Abstract Submitted
for the GEC19 Meeting of
The American Physical Society

Time-resolved Nanosecond Imaging of Single-electrode Pulsed Plasma Branches in Water CHRISTOPHER CAMPBELL, XIN TANG, CHRISTOPHER LIMBACH, Texas A&M University, YANCEY SECHREST, JEPH WANG, Los Alamos National Laboratory, DAVID STAACK, Texas A&M University — Pulsed plasmas in liquids present a complex multiphysics environment which challenges conventional fast (ns) imaging techniques. This work focuses on nanosecond-pulsed single-electrode plasma discharge processes in distilled water. Previous work identifies a mode transition from spherical discharges to branched discharges in these types of water plasmas, sensitive to water conductivity and pulse energy. For branched water plasmas generated with 30 kV 5 mJ voltage pulses (rise rate of 2.5 kV/ns), these plasma branches can be up to 5 mm long and <10 μm across. Preliminary results suggest that branch length scales with voltage, and that the propagation speed of these branches is $\sim$20 km/s. Due to the high power densities ($>10^{10}$ W/cm^3) and high electron densities ($>10^{18}$ cm^{-3}) which occur in multiphase water during short timescales (<50 ns), this thermodynamic environment is difficult to model; time-resolved experimental interrogation is therefore necessary. For sufficient time resolution, low-jitter operation was achieved using a laser-triggered (Nd:YAG, 266 nm, 30 mJ/pulse) air spark gap switch as well as a solid-state nanosecond-pulsed power supply. Fast time-resolved imaging results using optical and X-ray techniques are presented and discussed.

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Date submitted: 23 Oct 2019 Electronic form version 1.4