SCPY322 Nuclear and Particle Physics

Nuclear Physics - Midterm Examination (Take Home)

Date: Friday 2, April 2021. Due date: Monday 5, April 2021

(Via my e-mail: *udom.rob@mahidol.ac.th*)

1. (50 pt.) Nuclear structure is hard to evaluate, according to the unknown exact nuclear force and potential. The isotropic harmonic potential model, together with the LS-coupling scheme, always used to model the nuclear structure based on the important assumption that protons and neutrons occupy different nuclear potential well.

   (a) (10 pt.) Estimate the depth of nuclear potential well of the stable isotope of iodine $^{127}_{53}I$, using Fermi gas model.

   (b) (10 pt.) List occupied nuclear levels of all neutrons.

   (c) (10 pt.) List the occupied nuclear levels of all protons.

   (d) (20 pt.) According to Hund's rules, what is the ground state spin J and parity π of this nucleus.

2. (50 pt.) For the α decay of $^{252}_{98}Cf$:

   (a) (20 pt.) Estimate its half-life time using Geiger – Nuttall rule

   (b) (10 pt.) Calculate decay energy Q, in MeV.

   (c) (20 pt.) Calculate the kinetic energy and velocity the emitted α -particle.