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P1.1062 Rotational instabilities of liquid metal droplets in tokamaks

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Safely achieving the goal of stable power production in magnetic confinement fusion devices is critically dependent on controlling the mobilization and accumulation of dust[1]. The aggregation of high Z impurities in the core plasma from the ablation of metal dust grains causes strong bremstrahhlung losses[2] and can destabilise the plasma[3] which must be avoided to maintain acceptable fusion yield. The retention of dust causes a biological hazard due to the toxicity of beryllium and radioactivity of tritiated carbon dust[4] with the possiblity for inhalation and contamination of local environment in a loss of vacuum event[5]. This will be a key issue for ITER where operational time scales may be limited by radioactive dust inventories.
Impurity transport is greatly enhanced by dust breakup. A model for the rotational instability of liquid metals in tokamak plasmas is presented as the probable explanation for the observation of forking trajectories, characterised by consistent and repeatable splitting into pairs of sub-droplets. Inferred rotational speeds are consistent with longstanding theories of particle spinning in magnetized plasmas[6] but are two orders of magnitude greater than previous measurements of rotating particles in plasmas. Analysis with the Dust in TOKamakS (DTOKS) Figure 1: Liquid breakup event in code yields statistical predictions for fast-camera observations and predictions for droplet behaviour in current and next-generation tokamaks, see figure 1.

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