

Public Abstract

Eric Worts

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Theoretical Investigation of a Laser Triggered Spark Gap

Advisor: Dr. Scott Kovaleski

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A model of a spark gap used as a shorting switch in a Blumlein pulse power system has been developed. The model consists of two separate parts: a kinetic model, which shows the formation of the plasma streamer, and a fluid model, which describes the behavior of the arc after the connection is made. The resulting streamer radius and streamer conductivity from the kinetic model represent the initial conditions of the arc described by the fluid model. Intrinsic switch parameters, varied to determine their effect on the streamer radius and density, are the electric field in the gap and the type of gas and its pressure used in the gas chamber. Pulsing laser parameters varied are the laser pulse power, the spot area, and the spot shape. Conditions varied in the fluid model are the initial arc radius, which is depicted in the kinetic model, the steady state conductivity of the arc, and the gas type and pressure in the spark gap chamber. Increases in the initial radius of the arc showed a lower resistance for the first 10 ns after the connection is made, while changes in conductivity, gas type, and pressure showed a consistent reduction of the current throughout the life of the arc. Reorienting the laser pulse from a linear beam parallel to the electric field to one transverse yielded the most significant increase in the radius of the streamer, 25%. Increasing the electric field from 2 MV/m to 5 MV/m also increased the radius and density of the streamer. Other varied parameters had significant, but a less drastic effect.

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