

<b>Project name, IRN</b>	AP23486969 – Development and simulation of anti-resonance multipole systems based on a conducting circular cylinder
<b>Completion date</b>	01.01.2024-31.12.2026
<b>Project supervisor</b>	Spivak-Lavrov I. F.
<b>Report</b>	<p>Currently, quadrupole mass spectrometers are widely used. The quadrupole mass analyzer refers to the so-called antiresonance mass spectrometers, in which a part of the ions, when a beam of ions moves through an electric field having both a constant and a time-varying component, passes a field with a limited oscillation amplitude, while the amplitude of the oscillations of the other part of the ions increases indefinitely with time, and they drop out of the bundle. Since the nature of the motion of charged particles depends on the mass-to-charge ratio, such an electric field can work as a mass filter, that is, only ions having a certain value of the mass-to-charge ratio can pass through it.</p> <p>The main element of a quadrupole mass analyzer is a linear quadrupole, which is a structure of four cylindrical rods arranged parallel to each other. A constant and alternating RF voltage is applied to the electrodes.</p> <p>Quadrupole electrostatic fields are widely used in analytical instrumentation. Quadrupole, sextupole and octupole electrostatic systems are used to correct aberrations of electrostatic lenses and mirrors [1-3]. Quadrupole mass spectrometers, as well as various ion traps in which quadrupole fields are used, are now widely used. The linear ion trap was proposed by V. Paul in 1952, who was awarded the Nobel Prize in 1989 for these developments [4]. The linear ion trap, in fact, was still the same quadrupole mass spectrometer, which underwent some design changes for the possibility of three-dimensional stable localization of charged particles [4-7]. Over time, numerous modifications of the linear trap appeared, such as an ion surface trap [8], a micro trap on the surface for the implementation of a quantum processor [9], a toroidal ion trap [10], which, by changing the spatial shape and orientation of the electrodes [11], left the very idea of a quadrupole mass spectrograph unchanged [12-13]. Ion traps can also be used in the creation of quantum computers [14].</p> <p>The project will develop theoretically sound mathematical and computer models for calculating multipole mass analyzers based on a conductive circular cylinder equipped with grounded screens at the ends. Such screens allow us to take into account the influence of edge fields on the physical and instrument characteristics of the mass analyzer.</p> <p>The production of quadrupole mass analyzers, which could be used in a variety of fields, would allow Kazakhstan to reach the forefront in the field of scientific instrumentation. The author's certificate is supposed to be obtained for the new scheme of the quadrupole mass analyzer.</p> <p>Currently, the radio frequency quadrupole, due to its versatility and simplicity, has found wide application in various fields of science and technology. It is used both as a mass spectrometer and as a guiding system for beams, as well as as a standard measuring device</p>

<b>Purpose</b>	The purpose of this project is the development and mathematical and computer modeling of antiresonance mass-selective electric multipole systems based on a conductive circular cylinder
<b>Expected results</b>	<p>1) based on the results of research conducted within the framework of the project, the following publications are planned:</p> <p>2) at least 3 (three) articles and (or) reviews in peer-reviewed scientific publications in the scientific direction of the project, indexed in the Science Citation Index Expanded and included in the 1st (first), 2nd (second) and (or) 3rd (third) quartile by impact factor in the Web of Science database and (or) having a CiteScore percentile in the Scopus database of at least 60 (sixty); - at least 1 (one) article or review in a peer-reviewed foreign or domestic publication recommended by the Committee for Education and Science of the Republic of Kazakhstan;</p> <p>3) it is planned to obtain a patent from the Republican State Enterprise on the basis of economic management “National Institute of Intellectual Property” of the Ministry of Justice of the Republic of Kazakhstan RSE NIIS Ministry of Justice of the Republic of Kazakhstan;</p> <p>4) the development of scientific, technical and design documentation is not planned;</p> <p>5) dissemination of the results of the work among potential users, the scientific community and the general public will be carried out in the form of publications in scientific journals, as well as through participation in international scientific conferences;</p> <p>6) other measurable results in accordance with the requirements of the competition documentation and the characteristics of the project; the results obtained can be used in the design and calculation of mass analyzers for elemental, isotopic and chemical analysis of substances in a wide variety of fields of science, technology and production; implementation of the project results will allow Kazakhstan to reach the forefront in the field of scientific instrumentation and will contribute to the development of electron-optical research methods; The results obtained will be used in the preparation of dissertations for doctoral and master's students, and the defense of one PhD dissertation is expected.</p>
<b>Research group</b>	<p><i>Руководитель:</i> Спивак-Лавров Игорь Феликсович, доктор физико-математических наук, профессор, H index h=5  ResearcherID – 3708676  Researcher ID Web of Science – AAQ-8729-2020  ORCID – 0000-0002-2683-2425  Scopus Author ID – 6603647700 Scopus Author ID – 36134289000  <a href="https://www.scopus.com/authid/detail.uri?authorId=6603647700">https://www.scopus.com/authid/detail.uri?authorId=6603647700</a></p> <p>Baisanov O.A. – Candidate of Physical and Mathematical Sciences, H index h=3  Researcher ID – 3708676  Researcher ID Web of Science – AAQ-8729-2020  ORCID – 0000-0002-2683-2425  Scopus Author ID – 6603647700  <a href="https://www.scopus.com/authid/detail.uri?authorId=36134289000">https://www.scopus.com/authid/detail.uri?authorId=36134289000</a></p>

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<b>Publications in scientific publications</b>	A patent application has been filed for the invention «Anti-resonance mass analyzers based on a straight wire cylinder»