AMiBA ground contamination tests

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In analysing the ground emission tests, it may be useful to plot the Fourier transform of the correlator data (i.e. power against fringe frequency) in order to look for contaminant ground emission. I here present some plots produced by the VSA data reduction and analysis software which may explain the idea, and the motivation behind it.

The VSA suffered from a 'spurious signal', the origin of which was never established. The signal typically had fringe rates much lower than those of the astronomical signal, although there was some overlap with short north-south baselines. The signal was visible by eye only for the VSA *Compact Array*, and unfortunately all data has now been archived! The filtering technique assumed that in CMB/SZ data, the astronomical signal was negligible, thus any slow fringe rates fitted were attributed to the spurious signal.

For illustrative purposes, I here present observations of Cassiopeia A. This is a very bright source and as such demonstrates the proceedure clearly. Please note that the slow fringe rates here are real astronomical signal - any spurious signal would be at a level far below the fringes observed. (VSA CMB data essentially looks like white noise on a single baseline. The same procedure works and does indeed identify contaminant signal, but it would not be useful to show for this illustrative purpose.)

Figure 1 shows a plot of VSA fringes on five baselines. Notice that for three baselines, the fringe rate becomes very slow and passes through zero. Figure 2 shows the same data, Fourier transformed. Notice that the three baselines identified above show power at zero fringe rate. Figure 3 show the same data, with the slow fringe rates removed. This is achieved by applying a Hanning high pass filter to the Fourier transformed data. (The Hanning filter is used as it produces only a small amount of 'ringing' in the time–domain. The small remaining ringing effect is flagged out automatically by the software). Note that these data are also fringe rotated as the software only allows application of the filter in conjunction with full reduction of the data. However, comparison of times on the x–axis clearly shows that the appropriate portion of data has been removed.

My thought is that this could be a useful diagnostic for the AMiBA ground emission study. When quickly scanning the sky I would expect the only real signal to be from the ground emission, and I would also expect it to have a slow fringe rate. It may also have applications later, depending on what other systematics come to light!

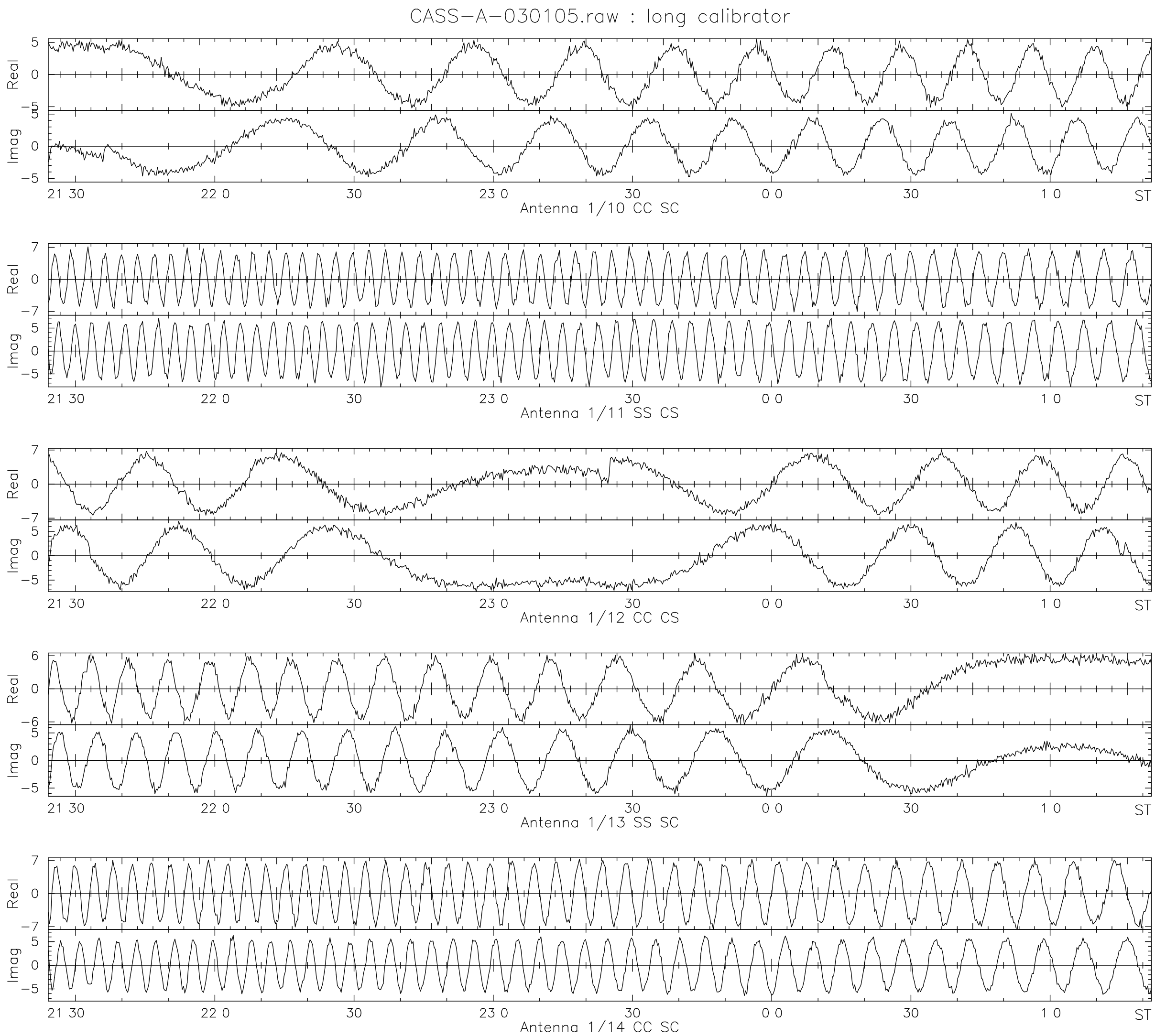

Figure 1: Fringes on five VSA baselines. Notice that the fringe rate on three of the baselines becomes very slow, and briefly goes to zero. (Aside - for any interested parties, this is a result of the addition of extra path to keep signals coherent. The fringe rate goes to zero when the extra path exactly compensates for the difference travelled by the signal from the source to the antennas in question.)

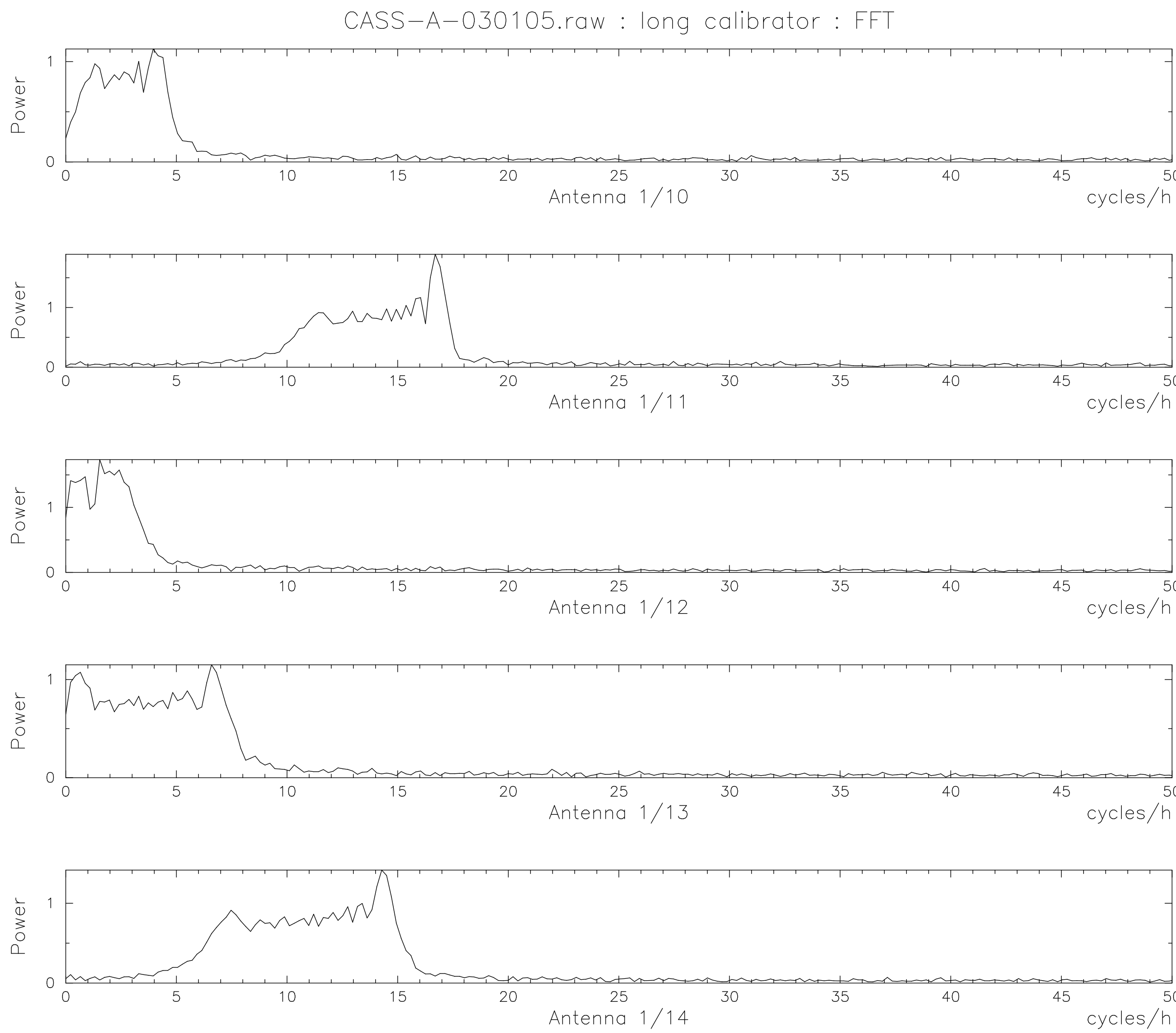

Figure 2: The same baselines, Fourier transformed to produce plots of power against fringe frequency. Notice that the same three baselines for which the fringe rates are observed to go to zero show power at sero fringe frequency.

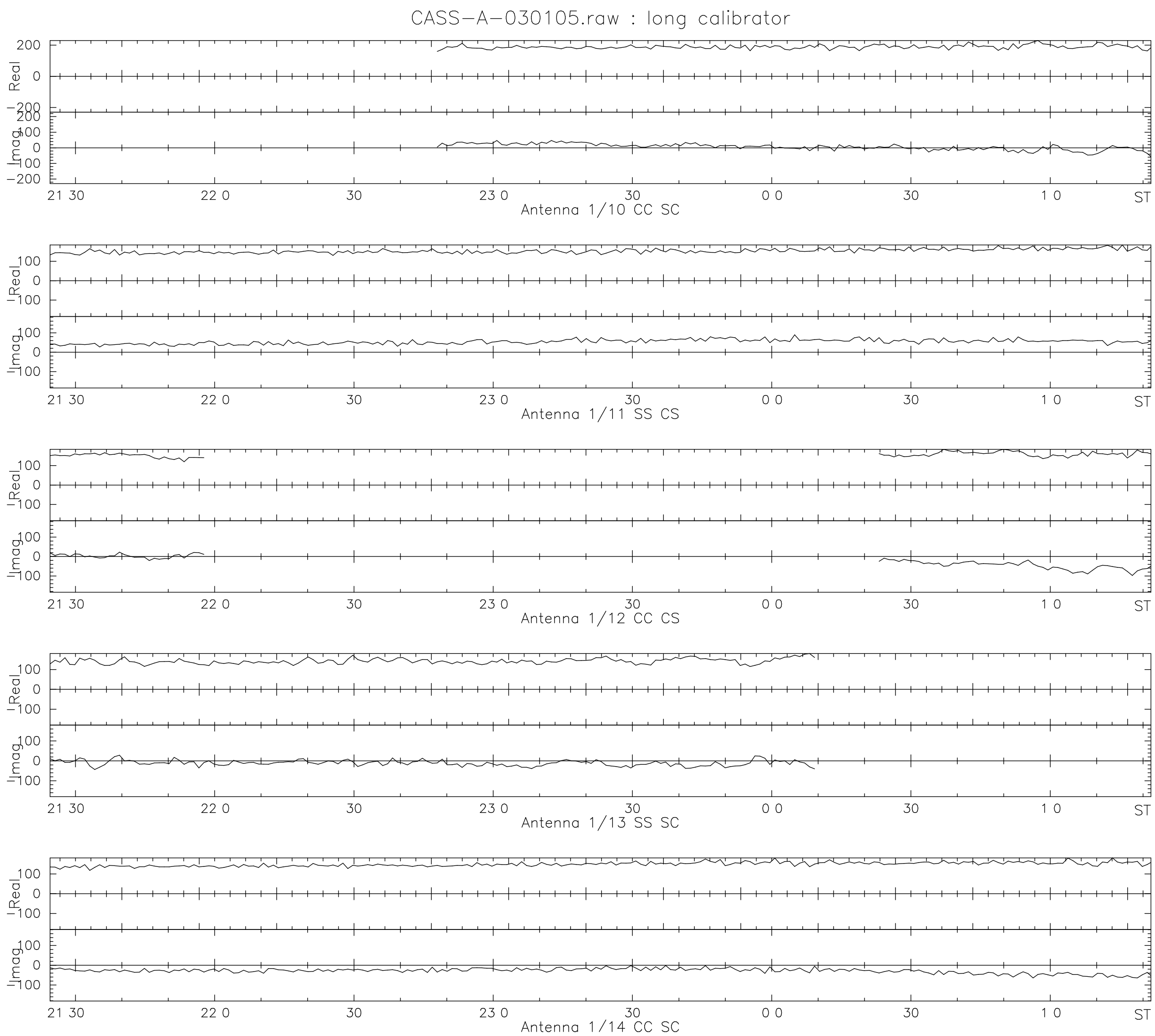

Figure 3: The same baselines, with the appropriate portions of data filered out. Note that the data have also been fringe–rotated (this is automatic - the software won't allow me to apply the filter and re-plot the fringes.) However, the x-axis can easily be compared with figure 3.