Low frequency instabilities based on electron and ion temperature anisotropies in non-Maxwellian plasmas

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In space plasmas, velocity distribution functions are often observed with high energy tails and /or flat tops in the profile of distribution function. Such distributions are frequently observed by CLUSTER space craft in the solar wind and magnetosphere. Since now we have numerous observations non-Maxwellian distribution functions from different regions of space plasmas, we need to employ real observed distribution rather using the same classical idealized Maxwellian distribution function. Therefore, in this study we first observe Alfven waves in the solar wind using CLUSTER space craft data when the CLUSTER space craft is well immersed in the solar wind. We then by using kinetic theory study the Alfven cyclotron instability using both the ion and electron temperature anisotropies for the first time. In this study, the distribution which we employed is a non-Maxwellian distribution function such as the generalized (r,q) distribution function which is the generalized form of kappa and Maxwellian distribution functions. Here the spectral index r represents the shoulders or flat tops in the distribution and spectral index q represents the percentage of high energy particles or high energy tails in the profile of the distribution function. The (r,q) distribution reduces to the kappa distribution function in the limit when r=0 and q+1 and reduces to the classical distribution function in the limit when r=0 and q. We then calculate the numerical values of the ion and electron temperature anisotropies from that time interval when Alfven waves are observed in the data. We study the role of electron to ion temperature ratios and found that by increasing the perpendicular electron temperature to parallel ion temperature ratio, growth rate of Alfven cyclotron instability decreases whereas by increasing the parallel electron temperature to parallel ion temperature ratio growth rate increases. We also found that left-hand circularly polarized wave becomes unstable not only when perpendicular ion temperature is greater than the parallel ion temperature as reported in the literature but also when perpendicular ion temperature is smaller than the parallel ion temperature. Theoretical values of frequency and growth rates are then compared with Maxwellian results.

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