

STUDIES OF THE DYNAMICS OF MAGNETIZED
GRAVITATING DISK

by

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A THESIS SUBMITTED FOR THE
DEGREE OF

DOCTOR OF PHILOSOPHY

OF THE
GUJARAT UNIVERSITY

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NOVEMBER, 1989

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Dedicated to


All those upon whose smiles
my own happiness is fully dependent

Certificate

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


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Prof. R.K. Varma
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Date: 17th November, 1989

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Acknowledgements

I have been fortunate to be associated with Professor R.K. Varma. I express my indebtedness for providing valuable guidance throughout the period of my work and introducing me to the fascinating field of plasma astrophysics.

I have been greatly benefitted by countless but useful* discussions with Professor J.C. Parikh. Professor Bimla Buti for her very "strict" reviewing of my basics (2nd year review) which has helped me enormously. Professor A.C. Das and Professor A.R. Prasanna for the very kind gestures and help during the long ups and down which is so common to this hazardous profession. Dr. B.R. Sitaram whose everreadiness and countless discussions have helped the author in many ways.

I express my deep sense of gratitude to the "human bondage" of Navin and Preeti, Bhushan, Anjan, Anindya and kailash whose love and affection has kept the author away from hundred years of solitude. Physics embedded in the warmth of friendship has been bestowed upon me selflessly by D.P.K. Banerjee, K.B. Vijaykumar, Dr. Sunil P. Rawat and Jitesh Bhatt. In a major way, they have influenced my scientific outlook, and I take this opportunity to express my gratitude.

It is a great pleasure to express my gratitude to Mr. P.S. Shah, Mr. M.S. Patel, Mr. G.N. Desai, Mr. G. Nathwani and Mr. S. Goel of Computer Centre for the help they have

rendered during the period of this work.

Everybody in the Library have been very kind and helpful and I take this opportunity to thank them all.

Most of the typing has been done by my friend Ravi Bhushan. I express my deep reverence for his selfless service rendered to me. Viswanathan has given the final touches to the manuscript and I express my gratitude to him.

Lastly, I am indebted to my wife without whose constant moral support this work might not have been possible.

B.P. Pandey

Abstract of the Thesis

The origin and maintenance of the galactic magnetic field have been studied in this thesis. Bisymmetric spirals are the most common feature of the magnetic field structure in the galaxies though some of them possess ring structure also. Even though dynamo theory explains the many observational features of the magnetic field of the galaxy, it remains unsatisfactory, on many counts.

Evolution of galactic magnetic field is related with the dynamics of the galactic plasma disk and hence it is necessary to find the "mechanism" which would contribute to the growth of the magnetic field in the galactic disk. We have studied here one such mechanism, which arises as a result of the non-uniformity of the matter density in the magnetized plasma disk. The inverted gradient of density column supported by plasma against the gravity is quite effective for the energy needed for the growth of the magnetic field. It is Rayleigh-Taylor instability which is responsible for the amplification of the magnetic field. It is found that such a process could amplify the magnetic field of the disk with the growth rates which depend on the density gradient of the matter etc.

A more complete theory of the bisymmetric spiral field, as the allowed eigen-functions of a gravitating magnetized disk would require a self-consistent solution as an eigenvalue problem with proper boundary conditions. We have

carried out such a study for a thin magnetized plasma disk with rigid rotation (which is the only permissible solution of the induction equation in the infinite conductivity limit). It is found that bisymmetric spirals appear as the allowed eigenmodes of the disks eventhough the disk is rigidly rotating which has to be contrasted with the differential rotations required for the dynamo action in the disk.