

White Paper

March 2002

Title: **High Kinetic Energy Particle Beam for Missile Defense**

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Summary:

A new form of high kinetic energy particle beam is proposed that will travel through air and clouds at velocities of 600,000 m/s (2000⁺ Mach). It will rapidly deliver a force of mega Newtons through air onto a target many kilometers away. This has potential to destroy incoming missiles and aircraft.

We make electron spiral toroids (EST's), a nearly charge neutral plasma configuration that requires no external magnetic fields to remain stable in atmosphere [Chen 2001]. Dr. Chen of MIT confirmed to BMDO in May 2001 that stable EST's are possible in air with no external magnetic fields, a new discovery. BMDO (now the MDA) has funded preliminary work on this technology since 1997.

We accelerate the EST's with magnetic field pressure, which adds far more energy than is possible with chemical means, potentially a mega joule per EST. This method is possible because the EST has an internal magnetic field. Chen calculates EST's can be accelerated to 600,000 m/s in the same way compact toroids are accelerated at Kirtland AFB. The difference is that we have learned how to do this in atmosphere, while the compact toroid work must be done in high vacuum. EST's can be accelerated as an entity in air, which the compact toroids cannot be. The EST's are essentially charge neutral, eliminating the problems of charged particle beams. Since EST's are produced in large number, potentially they can be initiated in rapid succession to form a beam.

Status of the Technology:

We have learned how to make electron spiral toroids (EST's) that remain stable in atmosphere with no external magnetic fields. A recent BMDO contract has funded work to characterize the EST's. As part of the BMDO contract, Dr. Chen of MIT produced an independent confirmation of the physics, and determined there is a generic class of self-organized spiral plasma toroids, stable in atmosphere with no external magnetic fields required for containment [Chen 2001]. This was published in the October 2001 "Physics of Plasmas."

Electrons travel in parallel orbits around a torus, traveling in the poloidal direction. This produces an internal magnetic field that provides the structure and the ability to cross magnetic field lines.



Figure 1: Electron Power Systems produces small EST's in atmosphere like this one.

The EST's we make are suitable for use as a particle beam in air. We accelerate them in our lab in partial atmosphere, and Dr. Chen calculates that the EST's can be accelerated as an entity at up to velocities of 600,000 m/s based on work done at Kirtland AFB. The EST's are different from any reported compact toroids since EST's are produced in air rather than in vacuum. EST's have three great advantages over vacuum based compact toroids: first, they endure in atmosphere; second they travel through atmosphere; third, they are made in a simple apparatus in large quantity.

Directing the EST's will form a particle beam that will potentially travel through atmosphere in a line-of-sight path. The system would deliver mega Newtons of force through air and clouds onto a target many kilometers distant. At 600,000 m/s it would be projected rapidly, which would be ideal for defense against missiles and aircraft.

Details can be provided on a nondisclosure basis.

Company Information and Facilities: Electron Power Systems, Inc. (EPS) is a small company founded to develop the technology. EPS maintains offices and a lab at 42 Washington Drive in Acton, Mass. EPS, Inc. has a strong R&D capability through networking with companies in the Boston Route 128 high tech area. MIT Plasma Science and Fusion Center has been a research collaborator on several contracts with EPS, helping to develop the theory behind the EST.

References:

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