

## Brief information about the project

Name of the project	AP09058005 "Computer modelling of dusty space plasma properties"
Relevance	A significant portion of space plasma consists of "dusty plasma," where a condensed dispersed phase is present. This type of plasma is found in various locations such as planetary rings, comet tails, interplanetary space, interstellar clouds, and so on. Measurements conducted by spacecraft have revealed deviations from the equilibrium particle distribution in the solar wind, plasma in planetary magnetospheres, and other astrophysical objects. This deviation is usually associated with the presence of high-energy particles. In most cases, a power-law tail is observed in the high-energy region. Empirical data are best described by the so-called $\kappa$ (kappa) family distributions. Therefore, studying the properties of cosmic dusty plasma considering this distribution is important for understanding the processes occurring in such systems.
Purpose	The purpose of the study is to study the properties of dusty space plasma based on computer modeling methods using the developed software package.
Objectives	<ol style="list-style-type: none"> <li>1. Study of the charge of a dust particle by approximating limited orbital motion without taking into account collisions of cosmic plasma particles.</li> <li>2. Study of the charge of a dusty particle taking into account the collision of cosmic plasma particles.</li> <li>3. Creation of mathematical models and writing programs for calculating and analyzing quantities characterizing the structural properties of dusty cosmic plasma.</li> <li>4. Creation of mathematical models and writing programs for calculating and analyzing quantities characterizing the dynamic properties of dusty cosmic plasma.</li> <li>5. Development of the internal structure of the software package, description of all constituent elements and their relationships, as well as development of design and interface.</li> </ol>
Expected and achieved results	Within the framework of the project, the current problem of charging dust particles in nonequilibrium space plasma was studied, its structural and dynamic properties were studied, and a software package was developed that allows one to quickly obtain information about the physical properties of dusty space plasma of interest without going into the details of calculations.
Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles	<ol style="list-style-type: none"> <li>1. Машеева Ранна Уытбаевна, PhD, Индекс Хирша – 7, ORCID: 0000-0002-6950-662X, Scopus author ID: 55185276700.</li> <li>2. Шаленов Ерик Онгарович, PhD, Индекс Хирша – 9; ORCID: 0000-0001-6469-6623, Scopus Author ID: 55693577400.</li> <li>3. Сейсембаева Мадина, Индекс Хирша – 5 ORCID: 0000-0003-3256-5957, Scopus Author ID: 57190004356.</li> <li>4. Мырзэли Мұрат Асланұлы, PhD-студент, Индекс Хирша – 1; ORCID: 0000-0002-8811-7099, Scopus Author ID: 57224626041</li> </ol>
List of publications with links to them	<ol style="list-style-type: none"> <li>1. R.U. Masheyeva, K. N. Dzhumagulova, M. Myrzaly, J. SchulzeZ. Donkó. Self-bias voltage formation and charged particle dynamics in multi-frequency capacitively coupled plasmas // AIP Advances. – 2021. – Vol. 11 (7). – P. 075024. (IF 1.548, 55%, Q2). <a href="https://doi.org/10.1063/5.0055444">https://doi.org/10.1063/5.0055444</a></li> </ol>

	<p>2. К.Н. Джумагулова, Т.С. Рамазанов, Р.У. Машеева, М. Мырзалы, Е.О. Шаленов, Н. Атаканов, М.Н. Джумагулов. Влияние внешнего магнитного поля и силы трения на динамические свойства системы заряженных частиц // Recent Contributions to Physics. – 2021. – №1 (76). – 2021</p> <p>3. R. U. Masheyeva, K. N. Dzhumagulova. Automated complex for investigation of the dusty plasma properties // XXXII IUPAP Conference on Computational Physics (CCP 2021), 2-6 August 2021, Coventry, England</p> <p>4. М.А. Мырзалі, Р.У. Машеева. Формирование смещения напряжения и динамика заряженных частиц в комплексной плазме // Материалы международной научной конференции студентов и молодых ученых «Фараби әлемі», Алматы, Казахстан, 6-8 апреля, 2021, С. 395.</p> <p>5. R.U. Masheyeva, M. Myrzaly, N. Atakanov, M.N. Jumagulov, T.S. Ramazanov, K.N.Dzhumagulova. Effect of external magnetic field and friction force on the dynamic properties of the particles in the Yukawa liquids // European Physical Society, 47<sup>th</sup> Conference on Plasma Physics, 21-25 June, 2021.</p> <p>6. M. Myrzaly, R. U. Masheyeva, K. N. Dzhumagulova. Charging of dust particles in space plasma in the presence of the suprathermal electrons // 7th International Conference on the Physics of Non-Ideal Plasmas (PNP17) which is to be held at Dresden, Germany, from September 20 to 24, 202</p> <p>7. Р.У. Машеева, К.Н. Джумагулова, М. Мырзали. Исследование зарядки пылевых частиц космической плазмы // Физика плазмы. – 2022. Том 48 (11). – с. 1066–1074 (Q3, 43%)</p> <p>8. R.U. Masheyeva, K.N. Dzhumagulova, M. Myrzaly Study of the Charging of Dust Grains in Space // Plasma. Plasma Phys. Rep. – 2022. – Vol. 48 (11) – p. 1203–1210 (Q3, 43%) DOI: 10.1134/s1063780x22600888</p> <p>9. М.А. Мырзалі, Р.У. Машеева. Тозаң плазмасының физикалық қасиеттерін зерттеуге арналған интерфейс // Материалы международной научной конференции студентов и молодых ученых «Фараби әлемі», Алматы, Казахстан, 6-8 апреля, 2022, С. 364.</p> <p>10. R. U. Masheyeva, M. Myrzaly, K. N. Dzhumagulova. Calculation of the charge of dust // Complex systems of charged particles and their interactions with electromagnetic radiation, International Workshop, April 11-13, 2022</p> <p>11. R. U. Masheyeva, M. Myrzaly, K. N. Dzhumagulova. Charging of dust particles in the space//Strongly Coupled Coulomb Systems, 24-29 July, 2022, Gornitz, Germany</p> <p>12. R.U. Masheyeva, P. Hartmann, J. Schulze, K.N. Dzhumagulova, M. Myrzaly, Z. Donkó. On the in-situ determination of the effective secondary electron emission coefficient in low pressure capacitively coupled radio frequency discharges // 24th Symposium on Application of Plasma Processes and 13th EU-Japan Joint Symposium on Plasma Processing (SAPP XXIV), 27<sup>th</sup> January and 1<sup>st</sup> February 2023, Štrbské Pleso, Slovakia</p>
Patents	-