Correlation of Microwave Emission and Current Oscillations in the Initial Stage of a Long Spark Discharge

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We study the correlation between current oscillations and microwave (MW) radiation in the initial phase of a megavolt discharge across an extended (∼50 cm) air gap. Experiments were performed on a large-scale axial-symmetry installation of the ERG [1]. Current dynamics were measured via an anode shunt, and MW radiation was detected by a broadband Vivaldi antenna [2]. Analysis reveals a consistent ∼1 ns delay of the MW signal relative to the current pulse, with an additional 3 ns attributable to the signal path geometry. These current oscillations are synchronous with peaks in dU/dt and correlate with key plasma events such as streamer merging [3] or leader connection [4]. The observed delay suggests that MW emission is not a direct bremsstrahlung effect but likely results from the finite-time excitation of plasma oscillations or electromagnetic modes by relativistic electron clusters generated during the current burst.

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