Name: PHY625 (Spring 2011), 01/19/11

Homework Assignment #1

(*Due Date*: Friday, Jan. 28, 9:10am, in class)

1.1 *Empirical Features of N-N Force* *(4 pts.)*

(a) Briefly discuss 2 empirical evidences for the attractive nature of the force between 2 nucleons.

(b) Briefly discuss 2 empirical evidences for the short-range nature of force between 2 nucleons.

1.2 *Central Nuclear Force* *(6 pts.)*

In this problem we develop a schematic model for nuclear saturation.

(a) Show that the Fourier transform of a static scalar meson-exchange potential,

$$V_\alpha(q) = -g_\alpha^2 \, \frac{1}{\vec{q}^2 + m_\alpha^2} \, , \tag{1}$$

yields the standard Yukawa potential in coordinate space, $V(r) = -g_\alpha^2/(4\pi)\, \mathrm{e}^{-m_\alpha r}/r$.

(b) Graph the r-dependence (in units of [fm]) of the attractive scalar potential (in [MeV]) from σ exchange (α=σ, $m_\sigma = 550\,\mathrm{MeV}$, $g_\sigma = 10.0$) and of the repulsive scalar potential from ω exchange (α=ω, $m_\omega = 782\,\mathrm{MeV}$, $g_\omega = 17.5$), as well as their sum (use the conversion factor $\hbar c = 197.33\,\mathrm{MeV\,fm}$).

(c) Based on your result for the central potential in part (b) estimate the nuclear saturation (ground-state) density.