

AST 250 – Spring 2018

Homework Due: Friday February 9

15. (a) Most of the Sun's energy comes from the fusion of Hydrogen in the Sun's core via the "p-p chain" of nuclear reactions ("proton-proton chain"). One cycle of the p-p chain of reactions converts mass into about 26.2 MeV of net energy ($1 \text{ eV} = 1.602 \times 10^{-12} \text{ erg} = 1.602 \times 10^{-19} \text{ J}$). Estimate how many times per second the p-p chain cycle is being completed in the Sun?

(b) The mass of the Eiffel Tower in Paris is about 7300 tons or $6.6 \times 10^9 \text{ g}$. How many Eiffel Towers worth of mass is converted into energy every second in the Sun?

(c) Neutrinos are elementary particles that have a really, really tiny cross section for interacting with normal matter (i.e. the probability that a neutrino produced in the core is absorbed as it flies out of the Sun is $\sim 10^{-9}$!). Two neutrinos, $2\nu_e$, are produced for every cycle of the p-p chain. Estimate the flux of neutrinos at the distance of the Earth and how many are flying through your brain each second.

