

Writing Assignment # 2: The Proton-Proton Chain

The “Answer”

The Question:

Describe the proton-proton cycle, -- what role it plays in astronomy, how it works, and what conditions are necessary for it to work. Consider this a heads-up on the first exam. I will “grade” your responses just like I would an exam question.

The Answer:

The proton-proton chain is method by which Sun generates energy in its core. It is a series of steps through which 4 protons (hydrogen nuclei) are fused into one helium nucleus. The helium nucleus has less mass than the 4 hydrogen nuclei, and the difference in mass between the input and the output becomes energy. At various stages in the process byproducts are created, including energy in the form of gamma-rays, positrons (which annihilate with electrons to create more gamma-rays) and neutrinos. The gamma-rays are the ultimate source of sunlight, and the neutrinos are small, nearly massless particles that pass out of the Sun unaltered. Scientists count the number of neutrinos that come from the Sun to determine if our ideas about energy generation in the Sun are correct. For each helium nucleus formed in the proton-proton chain, two neutrinos are created. In order for nuclear fusion to take place via the proton-proton chain, very high densities and temperatures (in excess of 10 million K) are needed. The only place in the Sun where these conditions can be found together is in the core.