Preface to the first edition

In writing this text we were concerned to assert the continuing importance of nuclear physics in an undergraduate physics course. We set the subject in the context of current notions of particle physics. Our treatment of these ideas, in Chapters 1 to 3, is descriptive, but it provides a unifying foundation for the rest of the book. Chapter 12, on β-decay, returns to the basic theory. It also seems to us important that a core course should include some account of the applications of nuclear physics in controlled fission and fusion, and should exemplify the role of nuclear physics in astrophysics. Three chapters are devoted to these subjects.

Experimental techniques are not described in detail. It is impossible in a short text to do justice to the ingenuity of the experimental scientist, from the early discoveries in radioactivity to the sophisticated experiments of today. However, experimental data are stressed throughout: we hope that the interdependence of advances in experiment and theory is apparent to the reader.

We have by and large restricted the discussion of processes involving nuclear excitation and nuclear reactions to energies less than about 10 MeV. Even with this restriction there is such a richness and diversity of phenomena that it can be difficult for a beginner to grasp the underlying principles. We have therefore placed great emphasis on a few simple theoretical models that provide a successful description and understanding of the properties of nuclei at low energies. The way in which simple models can elucidate the properties of a complex system is one of the surprises of the subject, and part of its general educational value.

We have tried to keep the mathematics as simple as possible. We assume a knowledge of the basic formulae of special relativity, and

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some basic quantum mechanics: wave-equations, energy levels and the quantisation of angular momentum. A few topics which may not be covered in elementary courses in quantum mechanics are treated in appendices. We consider the technicalities of angular momentum algebra, phase shift analysis and isotopic spin to be inappropriate to a first course in nuclear physics. Equations are written to be valid in SI units; results are usually expressed in MeV and fm. Each chapter ends with a set of problems intended to amplify and extend the text; some refer to further applications of nuclear physics. We have covered the bulk of the material in this book in 35 lectures of the core undergraduate curriculum at Bristol; these are given in the second and third years of the honours physics course.

We thank colleagues and students who read drafts of the text and drew our attention to errors and obscurities, which we have tried to eliminate. We are grateful to Margaret James and Mrs Lilian Murphy for their work on the typescript.

There is a less obvious debt: to the sometime Department of Mathematical Physics of the University of Birmingham where, under Professor Peierls, we first learned about physics.

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