3. RF Pulse

The pulse can be written as:

$$m(t) = A\left(\delta(t) + \frac{2}{3}\big(\delta(t-\tau/6) + \delta(t+\tau/6)\big) + \frac{1}{3}\big(\delta(t-\tau/3) + \delta(t+\tau/3)\big)\right) * \mathrm{rect}\left(\frac{t}{\tau/8}\right)$$

The 1D Fourier transform is

$$M(f) = A\frac{\tau}{8}\mathrm{sinc}\big(f\tau/8\big)\left(1 + \frac{4}{3}\cos\big(2\pi f\tau/6\big) + \frac{2}{3}\cos\big(2\pi f\tau/3\big)\right)$$

The slice profile is obtained with the substitution $f = -\frac{\gamma}{2\pi}G_z z$. A plot of the profile as a function of $f\tau = -\frac{\gamma}{2\pi}G_z z\tau$ is shown below, with the sinc and cosine components shown in dotted and dashed lines, respectively. Zeros due to the sinc function occur at multiples of $f\tau = 8$. To understand the presence of the other zeros at multiples of $f\tau = 2$ and the peaks near multiples of $f\tau = 6$, note that we can also write

$$m(t) = A\left(\left(\mathrm{rect}\left(\frac{t}{\tau/2}\right) * \mathrm{rect}\left(\frac{t}{\tau/2}\right)\right) \bullet \sum_n \delta(t - n\tau/6)\right) * \mathrm{rect}\left(\frac{t}{\tau/8}\right)$$

which has a transform

$$M(f) = A\frac{\tau}{8}\frac{\tau}{2}\frac{6}{\tau}\mathrm{sinc}\big(f\tau/8\big)\left(\mathrm{sinc}^2\big(f\tau/2\big) * \sum_n \delta(f - 6n/\tau)\right)$$