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RF Discharge Equilibrium, Transport, and Afterglow Radiation and Density Peaks in a Pre-Ionization Source for the Caltech MHD-Driven Jet Experiment VERNON CHAPLIN, PAUL BELLAN, Caltech — A novel pulsed battery-powered RF plasma source has been developed for pre-ionization in the Caltech MHD-driven jet experiment, enabling the formation of lower mass, faster jets than was possible with neutral gas breakdown alone. Results of jet experiments relevant to astrophysical and fusion plasmas will be presented, along with characterization of the custom 3 kW, 13.56 MHz RF amplifier and detailed studies of the argon RF plasma properties. The discharge conditions as a function of power input and axial magnetic field were monitored using Langmuir probes and optical spectroscopy; comparison of the data with a global discharge model indicated that the source was operating in a primarily inductively coupled mode with peak $n_i > 3 \times 10^{19}$ m^{-3}. A 1D transport model has been developed to quantitatively explain the expansion of the RF plasma into the jet experiment chamber. The plasma transitioned from an ionizing to recombining phase during the course of the experiment, causing fast camera images to be a poor indicator of the density distribution. The optical brightness in the afterglow was proportional to the gas pressure and exceeded the main discharge brightness above 500 mTorr, and the downstream ion density also increased after power turn-off, likely due to metastable-metastable ionization.

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