TECHNIQUES FOR INJECTION OF PRE-CHARATERIZED DUST INTO THE SCRAPE OFF LAYER OF FUSION PLASMAS

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Introduction of micron-sized dust into the scrape-off layer (SOL) of a plasma has recently found many applications aimed primarily at determining dust behavior in future fusion reactors. The dust particles are typically composed of materials found within a fusion reactor. On DIII-D [1] carbon dust has been introduced into the SOL using a probe inserted from below into the divertor region. On NSTX, both Li and W dust have been dropped from the top of the machine into the SOL throughout the duration of a discharge, by utilizing a vibrating piezo crystal-based powder dropper [2]. The original powder dropper was developed to inject passivated Li powder ~ 40 μ in diameter into the SOL for wall conditioning purposes. A simplified version of the dropper was developed to introduce small amounts of W powder for only a few discharges, thus not requiring a large powder reservoir. The particles become incandescent from plasma interactions and can be tracked by either spectroscopic means [3] or by fast frame rate visible cameras [4]. This data can then be compared with dust transport codes such as DUSTT [3] to make predictions of dust behavior in next-step devices such as ITER. For best modeling results, it is desired to be able to inject pre-characterized dust particles in the SOL with known velocities at various known poloidal locations, including near the vessel midplane. Purely mechanical methods of injecting particles are presently being studied using a modified powder dropper as a particle source and one of several mechanical methods to deflect the particles into the SOL at the desired location. Each of the candidate methods must be capable of operating in high radiation levels in a high vacuum with high ambient magnetic fields. Simple 45° deflectors at the bottom of the particle stream have already been shown to be effective at changing the incident angle of particles on NSTX but the particle velocity entering the SOL increases only as the square root of the height of the dropper and some velocity is lost in the impact with the deflector. Vibrating piezo fans operating at 60 Hz with a deflection of ± 1 cm can impart a significant horizontal boost in velocity, as can vibrating metallic membranes driven by audio oscillators. The highest injection velocities are expected from rotating paddle wheels capable of injecting particles at 10's of meters per second depending primarily on the revolutions per second of the wheel. Several injection concepts are presently being investigated and the merits of each method will be discussed. Also, a simplified version of the powder dropper will be presented.

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[1] D. L. Rudakov *et al.*, J. Nucl. Mater. **363**, 227 _2007

[2] D.K. Mansfield et al., 2nd NIFS-CRC International Symposium on Plasma-Surface Interactions: NIFS, Toki, Gifu, Japan

[3] J. Clementson et al. J. Nucl. Mater. To be submitted at the 19th PSI conference May 24th -28th 2010

[4] J. Nichols et al. J. Nucl. Mater. To be submitted at the 19th PSI conference May 24th -28th 2010

[5] A.Yu.Pigarovet al. Physics of Plasma 12, (2005)