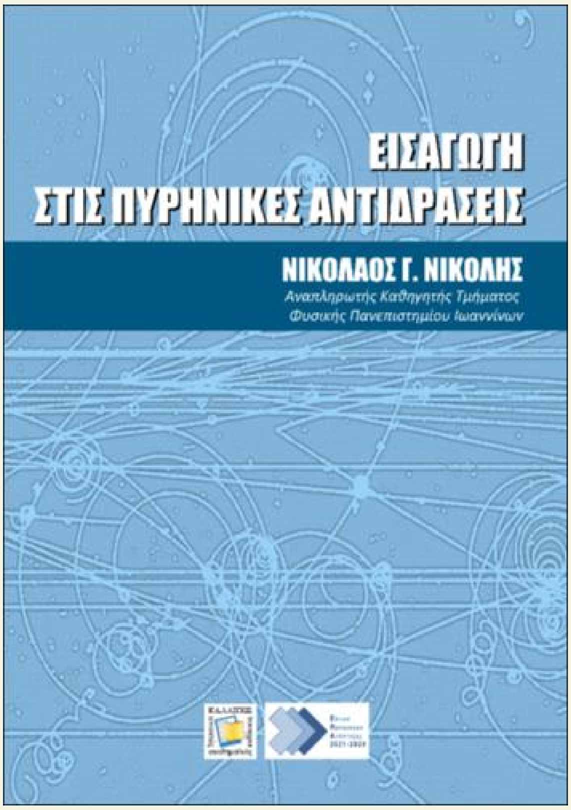


## METADATA

**Title:** Introduction to Nuclear Reactions

**Other Titles:** -

**Language:** Greek

**Authors:** Nicolis, N., Associate Professor, UOI

**ISBN:** 978-618-228-254-0

**Subject:** NATURAL SCIENCES AND AGRICULTURAL SCIENCES

**Keywords:** Nuclear Physics / Nuclear Reactions / Nuclear masses / Fermi gas model / Cross section

**Bibliographic Reference:** Nicolis, N. (2024). Introduction to Nuclear Reactions [Undergraduate textbook]. Kallipos, Open Academic Editions. http://dx.doi.org/10.57713/kallipos-998

### Abstract

The present introductory book is intended to be used by senior undergraduate or early postgraduate students of physics. As a background, we study the energetics of the nucleus and the Fermi gas model for the description of nuclear level density and its determination with nuclear reactions. We examine the characteristic time scales, two-body kinematics, the energy balance, and conservation laws. We introduce the differential and integrated cross section. We describe an accelerator experiment. In the framework of Coulomb scattering, we study the scattering of alpha particles from gold nuclei and electron scattering. After the introduction of quantum scattering, we discuss the coupled-channels and the optical model. We also describe the formation and decay of the compound nucleus, the characteristics of excitation functions of the final products, the energy, and angular distributions of the emitted particles. These features are contrasted with the ones of direct and preequilibrium reactions. We describe the basic characteristics of reactions between heavy ions, such as elastic and inelastic scattering, nucleon transfer reactions, compound nucleus decay, nuclear molecules, incomplete fusion, deep inelastic collisions, superheavy element formation, projectile fragmentation reactions and hadron-induced spallation reactions. We examine the statistical model of nuclear reactions, the exciton model in a simplified form and the Monte Carlo method for spallation reactions at intermediate energies. We discuss briefly the most popular nuclear reaction codes. In the final chapter, we describe the general characteristics of nuclear fission having the liquid drop model as a guide. Then, we examine the influence of shell effects and their fadeout with increasing excitation energy of the nucleus.

The Project is funded by the National Development Programme 2021-2025 of the Ministry of Education and Religious Affairs and implemented by the Special Account for Research Funds of the National Technical University of Athens and the Hellenic Academic Libraries Link.