

Free-Floating Atmospheric Pressure Ball Plasmas

By Glen Wurden, Program Manager, Los Alamos National Laboratory

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<http://www.lameetingplace.com/maps.htm>

Pizza will be provided as lunch --- while it lasts.

Abstract:

A long-lived (0.3 second, 10-20 cm diameter) ball plasma floating in the air above a water surface has been formed and studied in the laboratory. A 0.4 mF capacitor is charged to 4-5 kV, and subsequently discharged (30-250 Amps, 20-50 msec duration) into central (negative) copper cathode fixed just below the surface of a bucket of water (with a weak solution of various salts in distilled water, such as CuSO₄ or CuCl₂, LiCl or NaCl). An underwater ring anode completes the circuit. A spider-leg pattern discharge flashes out over the surface of the water in the first few milliseconds, and then a bubble of hot vapor from the water surface rises up, changing from a mushroom cloud with stalk, to a detached quasi-spherical object, finally evolving into a vortex ring. The plasma consists of ionized water vapor, with positive salts and OH- radicals, as well as molecular species, and it completely excludes nitrogen or oxygen from the rising plasma structure. A fine boundary layer is visible in orange, in contrast to a green ball interior when using Cu/CuSO₄, and filamentary structures are visible at late times. Finally, a whisp of smoke ring is observed as a residue. When the entire system is discharged into an inert helium atmosphere, the boundary layer which is routinely visible in air is absent. A variety of visible and infrared imaging (both video at up to 20,000 fps, and high resolution still cameras) are used, along with 200-800 nm time & space resolved spectroscopy, to identify features of this laboratory analog to ball lightning. Temperatures are in the range of a fraction of an electron volt, and the ball is only partially ionized.

Biography:

Dr. Glen A. Wurden, presently Magnetic Fusion Experimental Team Leader in P-24 Plasma Physics Group and Fusion Energy Sciences Program Manager at LANL, was born on Sept. 9, 1955 in Anchorage, Alaska. He attended public schools in western Washington, and went to the University of Washington with a National Merit Scholarship. There he earned three simultaneous B. S. degrees, in Physics, Mathematics, and Chemistry, summa cum laude (1977), graduating with the highest class honors as President's Medalist. He was awarded a National Science Foundation Graduate Fellowship, and received M.S. (1979) and Ph.D. (1982) Degrees in Astrophysical Sciences from Princeton University. He is a member of Phi Beta Kappa, the APS, the AAAS, and a senior member of the IEEE. Glen specializes in plasma diagnostics on fusion plasmas, and has worked on fusion experiments around the world.