3-D Trajectories of Small Dust Particles in NSTX*

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The creation and transport of dust in fusion reactors is important to the performance and safety of next-step devices such as ITER[1]. Incandescent dust particles are routinely observed in NSTX with two fast cameras toroidally separated by 60°-90° and which view a common region of the plasma. The open geometry of a spherical tokamak facilitates the derivation of 3-D trajectories of individual particles as well as detailed comparisons to modeling predictions. Particles in both the lower divertor as well as the main chamber of NSTX have been tracked [2] and the 3-D trajectories can be used to benchmark the dust transport code DUSTT[3]. In order to obtain the largest viewing area, the cameras were previously set to view a common region on the far wall of NSTX, a distance typically ≥ 3m. However, near-field observations of dust particles show that a prolific number of dimmer particles exist that are undetected by cameras viewing across the plasma due to poor photon statistics and a large level of background light. Recently, two new viewing ports have been added on NSTX, one in the lower divertor and one at the midplane of the main chamber that will complement existing ports and allow two different cameras to view a common region from a distance of ~ 1-1.5 m with a corresponding enhancement of a factor of ≥5 in light collection. This will allow recording of a much greater fraction of the more prolific smaller dust particles. The DUSTT code can be used to determine the physical parameters of the particles such as their mass, size, and temperature from their trajectory and brightness. These new camera views will concentrate on intrinsic dust created in NSTX through a variety of mechanisms including edge localized modes (ELMs) and MHD events.

A lithium particle dropper has been introduced for the 2008 campaign as part of Li wall conditioning studies. Gravity fed 50 micron Li powder will be dropped into NSTX at a rate of ~ 3 mg/sec and will attain a velocity of ~ 5 m/s at the plasma boundary. Cameras at up to three different positions will view the entry location of the Li dust and will provide the first detailed trajectory information of dust with a known size, composition and velocity entering the plasma. The data will be used to further constrain the comparisons to the DUSTT code. Observations from these experiments and simulations of the trajectories from the DUSTT code will be reported.

[1] G. Federici, C. H. Skinner, J. N. Brooks et al., Nucl. Fusion **41** (1967) 2001.
[2] A. L. Roquemore et. al., J. Nucl. Mater. **363-365**, (2007), 222-226
[3] A.Yu. Pigarov, S.I. Krasheninnikov, T.K. Soboleva, and T. D. Rognlien, Phys. Plasmas **12**, 122508 (2005)

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