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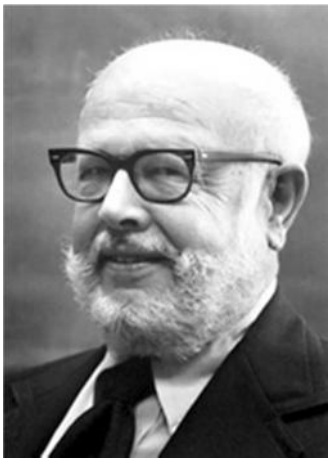
Nobel Prize in Physics 1983

Subramanyan Chandrasekhar



William Alfred Fowler

The Nobel Prize in Physics 1983 was divided equally between Subramanyan Chandrasekhar *"for his theoretical studies of the physical processes of importance to the structure and evolution of the stars"* and William Alfred Fowler *"for his theoretical and experimental studies of the nuclear reactions of importance in the formation of the chemical elements in the universe"*.

Information about winners:

Subrahmanyan Chandrasekhar,
University of Chicago, Chicago, USA,
William A. Fowler,
California, Institute of Technology, Pasadena, USA,

RESEARCH INFORMATION:

The common theme of this year's Nobel Prize in Physics is stellar evolution. A star is formed from the gas and dust clouds which exist in the galaxies. Under the influence of gravity, there is a condensation which slowly contracts to form a star. In this process, energy is released which leads to the heating of the newly-formed star. Finally the

temperature is high enough to set off nuclear reactions in the interior of the star. As a result, the hydrogen, forming the major part, is burnt to helium. This creates a pressure which stops the contraction and stabilizes the star so that it can exist for millions of years. When the hydrogen has been consumed, other nuclear reactions take over, particularly in the more massive stars, and increasingly heavy elements, up to iron, are formed. When the evolution has reached this stage, the star can no longer resist gravity, and it undergoes some form of collapse, the exact nature of which depends on the mass of the star. In some instances the collapse takes the form of an explosion whose visible result is the creation of a supernova. This brings about a brief but extremely intense flow of neutrons, which leads to the formation of the very heaviest elements. For less heavy stars having a mass of the order of our Sun, the collapse gives rise to a so-called white dwarf. The matter has here been compressed so that one cubic centimetre weighs around 1 kilogramme. The electron shells of the atoms have been crushed and the star consists of atomic nuclei and electron gas. For slightly heavier stars, the final stage is an even more compressed state in which electrons and nuclei unite to form neutrons. For the heaviest stars having a mass in excess of 2-3 Solar masses, the force of gravity becomes so strong that the matter simply disappears in the form of a so-called black hole.

This should indicate that stellar evolution gives examples of a number of physical processes of fundamental importance. Many scientists have studied these problems, but Chandrasekhar and Fowler are the most prominent.

Chandrasekhar's work deals with a large number of features in stellar evolution. A major contribution is the study of the stability problem in different phases of the evolution. In recent years he has studied relativistic effects, which become of importance because of the extreme conditions arising during the later stages of stellar evolution. Chandrasekhar's possibly best-known achievement, accomplished when he was in his 20's, is the study of the structure of white dwarfs. Although many of these investigations are of older dates, they have through the great progress of astronomy and space research in recent years gained renewed interest.

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Fowler's work deals with the nuclear reactions which take place in the stars during their evolution. In addition to generating the energy which is radiated, they are of importance because they lead to the formation of the chemical elements from the original matter, which chiefly consists of the lightest element, hydrogen. Fowler has done extensive work on the experimental study of nuclear reactions of astrophysical interest, as well as carried out theoretical calculations. Together with a number of co-workers, he developed, during the 1950s, a complete theory of the formation of the chemical elements in the universe. This theory is still the basis of our knowledge in this field, and the most recent progress in nuclear physics and space research has further confirmed its correctness.

For more details please visit:

http://www.nobelprize.org/nobel_prizes/physics/laureates/1983/press.html