— *Lectures on* —
Cosmology
and
Action at a Distance
Electrodynamics

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PREFACE

The idea for this book came out of a review article we wrote in 1995 in *Reviews of Modern Physics* to highlight the recent developments in action at a distance electrodynamics. Our article was also meant to be a tribute to the paper by John A. Wheeler and Richard P. Feynman on “Interaction with the Absorber as a Mechanism for Radiation” which had appeared in the same journal fifty years earlier. In this paper Wheeler and Feynman had introduced their now famous absorber theory of radiation in order to present a consistent picture of classical electrodynamics within the framework of action at a distance, that is, without using the notion of a field with its own degrees of freedom.

The absorber theory seemed to hold out hopes of linking the time asymmetry in electrodynamics to the large scale structure of the universe. Unfortunately Wheeler and Feynman did not explore this aspect further and the theory subsequently encountered problems at the quantum level. Later work by others, however, led to further progress on both these fronts with the result that most of the outstanding problems were resolved and by the early 1970s, the action at a distance description became at par with the standard field theoretic one.

Recent developments have taken the theory further and it is now seen that there is indeed a natural cut-off coming from cosmological boundary conditions which eliminates the so-called ultra-violet divergences in quantum electrodynamics. Thus the notorious infinities which require a renormalisation programme are eliminated. With this further input, we believe that the concept of action at a distance is now superior to the conventional field theory.

There is one important caveat, though. The cosmological boundary conditions that produce the right kind of time asymmetry at the classical level and provide the much needed cutoff at the quantum level are not satisfied by the currently popular big bang cosmology. They are satisfied by the steady state and the quasi-steady state cosmology, and in general by cosmologies that have a perfect future absorber and an imperfect past absorber. Moreover, the existence of an event horizon in the future also plays a critical role in making quantum electrodynamics convergent.

The failure of the conventional quantum field theory to deal with the problem of infinities is well known and has remained with us despite numerous attempts to resolve it. The success of the alternative approach described here reminds us that the problem is not purely local but that we need to include cosmological considerations.

We hope that the reader will see the merit of this approach and the important conclusions that it leads to. We urge him or her to weigh its advantages against the sacrifice of preconceived preferences for the big bang cosmology.

This monograph is aimed at students and research workers in theoretical physics and cosmology. We assume knowledge of electrodynamics, quantum mechanics and general relativity, although the description given here is self-contained. We have opted for the “Lecture” format to aim the book at classrooms.

We thank Professor K. K. Phua of World Scientific Publishing Company for inviting us to write this monograph.

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