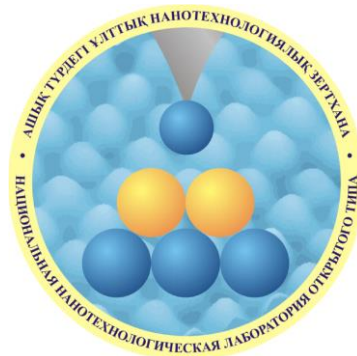


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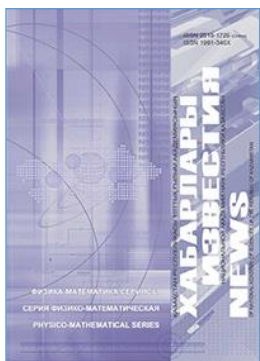
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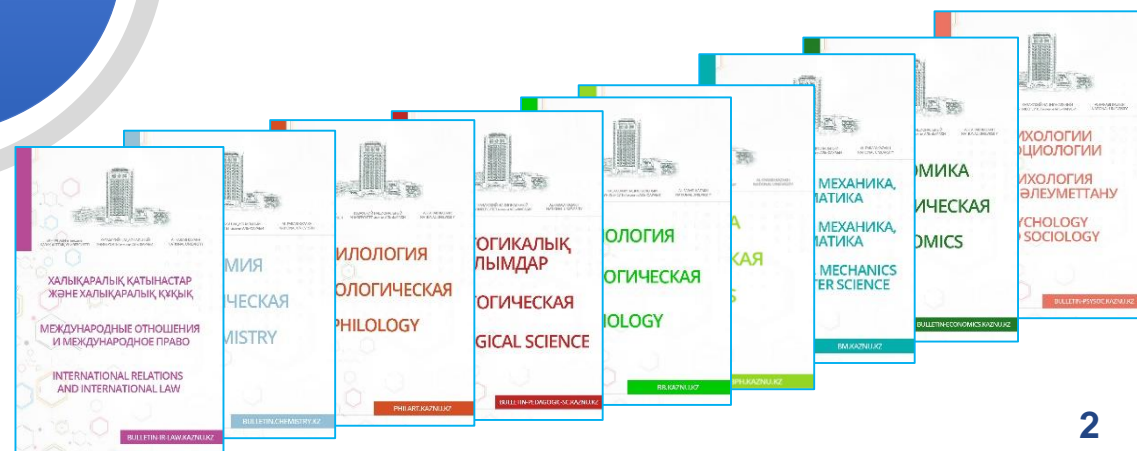
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Ionization cross section of noble gas atoms by electron impact

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The paper presents an analysis of data on the cross sections for ionization by electron impact of noble gas atoms such as hydrogen, helium, neon, argon, krypton and xenon. For the selected sets of experimental and theoretical data an analytical formula is proposed, based on separate accounting for the knockout of electrons from the outer and inner shells, and the corresponding approximation coefficients are selected. By single-term and two-term analytical dependences, approximation errors and coefficients of the ionization cross sections of noble gas atoms were obtained. The obtained semi-empirical formula reproduces the values of the ionization cross sections in a wide range of energies with an accuracy of several percent. Energy dependence of the ionization cross section for an electron collision with a noble gas atom was calculated and compared with available experimental data. The analysis of the approximation coefficients makes it possible to reduce the influence of errors in the initial experimental data and significantly increase the accuracy of estimating the ionization cross sections.

Key words: electron atomic collisions, ionization cross section, approximation of cross sections, noble gases.

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1 Introduction

The bibliography on cross sections of electron-atomic collisions has thousands of works, and probably an exhaustive review and selection of data is contained in the works [1–6]. However, it should be borne in mind that a critical analysis of the results of experimental data in the review work is very difficult due to the fact that the errors given in the original works of the order of 1–3% differ from each other sometimes by 50%. Therefore, in the review work, only a comparative analysis of the results obtained is really possible, which shows that at best, the relative errors of measuring cross sections are of the order of 5–10%, and more often 20–50%, sometimes reaching 100%.

The most convenient form of presenting experimental and computational-theoretical data is the selection of analytical approximations for them. We began a critical analysis and assessment of the cross sections for electron scattering by atoms of noble gases and vapors of some metals in a wide range of energies in [16–20], where approximations

were proposed for the cross sections of elastic and inelastic collisions of electrons with rare gas atoms. Ionization by electron impact from the ground state of the atom is the most common method for the formation and maintenance of a gas-discharge plasma. From a large number of experimental and calculated data on the cross sections for ionization of atoms by electron impact, we have chosen by comparative analysis such data that allowed us to significantly expand the range of applicability of the proposed analytical dependences.

2 Approximation of the ionization cross section

The formulation of the problem of finding an analytical approximation of the ionization cross section of an atom by an electron impact is based on the use of known analytical estimates, the results of experimental measurements and numerical quantum mechanical calculations. In 1912, Thomson proposed the dependence of the ionization cross-section on the electron energy of the following form [21]:

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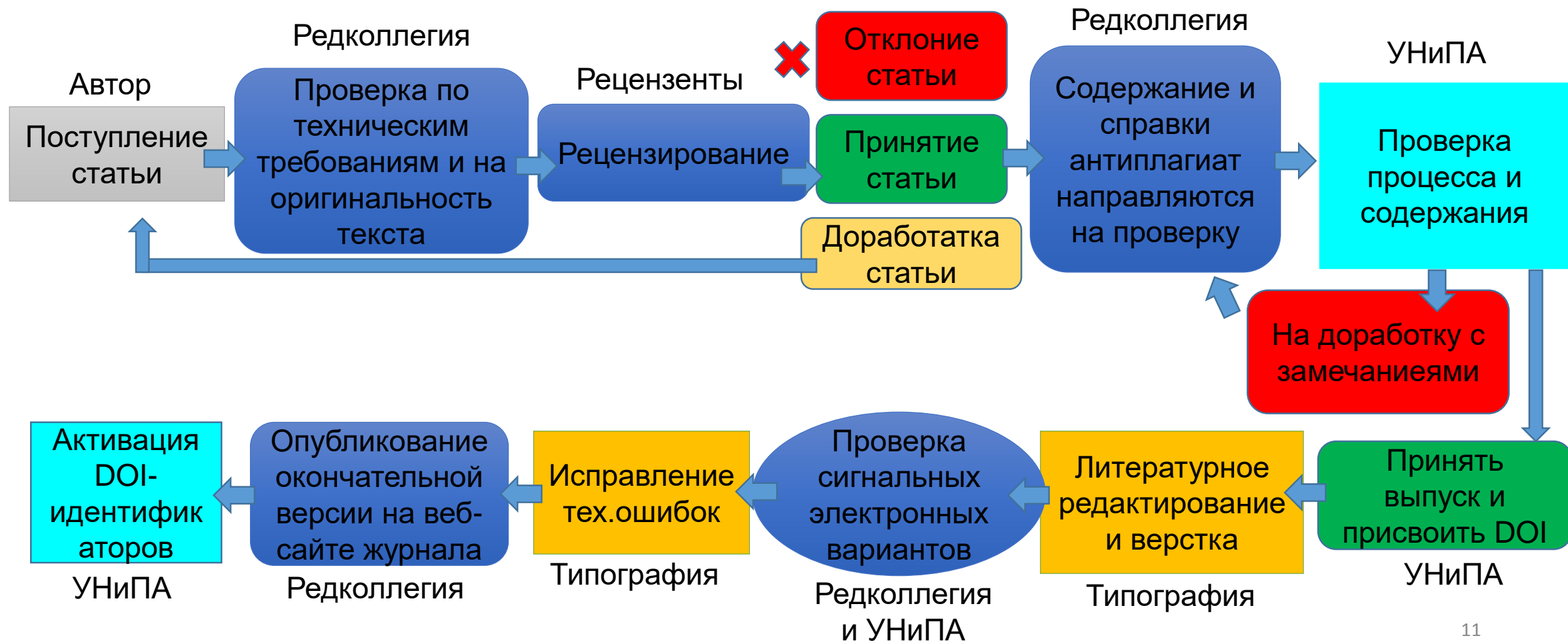


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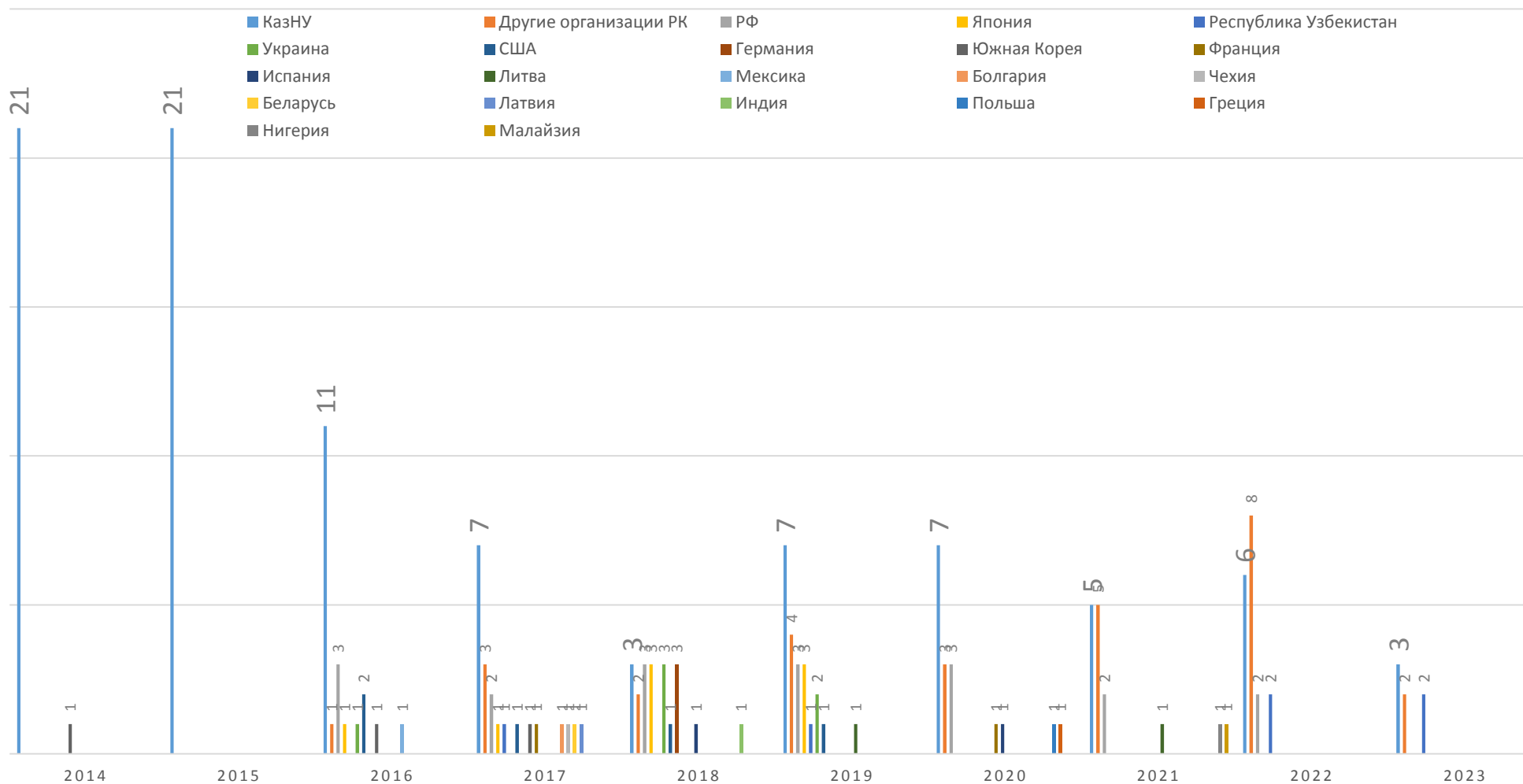


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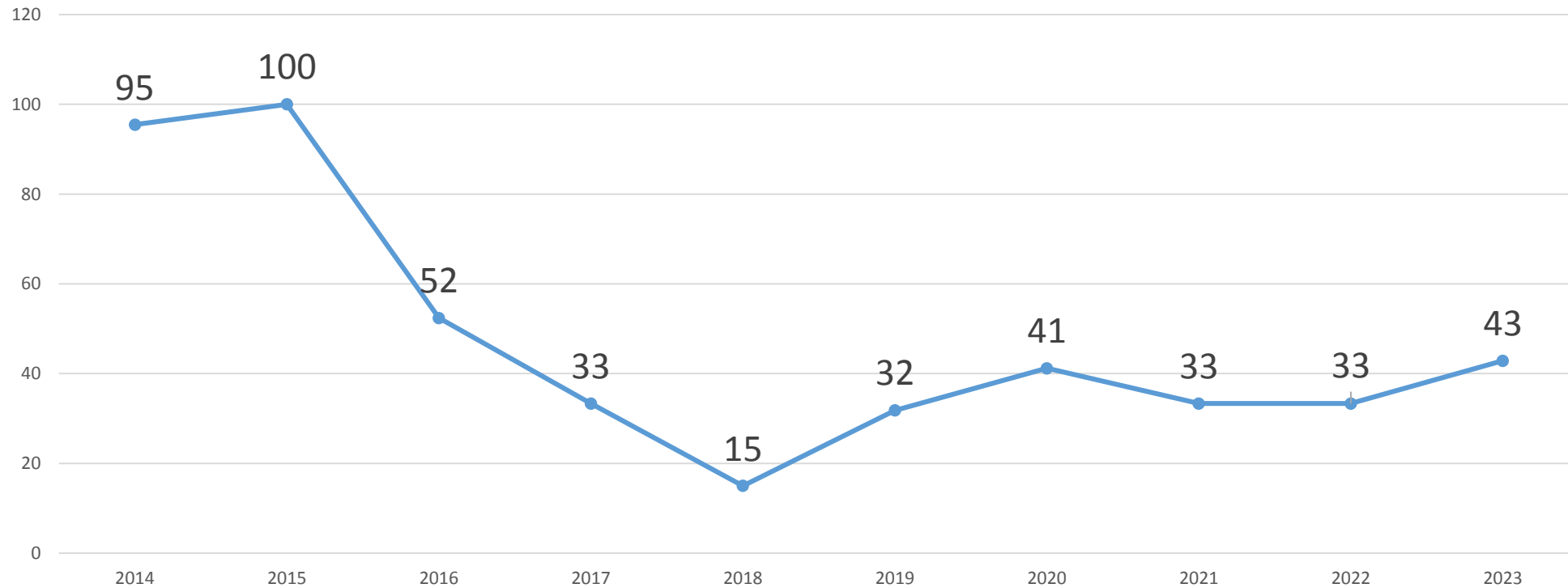
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