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Overview



- 13-element, compact cm-wave interferometer
- 10 GHz band from 26-36 GHz
- Largest separation of 115 | smallest scale of 1 ~ 900
- Smallest separation of 20 | largest scale of 1
 ~ 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 5th 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



 $\theta_{dk} = 0$

RCW38 visibility amplitudes





RCW38 9-Feb-2000

UV Radius

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

120

28

30



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



34

32

²⁷GHz

36

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



Frame-based editing on all baselines

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



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



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



Channel Mean/Standard-error distributions

100

/ndf 19.86 / 27

x/ndf 52.26 / 29

Channel Mean/Standard-error distributions

/ndf 33.80 / 29

/ndf 21.29 / 28

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

CMB A fields, no ground subtraction

h22661 at 31,000 GHz 2000 May 64



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CMB A fields, ground subtracted







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Arrest DAR



Comparison of data from different bands

Residual map. Array: DASI h22d61 at 30.214 GHz 2000 May 03



Residual map. Array: DASI h22d61 at 31.214 GHz 2000 May 03



Comparison of data from different azimuth ranges

Residual map. Array: DASI

h22d61 at 31.000 GHz 2000 May 04

Residual map. Array: DASI h22d61 at 31.000 GHz 2000 May 03



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.



