Home Work #1

(due Tuesday January 22, 2008)

[Please, write your solutions neatly!]

1. Calculate pion beam momentum corresponding to the threshold of the fixed-target raction $\pi^- p \to K^0 \Lambda^0$. Assume target proton at rest. Use masses from PDG.
2. Calculate maximum kinetic energy that can be transferred to electron by relativistic proton moving with velocity β. Neglect binding energy of electron. Compare your answer with formula that can be found in the PDG chapter "Passage of Particles Through Matter".
3. In elastic $p + p \to p + p$ scattering find the maximum laboratory angle between two final protons. What will be the maximum lab angle between final particles in case of elastic $\pi^+ + p \to \pi^+ + p$ scattering?
4. Study kinematics of antineutrino detecton process $\bar{\nu}_e + p \to e^+ + n$. Assume that the direction of incoming antineutrino is known (along z) and its total energy is $\mathcal{E}$= ENU. There is one independent kinematical parameter left that will determine the full kinematics of the reaction. Let's chose the lab angle of positron (THETAE, angle between initial direction of antineutrino and final positron direction) as this free parameter. Write and run fortran (or C++) program that calculates the following kinematical parameters: momentum of positron (PE), kinetic energy of positron (TE), transversal momentum of positron ⊥ to z-axis (PTE), longitudinal momentum of positron along z-axis (PLE), momentum of neutron (PN), kinetic energy of neutron (TN), transversal momentum of neutron (PTN), longitudinal momentum of neutron (PLN), and angle of neutron (THETAN) as functions of THETAE and ENU. Let THETAE vary from 0 to 180 degree with a reasonable steps, say 5 degrees, and antineutrino energies from 1 MeV to 10 MeV with step of 1 MeV. For any given energy $\mathcal{E}$ = ENU you will produce a table of raws: ENU, THETAE, THETAN PE, TE, PTE, PLE, PN, TN, PTN, PLN = 11 values per raw. Write this table into file, e.g. *enu7.txt*. Create NTUPLE in PAW, read file for given antineutrino energy into NTUPLE. Plot some kinematical parameters in PAW as function of THETAE and ENU. Send your file *enu7.txt* and your file *last.kumac* to instructor by email attachment.