Widefield Issues and the ASKAP Array

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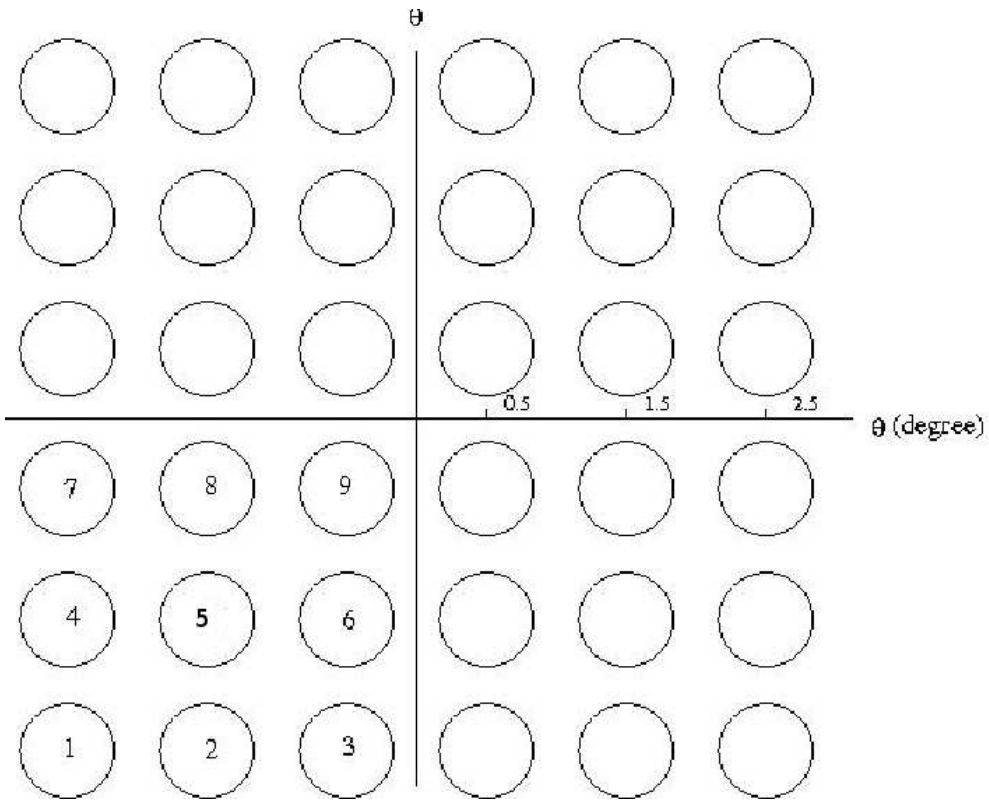
1) Topics

- Sensitivity as a Function of Beam Shape and Position
- Beam Shapes and Instrumental Polarization
- Sidelobe Responses and Wide Bandwidth Observations

2) ASKAP Phased-up Beam Positions

- We are observing with phased up beams at locations marked 1 through 9.
- One set of phased up beams was calculated by CSIRO engineers - optimized for sensitivity
- Beam calculations were done at 850, 1000, 1130, 1280 and 1430 MHz.



3) Noise will Increase Toward Outer Beam Positions

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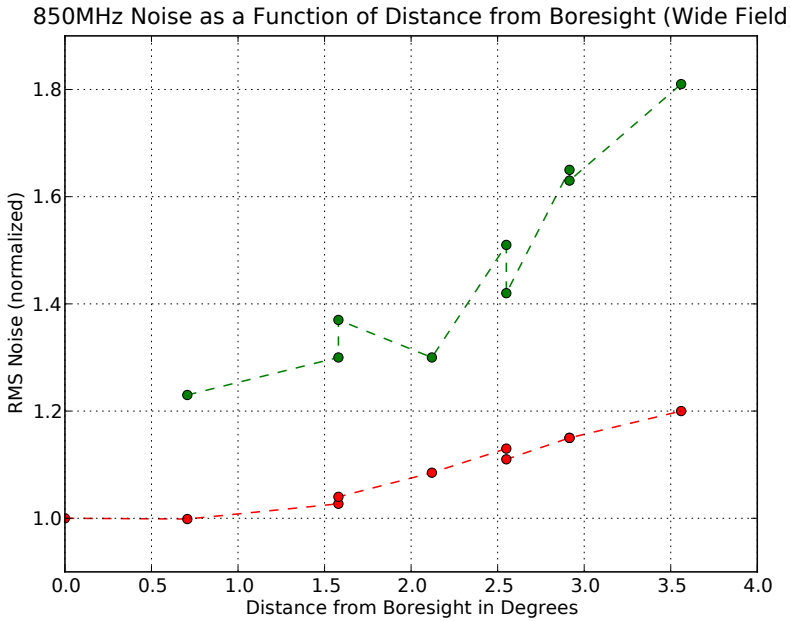
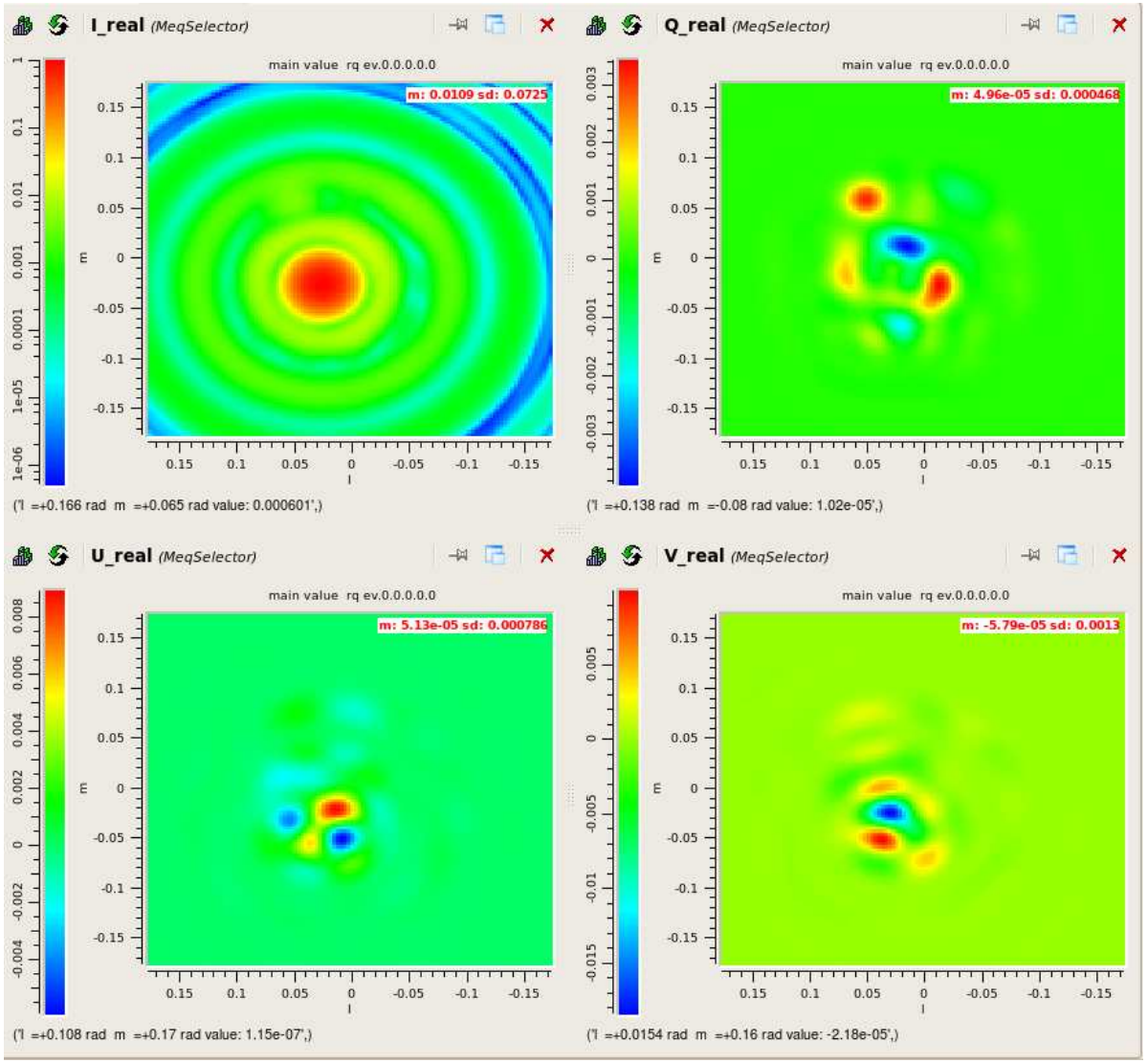


- 850 MHz Noise as a Function of Distance from Boresight
  - Upper curve - Gaussian Fitting
  - Lower curve - Conjugate Weighting. (Note: All results are normalized to conjugate weighting at boresight)
  - Outer phased array beams have a considerably higher noise than inner beams, no matter what weighting function used.

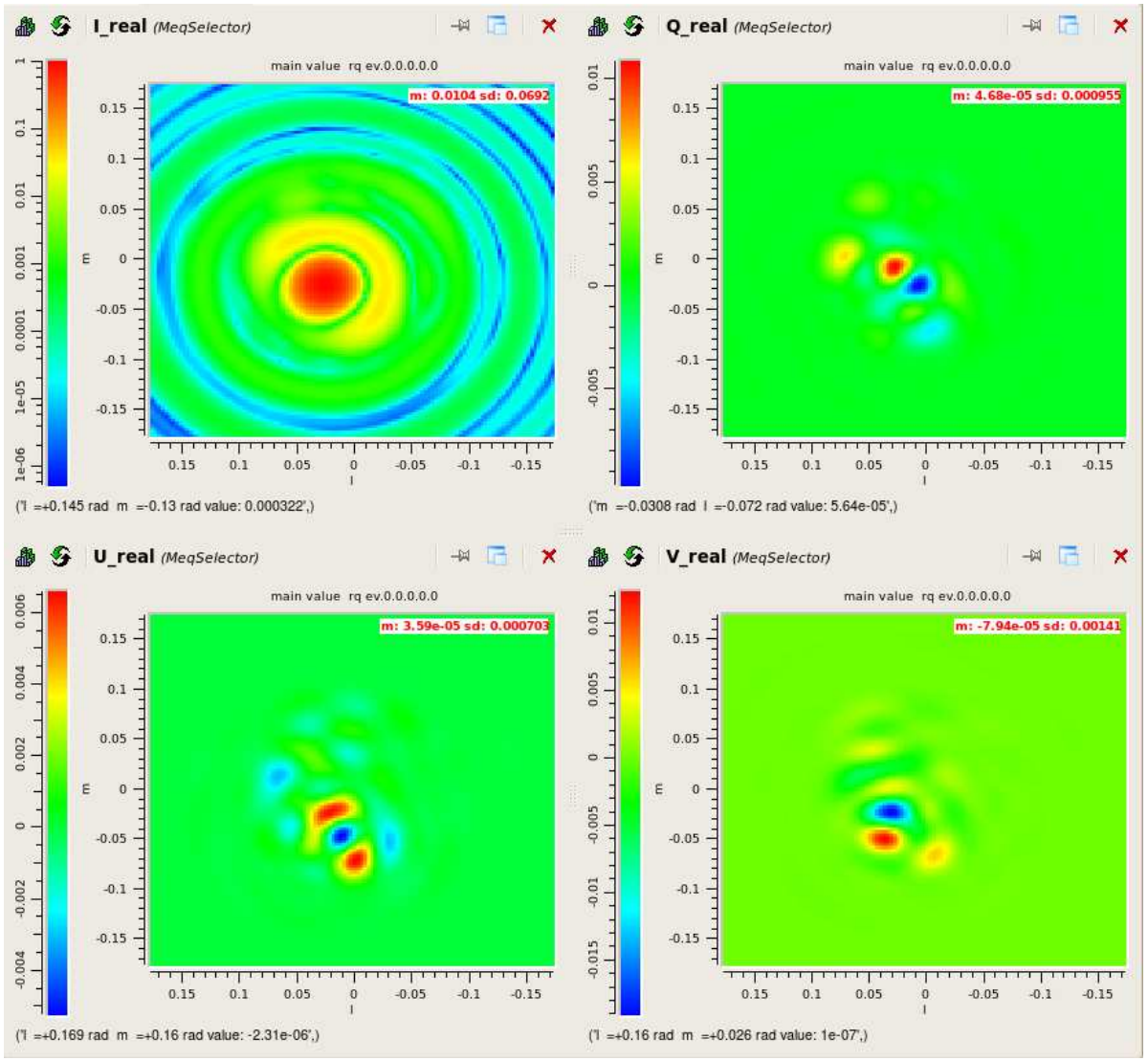
5) Examples of ASKAP Beam Shapes and Instrumental Polarization

- The following slides show the Stokes I, Q, U and V responses of ASKAP beam 5 as a function of frequency.
  - Stokes I images are shown on a log scale in order to display the side lobe response. Stokes Q, U, and V images have a linear scale.
- The shapes of the Stokes I responses are generally not circular (off-axis coma), so most current synthesis data reduction packages will have some difficulty!
- The Stokes Q, U and V instrumental polarization responses vary wildly as a function of position and frequency, but their values are generally quite low.

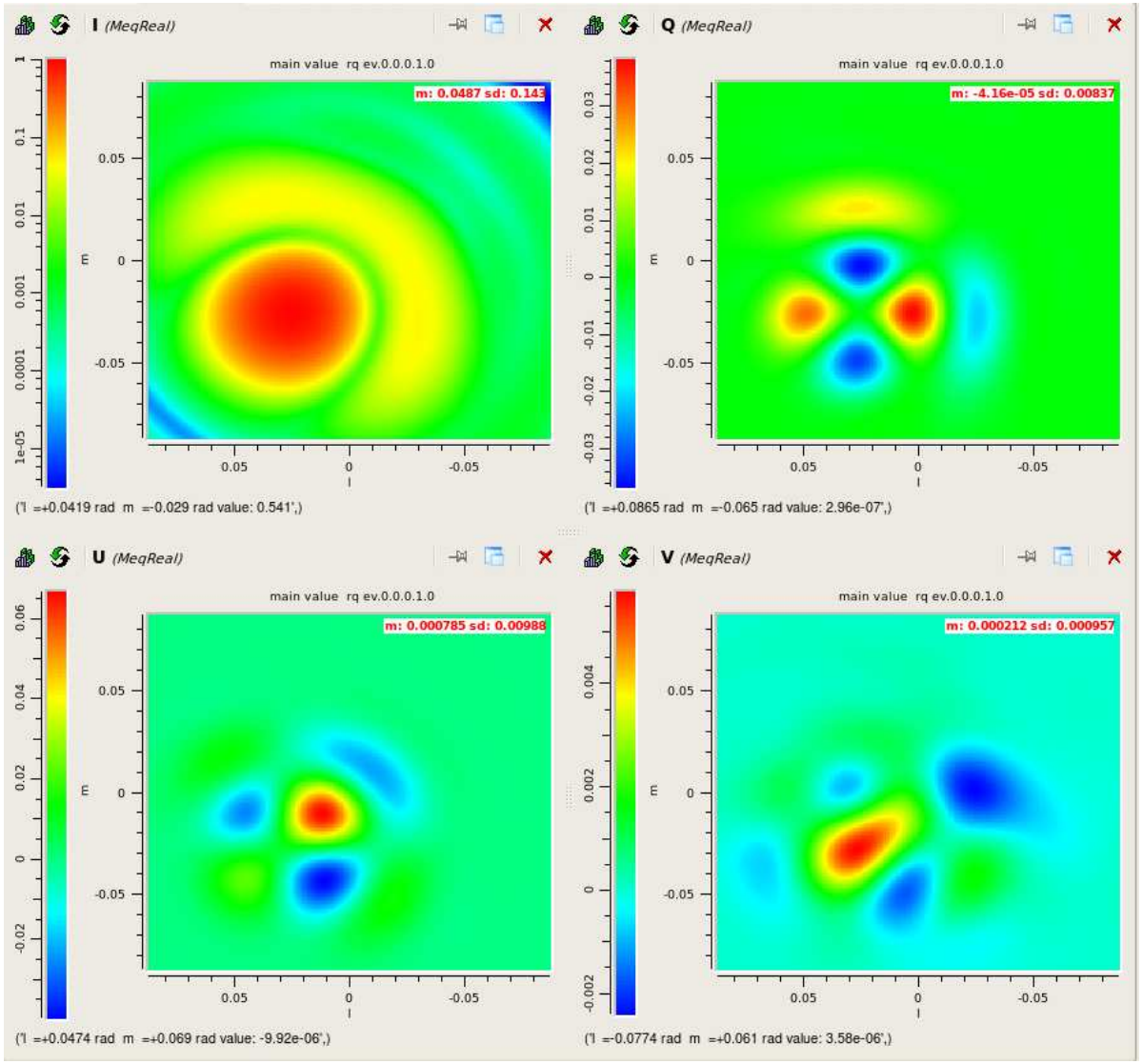
6) ASKAP Beam 5 - 850 MHz, Gauss Fit



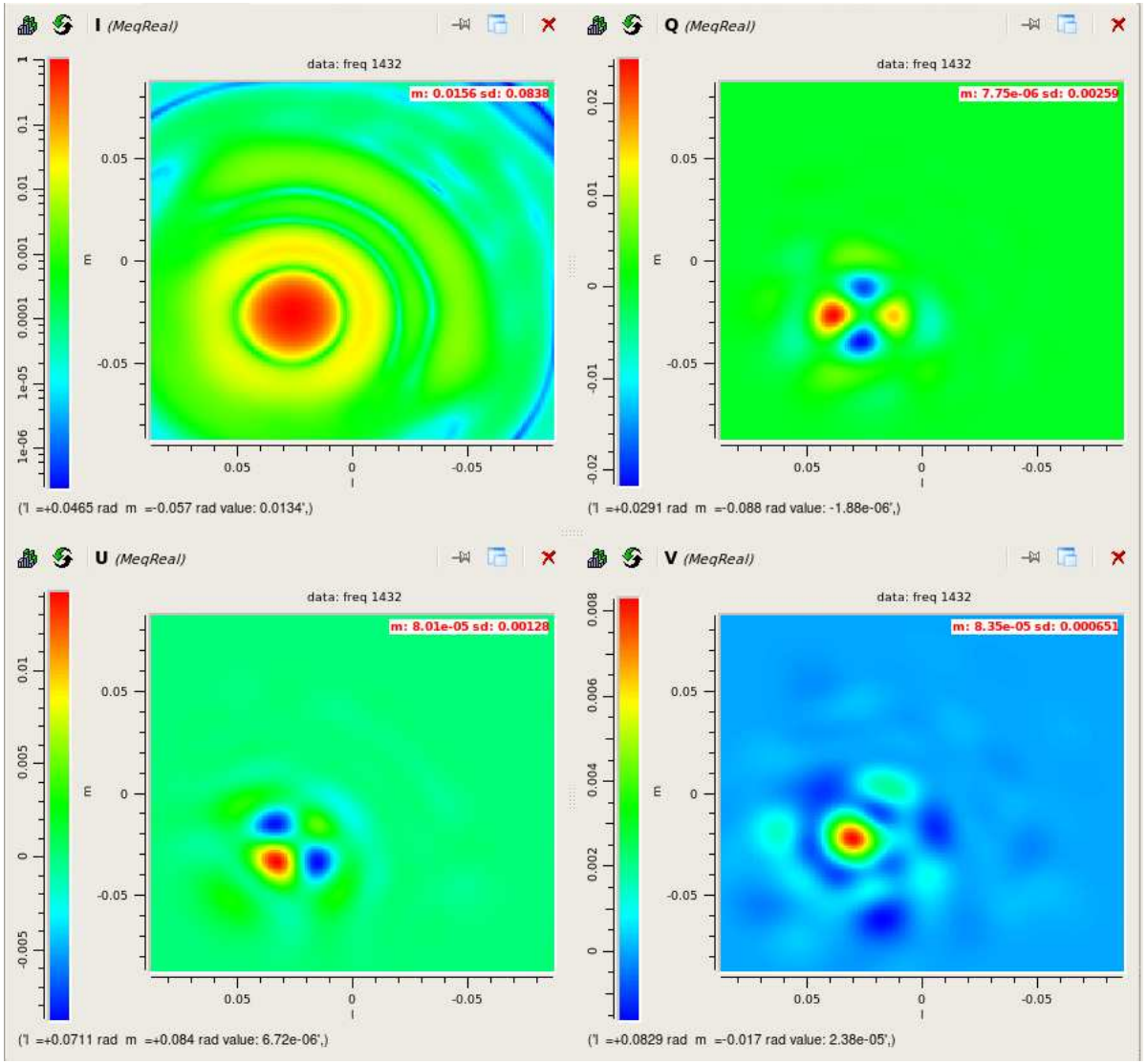
7) ASKAP Beam 5 - 850 MHz,Conjugate Fit



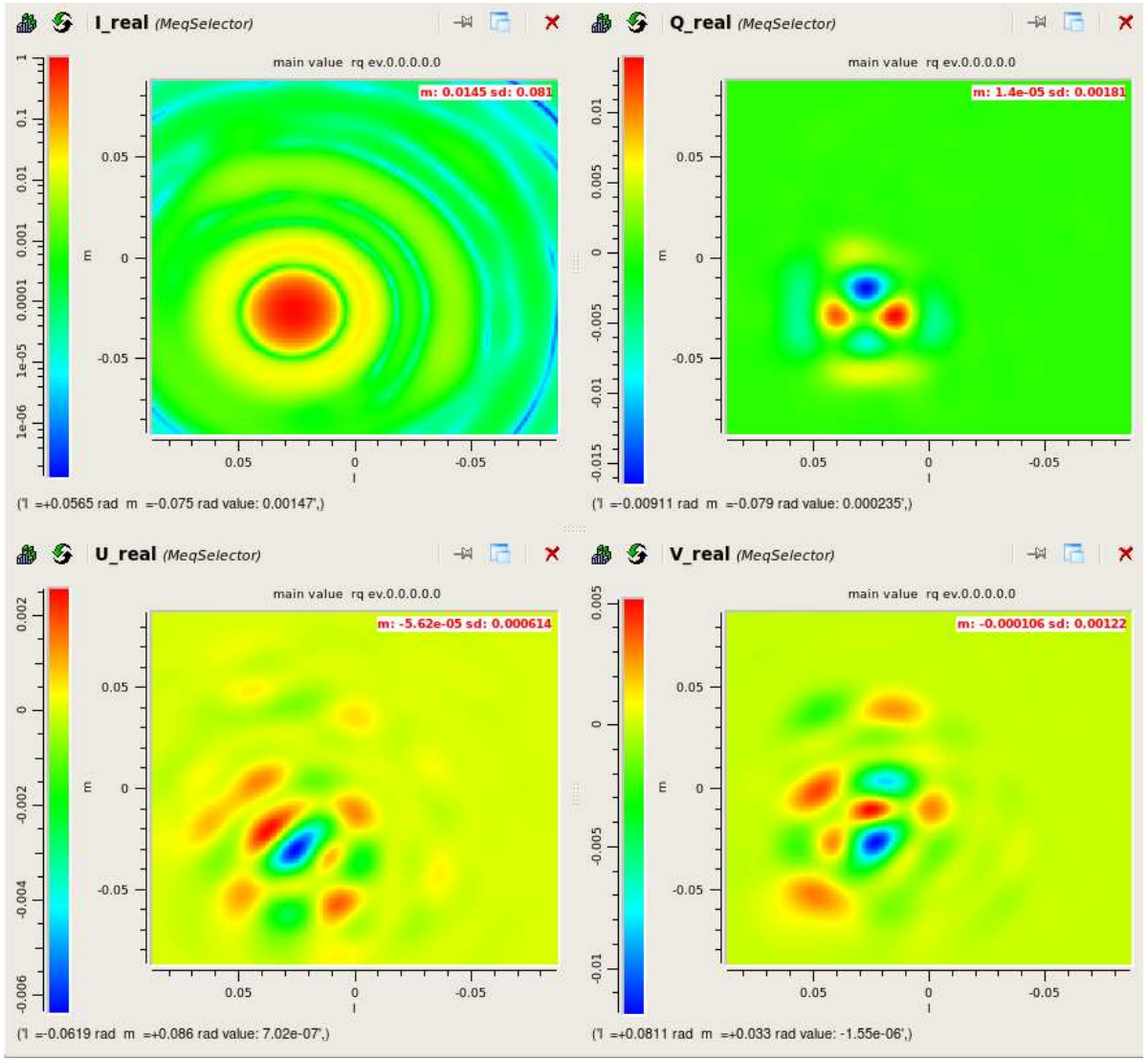
8) ASKAP Beam 5 - 850 MHz, FWHM = 1.83 deg, CSIRO Fit



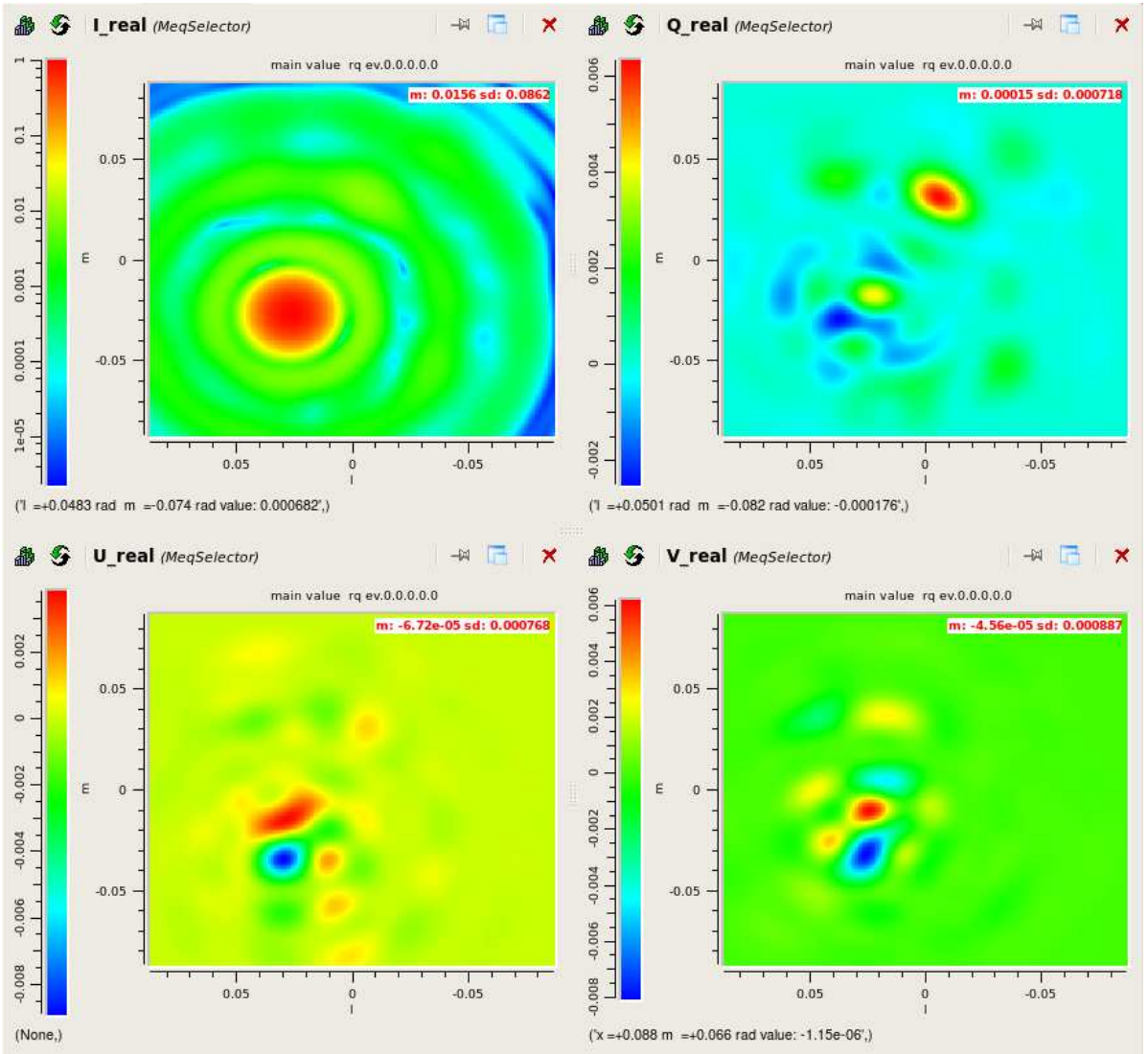
9) ASKAP Beam 5 - 1430 MHz, FWHM = 1.08 deg, CSIRO Fit



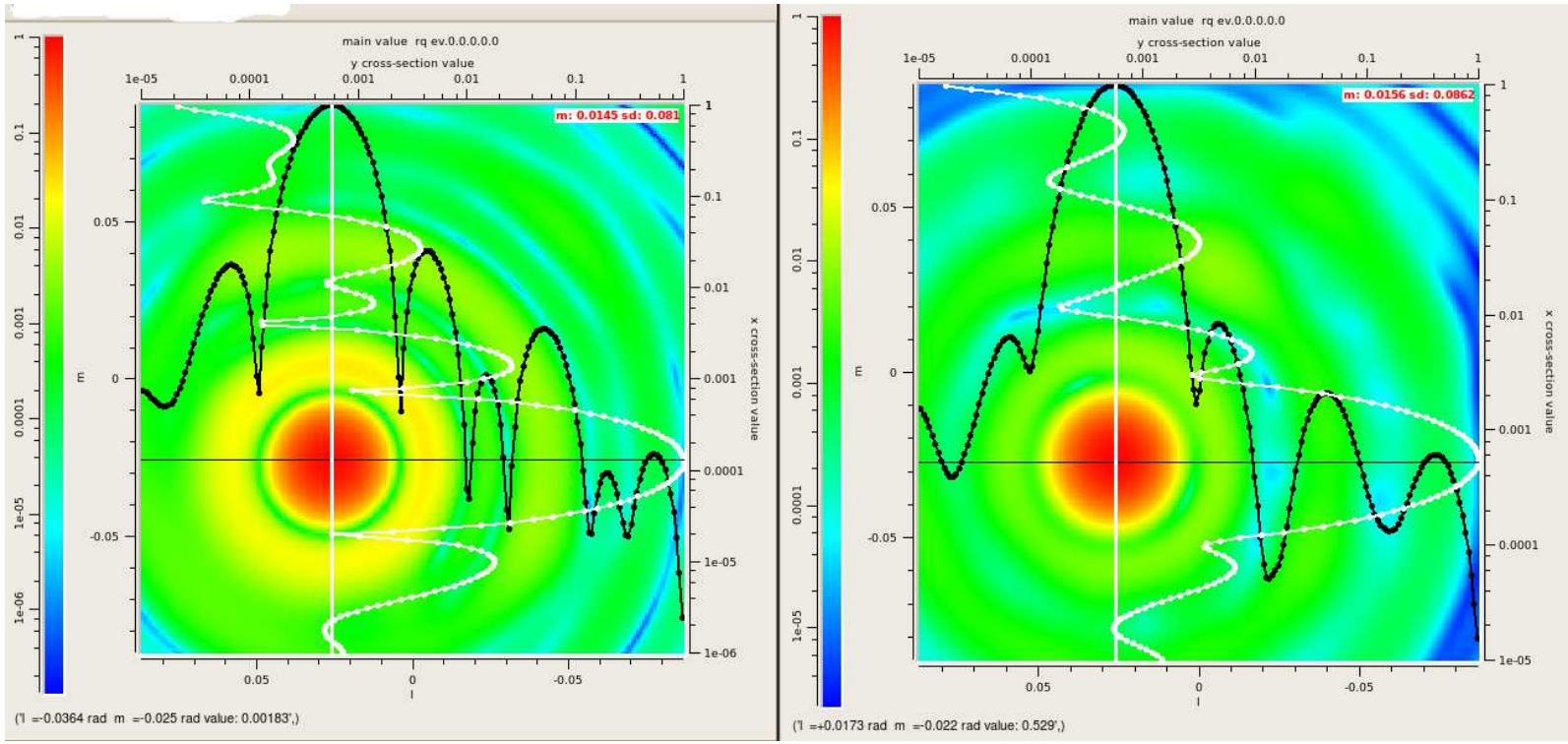
10) ASKAP Beam 5 - 1430 MHz,Conjugate Fit



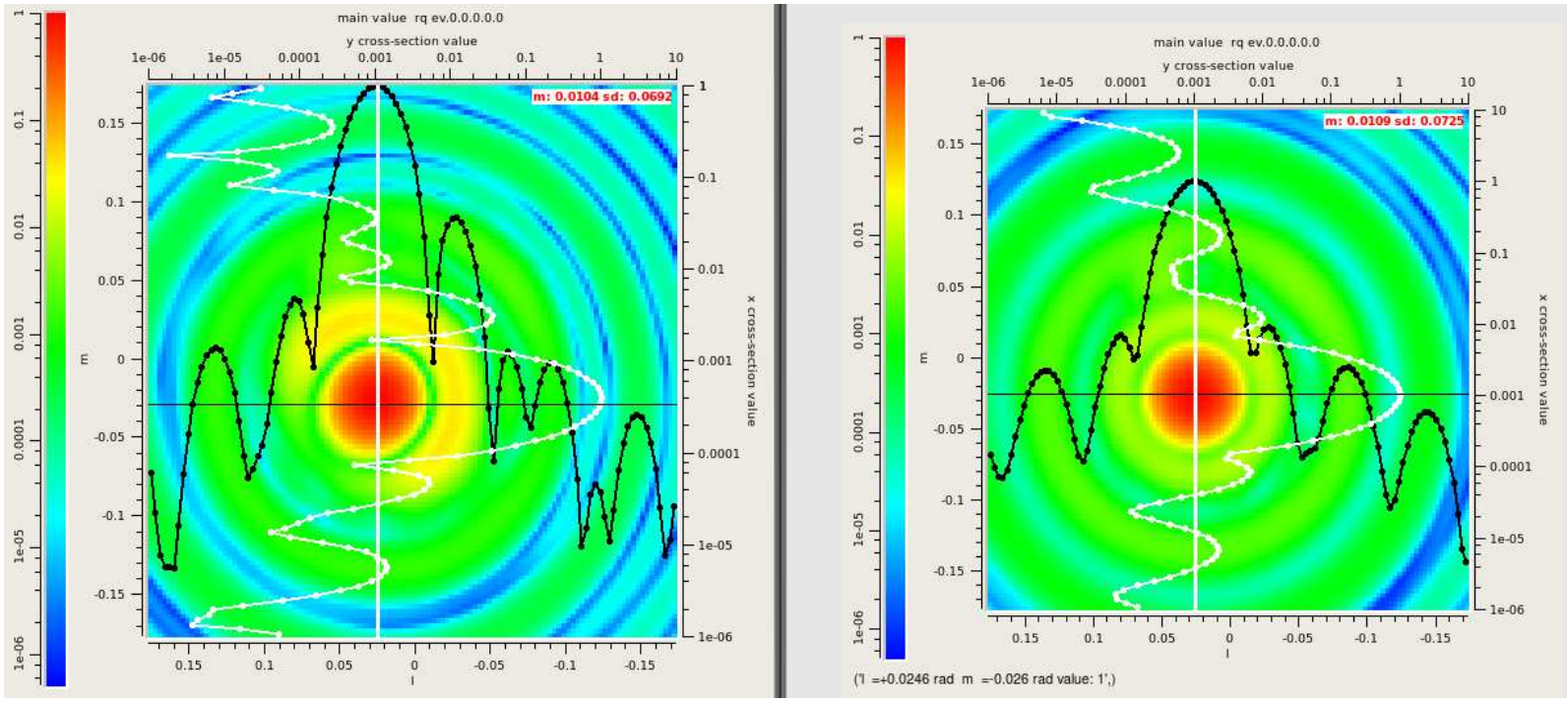
11) ASKAP Beam 5 - 1430 MHz, Gauss Fit



12) ASKAP Beam 5 - 1430 MHz,Conjugate vs Gauss Fit



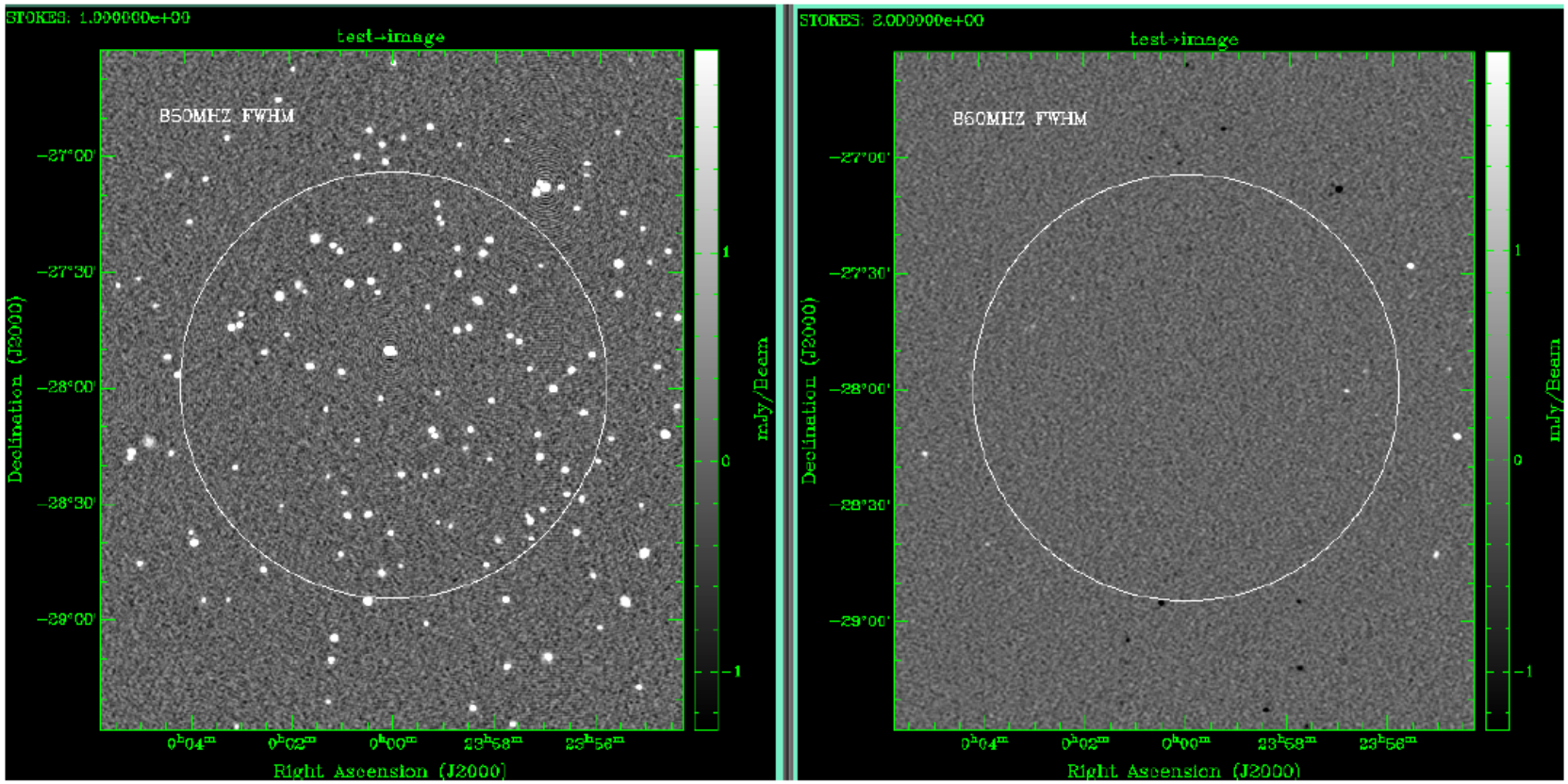
13) ASKAP Beam 5 - 850 MHz,Conjugate vs Gauss Fit



14) Parameters for ASKAP Simulation

- Array size set to 1/4 of final array size (so about 1.5 km)
  - Allows us to use 60 second integrations
- 563 MHz Bandwidth spread over 256 channels, so channel increment is 2.2 MHz
- Start frequency = 870 MHz, end frequency = 1433 MHz
- Use MeqTrees to observe with phased array beams calculated by CSIRO engineer Rong-Yu.
- Sky models supplied by Jeroen Stil
  - Include polarization rotation measure of sources
  - Include spectral index of sources (based on 610 to 1400 MHz flux densities)

15) Instrumental Polarization will be Visible in Individual Channels

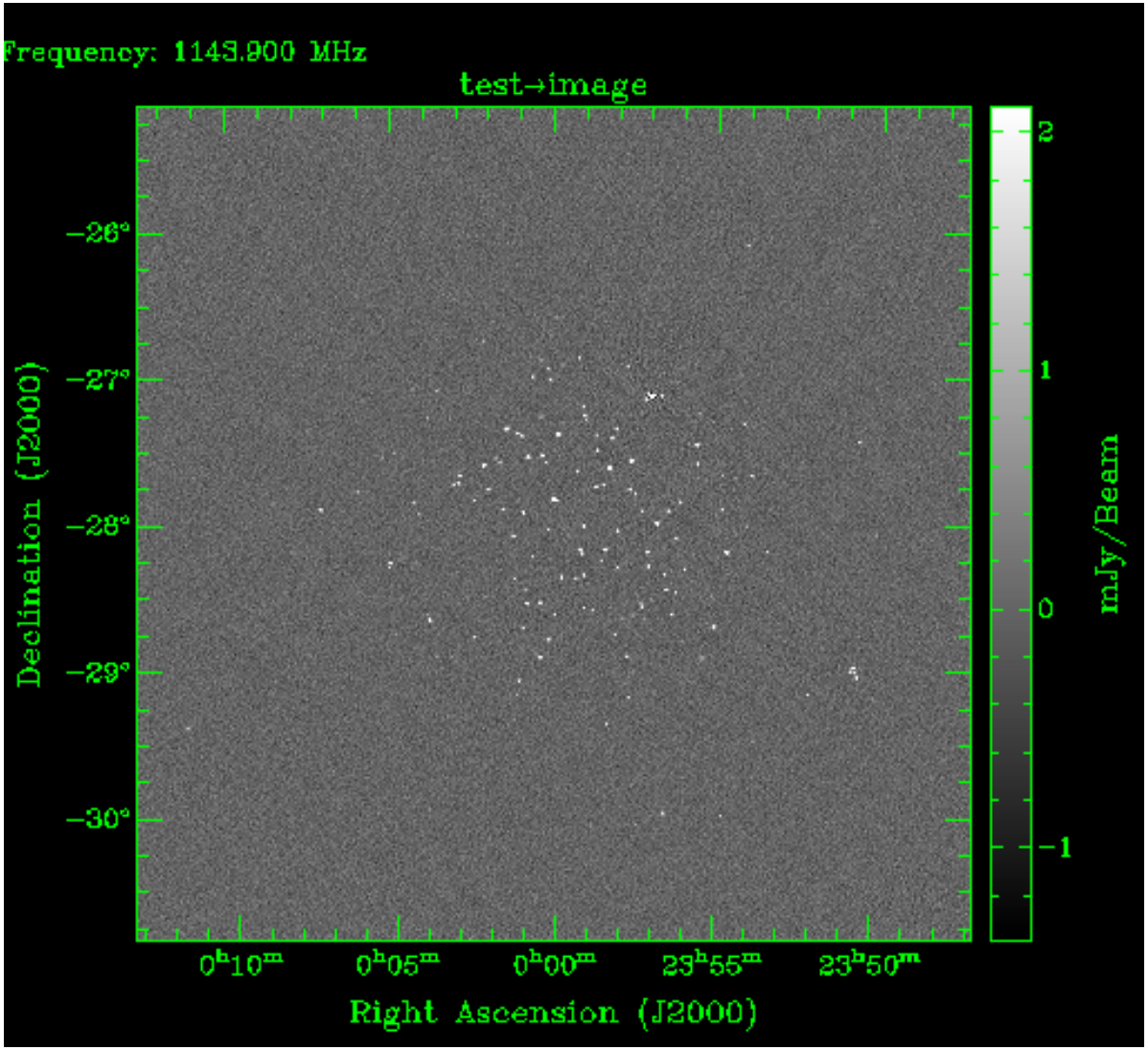


- Left: 874 MHz Stokes I image of the radio sky
- Right: Instrumental Stokes Q
- Noise per channel is 187 microJy

16) Sidelobes are High

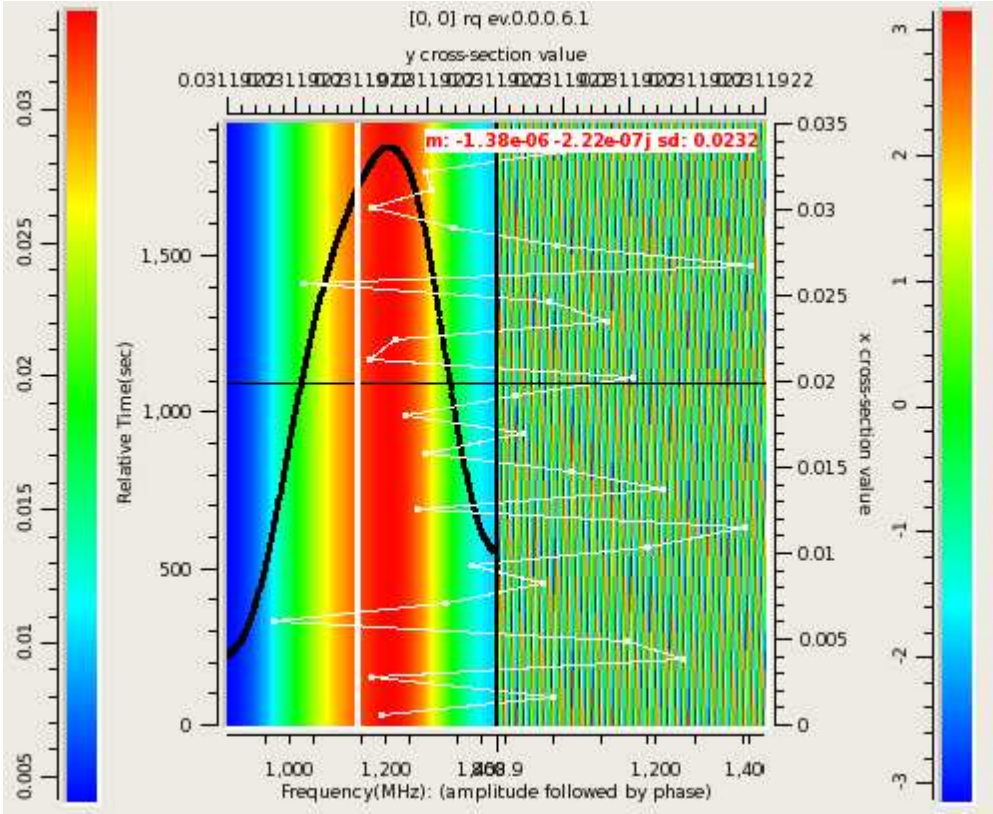
- FPA Sidelobes are high. We will see strong sources move in and out of the first sidelobe as frequency changes.

17) ASKAP Beam 5 - Field at 1144 MHz



18) ASKAP Beam 5 - Sidelobe Response as a Function of Frequency

- Observed amplitude (left) and phase (right) response of a unit source with spectral index -0.75 placed at RA=23h51m41.3s, DEC=-29d, which is in the first sidelobe, as a function of frequency.



19) That's All Folks!

- Thank you
  - Jeroen Stil - for sky models
  - Oleg Smirnov - for the superb MeqTrees simulation package
  - Rong-Yu Qiao and Ettore Caretti - for phased array beam data