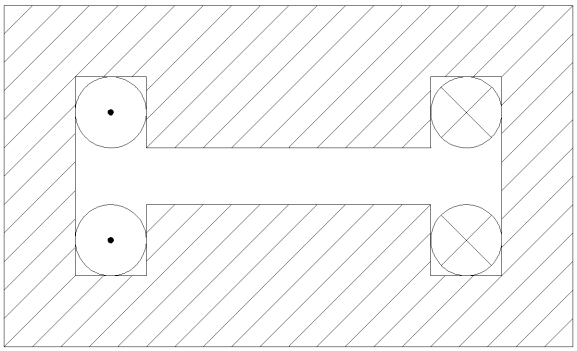
Idaho State University – Department of Physics
PHYS 499 / PHYS 630 Accelerator Physics — Spring 2009

Homework 2 (due Jan 28)

1. A simple dipole magnet (also called bending magnet) is made as shown in the figure below. N turns of conductor carrying current I are wound about each pole of the iron magnet. The poles are separated by a distance h. Assuming the permeability μ of the iron to be infinite, show that the field in the gap of the magnet is given by $B = 2\mu_0 NI/h$.



2. Consider a relativistic particle of mass m.

   (a) Write its de Broglie wavelength λ as a function of its kinetic energy T.

   (b) Plot the wavelength λ as a function of T for electrons ($mc^2 = 0.511$ MeV), for T varying between 1 eV and 1 TeV. Use logarithmic scales for both abscissa and ordinate.

   (c) On the vertical scale of wavelengths, identify the typical sizes of physical systems, such as cells, molecules, atoms, and nuclei. On the horizontal scale of kinetic energies, indicate the typical energy of electron accelerators you know, such as electron microscopes, Kerst's betatron, SPEAR, or LEP.