
U-GMRT EARLY RESULTS

u-GMRT test observations: Preliminary science results

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with due thanks to
Ishwara-Chandra C.H.,
staff of GMRT, ...

U-GMRT

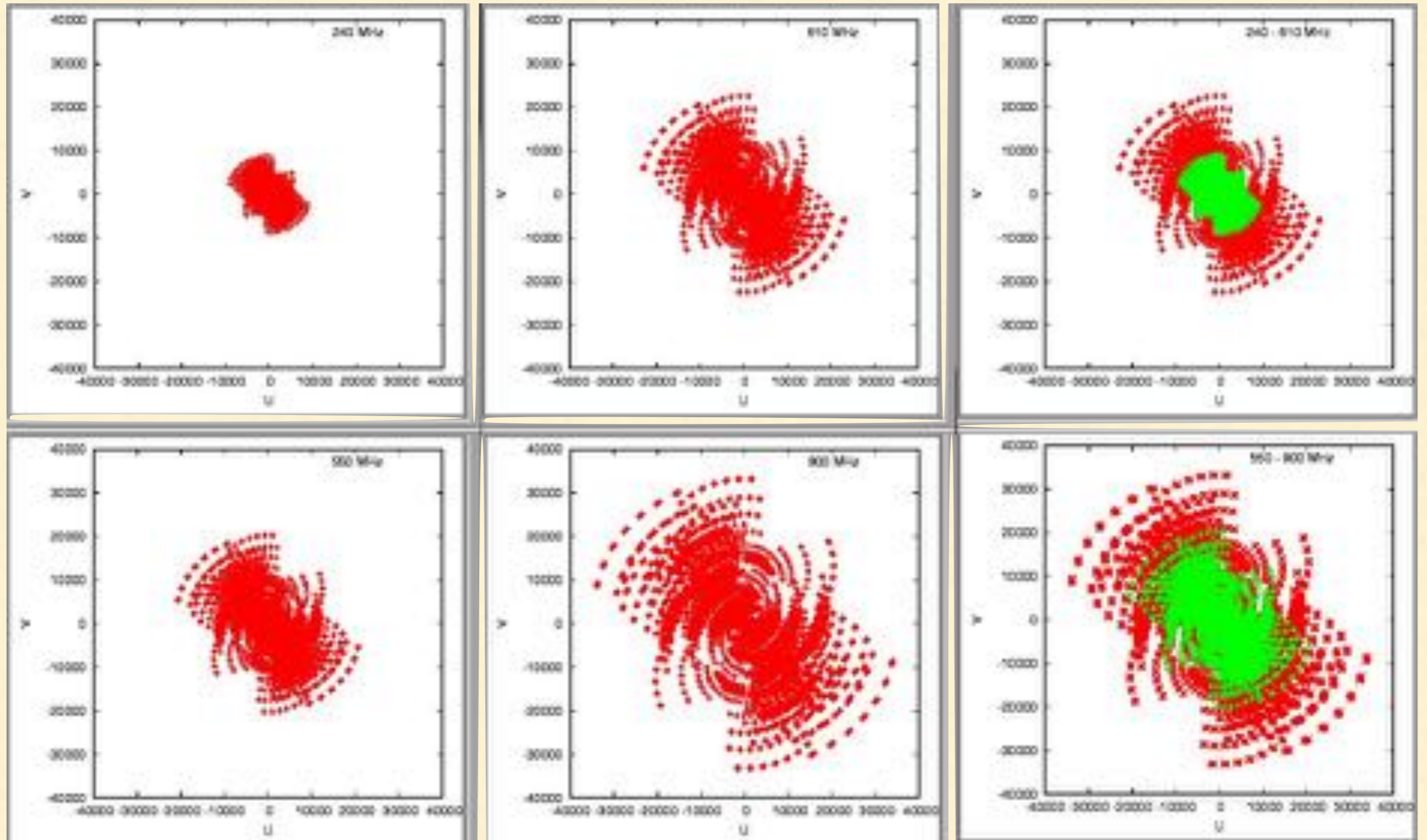
GMRT is undergoing a major upgrade

- The fundamental goal is to improve
 - major observational capabilities of the original GMRT (bandwidth, sensitivity).
- This is a leveraged project - built upon existing infrastructure of the GMRT.
- Nearly seamless frequency coverage from 125 MHz to 1450 MHz
 - provided by 4 frequency bands
 - with new receivers.
- New correlator with 400 MHz bandwidth capability.
 - New digital / analog design to maximise instrumental stability and repeatability.
- **Expectation - noise-limited, full-field imaging in all Stokes parameters for most observing fields.**
- **The project is scheduled to be completed by the end of 2017.**
(talk by Y. Gupta)

U-GMRT: CONTINUUM IMAGING

- **our ability to map extended, low-surface brightness diffuse structures**
(talk by D. Deo, from simulations perspective)
- **Clusters / AGNs with the uGMRT**
(talk by R. Kale)
- **Imaging challenges and solutions**
(talk by F. de Gasperin)
- **More objects, more types, more classes, more extremes**
(an ex. of 3C129, talk by B. Sebastian)
- **micro-Jy sensitivity continuum imaging**
(talk by Ishwara-Chandra C.H.)

U-GMRT: (U,V) COVERAGE



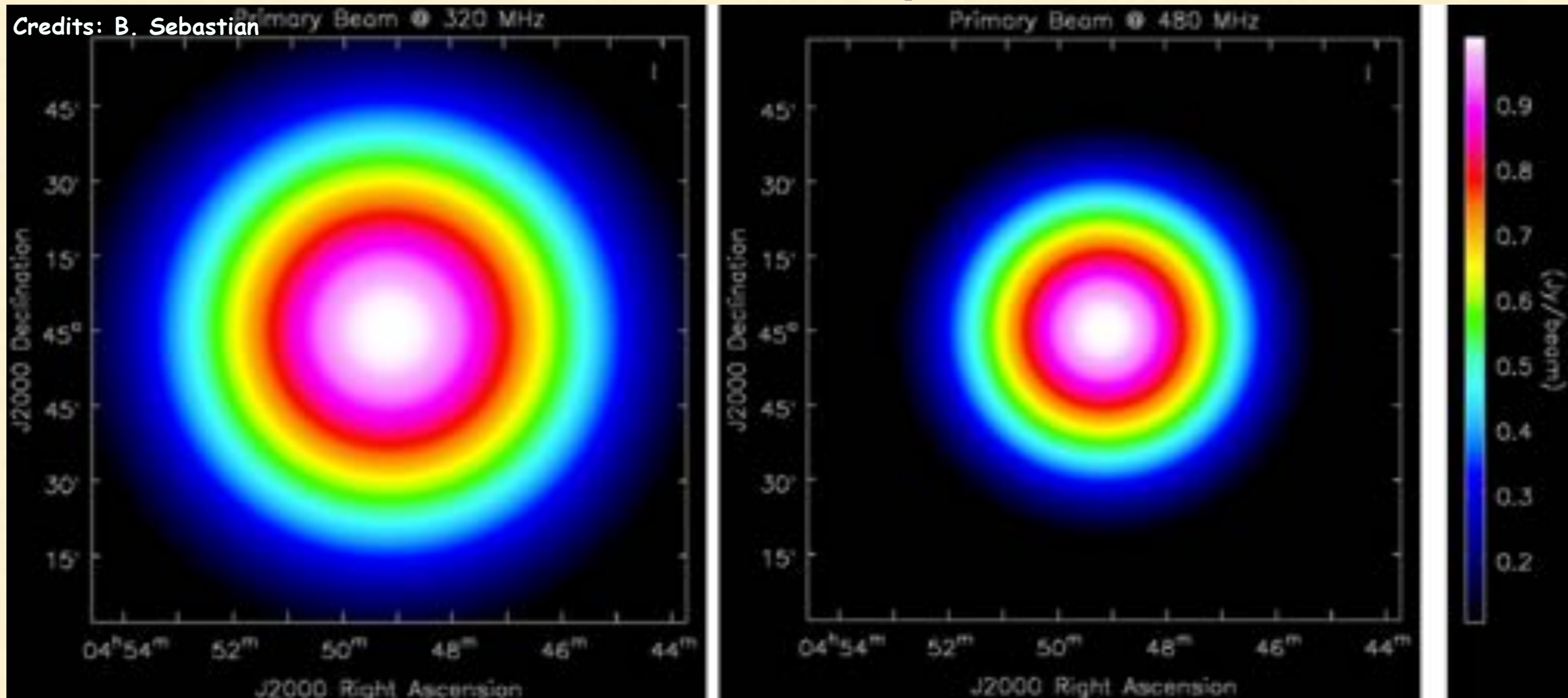
U-GMRT: WIDEBAND

- Larger bandwidth
 - better sensitivity
 - from 32 MHz to 200 MHz
 - => 2.5 times increase in sensitivity
- Increased (u,v) coverage
 - lower side-lobe levels of psf
 - => better dynamic range
- Information of spectral structure of the source.

- SPARCS 2015, I spoke re. 8-antenna U-GMRT system, today, I would add re. 16-antenna U-GMRT system.

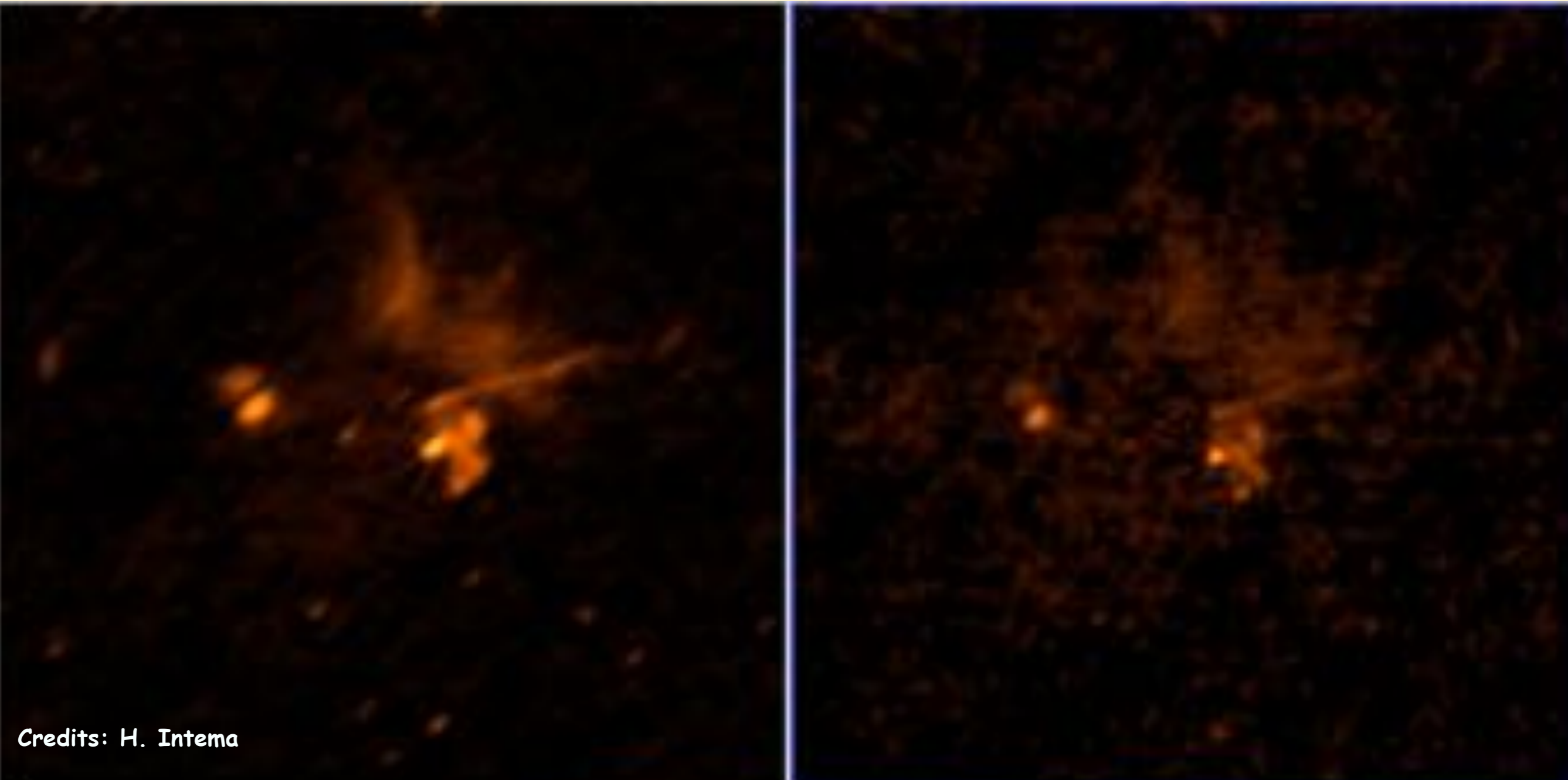
U-GMRT: CHALLENGES

- Wide field imaging, DD-calibration / A-projection
(talks by H. Intema, S. Mandal, ...)
- Primary beam and MS-MFS,
 - and several of these can only be done in CASA.



U-GMRT: DD CALIBRATION (PEELING)

- peak = 0.25 vs. 0.14 mJy/beam
- rms = 2.3 vs. 4.2 mJy/beam (34.1 arcsec vs. 21.6 arcsec)



Credits: H. Intema

U-GMRT: EXAMPLE I

3C 285

(demo science: B. Sebastian and D.V. Lal)

■ $z = 0.079$

11 antennas

2048 channels

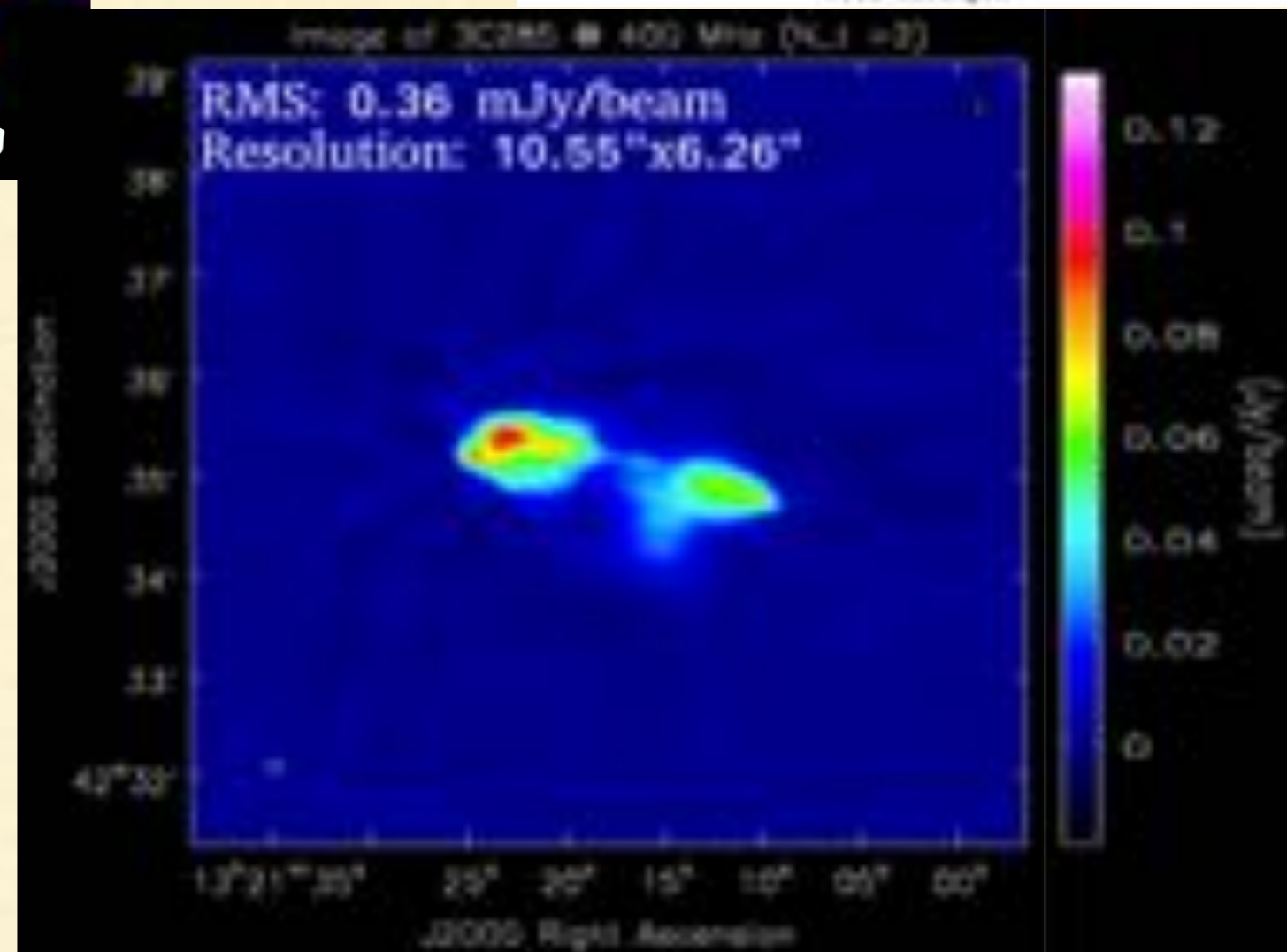
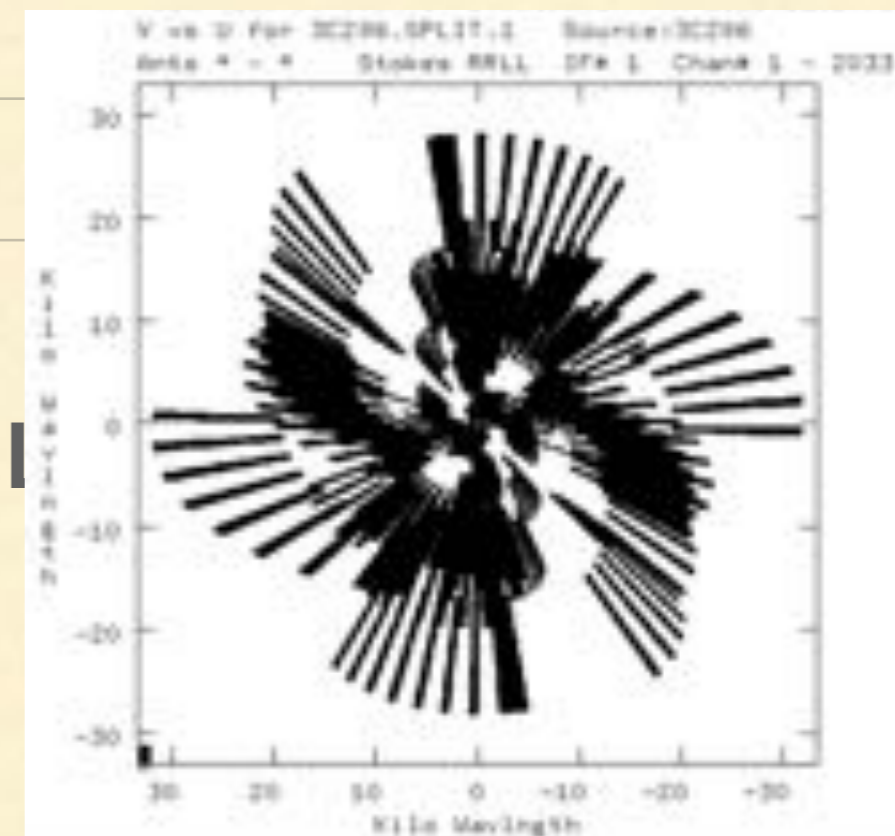
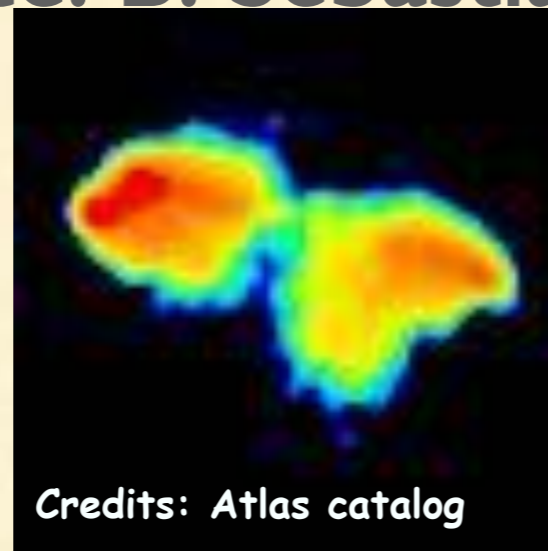
200 MHz

bandwidth

6 x 30 min

FoV 81 arcmin

RMS 0.36 mJy/beam



U-GMRT: EXAMPLE II

3C 129

(demo science: talk by B. Sebastian)

■ **$z = 0.021$**

12 antennas

2048 channels

200 MHz bandwidth

6 x 30 min

U-GMRT: EXAMPLE III

A85 (Relics / ... / dead radio plasma)

16 antennas

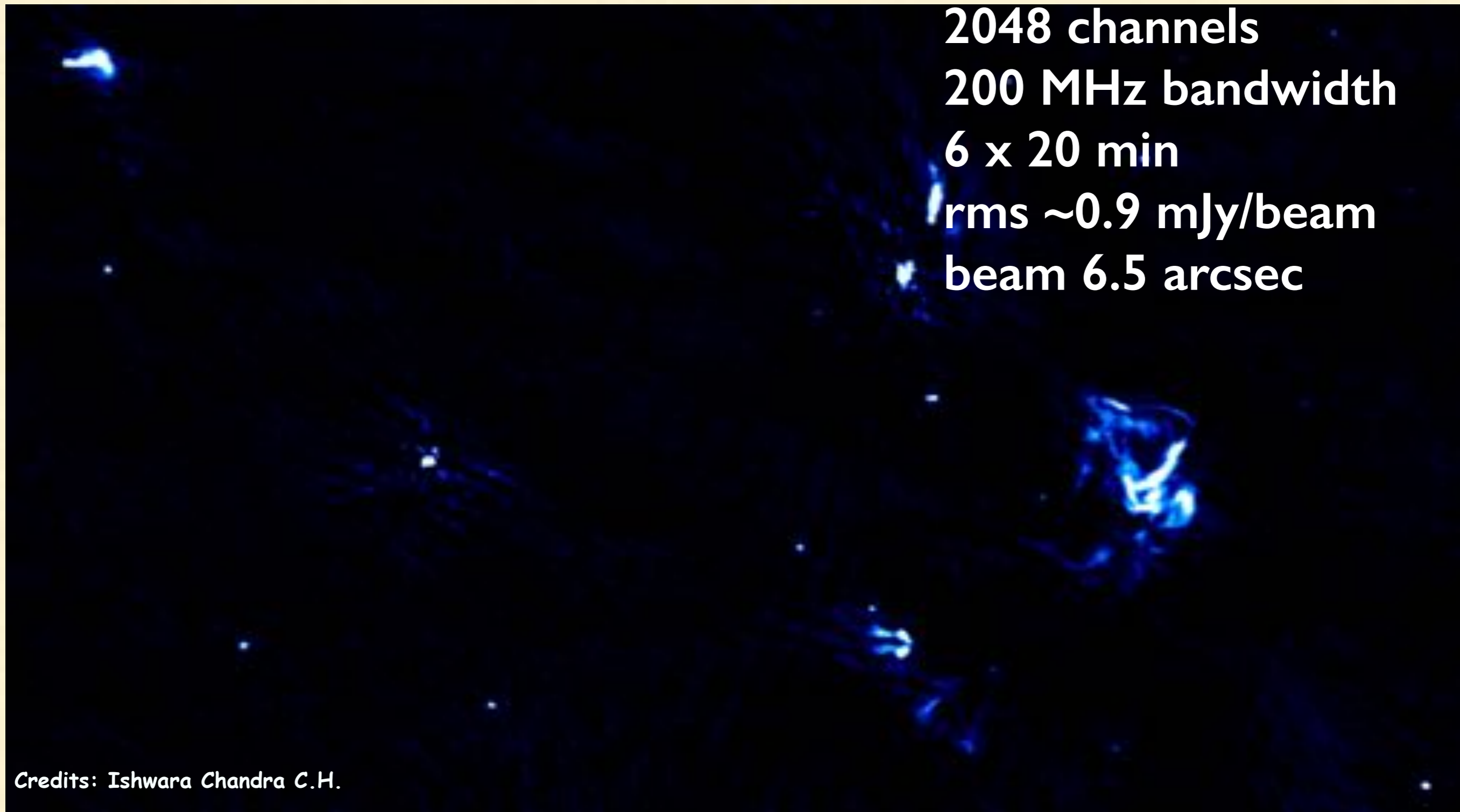
2048 channels

200 MHz bandwidth

6 x 20 min

rms ~ 0.9 mJy/beam

beam 6.5 arcsec



Credits: Ishwara Chandra C.H.

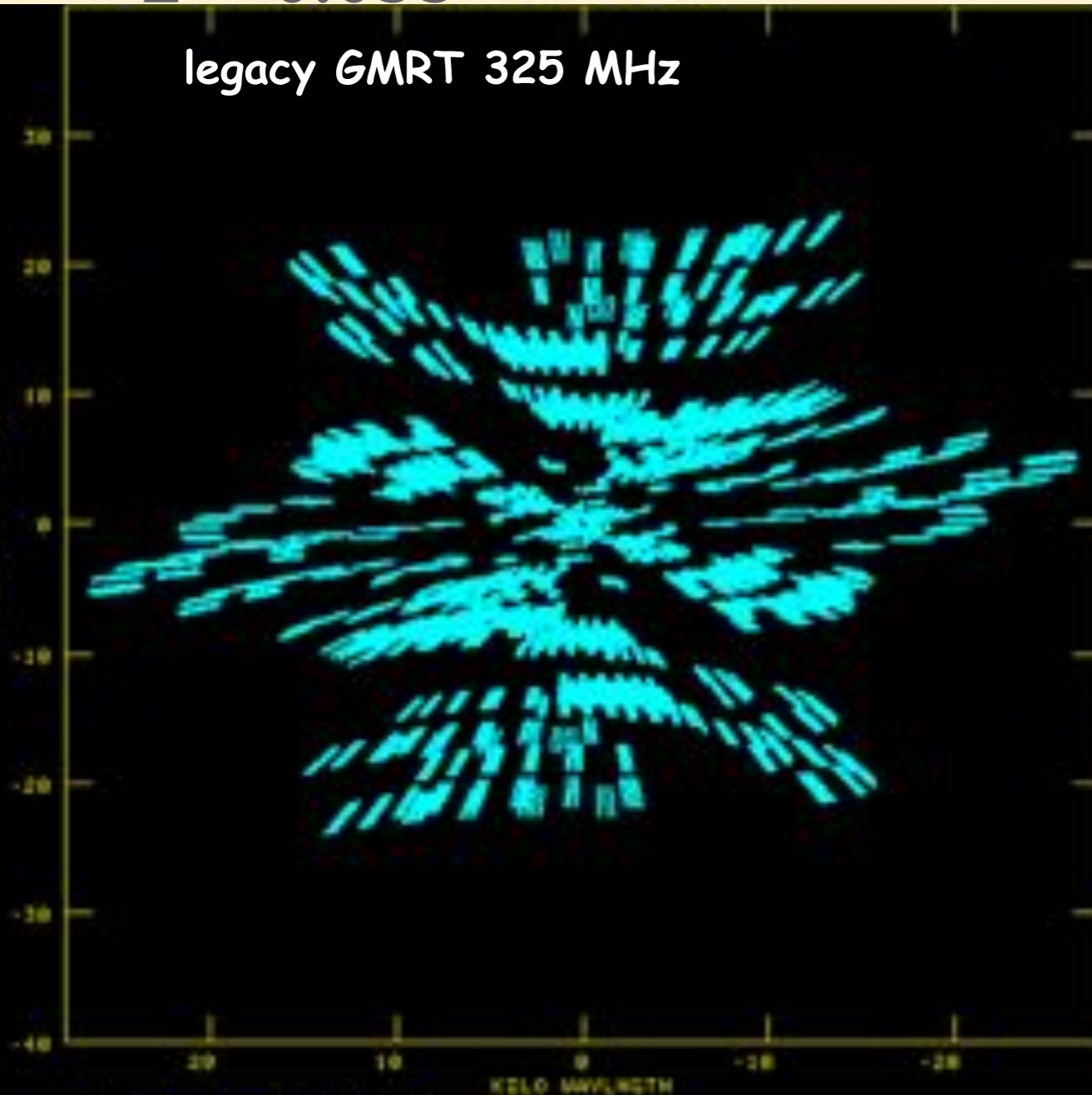
U-GMRT: EXAMPLE III

A85 (Relics / ... / dead radio plasma)

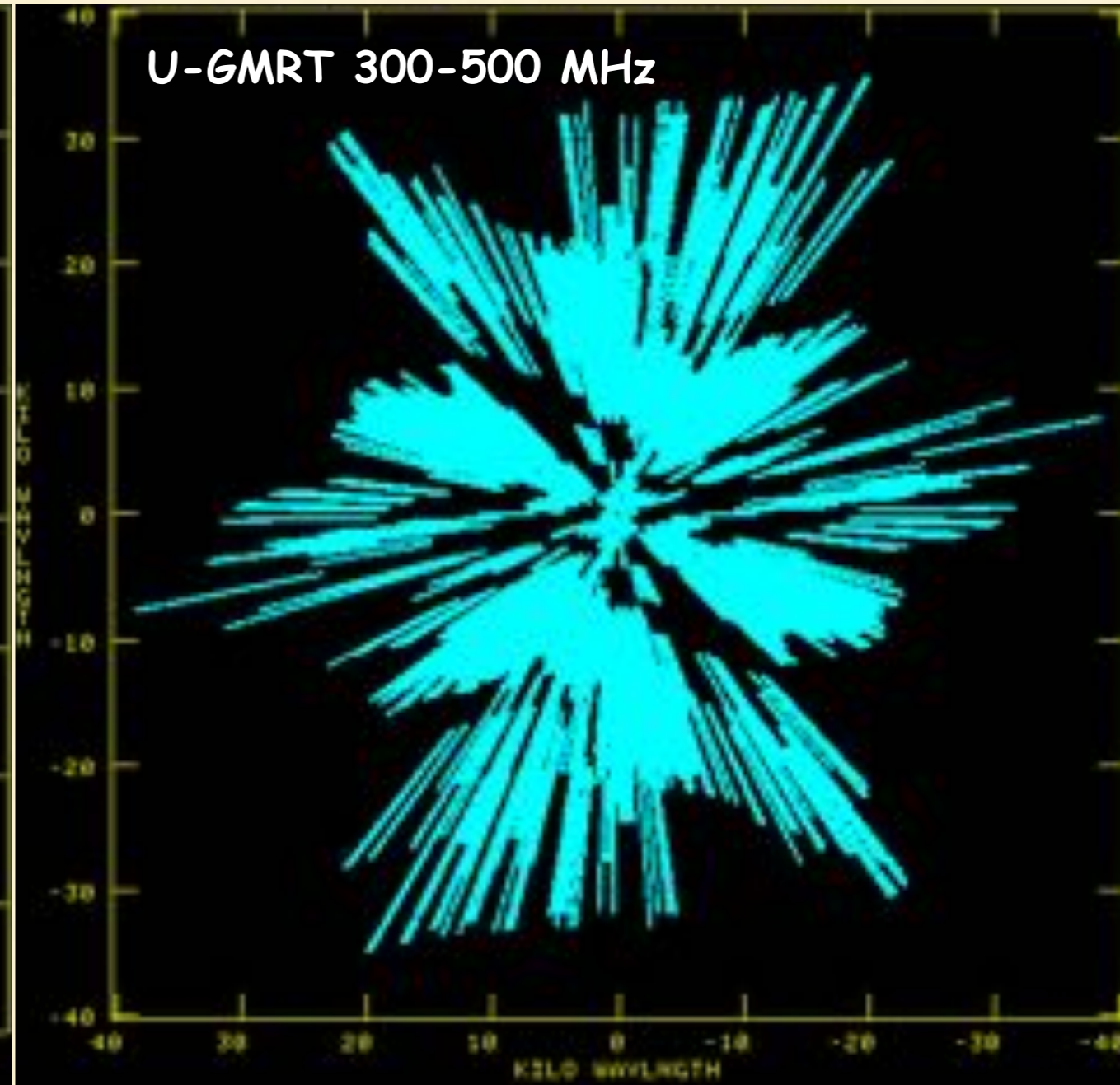
(demo science: Ishwara-Chandra C.H. and D.V. Lal)

■ $z = 0.055$

legacy GMRT 325 MHz



U-GMRT 300-500 MHz



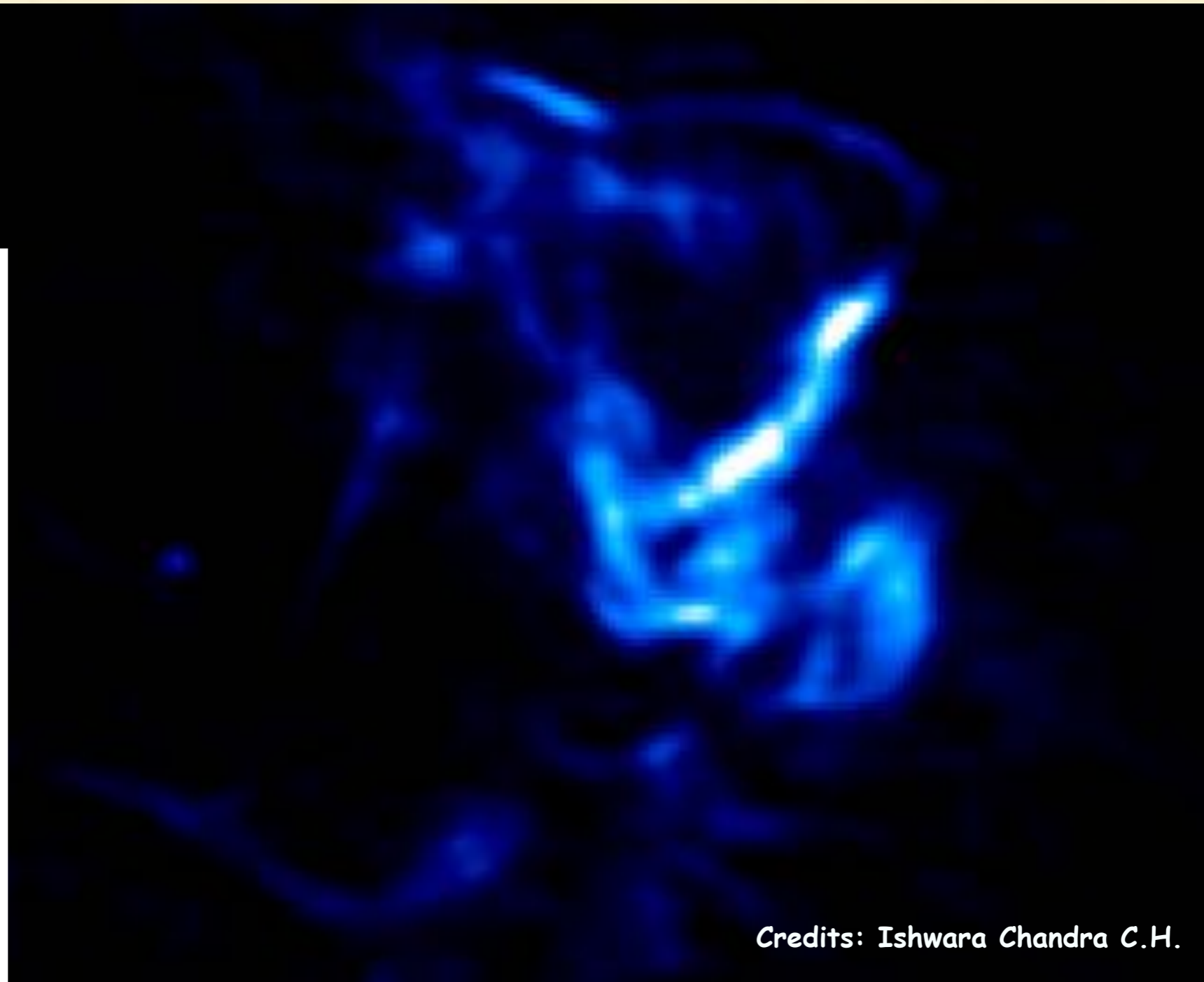
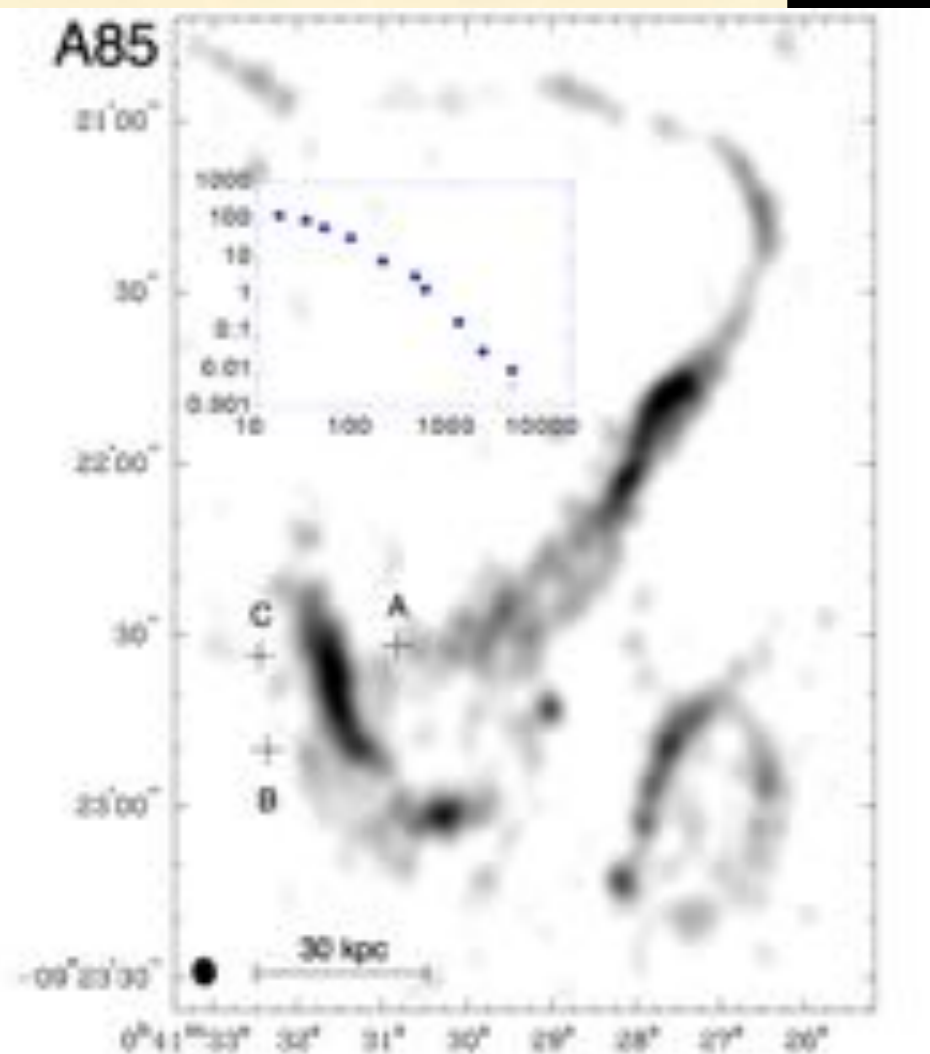
U-GMRT: EXAMPLE III

A85 (Relics / ... / dead radio plasma)

(demo science: Ishwara-Chandra C.H. and D.V. Lal)

■ $z = 0.055$

More diffuse sources
(talk by R. Kale)



U-GMRT: EXAMPLE IV

Shown here - 150 MHz

27 antennas

128 channels

14.2 MHz bandwidth

7 x 20 min

FoV 186 (177) arcmin

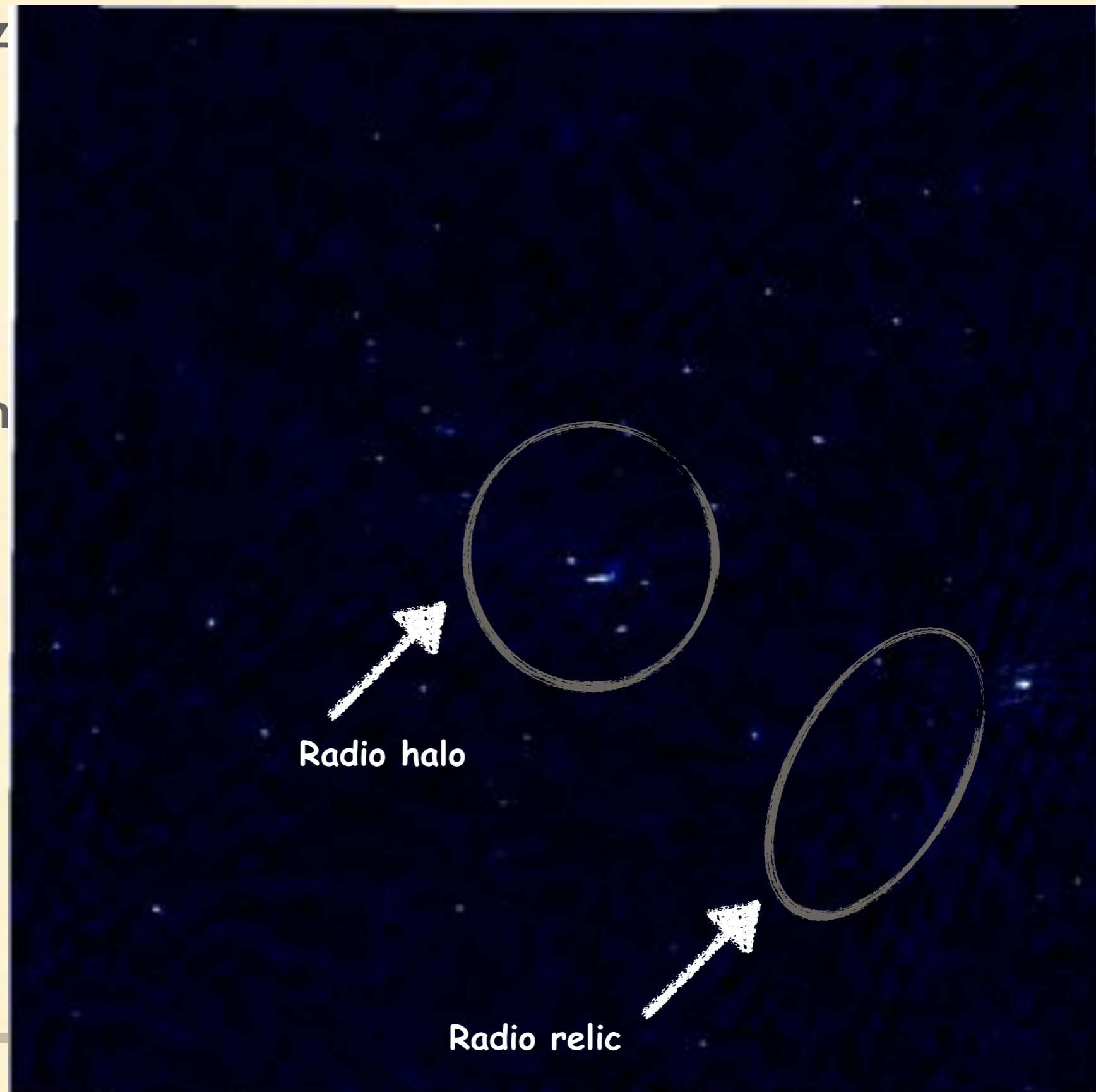
DR ~ 336

RMS noise

~10.9 mJy/beam

~21.8 arcsec beam

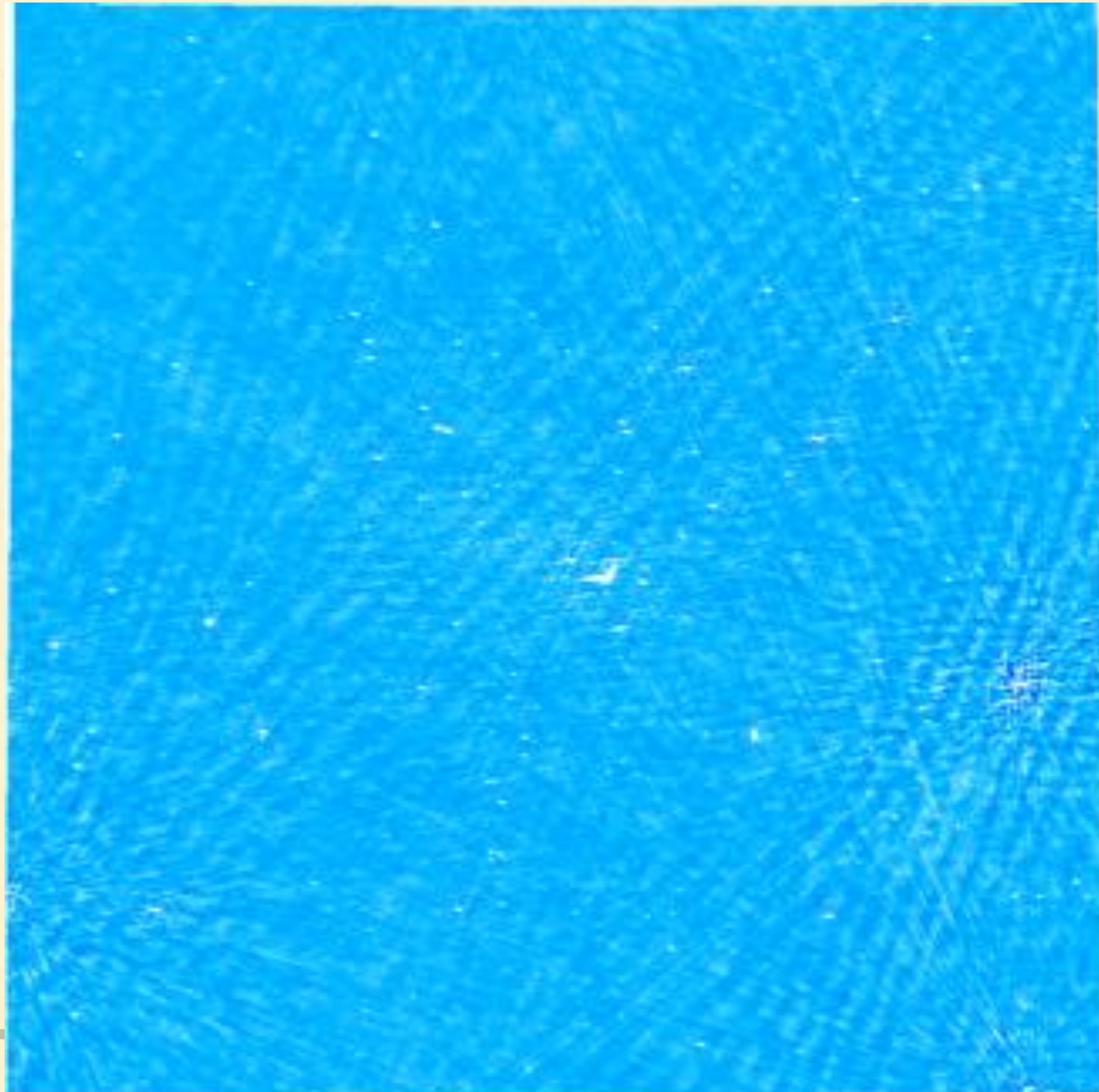
this is ~40 x thermal



U-GMRT: EXAMPLE IV

Shown here - highly saturated grey-scale image.

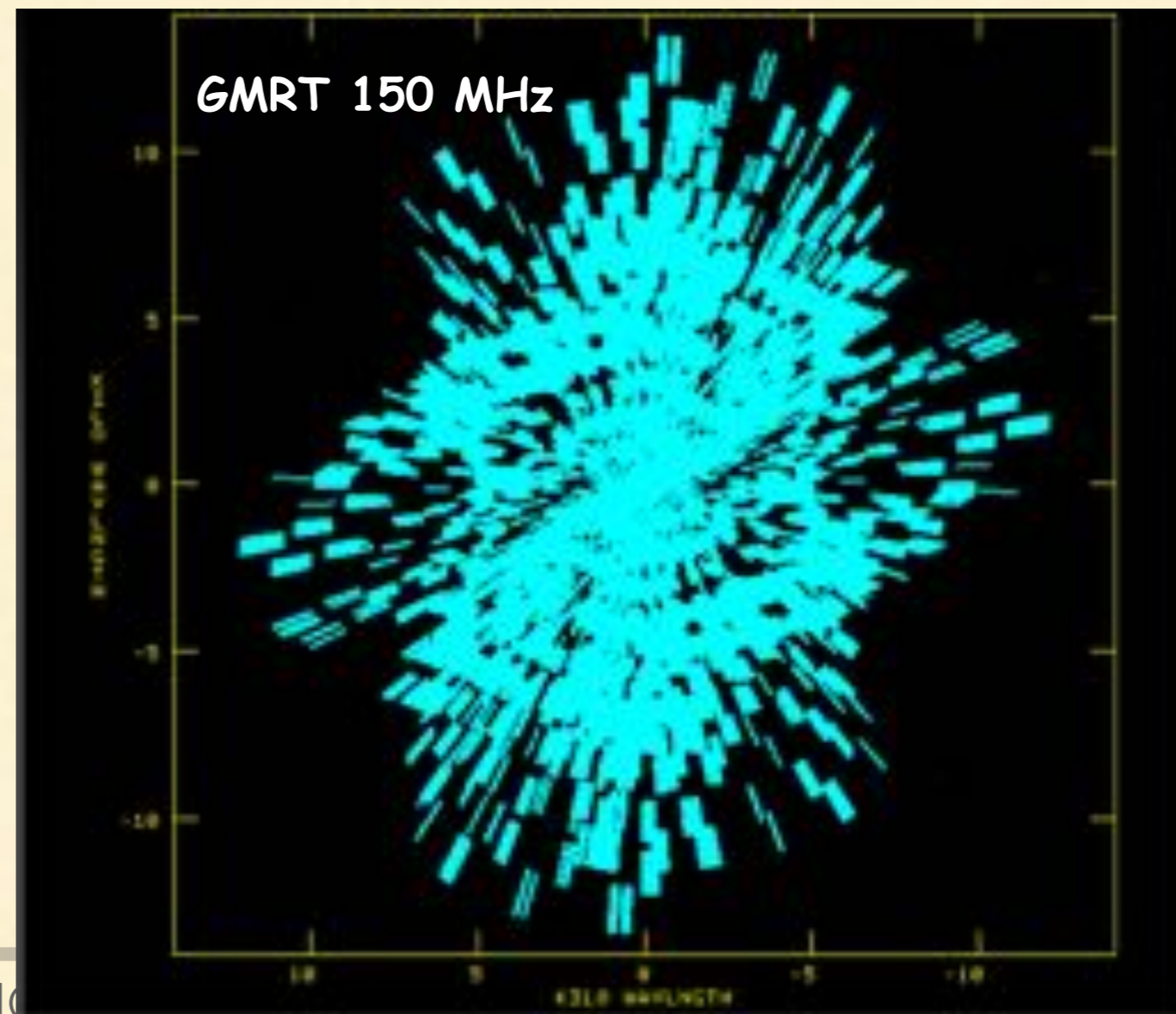
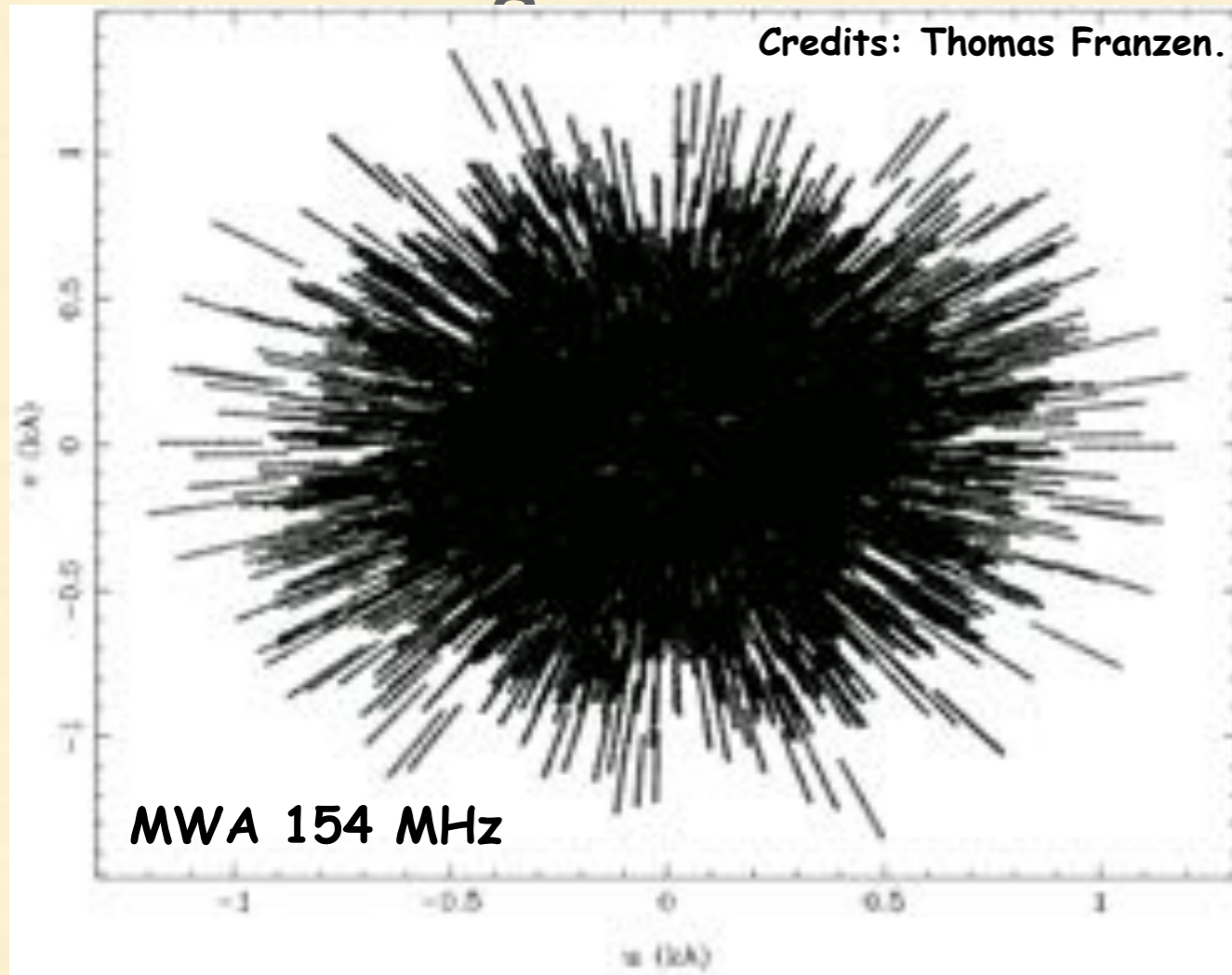
`swirls' in the error pattern suggest, imaging bright point-sources dominate the errors and these errors vary with time.



U-GMRT: EXAMPLE IV

uv-coverage

Credits: Thomas Franzen.



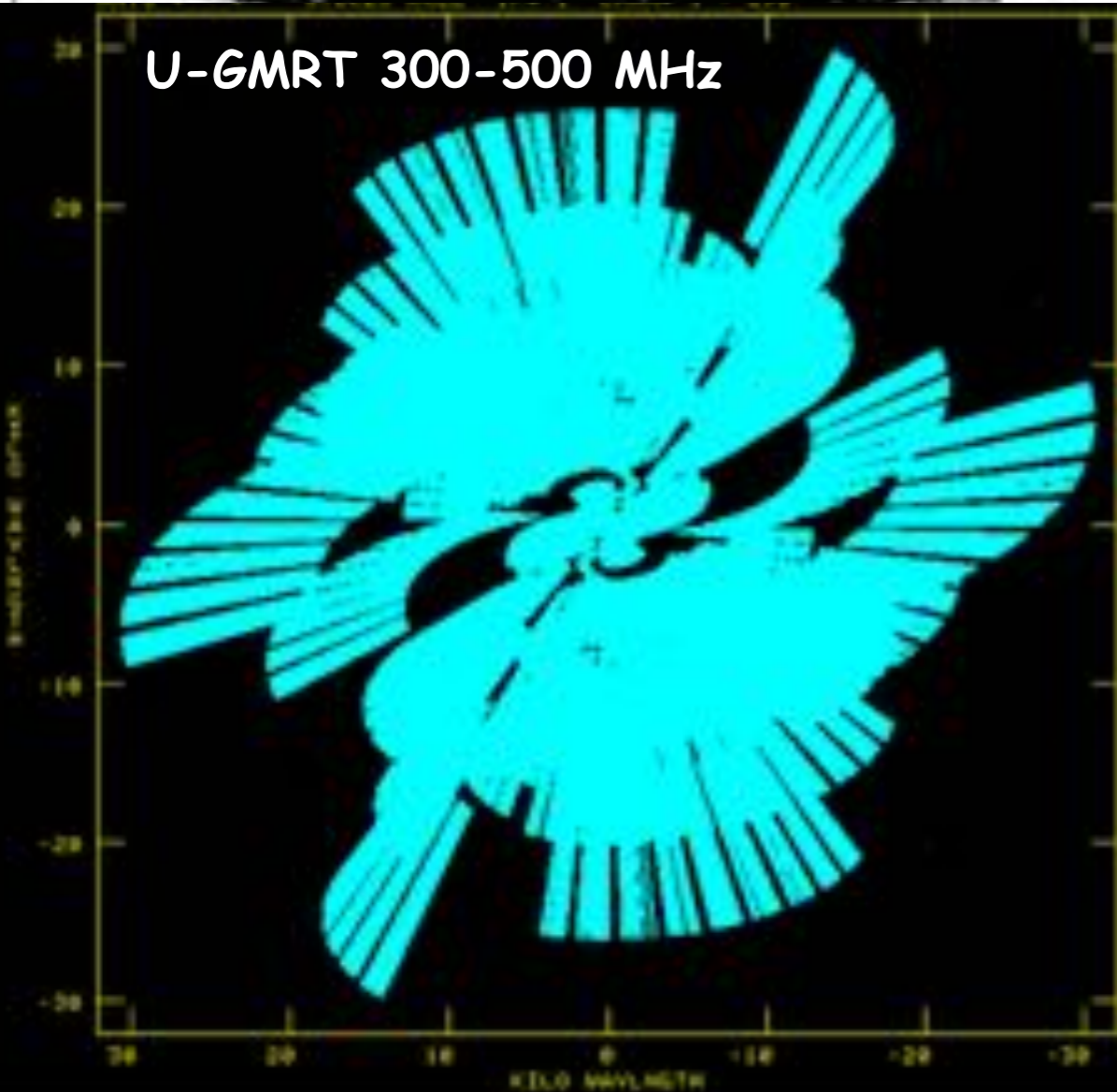
U-GMRT: EXAMPLE IV

uv-coverage

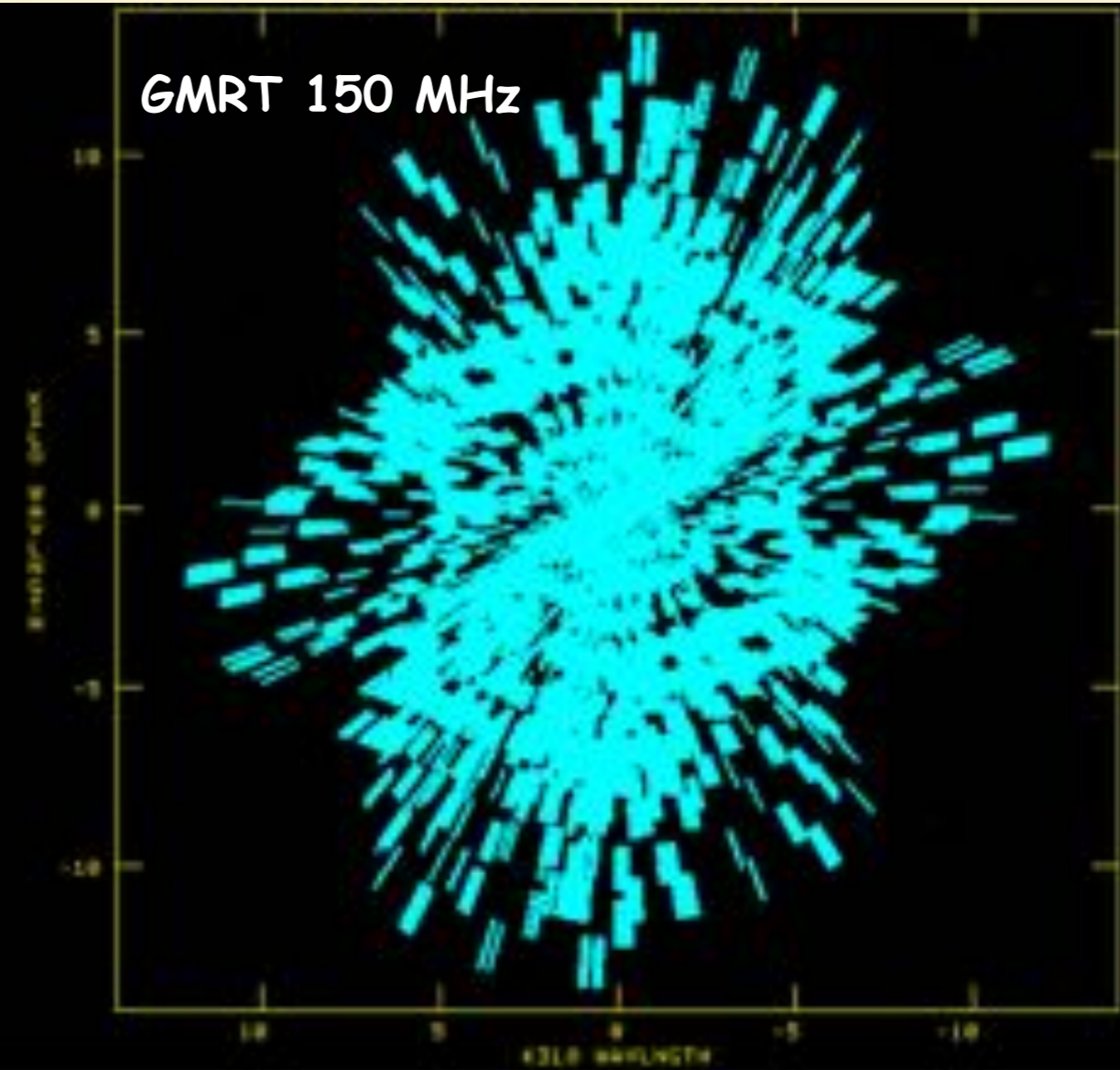
Credits: Thomas Franzen.



U-GMRT 300-500 MHz



GMRT 150 MHz



U-GMRT: EXAMPLE IV

Shown here - an early
test of **GWB**

250-500 band

synthesis on Coma

16 antennas

2048 channels

198.2 MHz

bandwidth

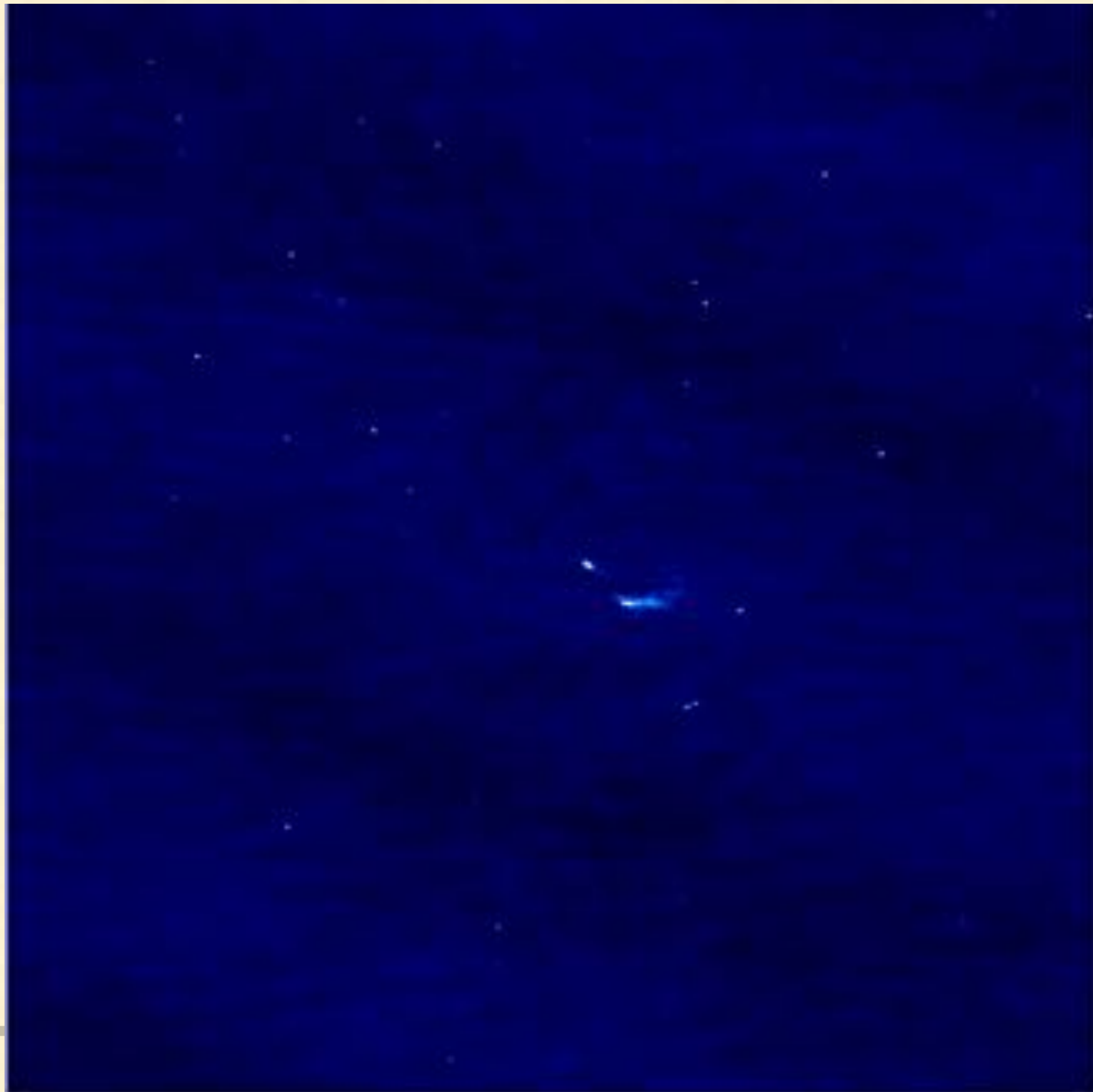
9 x 30 min

DR ~140

RMS noise

~0.7 mJy/beam

this is ~52 x thermal



U-GMRT: ENABLING CAPABILITIES

- Exploiting observational power of U-GMRT
(the scientific case for continuous frequency coverage)
 - spectral-line observations
 - pulsar observations
 - continuum observations
- Shared Risk Observing
- few restrictions, but well tested capabilities!
- scheduling - setup and supported
- Risk - we'll do everything to make observations successful but we do not support (re-observation) in case of problems/ failures.
 - Additionally observers can try certain capabilities that have not been tested, or known not to be robust.
- We request observers to be present at NCRA/GMRT to help us in commissioning.

ASTRONOMER'S WISHLIST

Imaging pipeline: A software element, which takes the visibilities, and processes them into final images or spectra or image cubes.

- flagcal (Prasad & Chengalur).

It includes data editing, flagging, calibration (bandpass, flux density scale, complex gain as a function of time, etc.).

It does not include imaging, including self-cal.

- Similar effort for the U-GMRT data on __ timescale.

Clear artefacts, 'swirls' associated with bright point sources
(‘DD’ / A-projection errors)

- AIPS CASA transfer issue
- MS-MFS imaging
- antenna pointing errors
- atmosphere phase gradients

SUMMARY

- **U-GMRT is an imaging instrument, which supports**
 - **Pulsar modes**
 - **several spectral modes**
- **Construction phase is in full swing**
 - **and science observing with the new capabilities is now in place.**
- **New and exciting results are being thought - with topics across several fields.**

U-GMRT is a much improved instrument over the existing GMRT.