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Subject: strange rms

There seems to be some descrepancy between the RMS measured in spectra from the GBT spectrometer versus the theoretical values. The problem has been noted in the 3-level modes for 50MHz and 12.5MHz bandwidths. Dave Hogg has pointed this out for astronomical checkout data in modes 4N2-6A-12 3 and 4N2-6A-50-3. These are the only narrow-band 3-level modes examined so far.

The rms decreases with integration time as expected, but measured values are significantly lower than theoretical. On the other hand, for 9-level modes, the observed rms agrees well with the theoretical.

I will summarize the details below, and the main questions are:

How is 3-level data treated differently from 9-level in the Spectrometer software, and in the filler?

Are we using the right theoretical formula?

-- frank

We are using the formula (as given in the GBT quick guide):

RMS = K1 * Tsys / sqrt(K2 * Teff * Npol * BW/Nchan)

K1 is the backend sampling factor, for which we are using:
K1 = 1.032 for 9-level
K1 = 1.235 for 3-level

and K2 is the autocorrelator channel weighting function, for which we use 2.0 because the spectra were Hanning smoothed.

Here is some data from the checkout of 4N2-6A-12-3:

Effective Int. Time	Theoretical RMS in mK	Observed RMS, in mK
150	153.	123.
300	108.	87.6
750	68.6	54.7
1500	48.5	39.1

More details in web page:
http://wwwlocal.gb.nrao.edu/gbt/gbtstatus/checkouts/4N2-6A-12-3_lband/Report.html
(note that in the report, Dave is using K1=1.36)