

ISSN: 1991-346X (Print)
ISSN: 2518-1726 (Online)

**ACADEMIC JOURNAL
OF PHYSICAL AND CHEMICAL SCIENCES**

**№3
2025**

ISSN 2518-1483 (Online),
ISSN 2224-5227 (Print)

2025 • 3



ACADEMIC JOURNAL OF PHYSICAL AND CHEMICAL SCIENCES

PUBLISHED SINCE JANUARY 1944

ALMATY, NAS RK

Editor-in-Chief:

ZHURINOV Murat Zhurinovich, Doctor of Chemical Sciences, Professor, Academician of NAS RK, Acting President of RPA NAS RK, General Director of JSC "Institute of Fuel, Catalysis and Electrochemistry named after D.V. Sokolsky" (Almaty, Kazakhstan) <https://www.scopus.com/authid/detail.uri?authorId=6602177960>

Editorial Board:

KALIMOLDAYEV Maksat Nuradilovich, Doctor of Physical and Mathematical Sciences, Professor, Academician of NAS RK (Almaty, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=56153126500>

ADEKENOV Sergazy Mynzhasarovich, Doctor of Chemical Sciences, Professor, Academician of NAS RK, Director of the International Science and Production Holding "Phytochemistry" (Karaganda, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=7006153118>

RAMAZANOV Tlekkabul Sabitovich, (Deputy Editor-in-Chief), Doctor of Physical and Mathematical Sciences, Professor, Academician of NAS RK (Almaty, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=6701328029>

ABIEV Rufat, Doctor of Technical Sciences (Biochemistry), Professor, Head of the Department of Optimization of Chemical and Biotechnological Equipment, St. Petersburg State Technological Institute (St. Petersburg, Russia) <https://www.scopus.com/authid/detail.uri?authorId=6602431781>

OLIVIERO Rossi Cesare, PhD (Chemistry), Professor at the University of Calabria (Calabria, Italy), <https://www.scopus.com/authid/detail.uri?authorId=57221375979>

TIGINYANU Ion Mihailovich, Doctor of Physical and Mathematical Sciences, Academician, President of the Academy of Sciences of Moldova, Technical University of Moldova (Chisinau, Moldova), <https://www.scopus.com/authid/detail.uri?authorId=7006315935>

SANG SU Kwak, PhD (Biochemistry, Agricultural Chemistry), Professor, Chief Scientist, Research Center for Plant Systems Engineering, Korea Research Institute of Bioscience and Biotechnology (KRIBB), (Daecheon, Korea), <https://www.scopus.com/authid/detail.uri?authorId=59286321700>

BERSIMBAYEV Rakhmetkazi Iskenderovich, Doctor of Biological Sciences, Professor, Academician of NAS RK, L.N. Gumilyov Eurasian National University (Astana, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=7004012398>

CALANDRA Pietro, PhD (Physics), Professor, Institute for the Study of Nanostructured Materials (Rome, Italy), <https://www.scopus.com/authid/detail.uri?authorId=7004303066>

BOSHKAEV Kuantai Aygazyevich, PhD, Associate Professor, Department of Theoretical and Nuclear Physics, Al-Farabi Kazakh National University (Almaty, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=54883880400>

BURKITBAEV Mukhambetkali, Doctor of Chemical Sciences, Professor, Academician of NAS RK, (Almaty, Kazakhstan) <https://www.scopus.com/authid/detail.uri?authorId=8513885600>

QUEVEDO Hernando, Professor, National Autonomous University of Mexico (UNAM), Institute of Nuclear Sciences (Mexico City, Mexico), <https://www.scopus.com/authid/detail.uri?authorId=55989741100>

ZHUSUPOV Marat Abzhanovich, Doctor of Physical and Mathematical Sciences, Professor of the Department of Theoretical and Nuclear Physics, Al-Farabi Kazakh National University (Almaty, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=6602166928>

KOVALEV Alexander Mikhailovich, Doctor of Physical and Mathematical Sciences, Academician of NAS of Ukraine, Institute of Applied Mathematics and Mechanics (Donetsk, Ukraine), <https://www.scopus.com/authid/detail.uri?authorId=7202799321>

TAKIBAEV Nurgali Zhabagaevich, Doctor of Physical and Mathematical Sciences, Professor, Academician of NAS RK, Al-Farabi Kazakh National University (Almaty, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=24077239000>

KHARIN Stanislav Nikolaevich, Doctor of Physical and Mathematical Sciences, Professor, Academician of NAS RK, Kazakh-British Technical University (Almaty, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=6701353063>

DAVLETOV Askar Erbulanovich, Candidate of Physical and Mathematical Sciences, Associate Professor, Branch of NRNU MEPhI Kazakh National University named after Al-Farabi (Almaty, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=6602642543>

ABISHEV Medeu Erzhanovich, Doctor of Physical and Mathematical Sciences, Professor, Academician of NAS RK, (Almaty, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=26530759900>

ABILMAGZHANOV Arlan Zainutallaevich, PhD in Chemistry, First Deputy Director General of JSC "Institute of Fuel, Catalysis and Electrochemistry named after D.V. Sokolsky", (Almaty, Kazakhstan), <https://www.scopus.com/authid/detail.uri?authorId=57197468109>

ACADEMIC JOURNAL OF PHYSICAL AND CHEMICAL SCIENCES.**ISSN 2518-1483 (Online), ISSN 2224-5227 (Print)**

Owner: «Central Asian Academic Research Center» LLP (Almaty).

The certificate of registration of a periodical printed publication in the Committee of Information of the Ministry of Information and Social Development of the Republic of Kazakhstan № **KZ93VPY00121157** issued **05.06.2025**Thematic scope: *physics and chemistry*.

Periodicity: 4 times a year.

<http://reports-science.kz/index.php/en/archive>

Бас редактор:

ЖҰРЫНОВ Мұрат Жұрыңұлы, химия ғылымдарының докторы, профессор, ҚР ҰҒА академигі, ҚР ҰҒА РҚБ президенті м.а., АҚ «Д.В. Сокольский атындағы Отын, катализ және электрохимия институтының» бас директоры (Алматы, Қазақстан) <https://www.scopus.com/authid/detail.uri?authorId=6602177960>

Редакция ұжымы:

ҚАЛИМОЛДАЕВ Мақсат Нұрәліұлы, физика-математика ғылымдарының докторы, профессор, ҚР ҰҒА академигі (Алматы, Қазақстан) <https://www.scopus.com/authid/detail.uri?authorId=56153126500>

ӘДЕКЕНОВ Серғазы Мыңжасарұлы, химия ғылымдарының докторы, профессор, ҚР ҰҒА академигі, «Фитохимия» халықаралық ғылыми-өндірістік холдингінің директоры (Қарағанды, Қазақстан) <https://www.scopus.com/authid/detail.uri?authorId=7006153118>

РАМАЗАНОВ Тілекқабұл Сәбитұлы, физика-математика ғылымдарының докторы, профессор, ҚР ҰҒА академигі, әл-Фараби атындағы Қазақ ұлттық университетінің ғылыми-инновациялық қызмет жөніндегі проректоры, (Алматы, Қазақстан) <https://www.scopus.com/authid/detail.uri?authorId=6701328029>

ӘБИЕВ Руфат, техника ғылымдарының докторы (биохимия), профессор, Санкт-Петербург мемлекеттік технологиялық институты «Химиялық және биотехнологиялық аппаратураны оңтайландыру» кафедрасының меңгерушісі, (Санкт-Петербург, Ресей) <https://www.scopus.com/authid/detail.uri?authorId=6602431781>

ОЛИВЬЕРО Росси Сезаре, PhD (химия), Калабрия университетінің профессоры (Калабрия, Италия) <https://www.scopus.com/authid/detail.uri?authorId=57221375979>

ТИГИНЯНУ Ион Михайлович, физика-математика ғылымдарының докторы, академик, Молдова Ғылым Академиясының президенті, Молдова техникалық университеті (Кишинев, Молдова) <https://www.scopus.com/authid/detail.uri?authorId=7006315935>

САНГ-СУ Квак, PhD (биохимия, агрохимия), профессор, Корея Биоғылым және биотехнология ғылыми-зерттеу институты (KRIBB), өсімдіктердің инженерлік жүйелері ғылыми-зерттеу орталығының бас ғылыми қызметкері, (Дэчон, Корея) <https://www.scopus.com/authid/detail.uri?authorId=59286321700>

БЕРСІМБАЕВ Рахметқажы Ескендірұлы, биология ғылымдарының докторы, профессор, ҚР ҰҒА академигі, Л.Н. Гумилев атындағы Еуразия ұлттық университеті. (Астана, Қазақстан) <https://www.scopus.com/authid/detail.uri?authorId=7004012398>

КАЛАНДРА Пьетро, PhD (физика), нанокүрылымды материалдарды зерттеу институтының профессоры (Рим, Италия) <https://www.scopus.com/authid/detail.uri?authorId=7004303066>

БОШКАЕВ Құнтай Ағвазыұлы, Ph.D. Теориялық және ядролық физика кафедрасының доценті, әл-Фараби атындағы Қазақ ұлттық университеті (Алматы, Қазақстан), <https://www.scopus.com/authid/detail.uri?authorId=54883880400>

Бүркітбаев Мұхамбетқали, химия ғылымдарының докторы, профессор, ҚР ҰҒА академигі, (Алматы, Қазақстан) <https://www.scopus.com/authid/detail.uri?authorId=8513885600>

QUEVEDO Hernando, профессор, Мексика ұлттық автономиялық университеті (UNAM), Ядролық ғылымдар институты (Мехико, Мексика), <https://www.scopus.com/authid/detail.uri?authorId=55989741100>

ЖҮСІПОВ Марат Абжанұлы, физика-математика ғылымдарының докторы, теориялық және ядролық физика кафедрасының профессоры, әл-Фараби атындағы Қазақ ұлттық университеті (Алматы, Қазақстан), <https://www.scopus.com/authid/detail.uri?authorId=6602166928>

КОВАЛЕВ Александр Михайлович, физика-математика ғылымдарының докторы, Украина ҰҒА академигі, Қолданбалы математика және механика институты (Донецк, Украина), <https://www.scopus.com/authid/detail.uri?authorId=7202799321>

ТАКИБАЕВ Нұрғали Жабағаұлы, физика-математика ғылымдарының докторы, профессор, ҚР ҰҒА академигі, әл-Фараби атындағы Қазақ ұлттық университеті (Алматы, Қазақстан), <https://www.scopus.com/authid/detail.uri?authorId=24077239000>

ХАРИН Станислав Николаевич, физика-математика ғылымдарының докторы, профессор, ҚР ҰҒА академигі, (Алматы, Қазақстан), <https://www.scopus.com/authid/detail.uri?authorId=6701353063>

ДАВЛЕТОВ Асқар Ербуланович, физика-математика ғылымдарының кандидаты, доцент, ҰЯЗУ МИФИ әл-Фараби атындағы Қазақ ұлттық университеті (Алматы, Қазақстан), <https://www.scopus.com/authid/detail.uri?authorId=6602642543>

ӘБІШЕВ Медеу Ержанұлы, физика-математика ғылымдарының докторы, профессор, ҚР ҰҒА академигі, (Алматы, Қазақстан) <https://www.scopus.com/authid/detail.uri?authorId=26530759900>

ӘБІЛМАҒЖАНОВ Арлан Зайнуталлаұлы, химия ғылымдарының кандидаты, Д.В. Сокольский атындағы "Отын, катализ және электрохимия институты" АҚ Бас директорының бірінші орынбасары, (Алматы, Қазақстан), <https://www.scopus.com/authid/detail.uri?authorId=57197468109>

ACADEMIC JOURNAL OF PHYSICAL AND CHEMICAL SCIENCES

ISSN 2518-1483 (Online), ISSN 2224-5227 (Print)

Меншіктеуші: «Орталық Азия академиялық ғылыми орталығы» ЖШС (Алматы қ.).

Ақпарат агенттігінің мерзімді баспасөз басылымын, ақпарат агенттігін және желілік басылымды қайта есепке қою туралы ҚР Мәдениет және Ақпарат министрлігі «Ақпарат комитеті» Республикалық мемлекеттік мекемесі **05.06.2025 ж.** берген № **KZ93VPY00121157** Күзлік.

Тақырыптық бағыты: *физика, химия.*

Мерзімділігі: жылына 4 рет.

<http://reports-science.kz/index.php/en/archive>

© «Орталық Азия академиялық ғылыми орталығы» ЖШС, 2025

Главный редактор:

ЖУРИНОВ Мурат Журинович, доктор химических наук, профессор, академик НАН РК, и.о. президента РОО НАН РК, Генеральный директор АО «Институт топлива, катализа и электрохимии им. Д.В. Сокольского» (Алматы, Казахстан) <https://www.scopus.com/authid/detail.uri?authorId=6602177960>

Редакционная коллегия:

КАЛИМОЛДАЕВ Максат Нурадилович, доктор физико-математических наук, профессор, академик НАН РК (Алматы, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=56153126500>

АДЕКЕНОВ Сергазы Мынжасарович, доктор химических наук, профессор, академик НАН РК, директор Международного научно-производственного холдинга «Фитохимия» (Караганда, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=7006153118>

РАМАЗАНОВ Тлеккабул Сабитович, (заместитель главного редактора), доктор физико-математических наук, профессор, академик НАН РК (Алматы, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=6701328029>

АБИЕВ Руфат, доктор технических наук (биохимия), профессор, заведующий кафедрой «Оптимизация химической и биотехнологической аппаратуры», Санкт-Петербургский государственный технологический институт (Санкт-Петербург, Россия), <https://www.scopus.com/authid/detail.uri?authorId=6602431781>

ОЛИВЬЕРО Росси Чезаре, доктор философии (PhD, химия), профессор Университета Калабрии (Калабрия, Италия), <https://www.scopus.com/authid/detail.uri?authorId=57221375979>

ТИГИНЯНУ Ион Михайлович, доктор физико-математических наук, академик, президент Академии наук Молдовы, Технический университет Молдовы (Кишинев, Молдова), <https://www.scopus.com/authid/detail.uri?authorId=7006315935>

САИГ-СУ Квак, доктор философии (PhD, биохимия, агрохимия), профессор, главный научный сотрудник, Научно-исследовательский центр инженерных систем растений, Корейский научно-исследовательский институт бионауки и биотехнологии (KRIBB), (Дэчон, Корея), <https://www.scopus.com/authid/detail.uri?authorId=59286321700>

БЕРСИМБАЕВ Рахметкажи Искендерович, доктор биологических наук, профессор, академик НАН РК, Евразийский национальный университет им. Л.Н. Гумилева (Астана, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=7004012398>

КАЛАНДРА Пьетро, доктор философии (PhD, физика), профессор Института по изучению наноструктурированных материалов (Рим, Италия), <https://www.scopus.com/authid/detail.uri?authorId=7004303066>

БОШКАЕВ Кунтайт Авгазыевич, PhD, преподаватель, доцент кафедры теоретической и ядерной физики, Казахский национальный университет им. аль-Фараби (Алматы, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=54883880400>

БҮРКИТБАЕВ Мухамбеткали, доктор химических наук, профессор, академик НАН РК, (Алматы, Казахстан) <https://www.scopus.com/authid/detail.uri?authorId=8513885600>

QUEVEDO Hernando, профессор, Национальный автономный университет Мексики (UNAM), Институт ядерных наук (Мехико, Мексика), <https://www.scopus.com/authid/detail.uri?authorId=55989741100>

ЖУСУПОВ Марат Абжанович, доктор физико-математических наук, профессор кафедры теоретической и ядерной физики, Казахский национальный университет им. аль-Фараби (Алматы, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=6602166928>

КОВАЛЕВ Александр Михайлович, доктор физико-математических наук, академик НАН Украины, Институт прикладной математики и механики (Донецк, Украина), <https://www.scopus.com/authid/detail.uri?authorId=7202799321>

ТАКИБАЕВ Нургали Жаббагаевич, доктор физико-математических наук, профессор, академик НАН РК, Казахский национальный университет им. аль-Фараби (Алматы, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=24077239000>

ХАРИН Станислав Николаевич, доктор физико-математических наук, профессор, академик НАН РК (Алматы, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=6701353063>

ДАВЛЕТОВ Аскар Ербуланович, кандидат физико-математических наук, доцент, Филиал НИЯУ МИФИ Казахский национальный университет им. аль-Фараби (Алматы, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=6602642543>

АБИШЕВ Медеу Ержанович, доктор физико-математических наук, профессор, академик НАН РК, (Алматы, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=26530759900>

АБИЛЬМАГЖАНОВ Арлан Зайнуталлаевич, кандидат химических наук, первый заместитель генерального директора АО «Институт топлива, катализа и электрохимии им. Д.В. Сокольского», (Алматы, Казахстан), <https://www.scopus.com/authid/detail.uri?authorId=57197468109>

ACADEMIC JOURNAL OF PHYSICAL AND CHEMICAL SCIENCES**ISSN 2518-1483 (Online), ISSN 2224-5227 (Print)**

Собственник: ТОО «Центрально-азиатский академический научный центр» (г. Алматы).

Свидетельство № **KZ93VPY00121157** о повторной регистрации периодического печатного издания информационного агентства, информационного агентства и сетевого издания, выданное Республиканским государственным учреждением «Комитет информации» Министерства культуры и информации Республики Казахстан **05.06.2025**

Тематическая направленность: *физика, химия*.

Периодичность: 4 раза в год.

<http://reports-science.kz/index.php/en/archive>

© ТОО «Центрально-азиатский академический научный центр», 2025

CONTENTS

PHYSICS

M.B. Albatyrova

Energy evolution equation in a nonlinear spin system: derivation and numerical modeling.....11

E.A. Dmitriyeva, A.E. Kemelbekova, A.K. Shongalova, O.A. Shilova

Effect of the precursor concentration on the morphology and photosensitivity of the resulting ZnO thin films.....21

A. Istlyaup, L. Myasnikova, A. Lushchik

Computer simulation of the electrical properties of a carbon sheet with alkali metal iodide crystals.....33

A. Kenesbayeva, Ye.I. Kuldeev, E.O. Shalenov, T.B. Nurpeissova

Determination of the gravitational constant.....49

Sh.T. Nurmakhmetova, N.L. Vaidman, S.A. Khokhlov, A.T. Agishev, A.A. Khokhlov

The emission-line dusty object IRAS 07080+0605: evidence for binarity.....60

E.Otunchi, A.A. Migunova, A.Umirzakov, N.Tokmoldin

Effect of the composition of the film-forming system on the properties of SnO₂ films obtained by spray pyrolysis.....71

U.A. Ualikhanova, A.N. Abdipatta, O.V. Razina, A.M. Syzdykova, G.S. Altayeva

Bulk viscosity in f(T) gravity and its impact on cosmological evolution.....83

A.Zh. Umirbayeva, L. Aktay, L.N. Kondratyeva, I.M. Izmailova, A. Shomshekova

Methodology for the reduction of archival slit spectra of planetary nebulae.....99

N. Eghtesadi, S.S. Uzakbaeva, Z.K. Aimaganbetova, N.N. Zhanturina, A.Z. Bekeshev

Prediction of the kinetic properties of low-density polyethylene.....115

D. Yurin, D. Kuvatova, A. Glushenko, Ch. Omarov, M. Makukov

Analysis of the limits of direct n-body simulation using Nvidia RTX4090 GPU cards.....131

CHEMISTRY

A.S. Beisenova, A.A. Zhanybekova, M.M. Duysebaeva, G.E. Berganaeva Study of the chemical composition of <i>Centaurea diffusa</i> Lam. growing in the territory of Almaty region.....	146
N.N. Berikbol, Zh.S. Kassymova, L.K. Orazzhanova, A.N. Klivenko, N.N. Nurgaliyev Synthesis of interpolyelectrolyte complexes from fluorescently labeled biopolymers.....	161
O.A.Yessimova, S.Sh. Kumargaliyeva, B.K. Musabekov, A.K. Konysbek Colloidal - chemical properties of alhagi and tansy (<i>tanacetum</i>) hydrolates.....	182
R.N. Zhanaliyeva, B. Imangaliyeva, B. Torsykbaeva, R. Kozykeyeva Catalytic hydrogenation of carbonyl-containing compounds: mechanism, catalysts and application.....	193
M.A. Zhumash, K. Tilegen, Y.A. Boleubayev, S.S. Itkulova Dry reforming of methane over the high active Co-Fe-Ir-containing alumina supported catalyst.....	207
M. Ibrayeva, N. Sagdollina, Zh. Mukazhanova, Sh. Sanyazova, M.Ozturk Optimization of flavonoid extraction conditions from a plant of the genus <i>Symphotrichum novi-belgii</i>	218
M.K. Kurmanaliev, Zh.E. Shaikhova, S.O. Abilkasova Supramolecular polymeric receptors for binding alkali metal ions.....	228
Y.A. Mussatay, M.I. Tulepov Carbon filters from rice husk for air purification in confined spaces.....	238
A.Zh. Mutushev, A.B. Seisenova, O.S. Kapizov, A.M. Nuraly, D.K. Mukhanov Integrated process for the synthesis of carbon–silicon nanocomposites from biowaste and metallurgical sludge.....	258
A.S. Sass, I.I. Torlopov, K.S. Rakhmetova, D.A. Zhumadullaev, M. Zhurinov Influence of metal surface mechanical preparation on the properties of phosphate coatings.....	274

МАЗМҰНЫ

ФИЗИКА

М.Б. Альбатырова

Сызықтық емес спиндік жүйедегі энергия эволюциясының теңдеуі:
шығарылуы және сандық модельдеу.....11

Е.А. Дмитриева, А.Е. Кемелбекова, А.Қ. Шонғалова, О.А. Шилова

Прекурсор концентрациясының алынған жұқа ZnO жабындарының
құрылымы мен фотосезімталдығына әсері.....21

**Н. Эхтесади, С.С. Узакбаева, З.К. Аймағанбетова, Н.Н. Жантурина,
А.З. Бекешев**

Төмен тығыздықтағы полиэтиленнің кинетикалық қасиеттеріне
болжау жасау.....33

А. Истляуп, Л. Мясникова, А. Лущик

Сілтілі металл иодидтерінің кристалдарымен көміртек қабатының
электрлік қасиеттерін компьютерлік модельдеу.....49

А. Кенесбаева, Е. Кульдеев, Е. Шаленов, Т. Нурпеисова

Гравитациялық тұрақтыны анықтау.....60

Ш.Т. Нурмахаметова, Н.Л. Вайдман, С.А. Хохлов, А.Т. Агишев, А.А. Хохлов

IRAS 07080+0605 эмиссиялық объекті: екіжұлдыздық жүйенің дәлелі.....71

Е. Отунчи, А.А. Мигунова, А.Г. Умирзаков, Н. Токмолдин

Жабын түзуші жүйе құрамының спрей-пиролиз әдісімен алынған
SnO₂ жабындарының қасиетіне әсері.....83

У.А. Уалиханова, А.Н. Әбдіпатта, О.В. Разина, А.М. Сыздыкова, Г.С. Алтаева

$f(T)$ гравитациясындағы көлемдік тұтқырлық және оның
космологиялық эволюцияға әсері.....99

**А.Ж. Умирбаева, Л. Актай, Л.Н. Кондратьева, И.М. Измайлова,
С.А. Шомшекова**

Планетарлық тұмандықтардың архивтік саңылаулы спектрлерін
өңдеу әдістемесі.....115

Д. Юрин, Д. Куватова, А. Глущенко, Ч. Омаров, М. Макуков

N-бөлшекті тікелей үлгілеудің шектерін Nvidia RTX 4090
GPU-карталарын пайдаланып талдау.....131

ХИМИЯ

А.С. Бейсенова, А.А. Жаныбекова, Г.Е. Берганаева, М.А. Дюсебаева Алматы облысының аумағында өсетін шашыңқы гүлкекіре <i>Centaurea diffusa lam.</i> өсімдігінің химиялық құрамын зерттеу.....	146
Н.Н. Берікбол, Ж.С. Касимова, Л.К. Оразжанова, А.Н. Кливенко, Н.Н. Нургалиев Флуоресцентті таңбаланған биополимерлерден интерполиэлектrolиттік комплексті синтездеу.....	161
О.А. Есимова, С.Ш. Құмарғалиева, К.Б. Мусабеков, А.Қ. Қонысбек Жантақ және түймешетен гидрولاتтарының коллоидтық-химиялық қасиеттері.....	182
Р.Н. Жаналиева, Б. Иманғалиева, Б.Б. Торсыкбаева, Р. Козыкеева, Р.Э. Ходжаназаров Құрамында карбонил бар қосылыстардың каталитикалық гидрогенизациясы: механизмі, катализаторлары және қолданылуы.....	193
М.А. Жұмаш, К.Т. Тілеген, Е.А. Болеубаев, Ш.С. Иткулова Алюминий тотығына қондырылған жоғары белсенді Co-Fe-Ir құрайтын катализатордағы метанның құрғақ риформингі.....	207
М. Ибраева, Н. Сағдоллина, Ж. Мукажанова, Ш. Санъязова, М. Ozturk <i>Symphyotrichum novi-belgii</i> тұқымдас өсімдіктен флавоноидтарды алу жағдайларын оңтайландыру.....	218
М.Қ. Құрманалиев, Ж.Е. Шаихова, С.О. Әбілқасова Сілтілік металл иондарын байланыстыруға арналған супрамолекулалық полимерлік рецепторлар.....	228
Е.А. Мұсатай, М.И. Тулепов Шағын кеңістіктегі ауаны тазартуға арналған күріш қауызы негізіндегі көміртек құрамды сүзгілер.....	238
А.Ж. Мутушев, А.Б. Сейсенова, Ө.С. Капизов, Ә.М. Нұралы, Д.К. Муханов Биоқалдықтар мен металлургиялық шламнан көміртек–кремний нанокomпозиттерін синтездеудің интеграцияланған әдісі.....	258
А.С. Сасс, И.И. Торлопов, К.С. Рахметова, Д.А. Жумадуллаев, М. Журинов Металдар бетін механикалық дайындаудың фосфатты жабындар қасиеттеріне әсері.....	274

СОДЕРЖАНИЕ

ФИЗИКА

М.Б. Альбатырова

Уравнение эволюции энергии в нелинейной спиновой системе:
вывод и численное моделирование.....11

Е.А. Дмитриева, А.Е. Кемелбекова, А.Қ. Шонғалова, О.А. Шилова

Влияние концентрации прекурсора на морфологию и фоточувствительность
получаемых тонких пленок ZnO.....21

А. Истляуп, Л. Мясникова, А. Лущик

Компьютерное моделирование электрических свойств углеродного листа
с кристаллами йодидов щелочных металлов.....33

А. Кенесбаева, Е. Кульдеев, Е. Шаленов, Т. Нурпеисова

Определение гравитационной постоянной.....49

Ш.Т. Нурмахаметова, Н.Л. Вайдман, С.А. Хохлов, А.Т. Агишев, А.А. Хохлов

Эмиссионный пылевой объект IRAS 07080+0605: доказательство двойной
природы.....60

Е. Отунчи, А.А. Мигунова, А.Г. Умирзаков, Н. Токмолдин

Влияние состава пленкообразующей системы на свойства пленок
SnO₂, полученных методом спрей-пиролиза.....71

У.А. Уалиханова, А.Н. Эбдіпатта, О.В. Разина, А.М. Сыздыкова, Г.С. Алтаева

Объемная вязкость в $f(T)$ гравитации и ее влияние
на космологическую эволюцию.....83

**А.Ж. Умирбаева, Л. Актай, Л.Н. Кондратьева, И.М. Измайлова,
С.А. Шомшекова**

Методика обработки архивных щелевых спектров планетарных туманностей...99

**Н. Эхтесади, С.С. Узакбаева, З.К. Аймаганбетова, Н.Н. Жантурина,
А.З. Бекешев**

Прогнозирование кинетических свойств полиэтилена низкой плотности.....115

Д. Юрин, Д. Куватова, А. Глущенко, Ч. Омаров, М. Макуков

Анализ пределов прямого моделирования n-тел с использованием
GPU-карт Nvidia RTX4090.....131

ХИМИЯ

А.С. Бейсенова, А.А. Жаныбекова, М.А. Дюсебаева, Г.Е. Берганаева Исследование химического состава василек раскидистый <i>Centaurea diffusa</i> Lam., растущий на территории Алматинской области.....	146
Н.Н. Берікбол, Ж.С. Касымова, Л.К. Оразжанова, А.Н. Кливенко, Н.Н. Нургалиев Синтез интерполиэлектrolитных комплексов на основе флуоресцентно-меченых биополимеров.....	161
О.А. Есимова, С.Ш. Кумаргалиева, К.Б. Мусабеков, А.Қ. Конысбек Коллоидно-химические свойства гидратов верблюжьей колючки и пижмы...182	182
Р.Н. Жаналиева, Б. Имангалиева, Б.Б. Торсыкбаева, Р. Козыкеева, Р.Э. Ходжаназаров Каталитическое гидрирование карбонилсодержащих соединений: механизм, катализаторы и применение.....	193
М.А. Жұмаш, К.Т. Тілеген, Е.А. Болеубаев, Ш.С. Иткулова Сухой риформинг метана на высокоактивном Co-Fe-Ir содержащем нанесенном на оксид алюминия катализаторе.....	207
М. Ибраева, Н. Сағдоллина, Ж. Мукажанова, Ш. Санъязова, М. Ozturk Оптимизация условий экстракции флавоноидов из растения рода <i>Symphotrichum novi-belgii</i>	218
М.К. Курманалиев, Ж.Е. Шаихова, С.О. Абилкасова Супрамолекулярные полимерные рецепторы для связывания ионов щелочных металлов.....	228
Е.А. Мұсатай, М.И. Тулепов Углеродные фильтры из рисовой шелухи для очистки воздуха в стесненных помещениях.....	238
А.Ж. Мутушев, А.Б. Сейсенова, О.С. Капизов, А.М. Нуралы, Д.К. Муханов Интегрированная технология получения углеродно-кремниевых нанокомпозитов из биоотходов и металлургических шламов.....	258
А.С. Сасс, И.И. Торлопов, К.С. Рахметова, Д.А. Жумадуллаев, М. Журинов Влияние механической подготовки поверхности металла на свойства фосфатных покрытий.....	274

© Sh.T. Nurmakhmetova¹, N.L. Vaidman^{1,2},
S.A. Khokhlov¹, A.T. Agishev¹, A.A. Khokhlov^{1*}, 2025.

¹ Faculty of Physics and Technology, Al-Farabi Kazakh National University,
Almaty, Kazakhstan;

² Fesenkov Astrophysical Institute, Almaty, Kazakhstan.
E-mail: kh.azamat92@gmail.com

THE EMISSION-LINE DUSTY OBJECT IRAS 07080+0605: EVIDENCE FOR BINARITY

Shakhida Tashmakhomedovna Nurmakhmetova — bachelor student, Al-Farabi Kazakh National University, Almaty, Kazakhstan,

E-mail: shahidanurmahametova@gmail.com, ORCID: <https://orcid.org/0009-0005-6851-7270>;

Nadezhda Leonidovna Vaidman — master in Physics and Astronomy, Al-Farabi Kazakh National University, Almaty, Kazakhstan,

E-mail: nvaldmann@gmail.com, ORCID ID: <http://orcid.org/0000-0002-7449-0108>;

Serik Anatolyevich Khokhlov — PhD, professor of the Department of Electronics and Astrophysics, Al-Farabi Kazakh National University, Almaty, Kazakhstan,

E-mail: skhokh88@gmail.com, ORCID ID: <http://orcid.org/0000-0001-5163-508X>;

Aldiyar Talgatovich Agishev — PhD, associate professor of the Department of Electronics and Astrophysics, Faculty of Physics and Technology, Al-Farabi Kazakh National University, Almaty, Kazakhstan,

E-mail: aldiyar.agishev@gmail.com, ORCID ID: <http://orcid.org/0000-0001-9788-7485>;

Azamat Anatolyevich Khokhlov — Senior Lecturer of the Department of Electronics and Astrophysics, Al-Farabi Kazakh National University, Almaty, Kazakhstan,

E-mail: kh.azamat92@gmail.com, ORCID ID: <http://orcid.org/0000-0001-6987-9058>.

Abstract. FS CMA-type stars are interacting binaries that show the B[e] phenomenon and strong infrared excess from dusty circumbinary material. We present a high-resolution spectroscopic study of IRAS 07080+0605 (A0–A1 II) to measure its orbital motion and test a common-envelope (CE) origin. Our dataset comprises 20 echelle spectra from FEROS, REOSC, Gecko, and ESPaDOnS ($R \approx 18\,000$ – $100\,000$; 3900 – $10\,150\text{ Å}$). Radial velocities were obtained via cross-correlation in IRAF/RVSAO; periodicities were identified with a Lomb–Scargle periodogram; orbital elements and their uncertainties were derived via Bayesian inference implemented with the MCMC method. We find a short-period solution with $P = 23.97 \pm 0.01$ days and a semi-amplitude $K_1 = 10.45 \pm 1.70\text{ km s}^{-1}$. The mass function together with literature constraints on M_1 and inclination from SED modeling, implies a low-luminosity secondary consistent

with a compact or low-mass main-sequence companion. The combination of a short orbital period and a persistent dusty disk is incompatible with a full AGB envelope and instead points to recent CE evolution that ejected the envelope and shrank the orbit to weeks. IRAS 07080+0605 thus emerges as a short-period FS CMa binary in a transitional post-AGB state, providing a benchmark for studying dust production and angular-momentum loss in non-conservative mass transfer and for testing CE-driven pathways to compact binaries.

Key words: spectroscopy; binary stars; B[e] stars; common envelope; stellar evolution; IRAS 07080+0605

***Acknowledgments.** This research was funded by the Committee on Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan (grant AP19175392 of the Ministry of Education and Science of the Republic of Kazakhstan).*

© Ш.Т. Нурмахаметова¹, Н.Л. Вайдман^{1,2}, С.А. Хохлов¹,
А.Т. Агишев¹, А.А. Хохлов¹, 2025.

¹ Физика-техникалық факультеті, Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан;

² Фесенков атындағы астрофизикалық институты, Алматы, Қазақстан.
E-mail: kh.azamat92@gmail.com

IRAS 07080+0605 ЭМИССИЯЛЫҚ ОБЪЕКТИ: ЕКІЖҰЛДЫЗДЫҚ ЖҮЙЕНІҢ ДӘЛЕЛІ

Шахида Ташмахомедовна Нурмахаметова — бакалавриат студенті, Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан,

E-mail: shahidanurmahametova@gmail.com, ORCID: <https://orcid.org/0009-0005-6851-7270>;

Надежда Леонидовна Вайдман — физика және астрономия магистрі, Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан,

E-mail: nvaldmann@gmail.com, ORCID ID: <http://orcid.org/0000-0002-7449-0108>;

Серик Анатольевич Хохлов — PhD, электроника және астрофизика кафедрасының профессоры, Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан,

E-mail: skhokh88@gmail.com, ORCID ID: <http://orcid.org/0000-0001-5163-508X>;

Алдияр Талгатович Агишев — PhD, электроника және астрофизика кафедрасының доценті, Физика-техникалық факультет, Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан,
E-mail: aldiyar.agishev@gmail.com, ORCID ID: <http://orcid.org/0000-0001-9788-7485>;

Азамат Анатольевич Хохлов — Электроника және астрофизика кафедрасының аға оқытушысы, Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан,
E-mail: kh.azamat92@gmail.com, ORCID ID: <http://orcid.org/0000-0001-6987-9058>.

Аннотация. FS CMa типті жұлдыздар — B[e] феномені мен шаңды циркумбинарлық ортадан туындайтын күшті инфрақызыл артығы бар өзара әрекеттесетін қос жұлдыздар. Біз IRAS 07080+0605 (A0–A1 II) нысанына жоғары айырымды спектроскопиялық зерттеу ұсынамыз, оның мақсаты — орбиталық қозғалысын өлшеу және жалпы қабық (CE) сценарийін тексеру.



Мәліметтер жиыны FEROS, REOSC, Gecko және ESPaDOnS құралдарымен алынған 20 эшелле-спектрден тұрады ($R \approx 18\,000\text{--}100\,000$; $3900\text{--}10\,150\text{ \AA}$). Сәулелік жылдамдықтар IRAF/RVSAO ортасындағы кросс-корреляция әдісімен анықталды; периодтылықтар Ломб–Скаргла периодогаммасымен табылды; орбиталық элементтер мен олардың белгісіздіктері Байесдік қорытындылау арқылы, MCMC әдісімен алынды. Қысқапериодты шешім алынды $P = 23.97 \pm 0.01$ тәулік және жарты амплитудасы $K1 = 10.45 \pm 1.70\text{ км с}^{-1}$. Массалық функция, әдебиеттегі M1 шектеулері және SED-модельдеуден алынған орбита еңкеюімен бірге, төмен жарқыраулы екінші компонентті меңзейді; ол ықтимал компакт объекті немесе аз массалы бас тізбек жұлдызына сай келеді. Қысқа период пен тұрақты шаңды дискінің қатар байқалуы толық AGB қабығын сақтаумен сыйыспайды және, керісінше, жақында өткен жалпы қабық кезеңін, онда жұлдыз қабығы тасталып, орбита апталар шамасындағы периодтарға дейін қысқарғанын көрсетеді. Осылайша IRAS 07080+0605 өтпелі post-AGB күйіндегі қысқапериодты FS CMa жүйесі ретінде көрінеді және масса беруінің неконсервативті режимінде шаң түзілуі мен бұрыштық импульс жоғалуын, сондай-ақ SE-мен қалыптасатын компакт қос жүйелердің эволюциялық жолдарын зерттеуге үлгі нысан болып табылады.

Түйін сөздер: қос жұлдыздар, B[e] жұлдыздары, жалпы қабық, жұлдыздардың эволюциясы, IRAS 07080+0605

© Ш.Т. Нурмахаметова¹, Н.Л. Вайдман^{1,2}, С.А. Хохлов¹,
А.Т. Агишев¹, А.А. Хохлов¹, 2025.

¹ Физико-технический факультет, Казахский национальный университет имени аль-Фараби, Алматы, Казахстан;

² Астрофизический институт имени Фесенкова, Алматы, Казахстан.
E-mail: kh.azamat92@gmail.com

ЭМИССИОННЫЙ ПЫЛЕВОЙ ОБЪЕКТ IRAS 07080+0605: ДОКАЗАТЕЛЬСТВО ДВОЙНОЙ ПРИРОДЫ

Шахида Ташмахомедовна Нурмахаметова — студент бакалавриата, Казахский национальный университет имени аль-Фараби, Алматы, Казахстан,

E-mail: shahidanurmahametova@gmail.com, ORCID: <https://orcid.org/0009-0005-6851-7270>;

Надежда Леонидовна Вайдман — магистр физики и астрономии, Казахский национальный университет имени аль-Фараби, Алматы, Казахстан,

E-mail: nvaldmann@gmail.com, ORCID ID: <http://orcid.org/0000-0002-7449-0108>;

Серик Анатольевич Хохлов — PhD, профессор кафедры электроники и астрофизики, Казахский национальный университет имени аль-Фараби, Алматы, Казахстан,

E-mail: skhokh88@gmail.com, ORCID ID: <http://orcid.org/0000-0001-5163-508X>;

Алдияр Талгатович Агишев — PhD, доцент кафедры электроники и астрофизики, факультет физики и технологий, Казахский национальный университет имени аль-Фараби, Алматы, Казахстан,
E-mail: aldiyar.agishev@gmail.com, ORCID ID: <http://orcid.org/0000-0001-9788-7485>;

Азамат Анатольевич Хохлов — старший преподаватель кафедры электроники и астрофизики, Казахский национальный университет имени аль-Фараби, Алматы, Казахстан,
E-mail: kh.azamat92@gmail.com, ORCID ID: <http://orcid.org/0000-0001-6987-9058>.

Аннотация. Звезды типа FS CMa – это взаимодействующие двойные системы, демонстрирующие феномен B[e] и выраженный инфракрасный избыток от пылевого циркум бинарного вещества. Мы представляем высококачественное спектроскопическое исследование IRAS 07080+0605 (A0–A1 II) с целью измерения её орбитального движения и проверки сценария общей оболочки (CE). Набор данных включает 20 эшелле-спектров, полученных на FEROS, REOSC, Gecko и ESPaDOnS ($R \approx 18\,000\text{--}100\,000$; $3900\text{--}10\,150\text{ \AA}$). Лучевые скорости определены методом кросс-корреляции в IRAF/RVSAO; периодичности выявлены периодограммой Ломба–Скаргла; орбитальные элементы и их неопределенности получены через байесовскую статистику, реализованную через метод MCMC. Найдено короткопериодическое решение с $P = 23.97 \pm 0.01$ суток и полуамплитудой $K_1 = 10.45 \pm 1.70\text{ км } \times \text{с}^{-1}$. Функция масс в сочетании с литературными ограничениями на M1 и наклон орбиты из SED-моделирования указывает на вторичную компоненту, с низкой светимостью, совместимую с компактным объектом или маломассивной звездой главной последовательности. Сочетание короткого периода и устойчивого пылевого диска несовместимо с сохраненной полной AGB-оболочкой и, напротив, указывает на недавнюю фазу общей оболочки, во время которой оболочка была сброшена, а орбита сократилась до периодов порядка недель. IRAS 07080+0605 тем самым предстает короткопериодной FS CMa-системой на переходной пост-AGB стадии и служит ориентиром для изучения пылеобразования и потерь углового момента при неконсервативной передаче массы, а также для проверки CE-управляемых путей формирования компактных двойных.

Ключевые слова: спектроскопия; двойные звезды; B[e]-звезды; общая оболочка; эволюция звёзд; IRAS 07080+0605

Introduction. The FS CMa-type objects demonstrate features of the B[e] phenomenon (presence of forbidden emission lines and IR excess). These stars were singled out as a separate new group by Prof. Miroshnichenko (2007). A leading hypothesis of the nature of the FS CMa objects are binary evolution with non conservative mass transfer, according to the confirmed results of the analysis (Miroshnichenko et al., 2023).

IRAS 07080+0605 is an emission-line star that was first noted in an H α survey by Kohoutek & Wehmeyer (1999). It was later classified as an FS CMa-type star by Miroshnichenko et al. (2007) based on its prominent B[e] characteristics, including strong permitted (e.g. H I, Fe II) and forbidden (e.g. [O I], [Ca II]) emission lines and a significant infrared excess. Classified as approximately A0-A1: II (Condori, 2019), it has attracted considerable attention in the context of stellar evolution due to its distinctive characteristics. IRAS 07080+0605 shows pronounced emission lines and a strong infrared excess similar to that seen in FS CMa stars. The dust component consists of carbonaceous compounds rather than silicates, which distinguishes the object from classical B[e] stars. However, its exact evolutionary status remains uncertain. Previous observations by Khokhlov (2022) made it possible to determine the object's basic

physical parameters, detect photometric variability with cyclic changes in brightness, and rule out a young stellar nature. Moreover, a number of its properties resemble those of the well-known binary system Red Rectangle, which possesses a developed dusty disk. This similarity has prompted the hypothesis that IRAS 07080+0605 could represent an earlier evolutionary stage of objects like the Red Rectangle. IRAS 07080+0605 is characterized by the fundamental parameters $T_{\text{eff}} = 8500 \text{ K} \pm 500 \text{ K}$, $\log g = 2.0$, and $L = 216 L_{\odot}$, with a corresponding radius of $R = 6.8 R_{\odot}$. Parameters were determined through synthetic spectrum modeling using SPECTRUM. The resulting spectrum demonstrates a high degree of agreement with the observed data, confirming the reliability of these estimates (Khokhlov et al., 2022).

The present study aims to further investigate IRAS 07080+0605, particularly by determining its orbital parameters, estimating the mass of the secondary component. These objectives will help deepen our understanding of how stars in close binary systems interact and how such processes contribute to dust production in our Galaxy. The new insights gained from this object may also shed light on the broader class of B[e] stars and their significant role in stellar evolution.

Methods and materials. Before any quantitative analysis, all spectra underwent standard preliminary reduction procedures using the IRAF environment. The reduction included continuum normalization, cosmic ray removal, and correction for instrumental effects. These steps ensured spectral consistency across different epochs and improved the reliability of subsequent radial velocity (RV) determinations.

To derive the RV of the stellar component, we employed the cross-correlation method, which identifies the Doppler shift between an observed spectrum and a reference template by maximizing their similarity. We used 20 high-resolution optical spectra of IRAS 07080+0605 obtained with FEROS at ESO ($R = 48,000$), REOSC at SPM ($R = 18,000$), and Gecko and ESPaDOnS at CFHT ($R = 100,000$ and $65,000$). The spectral range spans $3900\text{--}10150 \text{ \AA}$. The analysis was carried out using the *xciao* task from the RVSAO package (Mink, 1998) within IRAF. This task computes the cross-correlation function (CCF) between a target and a reference spectrum, locates its peak, and determines the wavelength shift $\Delta\lambda$. The resulting shift is then converted into a RV using the Doppler formula. As a template, we selected one of the highest-quality spectra from our dataset to ensure consistency in line profiles and instrumental characteristics. Additionally, *xciao* provides formal errors in the measured velocities based on the peak's sharpness and symmetry.

The resulting RV measurements, obtained at multiple epochs, were used to characterize the orbital motion of the system. Assuming Keplerian motion, the RV curve was approximated by the standard model:

$$V_r = \gamma + K \cdot (\cos(v + \omega) + e \cdot \cos\omega) \quad (1)$$

Where V_r is the RV, K is the RV semi-amplitude, v is the true anomaly, e is the orbital eccentricity, and ω is the argument of periastron. In the special case of a circular orbit

($e = 0$), this expression reduces to a simple sinusoidal function dependent on the orbital phase.

To investigate the periodic behavior of the RV variations and spectral line shifts, we applied a Lomb–Scargle periodogram analysis. This technique is particularly well-suited for unevenly spaced observational data, such as those commonly found in ground-based spectroscopic monitoring campaigns. The Lomb–Scargle periodogram is particularly well-suited for the analysis of unevenly sampled time series, as it preserves the native temporal structure of the data without requiring resampling or interpolation (Scargle, 1982). Its formulation enables the robust detection of sinusoidal or quasi-periodic signals, even in datasets affected by observational gaps or substantial noise. Using this method, we identified the dominant frequency in the RV data, corresponding to the orbital period of the binary system. The derived period was adopted as an input parameter in the final orbital model fitting, described further below.

To determine the orbital parameters of the binary system IRAS 07080+0605, we developed a specialized Python-based software framework designed for the analysis of RV measurements obtained over multiple epochs. The framework integrates several widely used scientific libraries: NumPy (1.26.4) for numerical computations, Pandas (2.0.3) for structured data processing, Matplotlib (3.8.4) for visualization, and scipy.optimize (1.13.0) for nonlinear least-squares fitting. For statistical inference and uncertainty estimation, we employed the emcee package, which implements the affine-invariant ensemble sampler for Markov Chain Monte Carlo (MCMC) analysis (Foreman et al., 2013).

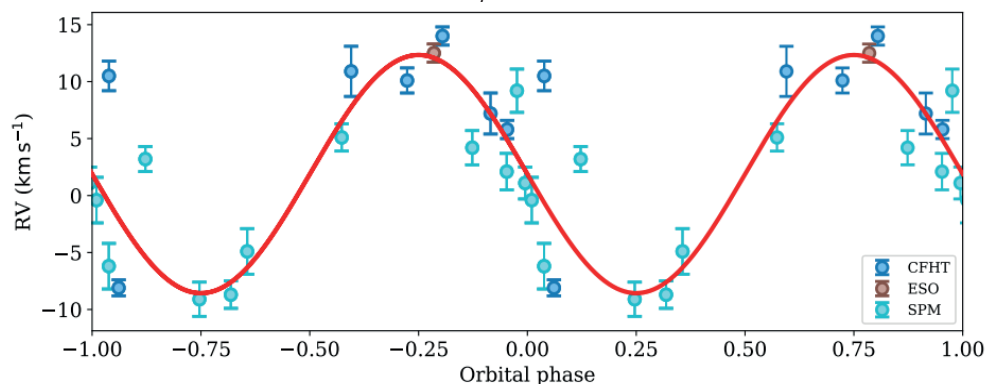
The analysis was carried out in two primary stages. First, we performed a nonlinear least-squares fit using scipy.optimize to obtain initial estimates for the orbital period (P), systemic velocity (γ), and RV semi-amplitude (K). These preliminary values served as starting points for the MCMC procedure. To refine parameter estimates and rigorously assess their uncertainties, we adopted a Bayesian framework using emcee. The posterior probability distribution was constructed as the product of a Gaussian likelihood function—assuming normally distributed observational errors—and physically motivated priors. We adopted uniform priors within plausible bounds based on initial fits and physical constraints (e.g., positive semi-amplitudes and periods). The MCMC sampler was initialized with multiple walkers and run for a sufficiently large number of iterations to ensure convergence and adequate sampling of the posterior.

Once the orbital period was established, observational epochs were converted into orbital phases. We constructed the phase-folded RV curve and overlaid the best-fit model to evaluate the quality of the solution. The reference phase (zero-point) was defined at time T_0 , corresponding to the point where the RV crosses the systemic velocity from above—facilitating comparison with theoretical predictions and analogous systems.

This methodology provides a consistent and statistically robust determination of the orbital parameters P , γ , K , and T_0 , along with credible uncertainty estimates. These results lay the groundwork for subsequent dynamical modeling and interpretation of the system’s evolutionary stage.

Results. To characterize the orbital motion of IRAS 07080+0605, we constructed a RV curve using the measured velocities and corresponding heliocentric Julian dates (HJD) obtained from our spectroscopic dataset. The RV points were plotted as a function of orbital phase, calculated based on the period derived from the Lomb–Scargle periodogram analysis. This resulting phase-folded RV curve is shown in Fig. 1.

Figure - 1. RV variations based on spectral line measurements. The red curve folded with the best-fit orbital period.



Based on the inclination angle of $i = 79^\circ$ and the primary component's mass of approximately $3 \pm 0.2 M_\odot$, both derived from spectral energy distribution (SED) modeling (Khokhlov et al., 2022), the mass of the secondary component was estimated using the standard mass function. For the adopted inclination, the resulting mass is $0.327 \pm 0.020 M_\odot$ (Fig. 2). The primary mass value accounts for luminosity attenuation caused by circumstellar dust, which also explains the observed significant optical dimming and the infrared excess due to dust re-emission.

Table №1 - Comparison of orbital parameters

	Elements	Value
1	P (days)	23.97 ± 0.01
2	T_0 (HJD)	3376.45 ± 0.70
3	γ (km $\times$ s $^{-1}$)	1.89 ± 1.47
4	K_1 (km $\times$ s $^{-1}$)	10.45 ± 1.70
5	$f(m)$, $M_\odot$	0.003 ± 0.002
6	N	20

Parameters listed are as follows (line number): 1—orbital period, 2—periastron (elliptical) or superior conjunction (circular), HJD – 2,450,000., 3—systemic velocity, 4—semi-amplitude of the RV variation of the visible component, 5—mass function, and 6—number of spectra used in the orbit calculation.

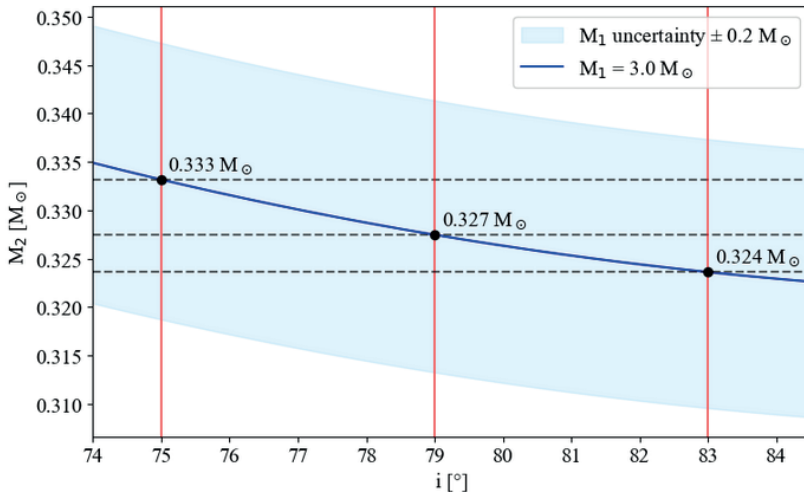
This estimated companion mass suggests that the system likely contains a compact object, such as a low-mass main-sequence star, a white dwarf, or another degenerate

companion. Importantly, to assess the robustness of this estimate, we considered a range of inclination angles, varying it within $i = 79 \pm 4^\circ$. This range reflects the uncertainty associated with the disk inclination derived from SED fitting and directly affects the derived secondary mass. When recalculating the mass function over this interval, the secondary mass was found to vary between approximately 0.31 and $0.35 M_\odot$, which still excludes a luminous companion and reinforces the interpretation that the secondary is a compact, low-luminosity object.

Furthermore, no spectral signatures attributable to a secondary component were detected in the optical spectrum, lending additional support to the scenario of a faint or degenerate companion. If the secondary were a luminous giant or an intermediate-mass star, its spectral contribution would likely be detectable in high-resolution spectra or manifest in significant photometric variability inconsistent with the observed light curve.

Taken together, the derived mass function, the inclination constraints from SED fitting, and the spectroscopic non-detection of the secondary all converge toward a consistent picture in which the companion is a low-mass, compact object. These findings are consistent with expectations for post-common-envelope binaries, where a substantial portion of the envelope mass has been lost and the secondary star remains in a tight orbit following the interaction.

Figure - 2. Secondary mass M_2 as a function of orbital inclination i for the IRAS 07080+0605.



Dependence of the secondary mass M_2 on the orbital inclination angle i (Fig. 2), assuming a fixed primary mass of $M_1 = 3.0 M_\odot$ and an observed mass function $f(m) = 0.003 M_\odot$. The solid blue curve represents the best-fit solution for M_2 , while the light blue shaded region corresponds to the uncertainty caused by $\pm 0.2 M_\odot$ variation in M_1 . Vertical red dashed lines indicate selected inclination angles (75° , 79° , and 83°) used for comparison.

IRAS 07080+0605 is considered a system transitioning towards the post-AGB phase. Our analysis of RV has revealed an orbital period of ~ 24 days, which is significantly shorter than the typical orbital periods observed in most post-AGB binary systems, which usually range from several hundred to several thousand days (Bollen et al., 2022; Kluska et al., 2022).

Such a compact orbit is too small to accommodate a fully expanded AGB star, implying that the primary's envelope was shed during a CE phase. In a CE event, a companion is engulfed by the giant's extended envelope, and the two cores spiral inward while orbiting inside a single envelope. Dynamical friction (drag forces) within the envelope transfers orbital energy and angular momentum from the binary's orbit to the envelope gas. This process leads to a rapid orbital decay: the released orbital energy heats and accelerates the envelope. If sufficient energy and momentum are deposited to overcome the envelope's binding energy, the envelope is ejected, leaving behind a close binary system; otherwise the two stars may merge. (Ropce et al., 2022).

In the case of IRAS 07080+0605, the observed ~ 24 -day orbit and low radial-velocity amplitude (only $\sim 10 \text{ km s}^{-1}$) indicate the presence of a low-mass secondary star that likely survived the spiral-in phase within a common-envelope interaction. The drastic shrinkage from a giant-star radius separation down to an orbit of only $\sim 0.2 \text{ AU}$ strongly suggests a common-envelope ejection as the mechanism for forming this close pair (Oomen et al., 2018; Izzard et al., 2012).

During the CE phase, the expanding envelope of the AGB star engulfs its close companion, and intense drag forces within the shared envelope cause the companion to spiral inward. As a result, orbital energy and angular momentum are transferred to the envelope gas, leading to a dramatic reduction in orbital separation. This process lays the groundwork for the formation of compact binaries with short-period orbits of only a few days (Izzard et al., 2012), as well as close pairs of white dwarfs, neutron stars, X-ray binaries, and other compact systems (Webbink, 2007; Ropce et al., 2022). CE evolution is considered one of the most important yet least understood processes that determine the formation of close pairs of compact objects (Ivanova, 2011).

Discussion. IRAS 07080+0605 appears to be an unusual post-AGB object in that its orbital period ($\sim 24 \text{ d}$) is extremely short compared to most known post-AGB binaries. In contrast, binaries that do pass through a common envelope typically end up with periods of only a few days (Oomen et al., 2018). For example, many close binary central stars of planetary nebulae (the products of CE ejection on the AGB) have orbital periods of hours to days. Surveys of planetary nebula nuclei in the Galactic bulge show a clustering of periods shorter than 1 day, with a tail up to a few days – these systems are essentially the lower-mass analogues of IRAS 07080+0605, where the primary has already become a hot white dwarf core. A notable case is the binary core of the PN Hen 2-428, which has a period of only 0.17 days and is believed to be a double-degenerate system formed via CE evolution (Miszalski et al., 2009).

According to classical models (Webbink, 2007), when a companion spirals into the envelope of a red giant or AGB star, orbital energy and angular momentum are transferred

to the envelope. If the deposited energy exceeds the envelope's binding energy, it may become unbound and ejected from the system, forming either a wide outflow or a bound equatorial disk — the latter often seen in systems like IRAS 07080+0605. The presence of such a bound disk, as opposed to a freely expanding outflow, serves as additional evidence supporting a common-envelope evolution scenario in this system.

Recent 3D hydrodynamic simulations (Ricker et al., 2012) support this scenario. They demonstrate that CE interactions can naturally produce post-AGB binaries with short-period orbits on the order of 0.2–1 AU, surrounded by residual disk-like structures, especially when the ejection is asymmetric. Post-AGB stars still burning helium (or hydrogen) in a shell, like IRAS 07080+0605, are rarely seen with periods as short as a few tens of days because they evolve quickly: after envelope ejection, the core contracts and heats up to become a planetary nebula nucleus on timescales of 1000–10000 years. The properties of IRAS 07080+0605 (B[e]-type emission, a dusty disk) point to an object that has recently shed its envelope and has not yet fully heated up.

Another noteworthy analog is HD 101584, a binary system that underwent a premature termination of its giant phase. ALMA observations of HD 101584 reveal a complex bipolar and equatorial outflow structure; this is interpreted as the result of a common-envelope ejection that halted just before merger, leaving a subgiant core and a companion with a circumbinary nebula. The estimated kinematic age of the outflows is approximately 770 years (assuming a distance of 1 kpc), suggesting that the envelope ejection occurred relatively recently. This timescale supports the interpretation of HD 101584 as a system caught in a transitional post-common-envelope phase (Olofsson et al., 2019). HD 101584 thus provides rare direct evidence of a common-envelope interaction caught in progress, where the anisotropic envelope ejection was likely driven by a spiral-in companion. Such dynamics are highly consistent with the morphology and orbital configuration inferred for IRAS 07080+0605, suggesting that it too may represent an outcome of an incomplete or stalled CE phase. These examples reinforce the interpretation that short-period binaries like IRAS 07080+0605 are best understood as post-common-envelope systems – analogous to close binary central stars of planetary nebulae, but observed at an earlier evolutionary stage.

Conclusion. Our study of IRAS 07080+0605 reveals a remarkable example of a binary star emerging from an episode of strong binary interaction. The object is characterized by an A-type luminous component embedded in a dusty circumstellar disk, and a close companion in a ~ 24 -day orbit. It exhibits significant dust-driven variability (190-day quasi-cycle) and shows evidence of substantial extinction along the line of sight. Notably, IRAS 07080+0605 does not show the heavy-element depletion seen in many post-AGB binaries with dusty disks (no evidence of the photospheric metal deficiency that is common in evolved post-AGB stars), and no extended nebula is detected around the system. These findings suggest that while the star has left AGB, it has undergone a different evolutionary pathway than the canonical stable post-AGB mass transfer scenario.

We propose that IRAS 07080+0605's properties can be consistently explained by a

recent CE event in this binary system. The short orbital period and presence of a compact circumbinary envelope are consistent with a common-envelope ejection scenario, wherein the primary star's envelope was shed as the companion spiraled inward. This process would naturally produce a tight binary remnant with a period of only a few weeks, as observed, and can account for the formation of the dust-rich circumbinary disk. Our interpretation aligns with theoretical expectations and other studies of CE evolution: a common-envelope phase is expected to create close binaries out of initially wider systems, leaving behind two stellar cores in a tight orbit. In the case of IRAS 07080+0605, the primary star appears to be on the cusp of the post-AGB stage, having had its evolution truncated by the CE event before it could develop a typical extended planetary nebula. This system thereby bridges the gap between classical post-AGB binaries with long-period orbits and the close binary central stars of planetary nebulae that result from common-envelope interactions.

In summary, the evidence points toward IRAS 07080+0605 being a post-common-envelope binary system. Although the common-envelope phase in this system cannot be confirmed with certainty, the available evidence – including orbital characteristics and analogies with other post-interaction binaries – is consistent with such a scenario. Continued observations and modeling efforts will be essential to evaluate this possibility further. IRAS 07080+0605 stands out as a promising system for probing the dynamics of binary interaction and post-AGB evolution.

References

- Miroshnichenko A.S., Manset N., Kusakin A.V., Chentsov E.L., Klochkova V.G., Zharikov S.V., Gray R.O., Grankin K.N., Gandet T.L. & Bjorkman K.S. (2007) Toward understanding the B[e] phenomenon. II. New Galactic FS CMa stars. *The Astrophysical Journal*, 671. — 828 p. DOI: 10.1086/523094 (in English)
- Miroshnichenko A.S., Chari R., Danford S., Prendergast P., Aarnio A.N., Andronov I.L., Chinarova L.L., Lytle A., Amantayeva A., Gabitova I.A. & others. (2023) Searching for phase-locked variations of the emission-line profiles in binary Be stars. *Galaxies*, 11(4), 83. DOI: 10.3390/galaxies11040083 (in English)
- Kohoutek L. & Wehmeyer R. (1999) Catalogue of H-alpha emission stars in the Northern Milky Way. *Astronomy and Astrophysics Supplement Series*, 134(2). — P. 255–256. DOI: 10.1051/aas:1999101 (in English)
- Condori C.A.H., Fernandes M.B., Kraus M., Panoglou D. & Guerrero C.A. (2019) The study of unclassified B[e] stars and candidates in the Galaxy and Magellanic Clouds. *Monthly Notices of the Royal Astronomical Society*, 488. — P. 1090–1110. DOI: 10.1093/mnras/stz1540 (in English)
- Khokhlov S.A., Miroshnichenko A.S., Zharikov S.V., Grankin K.N., Zakhozay O.V., Manset N., Arkharov A.A., Efimova N., Klimanov S., Larionov V.M. & others. (2022) Toward understanding the B[e] phenomenon. VIII. Nature and variability of IRAS 07080+0605. *The Astrophysical Journal*, 932. — 13 p. DOI: 10.3847/1538-4357/ac6de0 (in English).
- Mink J.D. & Kurtz M. (1998) RVSAO 2.0: Digital redshifts and radial velocities. *Publications of the Astronomical Society of the Pacific*, 110. — 934 p. DOI: 10.1086/316207 (in English).
- Scargle J.D. (1982) Studies in astronomical time series analysis. II. Statistical aspects of spectral analysis of unevenly spaced data. *The Astrophysical Journal*, 263. — P. 835–853. DOI: 10.1086/160554 (in English).
- Foreman-Mackey D., Hogg D.W., Lang D. & Goodman J. (2013) emcee: The MCMC hammer. *Publications of the Astronomical Society of the Pacific*, 125, 306. DOI: 10.1086/670067 (in English).
- Bollen D., Kamath D., Van Winckel H., De Marco O., Verhamme O., Kluska J. & Wardle M. (2022) The structure of jets launched from post-AGB binary systems. *Astronomy & Astrophysics*, 666, A40. DOI: 10.1051/0004-6361/202243429 (in English).

Kluska J., Van Winckel H., Coppée Q., Oomen G.M., Dsilva K., Kamath D., Bujarrabal V. & Min M. (2022) A population of transition disks around evolved stars: Fingerprints of planets. Catalog of disks surrounding Galactic post-AGB binaries. *Astronomy & Astrophysics*, 658, A36. DOI: 10.1051/0004-6361/202141690 (in English).

Roepke F.K. & De Marco O. (2022) Simulations of common-envelope evolution in binary stellar systems: Physical models and numerical techniques. DOI: 10.48550/arXiv.2212.07308 (in English).

Oomen G.M., Van Winckel H., Pols O., Nelemans G., Escorza A., Manick R., Kamath D. & Waelkens C. (2018) Orbital properties of binary post-AGB stars. *Astronomy & Astrophysics*, 620, A85. DOI: 10.1051/0004-6361/201833816 (in Eng).

Izzard R.G., Hall P.D., Tauris T.M. & Tout C.A. (2011) Common envelope evolution. In: Manchado A., Stanghellini L. & Schönberner D. (Eds.), *Planetary Nebulae: An Eye to the Future*, IAU Symposium No. 283, International Astronomical Union. — P. 95–102. DOI: 10.1017/S1743921312010769 (in English).

Webbink R.F. (2007) Common envelope evolution redux. Springer, arXiv:0704.0280. DOI: 10.48550/arXiv.0704.0280 (in English).

Ivanova N. (2011) Common envelope: The progress and the pitfalls. ASP Conference Series, arXiv:1108.1226. DOI: 10.48550/arXiv.1108.1226 (in English).

Miszalski B., Acker A., Moffat A.F.J., Parker Q.A. & Udalski A. (2009). Binary planetary nebula nuclei towards the Galactic bulge. I. Sample discovery, period distribution, and binary fraction. *Astronomy & Astrophysics*, 496(3). — P. 813–825. DOI: 10.1051/0004-6361/200811380 (in English).

Ricker P.M. & Taam R.E. (2012) An AMR study of the common envelope phase of binary evolution. *The Astrophysical Journal*, 746(1). — 74 p. DOI: 10.1088/0004-637X/746/1/74 (in English).

Olofsson H., Khouri T., Maercker M., Bergman P., Doan L., Tafoya D., Vlemmings W.H.T., Black J.H., Justtanont K., Lindqvist M. & Ramstedt S. (2019) HD 101584: Circumstellar characteristics and evolutionary status. *Astronomy & Astrophysics*. — 623 p, A153. DOI: 10.1051/0004-6361/201834897 (in English).

Publication Ethics and Publication Malpractice in the journals of the Central Asian Academic Research Center LLP

For information on Ethics in publishing and Ethical guidelines for journal publication see <http://www.elsevier.com/publishingethics> and <http://www.elsevier.com/journal-authors/ethics>.

Submission of an article to the journals of the Central Asian Academic Research Center LLP implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see <http://www.elsevier.com/postingpolicy>), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The Central Asian Academic Research Center LLP follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the Cross Check originality detection service <http://www.elsevier.com/editors/plagdetect>.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the Central Asian Academic Research Center LLP.

The Editorial Board of the Central Asian Academic Research Center LLP will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайте:

www.nauka-nanrk.kz

ISSN 2518-1483 (Online), ISSN 2224-5227 (Print)

<http://reports-science.kz/index.php/en/archive>

Ответственный редактор *А. Ботанқызы*

Редакторы: *Д.С. Аленов, Т. Апендиев*

Верстка на компьютере *Г.Д. Жадырановой*

Подписано в печать 3.09.2025.

Формат 60x88¹/₈.

18,0 п.л. Заказ 3.

«Central Asian Academic Research Center» LLP

Алматы, Қонаев к-сі, 142