Halo Profile

The Navarro-Frenk-White (NFW profile) is given by

\[ \rho(r, M) \propto \frac{1}{r_c/r_h (1 + r_c/r_h)^2} \]  

(1)

where \( r_h = [3M/4\pi \rho_m(z=0)\Delta_M]^{1/3} \) is the comoving radius associated with a halo of mass \( M \) at an overdensity of \( \Delta_M = 180 \) with respect to the mean matter density. \( c \) is the concentration and for the purposes of this project take it to be \( c = 10 \) independent of mass (we also ignore the distinction between the halo mass and virial mass). The normalization is set so that the volume integral over the halo profile out to \( R \) returns the mass \( M \).

Compute the Fourier transform of the NFW profile for use in the 1-halo term of the halo model

\[ y(k, M) = \frac{1}{M} \int_0^{r_h} dr 4\pi r^2 \rho(r, M) \frac{\sin (kr)}{kr} \]  

(2)

normalized such that \( y(0, M) = 1 \).