C-BASS

Analysis of commissioning data

Melis Irfan and the C-bass Collaboration :

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Project Summary

C-BASS, the C-Band All Sky Survey, will produce a survey of the sky in total intensity and polarisation at 5 GHz. This frequency choice allows for a polarised template of Galactic synchrotron emission which is weakly affected by Faraday rotation. Not only will the maps provide polarised foreground measurements for component separation techniques; they will enable us to probe into the physics of the Galactic interstellar medium. The target sensitivity is 0.1 mK /beam rms. Forthcoming papers include a Northern instrument paper (O. G. King et al), a project paper (M. E. Jones et al) and a commissioning paper (S.J.C Muchovej et al).

The Northern Setup

The Northern C-BASS receiver is situated at the Owens Valley Radio Observatory (OVRO), California. It is mounted on a 6.1 m diameter Gregorian dish and is equipped with absorber baffles to reduce the detection of ground spill over radiation. The beam FWHM is 0.73 ° with far out sidelobes of less than -70 dB.

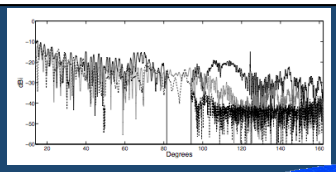


Figure Left: Northern C-BASS
Figure Below: Sidelobe measurements for Northern C-BASS without any baffles at all (black), with only the secondary /inner baffle (grey) and with both inner cone and outer rim baffles (dotted black). Holler et al (2012), arXiv:1111.2702.

The Southern Setup

The Southern C-Bass receiver will be situated within the Karoo Central Astronomy Advantage Area, South Africa. It is mounted on a 7.6 m Cassegrain dish. Both the Northern and Southern receivers follow the same design: a novel hybrid of a continuous comparison radiometer and a correlation polarimeter. Systematic errors in total intensity (Stokes I) are minimised with a comparison radiometer with balanced loads ; and errors in linear polarisation, Stokes Q and U, are minimised with a correlation polarimeter.

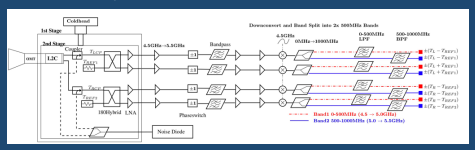


Figure Above Southern C-BASS receiver schematic. **Figure Right:** Southern receiver cold stages, bottom plate will be at 40 K whilst the top plate will be at 10 K.

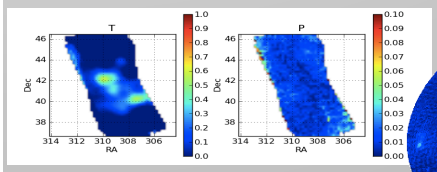
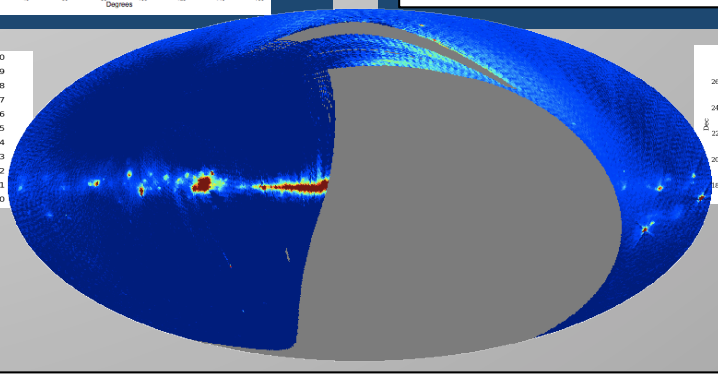


Figure Above: DR21 (Cygnus region) as seen by Northern C-BASS in total intensity (left) and total polarisation (right) . DR21 is not a polarised source so we can confirm minimal leakage of Stokes I into Q and U.



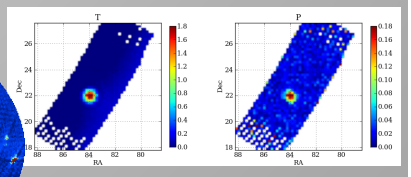


Figure Above: The Crab nebula (Taurus A) as seen by Northern C-BASS in total intensity (left) and total polarisation (right) . Taurus A has around a 7 % polarisation, hence the detection in Stokes Q and U.

Figure Above: A preliminary, not destriped, C-BASS Northern Hemisphere map clearly displaying the Galactic plane as well as several bright sources.

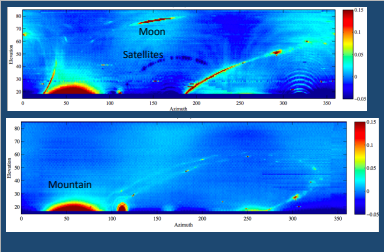


Figure Above: Intensity plots of the Northern C-Bass site taken before and after the notch filters were installed. The removal of RFI at azimuths ~ 170 ° and ~ 310 ° can clearly be seen.

Calibration and RFI removal

The Northern C-Bass site was affected by radio frequency interference (RFI) from fixed radio links. Several strong sources of RFI were indentified and successfully removed via the introduction of notch filters. Transient RFI (aeroplanes etc) are removed from the data by flagging algorithms. Northern calibration has been carried out through the measurement of well defined radio sources such as Taurus A, Cassiopeia A and Cygnus A . Opacity corrections have also been implemented to account for the atmospheric signal distortion.

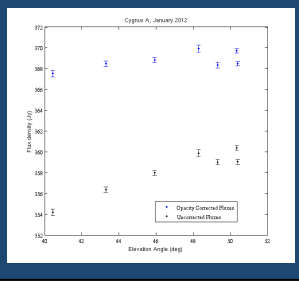


Figure Above: The flux density of Cygnus A as measured by Northern C-Bass over several dates at the beginning of January 2012. The percentage errors stem from the Gaussian fitting programme used to determine these flux densities. Opacity corrections have been applied to reduce the flux density scatter across different elevations.

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