- Question: Why does the new propagation **propagate_fresnel_transfer_2d** only need to return an amplitude, rather than additionally including new coordinates like previous propagation schemes?
- Task: Given the beam provided **amplitude** after a 10cm lens, compute the amplitude field at 20 points along the propagation out to 27cm. Start by propagating into the Fresnel region before the focus. Hint: always propagate from the initial conditions I provide **amplitude**, that way error does not build up for successive propagations.
- Question: Show your calculation for where the Fresnel approximation valid region begins (Hint: far enough that the Fresnel approximation holds reasonably, but under 10cm).
- Task: For each of those 20 propagation planes, calculate the X and Y widths using **beam_parameters_2d**, store them into arrays. Also store in an array the propagation distance associated with each pair of widths in a separate array.
- Task: Fit the M^2 model to the X and Y widths. Hint: As a test set phi_random = 0 and make sure your M^2 parameter is 1.0 in the short axis (this indicates that the Gaussian beam has M^2 1.0). Important: **beam_parameters_2d** generated by our code are 1σ widths, but the formulation of the M^2 model given is for 2σ, multiply the provided widths by 2 before making the fit.
- Question: do the focal planes have the same coordinate ($z_{0,x}$, $z_{0,y}$)? How do the focal plane $z_{0,x}$, $z_{0,y}$ coordinates compare to the lens focal length?