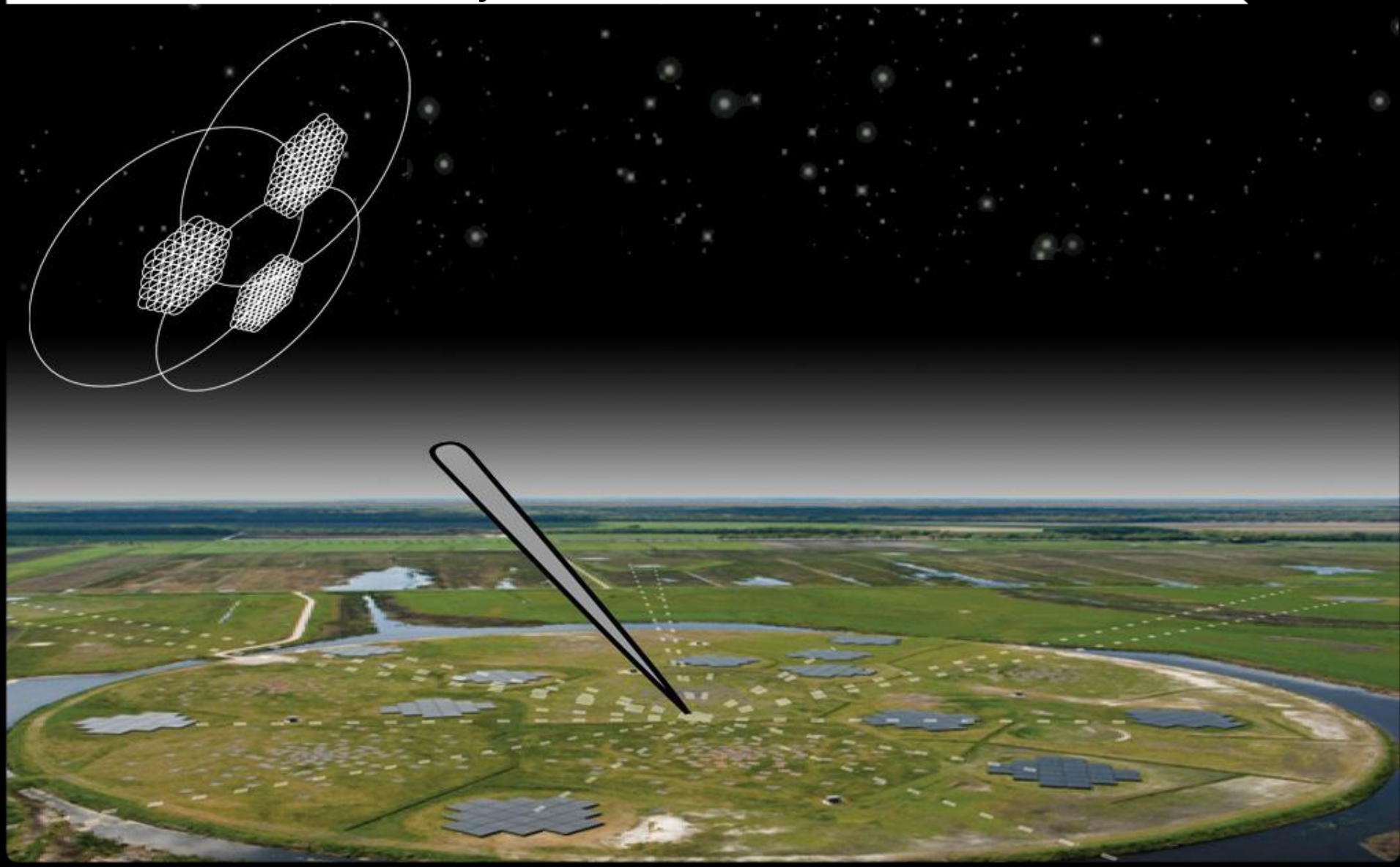
Joeri van Leeuwen

The LOFAR Pulsar Surveys

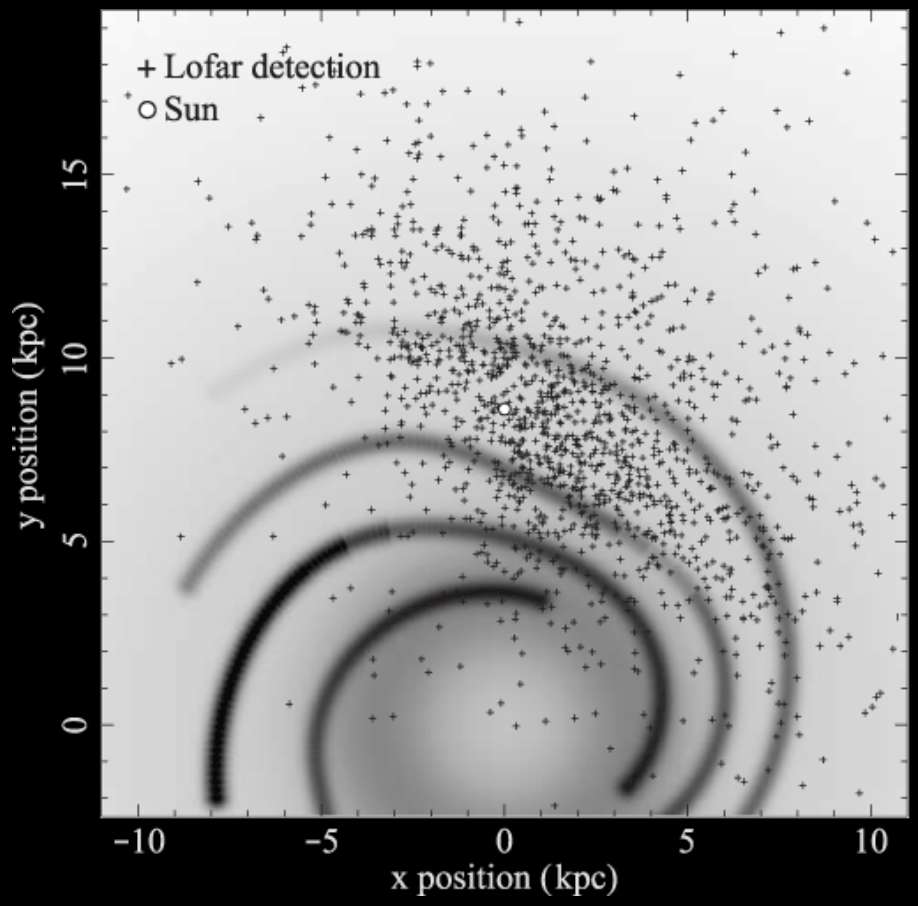


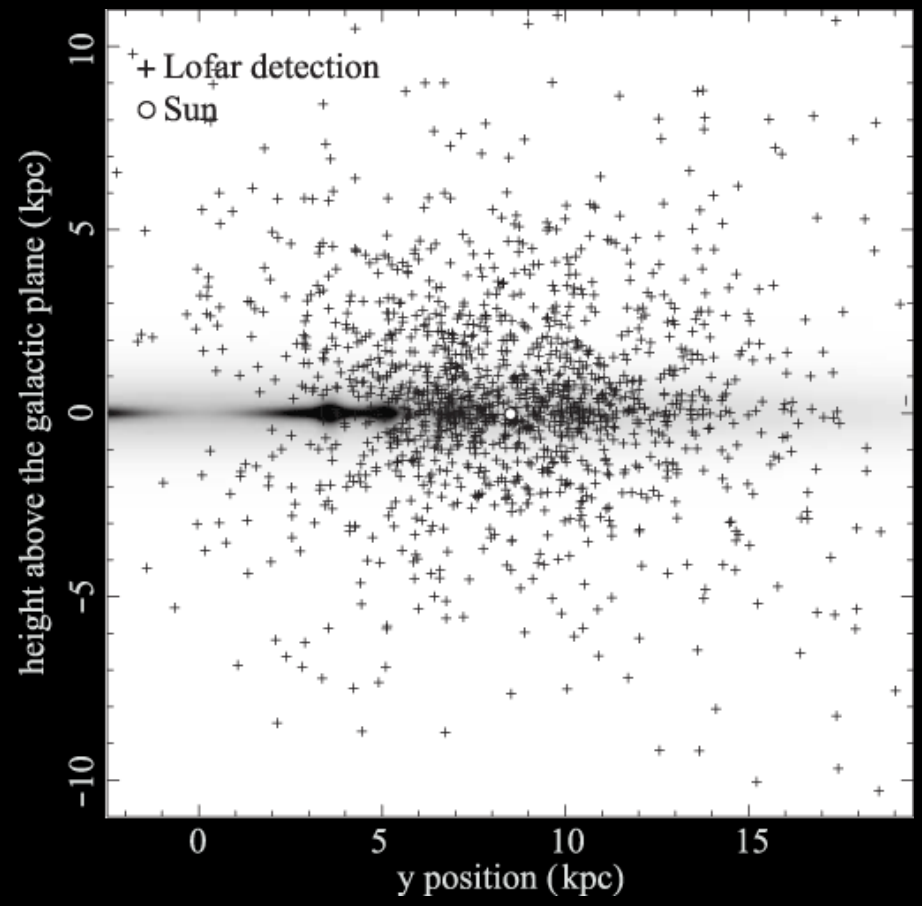
The team

Jason Hessels (ASTRON)
Vlad Kondratiev (ASTRON)
Thijs Coenen (UvA)
Ben Stappers (U. Manchester)

+LOFAR Pulsar Working Group
Anastasia Alexov, Anya Bilous, Sally Cooper, Heino Falcke, Jenny Green, Jean-Mathias Grießmeier, Tom Hassall, Aris Karastergiou, Evan Keane, Michael Kramer, Masaya Kuniyoshi, Aris Noutsos, Maura Pilia, Maciej Serylak, Charlotte Sobey, Sander ter Veen, Joris Verbiest, Patrick Weltevrede & Kimon Zagkouris

The goal





van Leeuwen (2004), van Leeuwen & Stappers (2010)

The bet

2008 -- Bailes vs. van Leeuwen & Stappers

"To find 200 new pulsars with LOFAR by 12 Dec 2012"

12 bottles of $12 wine.

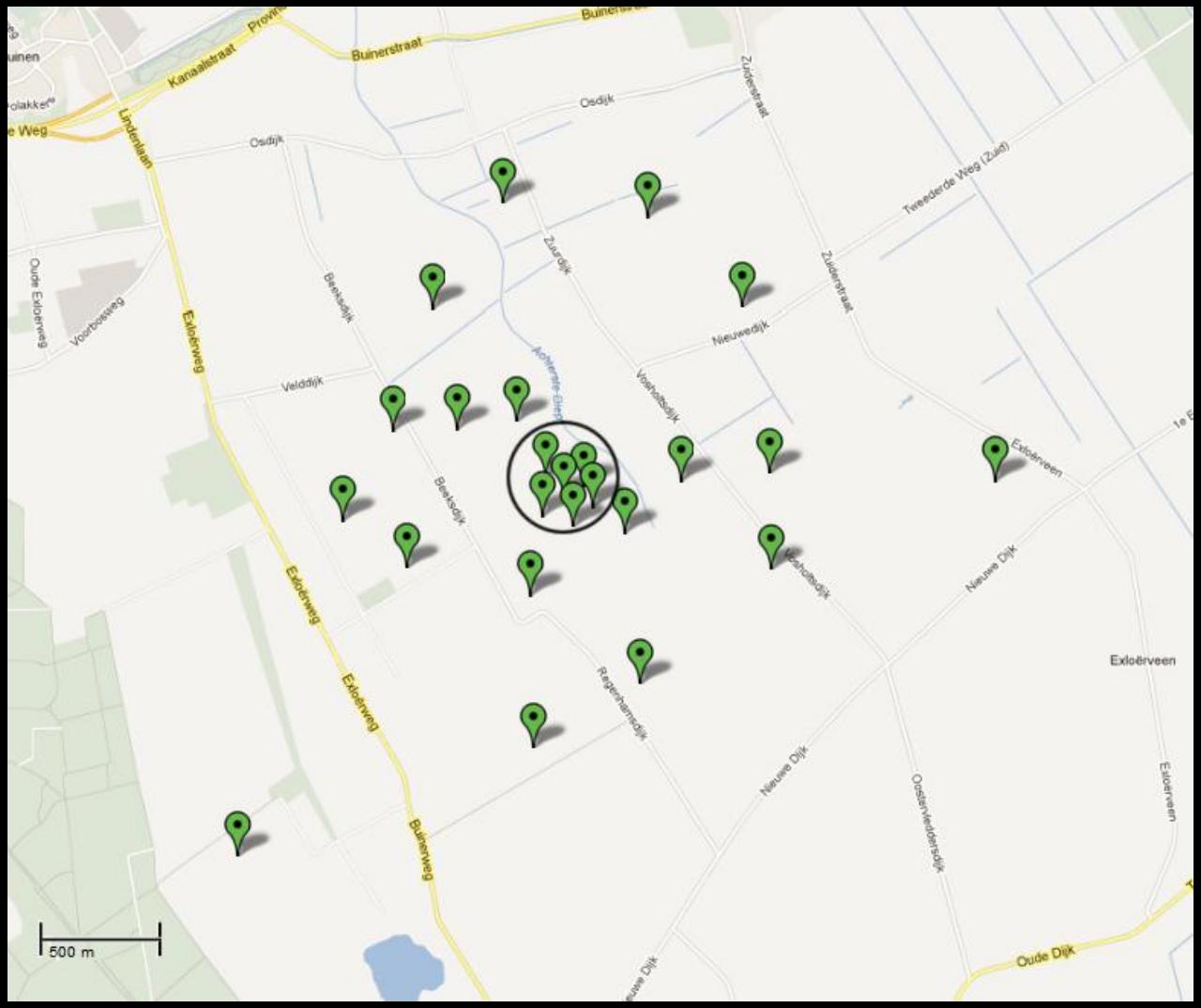
Survey definition(s)

Backer (1999)

– coherent versus incoherent beamforming;
  backend requirements and possibilities

– using part of the array with the highest filling factor
  LOFAR core/supercore

Survey definition(s)

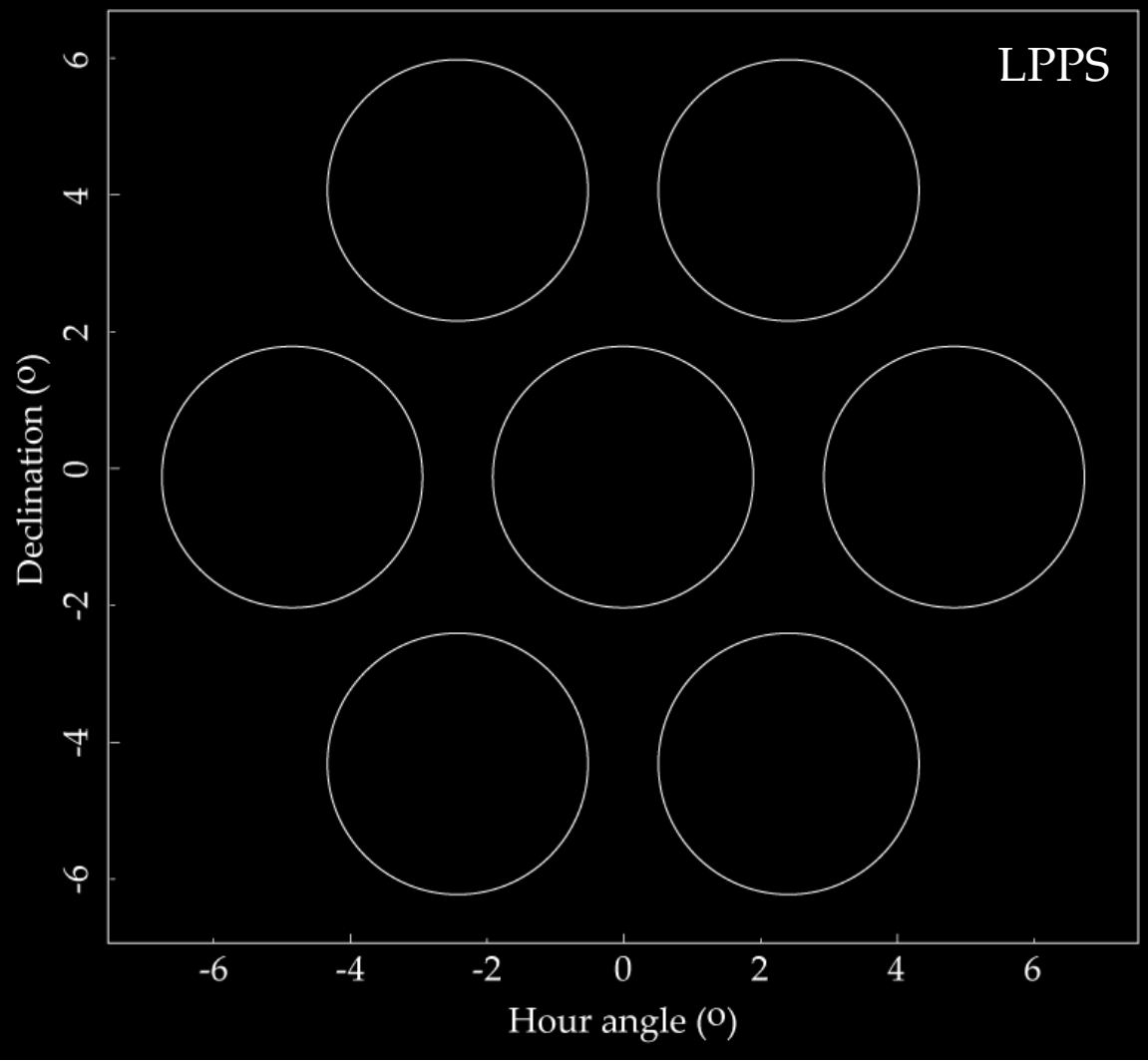


Survey definition(s)

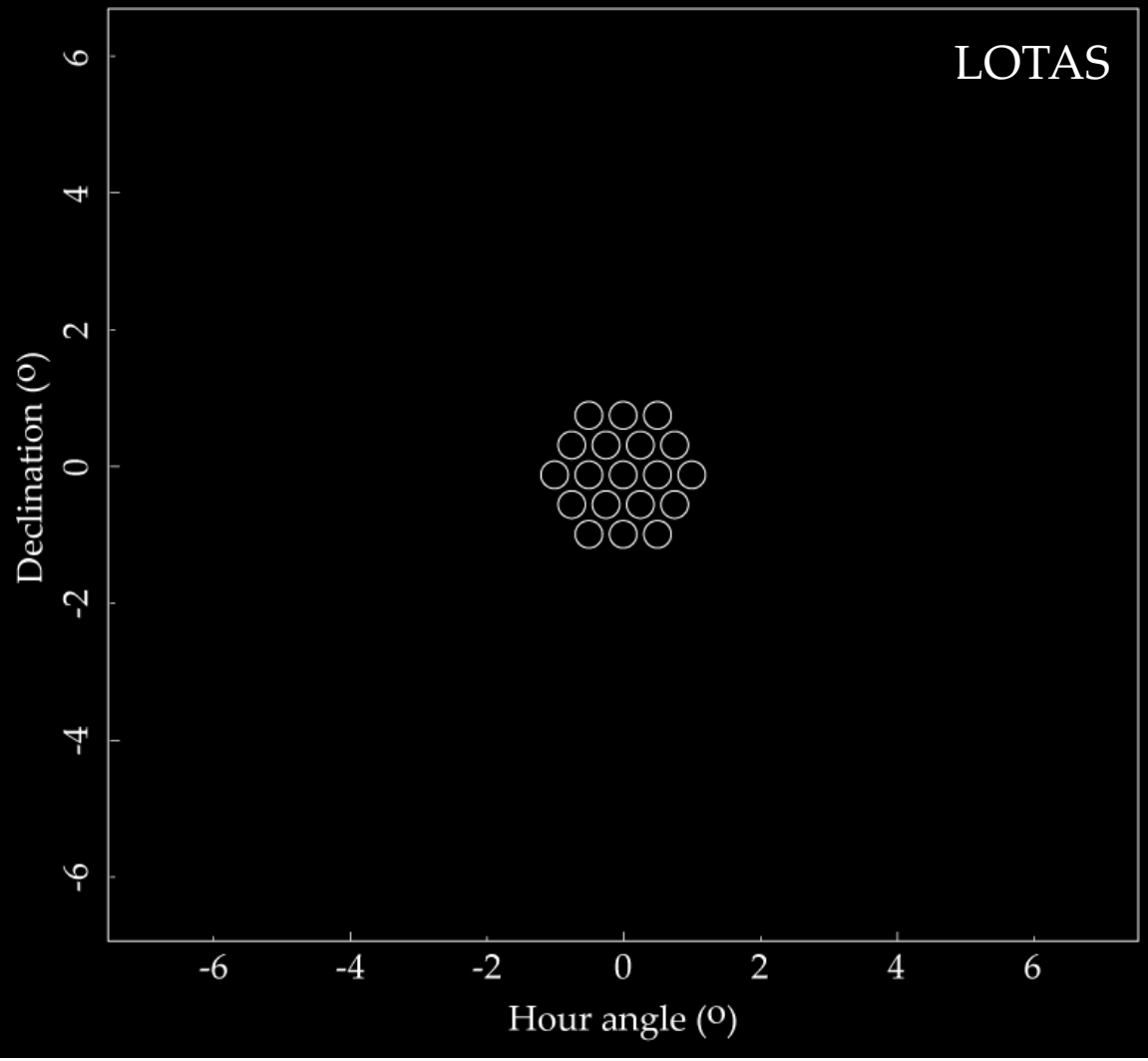
Three surveys:

- LPPS – The LOFAR Pilot Pulsar Survey
- LOTAS – The LOFAR Tied Array beam pilot Survey
- LOTAAS – The LOFAR Tied Array All-sky Survey

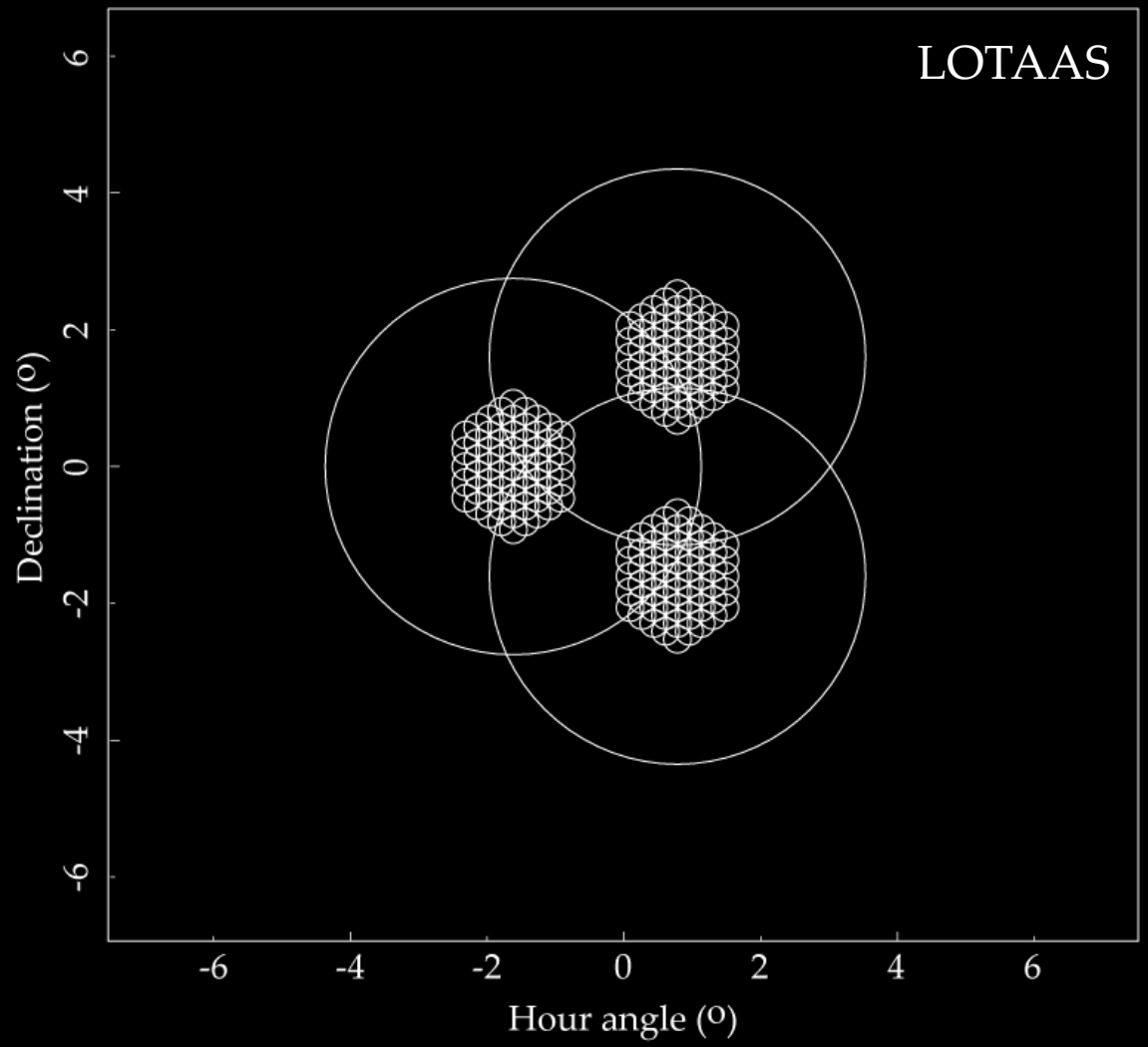
Survey definition(s)



Survey definition(s)

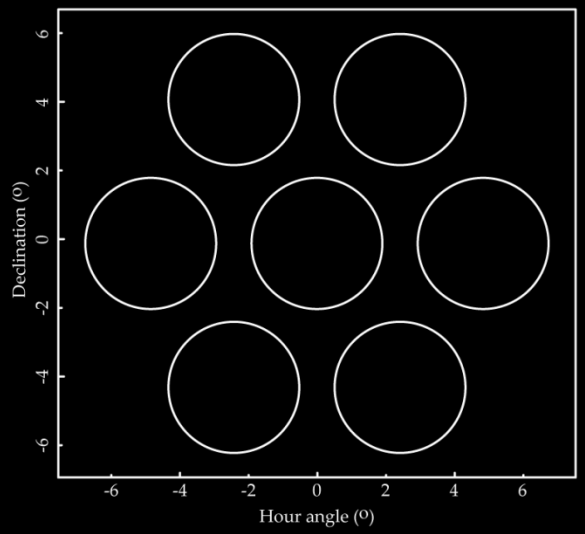


Survey definition(s)



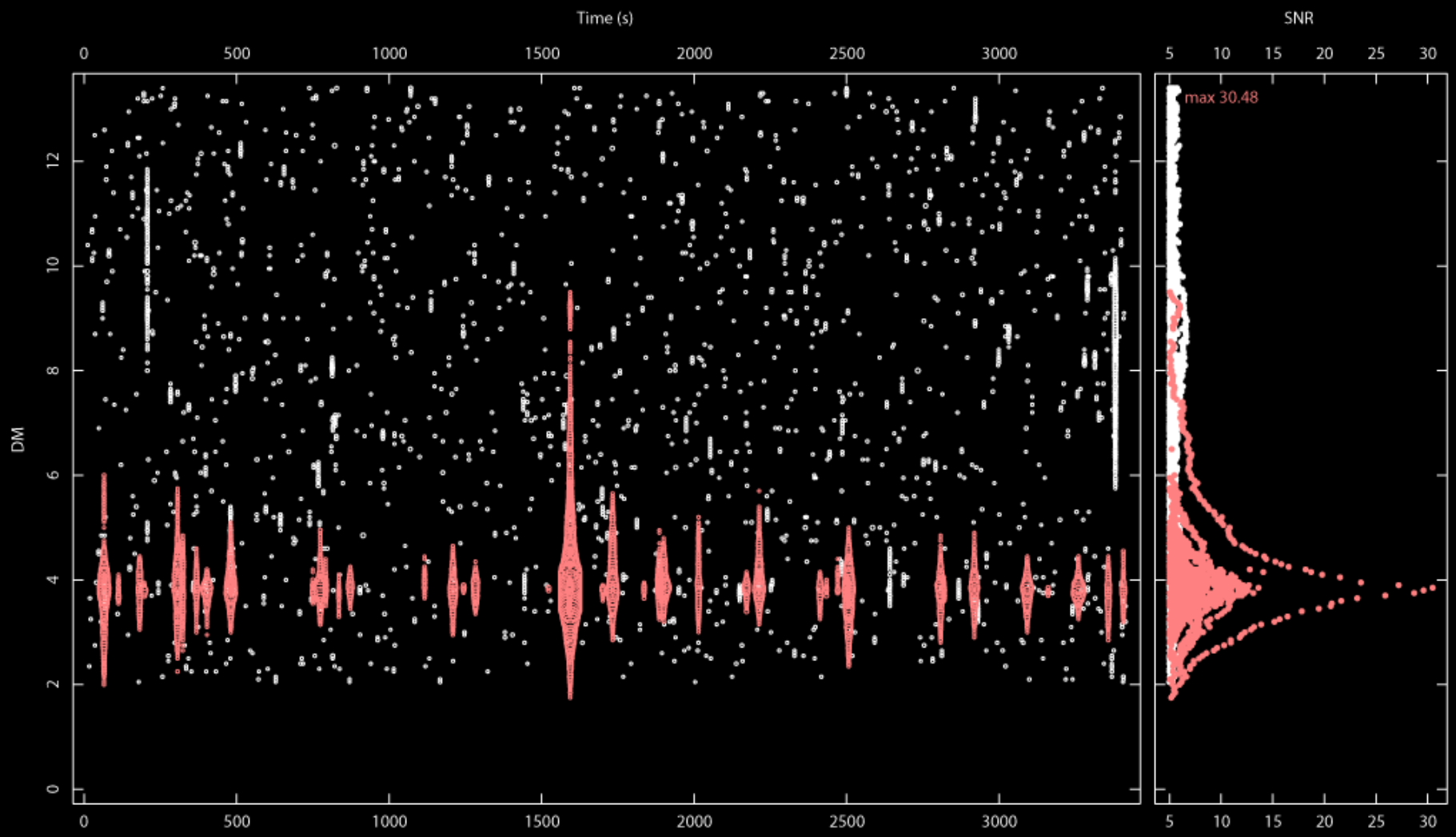
LPPS

7 incoherent beams using all core stations
7 MHz bandwith, 0.65 ms sampling time.
57 minute integrations
246 pointings at 75 square degrees FoV
Processed at U. Manchester



51 redetections (cf. 20 in Shrauner et al. 1998 – Cambridge 80MHz)
Plus, *independent discoveries* of three unpublished pulsars:
J0540+3207, J2317+68 & J0240+62

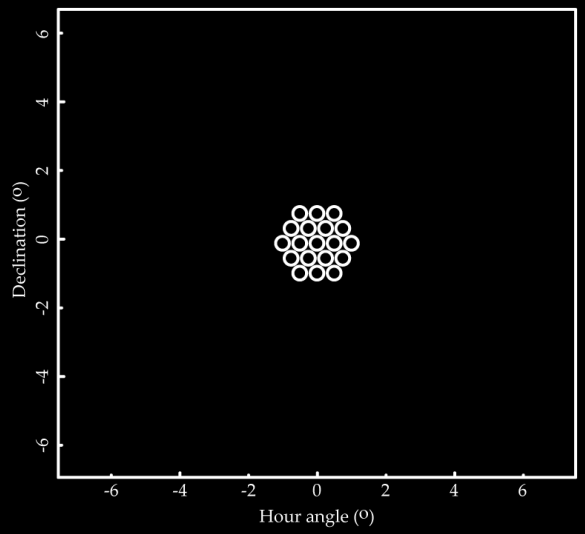
LPPS



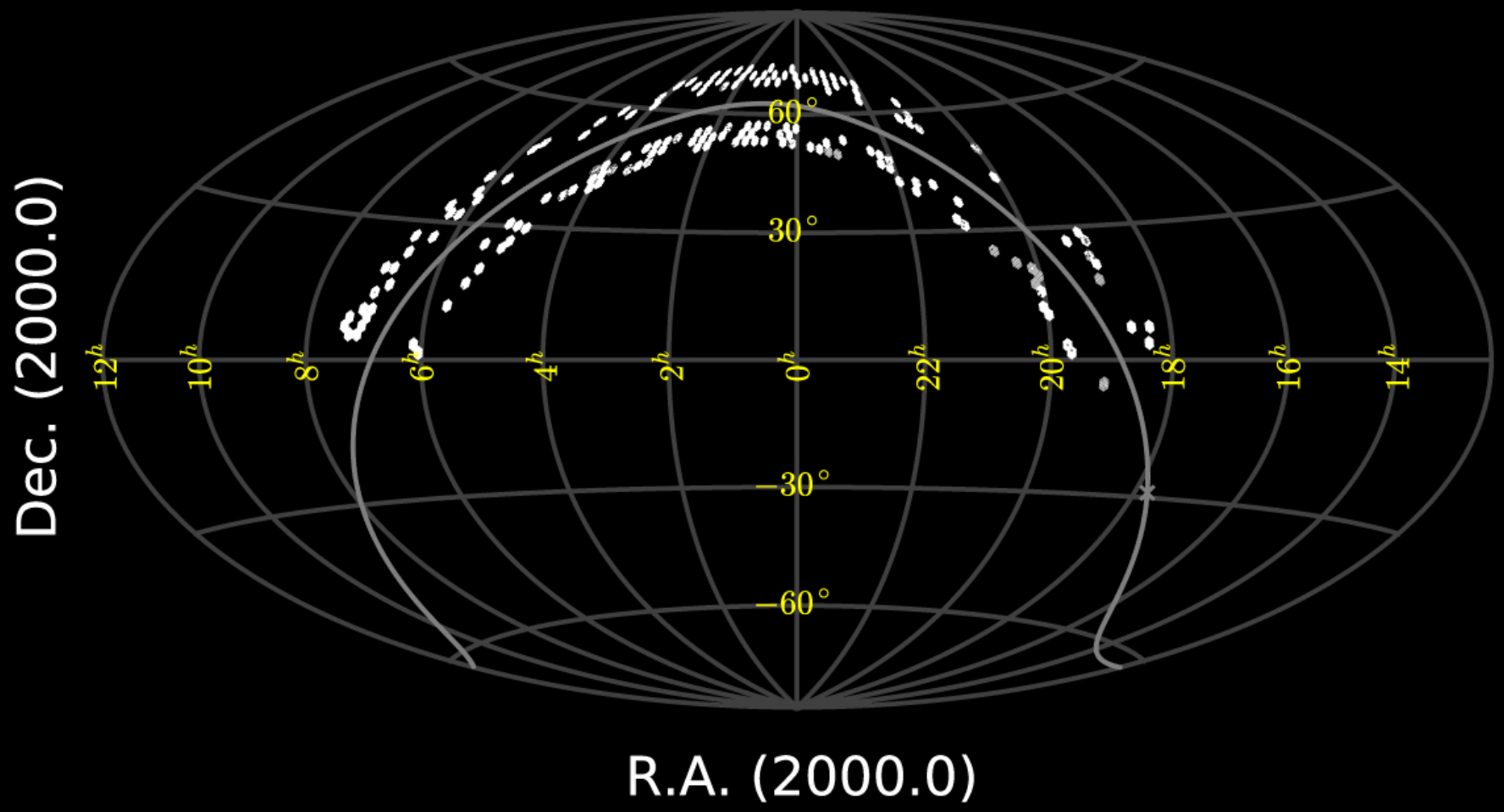
Coenen et al. (2013)

LOTAS

19 coherent beams using superterp
48MHz bandwidth, 1.3 ms sampling time.
17 minute integrations
206 pointings at 3.7 square degrees FoV
Processed at U. Manchester and SARA Amsterdam



LOTAS


Dec. (2000.0)
R.A. (2000.0)
60°
30°
−30°
−60°
12h
10h
8h
6h
4h
2h
0h
22h
20h
18h
16h
14h

LOTAS

19 coherent beams using superterp
48MHz bandwidth, 1.3 ms sampling time.
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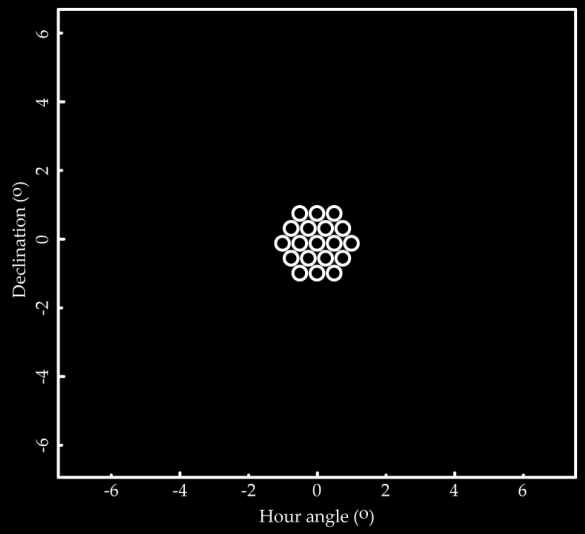
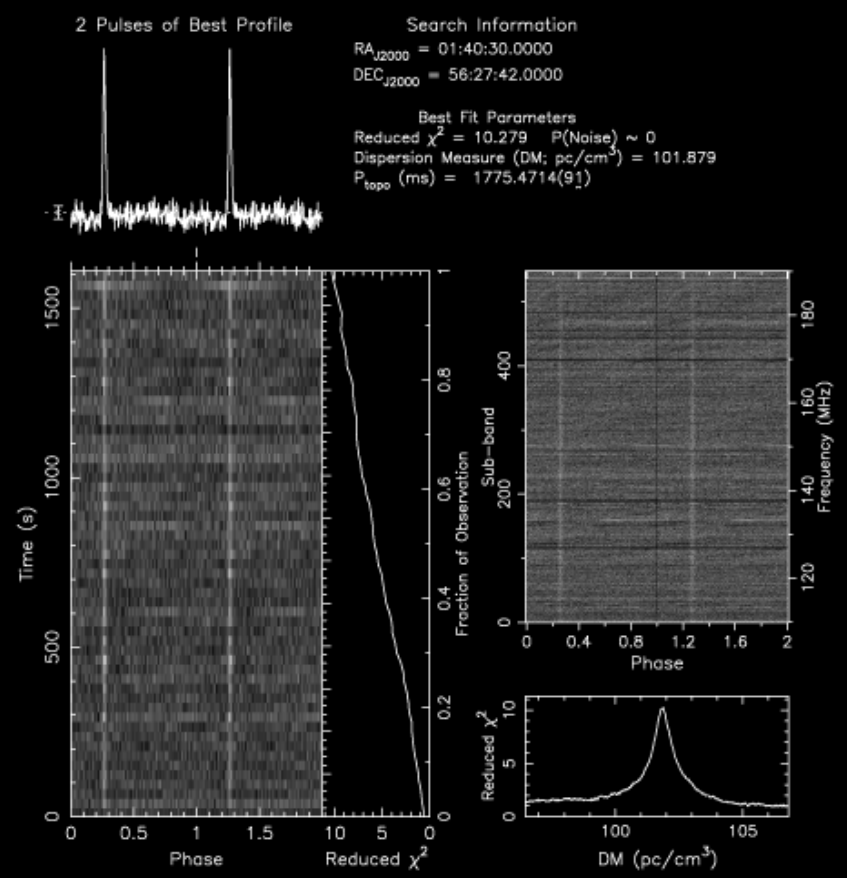
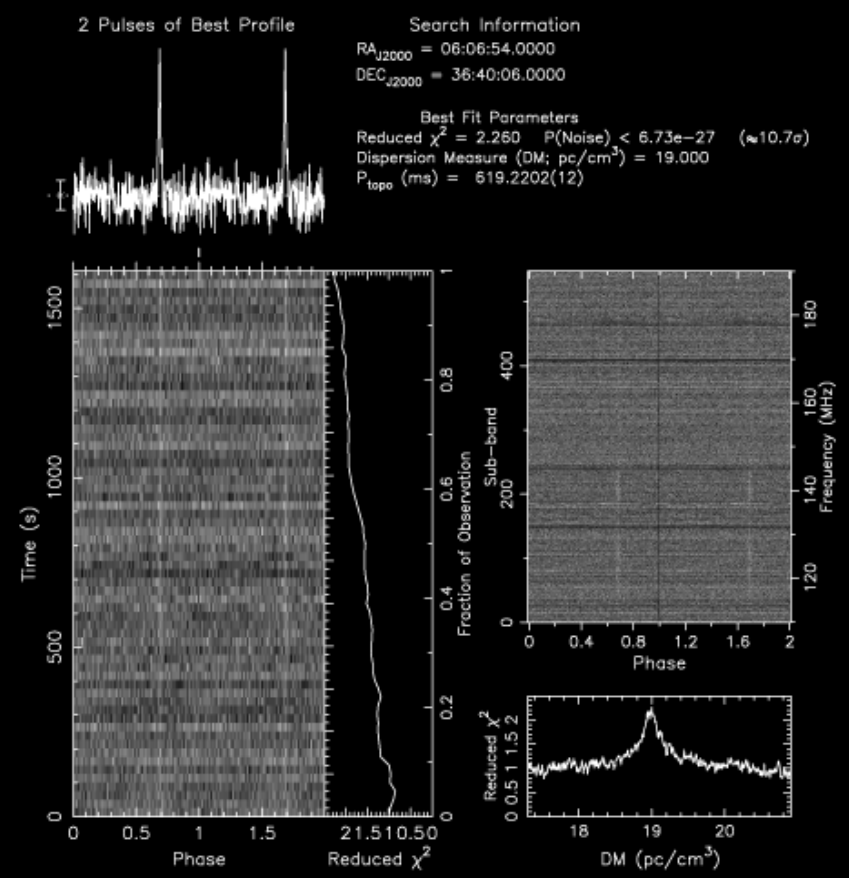


Resulting in another 5 independent discoveries, plus ..

LOTAS

2 unique LOFAR discoveries:

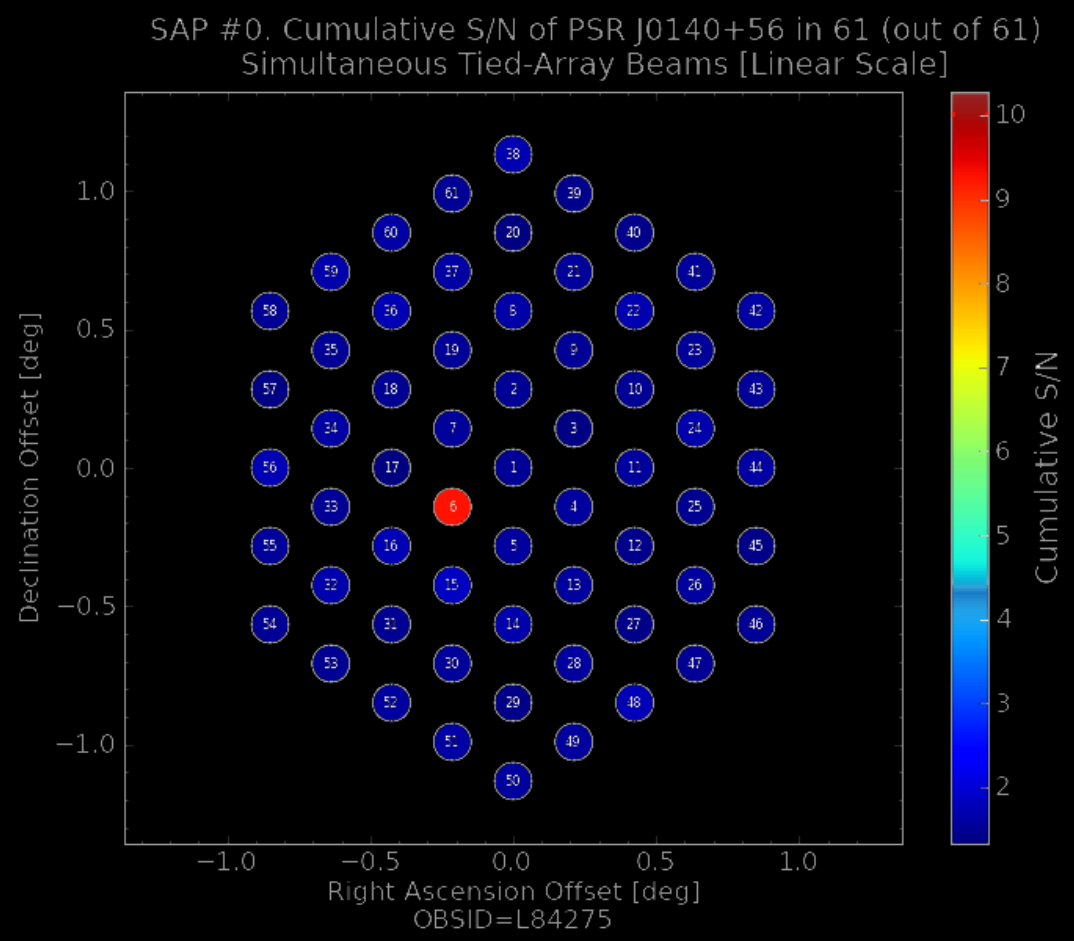




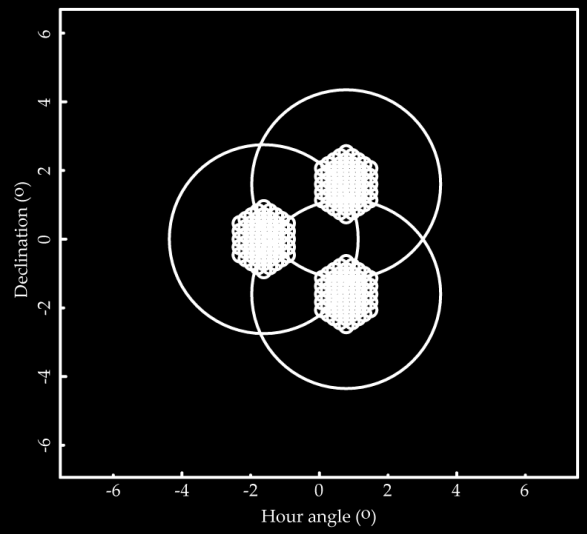
http://www.astron.nl/pulsars/lofar/surveys/lotas/

LOTAS

Full-core multibeam follow-up allows for immediate localisation to 0.06 degree:



LOTAAS



219 coherent beams **plus**
3 incoherent beams, using superterp
32MHz bandwidth (119-151MHz), 0.5 ms sampling time.
60 minute integrations
333 (1000) pointings at 12 square degrees FoV **plus**
60 square degrees incoherent
36 Gbps -> 16 TB/hr

As of yesterday, first 83 pointings observed.

Processing started at U. Manchester and SARA Amsterdam

About twice as sensitive as LPPS and LOTAS, and covering 20x more sky.

Conclusions

LOFAR pilot surveys have already discovered two unique LOFAR pulsars, plus another 8 independent discoveries.

The (in)coherent multi-beam setup provides
FoV, sensitivity **and** immediate localisation.

The all-sky survey has commenced: 2x more sensitive over 20x sky.

still, 10 ≠ 200 …
Cheers!