Energy Source for the Solar Corona

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The solar corona is that portion of the solar atmosphere which is above 104 R_s (R_s is the radius of the sun). The average temperature of the corona is about 10^{6}° K. It is not understood well what is the source of the energy of the corona.

A steady-state model for the corona has been developed. A flux of protons, electrons and high-energy neutrons is assumed to reach the base of the corona. The neutrons decay in the corona and release high-energy electrons. The decay energy of the neutrons is considered as the main source of the corona energy.

According to Von Weizsacker's theory (Chandrasekhar, 1957), the reaction chains which occur in stellar interiors lead to production of deuterons. The deuterons will produce neutrons according to the following reaction

$$D + D \longrightarrow He^3 + n + 3.25 \text{ MeV}$$

The cross section for this reaction is derived by G. Gamow (1938). From the density and temperature inside the sun and the DD reaction cross section, we have calculated the neutron production of the sun. The diffusion equation for the neutrons produced in the interior of the sun has been solved and we have calculated the neutron flux which reaches the base of the corona.

Conservation laws of mass, momentum, and energy are applied to the corona and the necessary input neutron flux is calculated. It is found that the flux of neutrons which escapes from the sun and reaches the base of the corona is essentially the same as the flux necessary for the aforementioned conservation laws. It is our belief therefore that this neutron mechanism should be seriously considered as a source of the unusual energy of the corona.

Since the sun is an ordinary star and since neutron-producing reactions are prominent in many galaxies, the neutron energy source theory can be generalized and applied to all stars.

LITERATURE CITED

1. Chandrasekhar, S. 1957. *An Introduction to the Study of Stellar Structure*. New York, Dover Publications, Inc.

2. Gamow, G. 1938. Nuclear energy sources and stellar evolution. Phys. Rev. 53:595-604.