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June 11, 2024

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To: EDGES group

From: Alan E.E. Rogers

Subject: Sharp spectral features in EDGES-3 data from scintillations

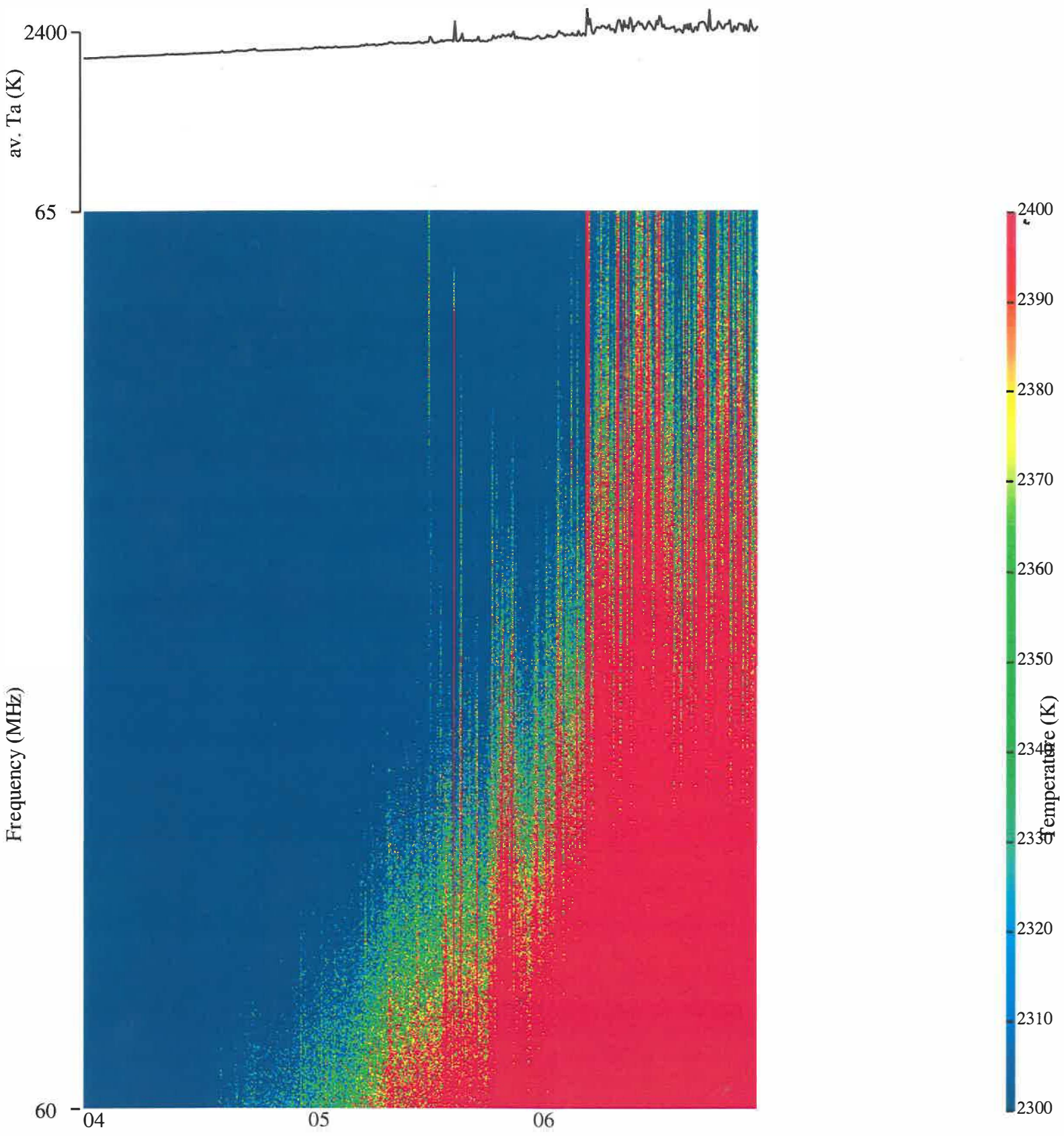
A study of the effects of the solar activity that are limiting EDGES-3 data to times when the sun is more than 20 degrees below the horizon was started in memo 438. The suggested mechanism was that 3c273 was being focused by intense regions of ionized plasma in the interplanetary medium or upper E for F layers of the ionosphere. The figures in memo 438 show that a spectral bump at about 65 MHz is occasionally present on a time scale of about one or two minutes. Tests of the effects on the results of measuring the global 21-cm absorption for a sun elevation of 0, 10, 20 and 30 degrees below the horizon are shown in Figure 1 of memo 448 and Figure 3 of memo 448 show how the FM reflections were greatly enhanced during this event when the sun was more than 20 deg below the horizon.

In this memo we show the waterfall plot of the data from day 156 (4 June 2024) in Figure 1 to show the brief broadband spectrum with a peak at about 65 MHz at 05:33 UT. Details of the spectrum of the “spike” at 05:33 UT in Figure 1 are shown in Figure 2 for steps of time in 0.01 hours of GHA. Figure 3 shows the spectral residuals at the next “spike” which occurs about 6 minutes later and has a more complex spectrum.

Some tests were made to see if setting a lower threshold on the “maxrmsf” in the acqplot processing of each 3-position switch cycle could be used to “clean-up” the spectra by not including switch cycles with higher rmsf. The result of this test on the data shown in figure 2 is shown in Figure 4 and while this looks encouraging it turns out that in general the spectra from this period of high solar activity are too complex and more continuous to offer much hope of getting much data useful for the extracting global 21-cm signal when the sun is at an elevation of more than 20 degrees. Another possibility under study is to use shorter data blocks than the one hour data blocks which are as short as the 6 minute data blocks used in some of the analysis of the data from Devon Island in memo 402.

In summary it looks like the acquisition of global 21-cm data from the WA is currently limited to periods when the sun is more than 20 degrees below the horizon. The exact mechanism for the added emissions with the fine structure in time and frequency could be scintillation of point radio sources or type 3 solar bursts from suprathermal electron beams propagating along open and quasi-open magnetic field lines or possibly a type 4 solar burst bent by refraction so that the sun has to be well below the horizon to avoid the emission. Solar radio emission with the sun below the horizon during the solar max in 2015 is reported in Marque et al.

ref. Marqué, C., Klein, K.L., Monstein, C., Opgenoorth, H., Pulkkinen, A., Buchert, S., Krucker, S., Van Hoof, R. and Thulesen, P., 2018. Solar radio emission as a disturbance of aeronautical radionavigation. *Journal of Space Weather and Space Climate*, 8, p.A42.



UT 4.00 to 7.00

EDGES-3 data from WA

Tues Jun 4 2024

fstart 60 fstop 65 pfit 0 smooth 0 resol 6 kHz rfi 0.0 nline 457 scint 2921

Figure 1. Waterfall plot of the spectra from EDGES-3 at the WA from 04 to 07 UT

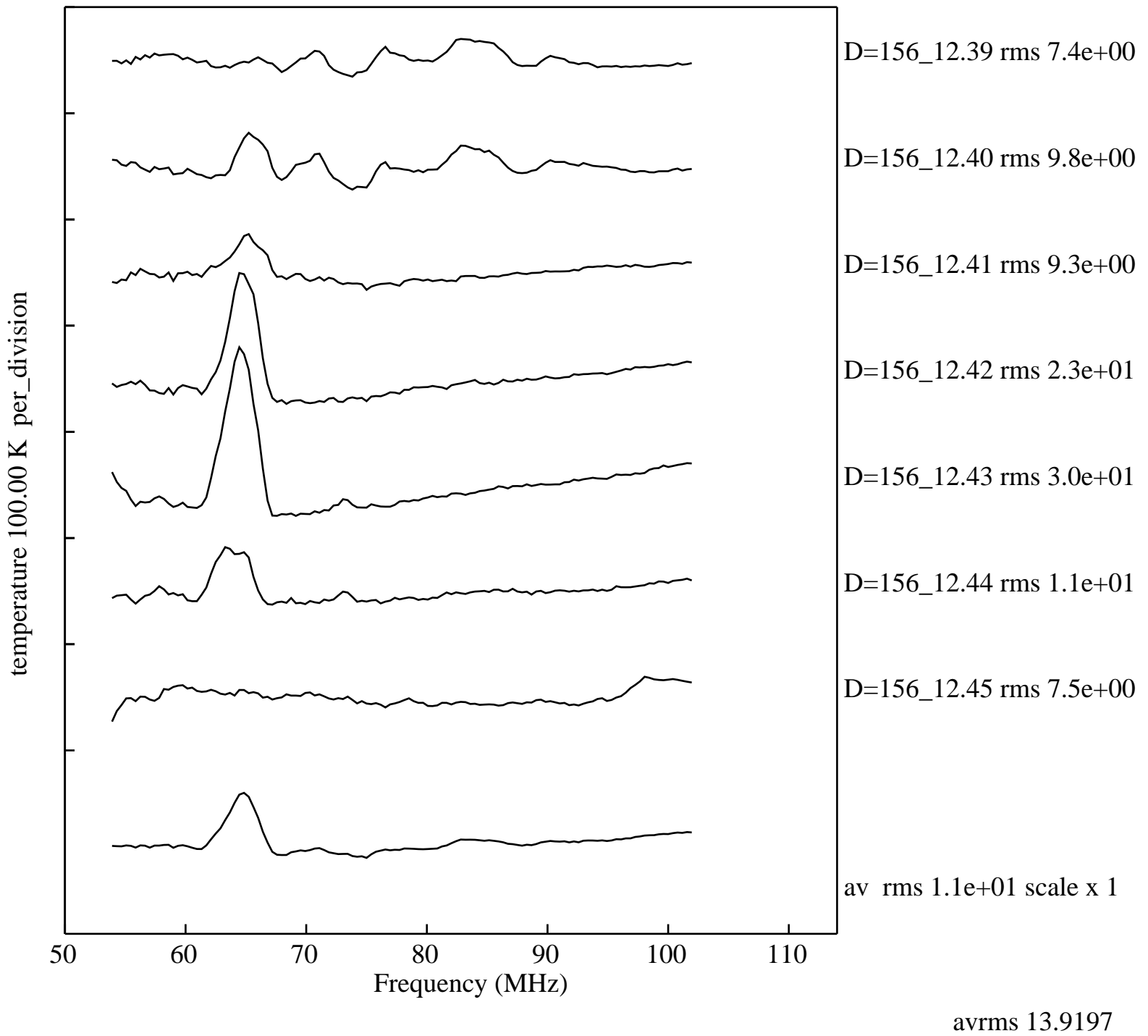
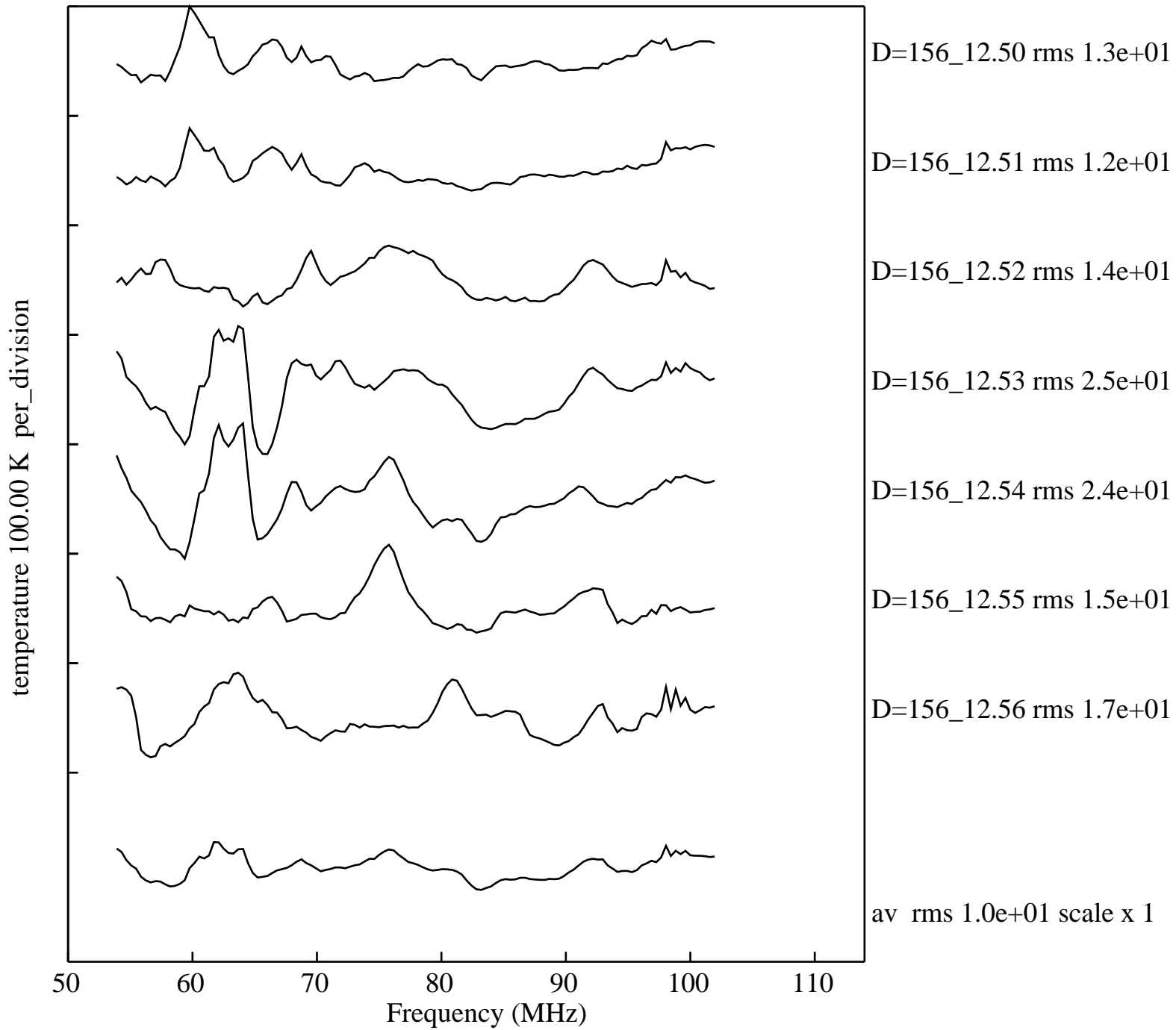
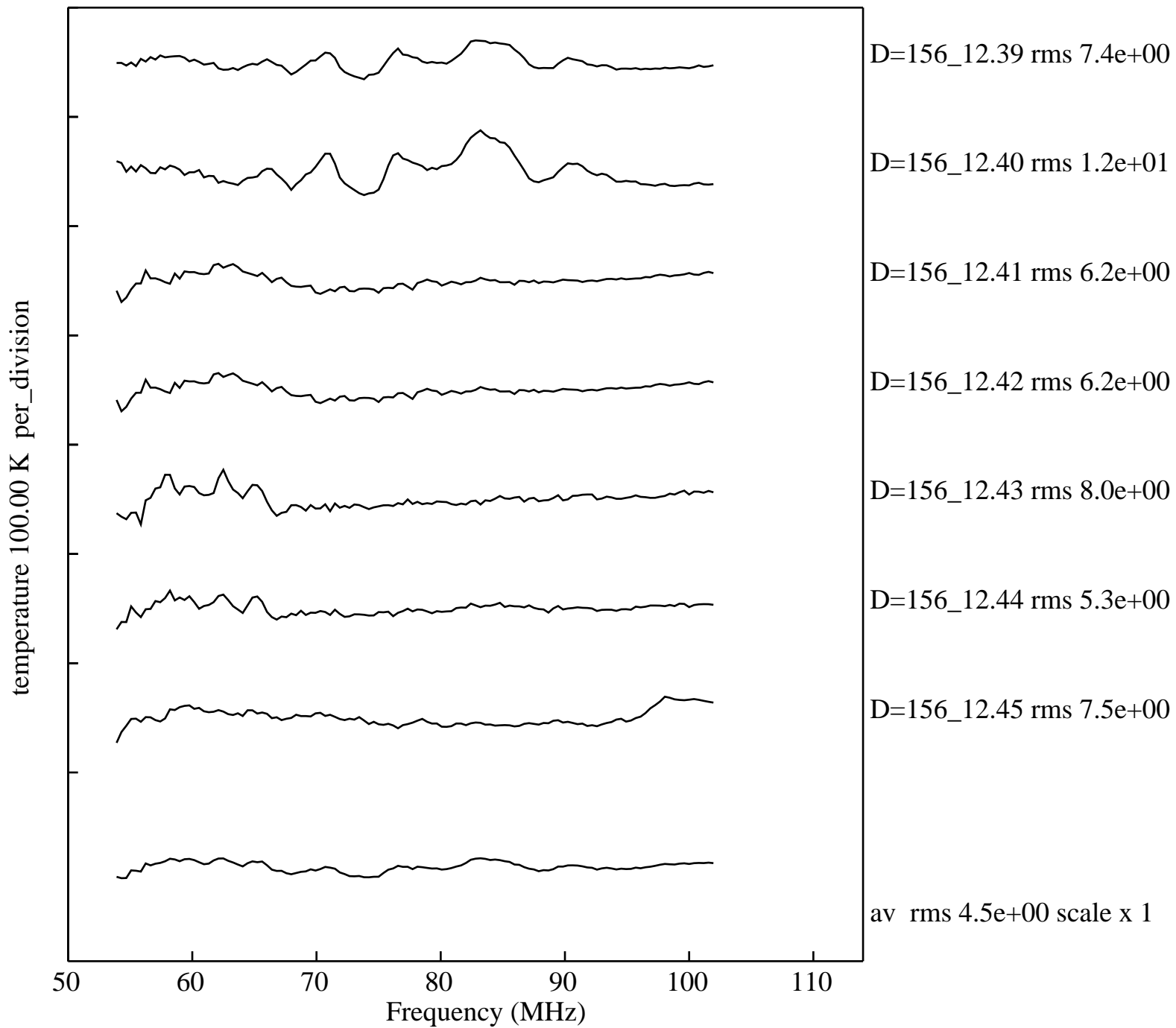


Figure 2. Spectral residuals with 5-terms removed for spike at 05:33 UT



avrms 17.3939

Figure 3. Spectral residuals with 5-terms removed for spike at 05:3 UT



avrms 7.5774

Figure 4. Spectral residuals for spike at 05:33 UT reduced with test limit on rmsff