Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Estimation of vorticity generated due to shock curvature in spark induced flow.[1] BHAVINI SINGH, LALIT RAJENDRAN, PAVLOS VLACHOS, SALLY BANE, Purdue University — Spark plasma discharges induce a complex, transient flow field. The spark discharge induces a shock wave at early times, that propagates radially outward from the electrode gap. The discharge also creates a hot gas kernel, and a pair of vortex rings in the electrode gap. It has been shown that long after the shock wave has departed the field of view, a vortex-driven mixing flow is produced, where the pair of vortex rings drive cooling of the hot gas kernel. The spark induced vorticity therefore plays a key role in the heat transfer and dynamics of the induced flow field. The mechanism(s) responsible for the generation of this vorticity and the effect of electrical energy deposited in the gap on the vorticity remain unresolved. In this work, we develop a detailed, analytical framework to estimate the vorticity generated due to the curvature of the induced shock wave and compare this to the magnitude of vorticity in the vortex rings for a range of energy values. We perform 700 kHz schlieren measurements to capture the induced shock wave and 50 kHz time resolved, stereoscopic, particle image velocimetry measurements of the velocity field to calculate the induced vorticity. This is a first step in understanding the role of the shock wave in vorticity generation and provided a framework for further research in the area.

[1]U.S. Department of Energy, Office of Science, Office of Fusion Energy Sciences: Award Number DE-SC0018156

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Date submitted: 03 Aug 2020 Electronic form version 1.4