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To: EDGES Group
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 Subject: Simulations of moisture on blade antenna

The high band blade antenna shows significant changes in the calibrated spectra. The largest change appears to be correlated with days when the relative humidity approaches 100 percent. As discussed in memos 154 and 161 high humidity is likely the result in condensation on the antenna. In the case of the Fourpoint moisture on the quartz is most likely to change the S11 via added capacitance and loss. In the case of the blade moisture is likely to effect the capacitance of the gap between panels. Tests of panels printed with Goldstone paint show they can be up to 3 K below ambient.

Figure 1 shows a photograph of a substantial amount of condensation observed on the blade antenna at the MRO. Electromagnetic simulation using FEKO show the changes in the gap produce changes in S11 of at the level of about 0.05 dB/percent change in gap width.

Figure 2 shows a sequence of spectra from days 204 to 237. Days 219 and 231 are examples of spectra which show a significant difference from the average.

Figure 3 shows a simulated spectrum made by adding the change for a 18% decrease in the gap amplitude and phase to the antenna S11 amplitude and phase as measured.

Figure 4 shows the result of adding 1 pf to the “topcap” capacitance. Table 1 summarizes the results.

| Change | rms with 1 term removed (mK) | rms with 4 terms removed (mK) |
|--------------------------------|------------------------------|-------------------------------|
| 1 pf on topcap | 3300 | 390 |
| 18% reduction in gap | 2036 | 147 |
| 2% reduction in antenna height | 1330 | 267 |

Table 1

Figure 2, 3 and 4 have 4 polynomial terms removed. Given the good match between the spectrum on days with high humidity and the simulated spectrum with an increase in the topcap capacitance it is most likely that the observed changes are due to moisture in the vicinity of the topcap. If this is observed to be the case a simple fix might be to encapsulate the topcap with a sealed clear plastic (PVC) cover which might also include a desiccant.



Figure 1. Moisture condensation on blade antenna at the MRO.

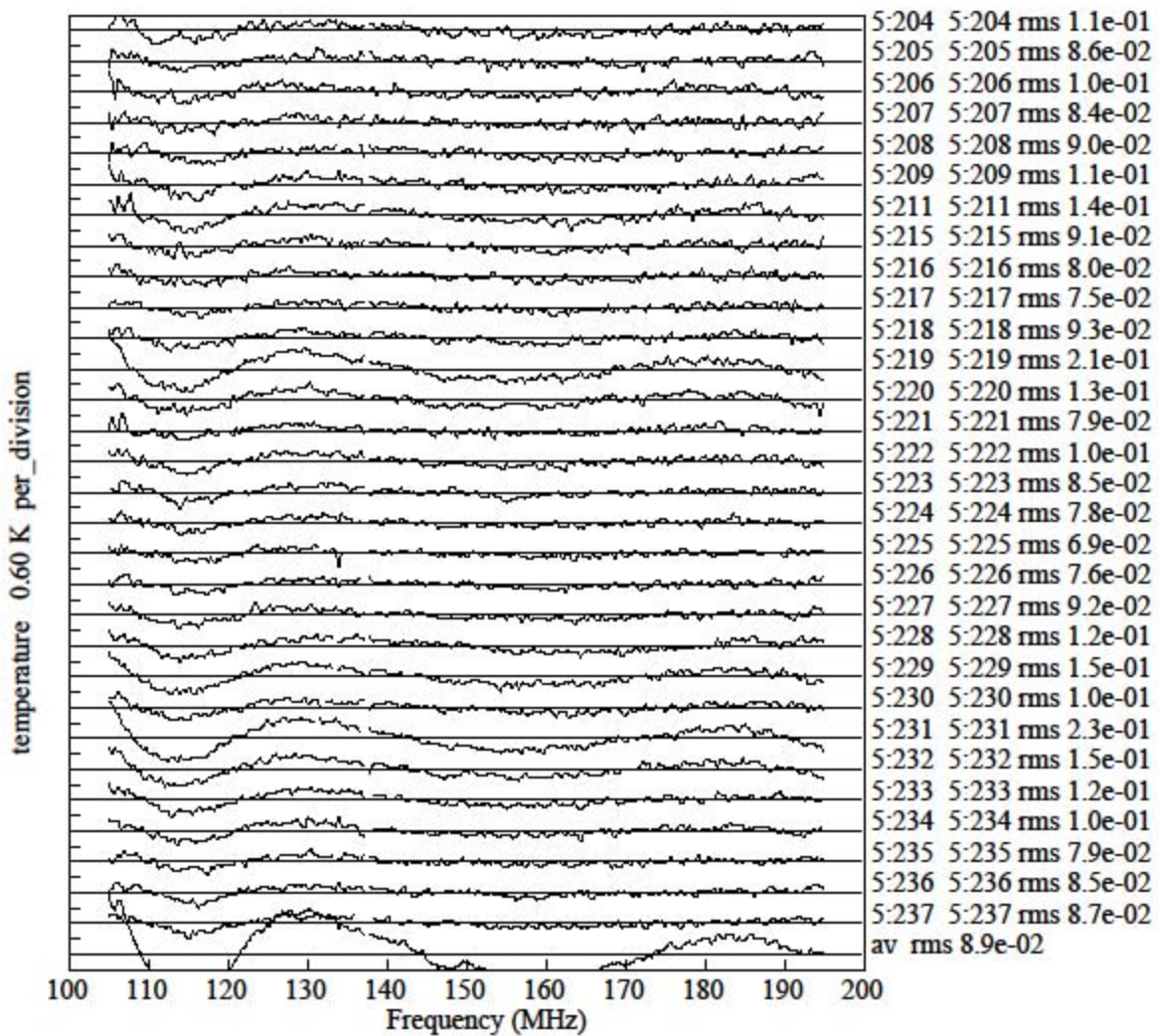


Figure 2. Nighttime spectra with 4 poly terms removed. Days 219 and 231 show significant differences. These days had high humidity after midnight.

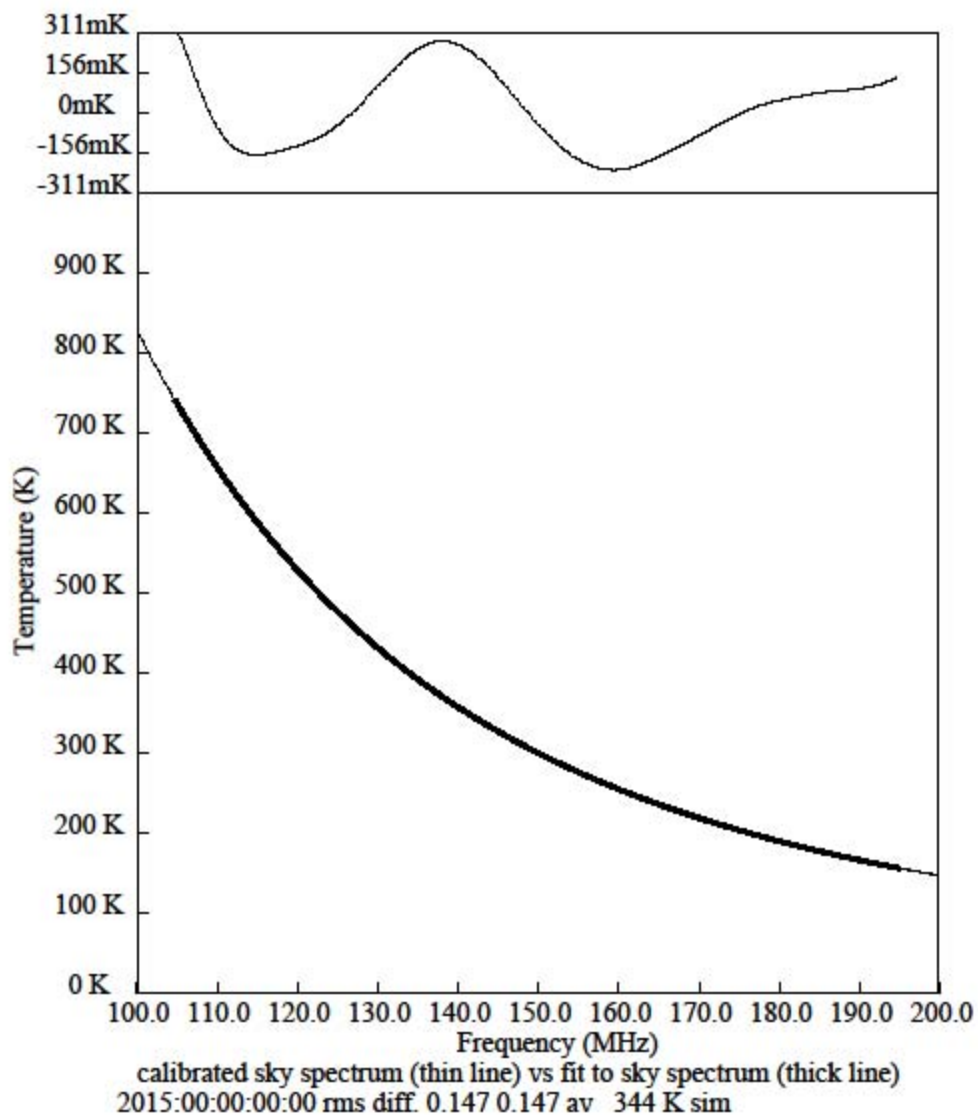


Figure 3. Simulated residual spectrum with 18% reduction in panel gap. 4 terms removed.

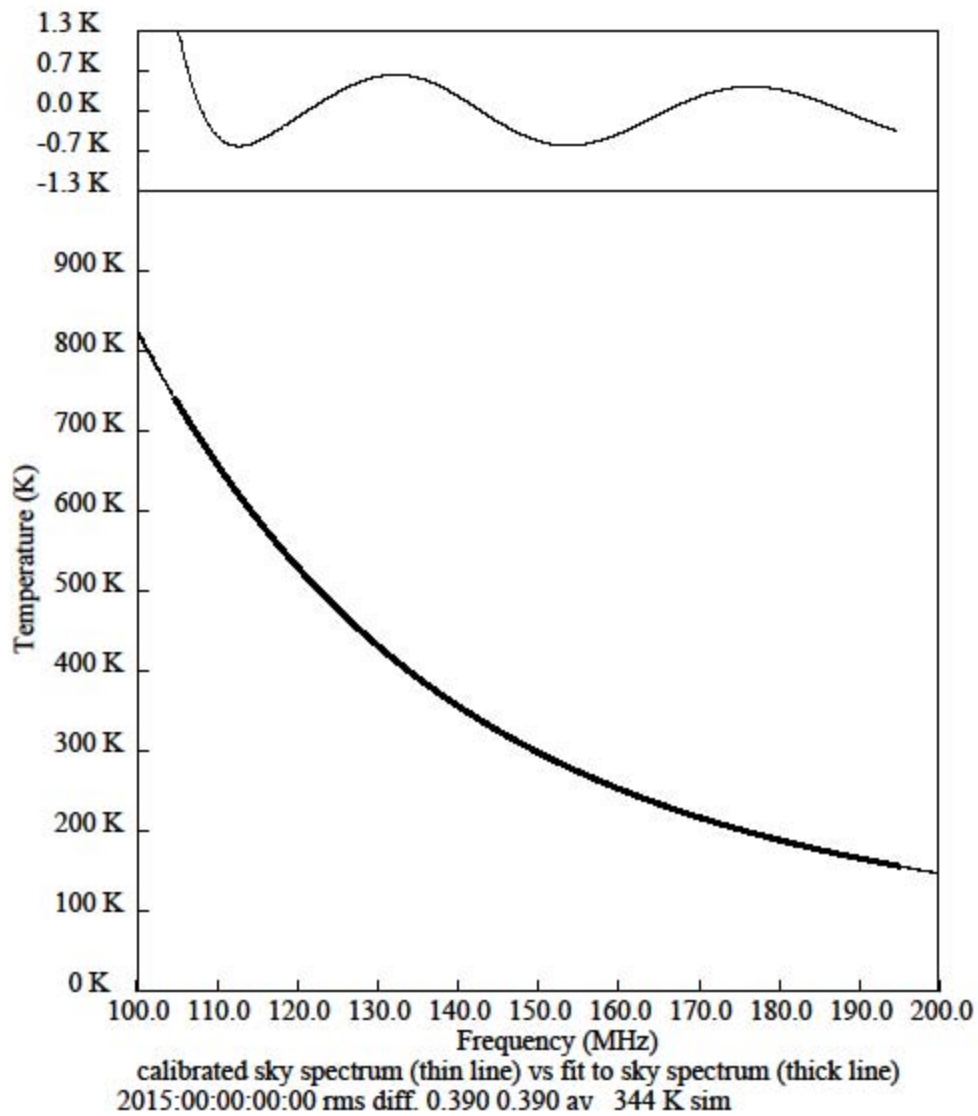


Figure 4. Simulated spectrum with 1 pf added topcap capacitance.