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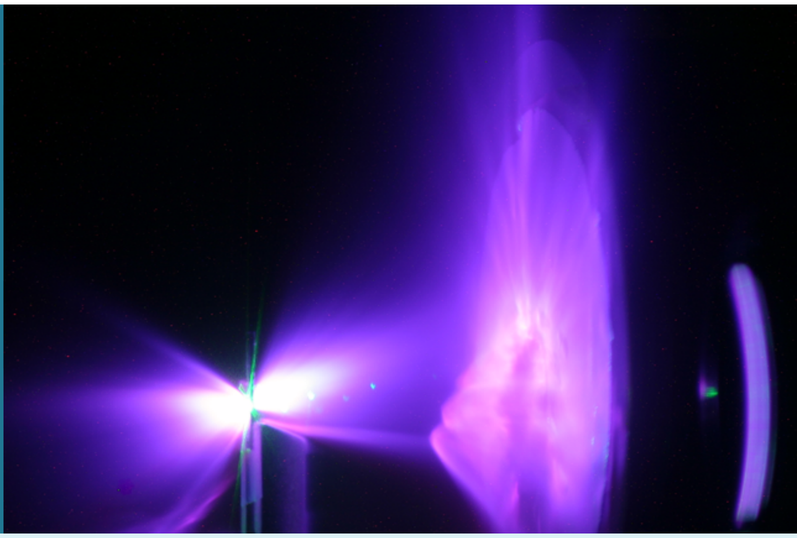
ULTRAION

ULTRAfast IONization, Heating, Thermalization and Constriction of High-Pressure Nanosecond Pulsed Discharge Plasmas



Inspiration

This award supports implementation of a novel measurement technique for atmospheric pressure discharge plasmas. Atmospheric pressure plasma - a partially ionized gas - has many potential applications, including the removal of volatile organic compounds through gas cleaning, lean ignition of combustion engines, and control of high-speed flows. The capability to extend and broaden the potential of atmospheric pressure plasmas for addressing societal needs is currently limited by our ability to generate these plasmas in a controlled and reproducible manner. Better understanding of the mechanisms responsible for the occurrence of instabilities in atmospheric pressure pulsed plasma discharges is key to improving control of these processes. This project will perform state-of-the-art laser diagnostics complemented with numerical simulations to investigate the instabilities.

Innovation

This research project aims to investigate the mechanisms of the fast transition from partially ionized atmospheric pressure discharges to fully ionized thermal spark discharges on nanosecond time scales by developing a suite of ultrafast optical diagnostics. The study will produce new insights in the plasma physics of nanosecond repetitively pulsed discharges (NRPs) with quantitative analysis of ultrafast ionization and thermalization. An important goal is to test theoretical models proposing a role of strongly coupled phenomena in the observed plasma heating. In addition, the large range of ionization degrees and plasma temperatures encountered in NRPs will be leveraged to assess the applicability of several optical diagnostics in the partially and fully ionized plasma regimes.

Impact

The outcomes of this study are expected to lead to new insights on electron kinetics, heating and thermalization mechanisms responsible for the occurrence of instabilities in atmospheric pressure plasmas.

Partenaires

University of Minnesota

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