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Developing Plasma Spectroscopy and Imaging Diagnostics to Understand Astrophysically-Relevant Plasma Experiments (PhD Oral-24)[1]

RYAN S. MARSHALL, PAUL M. BELLAN, Caltech — One of the main attractions of using laboratory experiments as a proxy to study solar and astrophysical plasmas is the ability to deploy diagnostics. Spectroscopy and imaging tools are especially useful because they do not perturb the subject plasma. This talk will showcase three surprising results obtained using novel diagnostics. First, an X-ray scintillator detector and a CMOS camera acting as an X-ray spectrometer detect a ~ 1 μs burst of ~ 6 keV hard X-rays on the $T = 2$ eV MHD-driven jet at Caltech. This observation leads to a new statistical theory of particle acceleration and the hypothesis that solar prominence microstructure resembles Litz-wire, i.e. small, braided filaments each on the order of a few times the ion skin depth. Second, analysis of a 4,000 frame per second movie of micron-size ice grains growing in the Caltech dusty plasma experiment leads to the conclusion that the grains grow by accretion. The majority of the talk will focus on the third diagnostic: A motorized laser-induced fluorescence (LIF) diagnostic developed for the Caltech dusty plasma. Despite the lack of absolute calibration in diode lasers and wavelength drift due to slight changes in ambient room conditions, 1-2 m/s bulk neutral flow speeds are measured with 0.6 m/s resolution.

[1]NSF, NASA, DOE, AFOSR

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