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To: EDGES Group  
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Subject: EDGES-3 Test observations at West Forks Maine

A test of the EDGES-3 system was made at the Ball field in West Forks. This site is relatively free of RFI from FM and digital TV. It has been used for EDGES tests a number of times the most recent being July 2011 as described in memo #75. On Wednesday 24 July 2019 the EDGES-3 prototype was installed on a 12'x6' meandering wire grid group plane using #18 awg wire and 18 pegs. This was smaller than the wire grid used in 2011 owing to the limited time available owing to the greater complexity of the EDGES-3 assembly summarized in Figure A at the end of the memo. Figure 1 shows the antenna S11 measured using automated SOL load calibration of the Fieldfox VNA in EDGES-3. This result was obtained using the shorter pipe lengths of 13.5" needed as a result of the test measurements described in memo #302. Figure 2 and 3 show the calibrated spectra for the receiver box with cover removed and with the cover installed with all screws respectively. The spectra are similar to that obtained in 2011 with the following differences:

- 1] The strongest FM signal at 105.1 MHz is broadened at the base in the EDGES-3 spectrum in EDGES-3 spectra.
- 2] There is RFI or an artifact in the 60-65 MHz range in the EDGES-3 spectra.
- 3] There is more fine frequency structure in the EDGES-3 spectra.

#### EDGES-3 spectra

Since there are only small differences between spectra with and without a cover it seems unlikely that the difference are the result of self-generated RFI from EDGES-3. Figures 4 and 5 compare the spectra with EDGES-3 with that from EDGES-2 in 2011 on the same log scale.

In a separate test of EDGES-3 made in the screen room at Haystack the spectrum of the fully assembled EDGES-3 with compared with and without the cover on and off in figures 6 and 7 respectively. On a fine scale there are some differences at the 10 K level. For example the rails with about 400 KHz spacing seen in Figure 2 above the FM band with the box cover off are also seen in the spectrum in the screen room with the box cover off showing that the box cover is needed to eliminate the leakage from the Nuvo DC/DC converter. A more sensitive test is still needed to be sure the leakage with cover in place is at the millikelvin level.

#### Summary

The test at West Forks provided a check on the level of self emissions. Based on the differences between measurements with antenna box cover removed the self emission levels are probably below 10 K with cover in place. The emissions in the 50-65 MHz are probably the result added external signal sources at West Forks which now has a very visible cell phone tower. Another trip may be needed to identify this source or we could just wait for a test deployment in Oregon. The broadened spectra at the base of strong signals is most likely due to a Spurious Free Dynamic Range (SFDR) problem with the Signatec PX14400 card or the FASTSPEC software. A separate test following the return from West Forks shows that the spectra taken using a signal generator show broadening with signal level which are well below ADC saturation which are not present in tests done with EDGES-2 and pxspect software.

Tests done with a signal generator back in the screen room at Haystack show that the problem is in the use of “multiple window taps” in FASTSPEC. The problem is a software error in the use of window taps beyond the first. This error will be fixed but the data cannot be corrected so we may consider another visit to West Forks prior to the deployment in Oregon. The signal around 60-65 MHz may be from a 39 kW TV station (CKLT-TV-1) in Canada broadcasting in analog on channel 3.

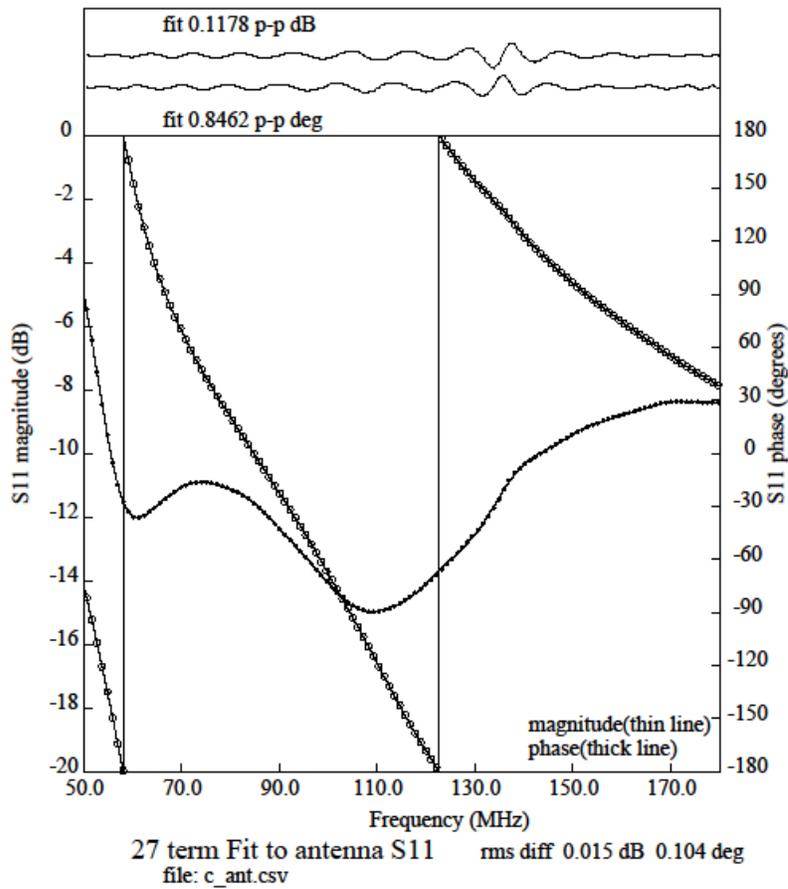


Figure 1. EDGES-3 S11 at West Forks, Maine.

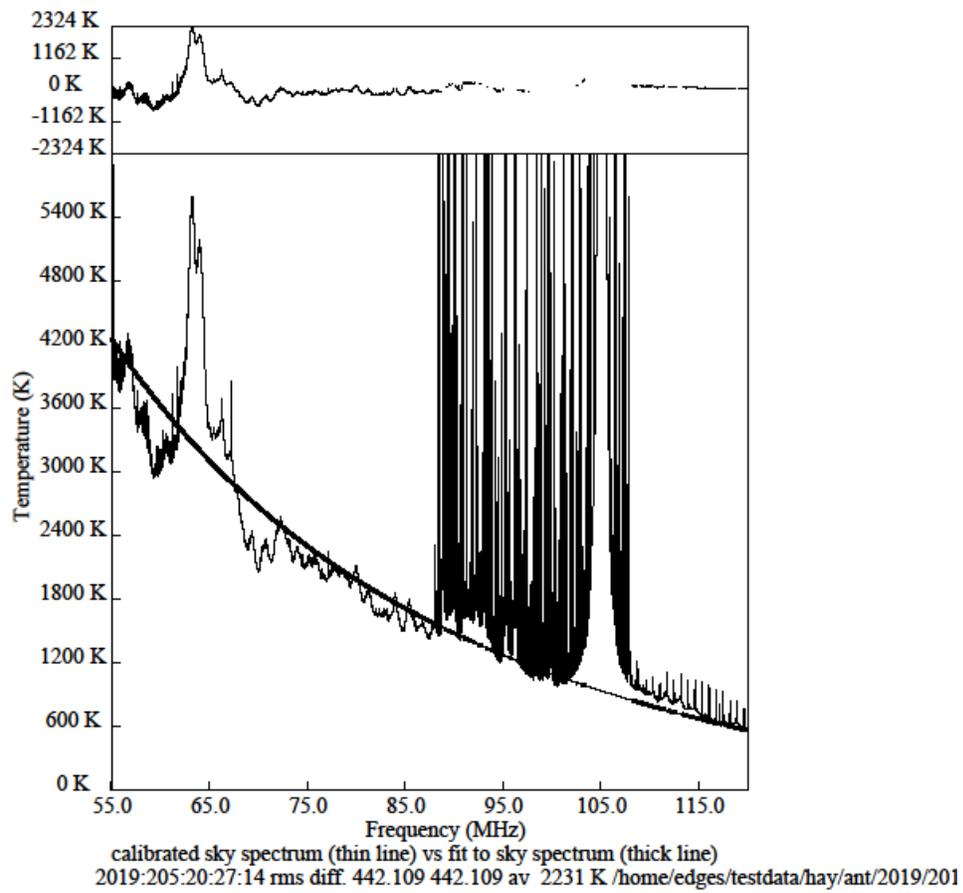


Figure 2. Spectrum at West Forks with antenna box cover removed.

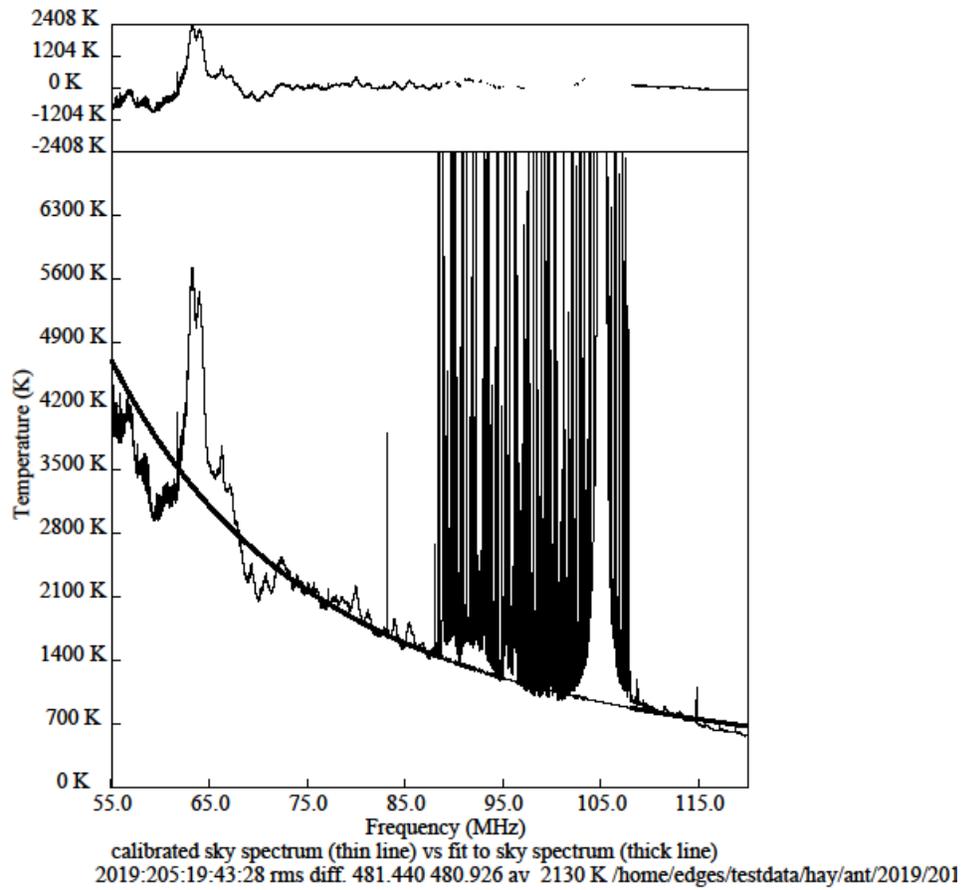


Figure 3. Spectrum with cover screwed down with all screws.

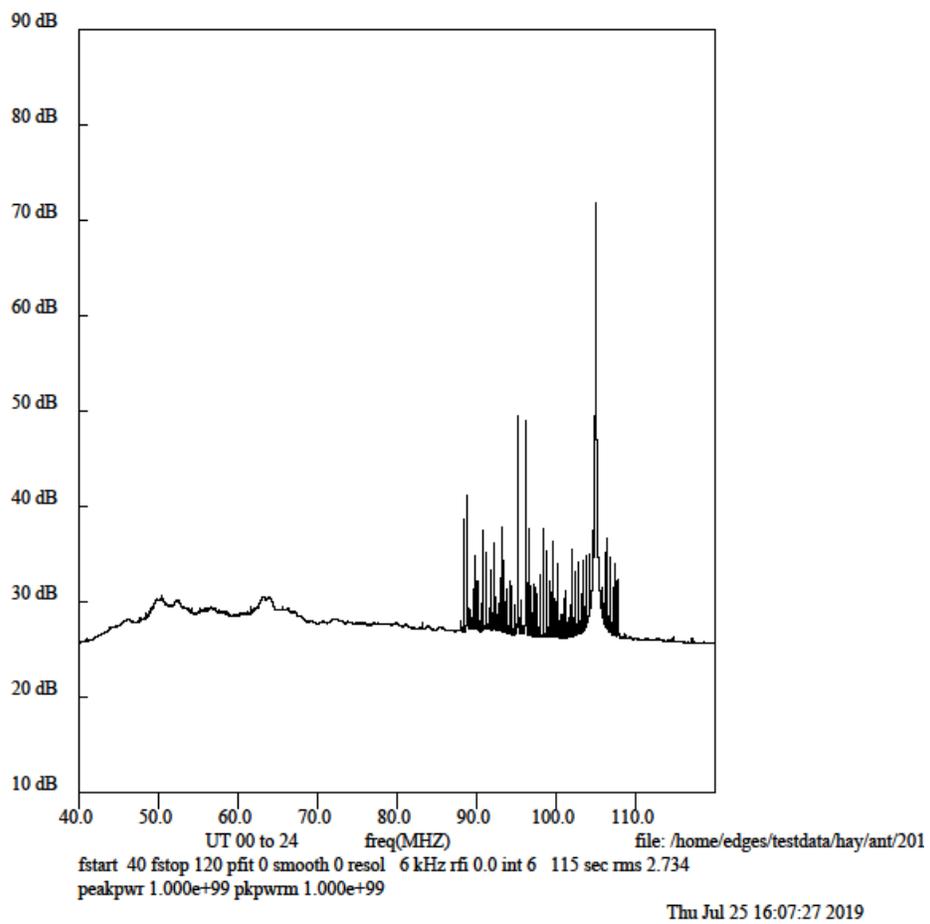


Figure 4. Spectrum from West Forks 23 July 2019 on log scale.

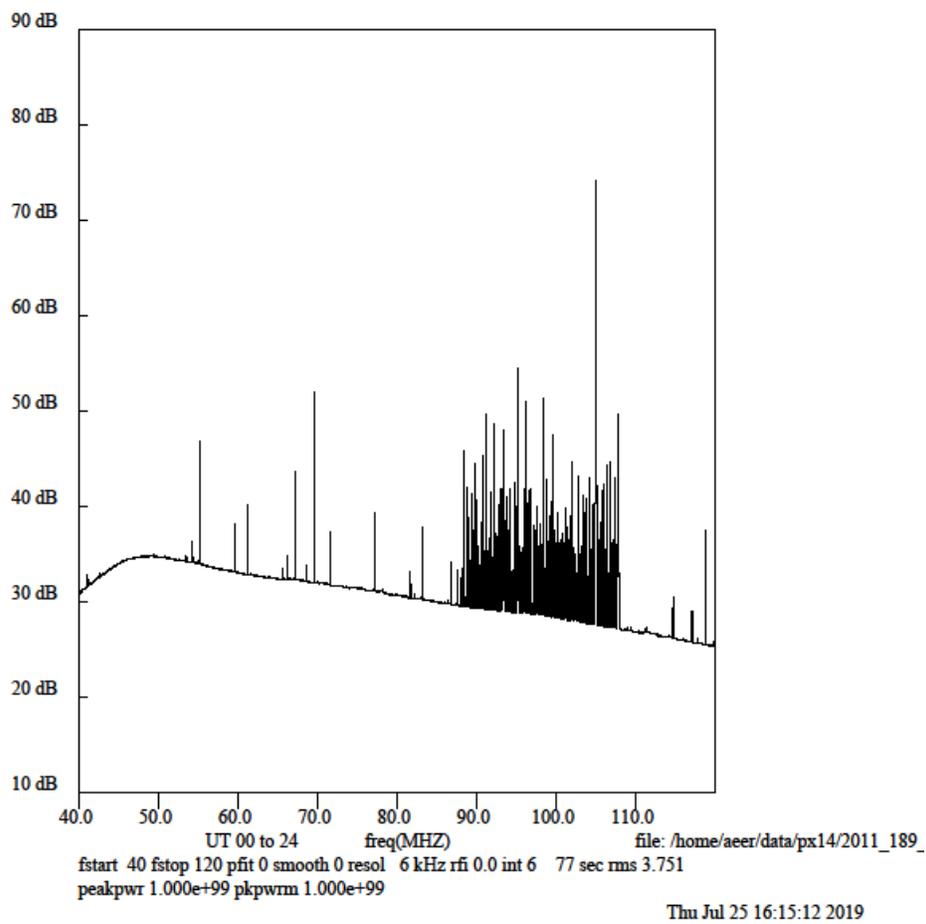


Figure 5. Spectrum from West Forks using low band prototype in July 2011.

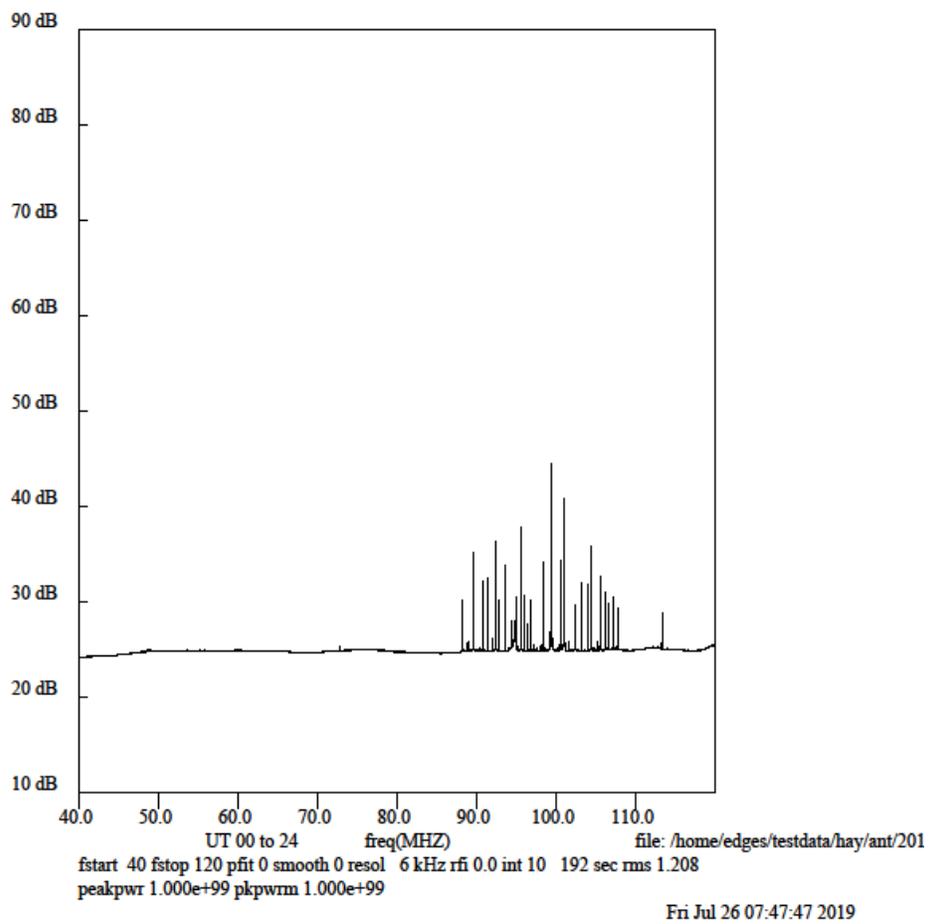


Figure 6. Spectrum in screen room with box cover on.

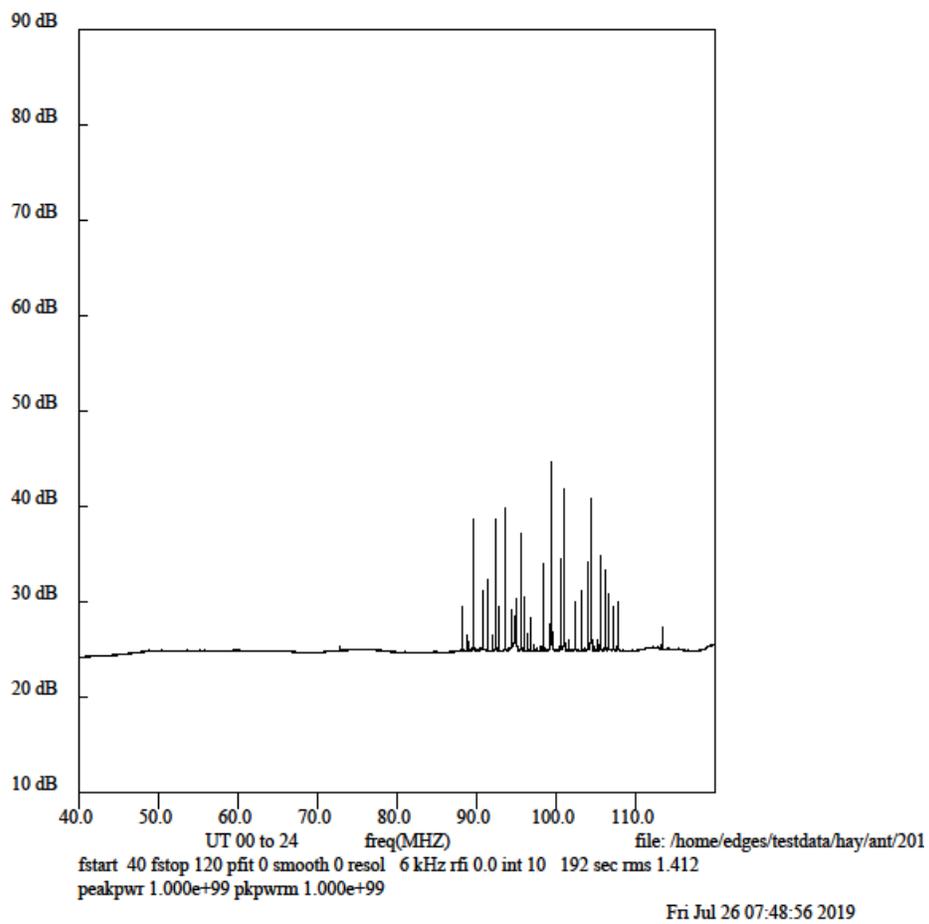
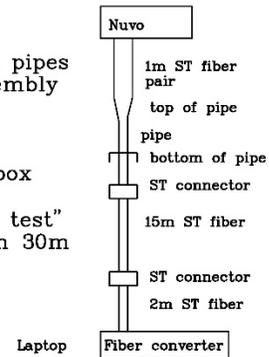
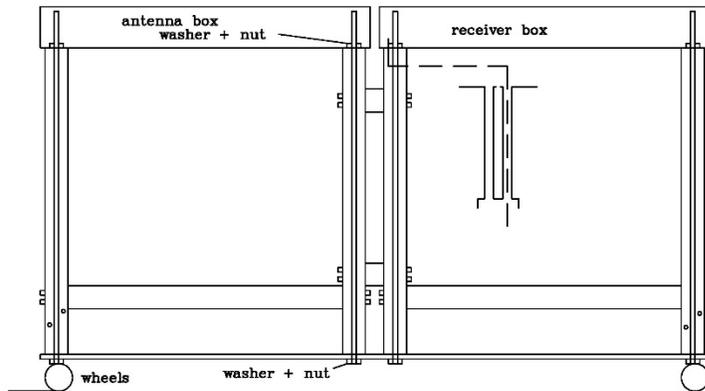


Figure 7. Spectrum in screen room with box cover off.

- 1] Assemble base with washers and nuts under the plywood and horizontal fiberglass sections tightened
- 2] Add antenna and receiver box without top covers
- 3] feed fiber from inner box down through hole and unattached pipes
- 4] Adjust antenna and receiver box separation so that pipe assembly can be attached with screws from below
- 5] Add washers and nuts and tighten
- 6] Check that box separation is about 1.5"
- 7] Carefully add SMA connection between antenna and receiver box
- 8] Connect Laptop via fibers using ST connectors
- 9] Put cover on antenna box and connect battery for "no cover test"
- 10] Put cover on receiver box - watch temp should be OK to run 30m
- 11] remove receiver box cover - to change battery



**EDGES-3 Assembly**  
 initial prototype with wheels  
 for test at West Forks Maine

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Figure A. Assembly sequence used at West Forks.



Figure B. EDGES-3 prototype assembled at West Forks Ballpark.