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Experiments on the Clam Shell Magnetically Insulated Transmission Line (CSMITL2) on Saturn

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Large multi-megampere pulsed power accelerators face current loss issues in combining multiple magnetically insulated transmission lines (MITLs) into a single radial disk feed for loads such as Z-pinch radiation sources, shock physics experiments and fusion studies. The method used in many of these machines is the post-hole convolute (PHC) where the MITLs are joined very near the load region. This region is highly stressed, has abrupt changes in the geometry, has electron loss through magnetic nulls, and significant, but currently not understood losses for high-impedance loads. A radically different alternative, the Clam Shell MITL (CSMITL) is designed to combine power from different levels at a large radius where the electric field is below the emission threshold and to transport the power to a single central load without abrupt changes in the geometry. Whether or not the CSMITL has the same anomalous losses as the PHC remains to be determined and may help illuminate the source of the losses.

The first generation CSMITL design was tested at the Saturn accelerator at Sandia National Laboratories in Albuquerque in 2011, utilizing half of its 36 pulse-forming lines. The results of that experiment proved promising and a second experiment was constructed, the CSMITL2, the results of which are presented here. In this second design, all 36 pulse-forming lines were combined through three of Saturn's six vacuum insulator sections into a radial disk feed and the pulse was inverted to drive a large area ion diode load. We report the results of power transport by current and voltage measurements, loss in the CSMITL through x-ray pin-hole camera imaging, and ion beam production with multiple diagnostics.

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