New Perspectives in Astrophysical Cosmology

This volume presents a unique and accessible synthesis of our understanding of modern cosmology, written by one of the world's foremost contemporary cosmologists. In recent years, observational cosmology has made remarkable advances, bringing into sharper focus a new set of fundamental questions that Professor Rees addresses in this book. Why is the universe expanding the way it is? What were the 'seeds' that caused galaxies, clusters and superclusters to form? What is the nature of 'dark matter'? What happened in the very early universe?

The latest exciting advances and theories are discussed, while maintaining a clear distinction between aspects that now have a firm empirical basis and those that remain speculative. Its wide scope and clear writing will be welcomed by anyone interested in cosmology and extragalactic astrophysics who has a basic grounding in physics, as well as academic researchers and graduate students in the field.

MARTIN REES, born in 1942, is a Royal Society Professor and Fellow of King's College, Cambridge. He also has the honorary position of Astronomer Royal. He has held chairs at the University of Sussex and the University of Cambridge. He is a former director of the Institute of Astronomy, Cambridge, and has held visiting positions at Harvard, Caltech and Princeton. In addition to his substantial contribution to the field as a researcher, he is the winner of the American Institute of Physics science writing prize, and is a talented lecturer at all levels.

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Preface

This small book is based on a series of Lezioni Lincee presented in Milan. In the lectures I tried to outline, for an audience of physicists as well as astronomers, some aspects of current research at the interface between extragalactic astrophysics, cosmology, and particle physics: topics addressed include galaxy formation, the origin of structure, dark matter, the background radiation, etc.

The presentation was superficial, and glossed over many key points. This was primarily through my own inadequacy, but was to some extent inevitable in any attempt to cover such a range of issues in only six hours. The present written text re-orders (and in some places updates) the lectures. However, in deference to the tradition of brevity established by earlier publications in this series, I have not expanded the material beyond the level of detail that could actually be presented in the lectures. The list of references, for the same reason, is not fully comprehensive (though it includes a selection of 'further reading').

This is definitely not a 'textbook', and cannot serve as a self-contained primer. But I have tried to highlight what seem the most important results and ideas (though Chapters 4 and 5 are somewhat more eclectic, being focussed on some more

specialised topics I was working on at the time). I hope that, as a whole, the lectures conveyed the essence of some recent developments and current debates, without too much distortion, and that this written version of them will provide specialists in other branches of physics, and students coming to the subject for the first time, with an accessible introduction and overview.

It is a pleasure to acknowledge the influence of many colleagues with whom I have collaborated or discussed cosmological topics. I also thank readers who pointed out errors and obscurities. These have been corrected in this second edition, which also contains substantial new material updating the 1995 text. I am grateful to the Accademia Nazionale dei Lincei for inviting me to give the original lectures, to Professor Ettore Fiorini for being such a supportive and hospitable host in Milan, and to Dr Simon Mitton for encouraging me to prepare this new version of the lectures.