



Contribution ID: 212

Type: Oral

Magnetic-field evolution in Z-pinch implosion with preembedded axial magnetic field

Tuesday, 20 June 2017 16:45 (15 minutes)

We investigate the effects of an axial magnetic field (B_z) on the current distribution in imploding plasma and the efficiency of the B_z -field compression by the imploding plasma. In the experiment, a cylindrical argon gas puff, in which is initially embedded quasi-static magnetic flux (up to 0.4 T), prefills the volume between two electrodes. Subsequently, a pulsed-current (rising to 300 kA, in 1.6 μ s) driven through the gas, ionizes it, and generates an azimuthal magnetic field that compresses the plasma and the embedded B_z -field. Here, for the first time, we directly and simultaneously measure the evolution of the axial and azimuthal magnetic fields during the implosion and stagnation. This measurement was achieved by employing a spectroscopic technique based on the polarization properties of Zeeman split emission, combined with laser-doping technique that provided mm-scale spatial resolution. The measurements show that for implosions with $B_z(t=0) = 0.4$ T, the azimuthal magnetic field (B) in the imploding argon plasma shell is much smaller than expected from the measured current and plasma radius, demonstrating that B_z dramatically affects the current distribution. It is found that in the presence of a low B_z , a significant part of the current flows at large radii through a non-imploding dilute plasma ($n_e \leq 10^{17} \text{ cm}^{-3}$). In addition, simultaneous B_z and B measurements at stagnation for $B_z(t=0) = 0.4$ T show that B_z is compressed about $12 \times$ relative to its initial value, giving at stagnation a B_z -magnitude $\sim 4 \times$ larger than B . The pressure in the stagnated plasma (including the thermal pressure) becomes $16 \times$ higher than the pressure of B . This demonstrates the large role of the ram pressure of the imploding plasma on the compression of B_z in this experiment.

This work is supported by the US-Israel Binational Foundation under Grant 2012096.

Primary author: MIKITCHUK, Dmitry (Weizmann Institute of Science)

Co-authors: Dr CVEJIC, Marko (Weizmann Institute of Science); Dr DORON, Ramy (Weizmann Institute of Science); Dr GIULLANI, John (Plasma Physics Division, Naval Research Laboratory); Dr KROUPP, Eyal (Weizmann Institute of Science); Prof. MARON, Yitzhak (Weizmann Institute of Science); Dr VELIKOVICH, Alexander (Plasma Physics Division, Naval Research Laboratory)

Presenter: MIKITCHUK, Dmitry (Weizmann Institute of Science)

Session Classification: Oral session 11 - Plasma Z-Pinches, Pulsed X-ray Sources, High-Power Diodes, Wire Array Implosions - Session Chair : Michael Mazarakis

Track Classification: High-Energy Density Physics and Technology