Estimation of Fluence Limit (06/20/2020)

In Arcus et al. 2020, their FRB distribution goes to 0 when the limiting fluence of the telescope $F_0 > F_{\nu,\mathrm{max}}$, the maximum fluence possible of an FRB. F_0 is around 3 Jy ms for Parkes, and $F_{\nu,\mathrm{max}}$ is given by:

$$F_{\nu,\mathrm{max}} = \frac{E_{\nu,\mathrm{max}}(1+z)^{2-\alpha}}{4\pi D_L^2}$$

The equation is given in section 3.2, where $\alpha \approx 1.8$ and $E_{\nu,\mathrm{max}} \approx 1.28 \times 10^{29}$ J Hz^{-1}. Although we expect to have $z \sim 3$ to be the cutoff of the FRB distribution, these numbers suggest even at $z = 10$, $F_{\nu,\mathrm{max}}$ is very large:

$$F_{\nu,\mathrm{max}}(z=10) = \frac{1.28 \times 10^{29}\ \mathrm{J\ Hz^{-1}}(1+10)^{2-1.8}}{4\pi(101643\ \mathrm{Mpc})^2} \times \left(\frac{1\ \mathrm{Mpc}}{3.086 \times 10^{22}\ \mathrm{m}}\right)^2 \times \left(\frac{1\ \mathrm{Jy\ ms}}{10^{-29}\ \mathrm{J\ m^{-2}Hz^{-1}}}\right)$$
$$= 167\ \mathrm{Jy\ ms} \gg F_0$$

See the footnote for the cosmological model[1]. $F_{\nu,,\mathrm{max}}$ only approaches F_0 at around $z \sim 50$:

$$F_{\nu,\mathrm{max}}(z=50) = \frac{1.28 \times 10^{29}\ \mathrm{J\ Hz^{-1}}(1+50)^{2-1.8}}{4\pi(595926\ \mathrm{Mpc})^2} \times \left(\frac{1\ \mathrm{Mpc}}{3.086 \times 10^{22}\ \mathrm{m}}\right)^2 \times \left(\frac{1\ \mathrm{Jy\ ms}}{10^{-29}\ \mathrm{J\ m^{-2}Hz^{-1}}}\right)$$
$$= 6.6\ \mathrm{Jy\ ms} \sim F_0$$

This result means that their model does not predict the fluence cutoff to kick in until much higher z, which does not agree with the data. This means one of two things:

1. The maximum possible energy of an FRB, 1.28×10^{29} J Hz^{-1}, is wrong.

   OR

2. The fluence limit F_0 is not the main factor in determining the maximum redshift; other factors like α and γ may be important.

[1] For D_L, the following parameters were used: $(H_0,\ \Omega_m,\ \Omega_\Lambda) = (70\mathrm{km/s/Mpc}, 0.318, 0.682)$