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Stereoscopic particle image velocimetry studies of transport in dusty plasmas[1]

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Over the past six years, the Auburn Plasma Sciences Laboratory (PSL) has been applying particle image velocimetry (PIV) techniques to the study of microparticle transport in dusty plasmas. PIV is a powerful experimental tool - originally developed in the fluid physics community - in which displacement of micron-sized particles is determined by two successive illuminations by a planar laser sheet. Since the time interval between the illuminations is a known quantity (i.e., set by the experimenter), the velocity of the particles can be computed. In a fluid, this measurement gives an indication of the collective motion of the medium. By contrast, in a dusty plasma, the PIV technique gives a direct measurement of the microparticle transport in the plasma. Furthermore, because the PIV technique is a measurement over a region, not just a point measurement, it can provide a global perspective on transport over the entire dusty plasma. In this manner, PIV provides a tool to study global plasma transport phenomena at a kinetic level. This presentation will briefly compare stereo-PIV to two-dimensional PIV and other optical dusty plasma diagnostics. The presentation will then highlight three unique capabilities of the stereo-PIV diagnostic: measuring three-dimensional particle transport, obtaining information on the three- dimensional velocity space distribution function, and reconstructing particle motion near dust acoustic waves.

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