

# Flute instability in Jupiter's middle magnetosphere and its relation to the plasma disk density distribution

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We analyse the flute instability of the equatorial plasma disk in Jupiter's middle magnetosphere. Particular attention is paid to wave coupling between the dense plasma in the equatorial disk and the more rarefied plasma at higher latitudes, and between the latter plasma and the conducting ionosphere at the feet of the field lines. It is assumed that the flute perturbations are of small spatial scale in the azimuthal direction, such that a local Cartesian approximation may be employed, in which the effect of the centrifugal acceleration associated with plasma rotation is represented by an 'external' force in the 'radial' direction, perpendicular to the plasma flow. For such small-scale perturbations the ionosphere can also be treated as a perfect electrical conductor, and the condition is determined under which this approximation holds. We then examine the condition under which flute perturbations are at the threshold of instability, and use this to determine the corresponding limiting radial density gradient within the plasma disk. We find that when the density of the high-latitude plasma is sufficiently low compared with that of the disk, such that coupling to the ionosphere is not important, the threshold radial density profile follows that of the equatorial magnetic field strength as expected. However, as the density of the high-latitude plasma increases toward that of the equatorial disk, the limiting density distribution in the disk falls increasingly steeply compared with that of the magnetic field, due to the increased stabilising effect of the ionospheric interaction.