4 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.

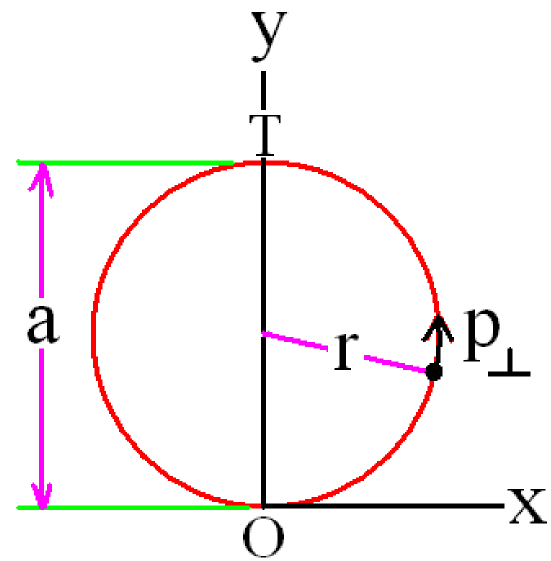
   (a) What is its motion in the lab frame and out to what transverse distance from the axis does it get.

   (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?

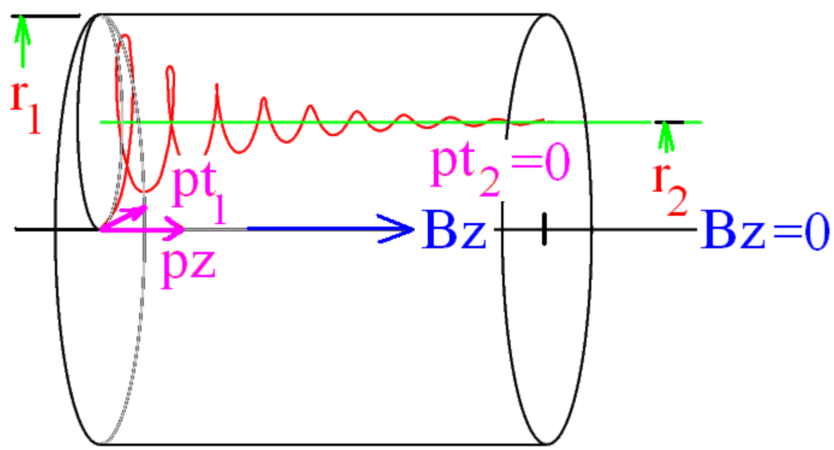
   (d) what is the lattice parameter $\beta_\perp$ for that particle

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 determine,
the field abruptly doubles to 6.66 T. In the two cases determine:
   (a) The shape of the motion projected onto the x, y plane
   (b) The following length in z for one helix rotation (λ_{helix})



7 IONIZATION COOLING HOMEWORK

1. Again consider a solenoid with $B_z = 3.33$ T and a muon with starting on axis with $p_t = 20$ 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, then the above particle will settle at half its maximum distance from the axis $r_2 = r_1/2$ and pass 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?

(c) Taking the initial phase space to be $\Phi_1 = pt_1\ r_1$, what is the final phase space if it is defined as $\Phi_2 = pt_3\ r_3$?

(d) This (from Bush's Law) is not good. What could one do to avoid it ?

2. In the longitudinal cooling section, we describe a cooling ring that, 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 $h = \frac{\ell}{2\ \tan(100^o/2)} = 12 \quad \mathrm{cm.}$ Assume that the sum of partition functions $\Sigma J_i \approx 2.0$, $C(mat, E) = 38\ 10^{-4}$, and assume good mixing between x and y. As before, β_v=0.85.

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

b) What is the expected equilibrium transverse emittance?