Collaborators

DASI Team

University of Chicago

J. E. Carlstrom

M. Dragovan

N. W. Halverson

W. L. Holzapfel

J. Kovac

E. M. Leitch

C. Pryke

E. Schartman

G. Davidson

J. Yamasaki

CBI Team

Caltech

A. C. S. Readhead

S. Padin

J. Cartwright

T. Pearson

W. Schaal

M. Shepherd

J. Yamasaki

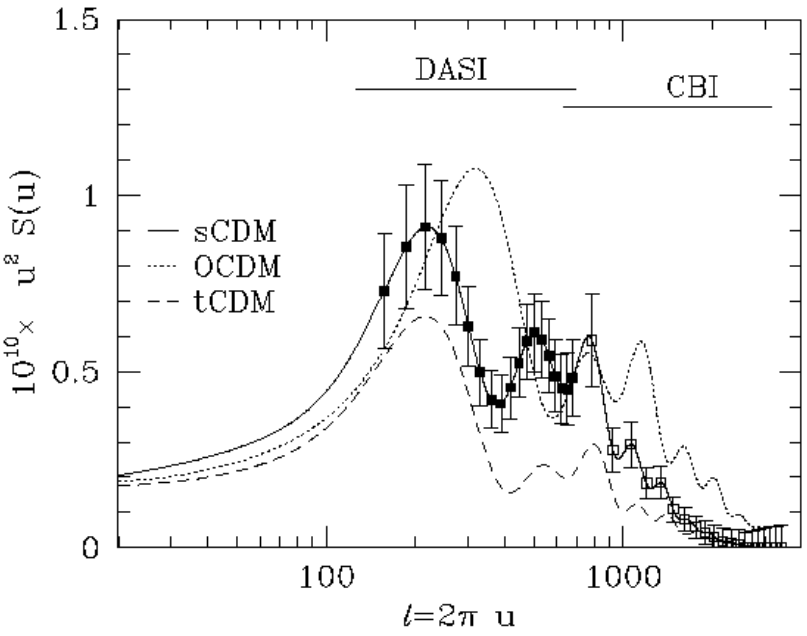
Also

M. White (UIUC)

M. Joy (MSFC)

S. Myers (NRAO)

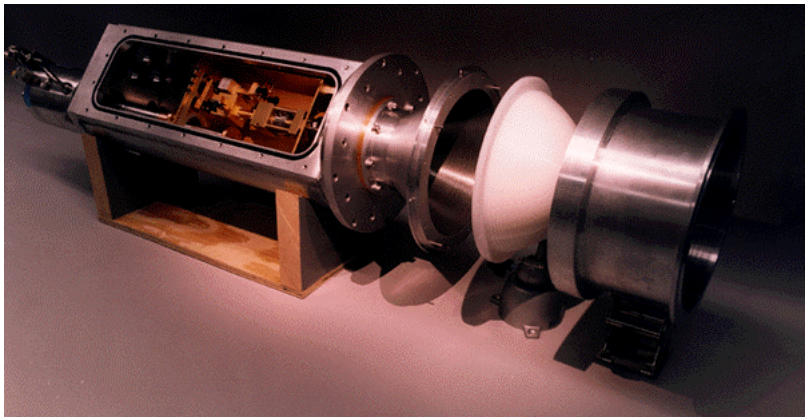
Overview

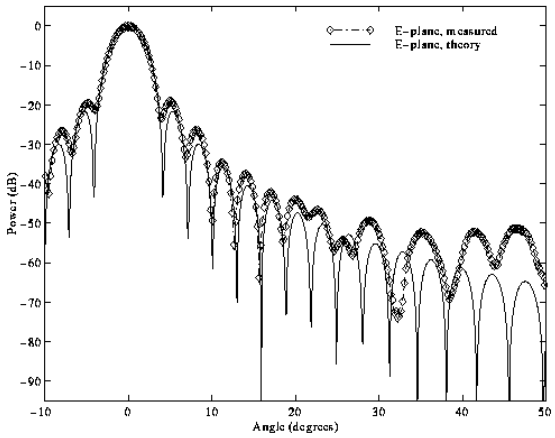


- 13-element, compact cm-wave interferometer
- 10 GHz band from 26-36 GHz
- Largest separation of 115 l – smallest scale of l ~ 900
- Smallest separation of 20 l – largest scale of l ~ 160
- Multi-frequency capability allows spectral discrimination of foregrounds

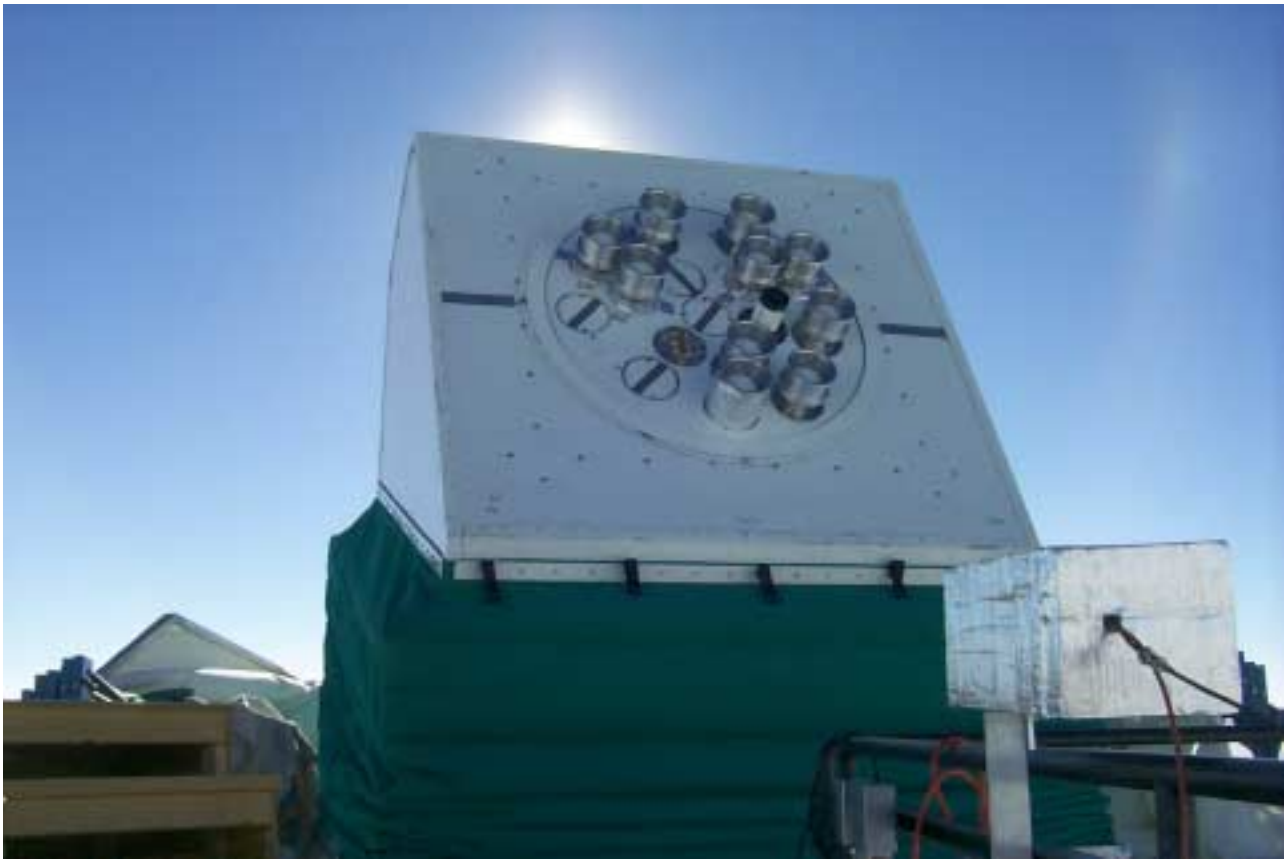
Receivers

- 20 cm feed horns
  - Unobstructed apertures
  - Low sidelobe response
  - Low crosstalk
- ~ 3 degree beam
- Lens + feed horn yield an aperture efficiency of 84%
- Ka-Band HEMTs between 26-36 GHz
  - Tnoise typically 14 K at band center
  - Trx ranges 18-25 K



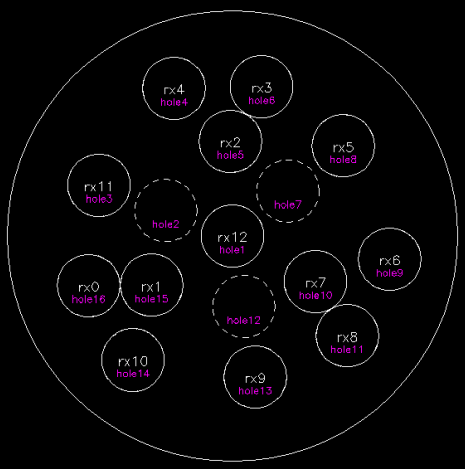


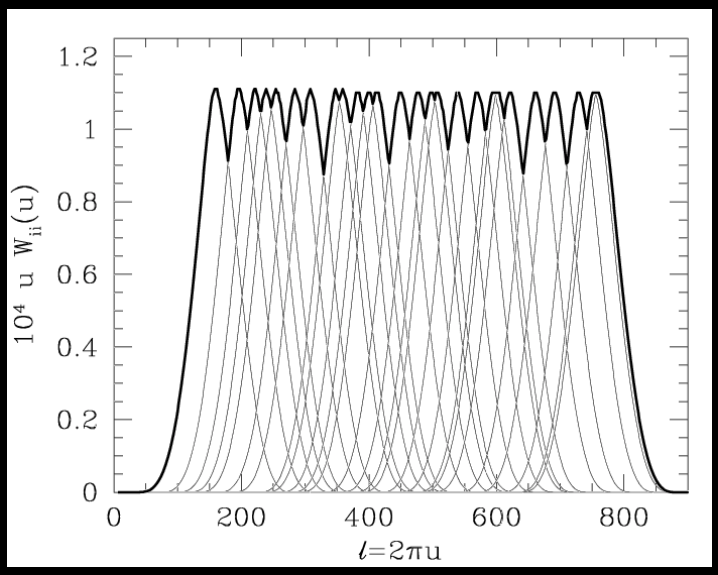
DASI Mount



- Standard alt-az mount, alt axis counter-weighted for stability
- 13 antenna elements, 78 baselines
- Rigid faceplate mount
  - No IF delays
  - No change in projected baseline lengths while tracking

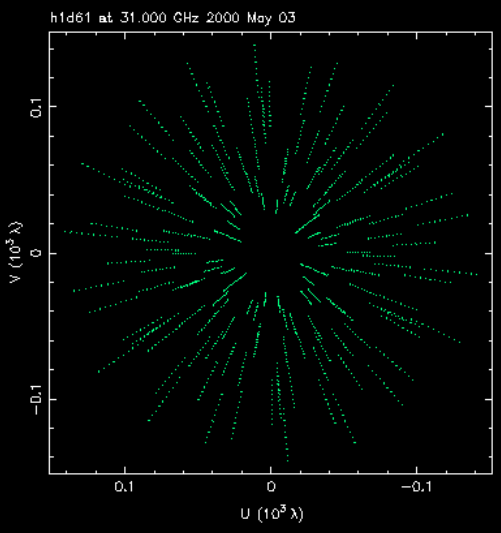
Fourier plane characteristics

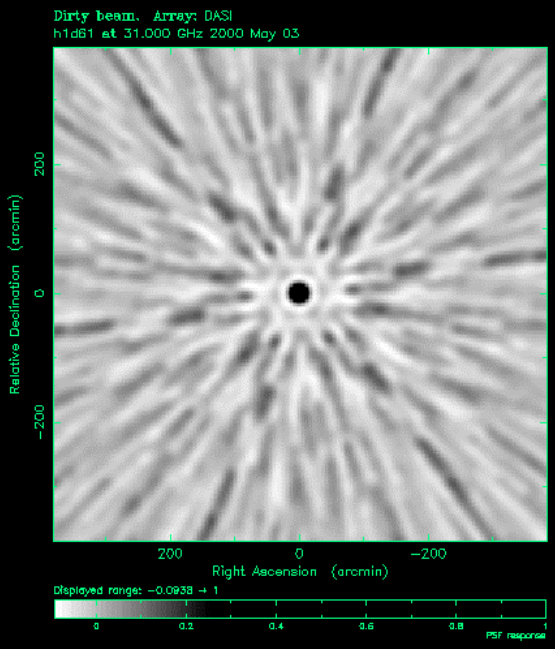




- 3-fold symmetry improves sensitivity at each UV radius
- Hole pattern optimized for uniform UV coverage

Image plane characteristics





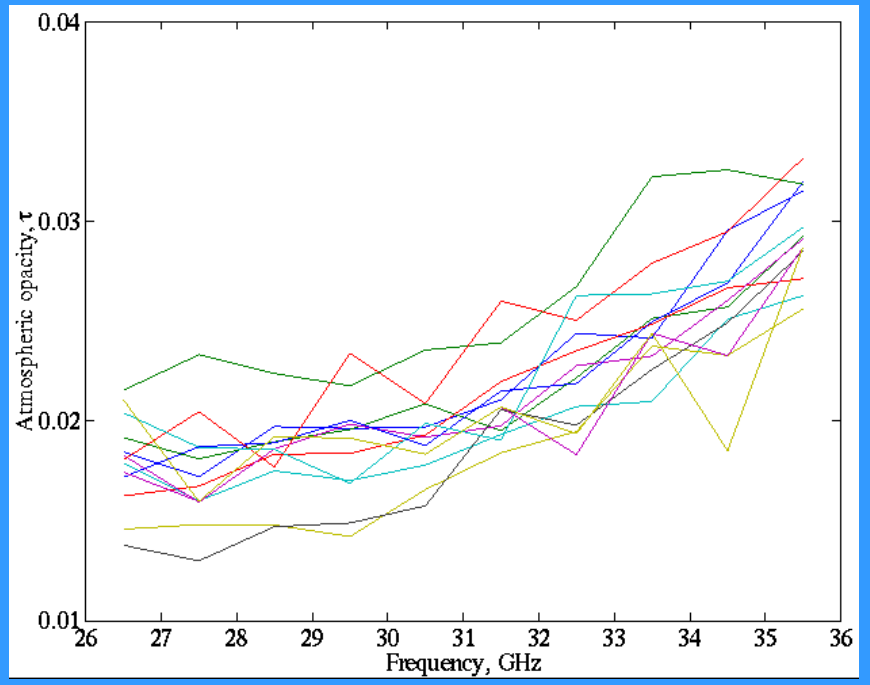
- Snapshot provides good coverage of the UV plane
- 10-channel correlator allows spectral discrimination or frequency synthesis
- Synthesized beam ~ 18 arcminutes.

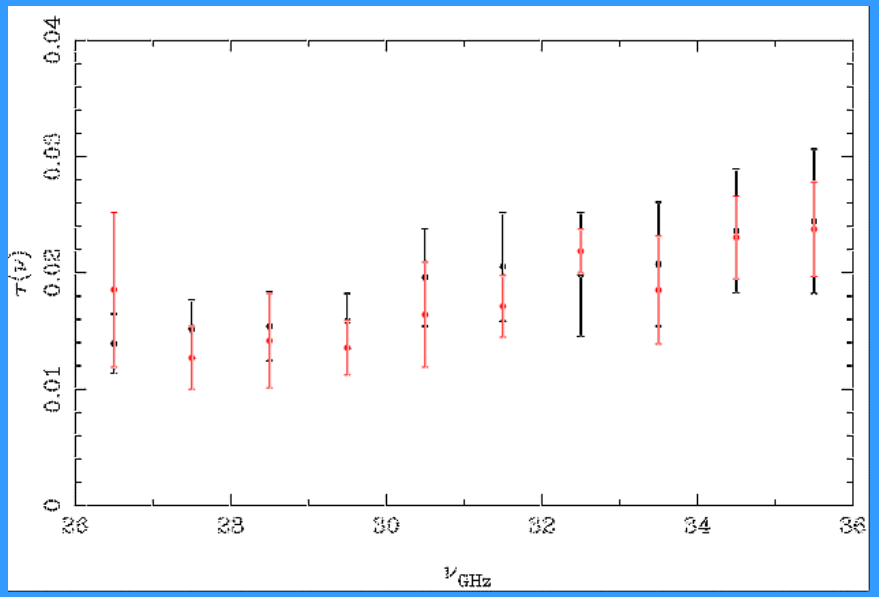
Pointing

- Pointing model determined by optical observations
- Pointing rms of 19 arcsec with stars down to 5^{th} magnitude
- Periodic checks with VME frame grabber
- Small diurnal temperature variations and weight of the telescope contribute to extremely stable pointing
- Pointing checks incorporated into observing strategy

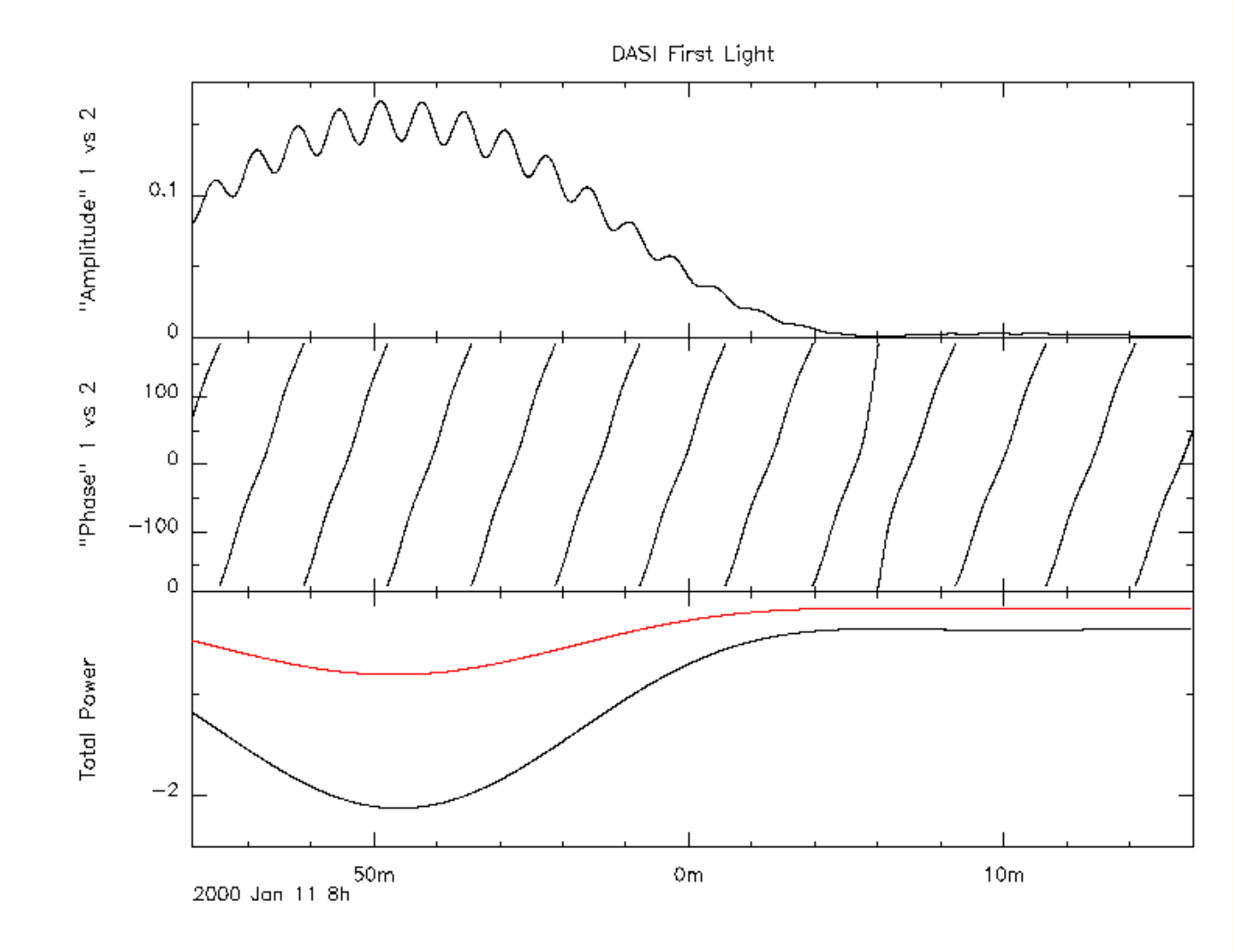
Site characterization

- Very low precipitation – typical zenith opacities ~ 0.02
- Observations 6 months later from skydips demonstrate extreme stability of the site
- Python results suggest 75% efficiency
- Measured zenith opacity indicates that winter atmosphere contributes no more than the CMB to our system temperature.

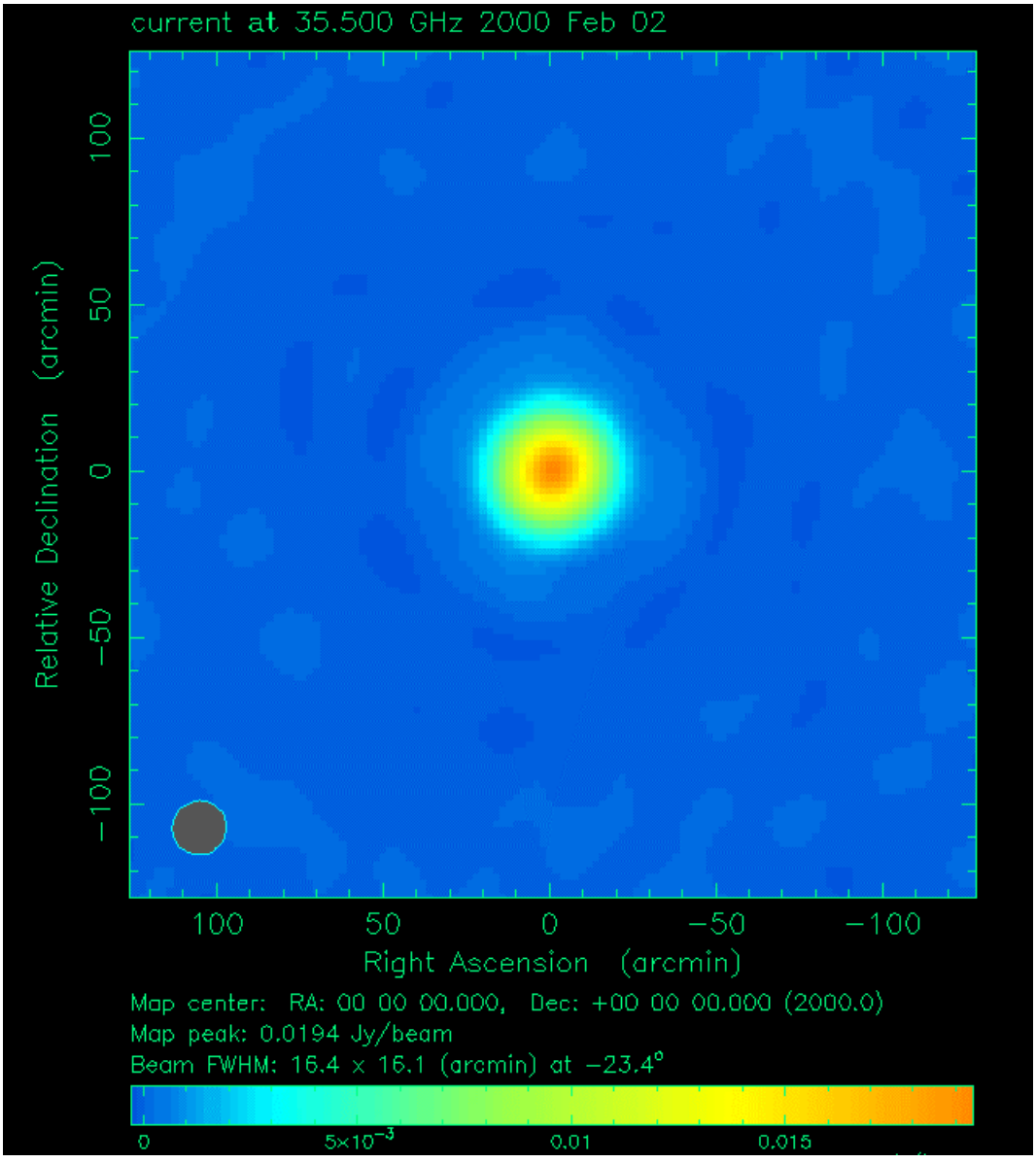




DASI first light; fringes on the sun



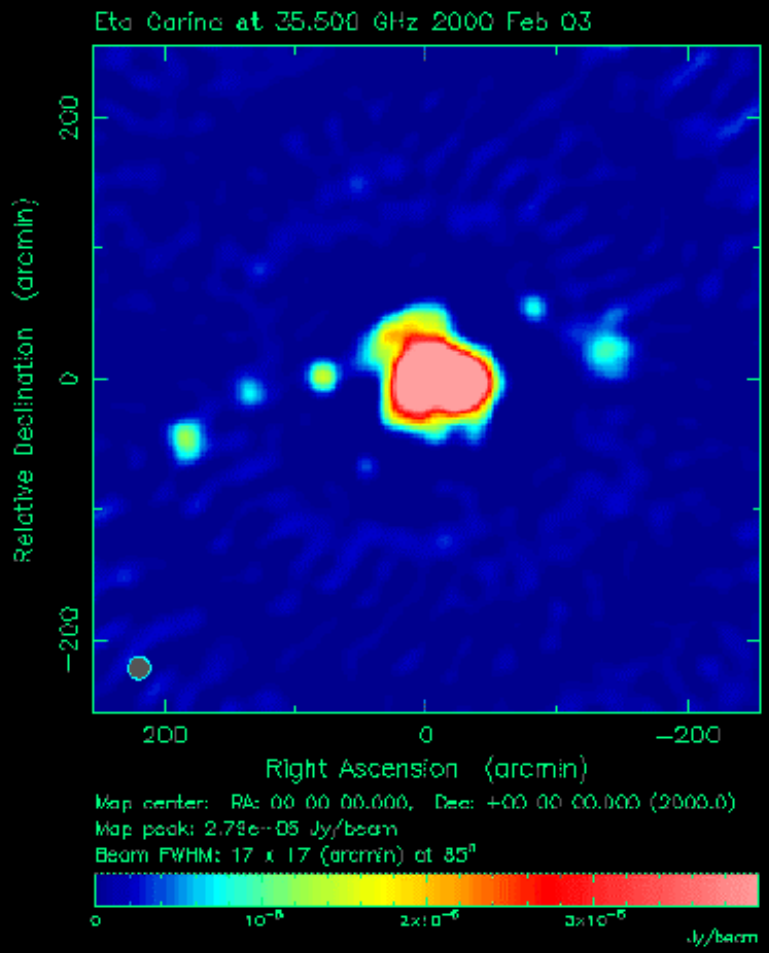
DASI first image: the moon

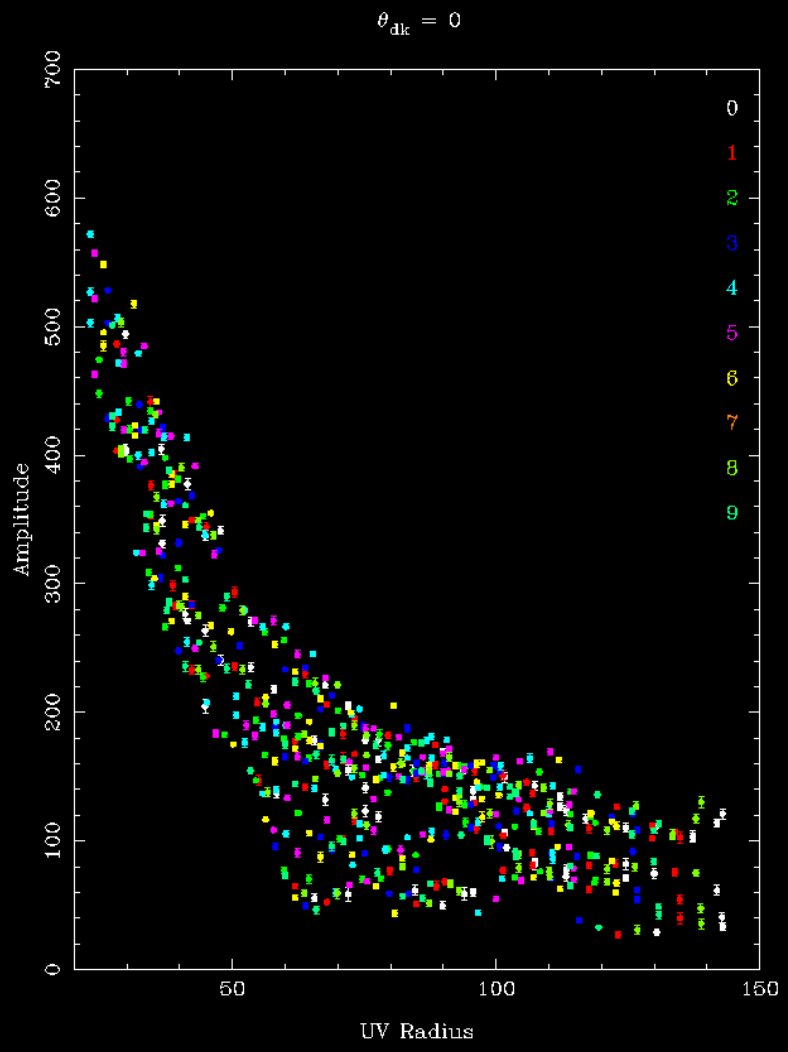


Absolute Calibration

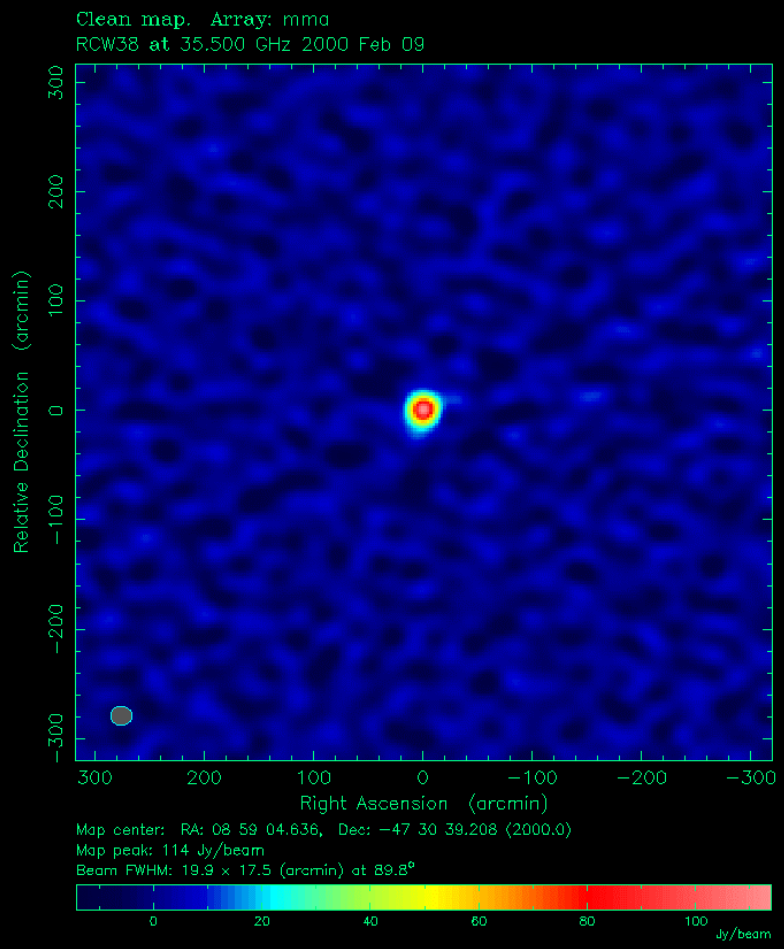
- Very few suitable high frequency calibrators
- DASI has low sensitivity to point sources:
  - Gain of ~10 uK/Jy
- Extended sources ok, especially at the pole
  - Modulo deck rotation
- Eta Carinae – extended Galactic HII region
  - High elevation
  - Peak flux ~ 600 Jy
  - Can measure flux to ~ 3% in minutes

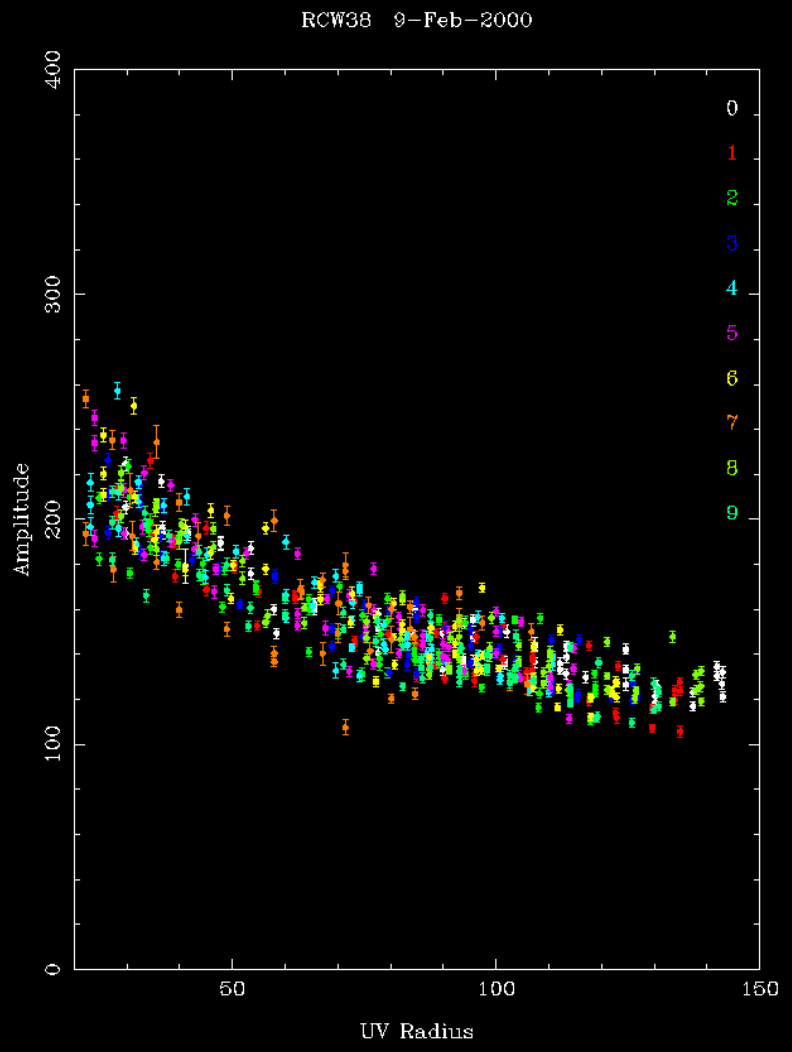
Eta Carinae visibility amplitudes



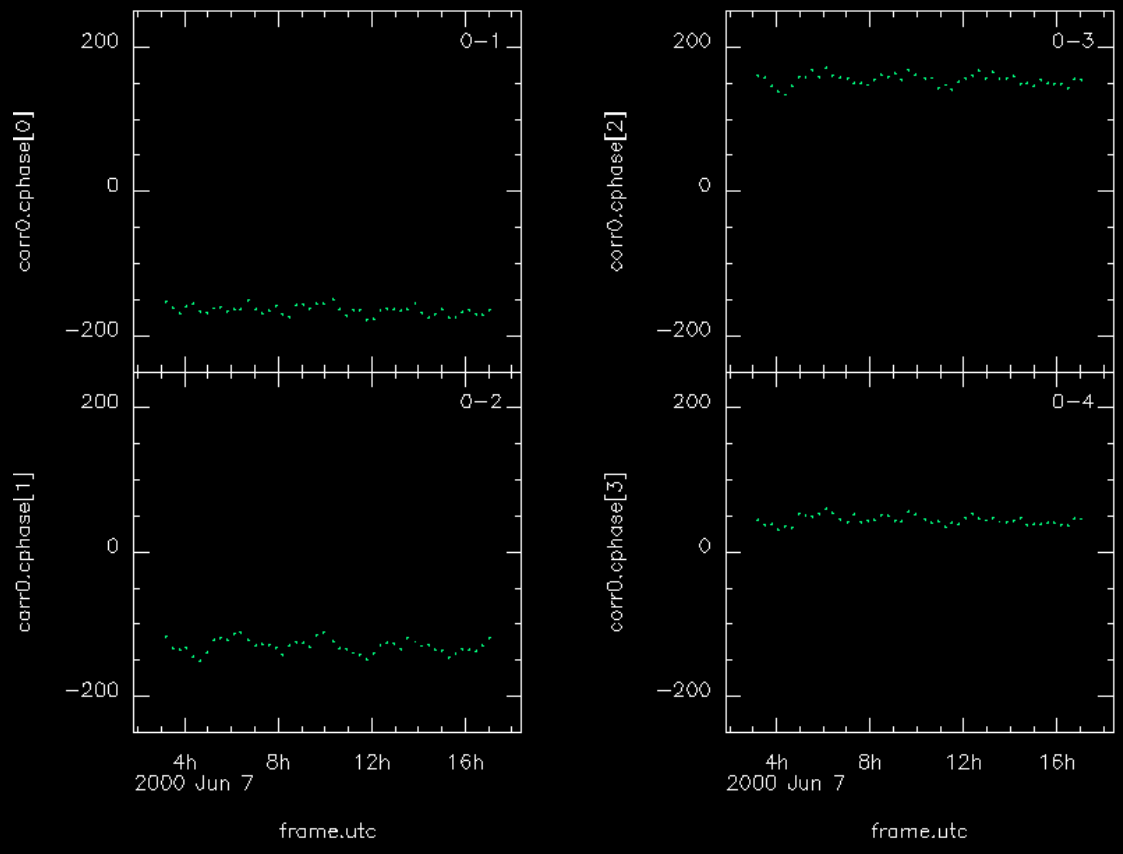


RCW38 visibility amplitudes





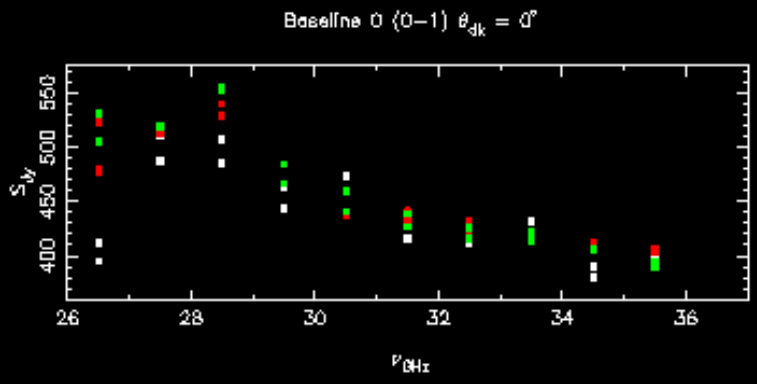
Phase stability while tracking RCW38

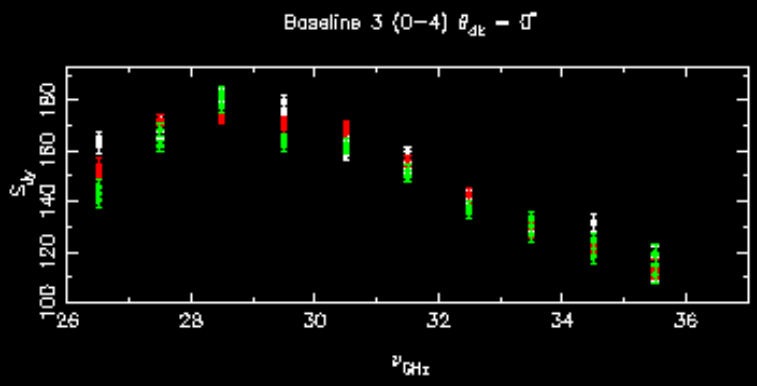


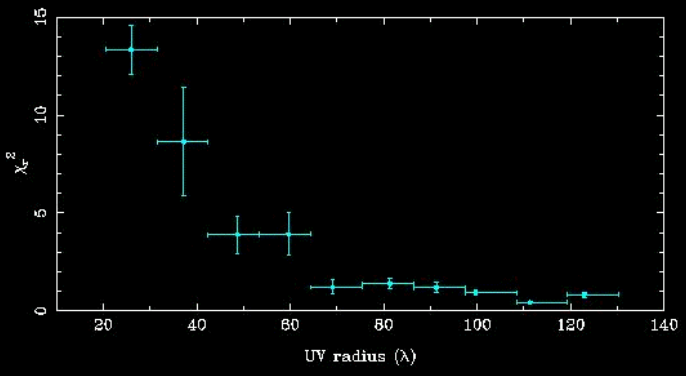
- Stability confirms that RCW38 is point-like or at least radially symmetric
- Galactic background in the vicinity of RCW38 is uniform
- No significant pointing offsets
- Excellent instrumental stability

Evidence for ground contamination while tracking Eta Carinae

- Comparison between redundant baselines
- Large variations on short baselines
- Small scatter on long baselines
- Consistent with ground contamination

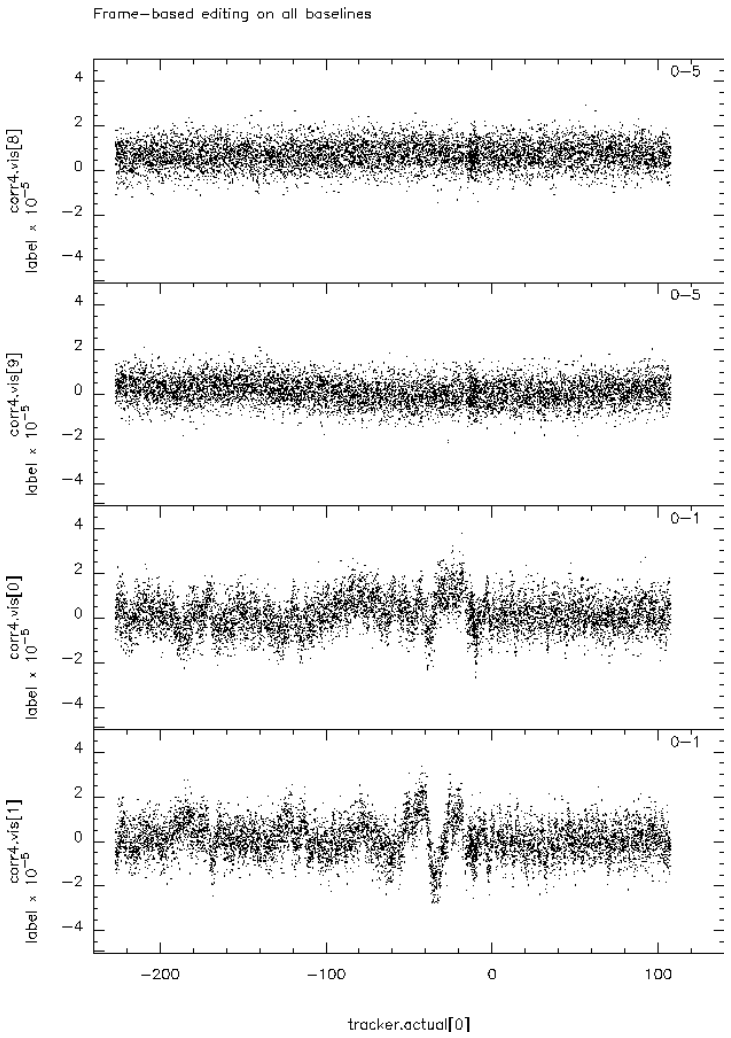






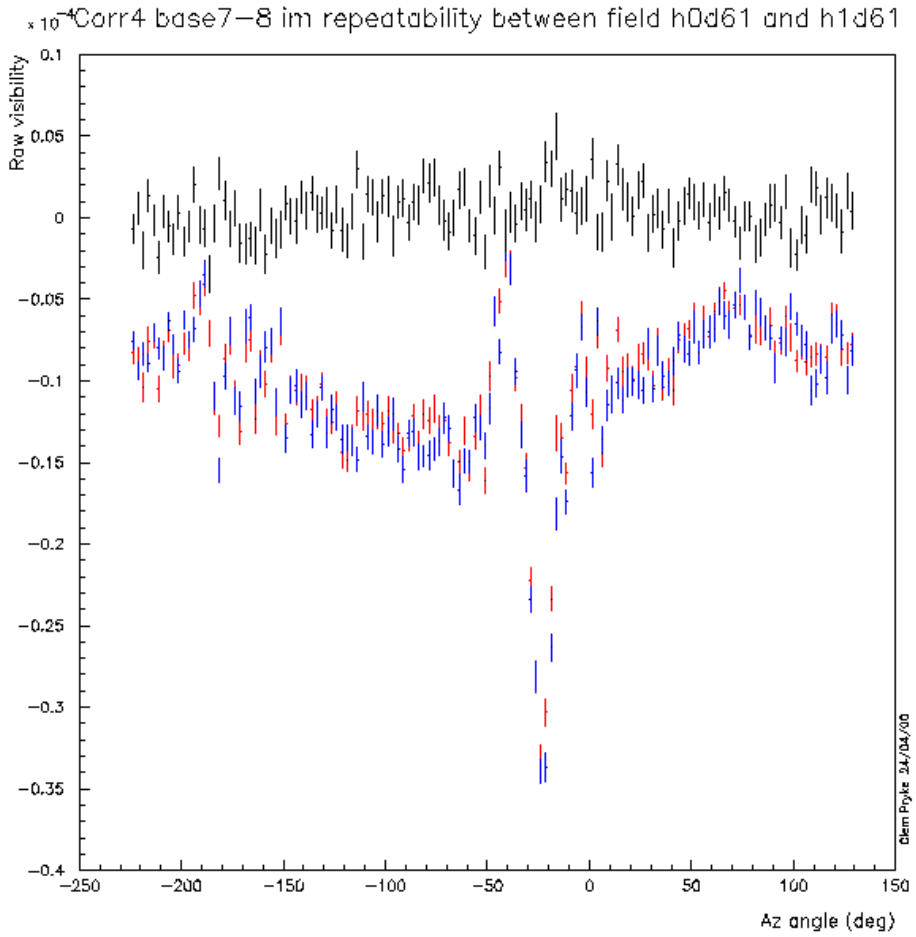
Ground signal in raw visibilities

- Blank field tracked over full azimuth range
- Rapid fringing on shortest baselines
- Little evidence for contamination on long baselines
- Large signal corresponds to MaPo

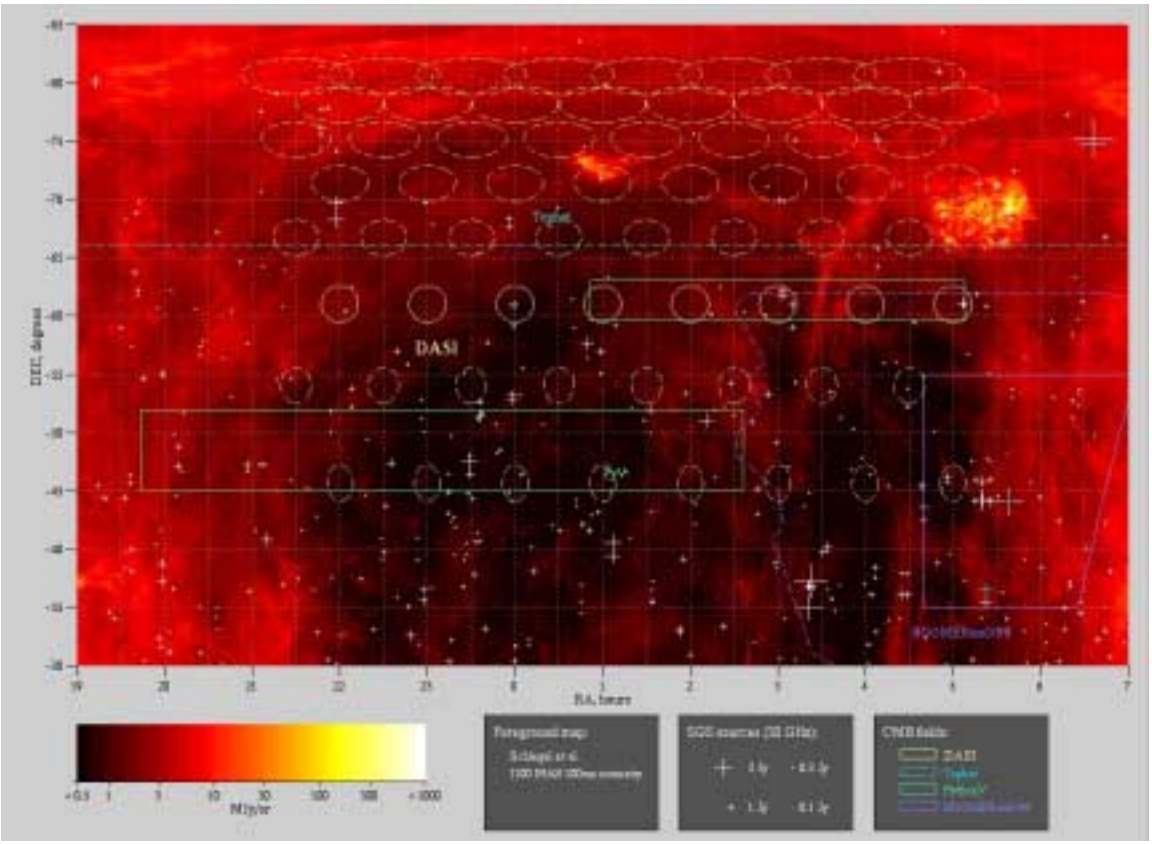


Repeatability of ground signals

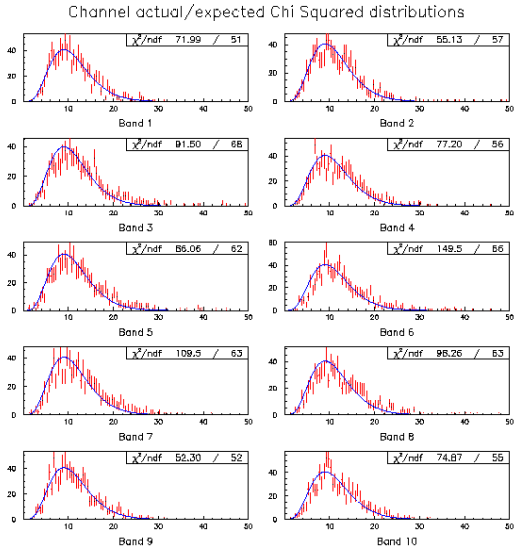
- Large signal corresponds to MaPo crossing
- Good repeatability over long time periods (5 days)
- Difference plot shows no evidence for residual ground contamination

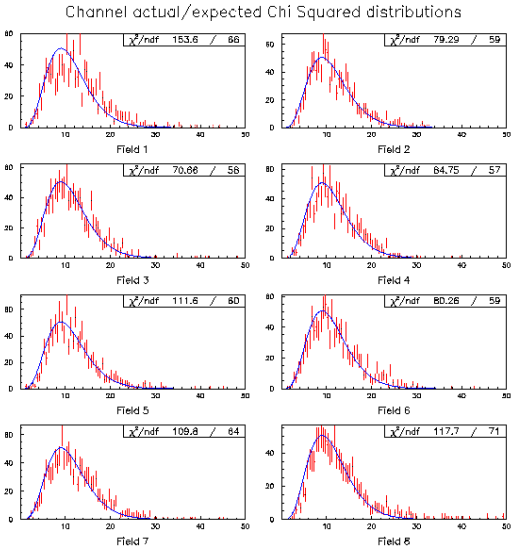


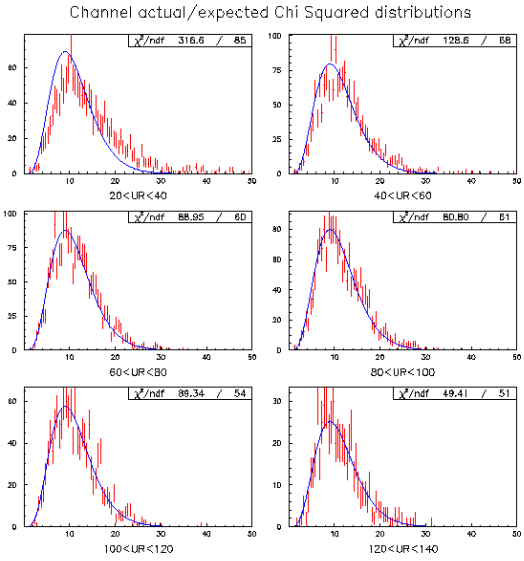
CMB Field Observations

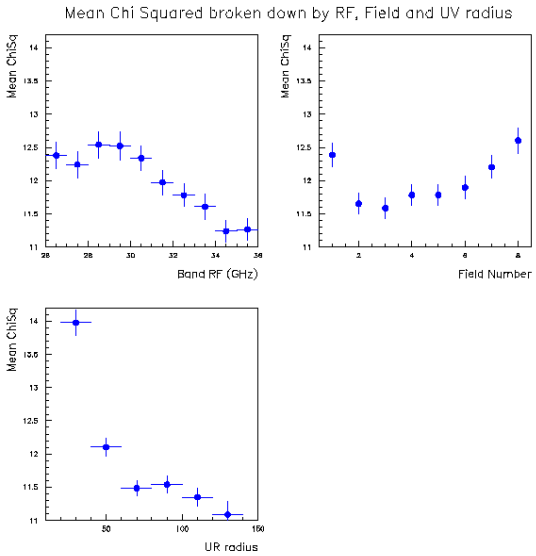


- Observe sets of 8 fields over the same azimuth range
- 8 fields as a suitable compromise between SNR on the ground signal, observing time and sample variance
- Azimuth ranges chosen to avoid obvious sources of interference
- 2 hours of observation on each field in 24 hours

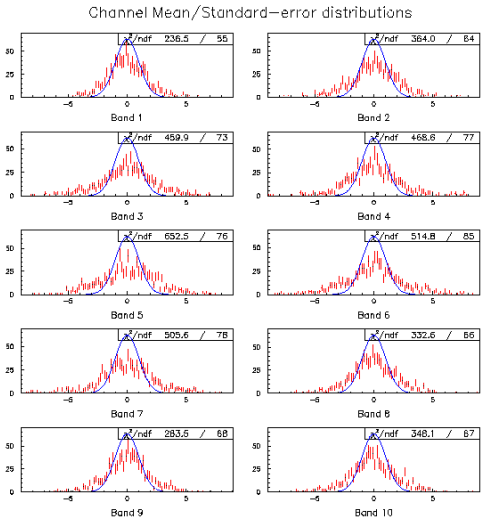


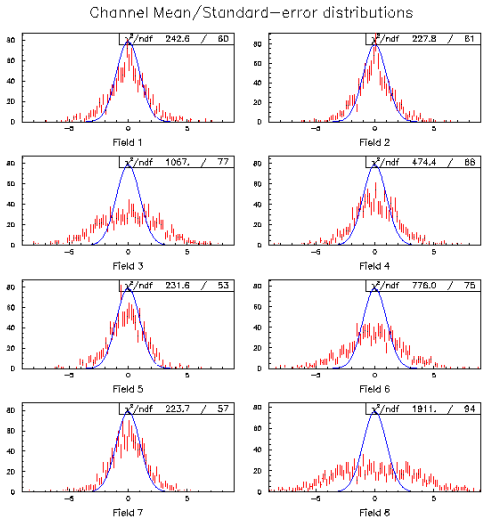


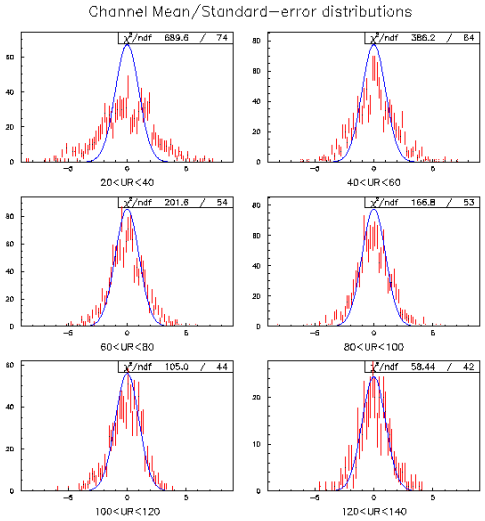


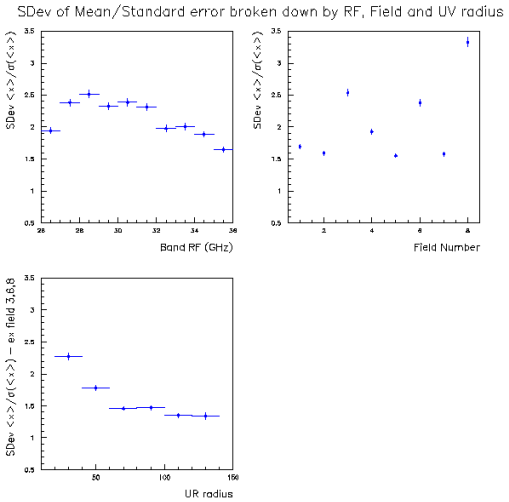


$$\chi^2 = \sum_{i=1}^{12} \frac{(x_i - \overline{x})^2}{\frac{7}{8}\sigma^2(x_i)}$$

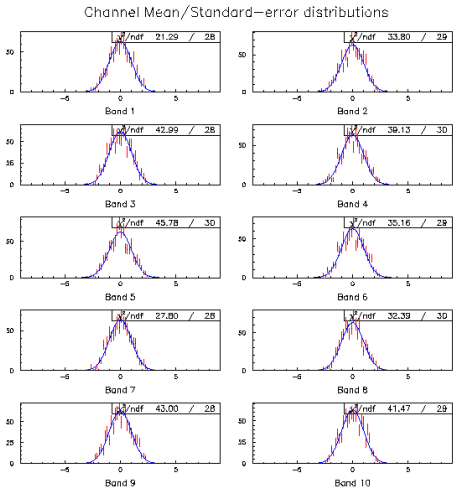


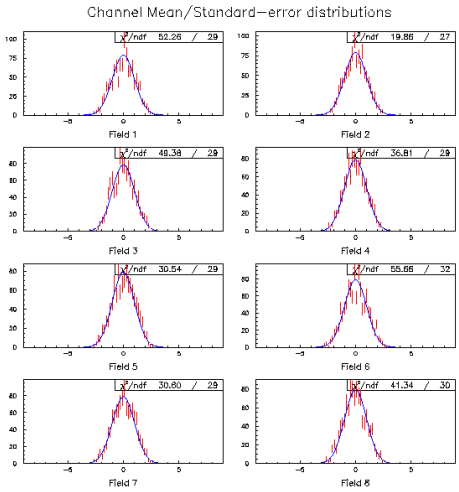


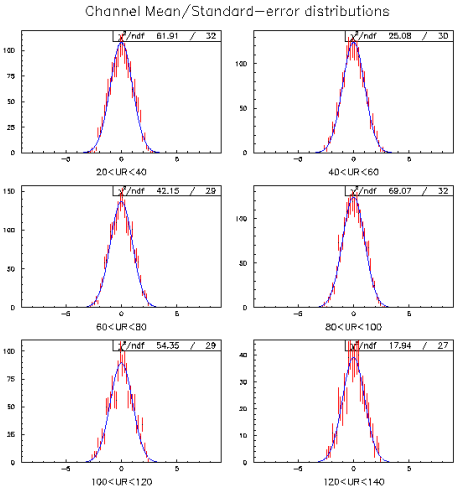


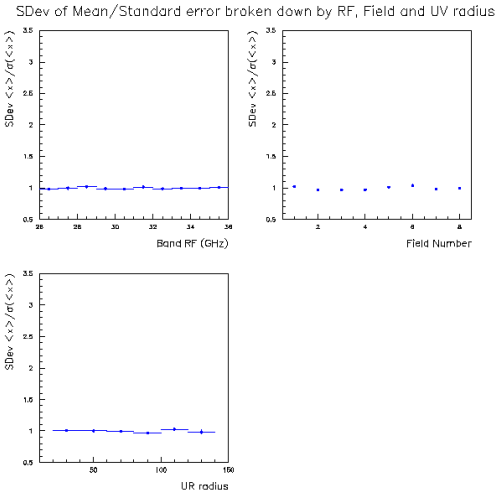


$$\overline{x} = \frac{1}{12}\sum_{i=1}^{12} x_i \qquad \sigma(\overline{x}) = \sqrt{\frac{1}{11.12}\sum_{i=1}^{12}(x_i - \overline{x})^2} \qquad Ratio = \frac{\overline{x}}{\sigma(\overline{x})}$$



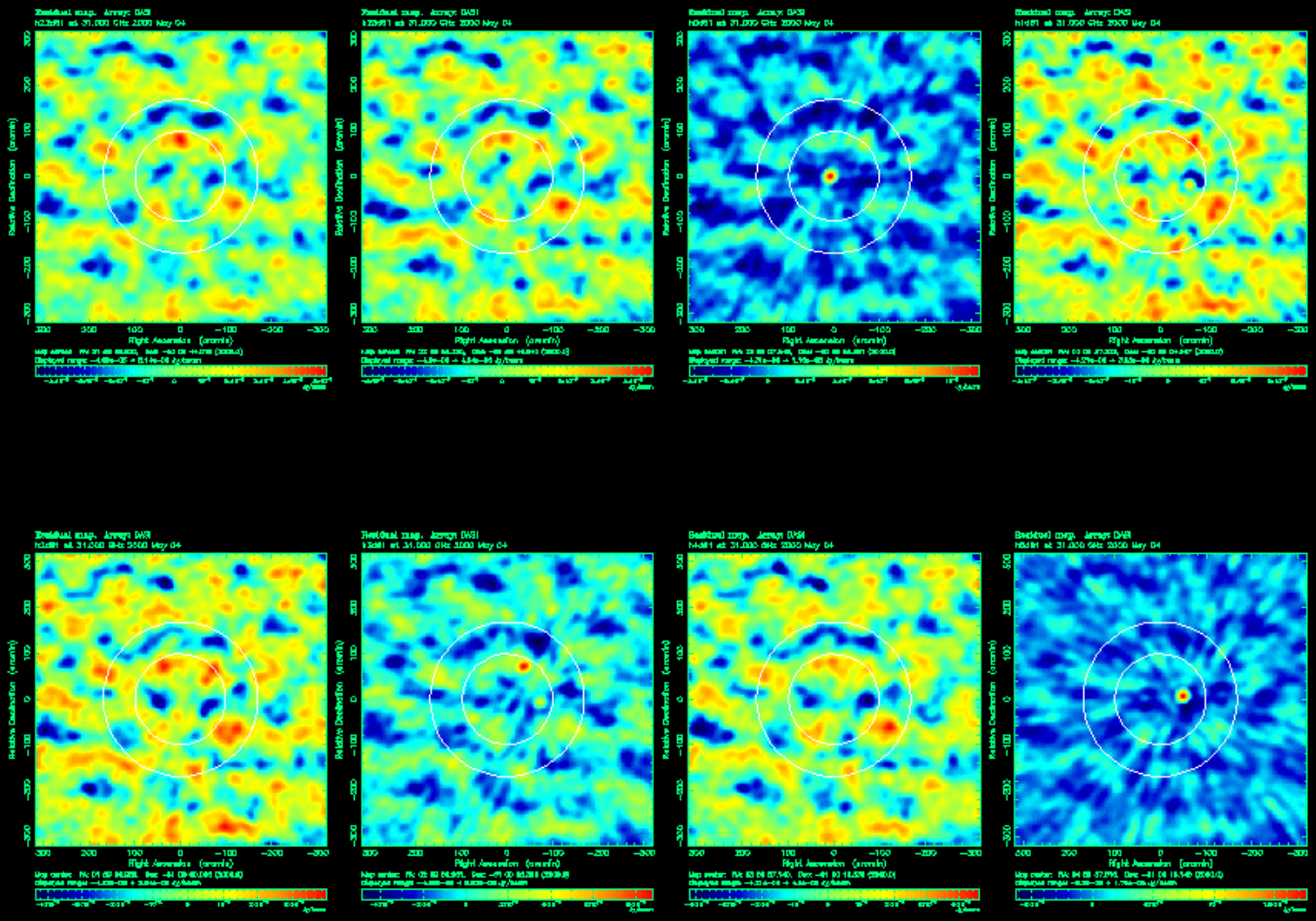




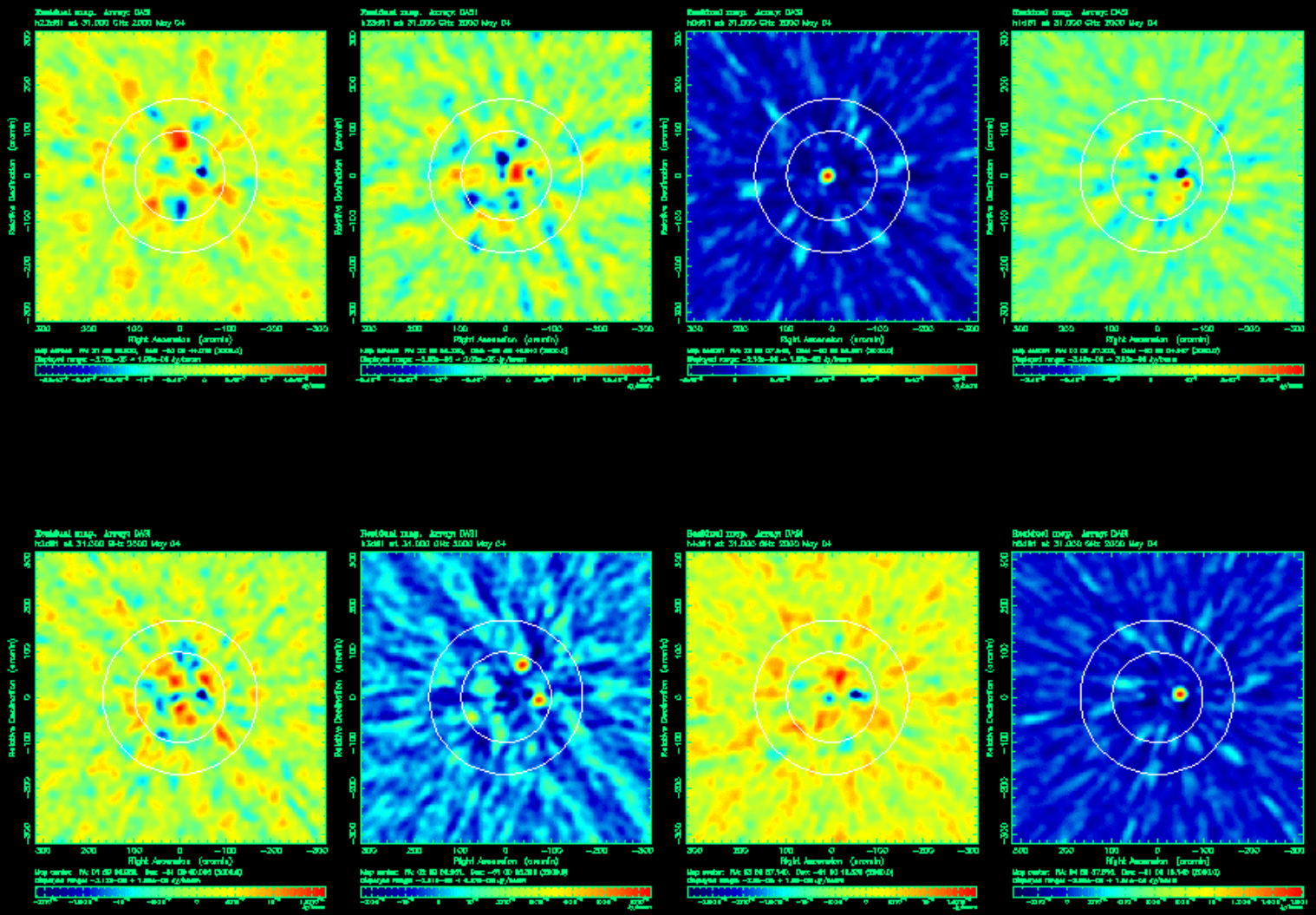


$$\overline{x_1} = \frac{1}{6}\sum_{i=1}^{6} x_i \qquad \overline{x_2} = \frac{1}{6}\sum_{i=7}^{12} x_i \qquad Ratio = \frac{\overline{x_1} - \overline{x_2}}{2\sigma(\overline{x})}$$

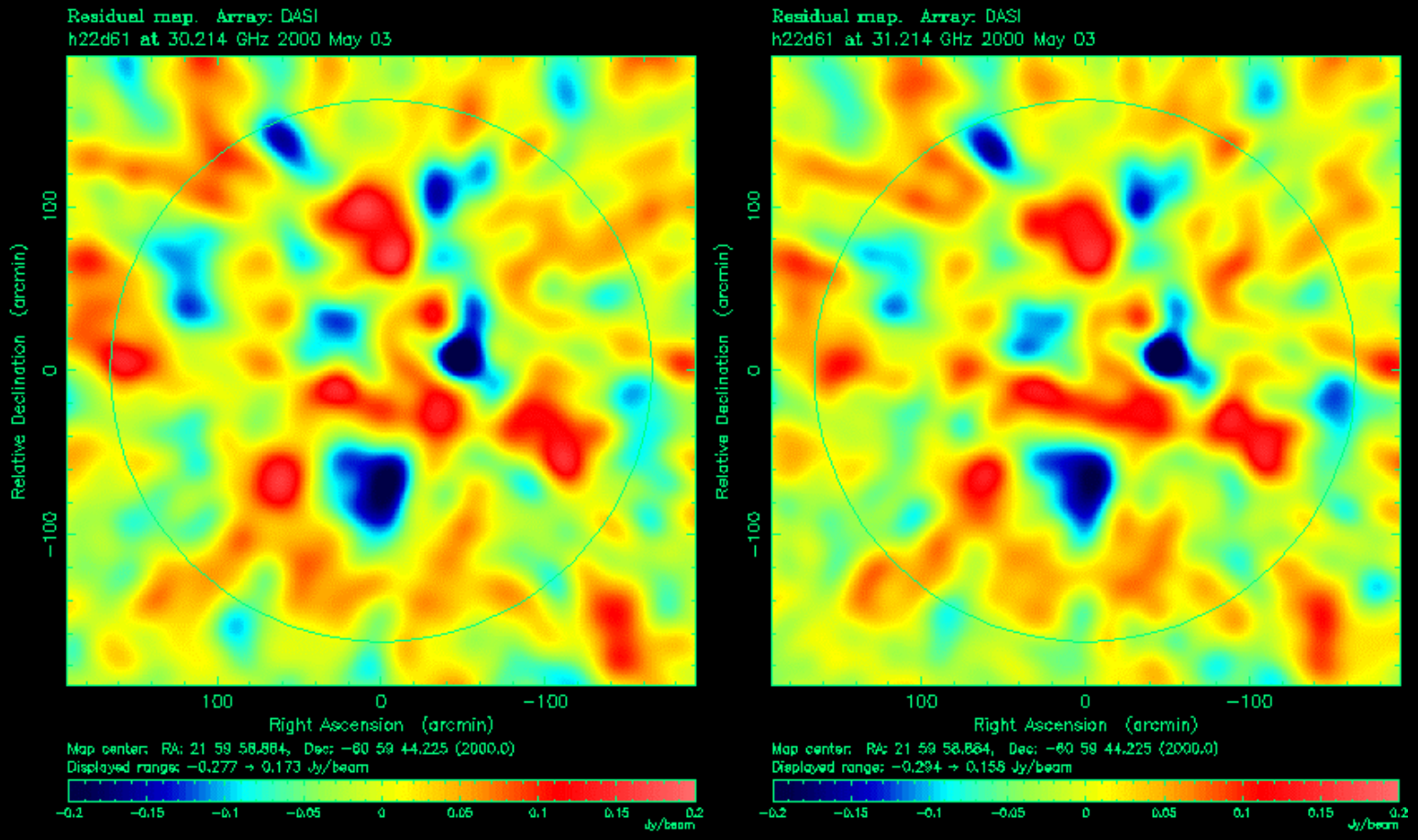
CMB A fields, no ground subtraction



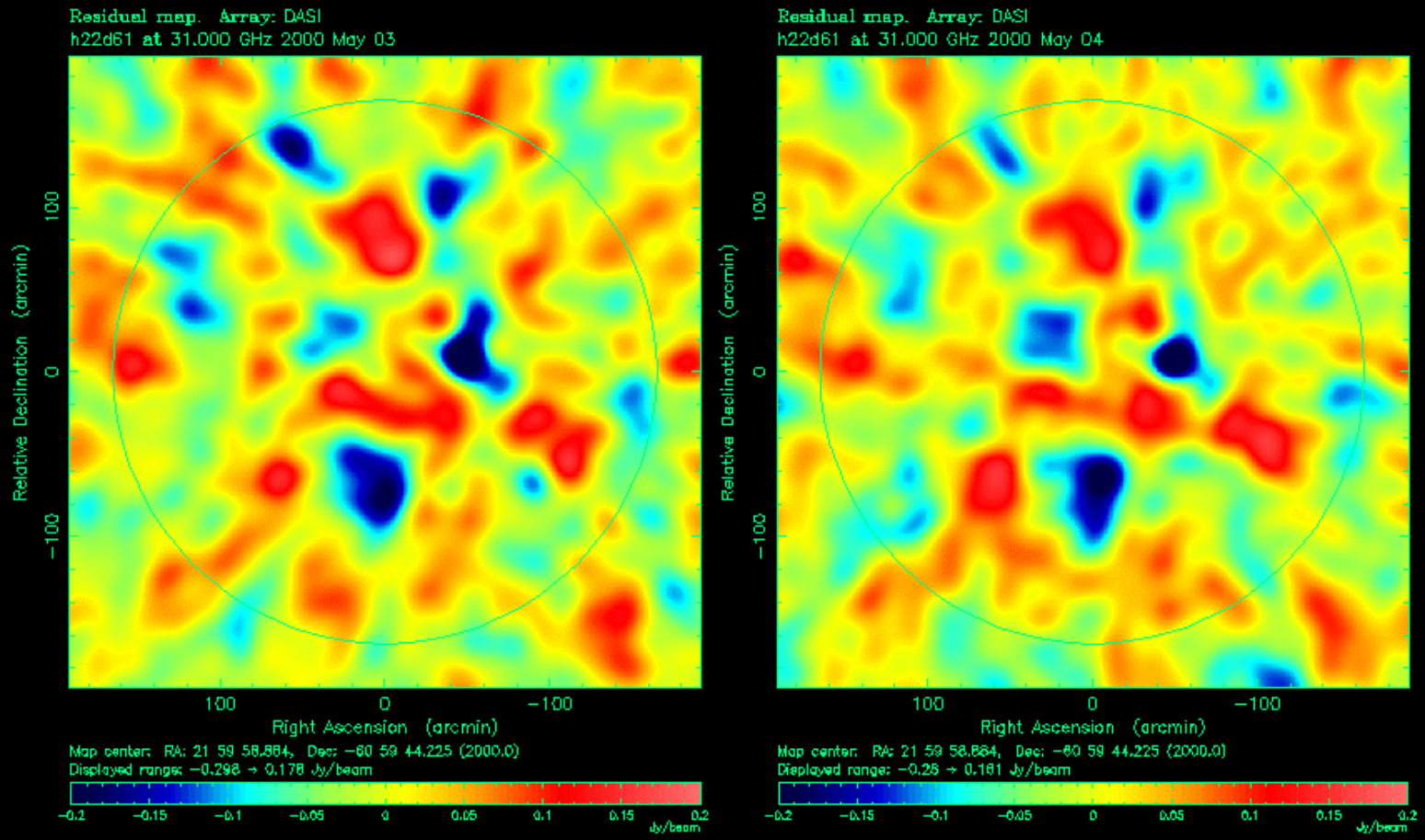
CMB A fields, ground subtracted



Comparison of data from different bands



Comparison of data from different azimuth ranges



Error on Binned Power Spectrum Estimates

- Note: this is NOT a measured power spectrum.
- (top) Current status: power spectrum errors for A + B fields, 48 hours per field.
- (bottom) Power spectrum errors as of September
- Error estimates include realistic correlations, actual data scatter.