

Physics of the **Sun** and its **Atmosphere**

Proceedings of the
National Workshop (India) on
“Recent Advances in Solar Physics”

This page intentionally left blank

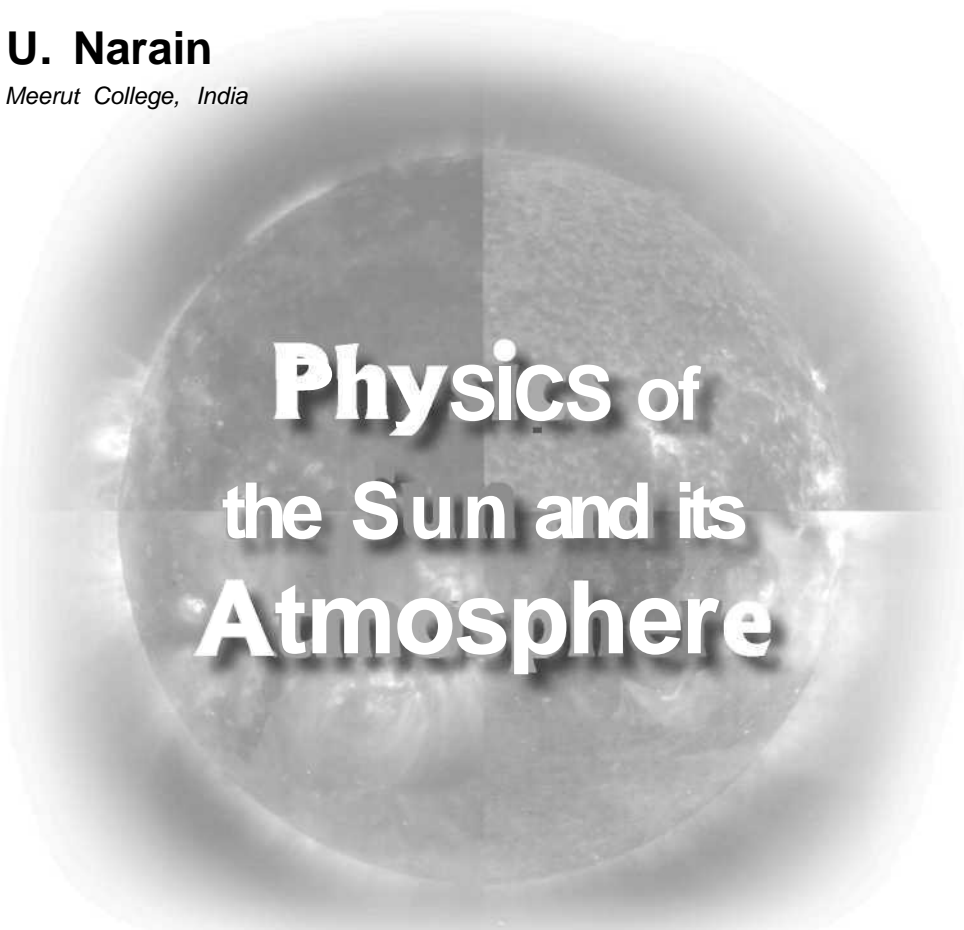
Editors

B. N. Dwivedi

Banaras Hindu University, India

U. Narain

Meerut College, India



**Physics of
the Sun and its
Atmosphere**

Proceedings of the National Workshop (India) on
"Recent Advances in Solar Physics"

Meerut College, Meerut, India

7-10 November 2006

 **World Scientific**

NEW JERSEY • LONDON • SINGAPORE • BEIJING • SHANGHAI • HONG KONG • TAIPEI • CHENNAI

Published by

World Scientific Publishing Co. Pte. Ltd.

5 Toh Tuck Link, Singapore 596224

USA office: 27 Warren Street, Suite 401-402, Hackensack, NJ 07601

UK office: 57 Shelton Street, Covent Garden, London WC2H 9HE

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library.

PHYSICS OF THE SUN AND ITS ATMOSPHERE

Proceedings of the National Workshop (India) on “Recent Advances in Solar Physics”

Copyright © 2008 by World Scientific Publishing Co. Pte. Ltd.

All rights reserved. This book, or parts thereof, may not be reproduced in any form or by any means, electronic or mechanical, including photocopying, recording or any information storage and retrieval system now known or to be invented, without written permission from the Publisher.

For photocopying of material in this volume, please pay a copying fee through the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, USA. In this case permission to photocopy is not required from the publisher.

ISBN-13 978-981-283-271-9

ISBN-10 981-283-271-8

Printed in Singapore.

PREFACE

This book emerged from a successful workshop on “Recent Advances in Solar Physics”, held at Meerut College, Meerut in November 2006. We thought a book covering the modern view of the Sun from its interior to its exterior from a pedagogical viewpoint will be a valuable input to the beginners pursuing solar physics. With this objective, we decided to publish this volume by World Scientific, Singapore. In this process, we invited most of the leading experts who lectured at the workshop apart from inviting some internationally reputed scientists to make this volume more valuable.

It is satisfying to see this book in print at a time when one of us (Dr. Udit Narain) superannuates after pursuing an active solar physics research for over three decades while teaching physics at Meerut College. All this could be possible with the kind and generous support of our esteemed colleagues from all over and above all, the authors of this book for which we cannot thank them enough.

B.N. Dwivedi & Udit Narain

This page intentionally left blank

ACKNOWLEDGEMENTS

It has been the voice of my soul to organize a National Solar Workshop at Physics Dept, Meerut College before my superannuation on 31 July 2007. Prof. B.N. Dwivedi (IT-BHU) was the first person to support me and the national workshop on “RECENT ADVANCES IN SOLAR PHYSICS” was held at Meerut College premises entirely through his efforts. I carried on his advice and programmes mechanically since the preparation for the workshop started.

Prof. N.K. Dadhich, Director, IUCAA wanted to hold the solar workshop at BHU under the leadership of Prof. Dwivedi who convinced him to let it take place at Meerut College in view of my superannuation. Dr H.P. Mittal, Head of Physics Dept and Dr S.K. Agarwal, Principal, Meerut College kindly allowed and supported it without any financial support. I gratefully acknowledge the SOC members: S.M. Chitre, B.N. Dwivedi (chair), R. Jain, P.K. Manoharan, J. Singh, W. Uddin and P. Venkatakrishnan.

Prof. Dwivedi started looking after the academic part, namely Scientific Organising Committee, speakers, schedule of lectures, publication of proceedings etc. I started looking after local organization part, namely LOC, financial aspects, accommodation, transport etc. The application for financial assistance was submitted to IUCAA, DST, UGC, CSIR, ISRO and INSA. The request for financial assistance was also made to IIA, PRL, and ARIES. IUCAA provided 25000/=; IIA 30,000/=; CSIR 20,000/=; INSA 10,000/= and UGC 50,000/=. PRL allowed four speakers, ARIES and RAC/TIFR one each with their travel expenses. I am very grateful to them as it was not possible to organize the workshop without their help.

Individuals, namely Late Prof. Rajkumar, Dr Mukul Kumar, Dr Rakesh Kumar Sharma, Dr Sushil Kumar, Mr Nishant Mittal and Mr Joginder Sharma provided crucial financial assistance for which I am very grateful to them.

I am very much grateful to Prof. S.S. Hasan, Director, IIA, Bangalore for inaugurating and delivering the keynote address at the workshop which was highly appreciated.

Prof. S.P. Khare (Former Head, Pro-VC, CCS Univ., Meerut) has been very kind in providing guidance and help from beginning to the end and I wish to express my gratitude to him. Help and support from Dr H.P. Mital and other faculty members, non-teaching staff, research scholars and PG students of Physics Dept, are greatly appreciated.

Special thanks are due to Dr Ajay Chauhan for his help in all computer related problems and presentations. The help, cooperation and encouragement by Dr S.K. Agarwal is highly appreciated. I also thank Prof. V.K. Rastogi (CCS Univ, Meerut) for help, support and his personal involvement. Last but not the least, I wish to express my gratitude to the retired and active faculty members and individuals of Meerut who enlivened the proceedings of the workshop by their participation.

Meerut

Udit Narain

CONTENTS

Preface	v
Acknowledgements	vii
Chapter 1: Recent Advances in Solar Physics <i>B.N. Dwivedi</i>	1
Chapter 2: Overview of the Sun <i>S.S. Hasan</i>	9
Chapter 3: Seismic View of the Sun <i>S.M. Chitre and B.N. Dwivedi</i>	21
Chapter 4: Solar Magnetism <i>P. Venkatakrishnan and S. Gosain</i>	39
Chapter 5: Waves and Oscillations in the Solar Atmosphere <i>R. Erdélyi</i>	61
Chapter 6: VUV Spectroscopy of Solar Plasma <i>A. Mohan</i>	109
Chapter 7: Active Region Diagnostics <i>H.E. Mason and D. Tripathi</i>	127
Chapter 8: Hall Effect and Ambipolar Diffusion in the Lower Solar Atmosphere <i>V. Krishan</i>	151

Chapter 9: On Solar Coronal Heating Mechanisms <i>K. Pandey and U. Narain</i>	173
Chapter 10: Coronal Mass Ejections (CMEs) and Associated Phenomena <i>N. Srivastava</i>	193
Chapter 11: The Radio Sun <i>P.K. Manoharan</i>	215
Chapter 12: The Solar Wind <i>P.K. Manoharan</i>	235
Chapter 13: The Sun-Earth System: Our Home in Space <i>J.L. Lean</i>	267