

# Arvind Borde

# AST 9: Homework 12

1] Let's check how much energy there is in 1 gm of matter. The unit of energy below will be an "erg." A 100 Watt bulb uses  $10^9$  ergs/second. A gallon of gas yields  $12 \times 10^{14}$  ergs of energy.

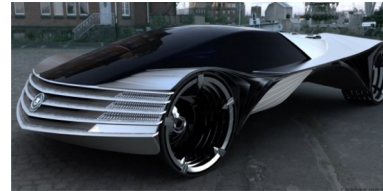
- a) The speed of light is  $c = 3 \times 10^{10}$  cm/sec. Calculate  $E = mc^2$  for  $m = 1$  gm.
- b) How many seconds would that power a 100 W bulb?
- c) How many seconds are there in a year? Convert the answer in (b) to years.
- d) How many gallons of gas is the answer in (a) equivalent to?

*"In breaking news on the energy and technology front, Laser Power Systems, a U.S. company based out of Connecticut is developing a method of automotive propulsion using the element thorium to produce electricity."*

October 20, 2013

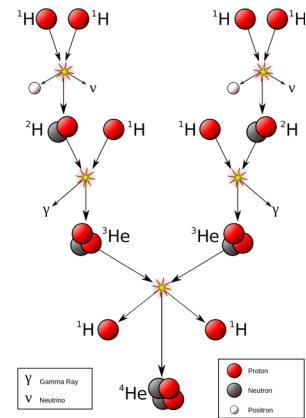
<http://politicalblindspot.com/car-runs-1-million-miles-on-8-grams-of-thorium/>

Car Runs 1 Million Miles on 8 Grams of Thorium



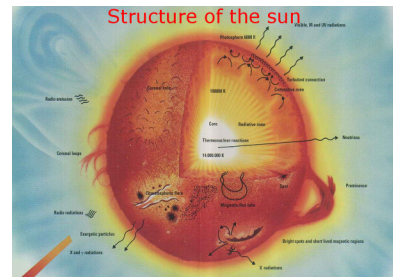
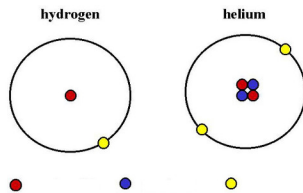
2] As we said in the class, fusion in the sun is a three-step process:

- a) Two protons collide to produce deuterium (a variant of hydrogen), a positron (an anti-electron), and a neutrino.
- b) A proton collides with the deuterium to produce a another helium variant (helium-3) and a gamma ray (high-frequency electromagnetic wave).
- c) Two helium-3s collide to produce a normal helium nucleus, releasing two protons.



- a) At what stage(s) is energy released that can escape from the sun?
- b) At what stage is light released that can escape from the sun?
- c) Which form of energy gets out quicker?

3] Where in this diagram of the sun on the right are the nuclear reactions that "fuel" it going on? Why just in that region?



4] Identify the colored dots in the diagram above as electrons, protons and neutrons.