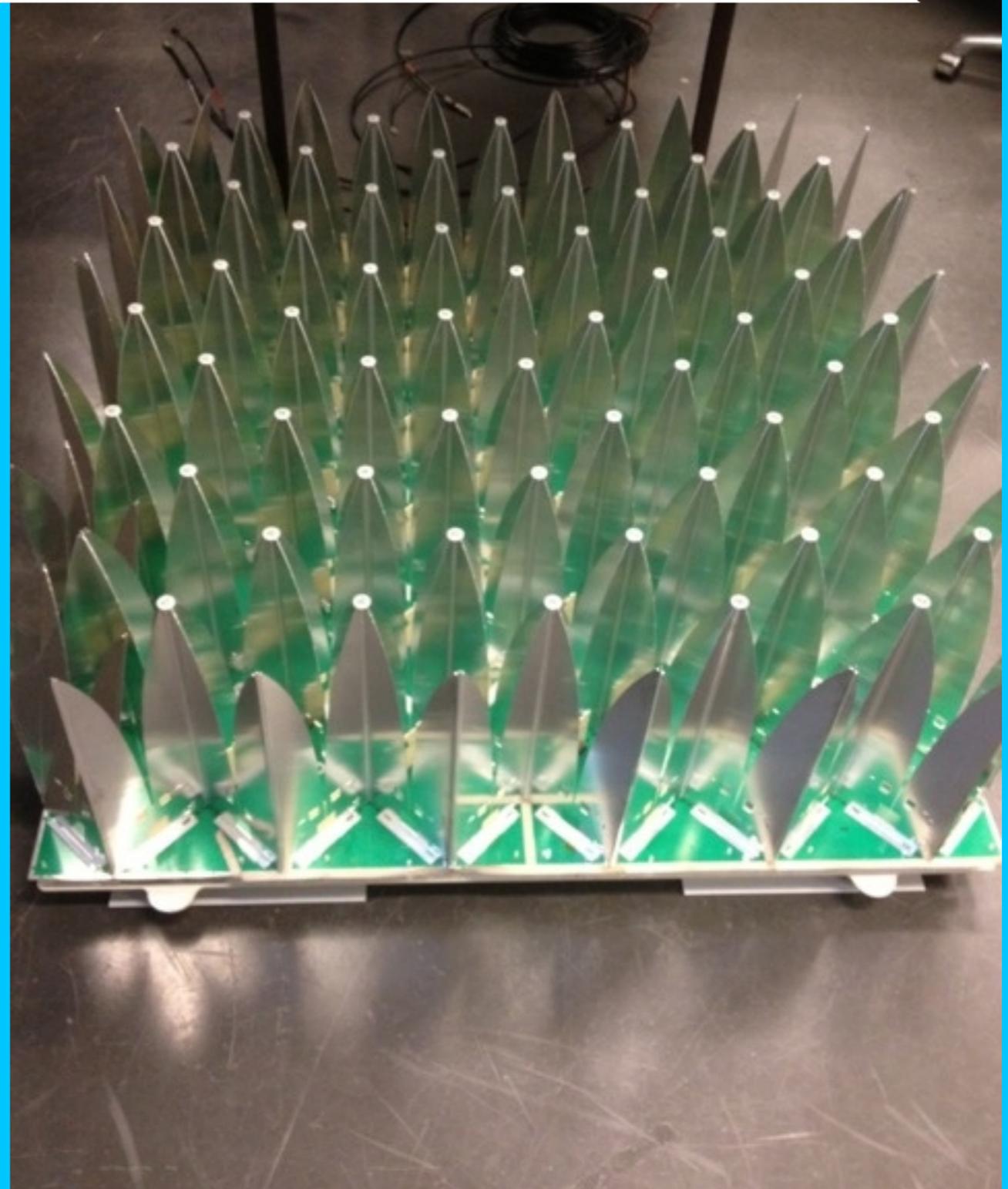


Renewable radio astronomy

Ilse van Bemmel
Aperture Array Verification Scientist

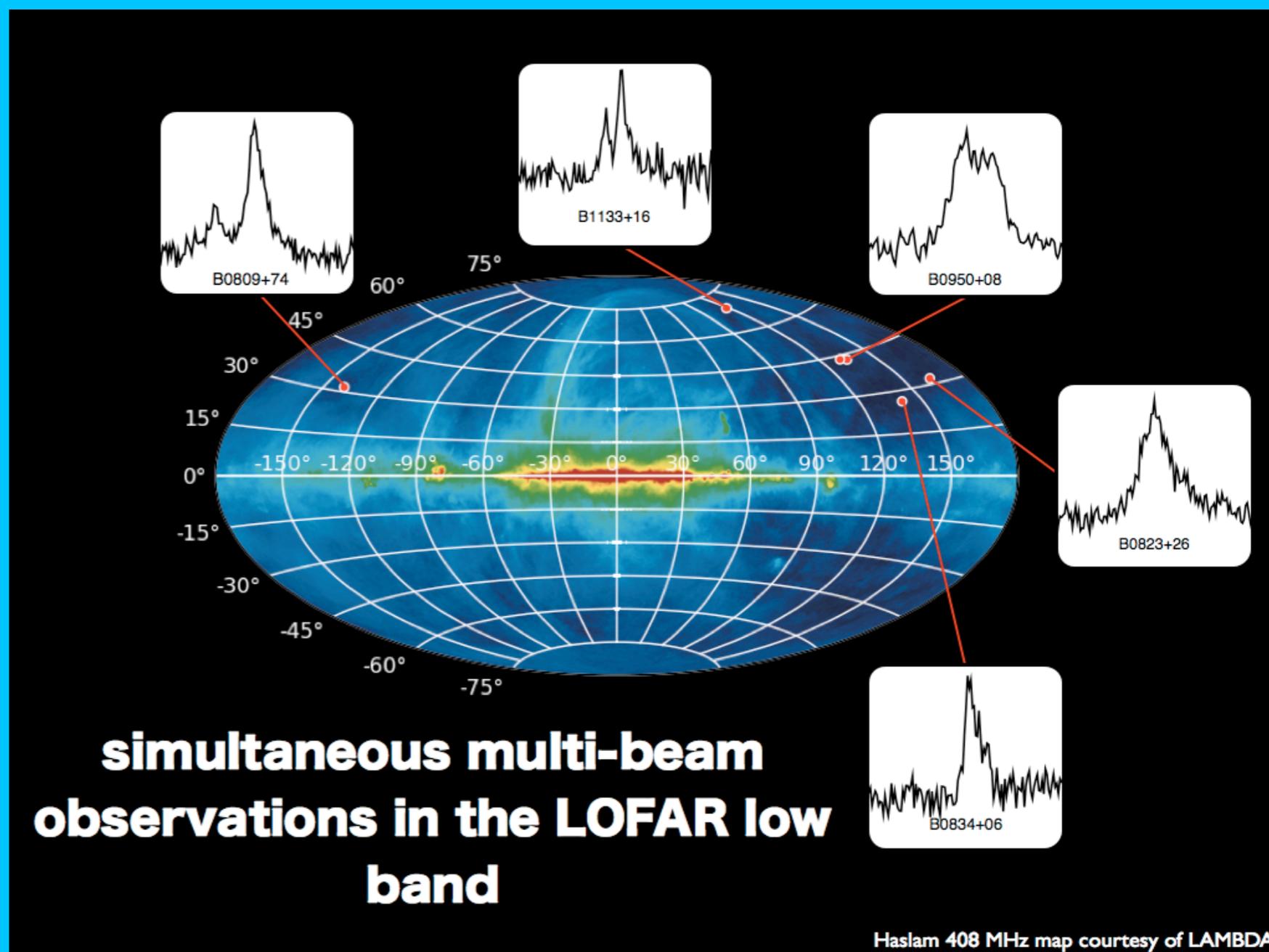
Aperture arrays

- Large field-of-view
- Multi-directional
- Flexible
- SKA technology



Aperture arrays

- Large field-of-view
- Multi-directional
- Flexible
- SKA technology



Hassall et al. 2011

EMBRACE: AA-mid technical demonstrator

- $A/T \sim 1 \text{ m}^2/\text{K}$
- 400-1500MHz
- TWO analogue beams
- ~ 200 digital beams (195.3kHz wide)
- $\sim 40\text{MHz}$ bandwidth
- single pol

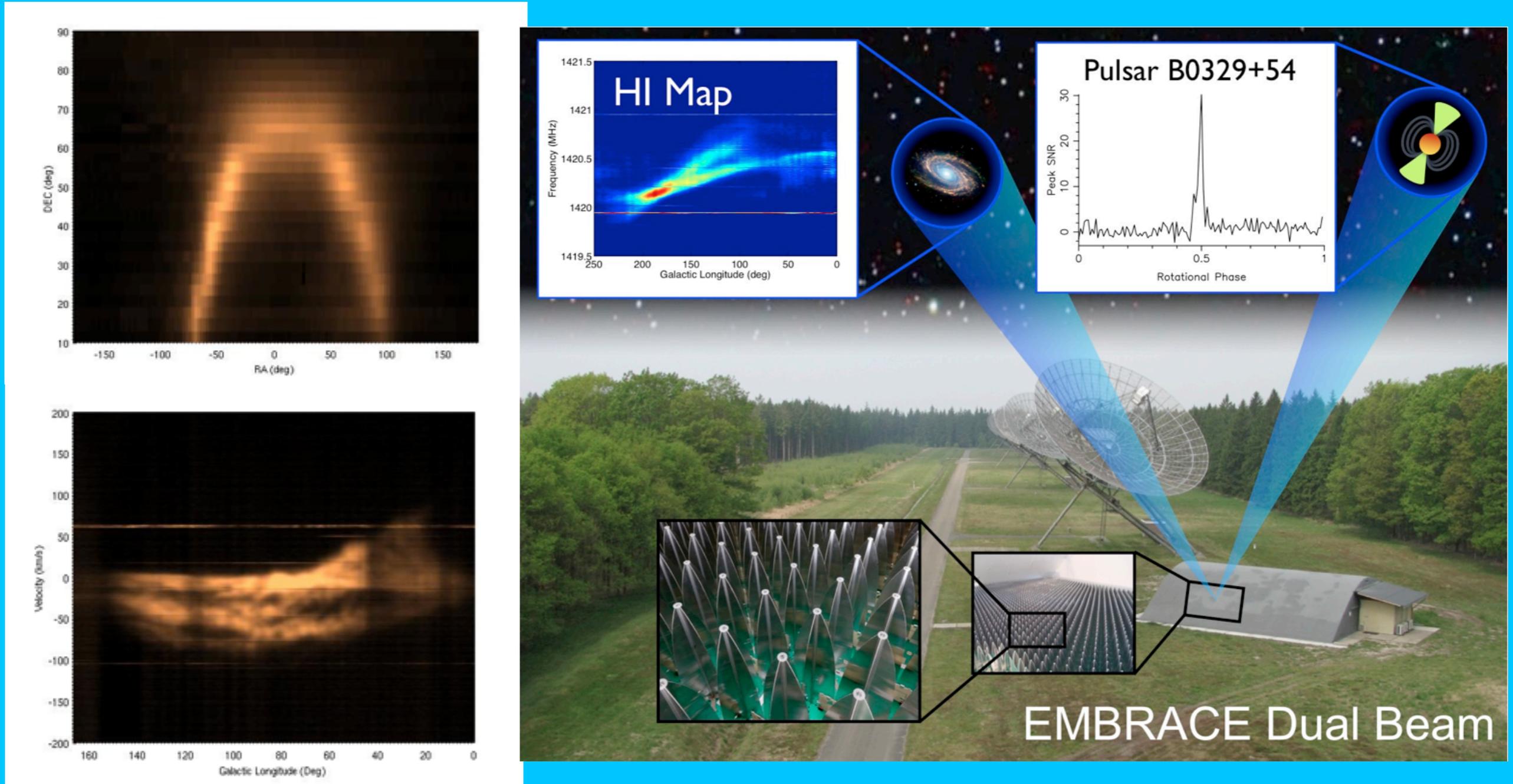
WSRT station (Netherlands)



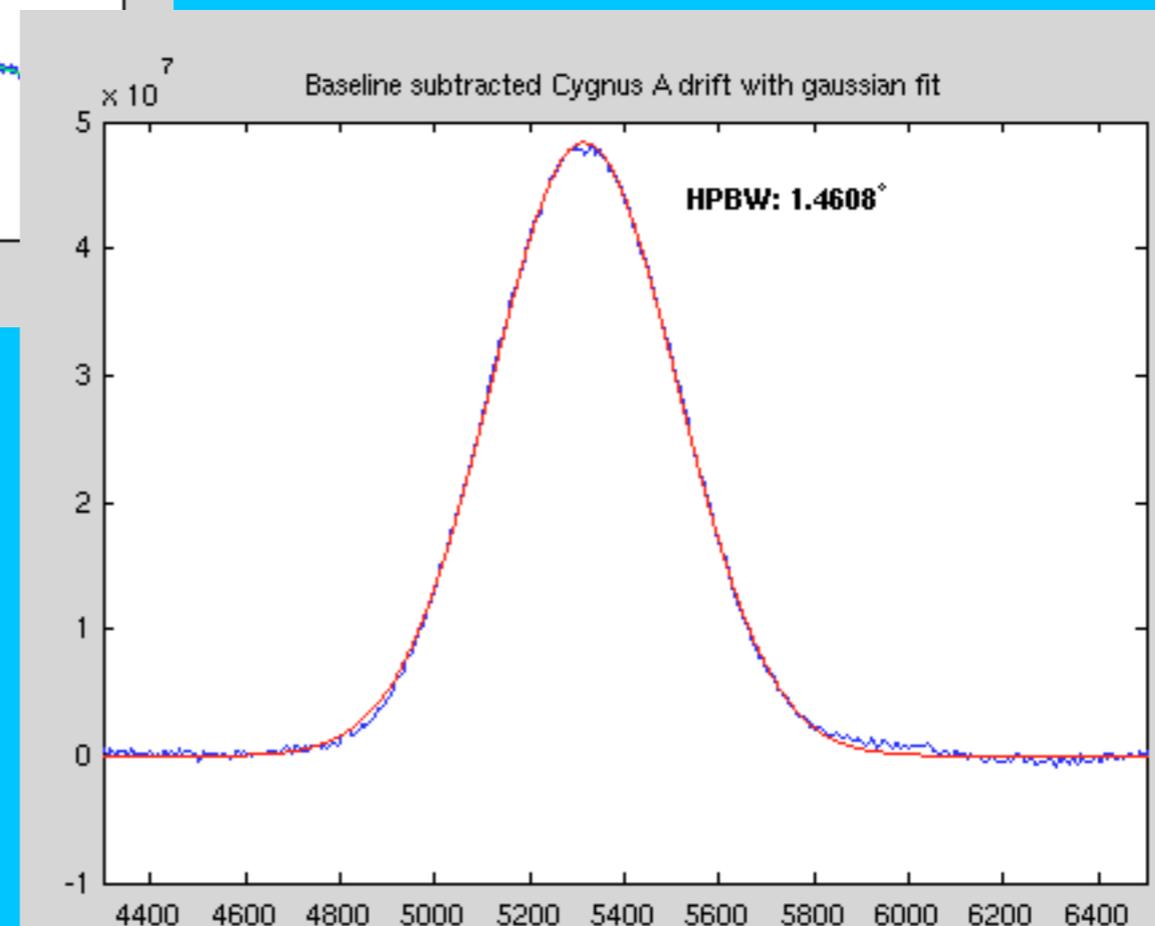
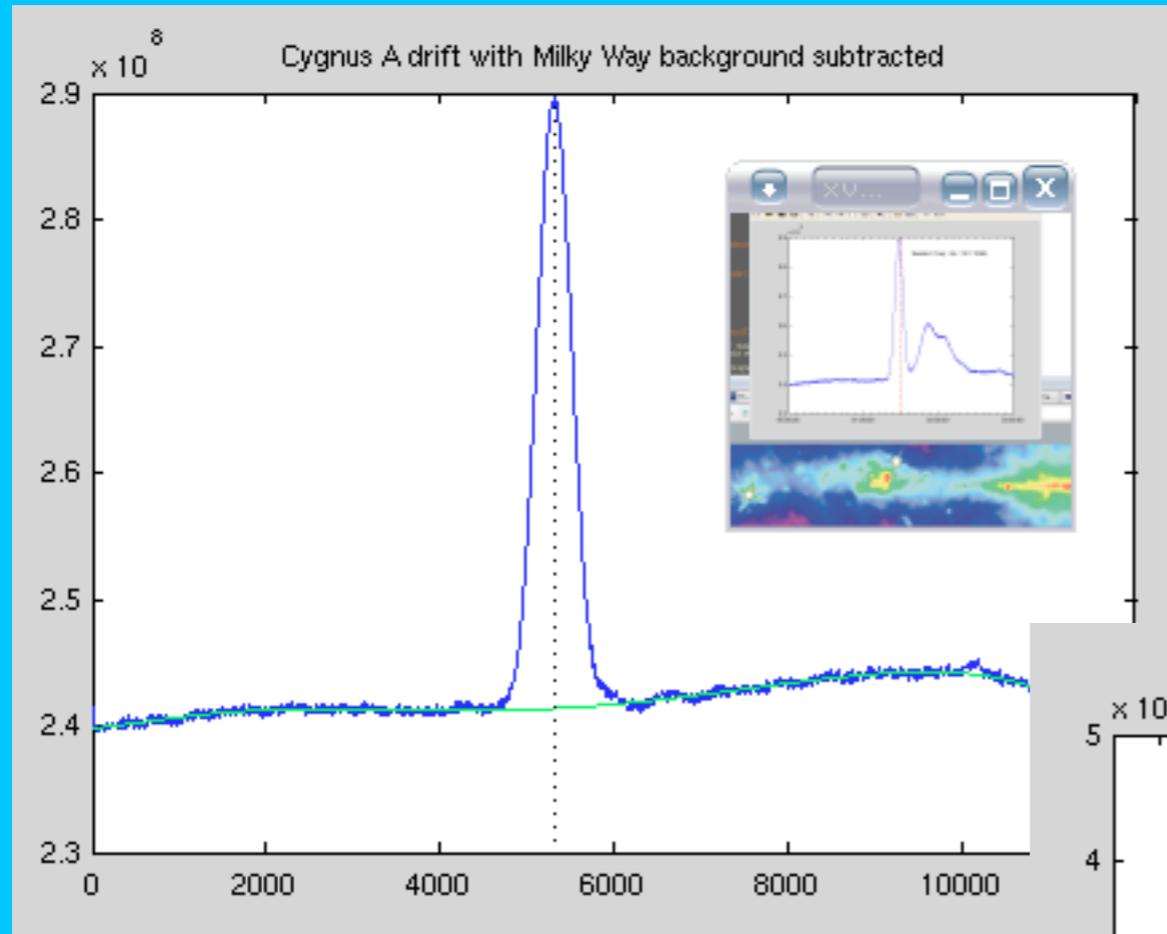
Nançay station (France)



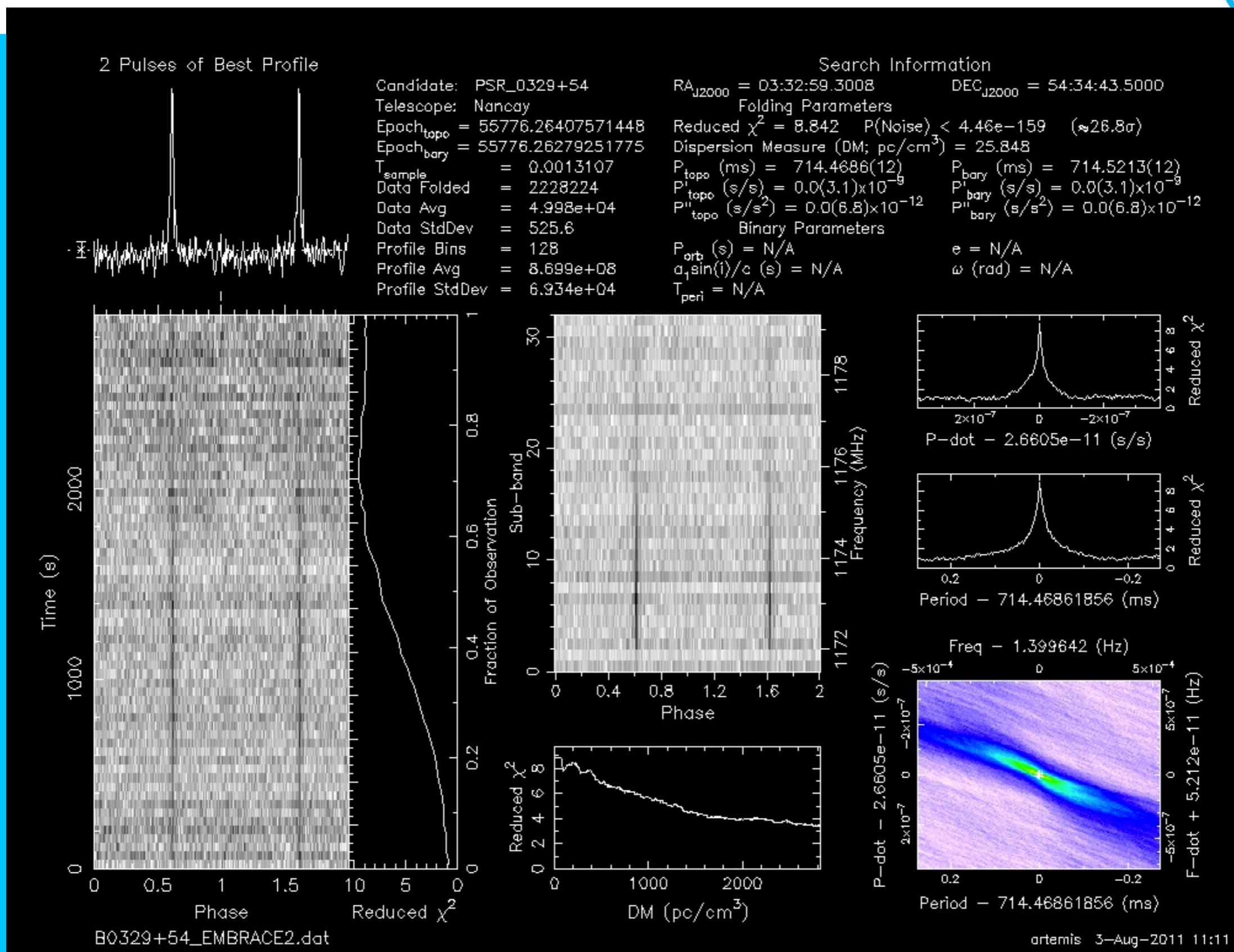
EMBRACE results: WSRT



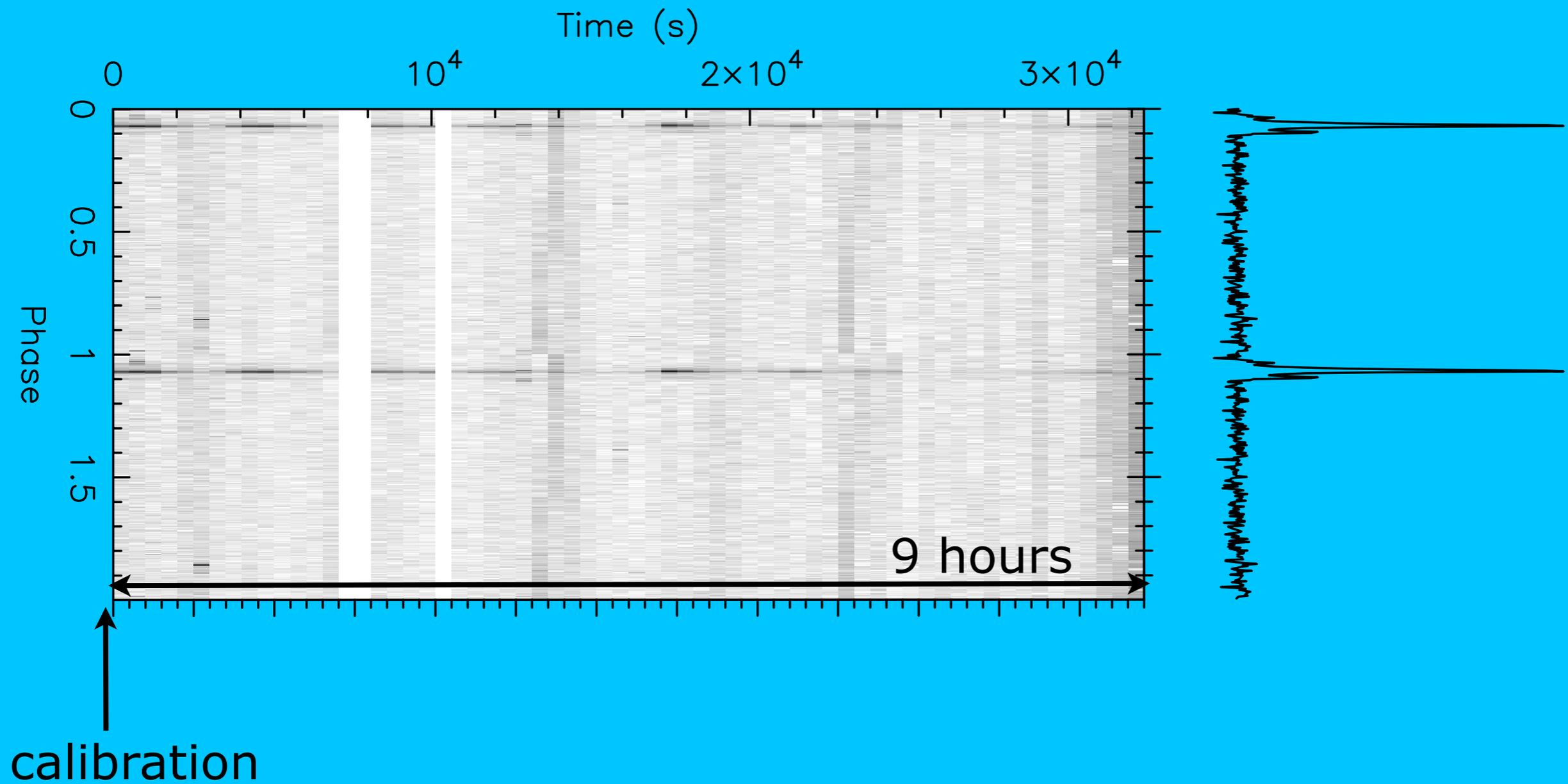
EMBRACE results: Nançay



EMBRACE results: Nançay



Breaking news!



EMBRACE WSRT, Benthem et al 2012

Limits for EMBRACE

- imaging dynamic range
- polarization
- bandwidth
- (post-)processing
- big gap towards SKA

- imaging dynamic range
- polarization
- bandwidth
- (post-)processing
- big gap towards SKA

Need for science
capable instrument

AAVS2-mid frequency demonstrator

- Renewable aperture array radio telescope
- Science capable interferometer
- Green energy



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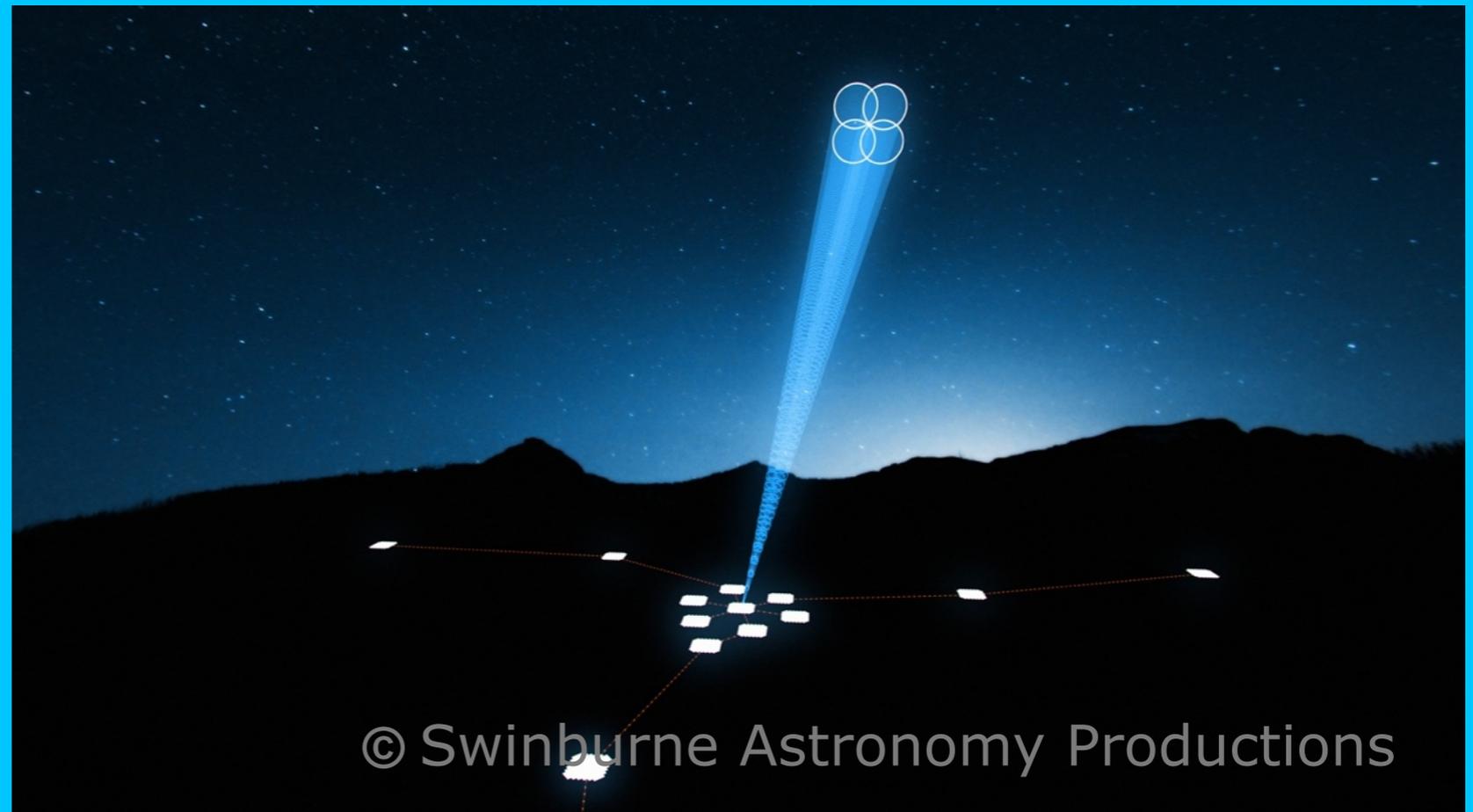
- Renewable aperture array radio telescope
- Science capable interferometer
- Green energy



© Swinburne Astronomy Productions

EMMA main goals

- Measure BAO signal (science)
- Demonstrate imaging capability (technology)



© Swinburne Astronomy Productions

EMMA specs

- 2000m² (A/T ~ 40 m²/K)
- multiple stations
- full Stokes
- 2 FoV, 64 digital beams
- ~80 deg² per FoV
- 450-1450 MHz
- T_{sys} ~50K
- bandwidth 500MHz

SKA single station



EMMA specs

- 2000m² (A/T ~ 40 m²/K)
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- 2 Fo
- ~80
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- T_{sys}
- band

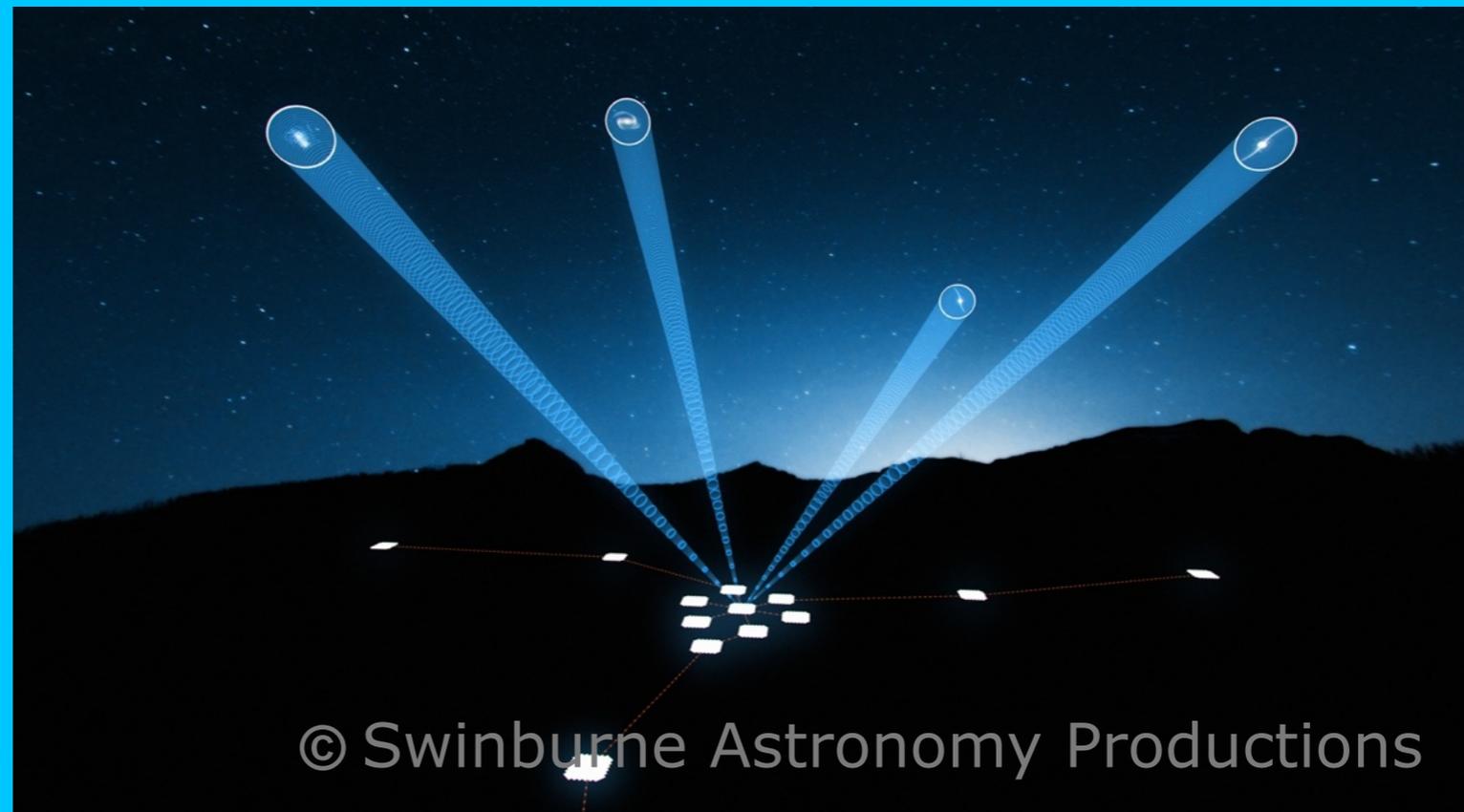


Derek McKay-Bukowski



EMMA configuration

- 14 stations
- 13.5m diameter
- central core: >50%
- longest baseline between 300-1000m



Location

- SKA site
- EU site

Location

- SKA site
- EU site

Lisboa

Sevilla



Location

- SKA site
- EU site

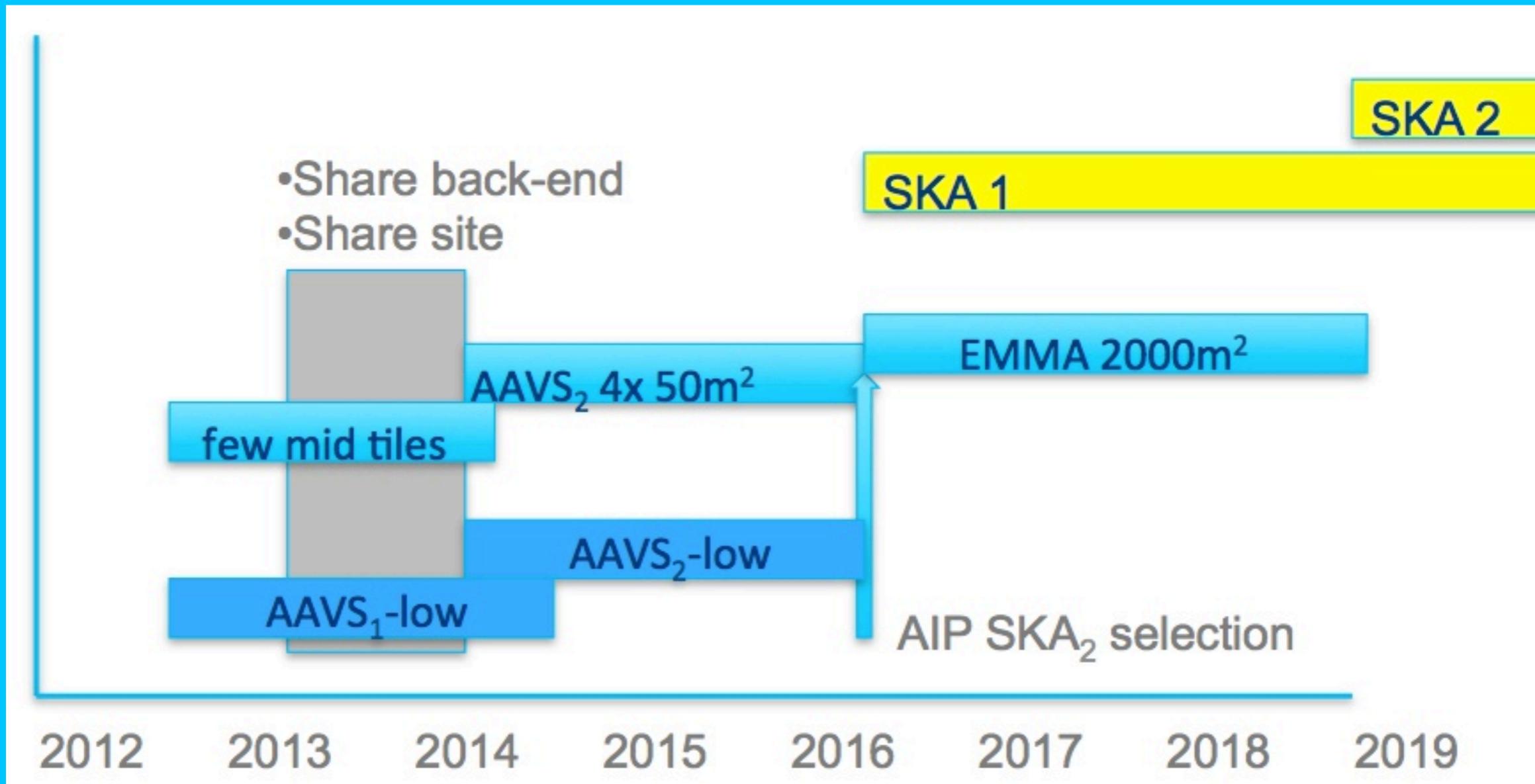
Lisboa

Moura

Sevilla



- AA-mid pathfinder
- Single SKA station



- Technical development:
 - ASTRON
 - Observatoire de Paris
 - IRA/INAF
 - UK
 - Spain & Portugal: green energy

- Science team in the making

- EC funding opportunities being explored

Performance comparison

	EMMA	APERTIF	ASKAP	EVLA	MeerKAT-1
Frequency (GHz)	0.450-1.45	1.0-1.7	0.7-1.8	1.0-50	0.9-1.75
Bandwidth (GHz)	0.5 (1.0)	0.3	0.3	0.5 (8.0)	0.35
FoV (deg ² , 1.4GHz)	78	8	30	0.3	0.6
z_{\max} for HI absorption	2.16	0.42	1.03	0.42	0.58
S_{rms} (μJy , 1h, full BW)	37 (27)	30	35	7.6	14.6
S_{rms} (μJy , 1h, 100MHz)	84	49	61	17	27
S_{rms} (mJy, 1h, 5 km/s)	5.5	3.7	4.0	1.1	1.8
A/T (m ² /K)	40	105	58	246	150
SSFOM $\times 10^4$ (m ⁴ /K ² / deg ²)	12.5	8.9	13.8	1.8	1.4
$\text{SSL}(\tau < \tau_o)/N_t$	1	0.92	0.73	5.3	5.6

based on online information late 2011

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based on online information late 2011

- low column density HI: few $\times 10^{19} \text{ cm}^{-2}$
- pulsars: survey and timing
- polarization in local Universe
- transient follow-up
- local cosmology

Movie credits:

Swinburne Astronomy Productions