Baseline Investigation Program

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Over the last year there have been a variety of spectral baseline problems revealed which may or may not be related. It is pretty clear, however, that there is more than one problem in the system. The philosophy will be to attempt to isolate each of the observed baseline problems and if possible to remove them or at least calibrate them.

Below is a list spectral baseline problems which currently have been identified.

1. 40 MHz ripple - The spectral processor shows a variation in measured Tsys/Tcal across the 40 and 20 MHz passbands which can appear to be a ripple in the Tsys/Tcal spectrum of a receiver if spectra are concatenated. The amplitude can be as large as 10% of the system temperature. This has probably colored the baseline measurements made with the 1.2-1.7 GHz receiver, and we know that it affected the 4-6 GHz receiver measurements before the spectral processor signature was recognized. The cause of this spectral processor distortion needs to be investigated.

In the 4-6 GHz receiver we see a 48 MHz ripple in Tsys/Tcal as measured with the spectrometer and with the spectral processor after the above effect is removed. This ripple has an amplitude that varies from about 1 to 7 percent across the receiver passband. This 48 MHz ripple does not appear in the Tsys/Tsource spectrum, which leads us to believe that the ripple is in the calibration noise source amplitude.

2. K-band, channel B instability - While performing a beam-switched observation it was noted that although both channels always had some baseline structure that in most instances channel B was not usable. The problem appears to be in the receiver room, outside the dewar, but before the fiber interface. Note that even the 'good' channel appears to be less stable than one expects. This could be more than one problem but we need to understand the stability problems.

3. 2.4 MHz ripple - This ripple was first observed at X-band but was later observed in all 8 IF channels. It was later tracked down to be associated with the optical IF links. It appears to be internal to the optical modulator used in the links. The structure appears to be very stable but this stability needs to be confirmed, and the 2.4 MHz gain ripple needs to be kept in mind when analyzing baseline problems. It will be present in all receiver spectra with a peak-to-peak amplitude of about 0.3%. Some fiber modems may be worse than others, so an inventory should be conducted and possibly the modems with the smallest gain ripple placed in the most frequently used channels.

4. L-band, YY Pol channel - One polarization contains significant baseline structure when using frequency switching with the spectral processor. It appeared that this structure was arising from the RF filter component. Inspection of this component

revealed no suspicious problems but the baseline structure persists. More work is required.

Baseline variations with smaller amplitudes were also observed as a function of subreflector position in both polarizations. The standard +/- lambda/8 defocussing appeared to cancel most of this structure. This baseline structure needs to be better characterized as there were multiple effects involved during these observations.

5. OMT resonances - Several OMT resonances have been identified in the 4-6 GHz receiver. Similar resonances exist in other receivers and need to be measured and documented. Currently, laboratory measured frequencies for the PF1, 1.2-1.7, and 2-4 GHz receivers have been made.

A few general guidelines about observing strategy.

1. Check for stability in any baseline structure by repeating each experiment more than once. Even if we do not understand where the baseline structure is being generated we might be able to calibrate it.

2. Perform all observations at night to remove the effects of the Sun. (Unless we specifically want to measure the effects of the Sun.)

3. In general, do not balance any attenuators after an observation begins, unless as a specific test.

4. Perform at least a subset of the observations with a different front-end. (e.g., if we observe repeatable baseline structure at L-band it would be useful to observe in a similar mode at S-band to check that the problem is not isolated to the L-band receiver.)

5. Perform at least a subset of the observations with a different bank-end. (e.g., use both the spectrometer and the spectral processor if possible to check if the problem is isolated to a specific back-end.)