EPIC MEMO #006

ARIZONA STATE UNIVERSITY
TEMPE, ARIZONA 85287

Detectability of FRBs/other Transients with EPIC on LWA-SV

Hariharan Krishnan

17, October, 2020

The collecting area A_e and T_{sys} for LWA-SV are considered to be the same as that of LWA1 since the two arrays are similar in array configuration and have the same number of antennas. We make use of these values to make estimates of sensitivity for LWA-SV for bandwidth and time-scales corresponding to EPIC. Table-1 is for LWA1 as listed in http://www.phys.unm.edu/~lwa/obsstatus/obsstatus006.html

Frequency (MHz)	A_e (m^2)	T_{sys} (K)	SEFD (Jy)	ΔS (mJy)
15	25600	107000	11540	118
25	9200	28900	8670	88
35	4700	12100	7180	73
45	2840	6420	6240	64
55	1900	3840	5570	57
65	1360	2500	5080	52
75	1020	1740	4680	48
85	800	1260	4370	45

Table 1*:* LWA1 theoretical noise (assuming dual polarizations, a bandwidth of 4 MHz, a 10 min integration time and a zenith pointing direction)

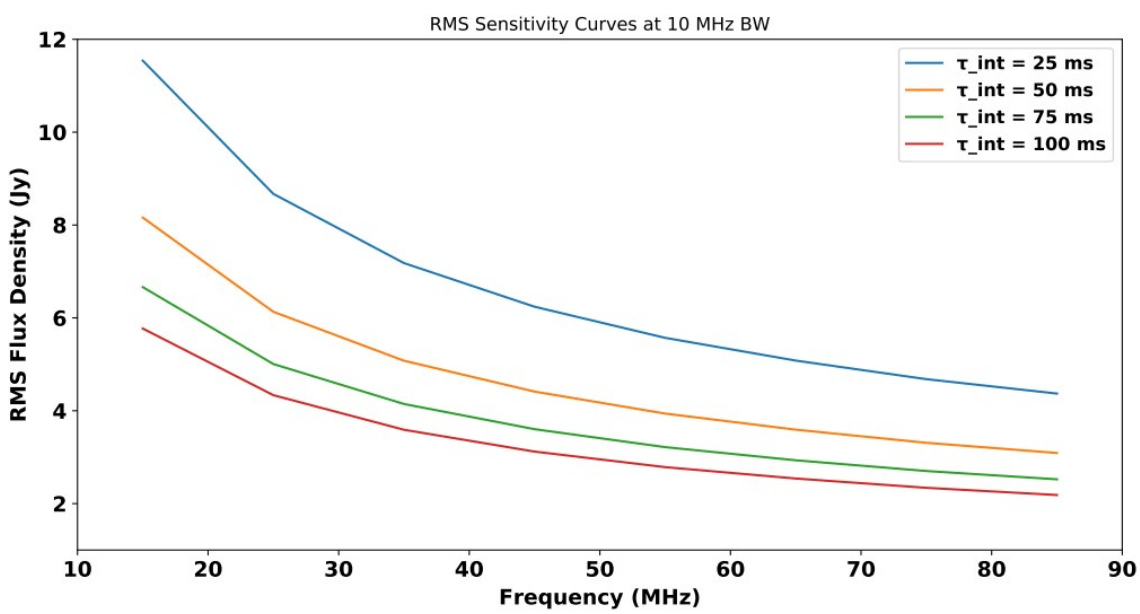

Figure 1: RMS Sensitivity curves for 10 MHz Bandwidth

The rms sensitivity curves are estimated for the entire LWA frequency range using the standard radiometer equation for 10 MHz (refer Figure 1) and 3 MHz (refer Figure 2) bandwidth integration

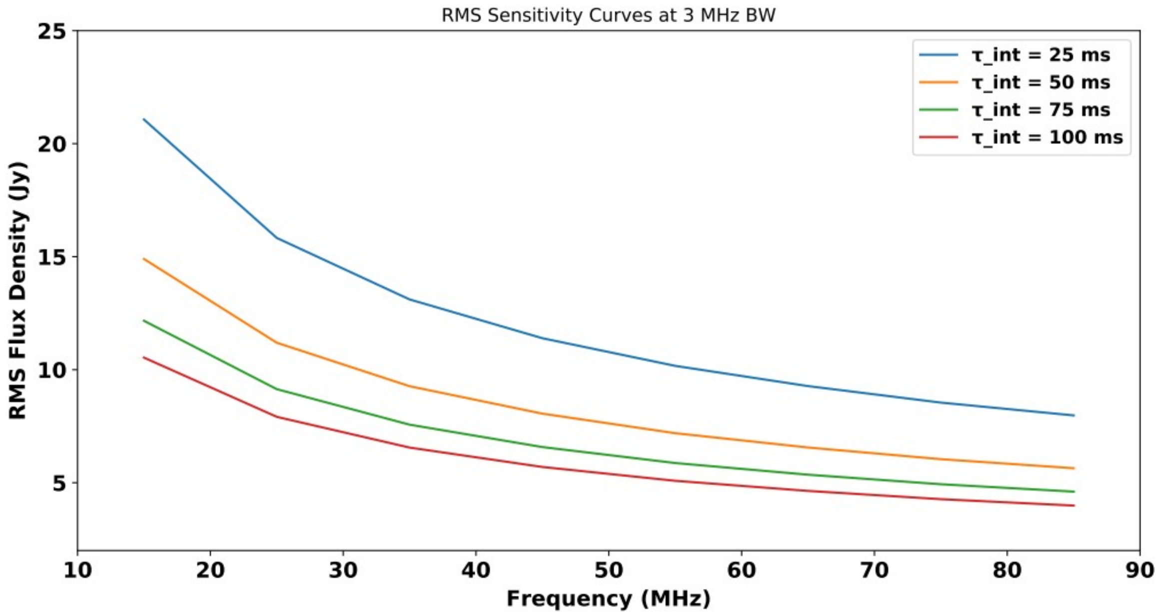

Figure 2: RMS Sensitivity Curves for 3 MHz Bandwidth

Our primary interest in FRB detection and imaging is to follow-up with CHIME FRBs based on triggers shared by the CHIME FRB team. The FRB pulses at low frequencies are expected to arrive at a delay with respect to the higher frequencies. The delay dispersion varies with frequency as ν^{-2}, with the low frequency limit of CHIME at 400 MHz as a reference we projected the dispersion delay for LWA frequencies for FRB dispersion (refer Figure 3)

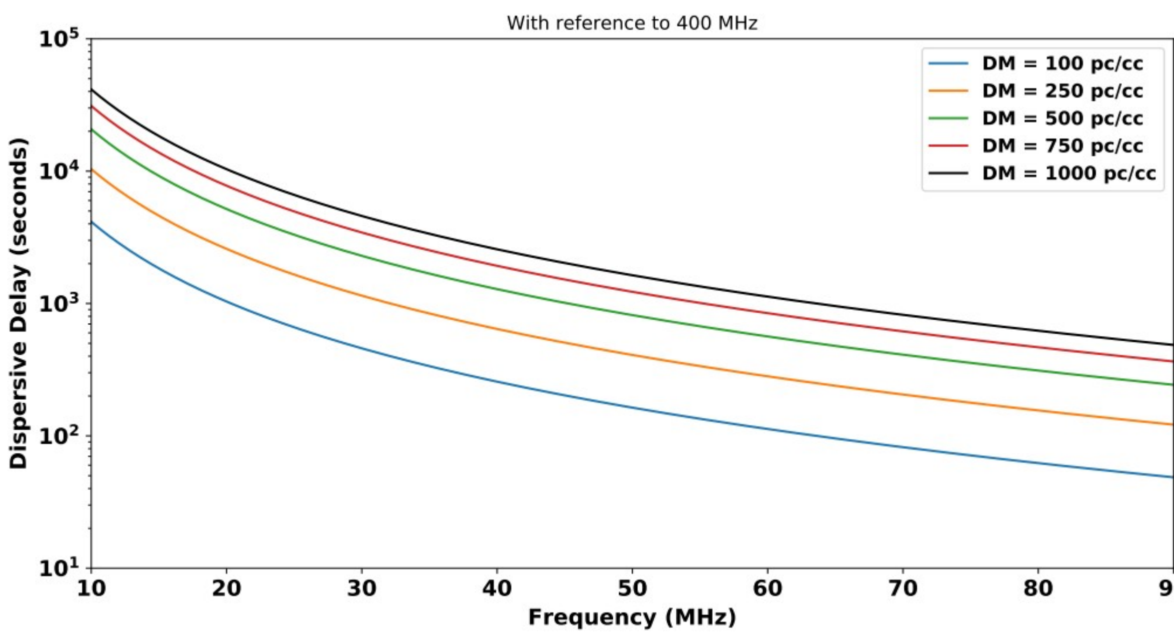

Figure 3: Estimates of dispersive delay for various FRB DMs

Considering the range of dispersive delays involved for the various FRB DMs, we limit our frequency range of interest to 50-80 MHz for the FRB science case. Figure 4 shows the dispersion curves for 50 – 80 MHz for FRB DMs upto 1000 pc/cc.

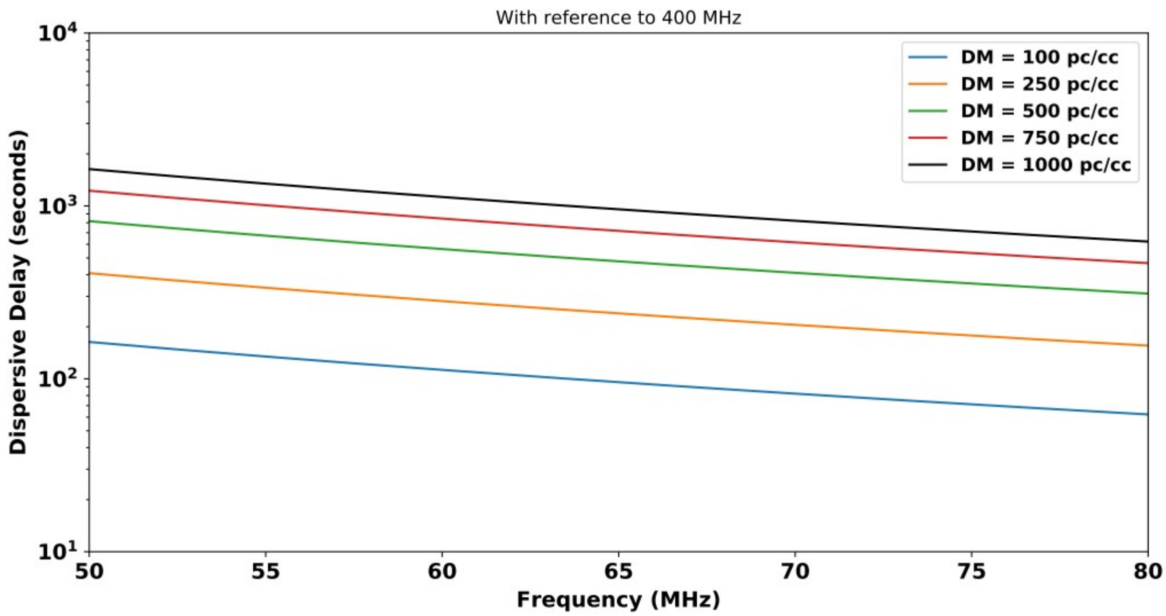

Figure 4: Dispersion Curves for the frequency range of Interest

Radio waves are scattered as they travel the interstellar medium and this broadens the inherent pulse width of the incoming FRB pulse. Pulse broadening is frequency dependent and varies as ν^{-4} (refer Bhat et al. 2004). With reference to median reported pulse widths at 400 MHz and 1.4 GHz, we made estimates of the scatter broadening of FRB pulses expected at LWA frequencies as shown in Figure 5.

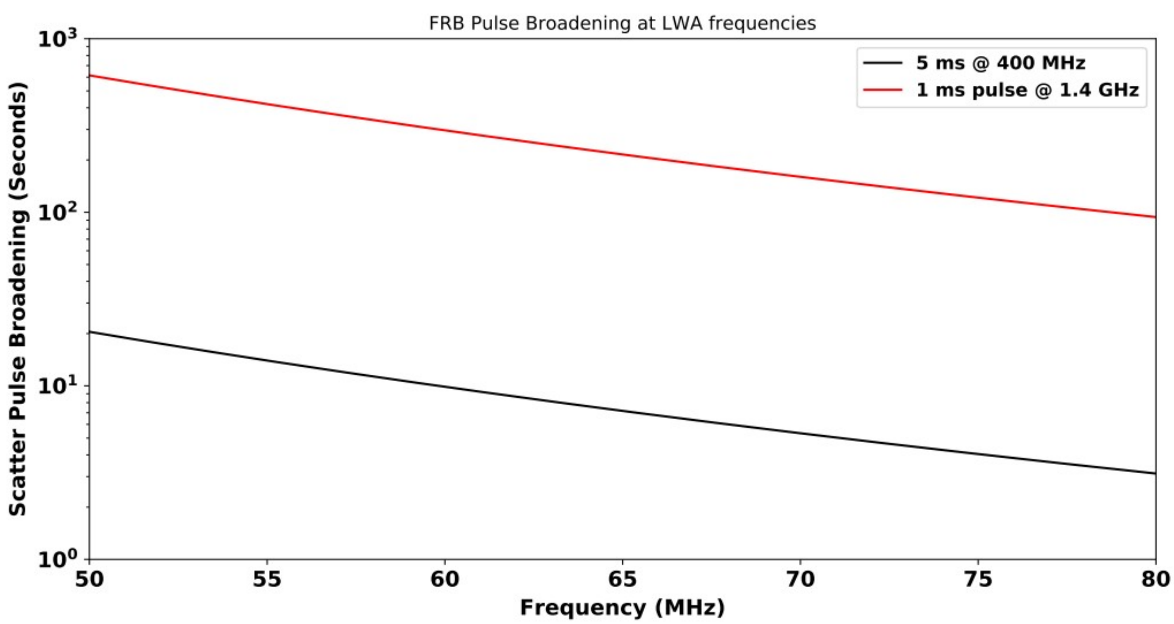

Figure 5: Projected Pulse Broadening at LWA frequencies assuming no DM variation and a power-law index of -4 ($\tau_d \propto \nu^{-4}$)