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4P17 - Electron Beam Studies and X-ray Spectroscopy of Dense Plasma Focus Experiments

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The study of electron beam generation in a dense plasma focus (DPF) can yield insight into the physical mechanisms that lead to the formation of electron beams in pinched plasmas. A detailed understanding of these mechanisms may enable the production of a high-intensity x-ray source for various applications. Plasma polarization spectroscopy (PPS) is a novel diagnostic tool that will be employed in this proposed work to investigate the electron distribution function and fields within a DPF plasma. We plan to use PPS to measure the degree of polarization of several x-ray spectral lines emitted by a DPF driven by NRL's Hawk pulsed-power generator. Preliminary experiments will focus on diagnosing the plasma electron temperature in DPF experiments doped with Ar gas. This data will be used to validate a finite volume MHD code that calculated the plasma temperature and density of a Hawk shot doped with Ar gas. These parameters are used as input in non-local thermodynamic equilibrium (non-LTE) kinetic models to identify possible line emission candidates that have appreciable degrees of polarization. To measure the degree of polarization experimentally, two spectrometers will be configured with identical crystals that yield a nominal Bragg angle as close to 45° as possible for the selected optimal lines. The two crystals will be oriented such that the separate spectrometers simultaneously record x-rays polarized parallel and perpendicular to the axial direction of propagation of the electron beam. The measured polarization will then be compared with atomic and radiation calculations for different electron distribution functions in order to determine the beam energy and infer the strength of the accelerating fields in the DPF. The development of a magnetic sublevel kinetics code, which will complement future spectropolarimetry studies, is also discussed.

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