Sandia National Laboratories

Development of Fast High Current Linear Transformer Drivers for the Next Generation of Z-pinch Fusion Drivers.

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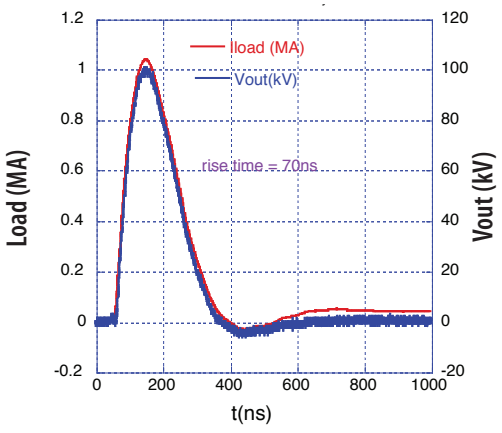
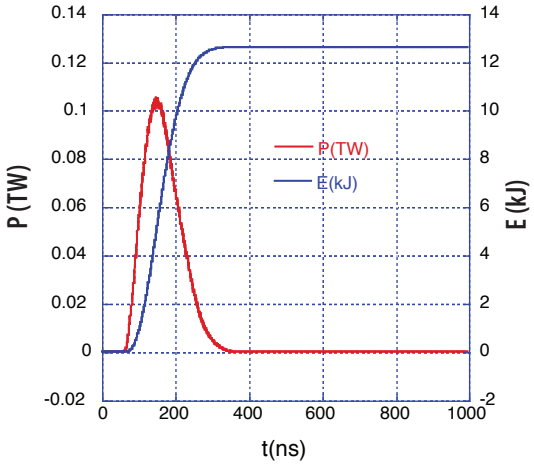
Project Description

This project constitutes a revolutionary approach to pulsed power that eliminates Marx generators' high voltage switches, oil and water tanks of the conventional Z-pinch drivers. Sandia and the High Current Electronics Institute (HCEI) at Tomsk, Russia are the leaders in developing a new type of very compact, high current, high voltage, voltage adders of short 70-100-ns pulses based on the Linear Transformer Driver (LTD) technology. The salient feature of the new technology is switching and inductively adding the pulses at low voltage straight out of the capacitors through low inductance transfer and ferromagnetic core isolation. High voltage is obtained by inductively adding many stages in series like in our voltage adder–HERMES III–accelerator. MultiMegamp currents can be achieved by connecting many voltage adders in parallel.

This collaborative effort, which started in 2004, involves the development and building of 1-MA, 100-kV, 1-TW LTD stages. Our near-term goal is to build a number of those LTD pulsers, stack them together and test them in a voltage adder configuration similar to that of our HERMES III pulsed power accelerator. Our ultimate goal is to utilize these devices as building blocks for the next generation of Z-pinch drivers.

Although the project has several tasks, there are three that are primary. The first involves the production of a detailed design of the oil-filled LTDZ stage suitable for vacuum tight serial connection in the module. This includes a detailed design of all the support tools needed to assemble and test separate stages, and to install 10 such stages in series into the module. The second involves the fabrication and assemblage of two LTDZ stages, the support tools, trigger and pre-magnetizing systems, air and oil communications for the whole module. The third involves performing electrical tests of the LTDZ stages, measuring and recording critical voltages and currents in the stages. Further optional effort could involve the production, assemblage and testing of some number of additional identical LTDZ stages to be installed into the same module. HCEI shall design and produce the vacuum diode load and the center conductor for tests of the module with matched diode load.





Technical Purpose and Benefits

This project studies transport problem computations in multiple-layer systems of various optical thickness using both space decomposition and decomposition in energy variables. Published mathematical tasks will be used for analysis. Two independent combinations of the two parallelization algorithms are assumed, and the efficiency of combining parallelization in energy groups with parallelization in space will be considered.

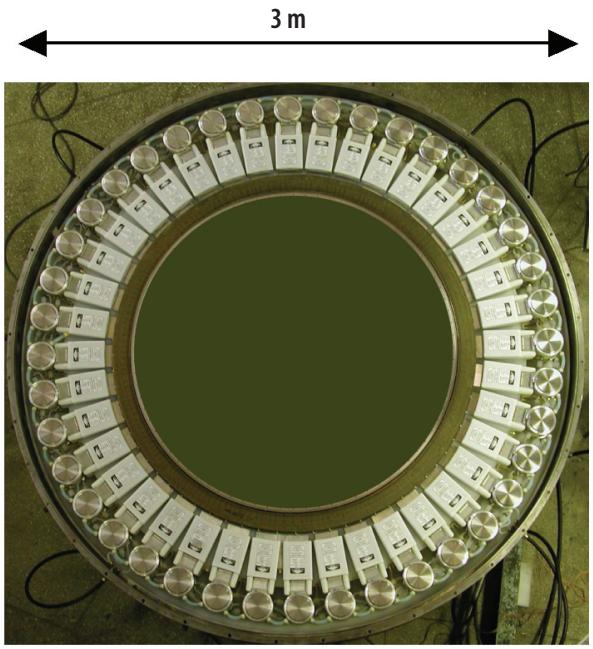


Figure 1. 1-MA, LTD stage top cover removed.

HCEI

Collaboration between Sandia National Laboratories (SNL), Albuquerque, NM, USA, and High Current Electronic Institute (HCEI), Tomsk, Russia.

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