FUSION

Z machine produces thermonuclear neutrons

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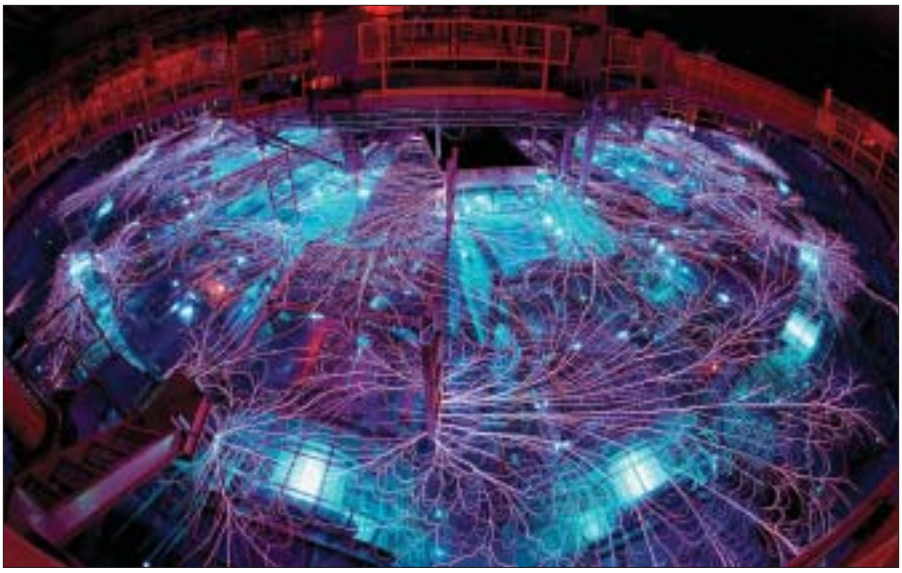
ADDING TO THE number of machines that offer the possibility of achieving controlled nuclear fusion, Sandia National Laboratories' Z pulsed power accelerator has created a hot dense plasma that produces thermonuclear neutrons. The laboratory made the announcement on April 7 at the April meeting of the American Physical Society in Philadelphia.

Unlike tokamaks and laser fusion machines, the Z machine causes reactions to occur through huge pulses of electricity applied with sophisticated timing. According to Sandia, 36 pulsed power sources are timed to fire within 10 billionths of a second. The pulse creates an intense magnetic field that crushes tungsten wires into a foam cylinder to produce X rays. The X-ray energy, striking the surface of a BB-sized target capsule embedded in the cylinder, produces a shock wave that compresses the deuterium within the capsule, fusing enough deuterium to produce neutrons.



New neutron producer: Sandia National Laboratories' Z accelerator at the instant of firing (Photo: Randy Montoya, courtesy of Sandia National Laboratories)

"Pulsed power electrical systems have always been energy rich but power poor," said Ray Leeper, a manager at Sandia. "That is, we can deliver a lot of energy, but it wasn't clear we could concentrate it on a small enough area to create fusion. Now it seems clear we can do that."

Neutron pulses were observed as early as summer 2001, but researchers were concerned that the output was produced by interactions between the target and ions generated by the Z machine's processes, rather than within the capsule itself. Ion-generated neutrons were not the point of the experiment, since they would not scale up into a high-yield event in any later, more powerful version of the machine, Sandia said.

But a series of experiments completed in late March demonstrated that the production was within the capsule itself. To show this, researchers inserted xenon gas within the capsule, which prevented the capsule from heating up during compression. As predicted, the neutron yield dropped dramatically.

Sandia has speculated that the amount of energy produced by a larger successor to the Z accelerator, which began operations in 1996, may one day offer the possibility of high-yield fusion—the state in which much more energy is released than is needed to initially provoke the reaction.