Fast Camera Imaging of Dust in the DIII-D Tokamak*

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Naturally occurring and injected dust particles are observed in the DIII-D tokamak in the outer midplane scrape-off-layer (SOL) using a fast-framing camera. Sources of naturally occurring dust include material eroded from plasma facing components by transient events such as edge-localized-modes (ELMs) or disruptions. ELM filaments interacting with the outer wall or rf antenna shield can liberate dust, presumably by blistering or thermal stress fracturing of redeposition layers on the carbon wall tiles. During disruptions with vertical displacement events, typically $>10^2$ of dust particles are observed after the plasma moves upward toward the top of the vessel. In addition, dust levels observed during the plasma cleanup period following an entry vent remain elevated for ~10 shots and are orders of magnitude larger than dust levels later in the experimental campaign. Dust particles in the SOL have velocities ranging from approximately 10 to 300 m/s, and the particles can abruptly change directions or break into smaller particles. Dust particles ablate when they enter a hot region of plasma near the separatrix, or when an ELM filament intercepts a dust particle already present in the SOL. The ablating dust particle sheds mass, generating an emission plume that is aligned with the local magnetic field. To compare dust trajectories and velocities with modeling by the DustT 3D code, pre-characterized micron-sized carbon dust particles are introduced at the lower divertor in an ELMing H-mode discharge using the divertor materials evaluation system (DiMES). The dust particles become mobile when the outer divertor strike point is swept over them, and are injected into the plasma raising the core carbon density by a factor of ~4.

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