

Names: _____

PHYS 7501, FS 2021

Group Activity 18

Due: In class, November 18th

1. In the s -process, the neutron density is $\sim 10^7 \text{cm}^{-3}$. Using a typical (n, γ) reaction rate $\langle \sigma v \rangle_{n, \gamma} \sim 10^{-16} \frac{\text{cm}^3}{\text{s}}$, calculate the typical time for neutron-capture to occur. Then, calculate the neutron density required for an r -process to occur which reaches nuclides with $\tau_\beta \sim 1 \text{ms}$.
2. In a type Ia supernova, at least one (mostly carbon) white dwarf burns (mostly) via $^{12}\text{C} + ^{12}\text{C}$ fusion. How much energy is released? Compare this to a typical white dwarf binding energy $U = \frac{3}{5} G \frac{M^2}{R} \sim G \frac{M_\odot^2}{R_\oplus} \sim 10^{51} \text{erg}$, noting that $1 \text{MeV} \sim 10^{-6} \text{erg}$.