

Plasma Seminar #1

June 15, 2005

Overview

This week we'll begin going through Chen's *Introduction to Plasma Physics and Controlled Fusion*. Given our varying physics backgrounds, I think Chen will be a good place to start learning about plasmas. We can always look at other books, especially for topics that aren't in Chen. I have Doc's copy of Goldston & Rutherford, which is at a higher level. There's also a (brand-new) book I got from Cornell, Gurnett & Bhattacharjee's *Introduction to Plasma Physics with Space and Laboratory Applications*. This is intermediate in level between Chen and Goldston, and I'm intrigued by it because it has some material that's not in either of the other two, particularly on magnetic reconnection. Given that it's brand new, I know for sure that it's not error-free (I've already found a glaring typo in an appendix giving the Laplacian in spherical coordinates).

The material from Chen Ch. 1 I think is mostly stuff Doc's already talked about, but it wouldn't hurt to go over it again: distributions, temperature, Debye shielding, and the plasma parameter. We'll begin to look at single-particle motions in Ch. 2 (particle motion in constant \mathbf{E} and \mathbf{B} fields, $\mathbf{E} \times \mathbf{B}$ drift, $\nabla \mathbf{B}$ drift, and curvature drift). We can finish off the rest of the chapter next week – those of us who have had classical mechanics might look at some of the stuff about the Hamiltonian treatment of particle orbits in Gurnett or Goldston.

Reading

Chen, Ch. 1 & Ch. 2, §2.1–2.3.2

Problems

Let's all try to read and attempt these beforehand, but we can solve them together in seminar. I haven't solved them yet, so they could turn out to be either really easy or ridiculously hard – I'm hoping that they're both interesting and somewhere in between! With some of them it may help to look at a decent E/M book like Purcell or Griffiths.

1. Chen 1-6, p. 12 (Alternate derivation and significance of Debye length)
2. Chen 2-5, p. 26 (Finite Larmor radius effects)
3. Chen 2-9, p. 35 (Electron drift due to charged current-carrying wire)