Sandia National Laboratories

Z-Theta Plasma Compression Experiments

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Project Description

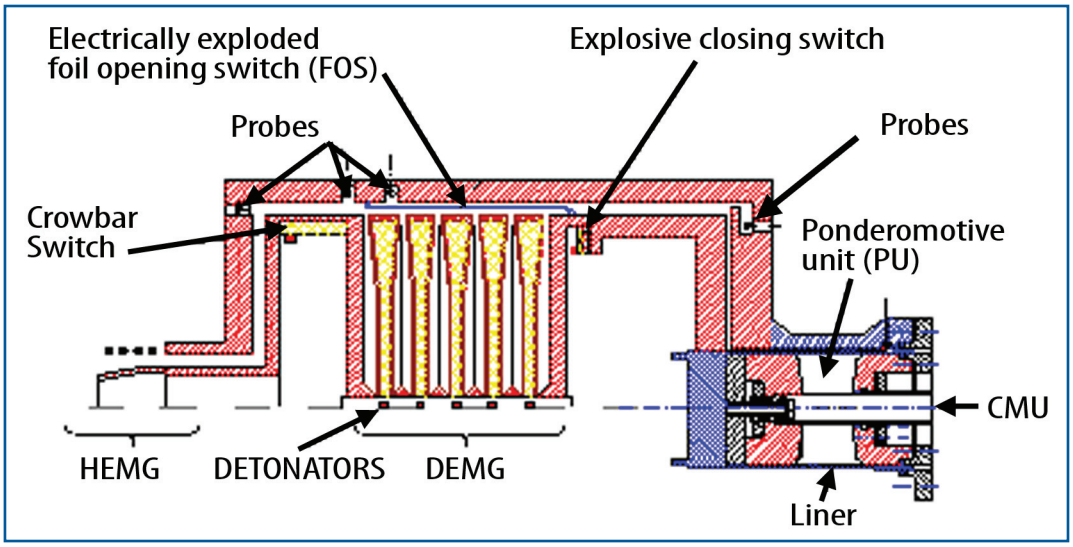
The purpose of this project is to prepare and perform joint U.S.-Russian Z-machine experiments on compression of longitudinal magnetic field using a collapsing z-pinch based on multi-wire arrays.

The possibility of longitudinal magnetic field compression with a hollow gas jet in a z-pinch configuration has been shown experimentally. The longitudinal magnetic field suppresses instabilities in the plasma, which allows radical compression of a liner 15 to 30 times. Similar experiments have been performed at currents with amplitude less than 10MA. At high currents, it is necessary to use liners with higher linear mass, which can be achieved with liners formed from multi-wire arrays. The work should address the question of efficiency of axial magnetic flux compression by plasma liners based on multi-wire arrays. Preliminary calculations show the possibility of obtaining and recording ultra-high magnetic fields (>50 MG).

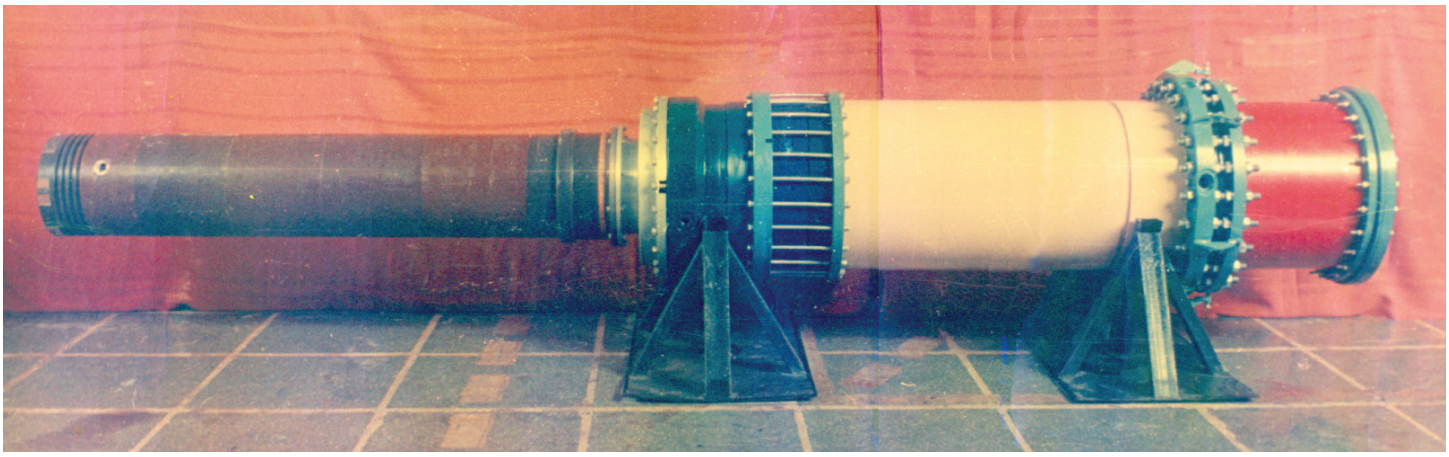
This work will include calculations and theoretical studies, preliminary experiments on the Saturn accelerator at Sandia National Laboratories, explosive generator shots at VNIIEF, and preparation and participation in similar experiments on the Z accelerator at Sandia if experiments in Russia are successful.

Technical Purpose and Benefits

This work evaluates an alternate plasma compression scheme that could lead to record-level magnetic field generation, and which could be a new fusion technique. This is a new effort based on proposals by the group at VNIIEF. It is expected that this effort will also relate to work on explosive generators at VNIIEF, and provide insight on Russian explosive generator technology. NNSA benefits by allowing the evaluation of a promising alternate plasma compression scheme for similar efforts, before committing resources and time on U.S. accelerators. Sandia researchers benefit by learning experimental techniques and plasma compression schemes from the Russians that broaden their capabilities and focus in an area of specific fusion expertise. The Russian experiments provide unique, complementary approaches to high-current z-pinch driver.



Russian Electromagnetic Pulse Generator



Russian Electromagnetic Pulse Generator

Collaboration between Sandia National Laboratories (SNL), Albuquerque, NM, and the Russian Federal Nuclear Center – All Russian Research Institute of Experimental Physics (RFNC-VNIIEF), Sarov, Russia

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