

- Chilbolton (UK)
- Nancay (FR)
- Effelsberg (DE)
- **Onsala (SE)**
- **Julich (DE)**



see poster **IAUS291-1-0254**
by M. Serylak for more details

[http://www.oerc.ox.ac.uk/
research/artemis](http://www.oerc.ox.ac.uk/research/artemis)

Image credit:
Karastergiou
Serylak

Towards LOFAR v1.1

- **Quadrupling the raw system sensitivity**

Full-Core Single Clock (end of Sep)

- Direct link between data and DSPSR (**very close**) and PRESTO (currently converting to PSRFITS)

- **Doubling BW**, 48 MHz => 96 MHz (useful 80 MHz)

- Online RFI excision

- Sub-arrays (simultaneous observations)

- True Fly's Eye mode

LOFAR Call for Proposals, Cycle 0

(Home (About ASTRON (Astronomy Group (Radio Observatory (R & D Laboratory

RADIO OBSERVATORY

LOFAR

- (Observing Proposals
- (Observing Capabilities
- (Weekly schedule
- (Commissioning Period & the LCCG
- (LOFAR MSSS
- (Station Status
- (LOFAR Science
- (Publications and Authorship Policy

WSRT

- (Astronomers
- (Weekly schedule
- (Observation status
- (Apertif
- (Apertif - EOIs

GENERAL

- (PC pages
- (Special projects
- (People

VISIT US

- (Female Visitor Programme

Home » Radio Observatory » Observing Proposals

- (Regular Proposal Call Instructions
- (Allocated Reserved Access Proposals
- (Detailed Allocation Mechanism

OBSERVING PROPOSALS

LOFAR is a powerful next-generation radio telescope for frequencies below 240 MHz that offers revolutionary new observing capabilities thanks to its phased-array technology with digital beam-forming. LOFAR Version 1.0 already allows novel and cutting-edge science projects, while considerable development is ongoing to reach the full potential of the International LOFAR Telescope (ILT).

For Cycle 0 which will run from December 2012 to May 2013, there is a limited but diverse set of standard observing capabilities. LOFAR Version 1.0 delivers correlated visibility data for synthesis imaging, incoherently added single and multiple station data as well as transient buffer read-out.

International LOFAR Telescope Regular Proposal Call Open to the Worldwide Community

Submission deadline: Monday September 17, at 12:00 UT

Cycle 0 will run from 01 December 2012 to 31 May 2013.

Detailed Instructions at the "[Regular Proposal Call Instructions](#)" page (here as [PDF](#) file).

Proposal Tool

Proposals should be submitted using the "[NorthStar for LOFAR](#)" *proposal submission tool*.

A short "[Walk Through](#)" manual of NorthStar [PDF file].

Answers to some [Frequently Asked Questions](#) for the use of NorthStar during the "Call for Proposals"

Proposers will be able to use the online "[LOFAR Data Volume Calculator](#)"

Further questions can be addressed to the Radio Observatory Science Support Group:
sciencesupport_AT_astron.nl

(search

<http://www.astron.nl/radio-observatory/astronomers/asking-time/asking-time-0>