# Few-Body Systems Group (DTAN Sector 3) at BLTP, JINR

# 2018 Annual Activity Report

## Содержание

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# 2 Main results

Исследовано туннелирование двух взаимодействующих атомов сквозь барьеры ангармонической ловушки. Данная система рассматривается в эксперименте, в Гайдельберге, по двум ультрахолодным атомам лития-6 во внешней дипольной оптической ловушке и градиенте магнитного поля. Нами изучены распады с возбужденных состояний и была обнаружена немонотонная зависимость скорости распада от константы межатомной связи. Также вычислены энергетический спектр начальных состояний, потоки вероятности и динамика частичных и полных вероятностей. Обнаружено условие для перехода от последовательного туннелирования к парному туннелированию [II].

Tunneling of two interacting atoms through anharmonic trap barriers is explored. Such a system is considered in an experiment, in Heidelberg, on two ultracold atoms of lithium-6 subject to an external dipole trap and a magnetic-field gradient. We investigate decays from excited states and find a non-monotonic dependence of a tunneling rate on an interatomic coupling strength. We also calculate the energy spectrum of initial states, probability currents and dynamics of partial and total probabilities. A condition for a transition from the sequential to pair tunneling is revealed [II].

[II] I. S. Ishmukhamedov and A. S. Ishmukhamedov, "Tunneling of two interacting atoms from excited states", *Physica E* (accepted for publication); arXiv:1806.09005.

В рамках модифицированной дифракционной модели с использованием экспериментальных данных были определены значения среднеквадратичных радиусов возбужденных состояний $^{11}$B и $^{13}$C, в которых предполагается существование кластерных состоянии $\alpha+\alpha+$t и $\alpha+\alpha+\alpha+$n, соответственно. Данные состояния являются возможными аналогами состояния Хойла в $^{12}$C. Для состояния $3/2^-$ при 8.56 МэВ в $^{11}$B и $1/2^-$ при 8.86 МэВ в $^{13}$C были получены увеличенные значения радиусов, близкие к радиусу состояния Хойла в $^{12}$C [Ja].

Within the framework of modified diffraction model, using the experimental data, we determined the values of the root-mean-square radii of the excited states $^{11}$B and $^{13}$C, which assume the existence of the cluster state $\alpha + \alpha +$ t and $\alpha + \alpha + \alpha +$ n, respectively. These states are possible analogs of Hoyle's state in $^{12}$C. For the $3/2^-$ state at 8.56 MeV in $^{11}$B and $1/2^-$ at 8.86 MeV in $^{13}$C, we obtained increased values of the radii close to the Hoyle state radius in $^{12}$C [Ja].

[Ja] N. Burtebayev, D.M. Janseitov, Zh. Kerimkulov, Y.S. Mukhamejanov, M. Nassurlla, A.S. Demyanova, A.N. Danilov, A.A. Ogloblin, and A.S. Aimaganbetov, "Investigation of exotic states of $^{13}$C at low energy", *Int. Jour. Mod. Phys. E* ***27* (03)**, *1850025 (2018)*.

Столкновения атома и молекулы изучаются с помощью дифференциальных уравнений Фаддеева [KEA]. Представлены результаты расчетов длины рассеяния атома $^4$He на димерах $^4$He$^6$Li и $^4$He$^7$Li. Также проведены расчеты энергий связи трехатомных систем He$_2{}^6$Li и He$_2{}^7$Li. Полученные численные результаты показывают, что современные потенциальные модели поддерживают по два связанных состояния в каждом из этих тримеров. В обоих случаях энергия возбужденного состояния очень близка к энергии нижайшего двухчастичного порога. Большие значения длин рассеяния указывают на то, что возбужденные состояния являются ефимовскими. типа.

Atom-molecular collisions are studied using the Faddeev differential equations [KEA]. The results of calculation of the scattering length for collision of a $^4$He atom with $^4$He$^6$Li and $^4$He$^7$Li dimer are presented. Also the binding energies of He$_2{}^6$Li and He$_2{}^7$Li three-atom systems are computed. The numerical results obtained show that the modern potential models support two bound states in both the trimers. In both cases the energy of the excited state is very close to the energy of the lowest two-body threshold. The large values of the scattering length indicate that these systems are of the Efimov-type.

[KEA] E. A. Kolganova, "Faddeev calculation of helium atom $^7$Li He-dimer scattering length", *Few-Body Systems* ***59**, 28 (2018) [7 pages].*

Рассмотрены ультранамагниченные атомные ядра, возникающие при взрыве сверхновых, слиянии нейтронных звезд, в коре магнитаров и столкновениях тяжелых ионов. Показано, что для напряженностей поля 0.1 — 10 *теpатесла* доминирует линейный магнитный отклик и эффект Зеемана приводит к увеличению энергии связи атомных ядер с открытой оболочкой. Заметное увеличение выхода соответствующих продуктов взрывного нуклеосинтеза согласуется с результатами наблюдений. Для ядер группы железа такое магнитное усиление выхода $^{44}$Ti предполагает значительное увеличение также доли основного изотопа титана $^{48}$Ti в химическом составе галактик [KV].

Ultramagnetized atomic nuclei arising at supernova explosions, neutron star mergers, in magnetar crusts and heavy ion collisions are considered. It is shown that for field strengths of 0.1 — 10 *teratesla* the linear magnetic response dominates and the Zeeman effect leads to an increase in the binding energy of atomic nuclei with an open shells. Considerable increase in a yield of corresponding products of explosive nucleosynthesis is consistent with results of observations. For iron group nuclei, such a magnetic enhancement of $^{44}$Ti yield also implies a significant increase in the fraction of the main titanium isotope $^{48}$Ti in chemical composition of galaxies [KV].

[KV] V. N. Kondratyev, "Zeeman splitting in structure and composition of ultramagnetized spherical nuclei", *Phys. Lett. B **782**, 167–169 (2018) [3 pages]*.

Целью работы [EK] является численное исследование влияния короткодействующего взаимодействия на двумерное квантовое рассеяние двух различимых диполей. Задача моделирует столкновения двух полярных молекул в плоскости. Обнаружена сильная зависимость полного сечения рассеяния от радиуса короткодействующего взаимодействия при низких энергиях столкновений. Также обсуждаются различия вычисленных зависимостей полного сечения рассеяния для различных углов наклона оси поляризации диполей.

The aim of the paper [EK] is a numerical investigation of the short range interaction influence on the two-dimensional quantum scattering of two distinguishable dipoles. The model simulates two ultracold polar molecules collisions in two spatial dimensions. The strong dependence of the scattering total cross section on the short range interaction radius was discovered for low collision energies. We also discuss differences of calculated scattering cross section dependencies for different polarization axis tilt angles.

[EK] E. A. Koval and O. A. Koval, “Short-range interaction impact on two-dimensional dipolar scattering”, *EPJ Web of Conferences* ***173**, 06008 (2018) [4 pages]*.

Улучшен метод решения азимутально-симметричной проблемы рассеяния на ограниченном потенциале [Kra]. Использован двумерный алгоритм Томаса. В области вне взаимодействия были использованы точные волновые функции для определения решения. Ранее поиск решения производился на границе диффракционной тени. Сравнение с предыдущими расчетами показывает улучшение точности и уменьшение времени расчетов. Метод был использован для модели рассеяния нейтронов на несферическом ядре. Показано, что рассеяние на сферичесом и несферическом ядре существенно различается.

The method for calculating the azimuth symmetric scattering problem for finite potential [**?**] were improved. The two-dimension Thomas algorithm has been used. The accurate wave function has been used for finding solution on the region of the free equation instead finding solution on the border of the diffraction shadow. The comprising with previous results shows improving of accuracy and decreasing of the time solution. The method was used for model of scattering neutrons at non-spherical nuclei. It is shows that significant difference between scattering neutrons at spherical and non-spherical nuclei.

[Kra] P. M. Krassovitskiy, F. M. Pen’kov, “Asymptotic behavior of solutions in finite-difference schemes”, *Bulletin of the Russian Academy of Sciences: Physics* ***82**, 1315–1319 (2018)*.

Проанализированы расщепления по четности и электрические дипольные переходы в полосах переменной четности тяжелых ядер в зависимости углового момента. Показано, что эти зависимости можно трактовать универсальным способом с использованием одного параметра - критического момента, характеризующего фазовый переход от октупольных колебаний к стабильной октупольной деформации. Используя простую модель аксиально-симметричной зеркально-асимметричной моды, получены аналитические выражения для расщепления по четности и момента электрического дипольного перехода. Результаты сравниваются с экспериментальными данными для различных изотопов Ra, Th, U и Pu. [ME]

Angular momentum dependences of the parity splitting and eletric dipole transitons in the alternating parity bands of heavy nuclei have been analyzed. It is shown that these dependences can be treated in a universal way with use of a single parameter of critical angular momentum, which characterizes phase transition from octupole vibrations to the stable octupole deformation. Using the simple model of axially-symmetric reflection-asymmetric mode, the analytical expression for the partiy splitting and electic dipole transitional moment have been obtained. The results obtained are compared with the experimental data for various isotopes of Ra, Th, U, and Pu. [ME]

[ME] E. V. Mardyban, T. M. Shneidman, E. A. Kolganova, R. V. Jolos, and S.-G. Zhou, “Analytical description of shape transition in nuclear alternating parity bands”, *Chin. Phys. C* ***42**, 124104 (2018)[11 pages]*.

Гибридная система из плененных ультрахолодных атомов и примесей (таких как ионы или ридберговские атомы) может быть использована в качестве полностью контролируемого квантового симулятора твердотельных или молекулярных систем. В качестве первого шага в теоретической реализации таких систем исследуется рассеяние квантовой частицы двумя центрами (примесями), закрепленными на продольной оси удерживающей атом гармонической волноводоподобной ловушки [SM]. Получены условия возникновения индуцированных конфанментом резонансов (CIR) в таких системах для регуляризованного псевдопотенциала, описывающего взаимодействие атома с рассеивающими центрами. Показано, что в пределе одного объединенного рассеивающего центра положение CIR для четного состояния стремится к общеизвестному результату, полученному ранее Ольшаным. Эти результаты могут быть использованы для описания рассеяния плененных в оптических ловушках атомов фиксированными примесями, с возможным обобщением на случай $N$ примесей, или двухатомными молекулами. Развитый подход может быть использован для построения моделей эффективного среднего поля с контактными взаимодействиями.

A hybrid system of trapped ultracold atoms and impurities (like ions or Rydberg atoms) can be used as a fully-controlled quantum simulator of solid state or molecular systems. As a first step in realizing these systems theoretically, the confined scattering of a quantum particle by two centers (impurities) fixed on the longitudinal axis of a harmonic waveguide-like trap is studied [SM]. The conditions of confinement-induced resonances (CIRs) appearing in these systems are derived for a regularized pseudopotential describing particle interaction with scattering centers. In the limit of a single center, the position of CIR for even state tends to the well-known result obtained by Olshanii. This result can be applicable to confined atomic scattering by fixed impurities with possible extension to $N$ impurities, or by two-atomic molecules. It can also be useful for constructing mean-field approaches with contact interactions.

[SM] S. Shadmehri and V.S. Melezhik, “Confinement-induced resonances in two-center problem via pseudopotential approach”, arXiv:1809.05351 (to be published in *Phys. Rev. A*).

В [MAK] исследуется модель Фридрихса-Фаддеева в случае, когда ядро интегрального оператора–возмущения голоморфно относительно обоих своих аргументов в некоторой области в $\mathbb{C}$. Сначала изучается строение $T$- и $S$-матриц на нефизических листах комплексной плоскости спектрального параметра. С этой целью строятся явные представления, выражающие продолженные $T$- и $S$-матрицы через их значения исключительно на физическом листе. Затем проводится комплексная деформация гамильтониана исследуемой модели (например, комплексный скейлинг — в случае когда первоначальный спектр занимает положительную полуось). Изолированные комплексные собственные значения деформированного гамильтониана называются деформационными резонансами. Для рассматриваемого класса возмущений с аналитическим ядрами доказывается, что деформационные резонансы совпадают с резонансами в смысле матрицы рассеяния, то есть с полюсами ее аналитического продолжения на соответствующие нефизические листы плоскости спектрального параметра.

In [MAK], we consider the Friedrichs-Faddeev model in the case where the kernel of the potential operator is holomorphic on both arguments on a certain domain of $\mathbb{C}$. For this model we, first, study the structure of the $T$- and $S$-matrices on unphysical energy sheet(s). To this end, we derive representations that explicitly express them in terms of these same operators considered exclusively on the physical sheet. Furthermore, we allow the Friedrichs-Faddeev Hamiltonian undergo a complex deformation (or even a complex scaling/rotation if the model is associated with a positive semi-axis). Isolated non-real eigenvalues of the deformed Hamiltonian are called the deformation resonances. For a class of perturbations with analytic kernels, we prove that the deformation resonances do coincide with the scattering matrix resonances, that is, with the poles of the scattering matrix analytically continued to the respective unphysical sheet.

[MAK] A.K. Motovilov, *Unphysical energy sheets and resonances in the Friedrichs-Faddeev model*, E-print arXiv:1812.08291 (to be published in *Few-Body Systems*).

Для атомной и молекулярной физики предложена модель, основанная на замене локального потенциала, описывающего взаимодействие активного электрона с атомом (молекулой) суммой сепарабельных потенциалов, каждое слагаемое которого поддерживает только одно связанное состояние квантовой системы. Эта модель применяется к описанию взаимодействия различных атомов и молекул (водород, анион водорода, молекулы водорода и воды) с внешним ультракоротким лазерным импульсом. Модель, будучи вычислительно малозатратной, дает, при удачном выборе участвующих в физическом процессе орбиталей, вполне удовлетворительные результаты как при сравнении с другими вычислениями, так и с экспериментом. Совпадение улучшается в случае сравнительно высоких частот и интенсивностей лазерного импульса. Модель с успехом может быть использована для предварительной качественной оценки динамики квантовой системы в переменном ЭМ поле конечной длительности [Po].

A model for atomic and molecular physics is proposed, which is based on replacing the local potential, describing the interaction of an active electron with an atom (molecule), by the sum of separable potentials, each term of which supports only one bound state of a quantum system. This model is applied to description of the interaction of various atoms and molecules (hydrogen, hydrogen anion, molecules of hydrogen and water) with external ultrashort laser pulse. The model, being computationally low-cost, gives, with a successful choice of orbitals involved in the considering physical process, quite satisfactory results as when comparing with other calculations, and with experiment. Coincidence improves in case of relatively high frequencies and intensities of laser pulse. The model can be successfully used for preliminary qualitative assessment of the dynamics of a quantum system in alternating EM field of finite duration [Po].

[Po] A. Galstyan, Yu.V. Popov, N. Janssens, F. Mota-Furtado, P. F. O'Mahony, P. Decleva, N. Quadri, O. Chuluunbaatar, and B. Piraux, "Ionisation of $H_2O$ by a strong ultrashort XUV pulse: A model within the single active electron approximation", *Chemical Physics* ***504***, *22–30 (2018)*.

Исследовано трехмерное финитное движение квантовой частицы в поле потенциала $V(r) = -V_0 r^{-\alpha}$ с параметрами $V_0 > 0$ и $\alpha \in (0,2)$. Дан анализ асимптотического уравнения, эквивалентного правилу квантования Бора-Зоммерфельда. В результате для энергий слабосвязанных состояний такой частицы получено простое и явное приближение [PVV].

We study the finite three-dimensional movement of a quantum particle in the field of the potential $V(r) = -V_0 r^{-\alpha}$ with the parameters $V_0 > 0$ and $\alpha \in (0,2)$. We analyse the asymptotic equation which is equivalent to the Bohr-Zommerfeld quantization rule. As a result, we derive a simple and explicit approximation for the energies of weakly-bound states of this particle [PVV].

[PVV] V. V. Pupyshev, “Bohr-Zommerfeld quatization rule in the case of decreasing power potential”, Preprint P4-2018-61, JINR, Dubna, 2018 (submited to JETP).

Впервые развит динамический подход для расчета перезарядки при столкновении H $^{+}$ + He $^{+}$ (1s) в широком диапазоне энергий вплоть до максимума сечения [GS]. При низких энергиях результаты в базисе 4-состояний правильно воспроизводят плечо в энергетической зависимости сечения в окрестности энергии столкновения $E_{cm}$ = 6 кэВ. Результаты в базисе 2-состояний правильно предсказывают положение максимума сечения при $E_{cm}$ = 40 кэВ.

For the first time the dynamical approach is developed for calculation of charge exchange in $H^{+}$+$He^{+}$(1s) collisions in wide range of energies up to the maximum cross section [GS]. At low energies our 4-state results correctly reproduce the shoulder in energy dependence of the cross section around $E_{cm}$=6 keV. The 2-state results correctly predict the position of the maximum of the cross section at $E_{cm}$=40 keV.

[GS] T.P. Grozdanov and E.A. Solov’ev, “Hidden crossing theory of charge exchange in $H^{+}$+$He^{+}$(1s) collisions in vicinity of maximum of cross section”, *Eur. Phys. J. D* **72**, 64 (2018) [9 pages].

Работа [Val] посвящена теоретическому исследованию кулоновского развала гало ядра $^{11}$Be в квантово-механическом подходе. Связанные состояния ядра $^{11}$Be можно достаточно хорошо описать как ядро $^{10}$Be и слабосвязанный нейтрон. Применяя численные методы, в данной работе в качестве тестовой программы были воспроизведены энергетические уровни ядра $^{11}$Be с использованием потенциала Вудс-Саксона для описания ядерного взаимодействия. Отрицательные энергетические уровни нормированы и описывают или физические связанные состояния снаряда или состояния, запрещенные принципом Паули. Также численно были найдены положительные энергетические состояния (непрерывный спектр), которые описывают рассеяние кора-фрагмента. Они необходимы для анализа конечного состояния системы. Эта работа является начальным этапом работы по исследованию развала гало ядер в квантово-механическом подходе [Val].

The work [Val] is devoted to a theoretical study of Coulomb breakup of halo nucleus of $^{11}$Be in quantum-mechanical approach. The bound states of a nucleus of $^{11}$Be can be regarded as a neutron halo consisting of a $^{10}$Be core and a loosely coupled neutron. Using numerical methods, in this paper, the energy levels of the $^{11}$Be nucleus were reproduced as a test program using the Woods-Saxon potential for describing the nuclear interaction. Negative energy states are normed and describe either the physical bound states of the projectile or states forbidden by the Pauli principle. In addition it was numerically calculated the positive energy states (a continuous spectra), which correspond to the core- fragment scattering. They are necessary for the analysis of a final condition of a system. This work is the initial stage of work on the investigation of the breakup of halo nuclei in the quantum-mechanical approach [Val].

[Val] D.S. Valiolda, S.A. Zhaugasheva, D.M. Janseitov, and N.K. Zhussupova, “The study of the neutron halo of $^{11}$Be nucleus taking into account the influence of an external field”, *News of the National Academy of Sciences of the Republic of Kazakhstan, Phys.-Math. Series* ***02 (318)**, 12–20 (2018)*.

Разработаны эффективные методы расчета параметров рассеяния для коллинеарных моделей тримера атомов бериллия с молекулярными парными взаимодействиями, рассеяния атомного димера на атоме, или туннелирования атомного димера через потенциальные барьеры. Модели сформулированы как двумерные краевые задачи в якобиевых и полярных координатах и решены в адиабатическом представлении. Построены асимптотические разложения параметрических базисных функций, эффективных потенциалов, фундаментальных решений систем обыкновенных дифференциальных уравнений второго порядка и соответствующие асимптотические состояния рассеяния. Эффективность разработанного метода, алгоритмов и программ демонстрируется сравнительными расчетами резонансного рассеяния, метастабильных и связанных состояний [SV].

Effective methods for calculating the scattering parameters for collinear models for a trimer of Beryllium atoms with molecular pairwise interactions and for an atomic dimer scattered by an atom or tunneling through potential barriers were developed. The models are formulated as 2D boundary-value problems in the Jacobi and polar coordinates and solved in the adiabatic representation. The asymptotic expansions of the parametric basis functions, effective potentials, fundamental solutions of the systems of second-order ordinary differential equations and corresponding asymptotic scattering states were constructed. The efficiency of the elaborated method, algorithms and programs is demonstrated by benchmark calculations the resonance scattering, metastable and bound states [SV].

[SV] A. A. Gusev, S. I. Vinitsky, O. Chuluunbaatar, A. Góźdź, V. L. Derbov, and P. M. Krassovitskiy, “Adiabatic representation for atomic dimers and trimers in collinear configuration”, *Phys. Atom. Nucl.* ***81**, 911–936 (2018)*.

# 3 Publications

## 3.1 Journal publications

1. T. L. Belyaeva, S. A. Goncharov, A. S. Demyanova, A. A. Ogloblin, A. N. Danilov, V. A. Maslov, Yu. G. Sobolev, W. Trzaska, S. V. Khlebnikov, G. P. Tyurin, N. Burtebaev, D. M. Janseitov, and E. Mukhamejanov, “Neutron halos in the excited states of $^{12}$B”, *Physical Review C* ***98**, 034602 (2018) [10 pages]*.

2. N. Burtebayev, D. M. Janseitov, Zh. Kerimkulov, Y. S. Mukhamejanov, M. Nassurlla, A. S. Demyanova, A. N. Danilov, A. A. Ogloblin, and A. S. Aimaganbetov, “Investigation of exotic states of $^{13}$C at low energy”, *Int. Jour. Mod. Phys. E* ***27 (03)**, 1850025 (2018).*

3. O. Chuluunbaatar, S. I. Vinitsky, A. A. Gusev, V. L. Derbov, and P. M. Krassovitskiy, “Solution of quantum mechanical problems using finite element method and parametric basis functions,” *Bull. Russian Academy of Sci.: Phys.* ***82**, 654–660 (2018)*.

4. O. Chuluunbaatar, S. I. Vinitsky, A. A. Gusev, V. L. Derbov, and P. M. Krassovitskiy, “Quantum transparency of barriers and reflection from wells for clusters of identical particles,” *Bull. Russian Academy of Sci.: Phys.* ***82**, 648–653 (2018)*.

5. A. Galstyan, Y.V. Popov, N. Janssens, F. Mota-Furtado, P. F. O’Mahony, P. Decleva, N. Quadri, O. Chuluunbaatar, and B. Piraux, “Ionization of $H_2O$ by a strong ultrashort XUV pulse: A model within the single active electron approximation”, *Chemical Physics* ***504**, 22–30 (2018)*.

6. M. Góźdź, A. Góźdź, A. A. Gusev, and S. I. Vinitsky, "Projection evolution of quantum states-the delayed choice puzzle" *Phys. Atom. Nucl.* ***81**, 819–823 (2018).*.

7. T.P. Grozdanov and E.A. Solov'ev, "Hidden crossing theory of charge exchange in $H^{+}$+$He^{+}$(1s) collisions in vicinity of maximum of cross section ", *Eur. Phys. J. D* **72**, 64 (2018) [9 pages].

8. A. A. Gusev, V. P. Gerdt, O. Chuluunbaatar, G. Chuluunbaatar, S. I. Vinitsky, V. L. Derbov, A. Góźdź, and P. M. Krassovitskiy "symbolic-numerical algorithms for solving elliptic boundary-value problems using multivariate simplex Lagrange elements", *Lecture Notes in Computer Sci.* ***11077**, 197–213 (2018)*.

9. A. A. Gusev, S. I. Vinitsky, O. Chuluunbaatar, A. Góźdź, V. L. Derbov, and P. M. Krassovitskiy, "Adiabatic representation for atomic dimers and trimers in collinear configuration", *Phys. Atom. Nucl.* ***81**, 911–936 (2018)*.

10. A. Deveikis, A. A. Gusev, V. P. Gerdt, S. I. Vinitsky, A. Góźdź, and A. Pędrak "Symbolic Algorithm for generating the orthonormal bargmann-moshinsky basis for SU(3) group," *Lecture Notes in Computer Sci.* ***11077**,131–145 (2018)*.

11. D. M. Janseitov, S. M. Lukyanov, K. Mendibayev, Yu. E. Penionzhkevich, K. N. Skobelev, Yu. G. Sobolev, K. A. Kuterbekov, D. S. Valiolda, T. K. Zholdybayev, W. Trzaska, S. V. Khlebnikov, G. P. Tyurin, B. A. Urazbekov, M. N. Harakeh, V. Burjan, V. Kroha, V. Mrazek, Š. Piskoř, I. Sivaček, and V. Glagolev, "Investigation of the elastic and inelastic scattering of $^{3}$He from $^{9}$Be in the energy range 30-60 MeV", *Int. Jour. Mod. Phys. E* ***27** **(10)**, 1850089 (2018).*

12. R. V. Jolos, V. G. Kartavenko, and E. A. Kolganova, "Isovector pair correlations of nucleons in atomic nuclei: Microscopic approach, boson representation and collective model", *Phys. Part. Nucl.* **49**, 125–145 (2018).

13. E. A. Kolganova, "Faddeev calculation of helium atom $^{7}$Li He-dimer scattering length", *Few-Body Systems* ***59**, 28 (2018) [7 pages].*

14. V. N. Kondratyev, "Zeeman splitting in structure and composition of ultramagnetized spherical nuclei", *Phys. Lett. B* ***782**, 167–169 (2018) [3 pages]*.

15. V. N. Kondratyev, Yu. V. Korovina, "Universal statistics of soft gamma-ray repeating (SGR) bursts", *Phys. Particles & Nuclei* ***49**, 105–108 (2018)*.

16. V. N. Kondratyev, "Zeeman energy in nucleosynthesis at strong magnetization in supernovae", *Monthly Notices of the Royal Astronomical Society* ***480**, 5380–5383 (2018).*

17. P. M. Krassovitskiy and F. M. Pen'kov, "Asymptotic behavior of solutions in finite-difference schemes" *Bull. Russian Academy of Sci.: Physics* ***82**, 1315–1319 (2018)*.

18. E. V. Mardyban, T. M. Shneidman, E. A. Kolganova, R. V. Jolos, and S.-G. Zhou, "Analytical description of shape transition in nuclear alternating parity bands", *Chin. Phys. C* ***42**, 124104 (2018)[11 pages]*.

19. E. V. Mardyban, T. M. Shneidman, E. A. Kolganova, and R. V. Jolos, "Analytical description of the excited state phase transition to octupole deformed shape in alternating parity bands", *Memoirs of the Faculty of Physics, Lomonosov Moscow State University*, ***4**, 1840203 (2018) [11 pages]* (in Russian); arXiv:1806.07548.

20. D. S. Valiolda, S. A. Zhaugasheva, D. M. Janseitov and N. K. Zhussupova, “The study of the neutron halo of $^{11}$Be nucleus taking into account the influence of an external field”, *News of the National Academy of Sciences of the Republic of Kazakhstan, Phys.-Math. Series **02 (318)**, 12–20 (2018).*

21. V. V. Pupyshev,“Coulomb scattering of a slow quantum particle in a space of arbitrary dimension”, *Theor. Math. Phys.* ***195**, 548-556 (2018)*.

22. D. S. Valiolda, S. A. Zhaugasheva, D. M. Janseitov, and N. K. Zhussupova, “Investigation of the neutron halo of the $^{11}$Be nucleus”, *Al-Farabi Kazakh National University Recent Contributions to Physics **01 (64)**, 81–88 (2018).*


### 3.2 Articles in paper collections/conference proceedings


1. D. Alimov, N. Burtebayev, I. Boztosun, Zh. Kerimkulov, J. Burtebayeva, M. Karakoc, Y. Mukhamejanov, D. Janseitov, A. Bahtibayev, A. Bahtibayev, and Sh. Hamada, “Investigation of interaction processes of light nuclei with $^{14}$N ”, *Journal of Physics: Conference Series **940**, 012029 (2018).*

2. N. Burtebayev, D. M. Janseitov, Zh. K. Kerimkulov, D. Alimov, Y. S. Mukhamejanov, M. Nassurlla, A. S. Aimaganbetov, and D. S. Valiolda, “Exotic states of $^{13}$C nuclei ”, *Journal of Physics: Conference Series **1023**, 012025 (2018).*.

3. N. Burtebayev, D. M. Janseitov, Zh. K. Kerimkulov, A. Demyanova, A. Danilov, D. Alimov, and Y. Mukhamejanov, “Investigation of $\alpha$ particle scattering from $^{13}$C at 29 MeV ”, *Journal of Physics: Conference Series **940**, 012033 (2018).*.

4. N. Burtebayev, D. M. Janseitov, Zh. K. Kerimkulov, Y. Mukhamejanov, M. Nassurlla, D. S. Valiolda, A. S. Demyanova, A. N. Danilov, and V. Starostin, “The cluster states in light nuclei”, *EPJ Web of Conferences **194 P.06003**, (2018)*.

5. N. Burtebayev, Zh. K. Kerimkulov, M. Bakhtybayev, Sh. Hamada, Y. Mukhamejanov, M. Nassurlla, D. Alimov, A. Morzabayev, D. M. Janseitov, and W. Trzaska. “Investigation of the elastic and inelastic scattering of $^{4}$He from $^{11}$B in the energy range 29 – 50.5 MeV ”, *Journal of Physics: Conference Series **940**, 012034 (2018).*.

6. O. Chuluunbaatar, K. Kouzakov, and A. Y. Popov, “Peculiarities of matrix-element calculations with few Coulomb functions for particles’ scattering processes”, *EPJ: Web of Conferences **173**, 03007 (2018) [4 pages]*

7. A. Góźdź, A. Pędrak, A. A. Gusev, and S. I. Vinitsky, “Point symmetries in the nuclear SU(3) partner groups model”, *Acta Phys. Polonica B Proc. Suppl. **11**, 19–27 (2018)*.

8. A.A. Gusev, O. Chuluunbaatar, Yu.V. Popov, S.I. Vinitsky, V.L. Derbov, and K.P. Lovetskiy, “One-dimensional “atom” with zero-range potential perturbed by finite sequence of zero-duration laser pulses”, *Proc. SPIE **10717**, 1071710 (2018) [8 pages]*.

9. A. A. Gusev, O. Chuluunbaatar, Yu. V. Popov, S. I. Vinitsky, V. L. Derbov, and K. P. Lovetskiy, “One-dimensional ”atom” with zero-range potential perturbed by finite sequence of zero-duration laser pulses,” *Proc. SPIE **10717**, 1071710 (2018) [8 pages]*.

10. A. Gusev, O. Chuluunbaatar, S. Vinitsky, V. Derbov, L. Hai, E. Kazaryan, and H. Sarkisyan, "Finite element method for calculating spectral and optical characteristics of axially symmetric quantum dots," *Proc. SPIE* ***10717****, 1071712 (2018) [8 pages]*.

11. A. A. Gusev, S. I. Vinitsky, O. Chuluunbaatar, V. L. Derbov, A. Góźdź, and P. M. Krassovitskiy, "Parametric bases for elliptic boundary value problem," *J. Phys. Conf. Ser.* ***965****, 012016 (2018) [6 pages]*.

12. A. Gusev, S. Vinitsky, O. Chuluunbaatar, G. Chuluunbaatar, V. Gerdt, V. Derbov, A. Góźdź, and P. Krassovitskiy, "Interpolation Hermite polynomials for finite element method," *EPJ Web of Conferences* ***173****, 03009 (2018) [4 pages]*.

13. A. Gusev, S. Vinitsky, O. Chuluunbaatar, G. Chuluunbaatar, V. Gerdt, V. Derbov, A. Góźdź, and P. Krassovitskiy. High-accuracy finite element method: Benchmark calculations," *EPJ Web of Conferences* ***173****, 03010 (2018) [4 pages]*.

14. A. Danilov, A. Demyanova, A. Ogloblin, T. Belyaeva, S. Goncharov, R. Sukhorukov, V. Maslov, Y. Sobolev, W. Trzaska, S. Khlebnikov, G. Tyurin, N. Burtebayev, D. Janseitov, E. Mukhamejanov and Y. Gurov, "Search for states with enlarged radii in excited states of $^{12}$B", Proceedings of the 3rd International Conference on Particle Physics and Astrophysics (02 – 05 October 2017, Moscow), National Research Nuclear University, Moscow, 2017, pp. 83–88.

15. I. S. Ishmukhamedov, A. S. Ishmukhamedov, and V. S. Melezhik, "Numerical solution of the time dependent 3D Schrödinger equation describing tunneling of atoms from anharmonic traps", *EPJ Web of Conferences* ***173****, 03011 (2018) [4 pages]*.

16. E. A. Koval and O. A. Koval, "Short-Range Interaction Impact on Two-Dimensional Dipolar Scattering", *EPJ Web of Conferences* ***173****, 06008 (2018) [4 pages]*.

17. V. S. Melezhik, "Mathematical modeling of resonant processes in confined geometry of atomic and atom-ion traps", *EPJ Web of Conf.* ***173****, 01008 (2018) [8 pages]*.


### 3.3 Articles accepted for publication


1. S. Albeverio and A. K. Motovilov, "Solvability of the operator Riccati equation in the Feshbach case", *Mathematical Notes* (accepted for publication).

2. I.A. Gnilozub, A. Galstyan, Yu.V. Popov, and I.P. Volobuev, "Compton scattering from hydrogen and helium atoms", *J. Phys. B Accepted manuscript* (to appear); arXiv:1809.08815.

3. Yu.V. Popov, A. Galstyan, B. Piraux, P.F. O'Mahony, F. Mota-Furtado, P. Decleva, and O. Chuluunbaatar, "Separable potentials model for atoms and molecules in strong ultrashort laser pulses", Chapter in "Progress in Photon Science: Basics and Applications" (Springer Series in Chemical Physics (2019)), to be published.

4. I. S. Ishmukhamedov and A. S. Ishmukhamedov, "Tunneling of two interacting atoms from excited states", *Physica E* (accepted for publication); arXiv:1806.09005.

5. R. V. Jolos, E. A. Kolganova, and D. A. Sazonov, "Decoupling parameter for rotational bands, based on the mixed symmetry states", *Phys. At. Nucl.* ***82****, No. 2 (2019)* (to appear).

6. V. N. Kondratyev, ”Zeeman effect at explosive nuclide formation”, *Phys. Atom. Nuclei* ***82*** *(2019)* (accepted for publication).

7. A.A. Korobitsin, and E.A. Kolganova, “Ultracold neon trimer via Faddeev differential equations”, *Proceedings of the XXII International Conference on Few-Body Problems in Physics (9–13 July 2018, Caen, France)*, to appear.

8. E. A. Koval and O. A. Koval, “Binding energies of quantum dipole in plane”, *EPJ Web of Conferences* (accepted for publication).

9. E. A. Solov’ev, “Solvable problems in classical representation”, *Quantum Stud.: Math. Found.*, Online First (2018).

### 3.4 Preprints and data bases

1. V. S. Melezhik, “Low-Dimensional Few-Body Processes in Confined Geometry of Atomic and Hybrid Atom-Ion Traps”, E-print arXiv:1812.01676; submitted to the *Proceedings of the XXII International Conference on Few-Body Problems in Physics* (9–13 July 2018, Caen, France).

2. A.K. Motovilov, *Unphysical energy sheets and resonances in the Friedrichs-Faddeev model*, E-print arXiv:1812.08291.

3. A.K. Motovilov and A. A. Shkalikov, Preserving of the unconditional basis property under non-self-adjoint perturbations of self-adjoint operators, E-print arXiv:1801.09789 (submitted to *Functional Analysis and Applications*).

4. V. V. Pupyshev, “Two-dimensional movement of a slow quantum particle in the field of a central long-range potential”, Preprint P4-2018-59, JINR, Dubna, 2018. — 11 pp. Submited to *TMPh*.

5. V. V. Pupyshev, “Bohr-Zommerfeld quatization rule in the case of decreasing power potential”, Preprint P4-2018-61, JINR, Dubna, 2018. — 37 pp. Submited to *JETP*.

6. S. Shadmehri and V.S. Melezhik, “Confinement-induced resonances in two-center problem via pseudopotential approach”, E-print arXiv:1809.05351; submitted to *Phys. Rev. A*.

## 4 Conference and seminar presentations

### 4.1 Conference presentations

1. N. Burtebayev, D. M. Janseitov, Y. S. Mukhamejanov and A. N. Danilov, “Investigation of the excited states of $^{11}$B nucleus”, The XXII International Scientific Conference of Young Scientists and Specialists (AYSS - 2018) (23.04.2018–27.04.2018, Dubna, Russia), oral presentation.

2. N. Burtebayev, D. M. Janseitov, Y. S. Mukhamejanov, Zh. K. Kerimkulov, A. S. Demyanova, A. N. Danilov, “investigation of interaction of deutrons with $^{11}$B and $^{13}$C nuclei ”, The IX International Symposium on EXOtic Nuclei (EXON - 2018) (10.09.2018–15.09.2018, Petrozavodsk, Russia), oral presentation.

3. D. M. Janseitov, N. Burtebayev, Zh. K. Kerimkulov, A. S. Demyanova, A. N. Danilov, "The cluster states in light nuclei" The International Conference EURORIB 2018 (27.05.2018–01.06.2018, Gien, France), poster session.

4. D. M. Janseitov, N. Burtebayev, Zh. K. Kerimkulov, Y. Mukhamejanov, M. Nassurlla, D. S. Valiolda, A. S. Demyanova, A. N. Danilov and V. Starostin, "The cluster states in light nuclei" The International Conference "Nuclear Structure and Related Topics" (NSRT - 18) (03.06.2018–09.06.2018, Burgas, Bulgaria), oral presentation.

5. O. I. Kartavtsev and A. V. Malykh, "Three two-species fermions with contact interactions", XXII International Conference on Few-Body Problems in Physics (09.07.2018–13.07.2018, Caen, France), oral presentation.

6. E. A. Kolganova, "Some three-body systems and Efimov effect", XIII Workshop on Particle Correlations and Femtoscopy (21.05.2018–26.05.2018, Krakow, Poland), plenary talk.

7. E. A. Kolganova, "Van der Waals three-body systems, potentialities for Efimov state observations", XXII International Conference on Few-Body Problems in Physics (09.07.2018–13.07.2018, Caen, France), invited talk.

8. E. A. Kolganova, "Efimov states in three-atomic systems", International Conference Mathematical Analysis and its Application to Mathematical Physics (17.09.2018–20.07.2018, Samarkand, Uzbekistan), plenary talk.

9. V. N. Kondratyev , "Self-organized critical superferromagnetic dynamics", 8-th International Conference "Physics of Liquid Matter. Modern Problems" (PLMMP-2018) (18.05.2018–22.05.2018, Kiev, Ukraine), section talk.

10. V. N. Kondratyev, "Synthesis of magnetized nuclei at the Zeeman regime", All-Russian Conference "High Energy Astrophysics: Today and Tomorrow"(18.12.2018–28.12.2018, IKI RAS, Moscow, Russia) poster.

11. V. N. Kondratyev and V. A. Osipov, "Magnetoresistive superferromagnetic sensors" (09.07.2018–12.07.2018, International workshop "Low Dimensional Materials: Theory, Modeling and Experiment" (Dubna, Russia) oral presentation.

12. V. N. Kondratyev, "Creation and transmutation of magnetized nuclei at Zeeman regime", Humboldt Kolleg and BLTP/JINR–KLFTP/CAS Joint Workshop "Physics of Strong Interacting Systems" (03.09.2018–07.09.2018, St. Petersburg, Russia), oral presentation.

13. V. N. Kondratyev, "Nucleosynthesis at strong magnetic fields vs the titanium problem", International Conference "Astronomy and Space Physics" (20.05.2018–25.05.2018, Kiev, Ukraine), oral presentation

14. V. N. Kondratyev, "Nucleosynthesis at strong magnetization and the titanium problem", XV International Seminar on Electromagnetic Interactions of Nuclei (08.10.2018 –11.10.2018, IKI RAS, Moscow, Russia), oral presentation.

15. V. N. Kondratyev, "Magnetar magnetoemission", XV International Seminar on Electromagnetic Interactions of Nuclei (08.10.2018 –11.10.2018, IKI RAS, Moscow, Russia), poster.

16. A.A. Korobitsin and E.A.Kolganova, “Ultracold three-body rare gas atomic clusters”, XXII International Conference on Few-Body Problems in Physics (09.07.2018–13.07.2018, Caen, France), oral presentation.

17. A.A. Korobitsin and E.A.Kolganova, “Three - body rare gas atomic clusters ”, BLTP/JINR - KLFTP/CAS Joint Workshop Physics of Strong Interacting Systems (03.09.2018–07.09. 2018, St. Petersburg, Russia), oral presentation.

18. A. A. Korobitsin and E. A. Kolganova, “Ultracold atomic clusters via Faddeev differential equations”, BASIS Foundation Summer School 2018 ‘Many body theory meets quantum information’ (19.08.2018–31.08.2018, Moscow Region), poster.

19. A. A. Korobitsin and E. A. Kolganova, “The rare gas clusters within Faddeev approach”, VII Annual Conference of Young Scientists and Specialists “Alushta-2018” (11.06.2018–18.06.2018, Alushta), oral presentation.

20. A. A. Korobitsin and E. A. Kolganova, “Ultracold three–body atomic clusters”, The XXII International Scientific Conference of Young Scientists and Specialists (23.04.2018–27.04. 2018, JINR, Dubna), oral presentation

21. A. A. Korobitsin and E. A. Kolganova, “Faddeev equations for study of ultracold clusters of neon atoms”, International scientific conference of students and young scientists “Lomonosov-2018” (09.04.2018–13.04.2018, MSU, Moscow, Russia), oral presentation.

22. E. A. Koval and O. A. Koval, “Effective numerical algorithm for calculating binding energies of 2D quantum dots in external fields”, XXV International conference “Mathematics. Computing. Education” (29.01.2018–03.02.2018, Dubna University, Dubna, Russia), oral presentation.

23. E. A. Koval, “Binding energies of quantum dipole in plane”, The XXII International Scientific Conference of Young Scientists and Specialists (23.04.2018–27.04.2018, Laboratory of High Energy Physics, JINR, Dubna, Russia), oral presentation.

24. P. M. Krassovitskiy and F. M. Pen’kov, “Solution of scattering amplitude for a finite region of calculations”, International Conference ”Nucleus-2018” (01.07.2018–06.07.2018, Voronezh, Russia), oral presentation.

25. P. M. Krassovitskiy and F. M. Pen’kov, “The calculation of neutron scattering on a non-spherical nucleus” *XXV Nuclear Physics Workshop “Structure and dynamics of atomic nuclei”*(25.09.2018–30.09.2018, Kazimierz Dolny, Poland), oral presentation.

26. E. V. Mardyban, T. M. Shneidman, E. A. Kolganova, and R. V. Jolos, “Phase transitions in heavy nuclei”, 48th meeting of the PAC for Particle Physics (31.01.2018, JINR, Dubna, Russia), poster.

27. E. V. Mardyban, “Analytical description of the excited state phase transition to octupole deformed shape in alternating parity bands”, International scientific conference of students and young scientists ”Lomonosov-2018” (09.04.2018–13.04.2018, Moscow M. V. Lomonosov State University, Moscow, Russia), section talk.

28. V. S. Melezhik, “Modeling quantum matter at extreme conditions with ultracold atoms and QFT methods”, VI International Conference “Modeling in Quantum Field Theory ” (MQFT-2018) (23.08.2018–31.08.2018, St. Petersburg, Peterhof, Russia), plenary talk.

29. V. S. Melezhik, “Low-dimensional few-body processes in confined geometry of atomic and hybrid atom-ion traps”, XXII International Conference on Few-Body Problems in Physics (09.07.2018–13.07.2018, Caen, France), oral presentation.

30. V. S. Melezhik and L. A. Sevastianov, “Calculation of probability density distribution of ultracold atoms and molecules in waveguide-like traps”, 12th International Workshop on Applied Problems and Mathematical Statistics (22.10.2018–27.10.2018, Lisbon, Portugal), ivited talk.

31. V. S. Melezhik, “Ultracold atomic and atom-ion processes in confined geometry of waveguide-like traps”, Conference “Frontiers of Matter Wave Optics” (17.09.2018–21.09.2018, Chania, Crete, Greece), poster.

32. A. K. Motovilov, “Solvability of the operator Riccati equation in the Feshbach case”, International Workshop on Operator Theory and Applications, IWOTA 2018 (23.07.2018–27.07.2018, Shanghai, China) section talk.

33. A. K. Motovilov, “Operator Riccati equation in the Feshbach case”, 7th International Conference on Mathematical Modeling in Physical Sciences (27.08.2018–31.08.2018, Moscow, Russia), section talk.

34. A. K. Motovilov, “Subspace perturbation problem and operator Riccati equation”, International Conference “Mathematical Analysis and Its Application to Mathematical Physics” (17.09.2018–20.09.2018, Samarkand State University, Samarkand, Uzbekistan), plenary talk.

35. A. K. Motovilov, “Unphysical energy sheets and resonances in the Friedrichs-Faddeev model”, International Conference “Nuclear Theory in the Supercomputing Era – 2018” (29.10.2018–02.11.2018, Daejeon, Korea), invited talk.

36. D. S. Valiolda, D. M. Janseitov, and S. A. Zhaugasheva, “The study of the neutron halo of the $^{11}$Be nucleus taking into account the influence of an external field”, The XXII International Scientific Conference of Young Scientists and Specialists (AYSS - 2018) (23.04.2018–27.04.2018, Dubna, Russia), oral presentation.

37. D. S. Valiolda and D. M. Janseitov, “Theoretical study of the halo nucleus of $^{11}$Be ” European Nuclear Physics Conference EuNPC-2018 (02.09.2018–07.09.2018, Bologna, Italy), poster.

38. S. I. Vinitsky, “On generation of the Bargmann-Moshinsky basis of SU(3) group”, 32nd International Colloquium on Group Theoretical Methods in Physics (Group32) (09.07.2018–13.07.2018, Prague, Czech Republic), oral presentation.

39. A. Deveikis, A. Gusev, V. Gerdt, S. Vinitsky, A. Góźdź, and A. Pędrak, “Symbolic algorithm for generating of orthonormal Bargmann and Moshinsky basis for SU(3) group”, The International Workshop on Computer Algebra in Scientific Computing (CASC 2018) (17.09.2018–21.09.2018, Lille, France), oral presentation.

40. S. I. Vinitsky, “Solution of multidimensional quantum mechanical problems using finite element method and parametric basis functions”, XXV Nuclear Physics Workshop, Structure and Dynamics of Atomic Nuclei(25.09.2018–30.09.2018, Kazimierz Dolny, Poland), oral presentation.

### 4.2 Seminar talks

1. I. S. Ishmukhamedov and A. S. Ishmukhamedov, “Tunneling of two interacting fermions” (10.04.2018, Seminar on Few-Body Systems, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).
2. A.V.Malykh, “Complete universal description of the energy spectrum of two-component three-body system ” (08.08.2018, Institute of Modern Physics, Chinese Academy of Sciences, Lanzhou, China).
3. A.V.Malykh, “On the spectrum of three-body states in the one-dimensional harmonic trap” (25.12.2018, Seminar on Few-Body Systems, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).
4. V. S. Melezhik, “Calculations of resonant processes in confined geometry of atomic and atom-ion traps” (24.04.2018, JINR, Dubna, Seminar of LIT).
5. V. S. Melezhik, “Effective computational scheme for integration of three-dimensional Schrödinger equation” (04.04.2018, RUDN, Moscow, Seminar of the Department of physical, Mathematical and Natural Sciences of RUDN).
6. A. K. Motovilov, “Unphysical energy sheets and resonances in the Friedrichs–Faddeev model” (04.12.2018, Seminar on Few-Body Systems, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).
7. V. V. Pupyshev, “Two-dimensional movement of a slow quantum particle in the field of a central long-range potential. I. The differential cross-section at low energies.” (13.11.2018, Seminar on Few-Body Systems, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).
8. V. V. Pupyshev, “ Two-dimensional movement of a slow quantum particle in the field of a central long-range potential. II The energies of weakly-bound states.” (20.11.2018, Seminar on Few-Body Systems, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).
9. S. Shadmehri and V. S. Melezhik “Confinement-induced resonances in two-center problem” (12.09.2018, Seminar of Nuclear Physics Department of BLTP, JINR, Dubna).
10. T. P. Grozdanov and E. A. Soloviev, “Hidden crossing theory of charge exchange in $H^+$ + $H^+(1s)$ collisions in vicinity of maximum of cross section” (15.06.2018, Seminar of Nuclear Physics Department of BLTP, JINR, Dubna).
11. S. I. Vinitsky, A. A. Gusev, P. M. Krassovitskiy, and O. Chuluunbaatar, “Adiabatic representation for atomic dimers and trimers in collinear configuration” (27.11.2018, Seminar on Few-Body Systems, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).

## 5 Teaching

1. E. A. Kolganova: PhD adviser of E. Mardyban, Univeristy Dubna.
2. E. A. Kolganova: PhD adviser of O. Klimenko, Univeristy Dubna.
3. E. A. Kolganova: PhD co-adviser of G.Nikoghosyan, Yerevan State University, Armenia.

4. E. A. Kolganova: Diploma co-adviser of E. Mardyban (master thesis), student of Dubna State University.

5. E. A. Kolganova: Diploma adviser of M. Makhnovets (bachelor diploma), student of Dubna State University.

6. E. A. Kolganova: Dozent of the Dubna University, lecture course “Mathematical modeling and numerical methods” (February–June and September–December, 2018).

7. **???** V. N. Kondratyev, Dozent of the Dubna State University, lecture course “Nucleosynthesis” (February–June 2017).

8. V.N. Kondratyev, Diploma adviser (master level) of A.Z.Zhomartova, student of MEPhI University, Moscow.

9. V.N. Kondratyev, Diploma adviser (master level) of U.M. Nurtaeva, student of MEPhI University, Moscow.

10. V. S. Melezhik: Ph. D. Thesis adviser of E.A. Koval, Ph. D. student of the State University “Dubna”, Dubna. Dissertation was defended 16 May, 2018 in the BLTP JINR

11. V. S. Melezhik: Ph. D. Thesis adviser of I. Ishmukhamedov, Jr.Sc. of Al-Farabi Kazakh National University, Almaty, Republic of Kazakhstan and BLTP JINR, Dubna.

12. V. S. Melezhik: Professor of the Dubna University, lecture course “General physics”(all the academic year), lecture course “Modern problems and methodology of physics” (September–December 2018).

13. V. S. Melezhik: scientific adviser of D. Valiolda, Ph. D student of Al-Farabi Kazakh National University, Almaty, Republic of Kazakhstan and Jr. Sc. of BLTP JINR, Dubna.

14. V. S. Melezhik: scientific adviser of D. Dzhanseitov, Sc. of Al-Farabi Kazakh National University, Almaty, Republic of Kazakhstan and BLTP JINR, Dubna.

15. A. K. Motovilov: Professor of Dubna State University, lectures and seminars on the course “Scattering theory for few-body systems” for post graduate students (October 2018 – February 2019).

16. Yu.V. Popov: Co-supervisor of A. Galstyan, PhD student of Université Catholique de Louvain, Louvain-la-Neuve, Belgium (PhD thesis has been defended on 26.09.2018).

## 6 Organizational activity

1. E. A. Kolganova: Scientific Secretary of the JINR STC.

2. E. A. Kolganova: Member of Scientific Council of Dubna State University.

3. E. A. Kolganova: Scientific Secretary of the Council for conferring of bachelor and magister degrees at the Theoretical Physics Department, Dubna State University.

4. E. A. Kolganova: Member of Editorial Board of the journal “Mathematical Modelling and Geometry”.

5. E. A. Kolganova: member of Advisory Committee XXII International Conference on Few-Body Problems in Physics (FB22) (9 – 13 July, 2018, Caen, France).

6. E. A. Kolganova: member of Organizing Committee Humboldt Kolleg / BLTP/JINR - KLFTP/CAS Joint Workshop Physics of Strong Interacting Systems (3 – 7 September, 2018, St. Petersburg, Russia).

7. E. A. Kolganova: Member of Organizing Committee Advances and Challenges in Physics within JINR and South Africa (4 – 9 November, 2018, Somerset West, South Africa).

8. E. A. Kolganova: Support of the BLTP Website.

9. E. A. Kolganova: Support of the BLTP Website.

10. V. N. Kondratyev: Member of Editorial Board of the International Journal of Astronomy and Astrophysics.

11. V. N. Kondratyev: Member of Editorial Board of the International Journal of Advanced Astronomy.

12. V. N. Kondratyev: Member of Editorial Board of "Research and Applications in Astronomy".

13. V. N. Kondratyev: Member of Editorial Board of American Research Journal of Physics.

14. A. A. Korobitsin: Member of Organizing Committee, VII Annual Conference of Young Scientists and Specialists "Alushta-2018" (11.06.2018–18.06.2018, Alushta, Russia).

15. A.V.Malykh: Secretary of Seminar on Few-Body Systems.

16. A.V.Malykh, Preparing Proceedings of student poster session of the VII International Pontecorvo Neutrino Physics School (Prague, Czech Republic, August 20 – September 1, 2017), Eds.F. Simkovic. – Dubna: JINR, ISBN 978-5-9530-0484-8 (2018).

17. V. S. Melezhik: Member of the D. Sc. Panel of LIT, JINR.

18. V. S. Melezhik: Federal expert of Russian Ministry of Education and Science (since 27.02.2014).

19. V. S. Melezhik: Member of International Program Committee of International Conference "Mathematical Modeling and Computational Physics" (MMCP2019), 1–5 July, Slovakia, 2019.

20. A. K. Motovilov: Member of the Scientific Advisory Committee of the International Conference "Nuclear Theory in the Supercomputing Era – 2018" (Daejeon, Korea, 29.10.2018–02.11.2018).

21. A. K. Motovilov: Member of the Council for the main educational program in magistracy "Applied physics and mathematics", St. Petersburg State University.

22. A. K. Motovilov: Member of Editorial Board of the "Few-Body Systems" journal.

23. A. K. Motovilov: Member of the BLTP NTS.

24. S. I. Vinitsky: Member of Advisory Board of the XXV Nuclear Physics Workshop, Structure and dynamics of atomic nuclei, (25.09.2018–30.09.2018, Kazimierz Dolny, Poland)

25. S. I. Vinitsky: Member of International Program Committee of the Saratov Fall Meeting - 18, Workshop on Laser Physics and Photonics XX (24.09.2018–29.09.2018, Saratov, Russia)

26. S. I. Vinitsky: Editor of the “Izvestiya of Saratov University. New Series: Series Physics”.

27. S. I. Vinitsky: Editor-in-Chief of “Mathematical Modelling and Geometry”.

28. S. I. Vinitsky: Member of the Dissertational Council D 212.203.28, RUDN, Moscow.

## 7 Awards, prizes, and thesis defences

1. E. A. Koval: Defence of the C.Sc. (Ph.D.) thesis “Quantum-mechanical analysis of two-body systems with anisotropic interaction in external fields in two-dimensional space” (01.04.02 - theoretical physics).

2. V. S. Melezhik: Outstanding Referee Awards from *Physical Review Letters* and *Physical Review A*.