

# Early Science Results From uGMRT

A radio image of a celestial source, likely a galaxy or nebula, showing a bright, curved structure. A white rectangular box highlights a specific region on the right side of the image.

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*Special thanks to Dharam and staff at GMRT*

# **Plan of the talk**

**Current status of uGMRT**

**Imaging results from 30 antenna uGMRT system**

**Single fields**

**Mosaic (of seven pointing)**

**Lessons learnt in using standard packages**

**Challenges ahead**

# **uGMRI – status as on today**

**Band 3 (250 – 500 MHz) and Band 5 (1000 to 1450 MHz) in all antennas since last year**

**Band 4 (550 – 850 MHz) 20 antennas done, expected by early 2018**

**Band 2 (120 – 240 MHz) – 9 antennas done, expected by early 2019.**

**30 antenna correlator with 100/200/400 MHz bandwidth and upto 16K channels operational since January 2017**

**Polarization capability**

# Observing with uGMRT...

The RF comes directly to CEB; only one LO to down convert  
To avoid aliasing, LO should be in one edge of the band

Correlator modes = 400/200/100 MHz (and spectral zoom modes)

Number of channels = 16K/8K/4K/2K

Integration time = 0.6s and up (4s/8s/10s – beware of data size!)

File size – ~ 35 GB/hour with 4K channels and 4s integration

Improved UV-Coverage due to wide bandwidth

# Observing with uGMRT - standard analysis

Wide-band imaging issues

Flux scale needs spectral index information across band

Primary beam varies from one end of band to other end

*(source at HPBW at lower end may fall into NULL at high end)*

Multi-frequency synthesis (MFS) algorithm required

Wideband □ more RFI?

Automated flagging software required

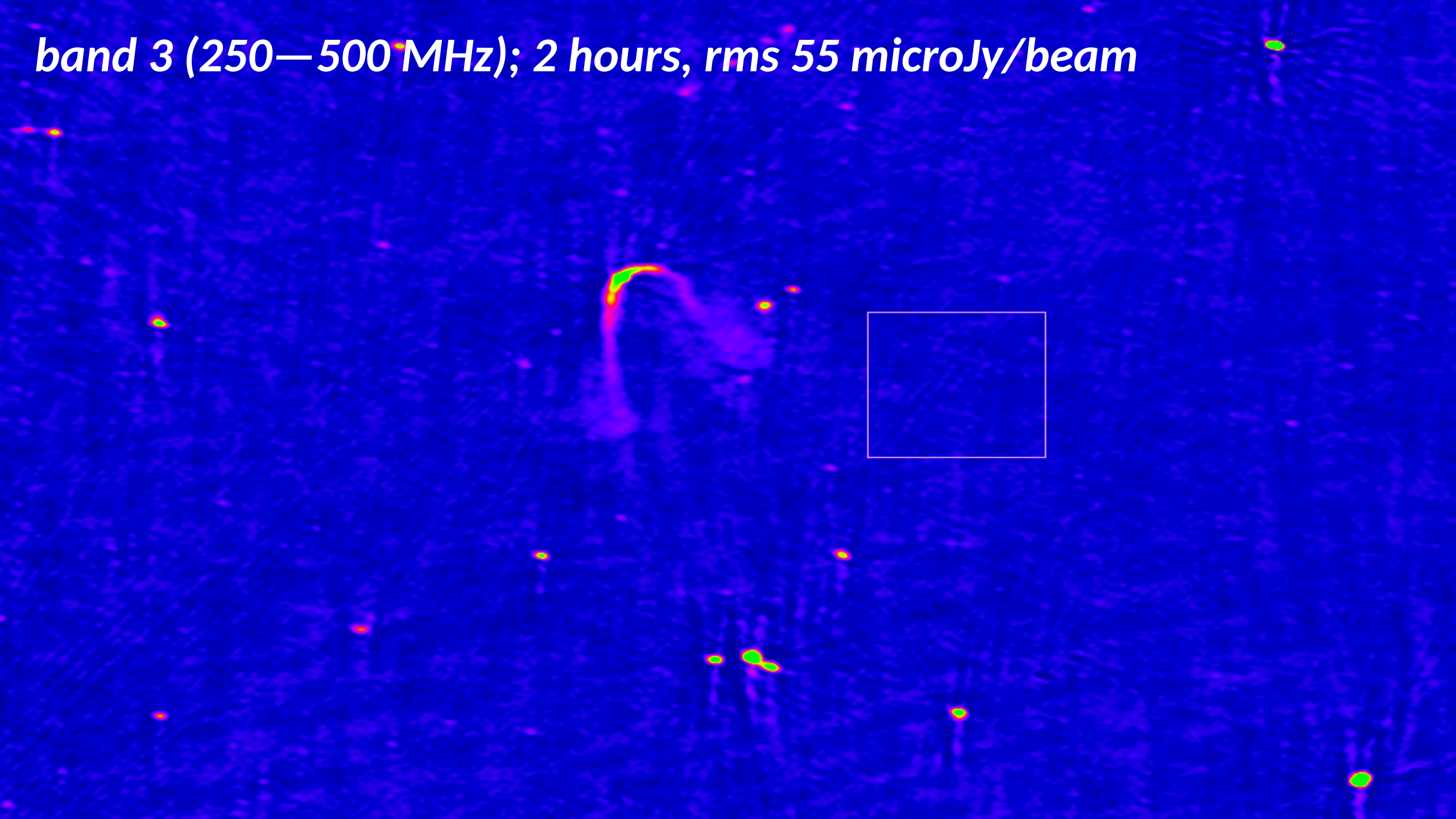
Options in hand - CASA (flagdata)

- AOFlagger
- AIPS (FLGIT)

CASA and WSClean can handle wide-band wide-field data

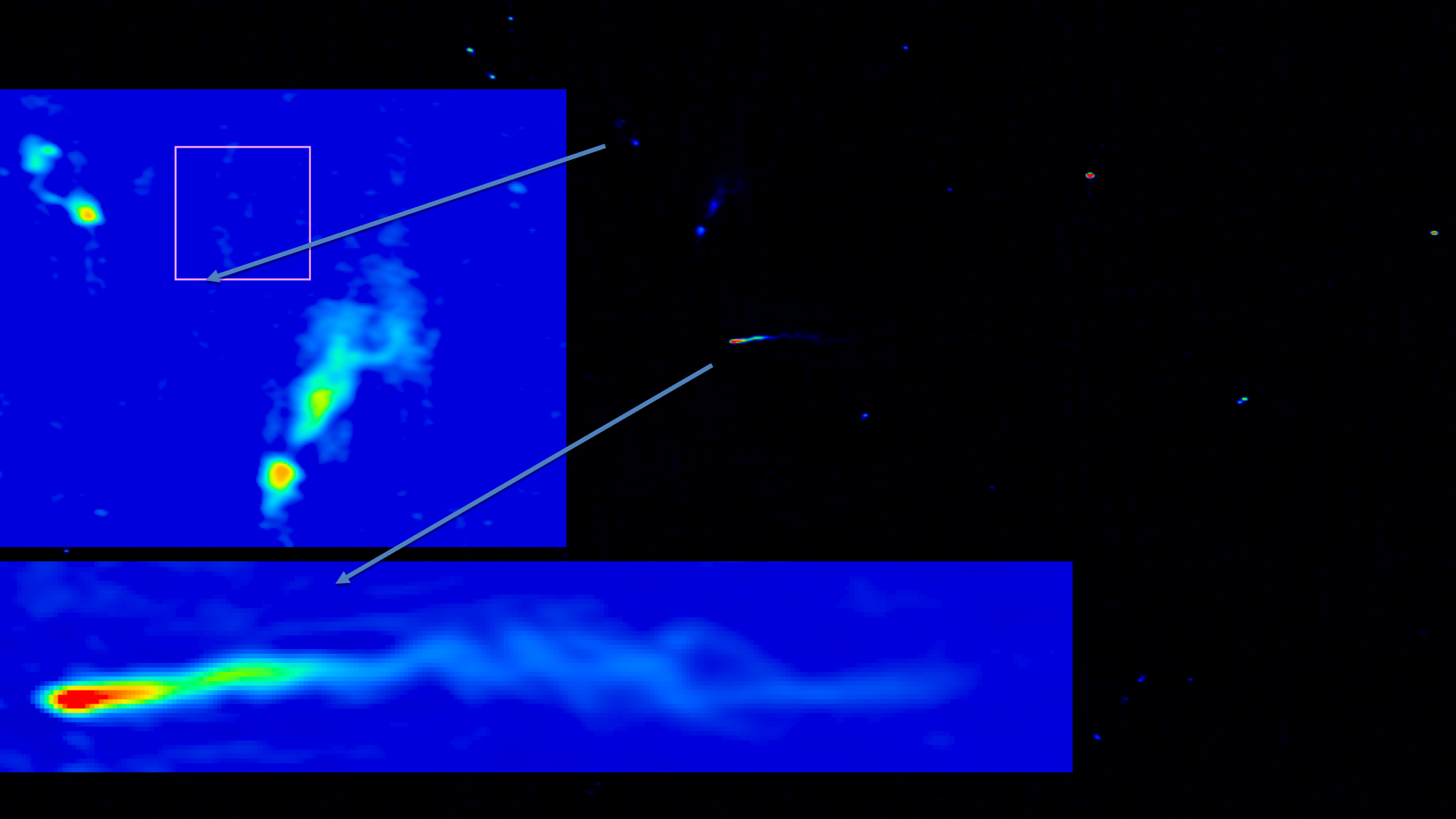


*band 3 (250—500 MHz); 2 hours, rms 55 microJy/beam*



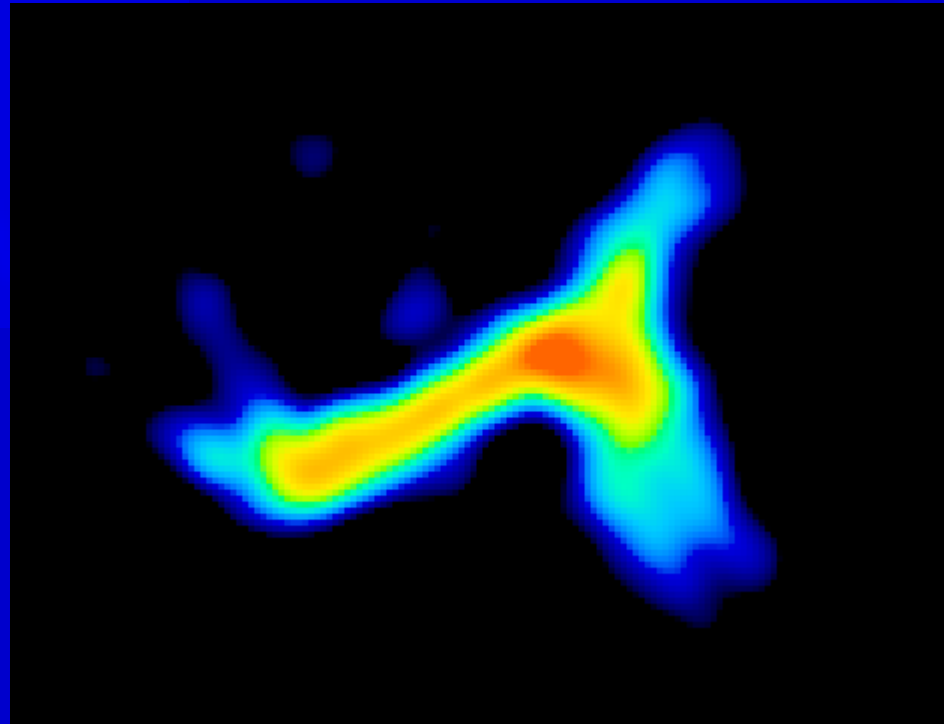
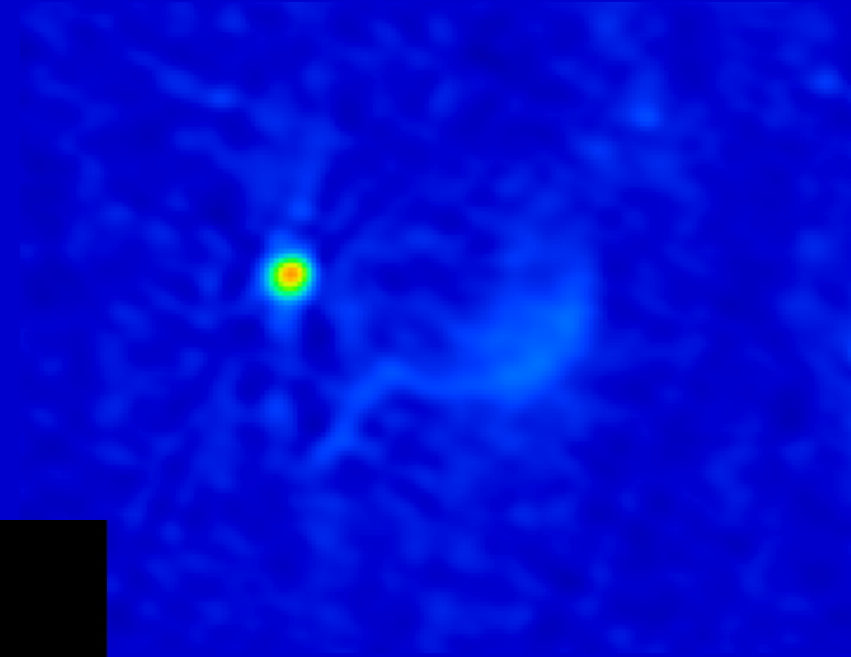
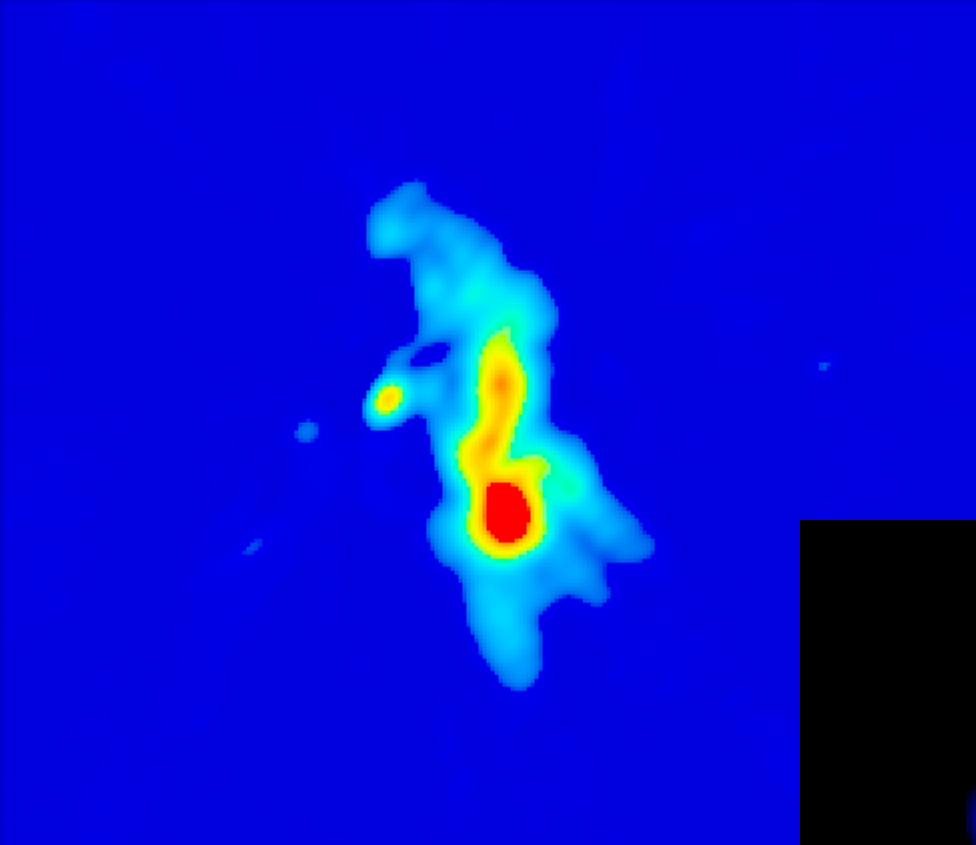


***band 3 (250—500 MHz); 2 hours; rms ~ 75 microJy/beam;  
resolution: 10"X6"***



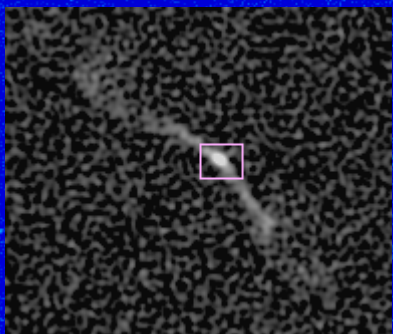


Some peculiar shaped source...





**ELAIS-N1; band 5 (1050-1450 MHz); 2 hrs; rms ~ 12  
microJy/bm; 1.5X thermal, 2"**



**7 pointing mosaic**



**uGMRT – Wide-band, wide area imaging, including mosaicking is working and is in regular use!**

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***Present status:***

- ***close to thermal noise at L-band;***
- ***a few times thermal noise at band 3 (250 - 500 MHz)***
- ***some artefacts near very bright sources***



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***We are working on improvements (pipeline, wide-band primary beam, pre-correlation RFI excision, direction dependent phase calibration, etc) with collaborators...***

# The Challenges ahead

Which package to use? AIPS, CASA, WSClean

- *A combination of more than one may be required*

RFI Flagging – AOFlagger, Flaggers in CASA, Miriad, AIPS...?

- *Higher #of channels and shorter integration may help*
- *RFI excision before correlation*

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- *on the fly wideband primary beam during imaging*
  - *mosaicking in UV domain for multi-pointing*
- *A-Projection*
  - *direction dependent phase calibration*
  - *low frequency wide-band polarization calibration*

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User friendly imaging pipeline with all of the above and source extractor – ultimate goal!



# ***Conclusions***

**Wide-band, wide-field imaging of single fields and mosaic, successfully demonstrated using uGMRT.**

**Imaging using CASA seems to be best bet now, WSClean also OK  
Calibration and flagging needs more refinement**

**A-Projection and primary beam modelling required to improve the dynamic range and image fidelity.**

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***Thank you!***

