Homework 5
Due: *Monday, April 4, 2020*

1. What is the value of critical density for a Ti:Sapphire laser ($\lambda = 0.8 \ \mu m$)? Compare this to the value of the critical density for a CO_2 laser ($\lambda = 10 \ \mu m$)?

2. Prove that the dispersion relation for a 1D linear electromagnetic waves does not depend on the electron temperature. In other words, explain why the thermal term in the fluid momentum equation does not contribute to the dispersion relation.

3. For the simple electron sheath model for a wakefield in the 3D blowout regime,
(a) Show that

$$\psi_0(\xi) = (1 + \beta)\frac{r_b^2}{4},$$

where

$$\beta = \frac{(1 + \alpha)^2 \ln(1 + \alpha)^2}{(1 + \alpha)^2 - 1}$$

and where

$$\alpha \equiv \frac{\Delta}{r_b}$$

(b) Show that $\beta \sim \alpha$, for $\alpha \ll 1$

4. Follow the instructions in the next few pages to set up a JupyterPIC environment on your computer. We will use this code for future homework problems and class project, so make sure it is working on your computer by the end of this week!