Magnetized Beamed Plasma Propulsion (MagBeam)

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Magnetized Beamed Plasma Propulsion (MagBeam) represents a hybrid between advanced electric propulsion, beamed energy systems, and plasma sail technologies that will provide high thrust, high speed and high payload fractions for robotic and human exploration of the entire solar system. MagBeam utilizes collective behavior of present high power helicon plasma thrusters to beam energy from a high-power platform (HPP) to the spacecraft. Unlike other beamed-energy scenarios, the MagBeam plasma creates a conductive path/magnetic link between the HPP and the spacecraft, which focuses the energy so that problems with collecting area are removed. Because the bulk of the energy is in the form of plasma, no energy conversion is required for propulsion, only the deflection of the incident plasma, thereby removing issues with energy conversion associated with beamed power systems. The deflection of plasma by the spacecraft means that the thrust exerted on the spacecraft is twice that generated by the HPP. Multiple deflections within a mirrored system can yield thrust levels orders of magnitude higher, providing enormous savings in power and propellant requirements. The actual acceleration of the spacecraft can be nearly an order of magnitude higher that AEP systems due to this enhanced thrust and because the mass associated with the power generation is removed from the payload spacecraft. As a result, the system would provide revolutionary capabilities for robotic and manned missions to the planets. The proposed work seeks to (1) quantify MagBeam's performance characteristics through computer modeling, and (2) perform initial laboratory prototyping to provide initial validation of the concept and supply critical input parameters for the computer simulations.

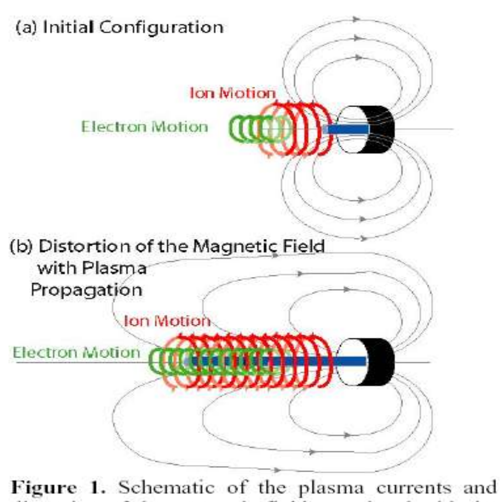

Figure 1. Schematic of the plasma currents and distortion of the magnetic field associated with the beamed plasma.

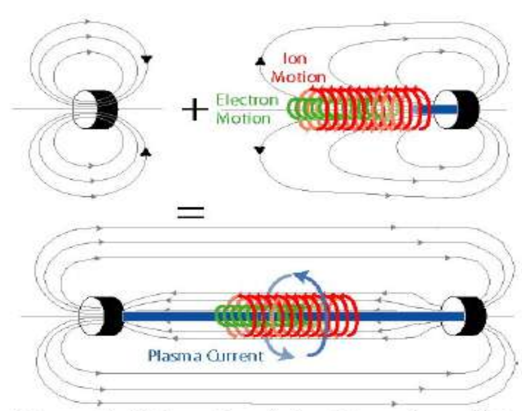

Figure 2. Schematic of the interaction of the beamed plasma with the payload. Due to reconnection the incident plasma will be funneled into the payload and an extended mirror device will be created.

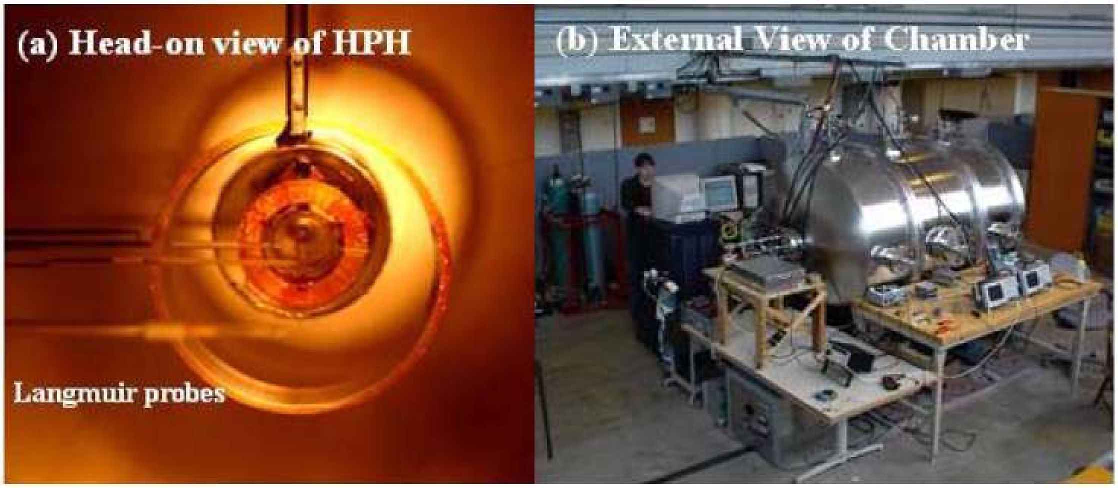

Figure 6. (a) Head-on view of HPH inside the 4000 liter UW chamber and (b) external view of chamber.

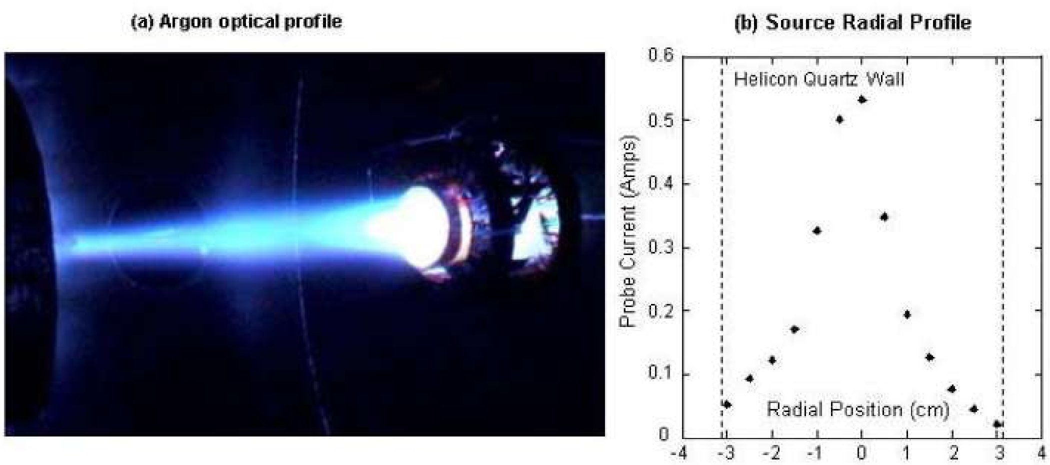

Figure 7. (a) Optical image of HPH in argon during a 1-ms shot and (b) data from a Langmuir just in front of the Helmholtz coils showing highly collimated plasma production. Peak density corresponds to about 10^{21} m^{-3}.

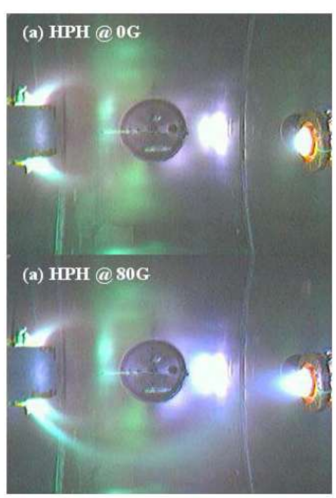

Figure 8. Beamed plasma interaction between M2P2 at 400 G and HPH with (a) zero magnetic field and (b) 80 G.