PHY 525 Homework 4 Due: Tue, October 29, 2019

1. L-wave cutoff

Left-hand circularly polarized waves are propagated along a uniform magnetic field $\mathbf{B}=B_0\,\mathbf{z}$ into a plasma with density increasing with z. At what density is cutoff reached if f=2.8GHz and B_0=0.3T?

2. Whistler wave

In the derivation of whistler mode do <u>not</u> assume that $\omega \ll \omega_{ce}$, that is, consider $\omega_{ci} \ll \omega < \omega_{ce}$. What is the maximal phase velocity of the whistler mode?

3. Faraday rotation

In some laser-fusion experiments in which plasma is created by a pulse of 1.06 – µm light impinging on a solid target, very large magnetic fields are generated by thermoelectric currents. These fields can be measured by Faraday rotation of frequency-doubled light (λ_0 = 0.53 µm) derived from the same laser. If B=100T, n=10^{27}m^{-3}, and the path length in the plasma in 30 µm, derive the Faraday rotation angle in degrees. (Assume $\mathbf{k}\parallel\mathbf{B}$.)

4. Alfvén waves

A hydrogen discharge in a 1-T field produces a density of 10^{16}m^{-3}.

(a) What is the Alfvén speed v_A?
(b) Suppose v_A had come out greater than c. Does this mean that Alfvén waves travel faster than the speed of light?