Stellarator Encyclopedia Article

Stellarator

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Stellarator

The stellarator is a device for containing the very hot gases that are used in experiments on the production of nuclear fusion for commercial purposes. Nuclear fusion is the process by which small atomic nuclei, such as protons and deuterium atoms, combine with each other to form larger nuclei. Theoretically, this reaction can be used to generate enormously large energies. The hydrogen bomb is a practical example of the way in which fusion energy can be utilized, albeit in a very destructive way.

Scientists would like to find a way to harness the energy produced by fusion for peaceful uses. The problem is that the combination of nuclei does not take place very easily. Two protons, for example, carry a common positive charge and experience a strong electrical force of repulsion. Only if the two nuclei are given very large kinetic energies can this force of repulsion be overcome. In practical terms, that means the nuclei must be heated to temperatures ranging into the hundreds of millions of degrees.

The technical problem, then, is how to contain a reaction that occurs at, say, 100,000,000K (99,999,727°C). Obviously, no ordinary construction material can withstand this temperature. The most common solution to this problem is to trap the hot gases inside a magnetic field. In the 1950s, the American astrophysicist, Lyman Spitzer, designed a magnetic field that could be used to contain a fusion reaction. The magnetic field takes the shape of a figure eight, wrapped around the hot gases. The field acts like a kind of magnetic " bottle" holding the fusion reaction inside.

Spitzer arrived at his design as a result of his earlier interest in the formation of stars. He tried to understand how stars can form out of cool hydrogen gas in the presence of weak magnetic fields. The results of his speculation form the basis of our present understanding of star formation in galaxies.

Spitzer was born in Toledo, Ohio, on June 26, 1914. He received his doctorate from Princeton University in 1938. He was on the faculty at Yale University from 1939 until 1942. Then, during World War II, he worked on undersea warfare. After the war, he returned to Yale. In 1947, he was appointed chairman of the astronomy department at Princeton. Spitzer was one of the first American scientists to express an interest in space research using rocket s and artificial satellites.