

APPH 6101 Plasma Physics I
Homework 4: Due 6 October, 2005.

Questions 1-4

Due problems 4.3, 4.4, 4.5, and 4.7 in Gurnett and Bhattacharjee, p. 131-132.

Question 5

[From *Plasma Physics*, by Peter Sturrock (Cambridge, 1994).] Radio signals from pulsars pass through the interstellar medium containing plasma with a mean density of about 0.03 cm^{-3} . The emission is directed in any given direction in a series of short “pulses”.

Part A

Show that the arrival time $t(f)$ of a signal will be a function of frequency of the form

$$t(f) = \frac{D}{f^2} + \text{constant}$$

where f is the frequency in Hz, and the “dispersion coefficient”, D is expressable as

$$D = C \int n_e ds$$

where the integral represents the path integral of the electron density along the propagation path of the radio signal.

Part B

Find the coefficient C .

Part C

For a particular pulsar it is found that the signal at 100 MHz arrives 2 s later than the signal at 200 Mhz. What is the value of D for this pulsar?

Part C

What is the distance to the pulsar?

Part D

Suggest other factors that complicate this analysis and the simple relationship between arrival time and wave frequency.