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# Experimental Platform Development for Studying Vacuum Power Flow Physics at the Sandia Z Accelerator

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While the Z Facility can routinely deliver 25-27MA current pulses to a variety of high energy density physics experiments, load configurations which require high-inductance (>3.0 nH) hardware typically suffer from reduced current coupling in the form of charged particle losses in magnetically insulated transmission lines (MITLs). These losses: (1) can be difficult to model with conventional simulation techniques; (2) can be caused by a number of coupled physical processes including space charge limited electron and ion flows, plasma formation in desorbed neutral layers, and negative ion transport; and (3) can potentially become even more severe for higher current, next-generation pulsed power accelerator concepts under consideration.

In order to provide critical experimental data for improving predictive models of vacuum power flow, we have developed a dedicated experimental platform based on a raised extension of the radial transmission line coupling a simple Al liner target to the Z vacuum convolute. This raised extension has been optimized to allow for multi-dimensional, chordal lines-of-sight for new spectroscopic diagnostics in development. New particle diagnostics, coupled with laser velocimetry and spectroscopic techniques, can be leveraged to explain the contributions of electrons and/or ions in global current loss. A combination of imploding and non-imploding liner concepts are used to separate dynamic impedance effects on current loss late in the current pulse. This paper will describe the ongoing development of this platform, examples of key diagnostics, and results from upcoming Z experimental campaigns dedicated to exploring vacuum power flow physics on large pulsed power accelerators.

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