



THE BIRTH OF QUASARS

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OBSERVATORY

Outline

- Introduction
 - Scientific background
 - Model
- Data
 - Observations
 - Calibration example
 - Nature of the data
- Results
- Future work

Scientific Background

- Active galactic nuclei (AGNs) influence the formation and evolution of galaxies, stars, gas, and dust
- Galactic-scale gravitational interactions trigger AGNs
- Study emergent AGNs:
 - ▣ How do radio jets interact with ISM?
 - ▣ How do interactions quench star formation and clear out dust and gas (feedback)?
- High resolution radio studies are key

Observed AGN Sample

- Taken from the Wide-field Infrared Survey Explorer (WISE) catalog
 - ▣ 500 million total objects
- Extremely red WISE colors
- Radio-loud (AGN)
- Extremely luminous
- 156 objects for detailed study
- Obtained data for only 90 of these for the study



Model

Relativistic AGN jet
in clumpy ISM

(Wagner & Bicknell,
2011)



Imaging Antenna Arrays

VLBA



VLA

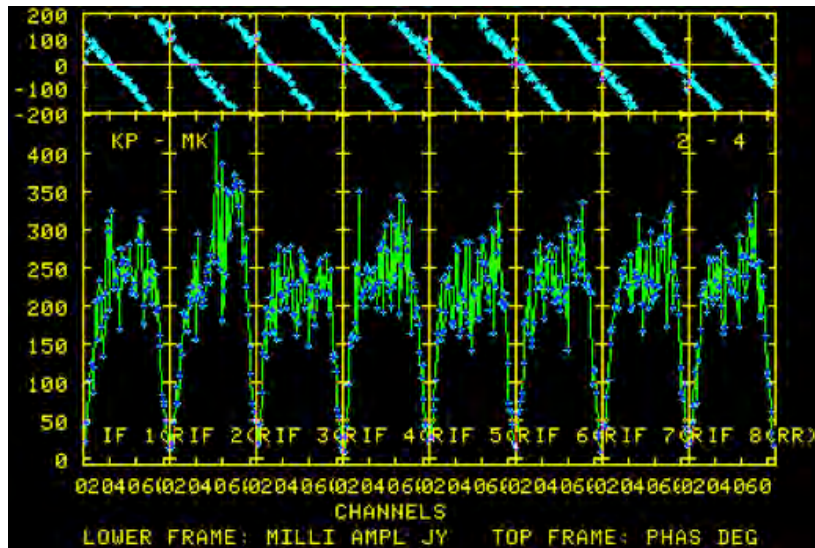


VLBA Observations

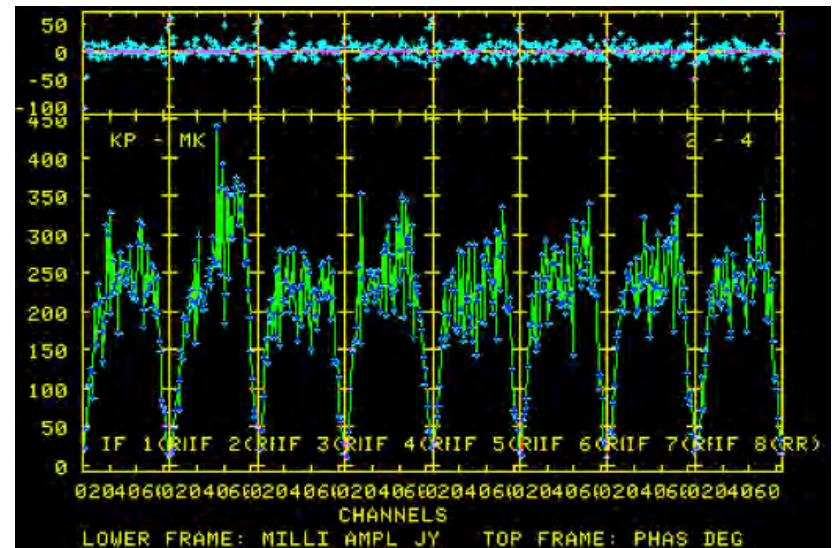
- 90 targets, 90 phase-reference calibrators
- 48 hours total observing time, 4.8 GHz
 - ▣ 3-15 minutes of on-source integration
 - ▣ Significant instrumental problems, data loss
 - ▣ Phase-referencing mode
- 1-2 mas angular resolution, 50 μ Jy sensitivity
- Amplitude calibration, instrumental correction, fringe fitting, phase transfer, self calibration, deconvolution

Example: Fringe Fitting

Before fringe fit



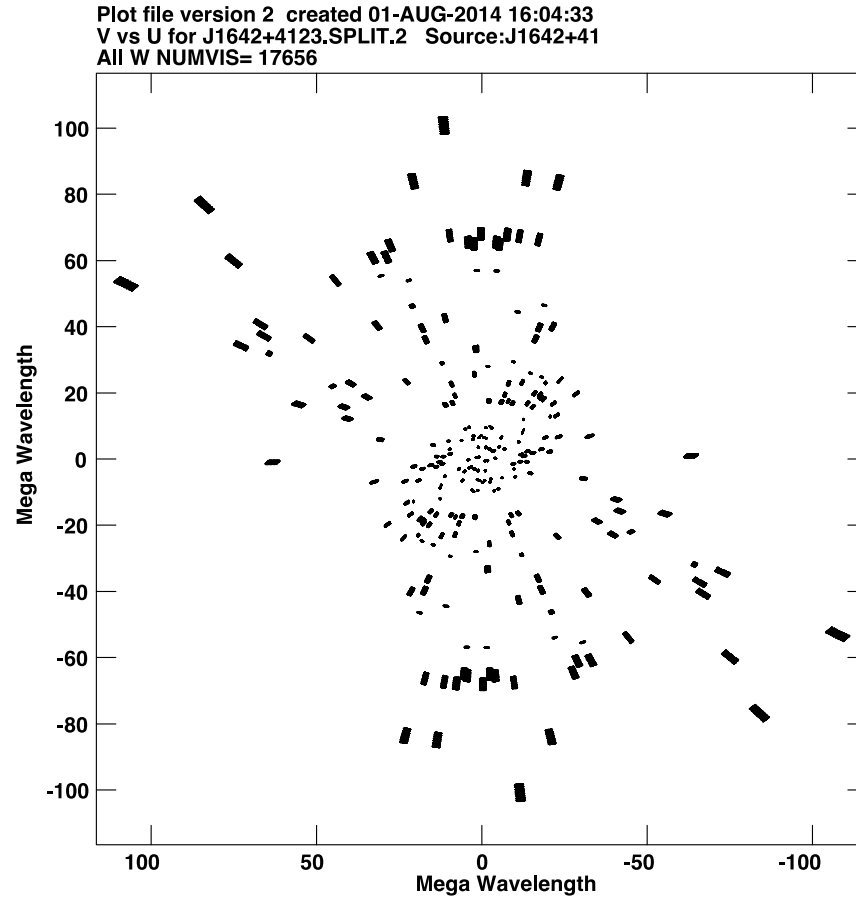
After fringe fit



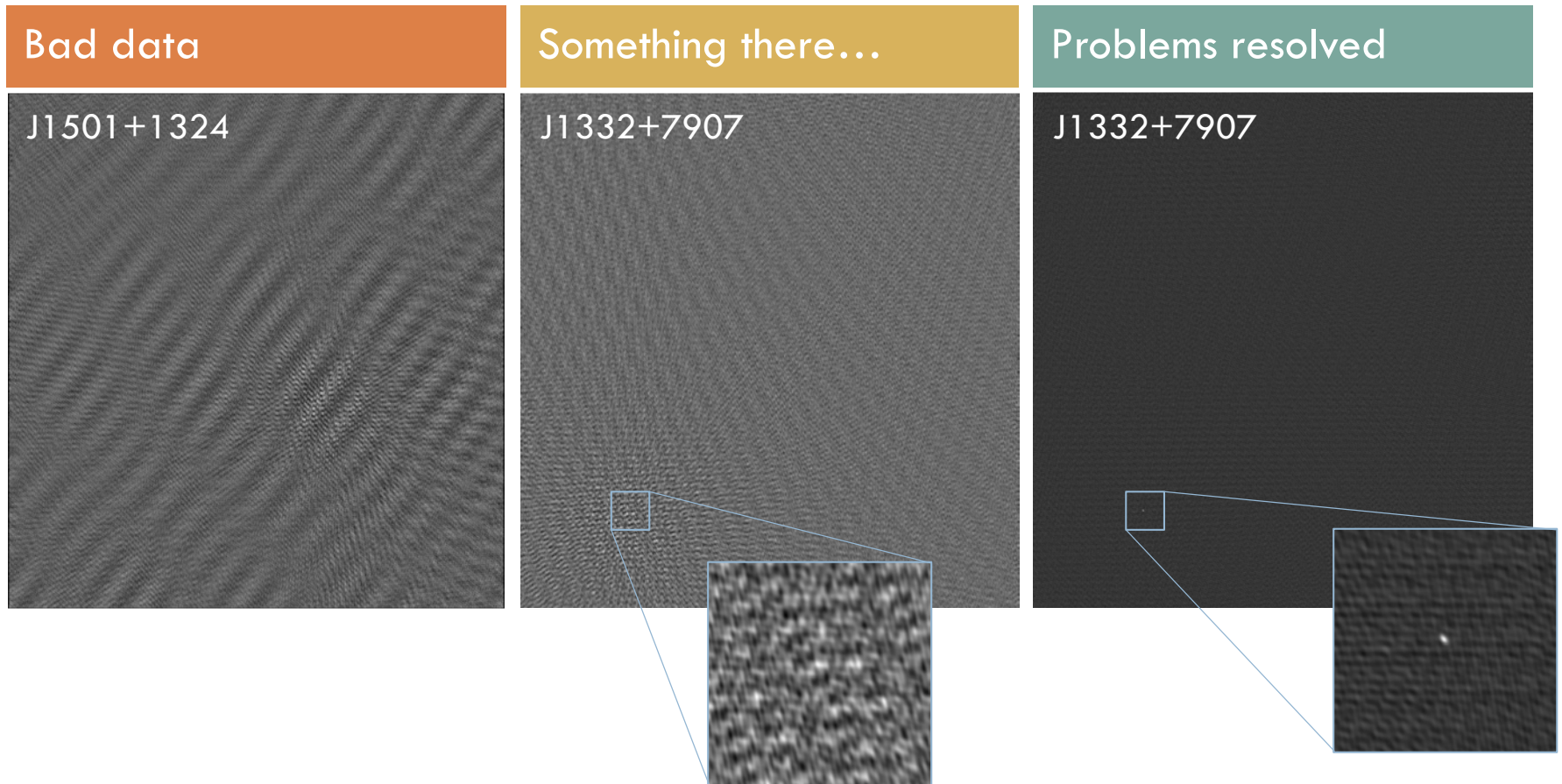
Must be able to average the data over both frequency and time without loss of coherence. If phase slopes are non-negligible, averaging data will null the signals.

Data: UV Coverage

Not ideal coverage, but suitable for now...



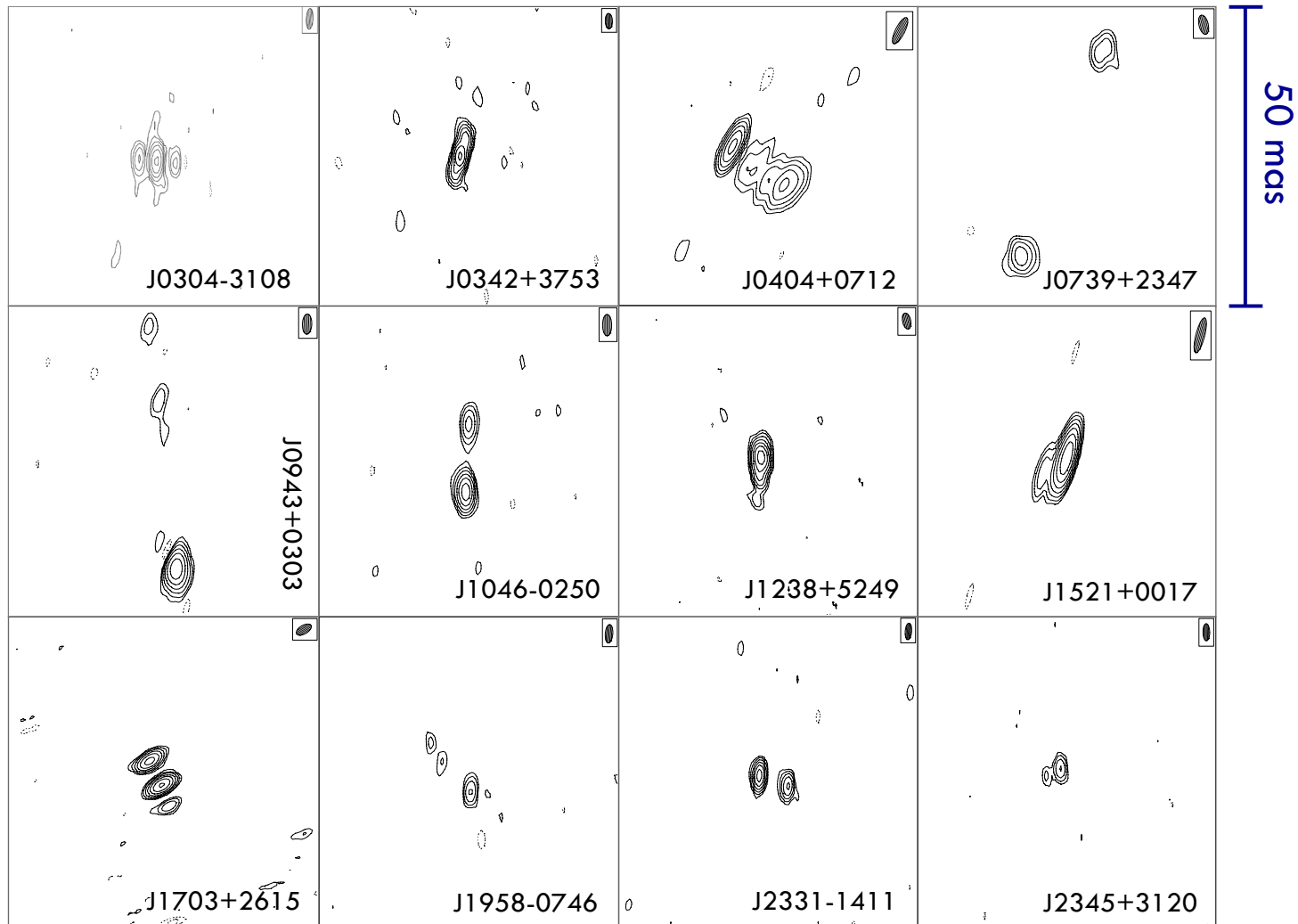
Data: Good or Bad?



Results

- 62/90 sources successfully imaged
- Peak brightness ranges from 0.3 to 70 mJy/beam
- Wide variety of structures observed
 - ▣ Point sources
 - ▣ Resolved single components
 - ▣ Double sources
 - ▣ Core-jets, and multi-component sources
- ~25 sources appear to be resolved out

Selected Results → New VLBA Proposal



VLA Data

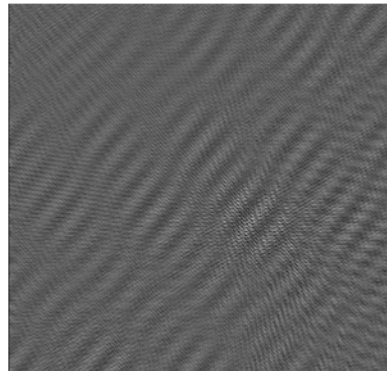
- X-band A-array data (8 GHz) \longrightarrow 0.25''
- Sources are unresolved
- Go to K_{α} -band (30-40 GHz) \longrightarrow 0.06''
- Reduced data for 1 source: 60 GB, 1 hour observing time
- CASA is slow ☹️

Future Work

- More VLA K-band imaging
- In-depth VLBA studies of subsample
 - ▣ Multi-frequency, polarimetry
 - ▣ 12 sources with complex structure
- MERLIN imaging
- Goal is comprehensive radio imagery across a broad range of size scales

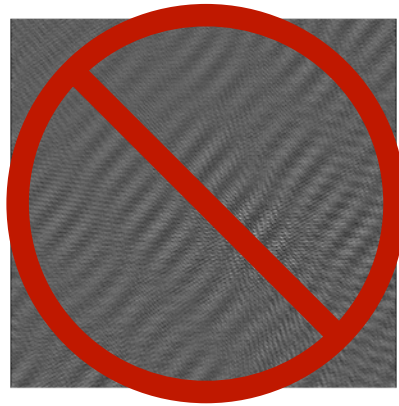
Summary

- AGNs affect almost all large-scale structures in the universe
- Properties of young radio jets in luminous quasars are still greatly unknown
- We've seen evidence of resolved structures that agree with previous models
- Time to get some better data:



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