

## Image Error Analysis

- Fourier-domain analysis of errors.
  - 2-D Fourier transform concepts
  - Examples of errors in UV-plane and image plane.
- Some common ATCA image errors.

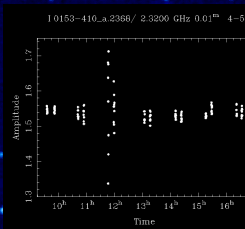
## Fourier-domain Analysis

- Errors occur in the visibility (uv) domain.
- These errors are Fourier transformed into the image.

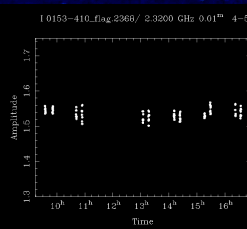


## Bad Scan - Visibilities:

Unflagged:



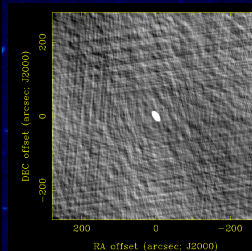
Flagged:



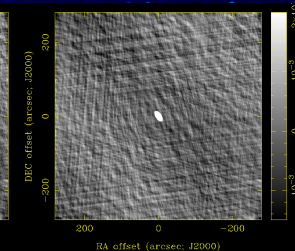
Only two scans on 1/15 baselines affected.

## Bad Scan - Images:

Unflagged:



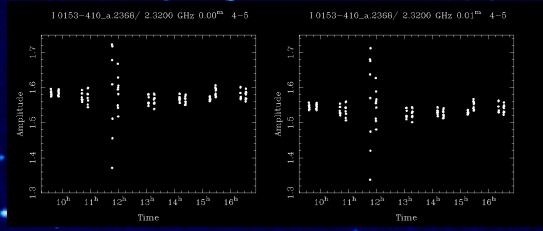
Flagged:



## Bad Gain - Visibilities:

2.5% Gain error:

Properly Calibrated:

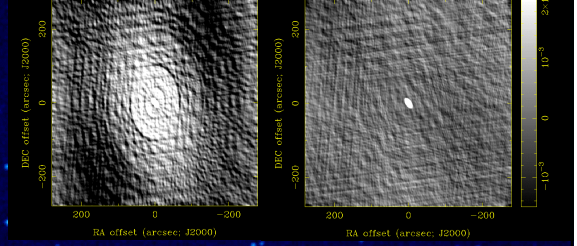


Gain error affects all visibilities on 5/15 baselines

## Bad Gain - Visibilities:

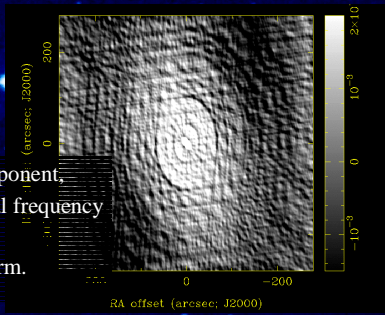
2.5% Gain error:

Properly Calibrated:

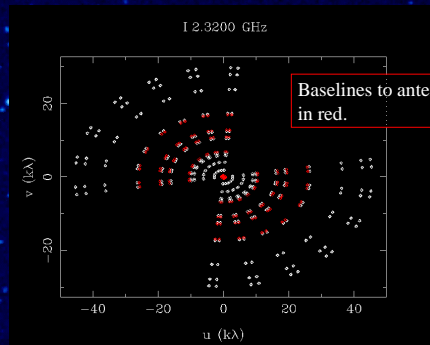


## Does this make sense!?

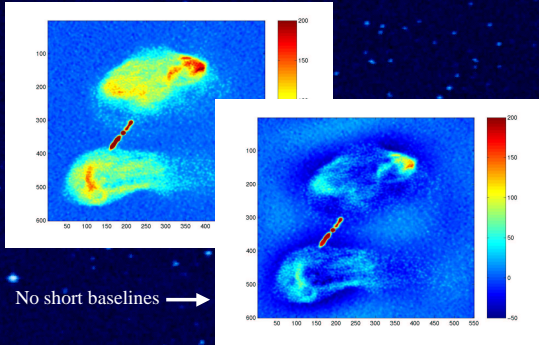
- Broad component,
- High spatial frequency structure,
- Circular form.



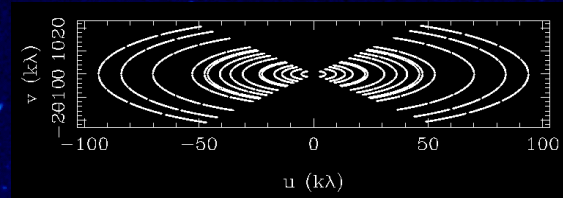
## UV Distribution of Errors



### Effect of missing short baselines



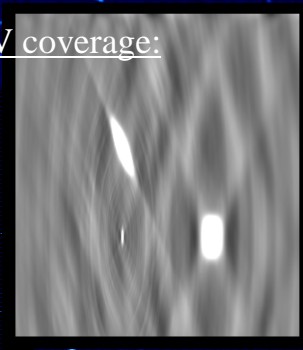
### Inadequate UV Coverage:



- ATCA:
  - No gain/phase errors.
  - 8 hours
  - Declination  $-15^\circ$

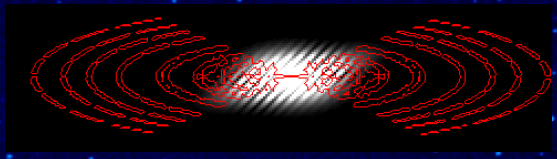
### Inadequate UV coverage:

- CLEAN
  - 3 clean boxes
  - 1000 iterations
- MAXEN
  - 3 boxes
  - 30 iterations

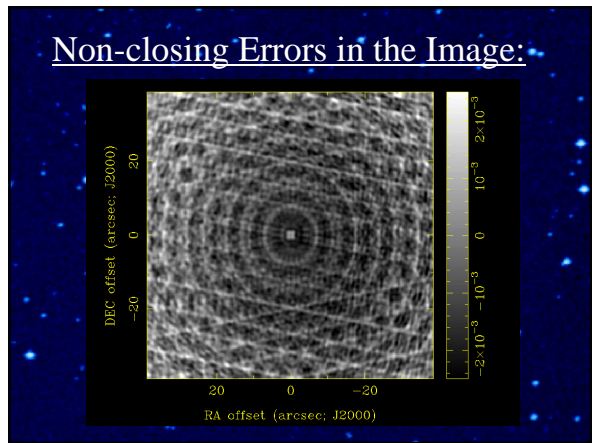
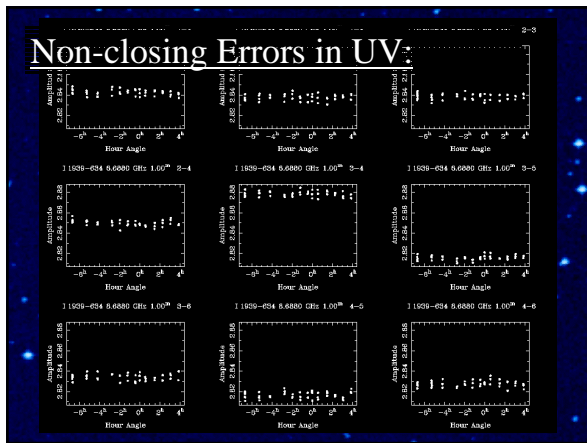
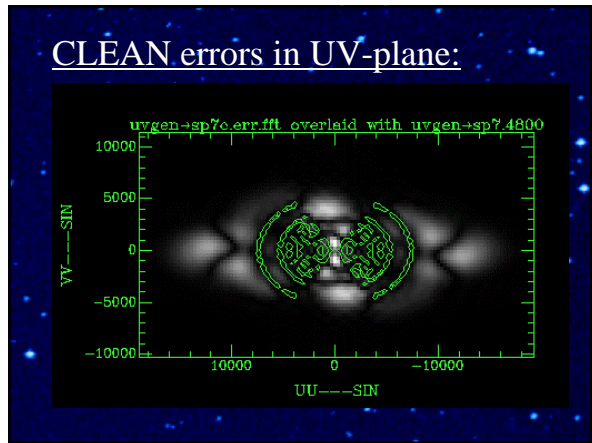
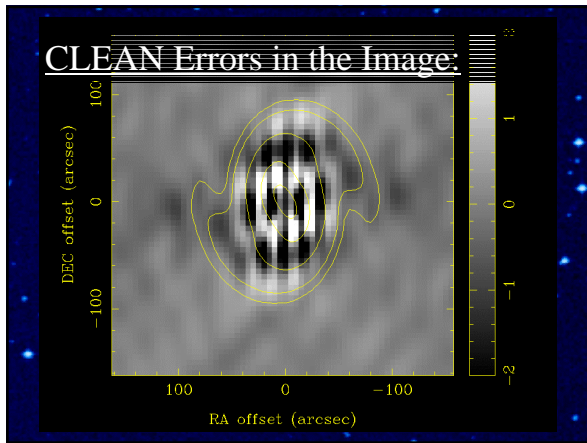


### Recognizing Poor UV Coverage:

- Fourier Transform the Source Model and Beam!



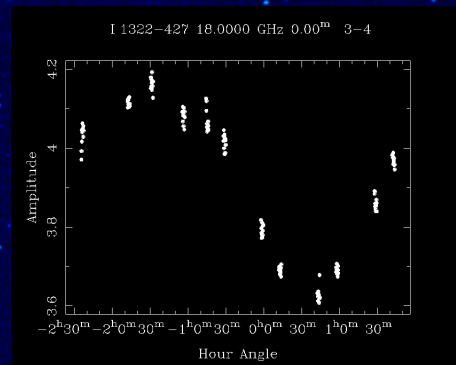
- Use different array configuration.
- Different frequency, if possible.
- North-spur, when available.



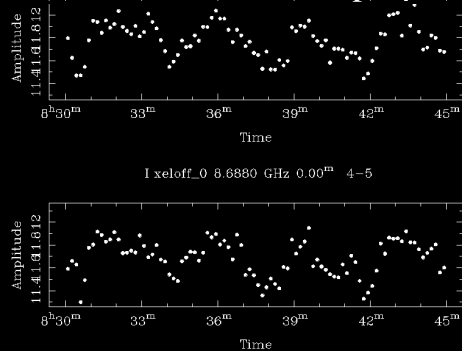
## Other things to consider:

- Check your calibrators!!
  - Resolved
  - Intra-day variability!
- Elevation dependent gains
  - Esp. atmospheric opacity at high frequencies.
- Primary beam
  - Images attenuated away from image centre.
  - Antenna gain very sensitive near half-power.

## Example of a Resolved Calibrator



## Gain errors at beam half-power:



## Summary

- Errors occur in the UV-domain.
  - An error which looks bad in the visibilities might not give a bad image error.
  - An error which is invisible in the visibilities might have a dramatic effect on the image.
- Be awake, be skeptical.
- Have fun!

