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Kelvin Helmholtz Instability in Non-Maxwellian magnetized dusty plasma

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In this work the investigates of Kelvin-Helmholtz instability (KHI) in the context of a non-Maxwellian plasma. The primary goal is to understand the dynamics of KH modes in non-Maxwellian plasmas defined by the kappa and Cairns distribution parameters influence the creation and features of KHI. Using Saturn ionosphere data, we conducted a thorough investigation to find and describe the different modes of KH instability. We studied the stabilizing and destabilizing effects of these instabilities by displaying their temporal and spatial fluctuations using different graphs. We discover that the development rates and threshold conditions for these instabilities are significantly altered in the presence of non-Maxwellian distributions, influencing the overall dynamics of Saturn's ionosphere. The results demonstrate that superthermal particles in the Cairns distribution speed up the KHI's development rate, but the kappa parameter has a more stable influence. The system showing more stability in the region where the particles follows kappa distributions and are less stable where the particles follows the cairns distribution. The effect of different parameters are investigated like sheared velocity, magnetic field, dust mass, dust temperature, and electron and dust particles number density.

The dust particle present there strongly influences the system dynamics by increasing the chances of growing modes. Increasing dust mass can produce more obvious instabilities in celestial environments such as comet tails and planetary rings, aiding our understanding of their production and evolution. Dust temperature can alter the dynamics of instabilities by influencing the kinetic energy and thermal velocity of dust particles within the plasma. Increased dust temperatures lead dust particles to move more thermally, which may influence how rapidly instabilities develop.

References

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