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ROCKET AND BALLOON STUDIES OF MIDDLE ATMOSPHERIC  
ELECTRODYNAMICS IN THE LOW LATITUDES

by

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A THESIS  
SUBMITTED FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

of the

GUJARAT UNIVERSITY

January 1988

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*Dedicated to*  
*My Parents...*

C E R T I F I C A T E

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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### ACKNOWLEDGEMENTS

I express with deep gratitude my indebtedness to Dr. S.P. Gupta, who has guided me during all the stages of my work. Throughout my Ph.D. career he has been a great source of inspiration and encouragement for me. Working with him has been a great experience.

I am grateful to Prof. B. H. Subbaraya for the encouragement which he has provided throughout my Ph.D. work. He has painstakingly gone through this thesis and offered many useful suggestions. I shall ever be grateful for the guidance I have received from him.

I am thankful to Prof. S.P. Pandya, Senior Professor, PRL and Prof. R.K. Varma, Director, PRL for taking a keen interest in my work throughout the period of my Ph.D. work.

I am thankful to Prof. Satya Prakash, Prof. P.R. Pisharoty, Dr. D.K. Chakrabarty, Dr. G. Subamanyam and Prof. R. Raghav Rao for the fruitful discussions I have had with them at a number of occasions which gradually helped me in understanding this subject better.

I want to thank my senior colleagues Dr. A. Jayaraman, Dr. Shyam Lal, Dr. R. Pandey, Dr. H. Chandra, Dr. H.S.S. Sinha and Dr. R. Sreedharan for the help they have given me at a number of

occasions in a number of ways.

Mr. S. G. Tikekar, Mr. D. Damle and Mr. N. R. Shah have worked with me throughout the stages of development, fabrication and testing of the different payloads. I am thankful for the help I have received from them in this project.

I am thankful to the staff of the PRL workshop, Mr. A. J. Shroff, Mr. C. K. Panchal, Mr. B. B. Panchal, Mr. S. C. Parmar, Mr. S. M. Shukla and others who have helped in the construction of the instruments.

Part of the data analysis has been done by Mr. K. S. Patel for which I acknowledge my thanks. I am also thankful to Mr. M. Nair for the typing assistance which he has provided at various occasions during my work.

I am thankful to Mr. R. N. Misra and Mr. Y. B. Acharya for the knowledge and experience in instrumentation which they have shared and the help which they provided in this project.

I thank Mr. Ranpura of the photography section, Mrs. Kokilaben Bhatt of the PRL library and Mr. H. S. Panchal of the drafting section for their help in preparing the diagrams. I acknowledge my thanks to the staff of the computer centre and the staff of the PRL library for the help which they have provided during my Ph.D. work.

The funds for the present experiments were provided by the Indian Space Research Organisation under the Indian Middle Atmospheric Program (1982-1987). I acknowledge my thanks to the authorities for providing the funds for the experiments. I also thank Prof. R. R. Daniel, Senior Professor,

TIFR and Chairman, ADCOS (Advisory committee of Space Research in India), Prof. P.D.Bhavsar, Chairman, Program and Management Board of the Indian Middle Atmosphere Program, and Prof. A. P.Mitra, Director General, Council of Scientific and Industrial Research, New Delhi for taking a keen interest in the project.

I am thankful to Shree R. T. Redkar, Mr. Joshi, Mr, Sreenivasan, Mr. Chitre and all the staff of the Balloon Launching Facility, Hyderabad for the excellent facilities which they have provided for our balloon experiments. At the same time I acknowledge my thanks to Shree R.U.Kundapurkar and all the members of the Control Instrumentation group of the Tata Institute of Fundamental Research for the help which they provided during payload integration and flight.

I thank Mr.P.Rajratnam of MAP office, Bangalore and Dr.S. C. Chakravarty of ISRO Headquarters, Bangalore for their keen interest and for the help they have provided during the balloon launchings.

Thanks are due to the IMD (Indian Meteorology Department) for their help in providing wind data and balloon tracking facilities.

I am thankful to Dr.S.Sampath of CESS, Trivandrum, Dr.M.N. M. Rao and Dr. S. C. Garg of NPL, New Delhi for their suggestions regarding the gondola charging problem. I thank Prof. S.V.Damle of TIFR for his important suggestions during balloon launch.

I am thankful to my friends and colleagues who have always provided a friendly encouragement to me and have

helped me in numerous ways. My special thanks are for Dr.D. Sengupta, Dr.B.R.Sitaram, Dr.K.P.Subramanyam, Dr.B.S.Kotlia, Mr. B. Pandey, Mr.G.Beig, Mr.S.Deshpande, Mr.Venkatramani and Mr.M. Ahmed. They have helped me through various phases of my work and illuminated me through numerous scientific discussions. I also thank all the people who have directly or indirectly helped me in completing this work.

The members of my family have been a constant source of moral support, emcouragement and inspiration. A special debt of gratitude is due to them. I am grateful to my wife who has ungrudgingly supported and encouraged me throughout my work with a lot of understanding and patience.

*Amarendra Narayan*  
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## STATEMENT

The work presented in this thesis was carried out by the author at the Physical Research Laboratory, Ahmedabad under the guidance of Dr. S. P. Gupta and Prof. B. H. Subbaraya.

The studies presented in this thesis deal with various aspects of the electrodynamics of the middle atmosphere at low latitudes.

The author has been involved in the design and construction of instruments for measuring conductivity and electric field at stratospheric altitudes. These instruments were flown from the low latitude station Hyderabad (India) on balloon-borne platforms at a number of occasions in order to make in-situ measurements of atmospheric conductivity and vertical electric field in the stratosphere. The results of these measurements are presented and discussed in this thesis.

The first chapter forms the introduction to this thesis. Various concepts which are important for the study of middle atmospheric electrodynamics have been reviewed briefly in this chapter.

The second chapter deals with the physics of conductivity and electric field measurement. In this chapter, an attempt has been made by the author to discuss different



theoretical aspects of the measurement process. A simple model for the probe behaviour has been presented in this chapter and various possibilities encountered during realistic measurement situations are discussed in detail. The relaxation technique for conductivity measurement and the double probe technique for electric field measurement are described in this chapter (These techniques have been used by the author for conducting balloon-borne measurements). This chapter also contains a discussion on the author's investigations on the nature and extent of charging of the balloon-borne gondola during its ascent and float periods.

A discussion of the use of rocket-borne Langmuir probes for measuring ion and electron conductivity in the mesosphere is given in the second chapter. Using the electron and ion currents obtained from Langmuir probe measurements, the conductivities at these altitudes were derived. Ion conductivity for the mesosphere has been obtained using rocket-borne Langmuir probe data. This has been presented in chapter four.

Chapter three describes in detail the instruments constructed by the author for conducting in-situ measurements. This chapter also describes various support instruments that go with the payload during balloon flight. A discussion of the instrument testing procedure and the balloon launch procedure has been included in this chapter.

The results of measurement of polar conductivity and electric field in the stratosphere and mesosphere

constitute the contents of the fourth chapter of this thesis.

The fifth chapter of this thesis contains discussions of the results and the new findings obtained during the present work.

A comparison of the conductivity measurements done by the author has been made with measurements done elsewhere by other groups. The positive ion conductivity was observed to be higher than the negative ion conductivity by a factor of four and half. This aspect has been discussed in chapter five where a comparison has been made between theoretically expected ratio between the two polar conductivities with the observed ratio.

A comparison of stratospheric and mesospheric conductivities has also been done in this chapter. A discussion of the rocket body potential in the mesosphere as observed during several rocket flights is given. A suggestion has been made that the existence of such potentials might be indicating a presence of large vertical electric field in the mesosphere.

The effects of volcanic eruptions on conductivity has also been discussed in chapter five. The positive ion conductivity has been found to be affected much more drastically than the negative ion conductivity by volcanic activity. The implications of this observation are discussed.

The sixth chapter contains a summary of the important results. This chapter also contains suggestions for further work.

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