

Homework Set 4

Due: May 16, 2013, *before class*

1. Nuclear Reaction Rates

Based on the general dependence of a non-resonant binary nuclear reaction,

$$\langle\sigma v\rangle \propto (k_{\text{B}}T)^{-2/3} e^{-\frac{3}{2}\left(\frac{4\pi^2 Z_1 Z_2 e^2}{h}\right)^{2/3} \left(\frac{m_{\text{red}}}{k_{\text{B}}T}\right)^{1/3}}$$

compute the temperature sensitivity of carbon burning, $^{12}\text{C}+^{12}\text{C}$ at $T = 10^9 \text{ K}$, that is, compute the exponent n in

$$\langle\sigma v\rangle \propto T^n$$

where n is given by

$$n = \frac{d \ln \langle\sigma v\rangle}{d \ln T}.$$

2. Mass Excess and Binding Energy.

A table of mass excess is given at

http://2sn.org/Class/M4111-2013-1/homework/mass_table.txt

The table lists in each line Z , A , and mass excess per nucleus in MeV. Which is the most tightly bound nucleus (binding energy per nucleon) and which has the highest mass excess *per nucleon*?