SHOCK WAVE INTERACTION WITH A TOROIDAL AIR PLASMA

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ABSTRACT

The University of Missouri-Columbia has recently developed an experimental test stand for the purposes of studying the interaction of shock waves with plasmas in ambient air. An exploding-wire-triggered shock tube is used to produce the shock wave for interaction with plasma in air.

For the plasma source, an exploding wire discharge has been confined in a cylindrical geometry to form a freely propagating toroid-shaped plasma. The initial plasma is formed by discharging a 11 μF, 4.4 kJ capacitor bank through a thin wire. This discharge is then forced to expand toward a secondary discharge region which further heats and energizes the plasma. The confining geometry coupled with the secondary heating produces a multi-millisecond duration toroidal air plasma, or TAP. The TAP has a sufficient duration to observe its interaction with the incoming shock wave.

Pressure sensors, high speed photography, schlieren imagery, emission spectroscopy, as well as current and voltage probes have been configured as a full diagnostic suite to observe the interaction of the shock wave and the TAP discharge. The novel TAP discharge is characterized and explored and the experiments within provide qualitative and quantitative results on the effects of interacting a shock wave with a plasma in ambient air.