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PIC simulations of dust particles and wake effects in magnetic fields

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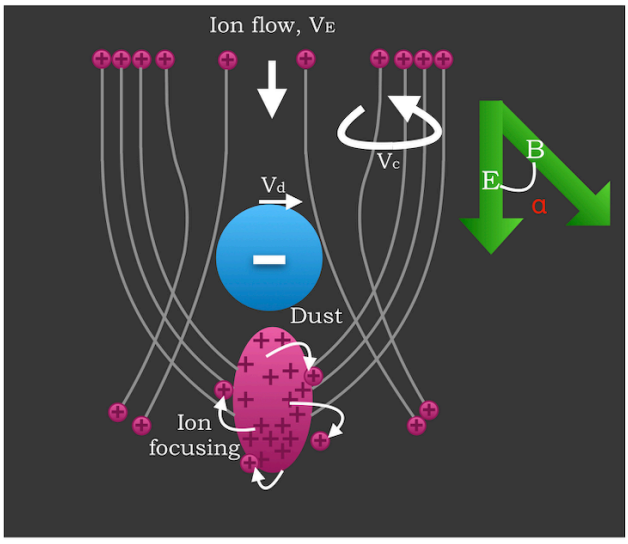
A systematic numerical study of wake potential and ion density distribution of a single grain in flowing ions under the influence of a magnetic field is presented. Astrong magnetic field introduces ion focus depletion behind grains, facilitating the entrance of electrons far in the downstream towards the grain when applied along flow. It is shown that the magnetic field suppresses the amplitude of the wake potential and modifies the ion density distribution substantially for magnetic field parallel to flow case and exhibits recurrent stable oscillating pattern for transverse to flow case for a chosen set of parameters. The wake peak potential and position characteristics and density distribution of plasma constituents in the presence of a magnetic field and charge-exchange collisions for the subsonic, sonic, and supersonic regime are also delineated. The wake has strong dependence on the direction of the magnetic field and exhibits sensitivity to even a meager deviation of magnetic field from the longitudinal orientation. In the subsonic regime, simulations demonstrate the accumulation of ions near the dust grain in the transverse direction, while complete suppression of oscillations in the transverse direction takes place for the sonic and supersonic regime for parallel to flow magnetic field case and two peaks behind grain are observed for transverse to flow case. The tool obtained with the study of impact of transverse component of magnetic field on the wake around grain in streaming ions can be used to potentially maneuver the grain-grain interaction to achieve controlled grain dynamics.



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References

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