Suppression of the Ion Drag Force in Strongly Magnetised Plasmas

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The ion drag force is one of the dominant forces determining the motion of dust particles in tokamak edge plasmas. We might expect that, in the same way that current onto a dust grain is suppressed by strong magnetic fields [1], the momentum flux will be also. However, the ion drag models employed by dust transport codes are magnetic field independent [2]. We use the monte carlo dust-plasma interaction code DiMPl [3] to consider the case of a dust particle immersed in a plasma flowing parallel to a magnetic field, and evaluate the ion drag force at different magnetic field strengths. Preliminary results show significant supression at fields for which the ion gyroradius is comparable to the dust radius, as shown in Figure 1.

Characterisation of the dependence of the drag force on magnetic field strength for a range of flow speeds, dust radii, and dust potentials is presented. Comparison is made with the widely-employed 'hybrid' ion drag model of Khrapak et al. [4], along with semi-analytic models of collection and deflection of charged particles by a dust grain in a magnetic field.

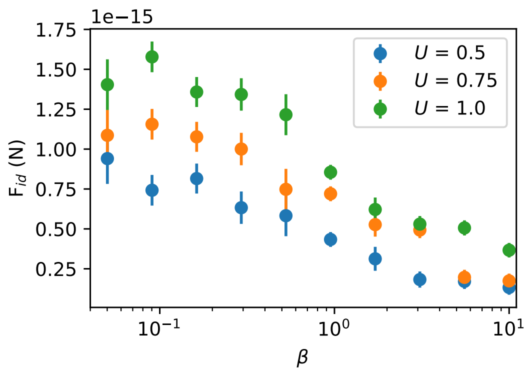

Figure 1: DiMPl results for the ion drag force at different magnetic field strengths, measured in β, the ratio of the dust radius to the ion gyroradius. Results are shown for plasma flows of mach numbers 0.5, 0.75, and 1.0, with a fixed dust potential of -3V and radius of 5μm.

References

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