

Preface

The main goal of this book is to provide an accessible and concise introduction to nuclear physics and energy production from nuclear fission. The book conveys quantitative information on the fundamental physical mechanisms at play in the nuclear fission process, as well as on current exploitation of fission in power plants, including technical aspects and trends. It provides a basis for a core undergraduate course in this area.

The text is divided into two parts; the first part encompasses the basics of nuclear forces and properties of nuclei, nuclear collisions, nuclear stability, radioactivity, as well as a detailed discussion of the fission process and relevant topics in its application to energy production. The second part covers the basic aspects of nuclear reactor technologies, nuclear fuel cycle and resources, reactor safety and regulation, security and safeguards, and spent fuel and radioactive waste management. The book also contains some sections devoted to a qualitative description of the phenomena associated with the passage of charged particles and radiation through matter, a discussion of the biological effects of nuclear radiation and of radiation protection, and a summary of the ten most relevant accidents occurred to nuclear installations, some of which have had a significant impact on the development and deployment of nuclear power. A glossary at the end of the book provides a handy reference to the terminology used in nuclear physics and nuclear energy.

The subject matter is broad and somewhat heterogeneous and obviously does not allow going deep into the subtleties of each single topic. However, the aim is to provide an as complete as possible overview of the many aspects and issues involved in the deployment of nuclear power. In topics ranging from the fundamental physical principles to the much-debated challenges of safety and closure of the nuclear cycle, whenever possible, authoritative sources of information are used (typically international agencies and institutions), thereby stimulating the reader to expand his/her knowledge on each topic by looking at the suggested references, or by searching further technical literature on the Web.

The book is suitable for undergraduates in physics, nuclear engineering, and other science subjects. However, mathematics is kept at a level that can be easily followed by a wide audience. The addition of solved problems, strategically placed throughout the text, and the collections of problems at the end of the chapters help to better understand the scientific and technical topics presented in the text, and allow appreciating the quantitative aspects of various phenomena and processes. Many illustrations and graphs effectively supplement the text and help visualising specific issues.

Energy from Nuclear Fission

An Introduction

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