Fusion Energy: 'Yes We Can'

by Laurence Hecht

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Jan. 11—Dr. John Nuckolls, former director of Lawrence Livermore National Laboratory, has proposed a ten-year strategy for achieving laser fusion, which he said could be accomplished with 10% of President-elect Obama's $150-billion projected energy program. The contents of Dr. Nuckolls' proposal addresses issues of science not well known to today's general public, but which should be better known.

In laser fusion, a tiny target of deuterium, sometimes combined with tritium, is compressed by a shock wave which is produced by focussed laser beams. The shock causes the deuterium, a naturally occurring isotope of hydrogen present in seawater, and tritium to combine, forming a nucleus of helium and a neutron. The mass of the resulting helium nucleus is less than the component nuclei, and the mass difference is released as energy, according to the famous equation $E=mc^2$. The energy release per fusion is several times greater than that produced by the fission of a uranium nucleus, which is millions of times greater than the energy released by burning of a molecule of oil or natural gas. The heat of fusion energy can thus drive electrical turbines with far greater efficacy than any known power source, and can also be utilized in a device known as the fusion torch, to break down raw ore, and even garbage, into its constituent elements.

Dr. Nuckolls, who led research on laser fusion at the national laboratory for many years, proposed "four steps to fusion power": 1) build an efficient high-average power laser module, a factory for producing laser targets, and a fusion chamber; 2) build a surged, heat capacity inertial fusion energy system; 3) build a fusion engine; 4) build a fusion power plant.

Fusion energy by laser ignition, known more generally as inertial confinement, has already been repeatedly demonstrated, and was one of the leading paths being pursued when the national fusion energy program was effectively dismantled in the 1980s. Nuckolls was addressing the means needed to develop a laboratory proof-of-principle demonstration into a commercially workable energy generation project.

Inertial confinement production of fusion energy is related to the means by which a hydrogen bomb is detonated, and thus emerged from the national laboratories as one of the peaceful spin-offs of military research. In one method of laser fusion known as indirect drive, a closed chamber known as a *hohlraum* is used to focus thermal x-rays produced by the laser heating, which in turn can drive the nuclear fusion. Indirect drive *hohlraum* targets are used to simulate thermonuclear weapons tests. A key to the technique involves understanding the singularity which occurs upon formation of a shock wave. Soviet research in the field was stimulated by study of the famous paper by 19th-Century mathematical physicist Bernhard Riemann, which had predicted the appearance of sonic shock waves decades before their experimental verification.

Non-Laser Fusion

Other methods of inertial confinement fusion do not require lasers. These include the Z-pinch, in which the vaporization of fine wires by an intense electrical current causes a compression of the wire (Z-pinch) that produces x-rays which drive the fusion of the target. In another method, recently proposed by Dr. Friedwardt Winterberg, the high-voltage discharge of an early type accelerator known as a Marx Generator produces a very powerful instantaneous magnetic field pressure which compresses a cone-shaped deuterium-tritium target, using an ingenious geometry.

Dr. Nuckolls made his "Yes we can" proposal at the annual meeting of Fusion Power Associates held in Livermore, Calif. Dec. 3-4, 2008, where he and fellow fusion pioneer Richard F. Post were presented Special Awards for their pioneering contributions to fusion energy development. Dr. Post, now 90 years old, was a leader in developing the other main branch of fusion power research, known as magnetic confinement.

Lyndon LaRouche has been promoting efforts to develop thermonuclear fusion power since the 1970s. His energy policy calls for immediate deployment of nuclear fission power, including a rapid gear-up of the new fourth-generation high-temperature reactors, expanded research and development of thermonuclear fusion energy, and broadened support for investigation into the anomalous nuclear effects implied by the phenomenon of cold fusion.