STUDIES OF LOW FREQUENCY INSTABILITIES IN A COLLISIONLESS PLASMA

BY

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CERTIFICATE

I hereby declare that the work presented in this thesis is original and has not formed the basis for the award of any degree or diploma by any University or Institution.

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Certified

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May 15, 1975

DEDICATED

TO

MY RESPECTED MOTHER

(SMT. DARYAW DEVI)

AND

TO THE SACRED MEMORY OF

MY FATHER

(LATE SRI NEELKANTH VYAS)

S T A T E M E N T

The work presented in this thesis is mainly centred around the study of very low frequency wave particle interactions in collisionless plasmas with a view to (i) investigating the generation mechanism for the magnetospheric VLF emissions, and (ii) explaining the favourable triggering of these emissions at half the equatorial gyrofrequency along the field line of their propagation.

Our approach to this study consists in first finding how the waves affect or modify the plasma particle distribution function and then investigating how this modified distribution affects low amplitude perturbations existing in the system.

The thesis starts with a preliminary introduction to the magnetospheric plasma and presents a brief survey of the work done by various investigators in the field.

The effect of the Landau resonance of whistler mode pulses on the particle distribution function in a homogenous collissionless magnetoplasma

has been discussed in chapter II and an extension of the model for VLF emissions proposed by Das (1968) has been presented in chapter III. The model is based on gyro resonant interaction and the modification made therein is the inclusion of the effect of increasing the amplitude of a resonant pulse beyond a certain critical limit.

Then the question of the preferential triggering of VLF emissions at half the equatorial electron gyrofrequency has been taken up. The behaviour of whistler mode dispersion relation has been examined carefully and it is found that it exhibits many interesting characteristics at that frequency. The influence of these characteristics on the generation of VLF emissions has been investigated in great detail in chapter IV and V and the results have been found to be quite encouraging.

In both the chapters IV and V, the emphasis has been put on the effects of Landau resonance. The former discusses the Landau resonant diffusion of particles in velocity space and the latter presents a study of the effects of Landau damping

on the gyroresonant interaction.

The last chapter presents a synoptic view of the whole work and gives a discussion of the results obtained. The scope for future work has also been pointed out towards the end of the thesis.

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C O N T E N T S