

Brief information about the project

Name of the project	Development of a numerical model of the interaction of the Earth's magnetosphere with solar wind plasma
Relevance	The project aims to address pressing issues in near-Earth space exploration, namely, the creation of a numerical model that can predict the dynamics of the geomagnetic field for various types of solar coronal mass ejections.
Purpose	Creation of a numerical model that allows describing the dynamics of the geomagnetic field for various types of solar coronal mass ejections.
Objectives	1) Systematize the events of solar coronal mass ejections (CME) based on the dynamics of the density and spectrum of solar wind velocities outside the Earth's magnetosphere based on data from the ACE, SOHO and SDO solar observatories. Based on the systematization, compile several typical portraits of the dynamics of the solar plasma substance for further use as boundary conditions of the model. 2) Improve our own numerical model of charged particle interaction based on the particle-in-cell method in order to increase the speed and compliance with the problem being solved. On its basis, a numerical model will be created that allows solving the interaction of a charged particle flow specified by boundary conditions with the Earth's magnetic field in a cubic space of 10-100 Re . 3) Conduct a simulation of the magnetic field dynamics for several cases of coronal mass ejections of the Sun. 4) Compare the modeling data with magnetic field measurements on the Earth's surface and on spacecraft.
Expected and achieved results	<i>Expected results:</i> A numerical simulation model will be created to reproduce the behavior of the magnetosphere and the particle density in the near space space depending on various input conditions, representing the spatiotemporal distribution of particles corresponding to the flux of protons and electrons of the solar wind and coronal mass ejections. <i>Achieved results:</i> A prototype program for modeling the interaction of the Earth's magnetosphere with solar wind plasma is currently under development. This program allows for the simulation of the interaction of a charged particle flow specified by boundary conditions with the Earth's magnetic field in a cubic space of 10-100 Earth radii.
Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles	Mukasheva Saule Nurmukhanbetovna / Saule Mukasheva, scientific director of the project, candidate of physical and mathematical sciences, member of the European Geophysical Society EGU (European Geosciences Union) Scopus Author ID: 6508123068 Researcher ID: AAP-9855-2020 ORCID: http://orcid.org/0000-0002-1609-4430. https://www.webofscience.com/wos/author/record/2015980 Vyacheslav Somsikov, Chief Researcher, Doctor of Physical and Mathematical Sciences, Professor, Member of the

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Usage	<i>The expected application areas of the results include:</i> solar activity and space weather research, space weather forecasting, computational physics, and geomagnetic research. <i>Target users:</i> LLP Institute of the Ionosphere, JSC Republican Space Communications Center, JSC National Company Kazakhstan Gharysh Sapary, and other organizations and universities conducting space weather research.
Priority compared to real-world alternatives	Name of the priority area of scientific development: 3. Advanced manufacturing, digital and space technologies

	Name of the specialized scientific field: 17. Fundamental and applied research in the field of advanced manufacturing, digital and space technologies. <i>Priority compared to real-world alternatives:</i> Unlike its analogues, the model of interaction between solar wind matter and the Earth's magnetosphere being developed in the project calculates the movement of charged particles in the magnetosphere, making it possible to determine the dynamics of magnetic field changes and the evolution of the Earth's radiation belts.
List of publications with links to them	1. Тилеу Г.Б., Мукашева С.Н. Состояние среднеширотной ионосферы во время гелиогеофизического события 24-25 марта 2024 года // Современные техника и технологии в научных исследованиях: Сб. материалов XVII Междунар. конф. молодых ученых и студентов. –Бишкек: НС РАН, 2025. – С. 86-89. ISBN 978-9967-12-998-6 (сборник индексируется в РИНЦ, статья размещена https://elibrary.ru/). 2. Mukasheva S.N., Andreyev A.B., Kaputin V.I., Sokolova O.I., Tileu G.B. Description of the helio-geophysical conditions during the magnetically disturbed period of june 21–26, 2015 // Azerbaijani Astronomical Journal (AAJ). – 2025. –№ 20(2). –С. 19–21. https://doi.org/10.59849/2078-4163.2025.2.19. AAJ индексируется в системе Astrophysics Data System (ADS), входит в Scopus (CiteScoreTracker 2025 -0.3).
Patents	-