The Effects of Dust Size Distribution and Dust Charging on Shock Waves in Non-maxwellain Dust in Tokamak Plasma

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The nuclear fusion field is very concerned about dusty plasmas. Such heavier particles can have a significant impact on the performance and operation of the plasma in fusion devices, in addition to posing certain safety risks and engineering challenges. Dust has long been seen as a major obstacle to the advancement of fusion energy, and recent studies reveal that it also exists in the divertor region, inside the tokamak chamber, and at the core of the tokamak plasma. Edge Localized Modes (ELMs), sputtering of tokamak walls made of carbon tiles, beryllium beryllium, and tungsten w, and possibly radioactive carbon-fiber composites (CFC) can all produce dust. The scrape-off layer (SOL) can sweep the majority of the dust created by these processes and collect it in the divertor.

Shocks in dusty plasma, which are discontinuous surfaces that significantly alter state variables like pressure, density, temperature, and entropy as they travel through a medium, are the subject of our present research. This has taken into account how dust size distributions and dust charge fluctuations affect the resulting shock parameters. The polynomial and power law distributions (PLD) are two different dust size distributions that have been applied.

Here we model this problem incorporating current due to secondary electrons which are emitted from the dust grain surface when dust grain is heated to a high temperature. These thermionically emitted particles influence the shock waves produced. The findings of this work will be interesting for the ICTP Fusion School participants.

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