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Plasma Window for Various Applications

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The Plasma Window is a novel apparatus that utilizes a stabilized plasma arc as interface between vacuum and atmosphere or pressurized targets without solid material. Additionally, the plasma has a lensing effect on charged particles. Furthermore, plasma from a plasma window was extended over 2 cm into atmosphere to form a plasma shield (Plasma Shield is basically a Plasma Window extended to engulf a target object).

The best results to date have been the following:
1. Vacuum (pressure of ~ 10^{-6} Torr) was successfully separated from atmosphere or argon gas target pressurized up to 9 bar.
2. A 2 MeV proton beam was propagated from vacuum through the plasma window into atmospheric pressure.
3. Electron beams with energies of 90 - 175 KeV were transmitted from vacuum through the plasma window to atmosphere. And, Self-pinched beam propagation was achieved with 6 - 25 mA, 90 –150 KeV electron beams. By comparison previously demonstrated self-pinched propagation used kA multi-MeV electron beams.
4. Successful transmission of X-rays from a light source to atmosphere.
5. Gas cell pressurized to 3 bar was successfully separated from atmosphere and HeNe laser light was transmitted through the gas cell and plasma window to atmosphere.
6. High quality electron beam welding in atmosphere performed.
7. Helium gas target (over 1 bar) sandwiched between two plasma windows was separated from vacuum on two opposite ends.

Scientific and industrial applications involving beam transmission from vacuum to atmosphere or to high pressure targets (like high quality electron beam welding that was performed in atmosphere) be enhanced by this technology. Specifically, the plasma window/shield can be beneficial to a number of scientific devices and machines like synchrotron light sources, high power lasers, internal targets, high current accelerators, and spallation neutron sources. A number of possible applications including windowless beamlines to atmosphere (or to high pressure targets) for neutron and/or x-ray generation will be discussed.

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