

TOTAL REACTIONS CROSS SECTIONS MEASURING METHODS

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Properties of nuclear sizes, such as material and charge root-mean-square radii and density distributions of nuclear matter, provide us with basic information for understanding the structure of the nucleus [1, 2]. One of the experimental approaches to extracting these parameters, particularly for radioactive nuclei, is based on measuring the total reaction cross sections σ_R and their energy dependencies $\sigma_R(E)$ [3-5]. The σ_R measurement provides us with an objective and model-independent test for various theoretical models.

Currently, the development of methods for measuring σ_R is especially important due to the low intensities of beams of exotic nuclei located at the boundary of nucleon stability [5].

The paper provides an overview of methods for measuring total reaction cross sections, provides a systematic description of the methods, and outlines the main directions of their development. Particular attention is paid to the analysis of 4π methods for measuring the total cross sections of reactions with radioactive nuclei in the energy range 5–50 MeV/nucleon [6,7].

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References

1. A. Ozawa, Matter radii and Density Distributions, Handbook of Nuclear Physics, editors I. Tanihata, H. Toki, T. Kajino, p. 218-240, World Scientific Publishing Co. Pte. Ltd., Singapore, (2023);
2. Yu. E. Penionzhkevich and R. G. Kalpakchieva, Light exotic nuclei near the boundary of neutron stability, World Scientific Publishing Co. Pte. Ltd., Singapore, (2022);
3. A. Ozawa, T. Suzuki, I. Tanihata, Nuclear size and related topics, Nucl. Phys. A 693, 32–62, (2001);
4. O. A. P. Tavares, E. L. Medeiros, and V. Morcelle, Universal trend for heavy-ion total reaction cross-sections at energies above the Coulomb barrier, Phys. Scr. 82, 025201 (2010);
5. Yu. E. Penionzhkevich, Yu. G. Sobolev, V. V. Samarin, M. A. Naumenko, N. A. Lashmanov, V. A. Maslov, I. Síváček, and S. S. Stukalov, Energy dependence of the total cross section for the $^{11}\text{Li} + ^{28}\text{Si}$ reaction, Phys. Rev. C 99, 014609 (2019);
6. I. Síváček, Yu. E. Penionzhkevich, Yu. G. Sobolev, and S. S. Stukalov, MULTI-2, a 4π spectrometer for total reaction cross section measurements, Nucl. Instrum. Methods Phys. Res. Sect. A 976, 164255 (2020);
7. Yu. G. Sobolev, V. V. Samarin, Yu. E. Penionzhkevich, S. S. Stukalov, and M. A. Naumenko, Total cross sections for the reactions $^{10,11,12}\text{Be} + ^{28}\text{Si}$ and $^{14}\text{B} + ^{28}\text{Si}$, submitted to Phys. Rev. C (2024).

Section

Applications of nuclear methods in science, technology, medicine and radioecology

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