Project name, IRN	AP26102895 - Understanding Compact Objects in Open Clusters and Their Vicinity
Completion date	18.07.2025-31.12.2027
Project supervisor	Kalambay Mukhagali Toktarbayuly, PhD
Report	Recent discoveries of binary black holes in the vicinity of the Solar System, identified using Gaia DR3 data, have challenged existing paradigms regarding the retention of compact objects in stellar clusters. This project aims to investigate the dynamics of black holes, neutron stars, and white dwarfs using GPU-optimized N-body simulations that reflect realistic star formation conditions. By examining how the retention fraction of compact objects influences the evolution of clusters and binary systems, the study will deepen our understanding of stellar dynamics and processes related to gravitational waves. The results will strengthen the theoretical foundation of astrophysics, enhance Kazakhstan's scientific potential, and prepare a new generation of researchers equipped with advanced computational skills.
Purpose	This project aims to comprehensively investigate the statistical properties and the dynamical evolution of compact objects in star clusters.
Expected results	An important goal of the project is to engage young Kazakhstani astrophysicists in a cutting-edge field at the intersection of astrophysics and computer science. Students will study the dynamics of compact objects — black holes, neutron stars, and white dwarfs — using N-body simulations and present their results at conferences. The research will deepen understanding of stellar dynamics, binary evolution, and galaxy formation, while the developed models will serve as a foundation for future academic and interdisciplinary studies. The project will strengthen Kazakhstan's scientific potential by developing the competencies of a new generation of researchers and promoting the country's integration into the international scientific community. It is expected to produce at least five peer-reviewed publications, including papers in high-impact journals, and to present findings at international conferences. The project's implementation will contribute to the advancement of astrophysics, computational methods, and scientific education, enhancing Kazakhstan's prestige in the global scientific arena.
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