ASTRON

Netherlands Institute for Radio Astronomy

LOFAR CITT

Calibration & Imaging Tiger Team

CALIBRATION AND IMAGING TIGER TEAM

George Heald (CITT PI)

LSM, 13/5/2015

ASTRON is part of the Netherlands Organisation for Scientific Research (NWO)

LOFAR

Outline

- CITT updates: personnel and progress
- Developments on direction dependent calibration
- Example: NGC 5775 (with early science results!)

CITT members and roles

George Heald
PI

Tammo Jan Dijkema
Project Manager
Calibration tools

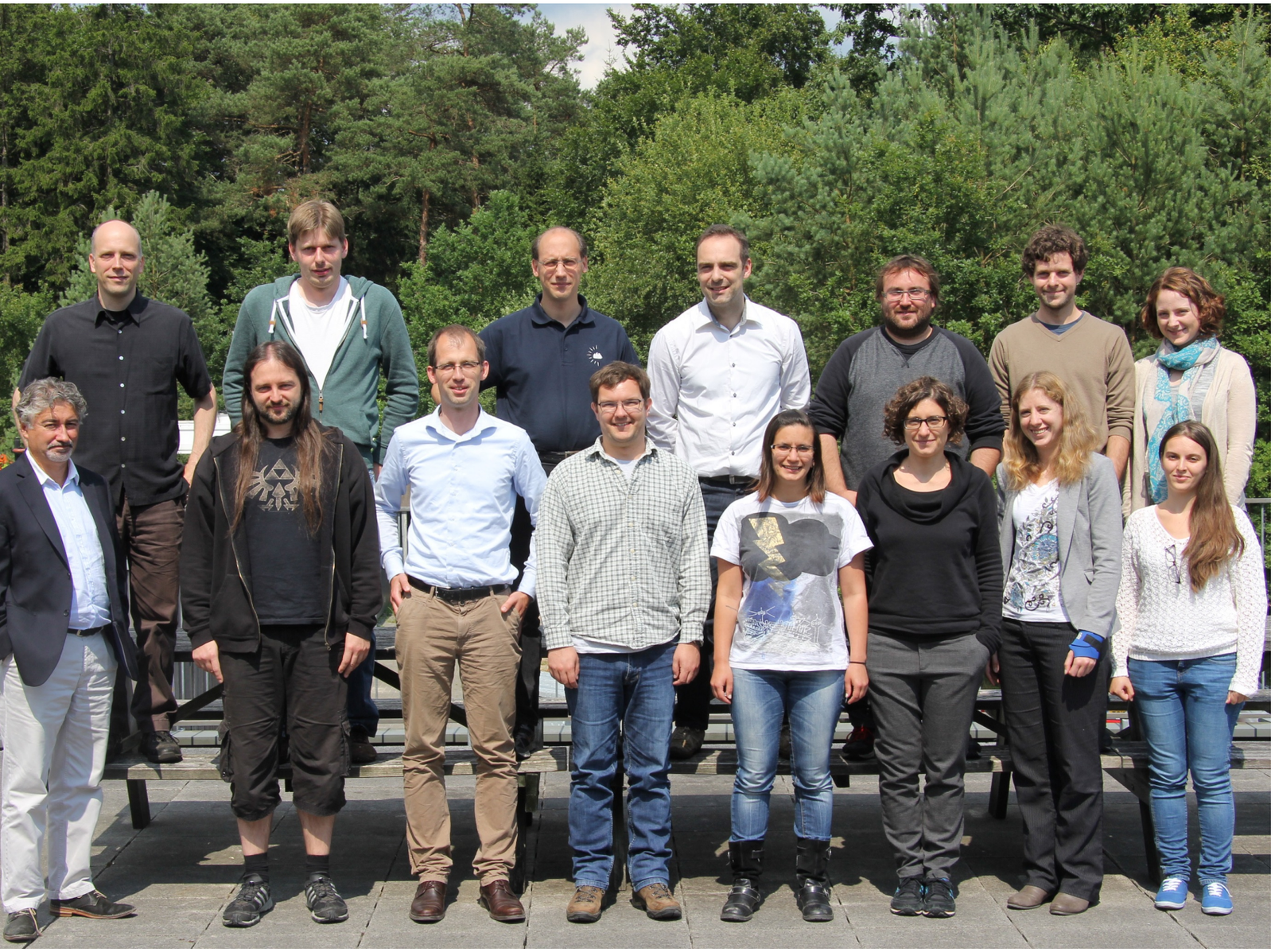
Bas van der Tol
LOFAR Imager

Nicolas Vilchez
Selfcalibration pipeline

David Rafferty
Ionospheric calibration

Stefan Fröhlich
HPC consultant

Tim Shimwell
Calibration & surveys



CITT Mid-year Progress Workshop, 2014

Manu Orru &
Carmen Toribio
RO Liasons

Summary of activity (main points)

- Calibration in NDPPP/BBS
  - Demonstrated huge speedup (40x) and memory usage improvement
  - **Delivered substantially improved capability in NDPPP**
- Imaging in awimager [critical path]
  - improvements to feature set through build against casa 4.2
  - acceleration development well under way
  - **Delivered fully functional imager in new build**
- Self-calibration recipe [now being finalized in operational (RO) pipeline]
  - direction-independent: standalone and pipeline implementation
  - development of direction dependent version well under way
  - **Delivered functional selfcal pipeline [available on github]**
- Ionospheric / direction-dependent calibration (BBS+awimager)
  - Decision taken to transition from phase screen to extreme peeling
  - **Delivered essential components of direction dependent pipeline**

Other supporting activities

- Smart demixing
  - Required for good quality HBA data to enter the pipeline
  - New scheme not yet verified
  - Testing started with new dataset (Horneffer)
- Beam model adjustments
  - For now, normalization (HBA flux scale)
  - Further improvements will need commitment at ASTRON
- Continued support of software packages (BBS etc), ~20% time
- Fast rollout of improvements to the community
  - e.g. gaincal, awimager, support of LoSoTo, LSM tool, …
- Engagement with the RO to implement software in operational system (in progress: e.g. selfcal - later, pipeline structure)
- Support release of casacore 2.0 (now for NRAO and LOFAR)

Documentation

- Documentation can always be improved, but we've kept usage information up to date as we move along (cookbook & wiki):

Calibration and Imaging Team Start page

This page is (to be) the central information point for the Calibration & Imaging Tiger Team.

From 1-5 December we are hosting the 22nd Imaging Busy Week.

Table of Contents –

- Calibration and Imaging Team Start page
  - Progress updates
  - Advisory Group
  - Prerelease software documentation
  - Release notes
  - Team
  - Internal link

edit

Progress updates

- 9 July 2014: CITT Status update at LSM
- 28 May 2014: CITT Status update at LSM
- 16 April 2014: Results and plans of the Calibration and Imaging Tiger Team at LSM
- 5 March 2014: Imaging Tiger Team progress report

edit

Advisory Group

We try to channel our contact with the KSPs through an Advisory Group with which we have regular contact. This group consists of Reinout van Weeren, Francesco de Gasperin, Martin Hardcastle, Maaijke Mevius, Björn Adebahr, Jess Broderick and Tim Shimwell.

edit

Prerelease software documentation

We aim to test the software to a certain level before we distribute it to the world. A team of testers helps us do that. The following documentation is meant for them:

- AWImager documentation
- NDPPP documentation, specifically the part on GainCal
- Self-Calibration documentation page
- Ionospheric scripts documentation
- Local Sky Model Tool documentation

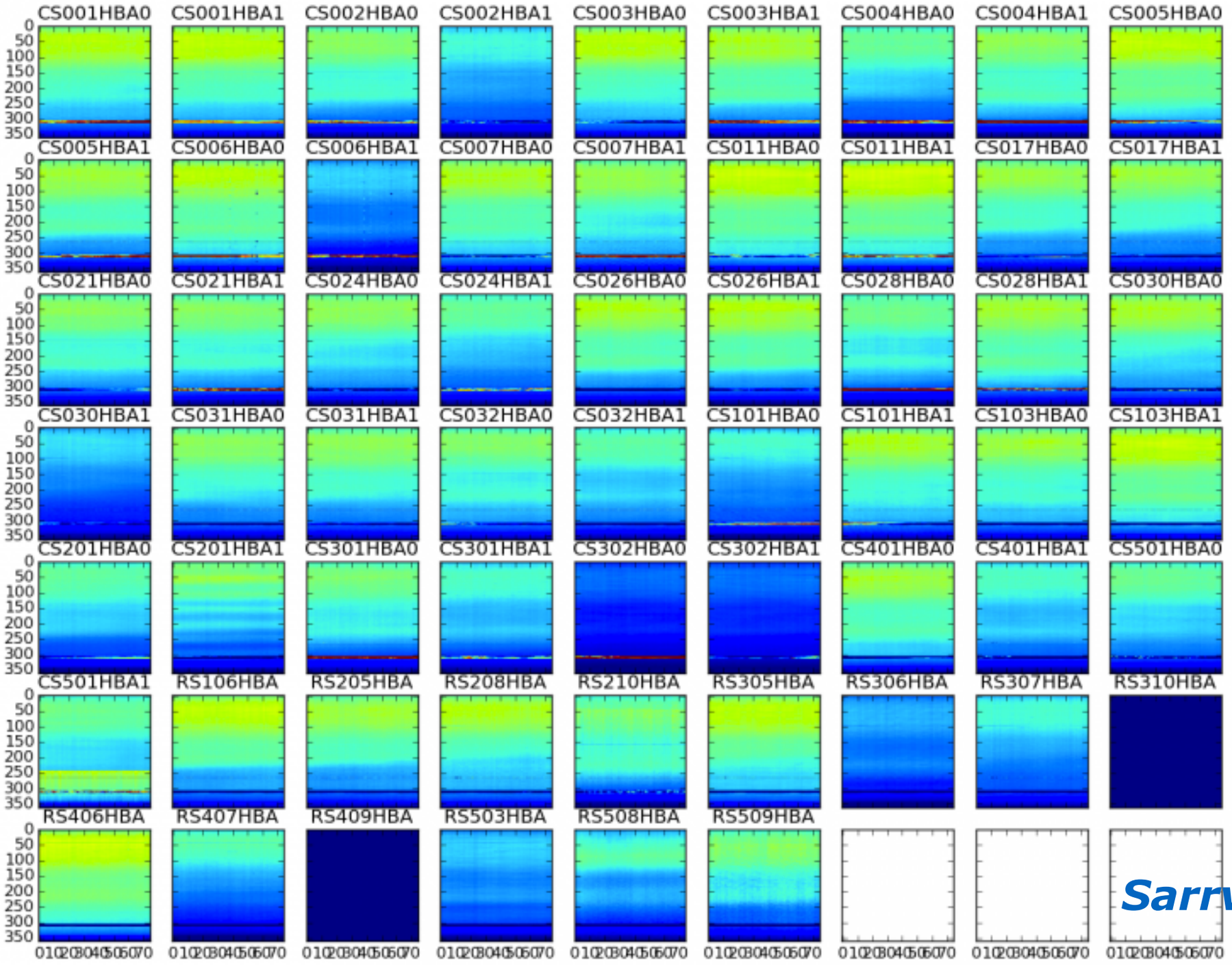
- (Data school book will mention aspects of the new software too)

Major points for 2015

- Pipeline development framework has been added to our portfolio
- Development of enhanced gridding/degridding
  - NB: this is a change from plans for multi-node approach
  - 3 months for CPU implementation of Bas's new algorithm
  - 3 months for GPU version (Bram Veenboer)
  - "plug and play" nature of new imager (gridder/degridder and beam modules) is key for rapid development toward end of the CITT project
- Planning for what comes after CITT
  - End of current project in August
- Emphasis on "facet calibration" in pipeline development
  - **see recent LSM presentations by van Weeren & Williams**

Direction dependent pipeline: prepare stage

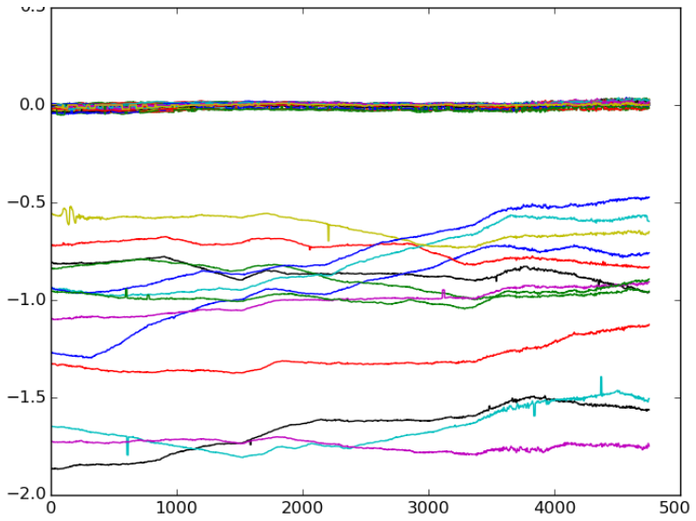
- Careful initial inspection and processing is being coordinated in preparation for the extreme peeling testing next month

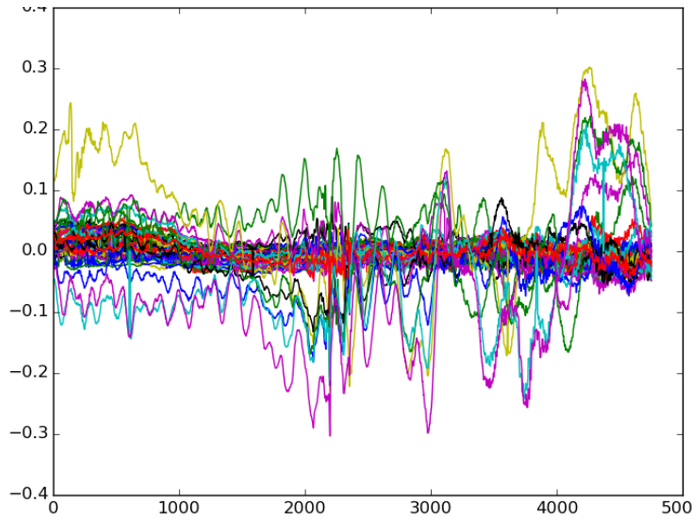


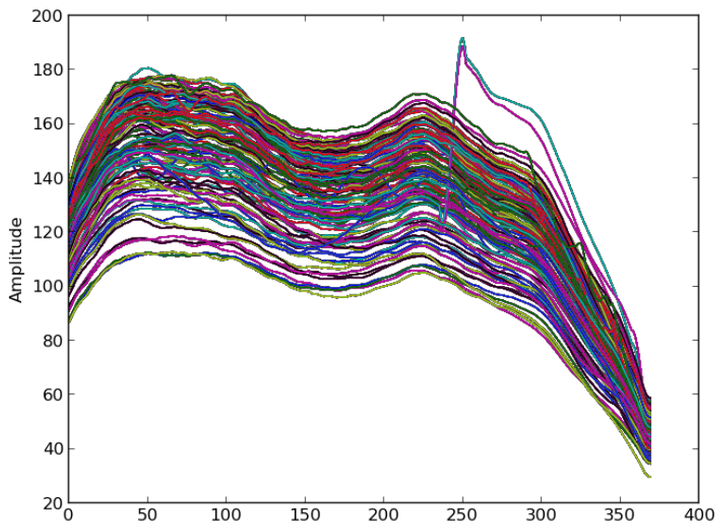
Sarrvesh

Clock-Tec separation

- All core stations are on the same clock
- Note both clock offset and clock drift are present







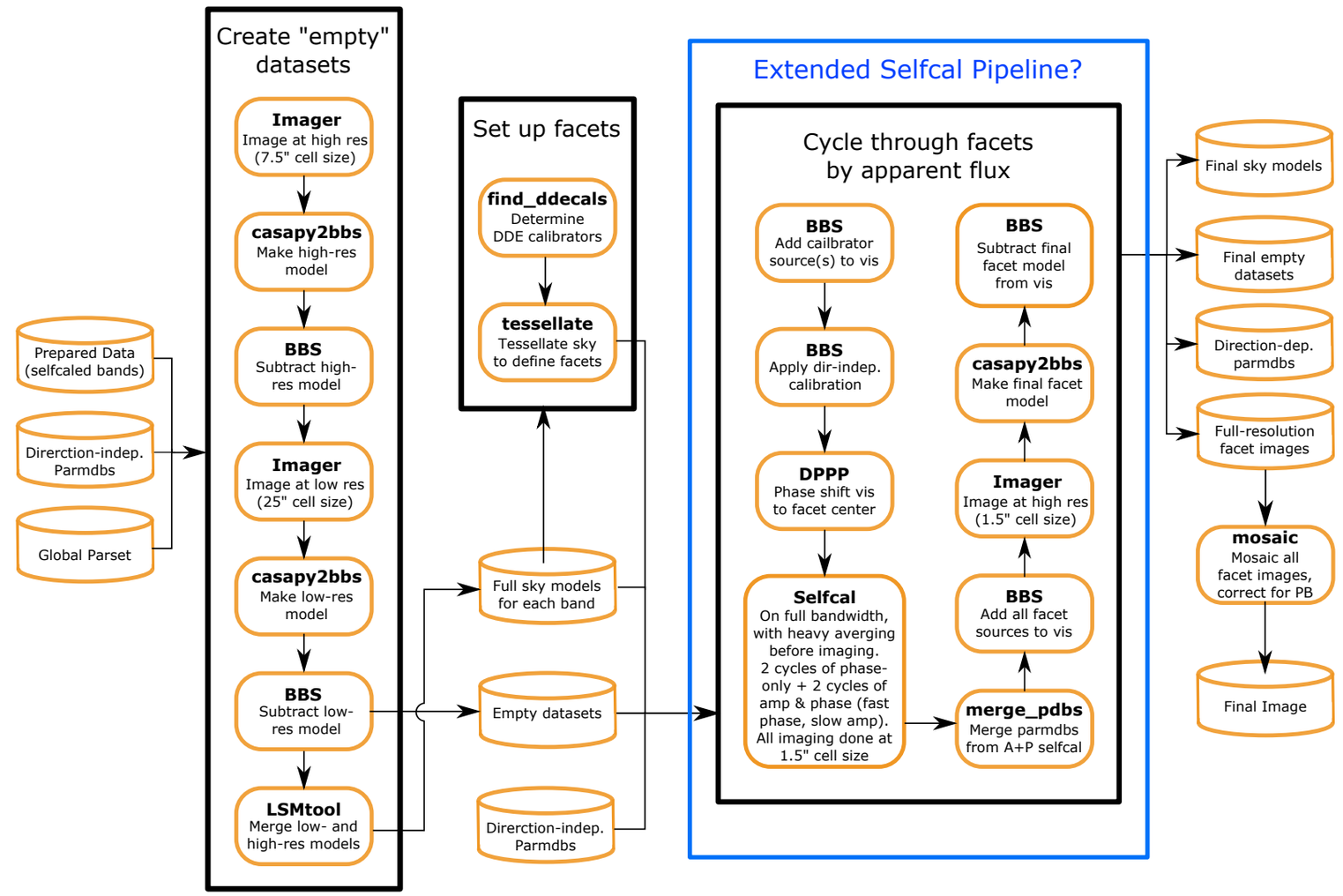
Sarrvesh

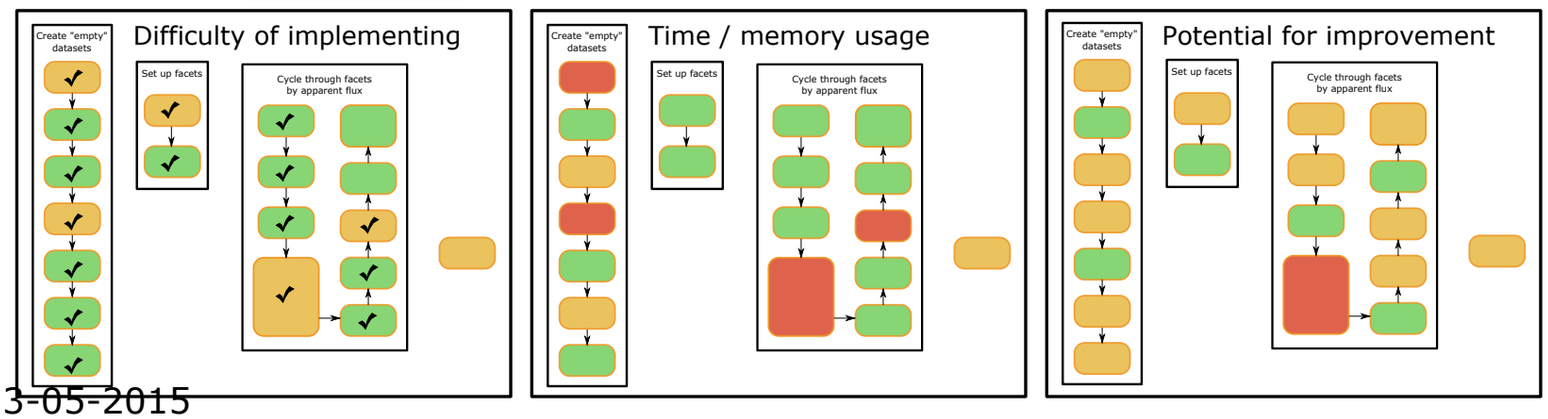
university of groningen

ASTRON

Direction dependent pipeline

- Mature development of facet cal in LOFAR pipeline framework
- Preparatory steps also implemented in framework (Tim Shimwell)





David Rafferty

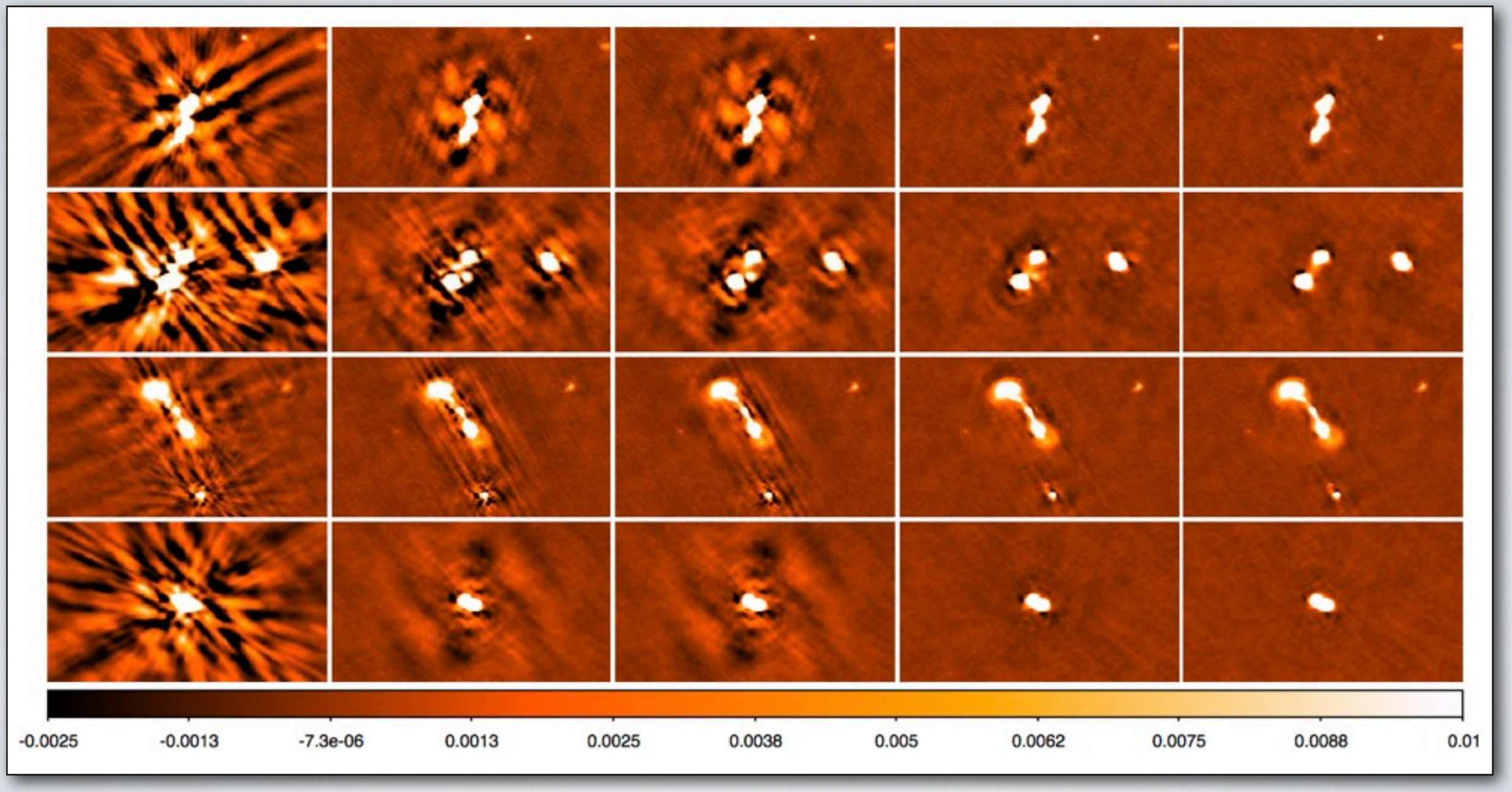
10 block non-DDE solution
(instrument_ap_smoothed)

CommonScalarPhase TEC

CommonScalarPhase TEC

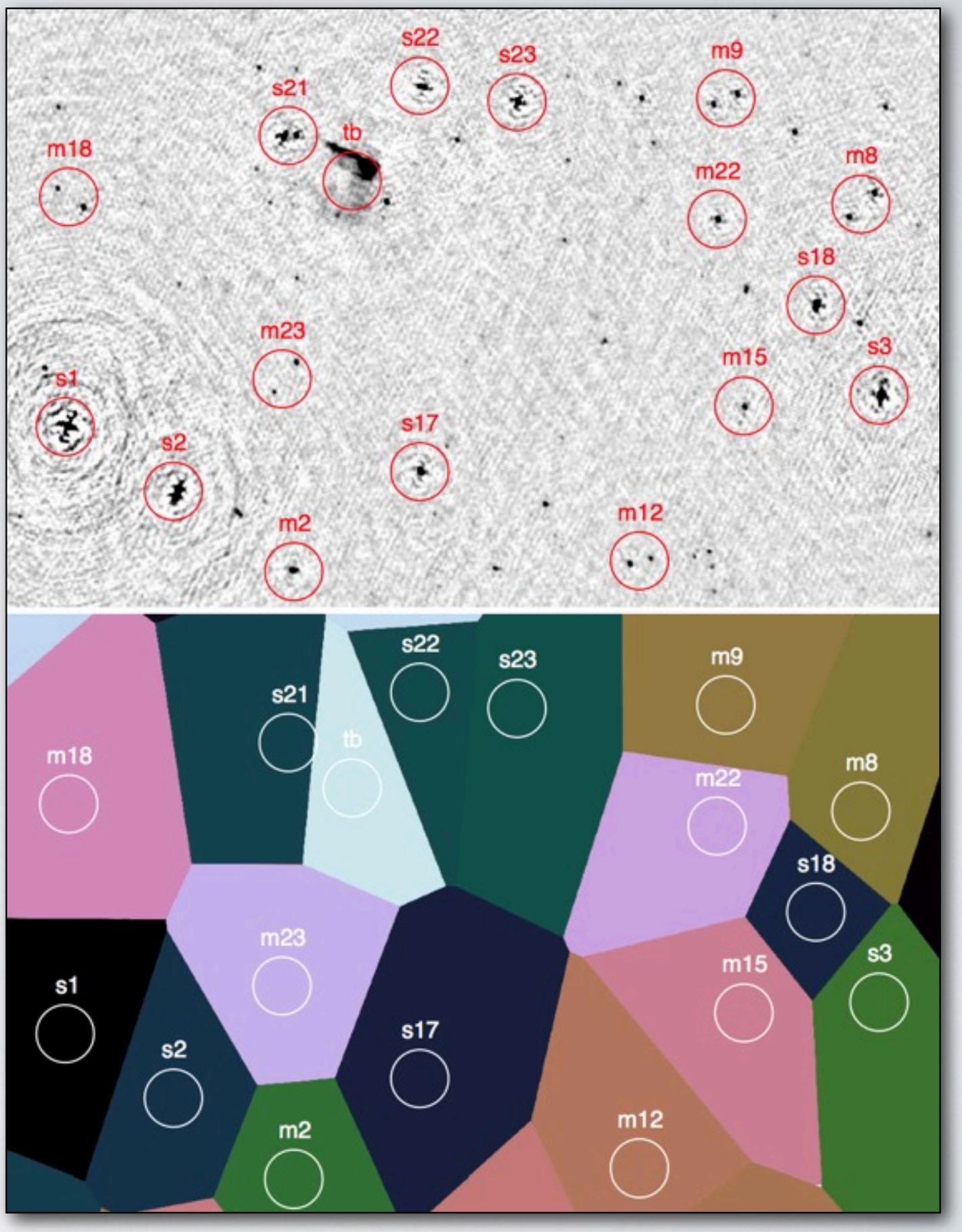
CommonScalarPhase TEC
Gain:0:0
Gain:1:1

CommonScalarPhase TEC
Gain:0:0
Gain:1:1

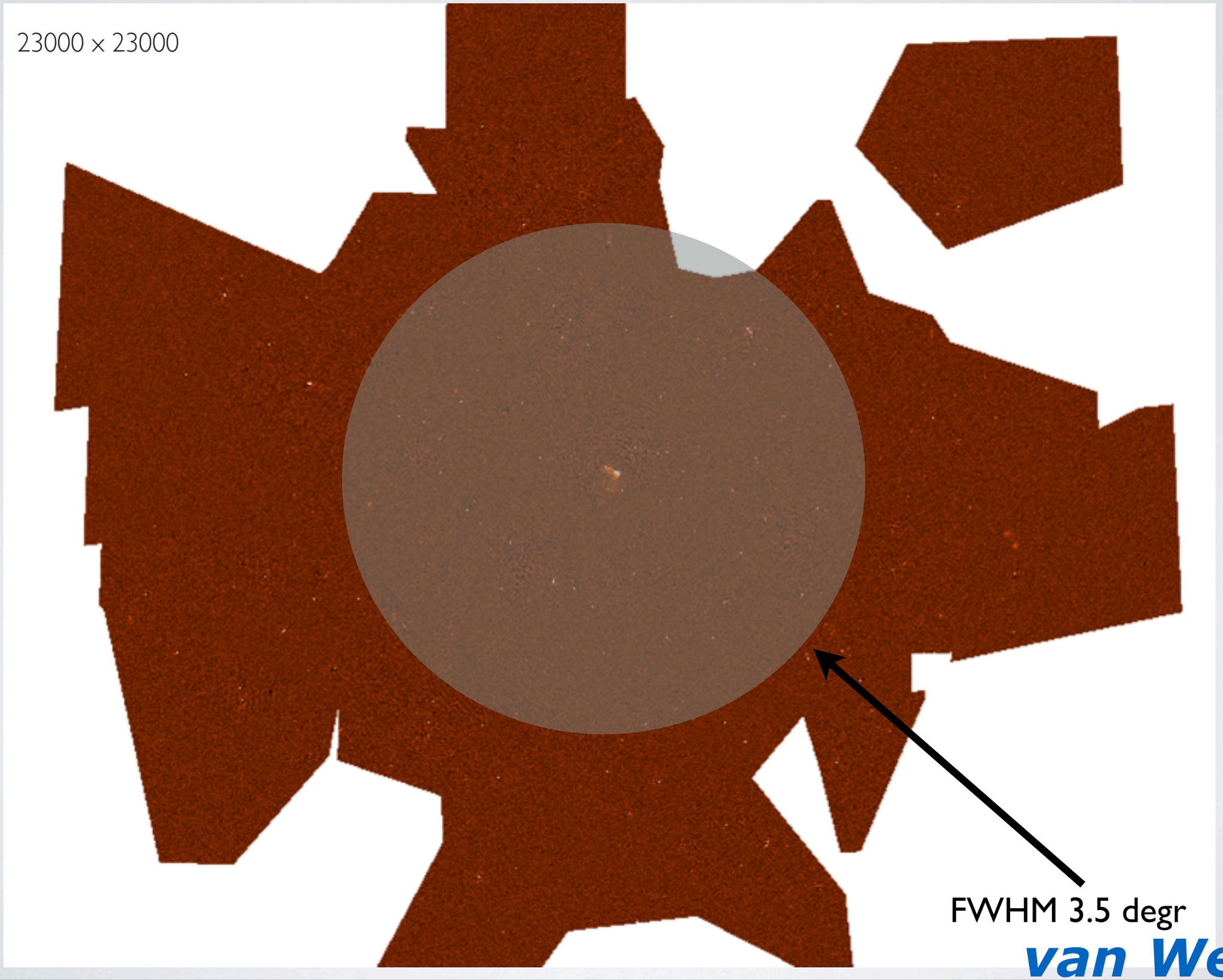


van Weeren

FACET LAYOUT



AFTER ~60 DDE CALIBRATORS



Leiden workshop

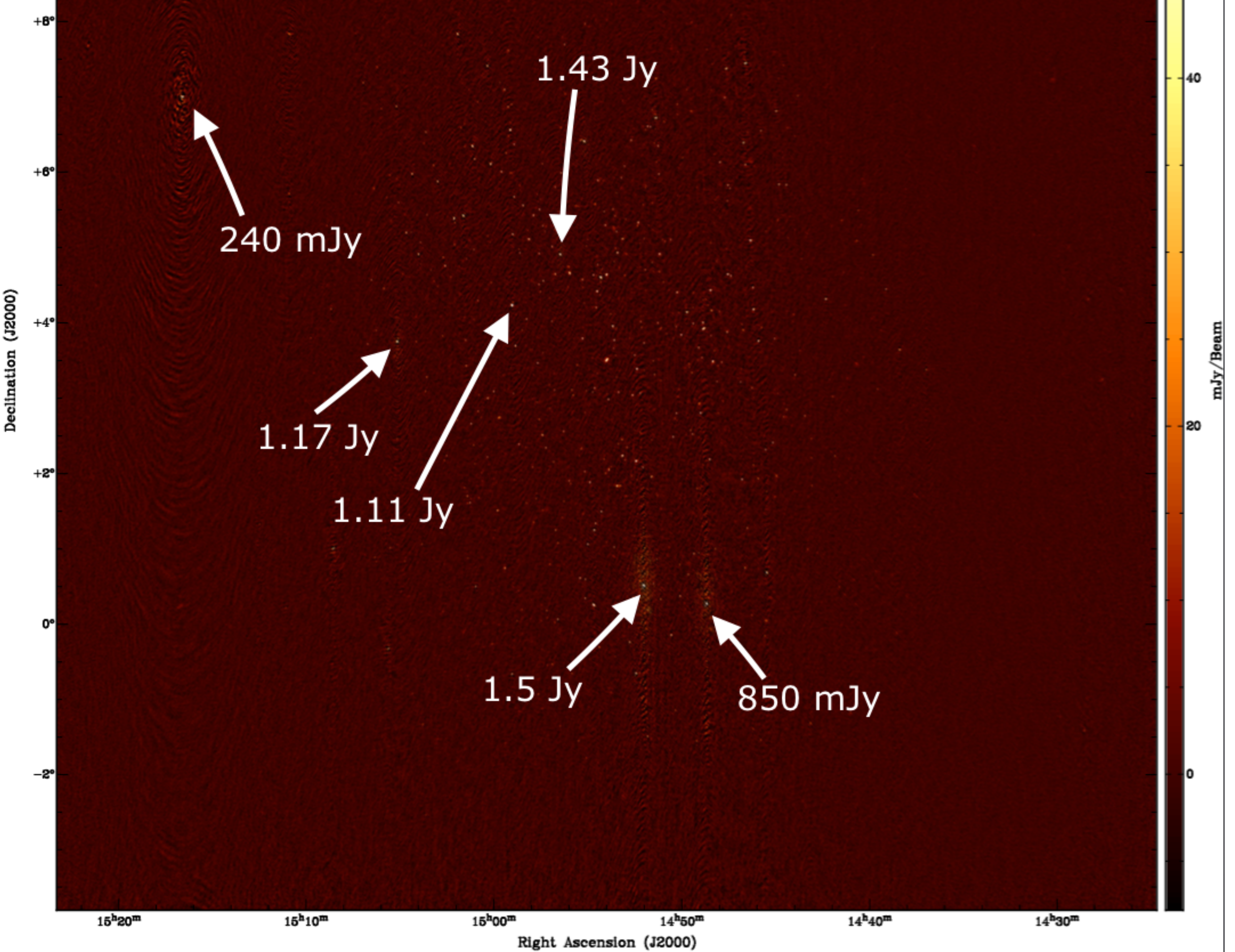
- Organizers: Tim Shimwell, Reinout van Weeren & Wendy Williams
- 20-24 April at Leiden University
- Participants (fields / development):
  - Wendy Williams (Boötes)
  - George Heald (NGC 5775)
  - Martin Hardcastle (H-ATLAS NW)
  - Sarrvesh Sridhar (M101)
  - Elizabeth Mahony (Lockman Hole)
  - Jose Sabater Montes (ELAIS-N1)
  - Tim Shimwell (A2034)
  - Reinout van Weeren (A2256)
  - Duy Hoang and Edwin Retana Montenegro (Boötes)
  - Francesco de Gasperin (Toothbrush cluster; LBA)
  - David Rafferty & Stefan Fröhlich (CITT pipeline / framework)
  - Tammo Jan Dijkema (NDPPP / general development support)

Leiden workshop: Outcomes

- Development scripts improved, generalized, made easier to use
- Shift from casa imager to wsclean for speed enhancement
- Development version continues to evolve on github repository
- (Early) analysis of source flux densities: stable within FWHM

- Meanwhile: CITT version (based on LOFAR pipeline framework) made more robust; automated aspects underway

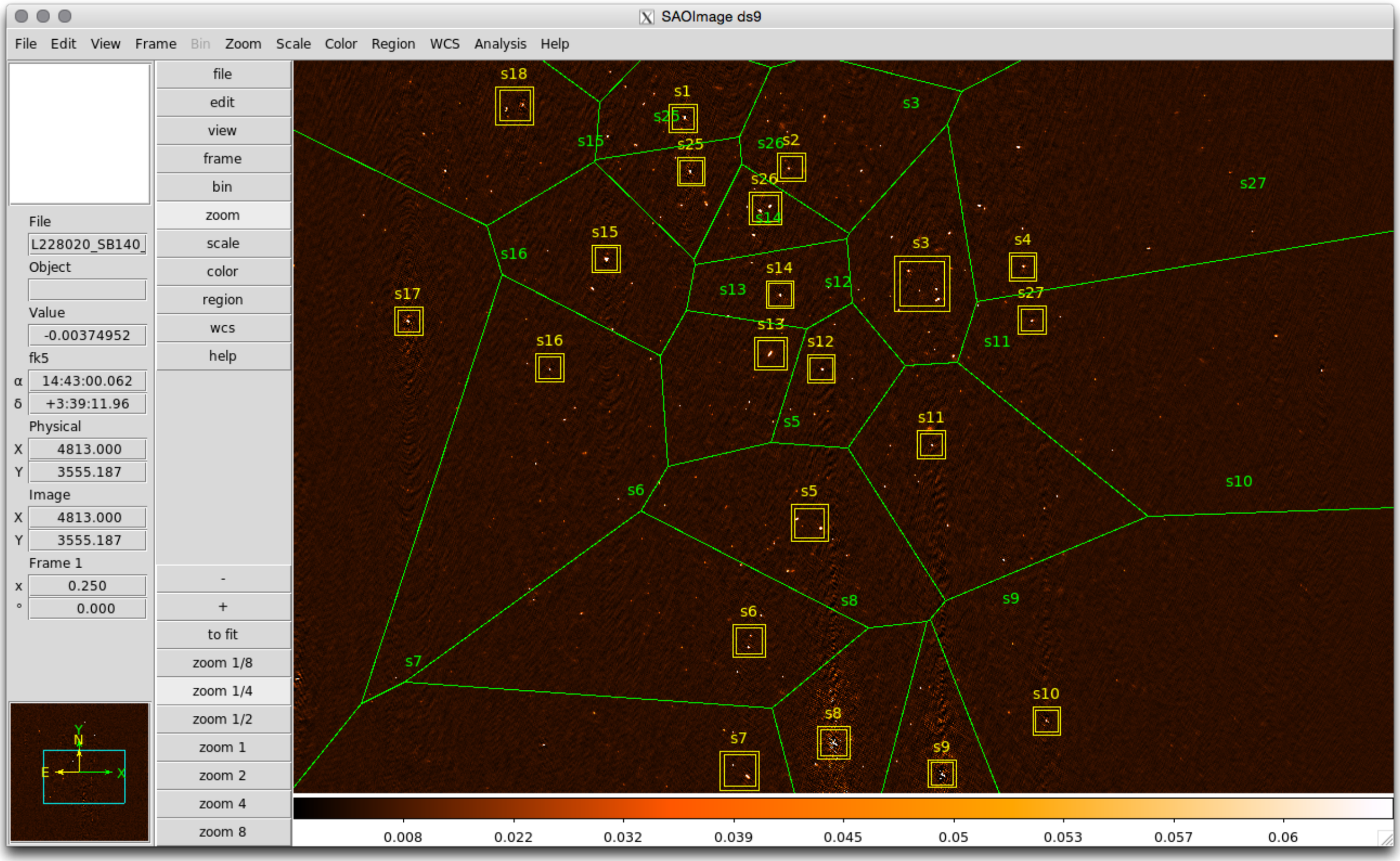
- Soon: NDPPP to replace BBS for faster calibration steps


1.43 Jy
240 mJy
1.17 Jy
1.11 Jy
1.5 Jy
850 mJy
+8°
+6°
+4°
+2°
0°
−2°
Declination (J2000)
15h20m
15h10m
15h00m
14h50m
14h40m
14h30m
Right Ascension (J2000)
40
20
0
mJy/Beam

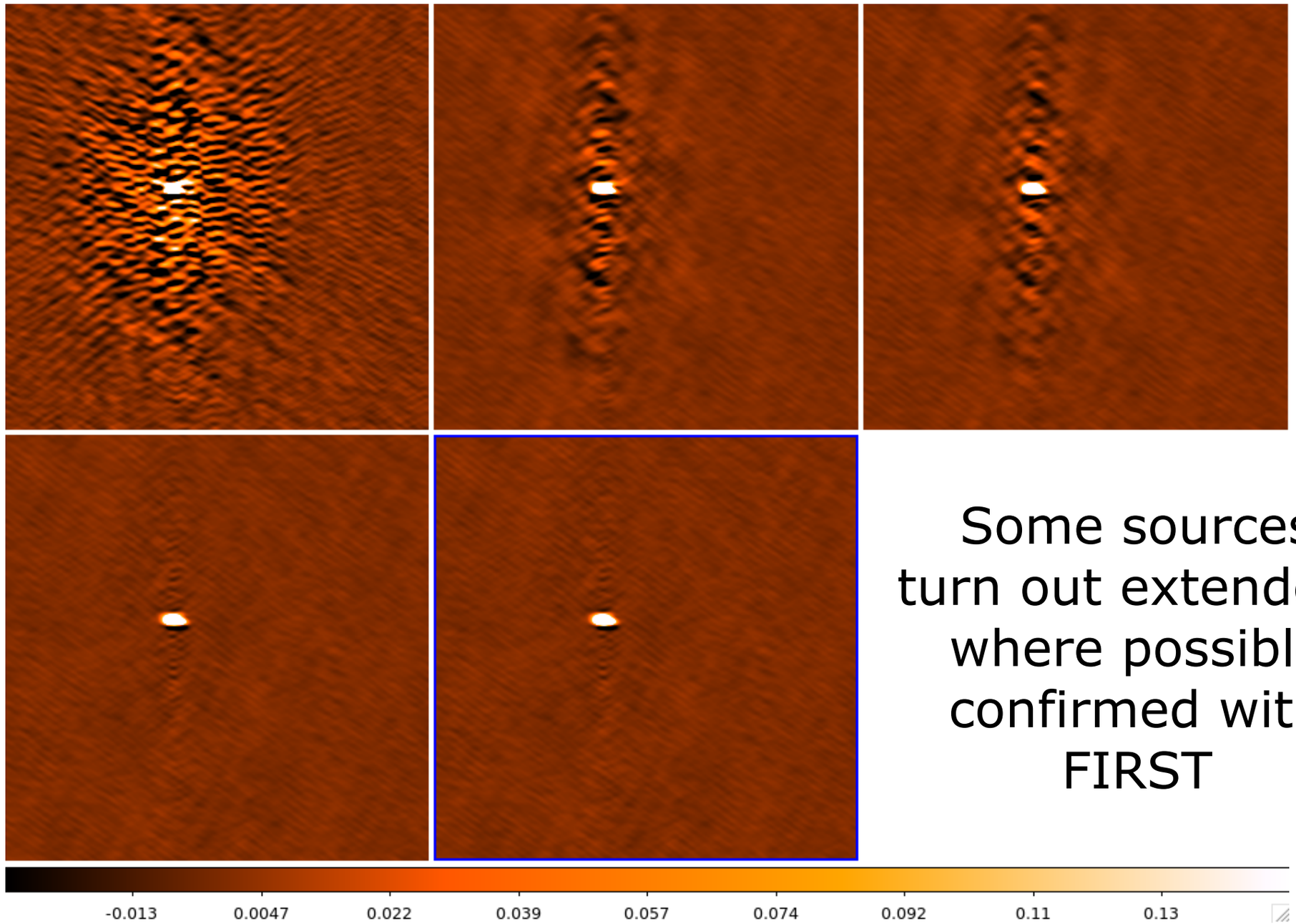
+5°00′
+4°30′
+4°00′
+3°30′
+3°00′
Declination (J2000)
14h58m
56m
54m
52m
50m
Right Ascension (J2000)
30
20
10
0
mJy/Beam

Example: NGC 5775

Divide up the sky into multiple facets



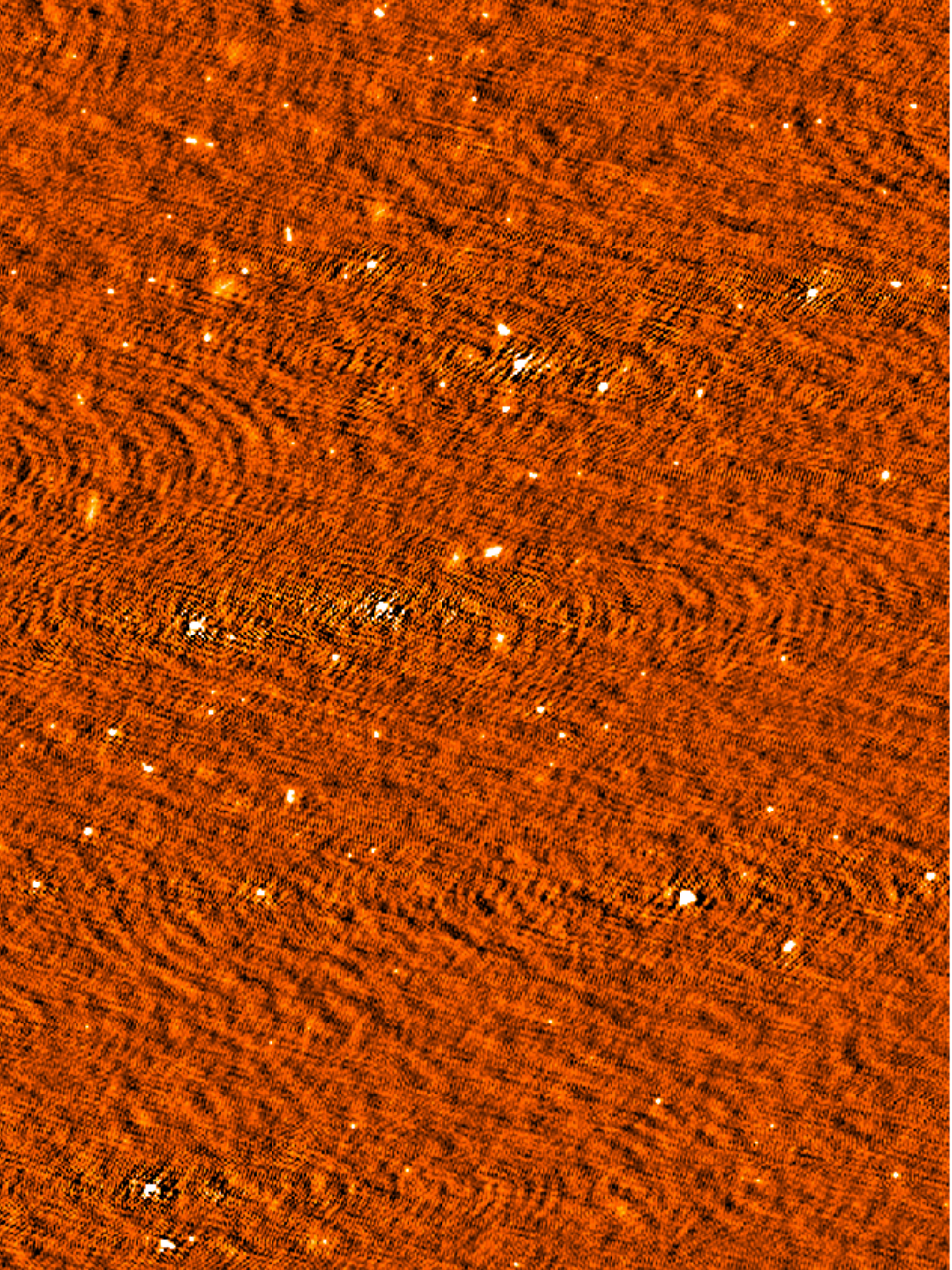
4C +05.61 (Peak: 1.6 Jy)

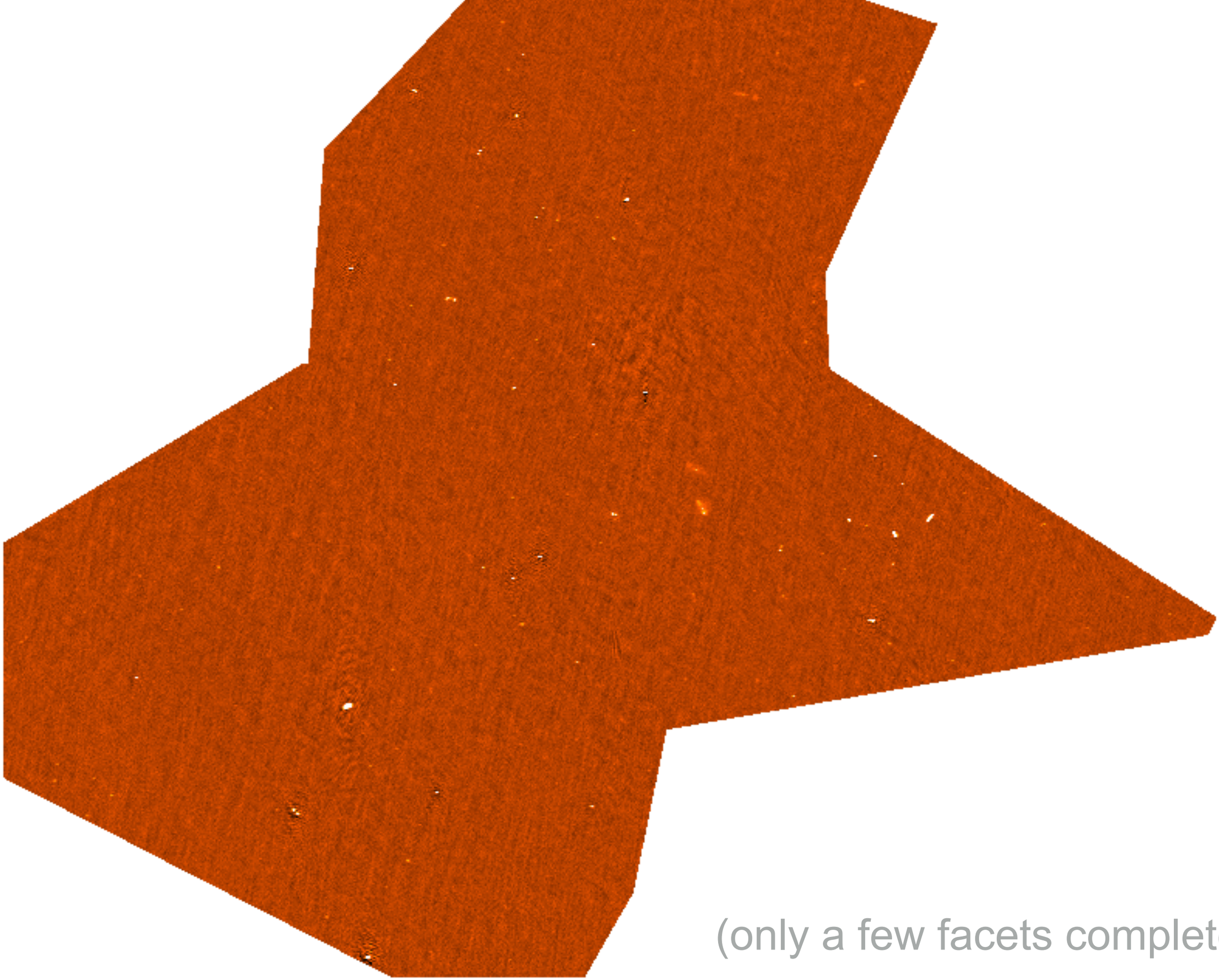


Some sources turn out extended; where possible confirmed with FIRST

university of groningen

ASTRON

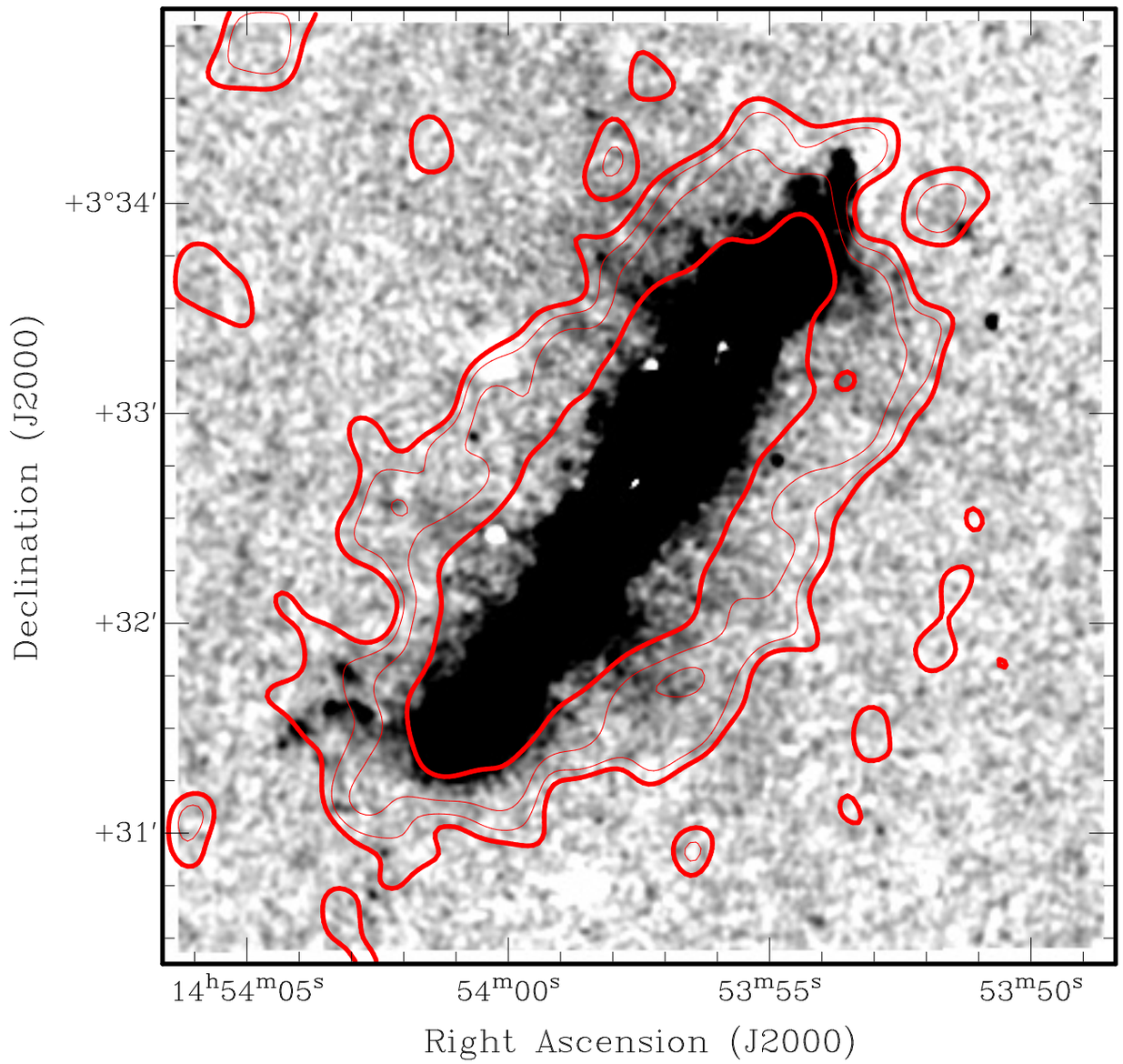




(only a few facets complete)

NGC 5775

- Data: 4 hours and 50 sub bands (1/12th of the entire dataset)
- Contours: 2, 3, 5 and 10 σ



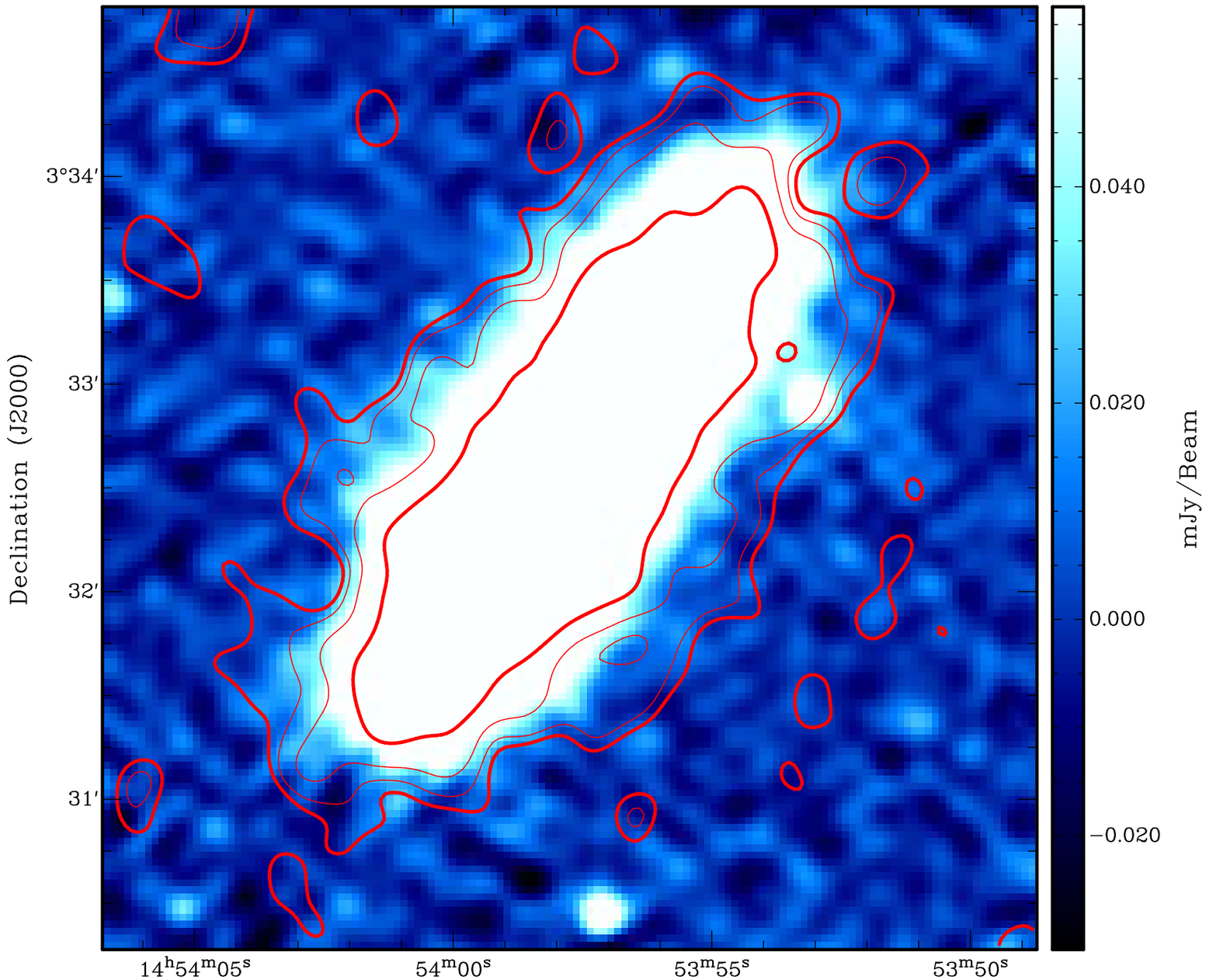
Hα Image: Rich Rand

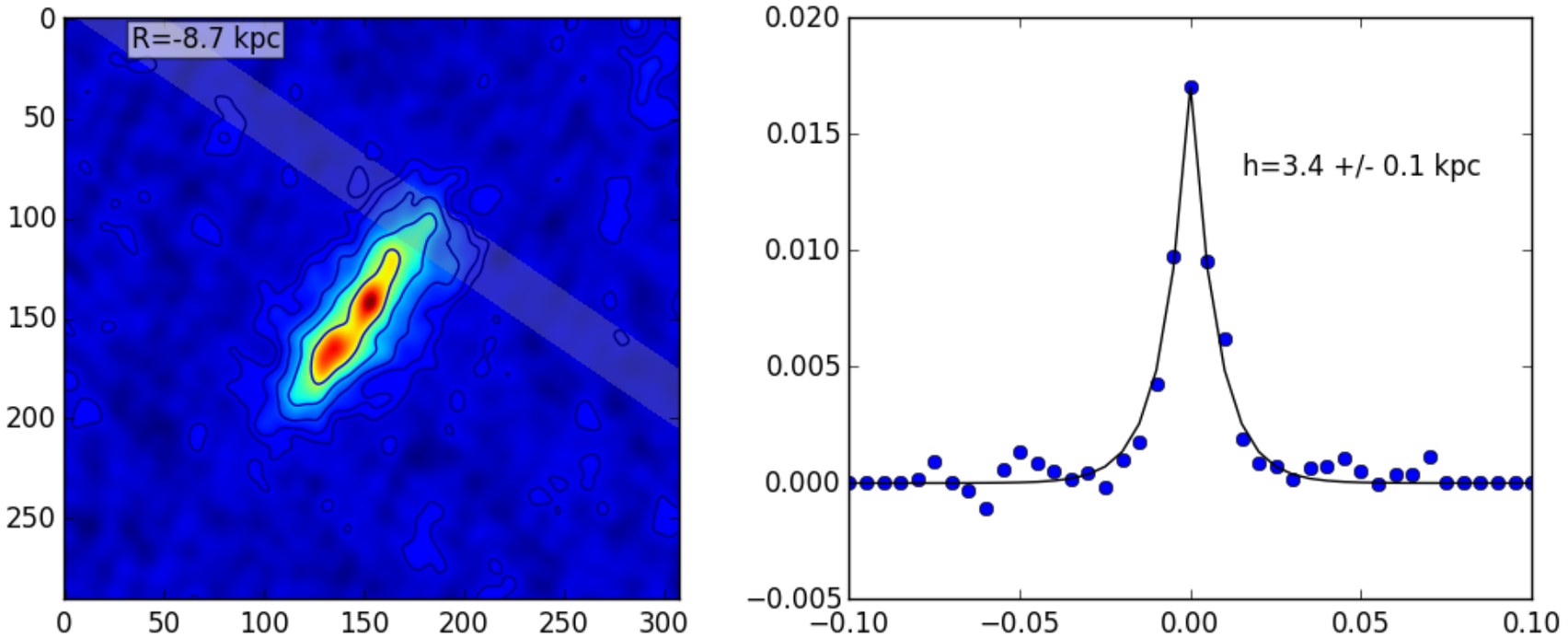
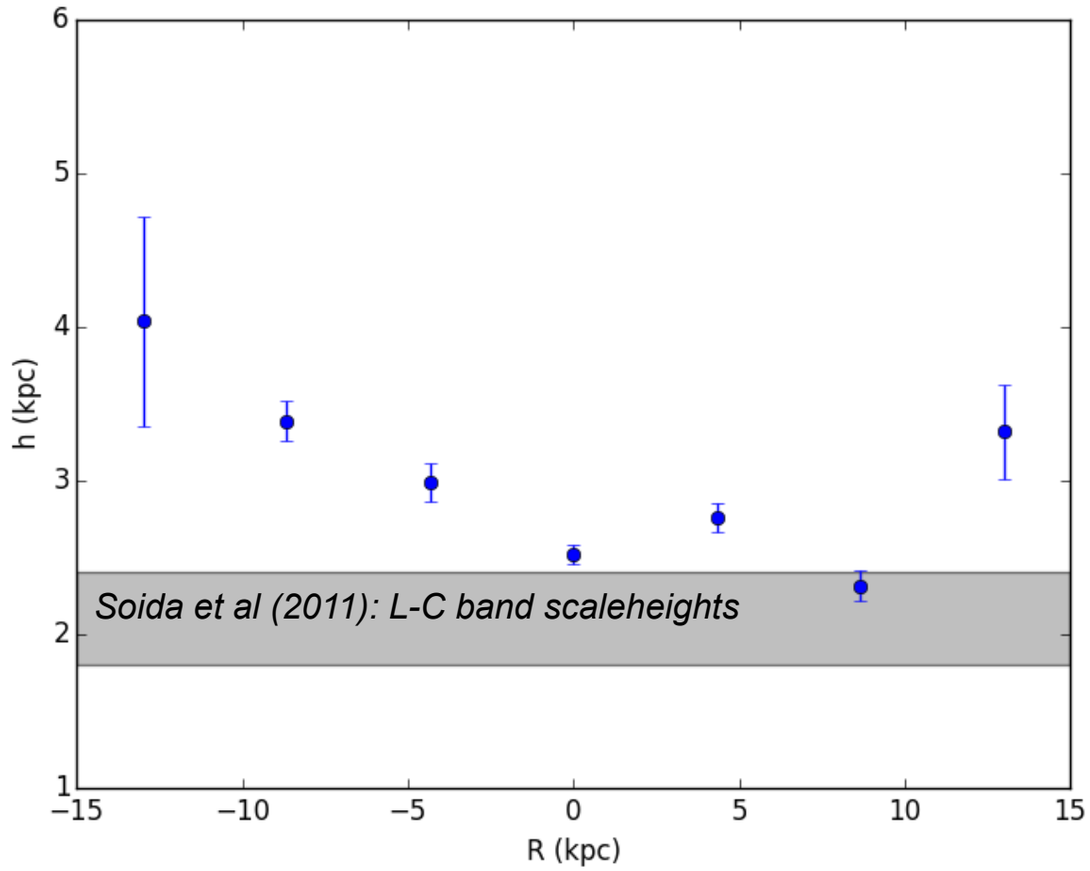
university of groningen

ASTRON

NGC 5775

- Same contours as previous slide
- Compared with CHANG-ES (Irwin et al 2012) image (VLA C-band, D-array, 10” resolution, rms 6 μJy/beam)



NGC 5775

- Preliminary analysis of vertical scale heights