

论文

弱纵向外电场对磁化等离子体中哨声波的影响

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摘要

本文以等离子体动力学为基础讨论存在纵向外电场时磁化等离子体的哨声波。由于外电场的影响, 等离子体偏离平衡态。取电子稳态分布函数为局域的麦克斯韦分布, 用沿无扰轨道积分方法求出系统的介电张量, 并分别用介电张量的厄米部份和反厄米部份分析哨声的色散关系和增长率。对于波矢在以电场方向为轴顶角为 $2\theta_c$ 锥角范围内的哨声, 外电场的作用使波增长; 波矢在此锥角范围之外, 外电场的作用使其衰减。波的增长率随频率增高而增大, 随波矢倾角增大而减小。 $\omega_e \gg \Omega_e$ 时, 波矢与外电场平行对应的最大增长率与等离子体密度成正比, 与磁场强度成反比。文中还给出了以电离层F层为背景参数的数值计算结果。

关键词 [等离子体](#) [纵向电场](#) [哨声波](#) [增长率](#)

分类号

EFFECT OF A WEAK LONGITUDINAL ELECTRIC FIELD ON WHISTLER WAVES

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Abstract

The effect of a longitudinal electric field on whistlers is studied based on kinetic theory. A local Maxwellian distribution is taken as steady distribution function of electrons which departs from equilibrium due to the applied electric field. The dielectric tensor is derived by integrating along orbits of the particles in the unperturbed field. Dispersion relation and growth rate are analyzed from Hermitian and anti-Hermitian part of this tensor respectively. It is found that the waves are growing when the angle between wave vector and electric field is in the range of θ_c , otherwise the whistler waves are damping.

The growth rate increases with the wave frequency and decreases with the angle between wave vector and applied field. In case $\omega_e \gg \Omega_e$, the maximum of growth rate, which is at $\theta=0$, is proportional to the plasma density and anti-proportional to the magnetic field intensity. Some computed results for parameters at top of F layer are given.

Key words [Plasma](#) [Longitudinal electric field](#) [Whistler waves](#) [Growth rate](#)

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