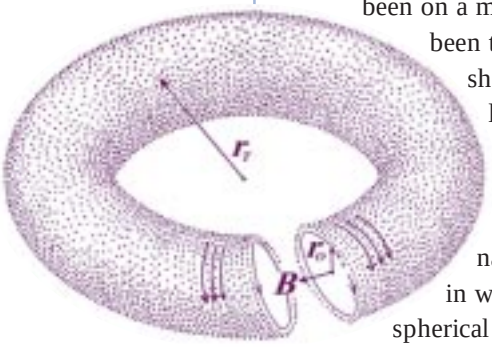
BMDO Update
Linking American Businesses to Ballistic Missile Defense Technology
www.bmdotechnology.net

This article is reprinted from the *BMDO Update* newsletter, a publication of the BMDO Technology Applications program.

WINTER 2001-2002
ISSUE #40

ENERGY STORAGE

TAMING BALL LIGHTNING



Plasma ring. *A conceptual drawing of Electron Power System's spiral plasma toroid (SPT). Electrons travel in parallel orbits around a torus, which produces an internal magnetic field. According to recent theoretical work by Chen, at sufficiently high electron densities, SPTs will be stable in atmosphere with no external magnetic fields.*

For over ten years, Clint Seward of Electron Power Systems, Inc. (Acton, MA), has been on a mission. He's been trying to show that ball lightning—a rare and unexplained natural event in which a spherical cloud glows for as long as a minute—could hold the key to a revolutionary energy technology. This mission recently passed an important milestone as Dr. Chiping Chen, a research scientist at the MIT Plasma Science and Fusion Center, has confirmed the existence of a generic class of self-organized plasma toroids, stable in atmosphere with no external magnetic fields required for containment. A paper by Chen, Pakter, and Seward will be published in October in *Physics of Plasmas*.

Credible science

Chen's work supports Seward's experimental research on plasma toroids, which began after theorizing that ball lightning is a naturally occurring self-organized plasma toroid. Since producing small, short-lived, self-organized plasma toroids in the lab—which he calls spiral plasma toroids (SPTs)—Seward has concentrated on developing a theoretical framework to explain their existence. This framework was essential, he thought, to obtain the scientific credibility he needed to sustain a long-term program for building larger, more practical SPTs. Seward and Chen presented a paper at ICOPS 2001 titled "Ball Lightning Explained as a Stable Plasma Toroid."

Ball lightning could hold the key to a revolutionary energy technology.

With Chen's theoretical work published, Seward now has this stamp of approval on the physics, and he can start moving toward his ultimate goal and that of the BMDO STTR program managers who funded some of this work: a workable energy storage device for propulsion or directed energy weapons.

For instance, Chen has suggested a radical new propulsion system based on this technology. Theoretical calculations suggest that the SPT can be accelerated as an entity at up to 600,000 m/s. This would provide thrust in atmosphere with a specific impulse of 60,000 seconds, compared to the 500 seconds for chemical systems. This improvement in specific impulse means that rockets using the SPT unit would be able to carry 120 times less propellant. While similar accelerators are being devel-

Continued on page 2

ENERGY STORAGE

Taming Ball… from page 1

oped using compact toroids at Kirtland AFB, SPT's can be made rapidly in a simple apparatus, and can last in atmosphere.

By directing the SPT beams outward from a gun, instead of backward from a rocket, the SPT could also be used to form a new kind of directed particle beam that would travel through atmosphere. Such a system would project significant force and energy through atmosphere and onto an incoming missile or aircraft. And, at 600,000 m/s, it would be projected rapidly over long distances.

Finally, Seward has also calculated that the technology will increase the capacity of charged particle traps by an order of magnitude. If so, it can be useful for storing protons, ions, and antimatter. This will have long-term benefits in the field of energy storage and power generation.

Next Steps

Seward says the next steps for developing the technology are clear. Plans are on the drawing board to make a larger, more practical SPT. "The physics provide guidance on how to modify the present experimental apparatus to do this," added Seward. "There is no technical impediment, just time and effort." The scale-up will allow the demonstration of the particle trap technology, and will lead to experiments to demonstrate the SPT acceleration. Seward is looking for strategic partners to complete these experiments.

—T. Lynch

■ CONTACT INFORMATION:

Clint Seward
Electron Power Systems, Inc.
42 Washington Drive
Acton, MA 01720
Tel: (978) 263-3871
Fax: (978) 263-7834
E-mail: cseward@ieee.org