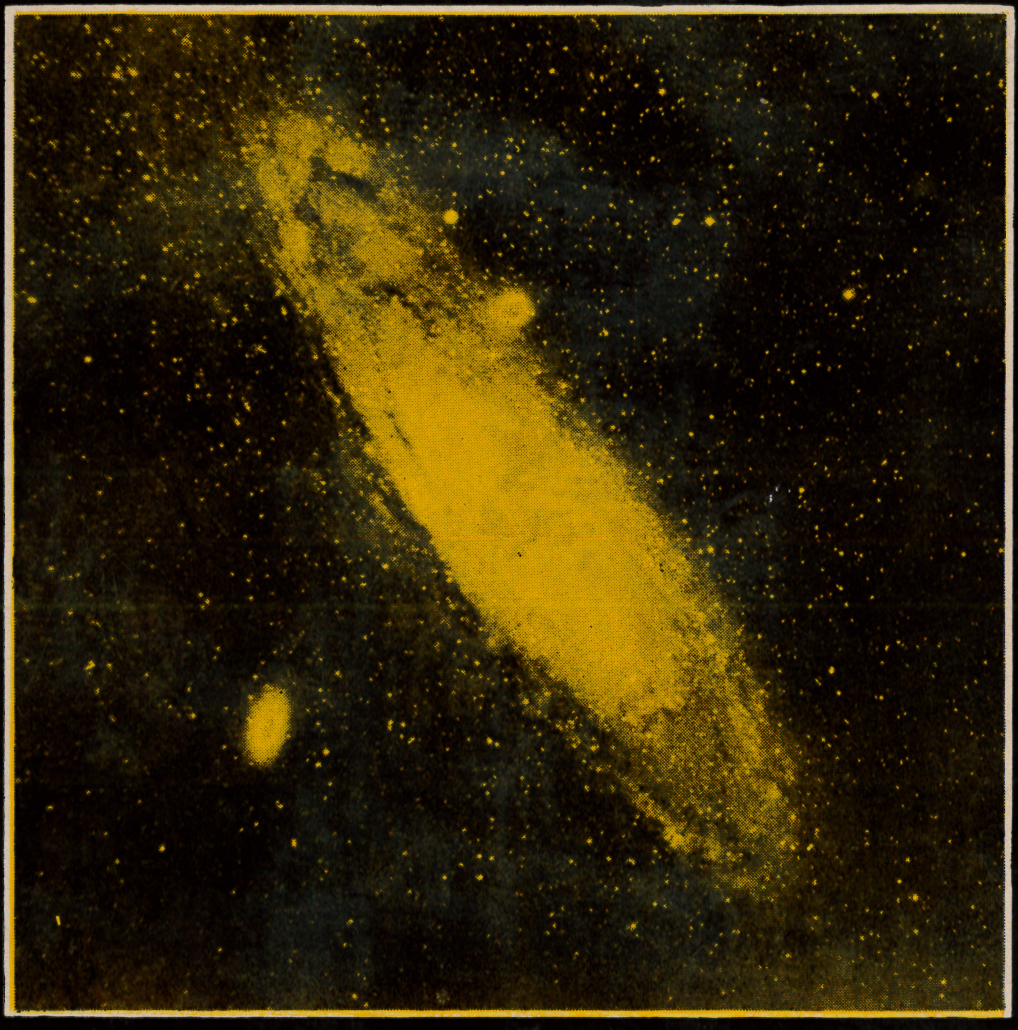
A RANDOM WALK

In Relativity and Cosmology



Edited by
N DADHICH
J V NARLIKAR
J KRISHNA RAO
C V VISHVESHWARA

A RANDOM WALK IN RELATIVITY AND COSMOLOGY

Essays in honour of

P.C. Vaidya and A.K. Raychaudhuri

EDITED BY

N. Dadhich
J. Krishna Rao
J.V. Narlikar
C.V. Vishveshwara

WILEY EASTERN LIMITED

New Delhi Bangalore Bombay Calcutta Madras Hyderabad

Contents

List of Contributors *vii*
Foreword by V.V. Narlikar *ix*
Preface by the Editors *xi*

1. *A. Ashtekar and K.S. Narain* 1
Generation of a Mass-gap by Restoration of Broken Symmetry

2. *S. Banerji, T.K. Das and D.R. Mandal* 15
Scalar Particle Energy Levels Bound by a Schwarzschild Black Hole

3. *B. Bertotti* 23
Long Range Prospects for Low Frequency Gravitational Wave Detection

4. *W.B. Bonnor* 33
Curves with Null Normals in Minkowski Space-time

5. *B. Carter* 48
The Canonical Treatment of Heat Conduction and Superfluidity in Relativistic Hydrodynamics

6. *Y. Choquet-Bruhat* 63
Recent Proofs of the Positivity of Gravitational Energy

7. *N. Dadhich* 72
Some Features of the Kerr Geometry

8. *H.G. Dalal and B.K. Datta* 85
Some Theorems on Relativistic Magnetohydrodynamics

9. *G.F.R. Ellis and D.R. Matravers* 92
Spatial Homogeneity and the Size of The Universe

10. *B.R. Iyer and C.V. Vishveshwara* 109
General Relativistic Aspects of Neutron Star Models

11. *P.S. Joshi* 128
Topological Properties of Certain Physically Significant Subsets of Spacetimes

12. *J. Krishna Rao and M. Annapurna* 137
Static Gaseous Spheres in General Relativity

13. *M. Nagaraj* 147
Sp(n)-Fields in General Relativity

14. *H. Nariai and H. Ishihara* 164
On the de Sitter and Nariai Solutions in General Relativity and Their Extension in Higher Dimensional Spacetime

15. *J.V. Narlikar* 171
Some Conceptual Problems in General Ralativity and Cosmology

16. *A. Papapetrou* 184
Formation of a Singularity and Causality

17. *A.R. Prasanna* 192
Equations of Motion for a Radiating Charged Particle in Electromagnetic Fields on Curved Space-time

18. *M.M. Som* 200
Static Electromagnetic Field Coupled Non-minimally to Gravity

19. *M.M. Som* 207
Homogeneous and Isotropic Cosmology with Conformally Invariant Scalar Field

20. *P. Szekeres* 211
Singularities of the Raychaudhuri Kind

21. *J.A. Wheeler* 222
Gravitational Collapse of a Gravitational Wave via Geon Transition State

Curriculum Vitae of P.C. Vaidya 229
List of Publications by P.C. Vaidya 230
Books by P.C. Vaidya 233
Curriculum Vitae of A.K. Raychaudhuri 234
List of Publications by A.K. Raychaudhuri 235
Books by A.K. Raychaudhuri 236

A Random Walk in Relativity and Cosmology

This volume is a collection of essays written in honour of Professor P.C. Vaidya and Professor A.K. Raychaudhuri. These two distinguished scientists are well-known for their important contributions to general relativity and cosmology, and are widely respected as inspiring teachers. The international composition of the authors, including some of their former students, is an indication of the measure of affection and admiration Vaidya and Raychaudhuri enjoy.

Topics in general relativity fall broadly into two types namely the study of gravitational effects around local objects and the investigation of the global structure of spacetime. The Vaidya metric is an example of the former while the Raychaudhuri equation belongs to the latter category. Appropriately, the articles in this volume highlight problems of both kinds and are written by experts in the respective fields. These essays span a wide spectrum of diverse areas from abstract concepts to observational techniques within the framework of relativity, cosmology and astrophysics. Some of them represent original results of recent research, while others are broad-based state of the art reviews. The variety of subjects discussed here includes the detection of gravitational radiation, structure of spacetimes, the nature of singularities, positivity of gravitational energy, relativistic astrophysics in relation to gravitational collapse, neutron stars and black holes, and fundamental conceptual problems in general relativity and cosmology.

General relativity and associated fields constitute today a rapidly expanding area of research. *A Random Walk in Relativity and Cosmology*, by presenting new ideas and offering a glimpse of the excitement of ongoing exploration, should be both useful and stimulating to any interested reader.

WILEY EASTERN LIMITED

New Delhi Bangalore Bombay Calcutta Madras Hyderabad