SOLENOID HOMEWORK

1. Consider a 200 MeV/c particle starting on the axis with a transverse momentum of 20 MeV/c in an axial solenoidal field of 3.33 T.

   (a) What is its motion in the lab frame and out to what transverse distance from the axis does it get.

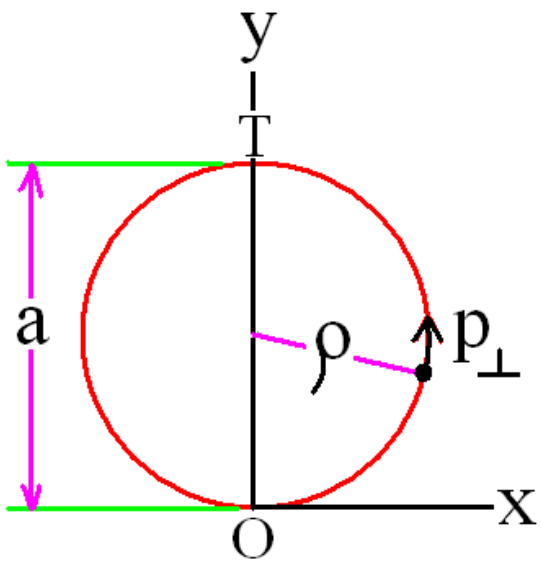
   (b) What is the distance along the axis before it first returns to that axis?

   (c) What is the wavelength λ in the Larmor frame?

   (d) What is the lattice parameter $\beta_\perp$ for that particle

2. Consider again a 200 MeV/c particle starting on the axis with a transverse momentum of 20 MeV/c in an axial solenoidal field of 3.33 T. After a distance
   A) corresponding to 1/2 a helix rotation, or
   B) corresponding to a full helix rotation,
   the field doubles, over a short distance, to 6.66 T.

   In the two cases determine the shape of the subsequent motion projected onto the x, y plane



COOLING HOMEWORK

1. In a linear cooling channel, assume $\beta_\perp = 0.4$ m, $C(mat, E) = 38\ 10^{-4}$, β_v=0.85.

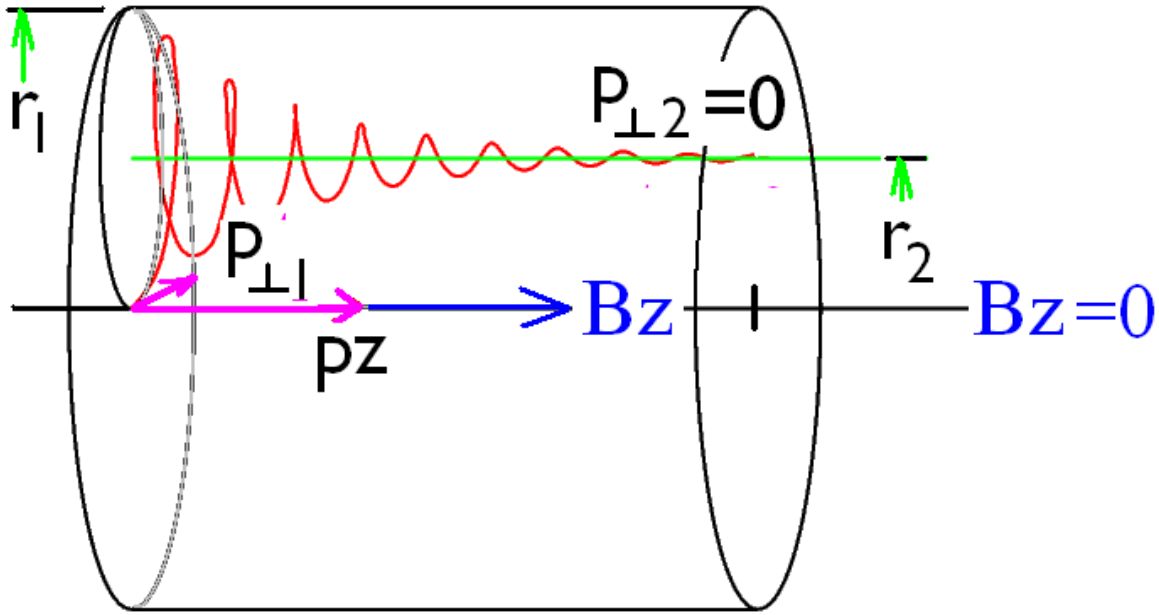
   a) What is the expected equilibrium transverse emittance?

2. A Guggenheim cooling channel, with emittance exchange in wedges cools all 6 dimensions. Assume $\beta_\perp = 0.4$ m, dispersion at the hydrogen wedge $D = 7$ cm, the length of the wedge on axis $\ell = 28.6$ cm, and the height from the axis to the apex of the wedge $h = \frac{\ell}{2\ \tan(100^o/2)} = 12$ cm. Assume that the sum of partition functions $\Sigma J_i \approx 2.0$, $C(mat, E) = 38\ 10^{-4}$, good mixing between x and y, and the relativistic β_v=0.85.

   a) What are the three partition functions in this case?

   b) What is the expected equilibrium transverse emittance?

3. Consider a long solenoid with $B_z = 3.33$ T and a muon starting on axis with $p_\perp = 20$ MeV/c and $p_z = 200$ MeV/c. Imagine an ideal transverse cooling system with continuous energy loss and re-acceleration so that all transverse momenta are reduced to near zero, and the muon now at half its maximum distance from the axis $r_2 = r_1/2$, passing straight down the field lines at p_z.



(a) What now is its motion in the Larmor frame?

(b) If now the field B_z suddenly stops, what is the further motion of the muon?