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Modeling a gas puff z-pinch as an RL circuit load

James VanGordon & Scott Kovaleski

A Z-pinch is process through which current is passed through a column of plasma and the resultant $J \times B$ force acts to "pinch" the plasma to smaller and smaller radii. More specifically, a gas puff Z-pinch is a Z-pinch that utilizes a puff of ionized gas (in this case hydrogen) to start the initial plasma. As the radius of the Z-pinch approaches zero the resistance and inductance of the pinch in the circuit change as a function of time. Through an iterative process of circuit simulations with PSpice, a function of the radius with respect to time can be determined. Using this information, the pinch can be modeled on the MU Terawatt Test Stand (MUTTS) as a load consisting of an inductor and a resistor. With this time-varying impedance the transient voltage and current can be graphed to determine the possibility of such a load in the future.