

NUMERICAL STUDY OF DRIFT BALLOONING MODE IN UMIST QUADRUPOLE

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ABSTRACT

The one-dimensional and two dimensional model is studied in UMIST quadrupole field geometry and eigenfunctions are compared

INTRODUCTION

Drift waves have been studied both theoretically and experimentally in the UMIST GOLUX [1] and [2]; the theory was based on the general theory of Quadrupole [3]. Most of this work was concerned with the ordinary drift mode which has its maximum at the points of minimum field strength and is anti-symmetric between the two sides of the machine, though [1] searched experimentally for the drift-ballooning mode of the opposite symmetry which has its maxima at the field maxima and is anti-symmetric between the top and bottom of the machine. No trace of this mode was found; this was unexpected because previous studies of drift waves in quadrupole [4,5] had concluded that this was the mode expected to be unstable. Later, it became possible to launch waves in the quadrupole [6] and a damped propagating mode of the drift-ballooning character was successfully launched. Accordingly, a theoretical study of the drift-ballooning mode was undertaken and is described in this paper.

The Plasma in the UMIST quadrupole [7] has typically $T_e \sim 0.5\text{eV}$, $n \sim 10^{15} \text{ m}^{-3}$ where the drift waves are strongly excited. The plasma is only weakly collisional, and the plasma properties are guaranteed to be constant along field lines.

The important features of quadrupole geometry are closed lines of force [Fig.1] giving a well-defined parallel wavelength and no problems with boundary conditions; and strong variation of field strength along the field lines, implying a preponderance of trapped over passing particles.

THEORY OF THE DISPERSION CURVE

The derivation is based on the model developed by Hastie and Taylor [3] for multi pole field geometry, referred to below as HT, whom we follow with some obvious changes in notation. We consider electrostatic mode propagating parallel to the quadrupole axis and quasi-neutrality is