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APERTIF
APERture Tile In Focus

RadioLife

Netherlands Institute for Radio Astronomy

APERTIF

Capabilities for next generation continuum and polarisation radio surveys

Björn Adebahr

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The people behind the project

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Science:

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Sieds Damstra
Raymond van den Brink
Wim van Cappellen
Alexander van Amersfoort
Ger van Diepen
Agnes Mika

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An upgrade to the WSRT

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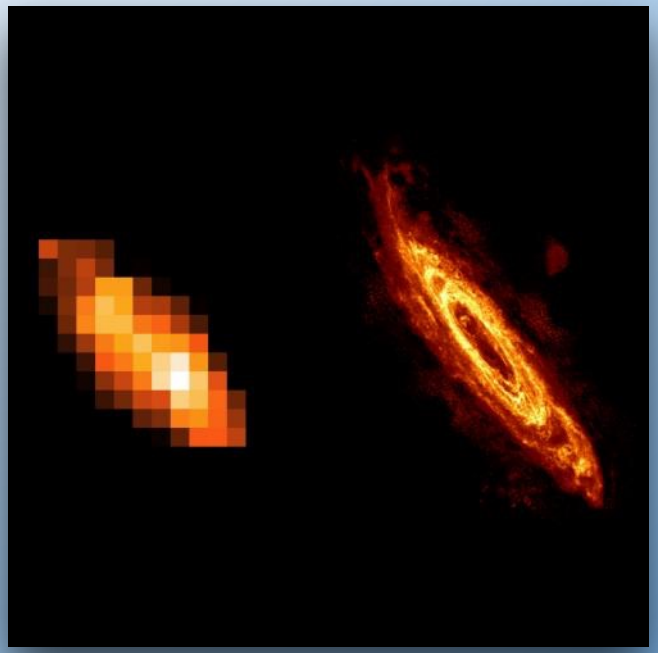
APERTIF is a fixed wavelength wide-field receiver system for an interferometer

	old WSRT	APERTIF
Number of dishes	14	12
System-type	different single-feed horns	Phased Array Feed
Wavelength range	310 - 8650 MHz	1130 - 1430 MHz
Bandwidth and Frequency resolution	160 - 1.2 MHz 312.5 - 0.15 kHz	300MHz 12.2 kHz
Field of view and resolution	2.6° - 0.1° 55″ - 2.2″ 0.6° / 13″ at L-band	2.9° / 13″ at L-band



FOV 25x the area of the full moon

Phased Array Feeds (PAFs) on the WSRT dishes

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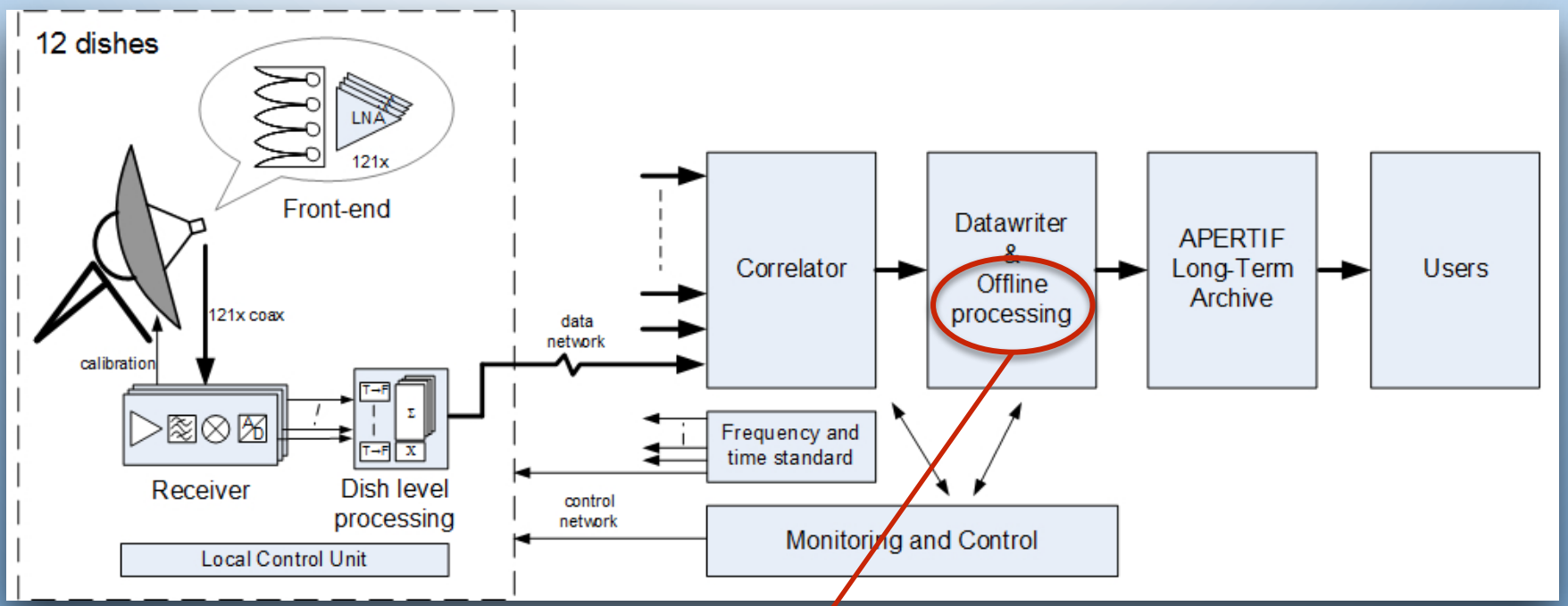
Overview of the APERTIF system



APERCal
(APERTIF Calibration Pipeline)

APERCal
Data reduction scheme

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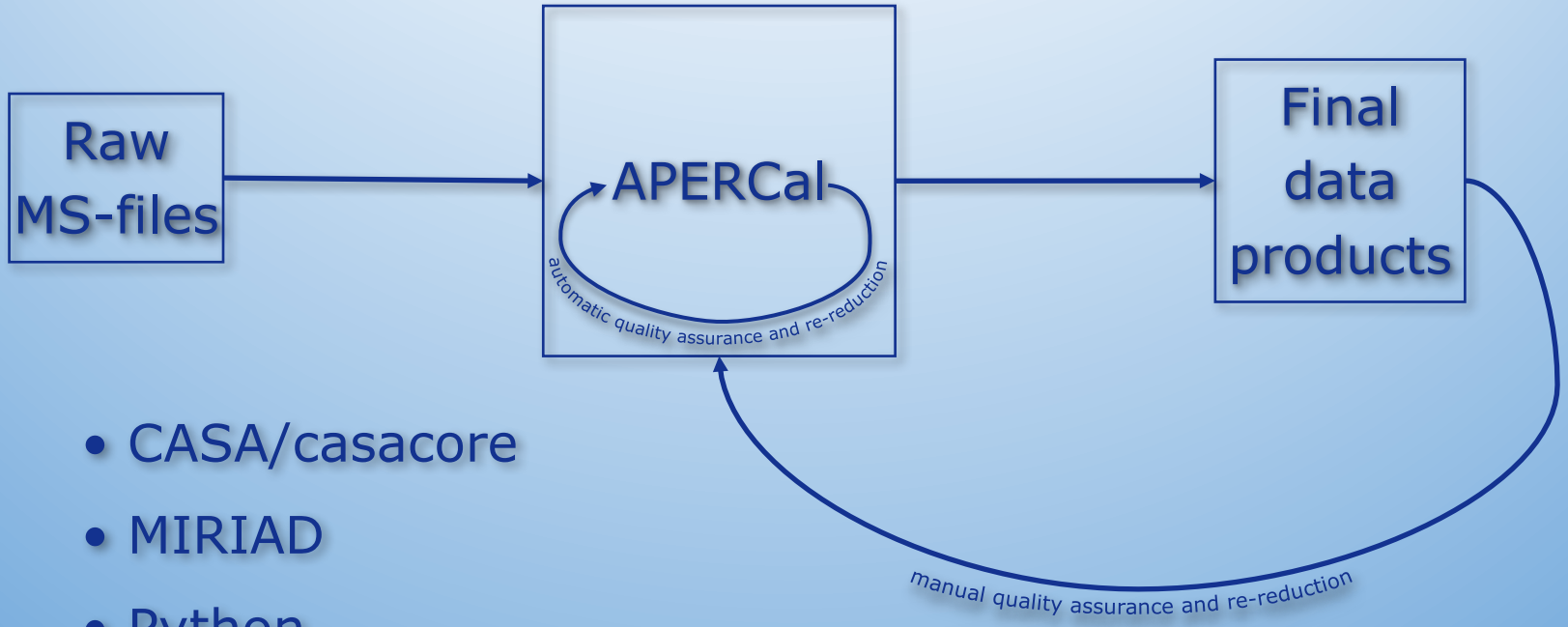
Goal:

- Reduce 95% of the APERTIF data without any additional work



- CASA/casacore
- MIRIAD
- Python
- Sophia
- PyBDSF

Runs as a Jupyter notebook, but can be used as a script

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Structure and final data products

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Pipeline structure:

- Modules (preflag, convert, crosscal, selfcal, final etc.)
- config files
- Modification of parameters on the fly possible

Final data products:

- Cross- and self-calibrated datasets in MIRIAD-/UVFITS-format
- Continuum subtracted line datasets
- Deep continuum mosaics of individual frequency bands
- Deep continuum mosaics of the whole band (DR=10000)
- Cleaned line cubes
- Stokes Q-, U-, and Faraday cubes
- Stokes V images

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Higher Tier products and compatibility with additional modules

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Higher Tier products:

- Total power source catalogues
- HI detections catalogue and masks
- Absorption spectra

Usage of the final data products:

- Final pipeline should be portable to any linux system without a lot of effort
- Parallelisation on our 5 node cluster nearly done
- Projects can use final pipeline products to use in their own programmes or extend the pipeline with additional modules

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Test on archival Lockman Hole WSRT data

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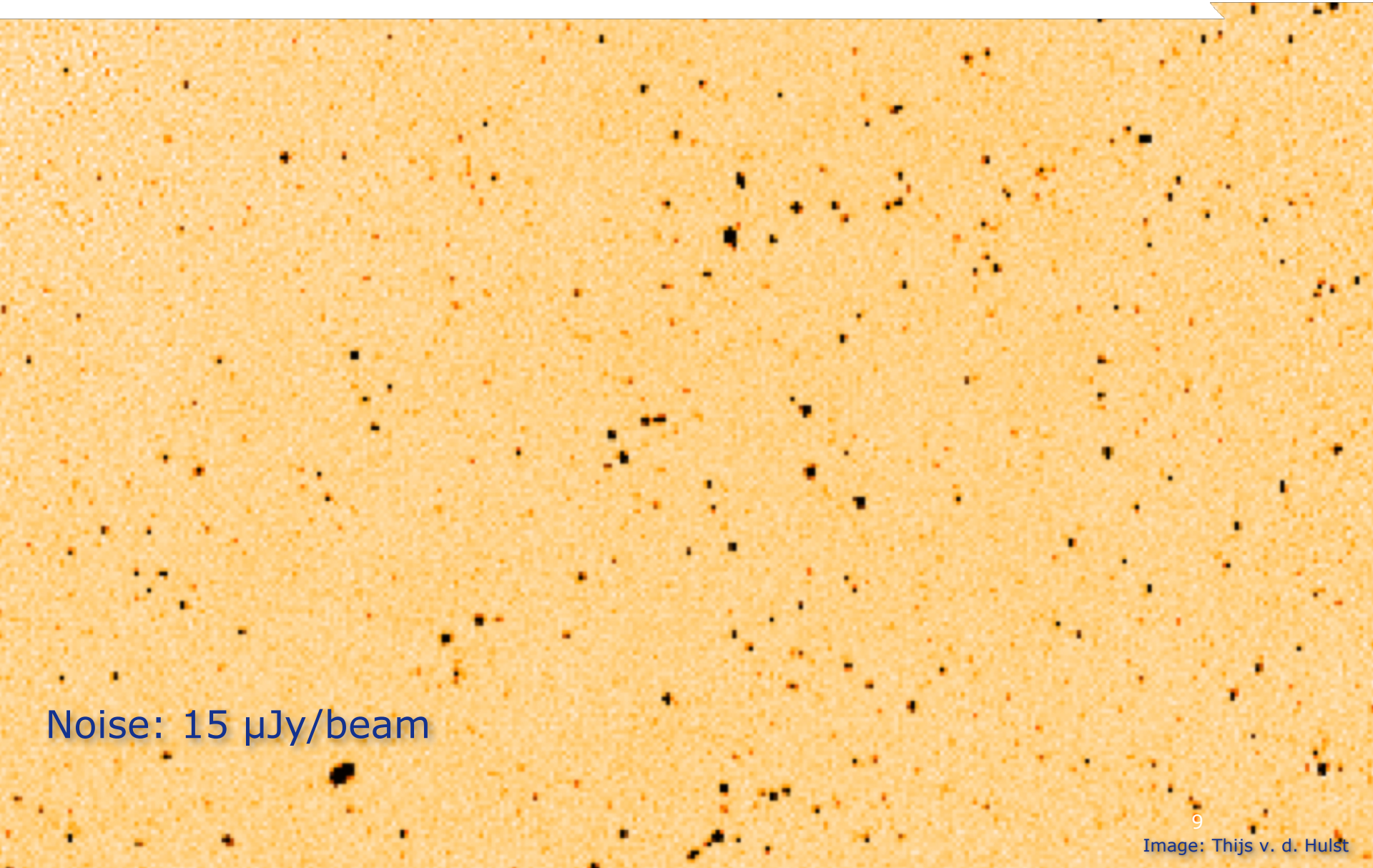

Image: Thijs v. d. Hulst

Imaging Survey plans

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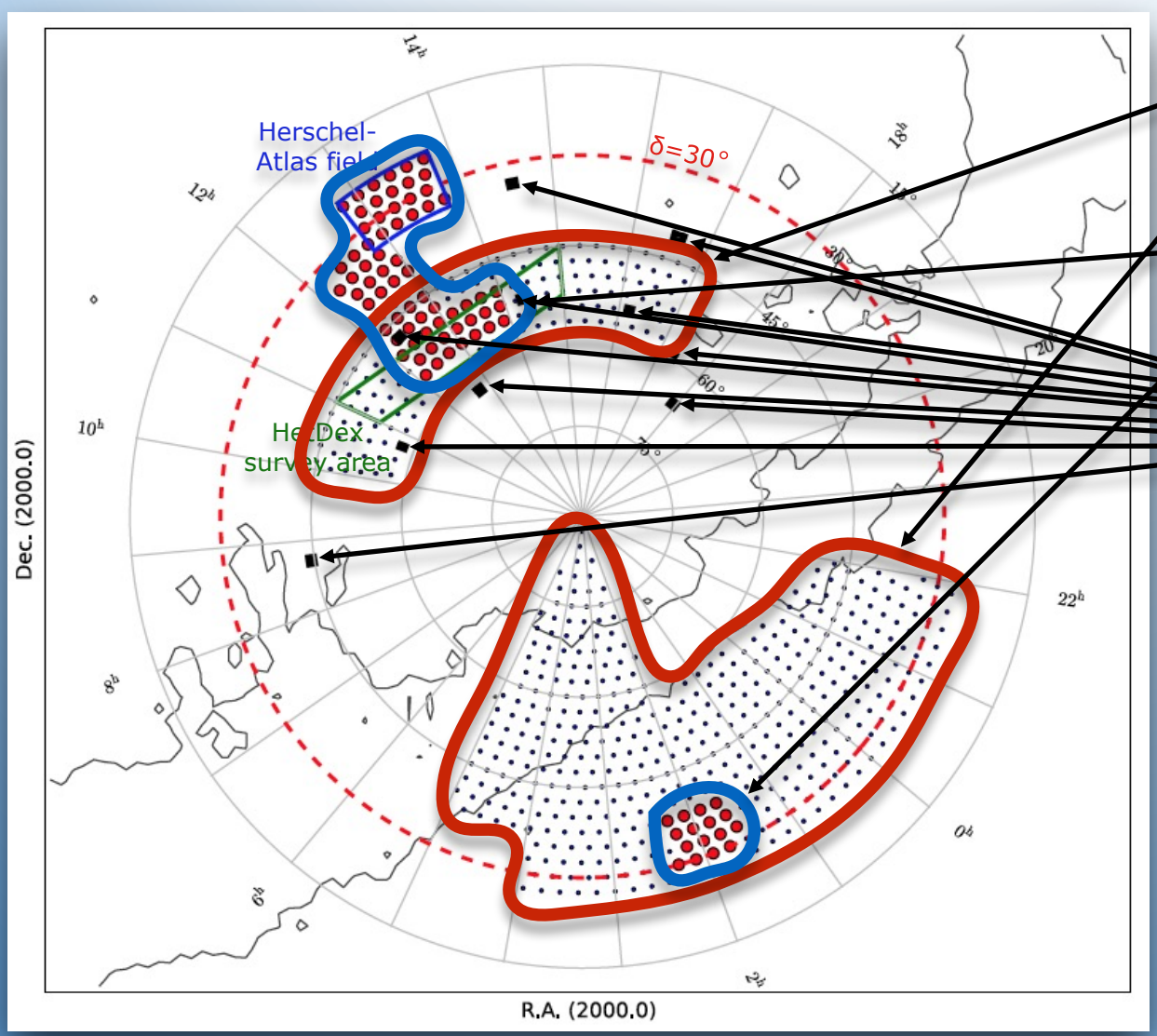
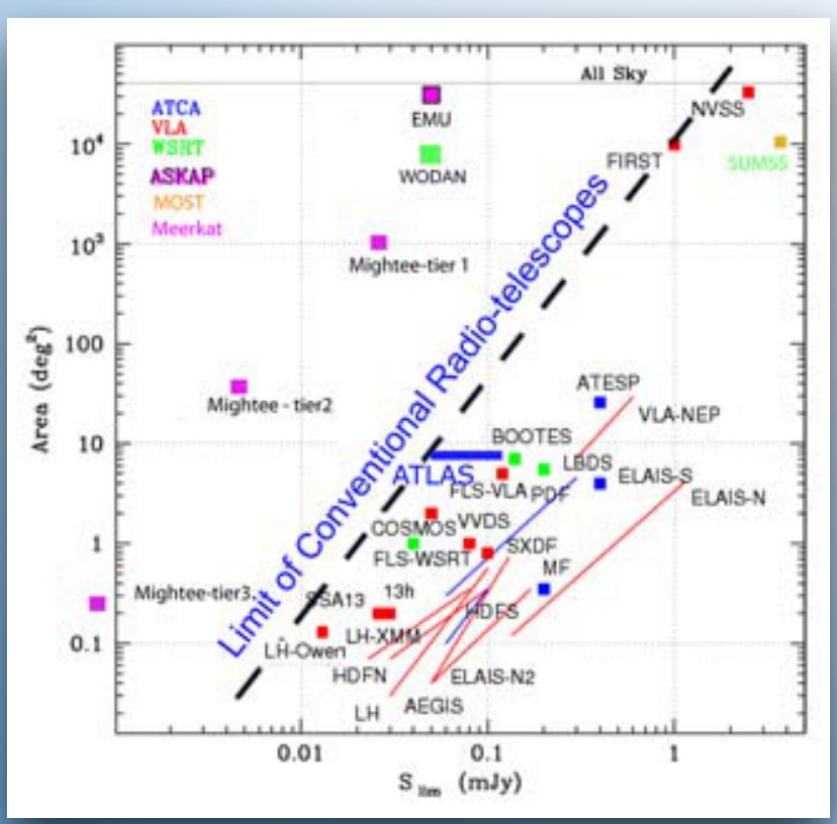


1. Shallow Survey (1x12hrs)
2. Medium deep Survey (7x12hrs)
3. LOFAR fields (4x12hrs)

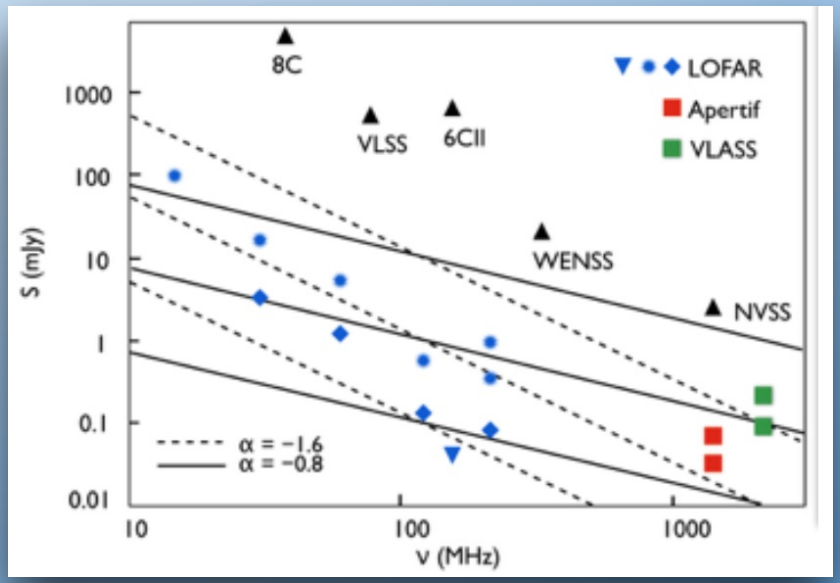
All surveys include all spectral channels and full polarisation information

Comparison with other continuum surveys



Norris et al. 2012

1. Much more sensitivity in combination with survey area than conventional surveys
2. Synergy with LOFAR fields
3. Full polarisation information



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The best telescope for L-band polarisation observations?!

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- On-axis feeds
- Noise source corrections
- Equatorial mount

APSSS

APERTIF Polarised Sources Sky Survey

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- Polarisaton spectra are largely unexplored
- No blind search for circular polarised sources

Science goals:

- Investigate a large number of polarisation spectra for fundamental depolarisation effects (DFR, IFD, EFD)
- Examine the underlying depolarising magnetic field structure and strength and look for correlations with other source parameters
- Explore the time variability of these sources using the MDS

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First observations and results

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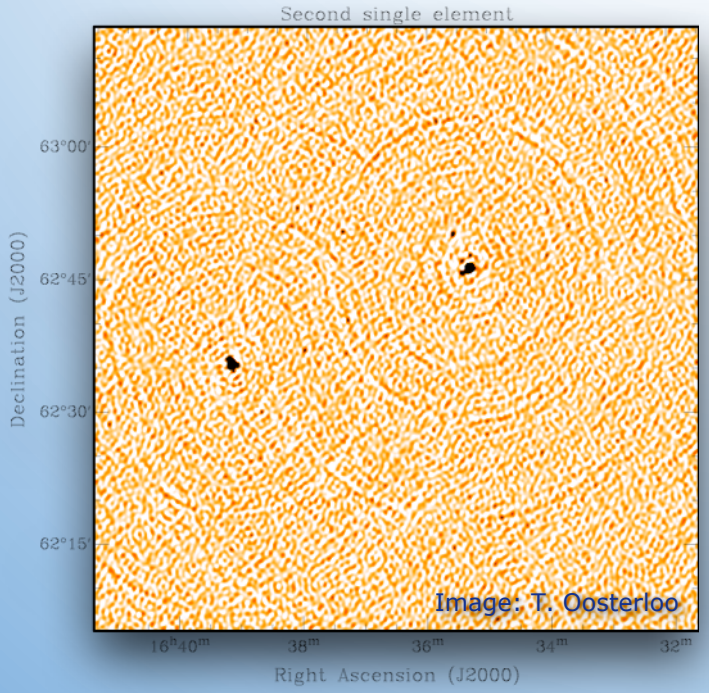
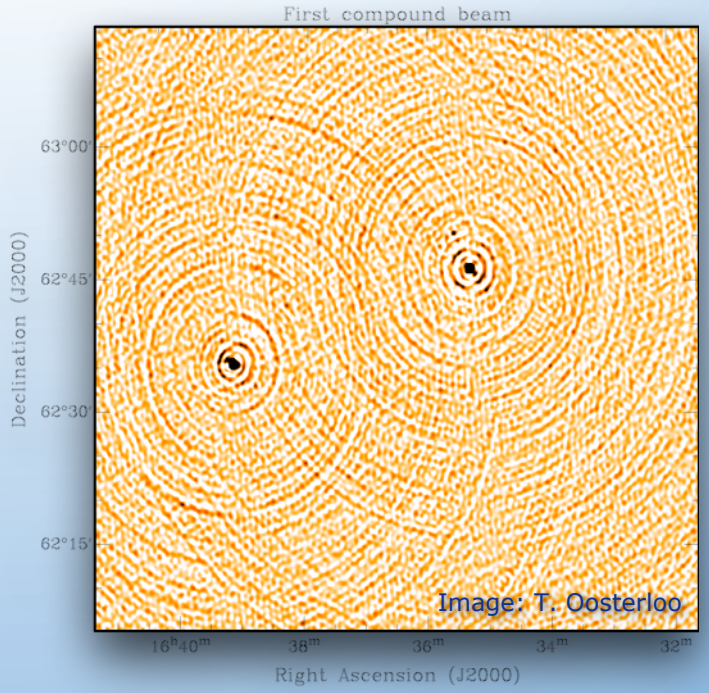
First images with and without beam forming





- Limited bandwidth
- No noise source corrections
- No fringe stopping
- Artefacts can be understood as pointing errors

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First images with and without beam forming

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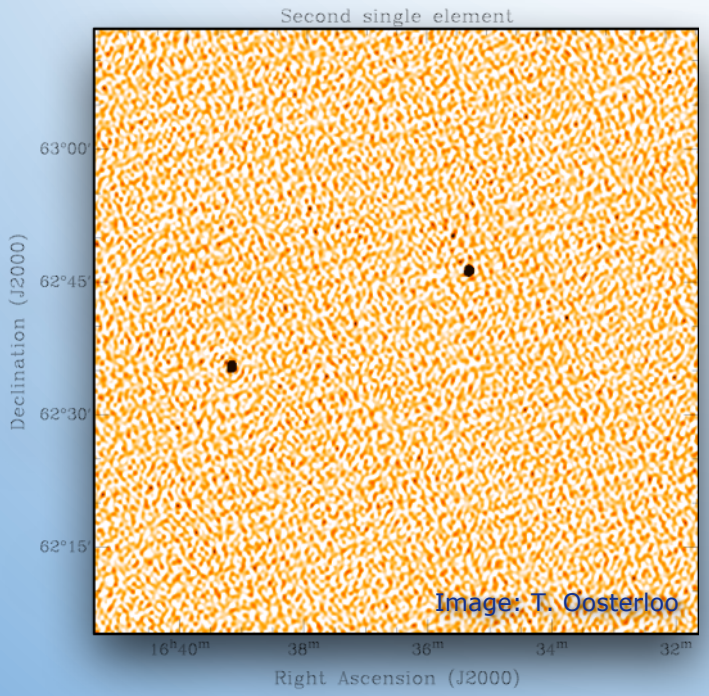

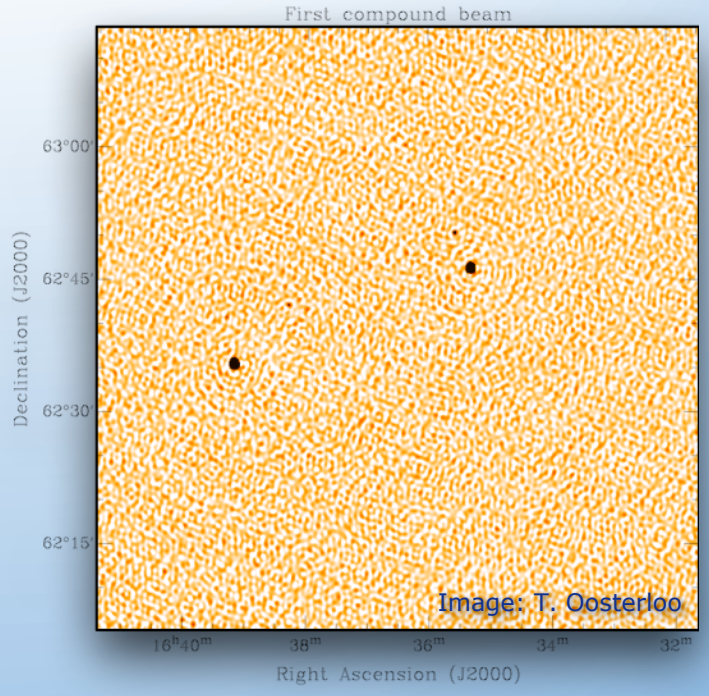

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First full mosaics with beamforming

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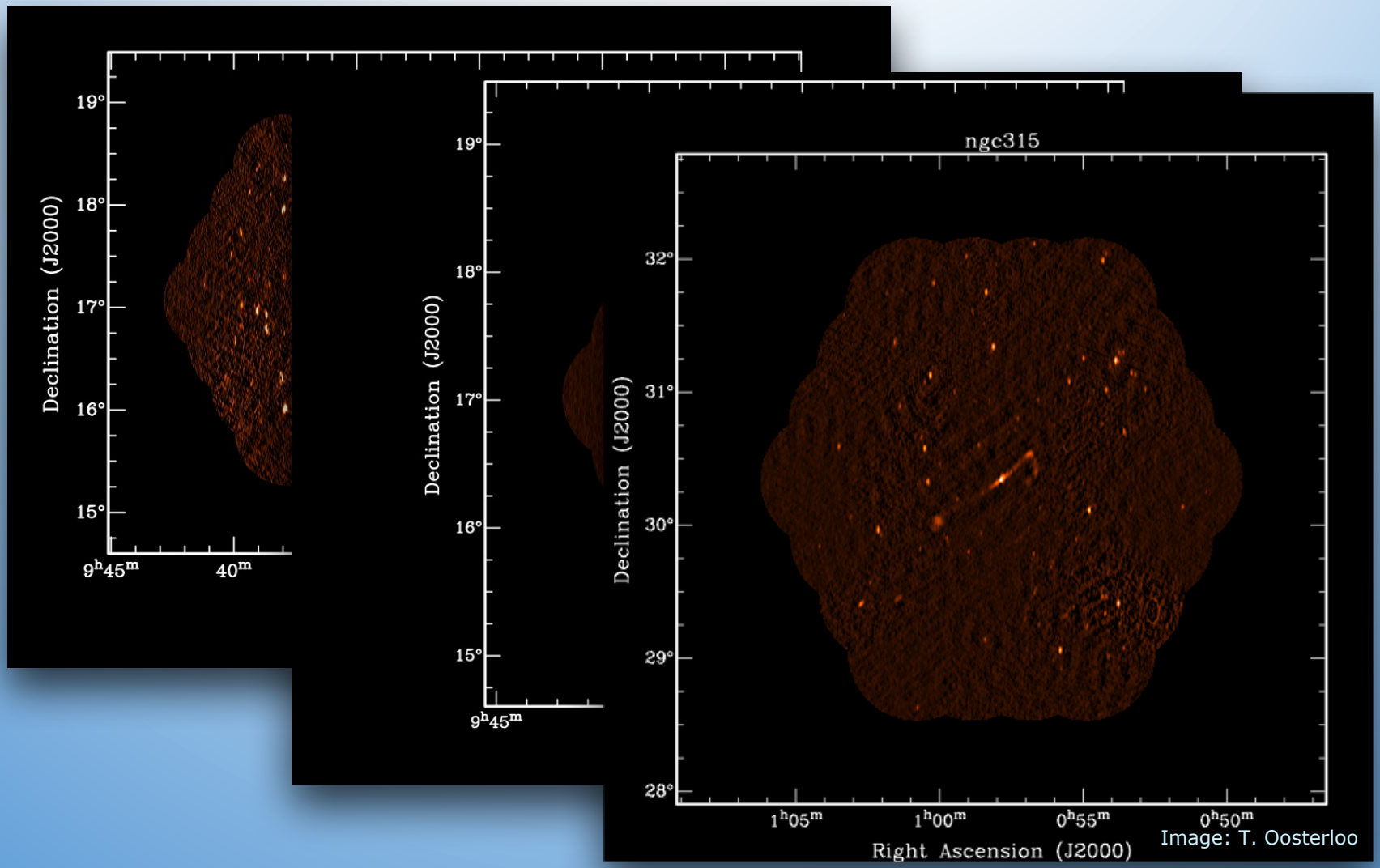

Image: T. Oosterloo

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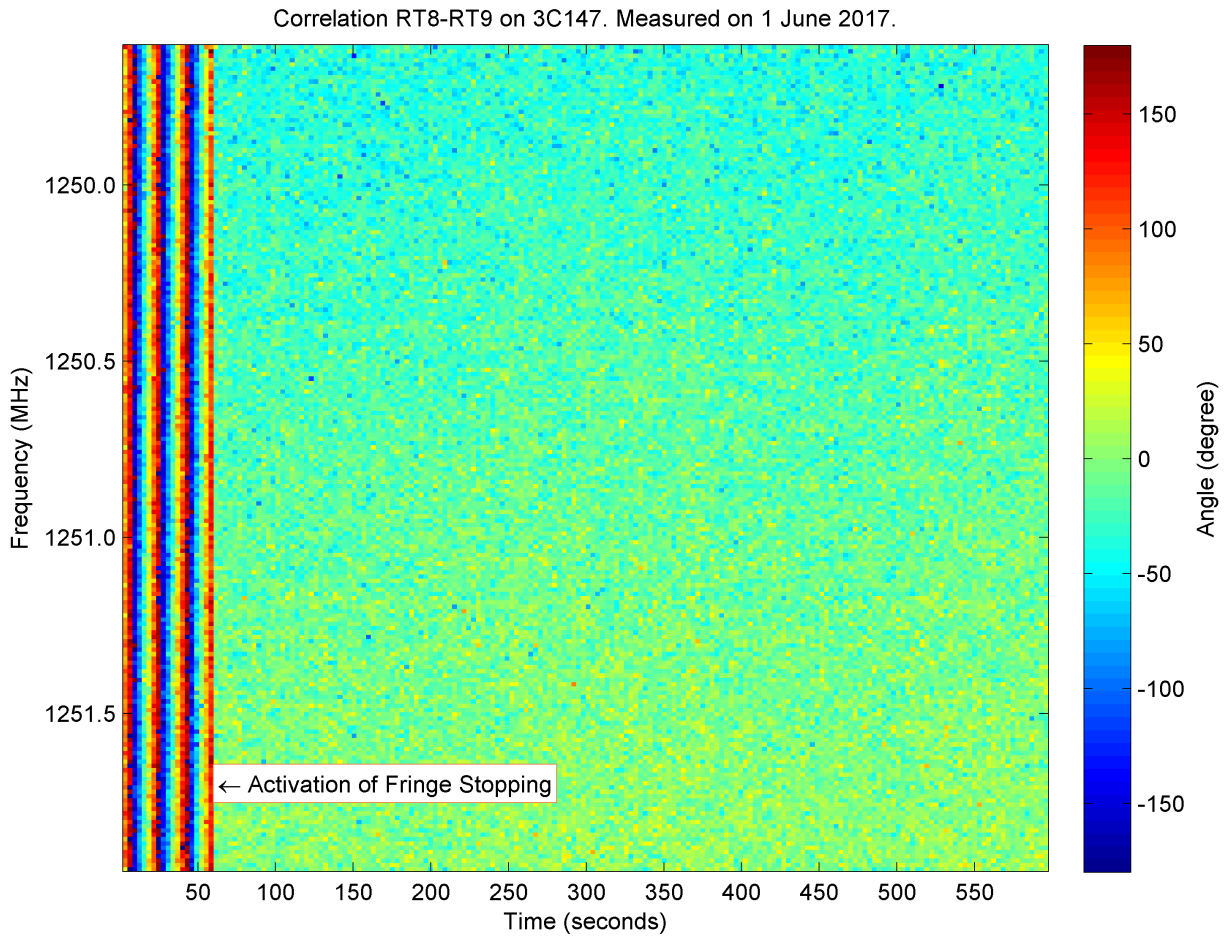
Fringe stopping working



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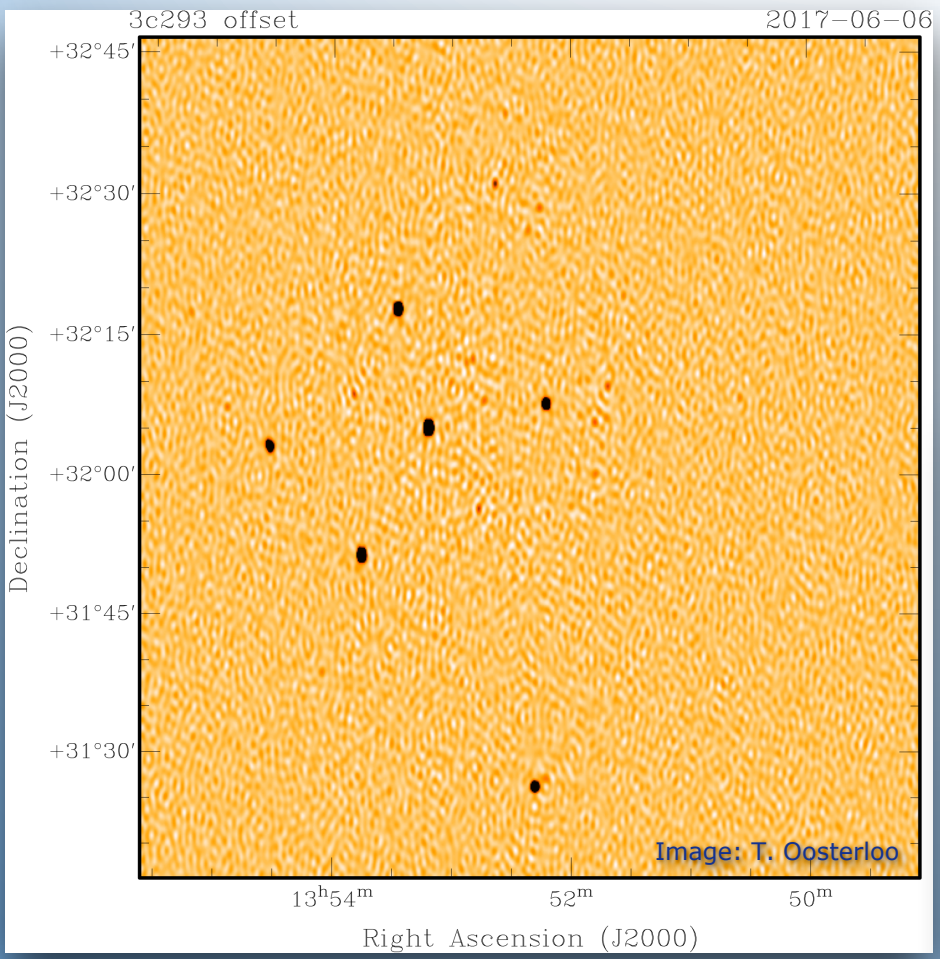
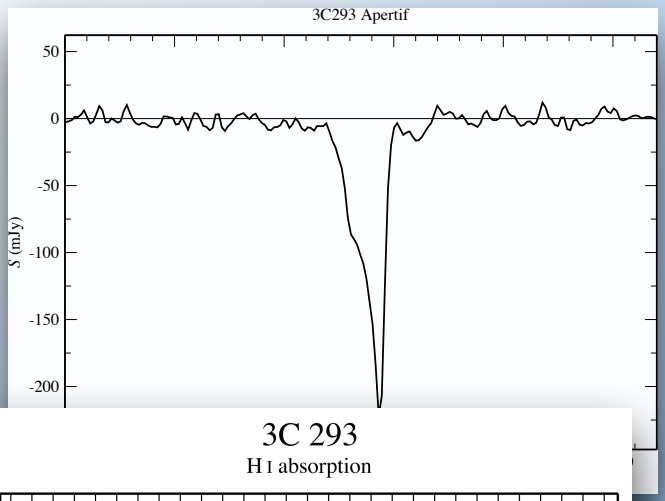
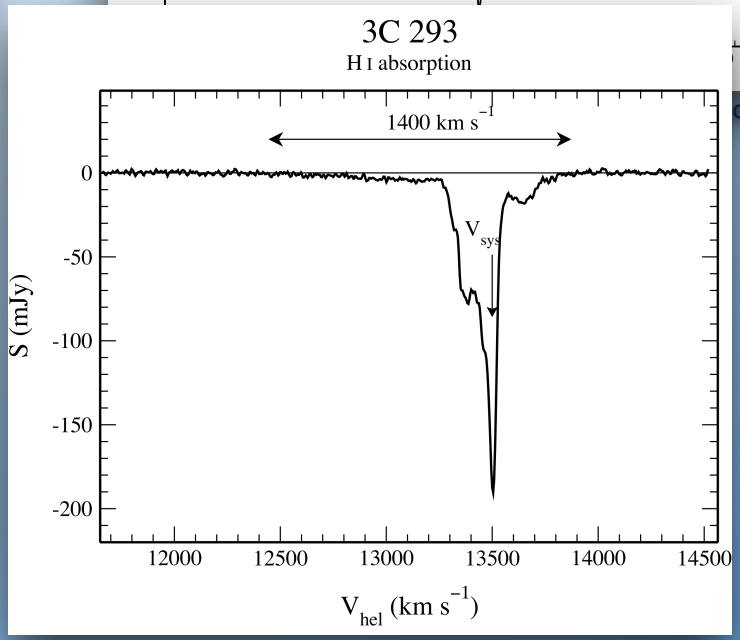
More bandwidth (135 MHz)
single element, fringe stopping







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Comparison with archival WSRT data

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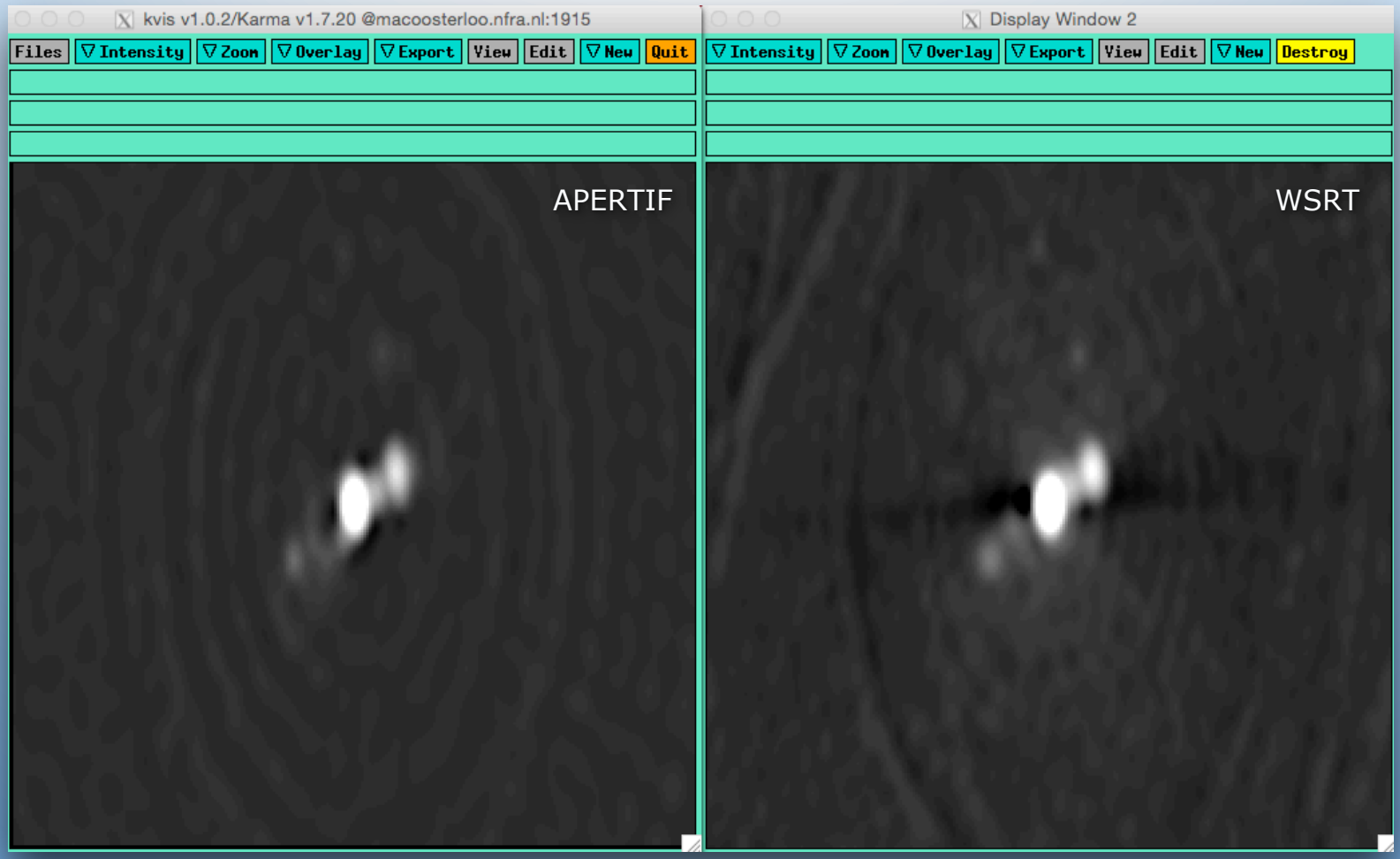

Image: T. Oosterloo

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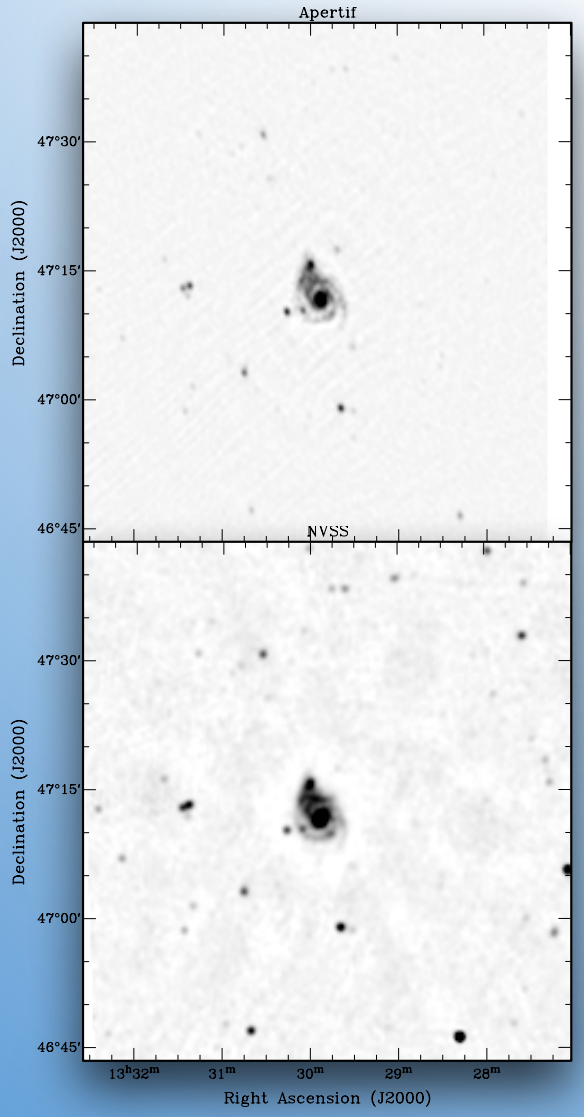
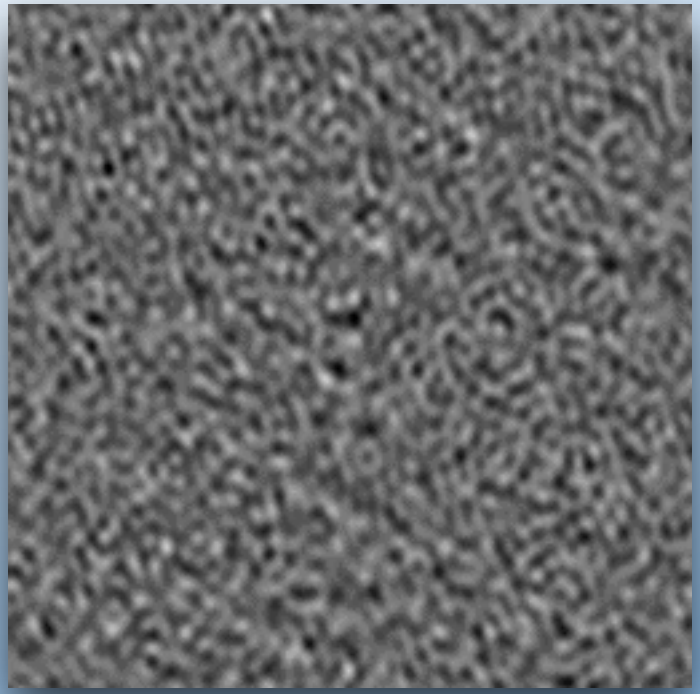
M51 simultaneous line and continuum observation





Images: T. Oosterloo

APERTIF development plans

What is next?

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1. Increase bandwidth to 200 MHz
2. Beam forming with large bandwidth
3. Online calibration
4. Primary beam measurements (holography)
5. Second polarisation
6. Subband filter
7. Polarisation calibration
8. Extension to 300 MHz bandwidth