Few-Body Systems Group (SD TAN Sector 3) at BLTP, JINR

2017 Annual Activity Report

Contents

1 Staff of the BLTP SD TAN Sector 3 in December 2017

1. Ilyaz S. Ishmukhamedov, M.Sc., Junior Researcher
2. Daniyar Janseitov, M.Sc., Junior Researcher
3. Sabit S. Kamalov, Dr., Senior Researcher
4. Elena A. Kolganova, Dr., Senior Researcher
5. Vladimir N. Kondratyev, Dr., Senior Researcher
6. Artem A. Korobitsin, M.Sc., Junior Researcher
7. Evgeny A. Koval, M.Sc., Junior Researcher
8. Anastasia V. Malykh, Dr., Researcher
9. Vladimir S. Melezhik, Dr. Sc., Leading Researcher
10. Alexander K. Motovilov, Dr.Sc., Head of Sector
11. Yury V. Popov, Dr., Senior Researcher (part-time)
12. Vasily V. Pupyshev, Dr.Sc., Leading Researcher
13. Evgeni A. Solov'ev, Dr.Sc., Leading Researcher
14. Dinara S. Valiolda, M.Sc., Junior Researcher
15. Sergue I. Vinitsky, Dr.Sc., Leading Researcher

Olga P. Klimenko (Ph.D. Student, since November 2014)

2 Main results

Tunneling rates of two interacting ultracold atoms confined in an anharmonic trap are calculated [IM]. The ground and excited states with respect to relative and center-of-mass motions are considered and a monotonic and non-monotonic behavior of the tunneling rates as a function of the interatomic coupling strength is observed. The origin of the such behavior lies in an initial wave-packet distribution. It is also found that the only possible tunneling scenario in the considered cases is a sequential particle tunneling. Another interesting feature of the tunneling from the excited state is a two-stage decay in which the population of the atoms of different quantum states during the tunneling process occurs.

[IM] I. S. Ishmukhamedov and V. S. Melezhik, "Tunneling of two bosonic atoms from a one-dimensional anharmonic trap", *Phys. Rev. A* ***95****, 062701 (2017) [10 pages]*.

The energy levels of the halo nucleus of ^{11}Be are calculated, taking into account the effect of an external magnetic field [VJ]. The ^{11}Be nucleus is regarded as a neutron halo consisting of ^{10}Be core and one neutron. Also the root-mean-square (RMS) radius of the ^{11}Be nucleus is numerically calculated in the ground state.

[Vj] S. A. Zhaugasheva, D. Valiolda, D. M. Janseitov, N. K. Zhussupova, Z. Serikov, and F. Aitzhan, "Theoretical study of the coulomb breakup of the halo nuclei ^{11}Be ", ^{15}C, *News of the National Academy of Sciences of the Republic of Kazakhstan Phys.-Math. Series* ***3 (313)****, 81–85 (2017)*.

A manifestation of the Efimov effect in heteronuclear cold atomic systems formed of the ^{4}He and ^{6}Li or ^{7}Li atoms was studied [K1,K2]. The binding energies of ^{6}Li He$_2$ and ^{7}Li He$_2$ systems [K1] and for the first time the scattering length for the collision of a ^{4}He atom with a ^{4}He^{7}Li dimer [K2] were calculated. It has been shown that the excited states in both systems are of the Efimov nature. The large value of the scattering length also supports this conclusion. The results were obtained by using the hard-core version of the Faddeev differential equations and realistic interactions.

[KE1] E. A. Kolganova, "Weakly bound Li He$_2$ molecules", *Few-Body Systems,* ***57****, 58 (2017) [6 pages]*.

[KE2] E. A. Kolganova, "Scattering length calculations via Faddeev approach", *J. Phys: Conf. Ser.* ***915****, 012003 (2017) [7 pages]*.

Soft gamma-ray repeating (SGR) bursts are considered as a release of magnetic energy stored in the baryon degrees of freedom of magnetar crust. It is shown that such an interpretation allows to systemize all the observations of such bursts, reveal and explain the universal statistical properties [KnK].

[KnK] V. N. Kondratyev and Y. V. Korovina, "Magnetoemission of magnetar crust," *Phys. Atom. Nuclei* ***80****: 558 - 561 (2017) [3 pages]*.

The properties of two- and three-atomic clusters of neon are investigated [KrK]. Namely, we have calculated binding energy, the average radius and the root mean square radius for neon dimers and binding energies of ground and first excited states for neon trimer, using modern potential models. In order to perform the calculations we developed numerical algorithm for solve the differential Faddeev equations in the total angular momentum representation. Our results are in a good agreement with the results obtained by other methods. The developed numerically effective computational scheme, especially in combination with an option of using multiple processors, makes it possible to calculate wide range of three-body problems.

[KK] A. A. Korobitsin and E. A. Kolganova, "A theoretical study of van der Waals neon trimer using Faddeev equations", *Phys. Part. Nuclei Lett.* ***14****, 971–974 (2017)*.

Paper [KvK] is is aimed at a numerical study of anisotropic characteristics of a "two-dimensional" (2D) hydrogen atom induced by a magnetic field. The ground state energy (GSE) of the "2D" hydrogen atom and the corresponding wavefunction have been numerically calculated in the Born–Oppenheimer approximation and taking into account the finite proton mass. The nonlinear dependence of the GSE on angle α between the magnetic field vector and the normal to the electron motion plane has been found in a wide range of the magnetic field. The effect of a significant reduction of the GSE (up to 1.9-fold) is observed with increasing the angle α up to 90°. The agreement with experimental data has been demonstrated. The dependences of the GSE of a "2D" exciton in $GaAs/Al_{0.33}Ga_{0.67}As$ have been determined for various tilt angles and magnetic fields.

[KvK] E. A. Koval and O. A. Koval, "Anisotropic features of two-dimensional hydrogen atom in magnetic field", *JETP* ***125****, 35–42 (2017)*.

Let L be a 2×2 block operator matrix whose main-diagonal entries are self-adjoint operators. It is assumed that the spectrum of one of those entries is absolutely continuous, being presented by a single finite band, and the spectrum the other main-diagonal entry is completely embedded into the band. We establish conditions under which the operator matrix L admits a complex deformation and, simultaneously, the operator Riccati equations associated with the deformed L possess bounded solutions. The same conditions also ensure the Markus-Matsaev-type factorization of one of the initial Schur complements analytically continued onto the unphysical sheet(s) of the complex plane of the spectral parameter. We prove that the operator roots of this Schur complement are explicitly expressed through the respective solutions to the deformed Riccati equations [AM].

[AM] S. Albeverio and A. K. Motovilov, "Solvability of the operator Riccati equation in the Feshbach case", arXiv:1712.05770 [math.SP] (2017).

The theoretical investigation is devoted to the convergence of perturbation series in the case of high frequency laser pulse interaction with the hydrogen atom [P]. There is shown, that the series is divergent if only the Coulomb potential is used like a perturbation, even for high frequencies 0.7 a.u. At the same time the series, where the Faddeev reduction of the wave function is used, gives correct values of total ionization, excitation and ground probabilities up to frequencies 0.2 a.u. The study is based on numerical calculations. Special attention is paid to the gauge invariance of series terms.

[1] Y. V. Popov, A. Galstyan, F. Mota-Furtado, P. F. O'Mahony, and B. Piraux, "The strong field approximation within a Faddeev-like formalism for laser-matter interactions", *Eur. Phys.Journal D* ***71****, 93–93 (2017) [7 pages]*.

In [PV] the Coulomb scattering of a slow quantum particle in the space of dimension $d = 2, 3, \ldots$ is studied. The expansions of the wave-functions and all radial wave-functions of this particle over integer powers of the wave number and the Bessel functions of real order are derived. It is proven that the finite sums of these expansions are the asymptotics of the wave-functions in the low-energy limit. A special attention is paid to the case $d = 3$.

[PV] V. V. Pupyshev, "Coulomb scattering of a slow quantum particle in a space of arbitrary dimension", *Theoretical and Mathematical Physics* (accepted for publication).

Within the framework of dynamical adiabatic approach the hidden crossing theory of inelastic transitions is applied to charge exchange in H^++He^+(1s) collisions in wide range of center of mass collision energies, E_{cm} = (16-70) keV [GS]. The good agreement with experiment and molecular close coupling calculations is obtained. 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* (accepted for publication).

Effective methods for calculating the scattering parameters for penetration of cluster consisted of several identical particles through short-range potential barriers and wells are developed. The effects of resonant transmission through the barrier, over-barrier reflection and reflection from the well, generated by the metastable states of the composite system (cluster plus barrier or well), with complex energy eigenvalues corresponding to shape and Feshbach resonances, respectively, are revealed [SV]. In the subsequent publications, a version of the finite element method for calculation of parametric basis functions was developed.

[SV] A.A. Gusev, S.I. Vinitsky, O. Chuluunbaatar, V.L. Derbov, A. Góźdź, and P.M. Krassovitskiy, "Transmission of clusters consisting of a few identical particles through barriers and wells", *Acta Phys. Pol. B (Proc. Suppl.)* ***10****, 269–274 (2017)*.

3 Publications

3.1 Books

1. E. A. Solov'ev, "The Foundations of Quantum Physics. New Interpretation and Systematic Application", Lambert Academic Publishing, Saarbrücken, 2017 (158 pages).

2. V. S. Melezhik and L A. Sevastianov, "Quantum-semiclassical calculation of transition probabilities in antiproton collisions with helium ions", Chapter 37 in the book "Analytical and Computational Methods in Probability Theory", Springer 2017, V. Rykov et al. (Eds.): Proceedings of the ACMPT 2017 Conference. *Lecture Notes in Computer Science* ***10684****, 449-460 (2017).*

3.2 Journal publications

1. A.A. Gusev, O. Chuluunbaatar, S.I. Vinitsky, and A. Góźdź, "Finite Element Method for Solving Boundary-Value Problems of Quantum Mechanical Systems", *Bulletin of Russian-Armenian (Slavonic) University: Physical, Mathematical and Natural Sciences* ***1****, 12–25 (2017)*.

2. A.A. Gusev, O. Chuluunbaatar, S.I. Vinitsky, V.L. Derbov, and A. Góźdź, "Algorithms for solving the parametric self-adjoint 2d elliptic boundary-value problem using high-accuracy finite element method", *RUDN Journal of Mathematics, Information Sciences and Physics* ***25****, 36–55 (2017)*.

3. A.A. Bulychev and K.A. Kouzakov, "Electron momentum spectroscopy of H_2^+ in the presence of laser radiation", *Eur. Phys. J. D* ***71****, 23 (2017) [5 pages]*.

4. N. Burtebayev, Zh. K. Kerimkulov, D. K. Alimov, A. M. Otarbayeva, D. M. Janseitov and Y. S. Mukhamejanov. "Study of elastic scattering of deuterons from ^{6}Li at energy 18 MeV ", *News of the National Academy of Sciences of the Republic of Kazakhstan, Phys.-Math. Series* ***1 (311)****, 5–11, (2017) [editorially misprinted as* ***6 (310)****, 5–11, (2016)]*.

5. O. Chuluunbaatar, S. A. Zaytsev, K. A. Kouzakov, A. Galstyan, V. L. Shablov, and Y. V. Popov. "Fully differential cross sections for singly ionizing 1-MeV p+He collisions at small momentum transfer: Beyond the first Born approximation," *Phys. Rev. A****96****, 042716–042716 (2017) [7 pages]*.

6. A. Galstyan, Y. V. Popov , F. Mota-Furtado, P.F. O'Mahony, N. Janssens, S. D. Jenkins, O. Chuluunbaatar, and B. Piraux, "Modelling laser-atom interactions in the strong field regime," *Eur. Phys. Journal D* ***71****, 97–97 (2017) [11 pages]*.

7. A. N. Grum-Grzhimailo, Y. V. Popov, E. V. Gryzlova, and A. V. Solov'yov, "Many particle spectroscopy of atoms, molecules, clusters and surfaces: International conference MPS 2016 (Editorial)", *Eur. Phys. Journal D* ***71****, 201–201 (2017) [6 pages]*.

8. I. S. Ishmukhamedov and V. S. Melezhik, "Tunneling of two bosonic atoms from a one-dimensional anharmonic trap", *Phys. Rev. A* ***95****, 062701 (2017)*.

9. R. V. Jolos and E. A. Kolganova, "Kinetic energy in the collective quadrupole Hamiltonian from the experimental data", *Phys. Lett. B* ***769****, 368–371 (2017).*

10. E. A. Kolganova, "Weakly bound Li He_2 molecules", *Few-Body Systems* ***57*** *, 58 (2017) [6 pages].*

11. E. A. Kolganova, "Efimov states in asymmetric three-body atomic clusters", *Phys. Part. Nucl.* ***48****, 892–896 (2017).*

12. E. A. Kolganova, A. K. Motovilov, and W. Sandhas, "The ^{4}He Trimer as an Efimov system: Latest developments", *Few-Body Systems* ***58****, 35 (2017) [4 pages].*

13. V. N. Kondratyev and Y. V. Korovina, "Magnetoemission of magnetar crust", *Phys. Atom. Nuclei* ***80****, 558–561. (2017) [3 pages]* .

14. V. N. Kondratyev, U. M. Nurtaeva, A. Z. Zhomartova, and T. V. Mishenina, "Nucleosynthesis at dynamo active supernova explosion", *Odessa Astronomical Publications* ***30****, 91–92 (2017)*.

15. V. N. Kondratyev, "Short soft Γ ray burst spectral evolution", *Odessa Astronomical Publications* ***30****, 89–90 (2017)*.

16. A. A. Korobitsin and E. A. Kolganova, "A theoretical study of van der Waals neon trimer using Faddeev equations", *Phys. Part. Nuclei Lett.* ***14****, 971–974 (2017).*

17. A. A. Korobitsin and E. A. Kolganova, "Clusters of inert gases", *Bull. Russ. Acad. Sci. Phys.* ***81****, 1211–1218 (2017).*

18. A. A. Korobitsin and E. A. Kolganova,"Two-body and three-body rare-gas clusters ", *Phys. Part. Nucl.* ***48****, 900-905 (2017).*

19. A. A. Korobitsin, E. A. Kolganova, O. P. Klimenko, and W. Sandhas, "Three-atomic clusters of rare gases within Faddeev approach", *Phys. Atom. Nucl.* **80***, 553–557 (2017).*

20. E. A. Koval and O. A. Koval, "Anisotropic features of two-dimensional hydrogen atom in magnetic field", *JETP* ***125****, 35–42 (2017)*.

21. E. A. Koval and O. A. Koval, "Excited states of two-dimensional hydrogen atom in tilted magnetic field: Quantum chaos", *Physica E* ***93****, 160–166 (2017)*.

22. A. K. Motovilov and A. A. Shkalikov, *Unconditional bases of subspaces related to non-self-adjoint perturbations of self-adjoint operators*, Eurasian Mathematical Journal **8**:1, 119–127 (2017).

23. G. Nikoghosyan, E. A. Kolganova, and R. V. Jolos, "Isovector and isoscalar pair correlations in boson representation technique", *Bulg. J. Phys.* ***44****, 443–453 (2017).*

24. G. S. Nurbakova, N. Habyl, D. S. Valiolda, and Z. Z. Tyulemissov, "The form factor for the transition $\Lambda_b \to \Lambda_c$", *News of the National Academy of Sciences of the Republic of Kazakhstan. Phys.-Math. Ser.* ***06 (316)****, 78–84, (2017).*

25. B. Piraux, F. Mota-Furtado, P. F. O'Mahony, A. Galstyan, and Y. V. Popov, "Excitation of Rydberg wave packets in the tunneling regime," *Phys. Rev. A* ***96****, 043403–043403 (2017) [10 pages].*

26. Y. V. Popov, A. Galstyan, F. Mota-Furtado, P. F. O'Mahony, and B. Piraux, "The strong field approximation within a Faddeev-like formalism for laser-matter interactions", *Eur. Phys. Journal D* ***71****, 93–93 (2017) (7 pages).*

27. V. V. Pupyshev, " The amplitude functions method in the theory of two-dimensional scattering", *Theor. Math. Phys.* ***191****, 499–523 (2017).*

28. V. V. Pupyshev, "Two-dimensional nuclear Coulomb scattering of a slow quantum particle", *Theor. Math. Phys.* ***193****, 1602–1629 (2017).*

29. S. Saeidian and V. S. Melezhik, "Multichannel scattering problem with a nonseparable angular part as a boundary-value problem", *Phys. Rev. E* ***96****, 053302 (2017) [8 pages].*

30. S. A. Zhaugasheva, D. Valiolda, D. M. Janseitov, N. K. Zhussupova, Z. Serikov, and F. Aitzhan, "Theoretical study of the coulomb breakup of the halo nuclei ^{11}Be ", ^{15}C, *News of the National Academy of Sciences of the Republic of Kazakhstan, Phys.-Math. Series* ***3 (313)****, 81–85 (2017).*

3.3 Articles in paper collections/conference proceedings

1. A. Galstyan, Y.V. Popov, F. Mota-Furtado, P. F. O'Mahony, and B. Piraux, "Modelling laser-matter interactions for simple molecules", *J. Phys.: Conf. Ser.* ***875****, 032010 (2017) [1 page].*

2. J. Gatzke, F. Navarrete, M. Ciappina, H. Gatzke, O. Chuluunbaatar,..., Y.V. Popov, et al., "Single ionization of Helium at 0.5 - 2 MeV proton impact: On the quest for projectile coherence effects", *J. Phys.: Conf. Ser.* ***875****, 092006 (2017) [1 page].*

3. A.A. Gusev, V.P. Gerdt, O. Chuluunbaatar, G. Chuluunbaatar, S.I. Vinitsky, V.L. Derbov, and A. Góźdź, "Symbolic-Numerical Algorithm for Generating Interpolation Multivariate Hermite Polynomials of High-Accuracy Finite Element Method", *Lecture Notes in Computer Science.* ***10490****, 134–150 (2017)*

4. A.A. Gusev, V.P. Gerdt, O. Chuluunbaatar, G. Chuluunbaatar, S.I. Vinitsky, V.L. Derbov, A. Góźdź, "Symbolic-Numerical Algorithms for Solving the Parametric Self-adjoint 2D Elliptic Boundary-Value Problem Using High-Accuracy Finite Element Method", *Lecture Notes in Computer Science.* ***10490****, 151–166 (2017).*

5. A.A. Gusev, S.I. Vinitsky, A. Góźdź, A. Dobrowolski, A. Szulerecka, A. Pedrak, "Symmetrized vibrational-rotational basis for collective nuclear models", *J. Phys. Conf. Ser.* ***804****, 012018 (2017)*.

6. A.A. Gusev, S.I. Vinitsky, A. Góźdź, A. Dobrowolski, "Parametric Basis Functions for Collective Nuclear Models", *Acta Phys. Pol. B (Proc. Suppl.)* ***10****, 99–105 (2017)*.

7. A.A. Gusev, S.I. Vinitsky, O. Chuluunbaatar, V.L. Derbov, A. Góźdź, P.M. Krassovitskiy, "Transmission of clusters consisting of a few identical particles through barriers and wells", *Acta Phys. Pol. B (Proc. Suppl.)* ***10****, 269–274 (2017)*.

8. E. A. Kolganova, "Scattering length calculations via Faddeev approach", *J. Phys: Conf. Ser.* ***915****, 012003 (2017) [7 pages].*

9. V. S. Melezhik,"Quantum-semiclassical approach for treating excitation and ionization of hydrogen-like atoms and ions in collisions with heavy particles", Analytical and Computational Methods in Probability Theory and its Applications (ACMPT-2017), Proc. of the Intern. Scientific Conference / A.V.Lebedev, Ed. RUDN, Moscow, 2017, pp. 319–323.

10. Y. V. Popov, A. Galstyan, F. Mota-Furtado, P. F. O'Mahony, and B.Piraux, "Perturbative expansions for laser-atom interactions", *J. Phys.: Conf. Ser.* ***875****, 032011 (2017) [1 page]*.

11. S.I. Vinitsky, A.A. Gusev, O. Chuluunbaatar, V.L. Derbov, P.M. Krassovitskiy, and L.L. Hai, "Three-body scattering model: diatomic homonuclear molecule and atom in collinear configuration", *Proceedings of SPIE.* ***10337****, 103370 (2017)*.

3.4 Articles accepted for publication

1. A.A. Gusev, O. Chuluunbaatar, Y.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, SFM17-SFM100-183* (accepted for publication).

2. O. Chuluunbaatar, K. Kouzakov, and Y. Popov, "Peculiarities of matrix-element calculations with few Coulomb functions for particles' scattering processes", *Eur. Phys. J.: Web of Conferences* (accepted for publication).

3. N. Burtebayev, D. M. Janseitov, Zh. K. Kerimkulov, D. Alimov, Y. S. Mukhamejanov, M. Nassurlla, A. S. Aimaganbetov, and A. N. Danilov, "Exotic states of ^{13}C nuclei", *Journal of Physics: Conference Series* (accepted for publication).

4. 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* (accepted for publication).

5. D. M. Janseitov, D. Valiolda, and S. A. Zhaugasheva, "The study of the neutron halo of the ^{11}Be nucleus taking into account the influence of an external field", *EPJ: Web of Conferences* (accepted for publication).

6. 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.* (accepted for publication).

7. V. N. Kondratyev and Y. V. Korovina, "Universal Statistics of Soft Gamma-Ray Repeating (SGR) Bursts" , *Physics of Particles and Nuclei* ***49****, 105—108 (2018)*.

8. E. A. Koval and O. A. Koval, "Short-range interaction impact on two-dimensional dipolar scattering", *EPJ Web. Conf.* [Proccedings of the International Conference "Mathematical Modeling and Computational Physics, 2017" (MMCP2017)] (accepted for publication).

9. V. S. Melezhik,"Matematical modeling of resonant processes in confined geometry of atomic and atom-ion traps", *EPJ Web of Conferences* (accepted for publication).

10. V. V. Pupyshev, "Coulomb scattering of a slow quantum particle in a space of arbitrary dimension", *Theoretical and Mathematical Physics* (accepted for publication).

3.5 Preprints and data bases

1. S. Albeverio and A. K. Motovilov, *Solvability of the operator Riccati equation in the Feshbach case*, arXiv:1712.05770 [math.SP] (2017).

2. A. Galstyan, Y.V. Popov, N. Janssens, F. Mota-Furtado, P. F. O'Mahony, P. Decleva, N. Quadri, and B. Piraux, "Ionisation of H_2O by a strong ultrashort XUV pulse: a model within the single active electron approximation", arXiv:1703.05517 [physics.atom-ph] (2017).

3. A. Galstyan, V.L. Shablov, Y.V. Popov, F. Mota-Furtado, P. F. O'Mahony, and B. Piraux, "Exact low frequency behavior of excitation probabilities in laser-atom interactions", arXiv:1711.11350 [physics.atom-ph] (2017).

4 Conference and seminar presentations

4.1 Conference presentations

1. O. Chuluunbaatar, K. Kouzakov, A. Galstyan, Y. Popov, and M. Schoeffler, "Fully differential cross sections for single ionizing 1-MeV p+He collisions at small momentum transfer", Int. Conf. Mathematical Modelling and Computational Physics (MMCP'17) (03 – 07 July 2017, Dubna, Russia), section talk.

2. I. S. Ishmukhamedov and V. S. Melezhik, "Finite-difference splitting scheme for three-dimensional Schroedinger equation, describing tunneling from anharmonic atomic traps", Proceedings of the International Conference "Mathematical Modeling and Computational Physics, 2017" (MMCP2017) (3 – 7 July 2017, Dubna, JINR), section talk.

3. I. S. Ishmukhamedov and V. S. Melezhik, "Tunneling of two bosonic atoms from a one-dimensional anharmonic trap", Proceedings of the XXI International Scientific Conference of Young Scientists and Specialists (AYSS-2017) (2 – 6 October 2017, Dubna, JINR), section talk.

4. D. M. Janseitov, "Investigation of exotic states in light nuclei" 46th meeting of the PAC for Nuclear Physics, JINR (15 June 2017, Dubna, Russia), poster section.

5. D. M. Janseitov, “Investigation of exotic states in light nuclei” 122nd session of the Scientific Council, JINR (19 September 2017, Dubna, Russia), section talk.

6. N. Burtebayev, D. M. Janseitov, Zh. K. Kerimkulov, D. Alimov, Y. S. Mukhamejanov, M. Nassurlla, A. S. Aimaganbetov and A. N. Danilov, “Exotic states of ^{13}C nuclei”, XXII International School on Nuclear Physics, Neutron Physics and Applications (10 – 16 September 2017, Varna, Bulgaria), section talk.

7. N. Burtebayev, D. M. Janseitov and A. N. Danilov, “Investigation of exotic states in light nuclei”, The XXI International Scientific Conference of Young Scientists and Specialists (AYSS-2017) (02 - 06 October 2017, Dubna, Russia), section talk.

8. N. Burtebayev, D. M. Janseitov, Y. S. Mukhamejanov, A. S. Aimaganbetov and E. R. Nurtazin, “Investigation of the scattering of alpha particles by ^{13}C nuclei at low energies ”, 5th International Conference on Cosmology, Relativistic and Nuclear Astrophysics, ICCRNA 2017 (31 October - 04 November 2017, Almaty, Kazakhstan), section talk.

9. R.V.Jolos and E.A.Kolganova, “Kinetic energy in the collective quadrupole Hamiltonian from the experimental data”, *36th International Workshop on Nuclear Theory, Institute for Nuclear Research and Nuclear Energy*, July 9 – 15, 2017, Rila Mountains, Bulgaria, oral presentation.

10. R.V.Jolos and E.A.Kolganova, “Kinetic energy in the collective quadrupole Hamiltonian from the experimental data”, *BLTP/JINR - SKLTP/CAS Joint Workshop on Physics of Strong Interacting Systems, Shenzhen, China*, November 26 - December 1, 2017, Shenzhen, China, oral presentation.

11. R.V.Jolos, G.Nikoghosyan, and E.A.Kolganova, “Isovector and isoscalar pair correlations in nuclei with $N = Z$”, *International Workshop “Shapes and Dynamics of Atomic Nuclei: Contemporary Aspects” (SDANCA-17)*, October 5 – 7, 2017, Sofia, Bulgaria, oral presentation.

12. O.P. Klimenko, E.A.Kolganova, A.A. Korobitsin, and W. Sandhas, “Atomic trimers at ultra low energies’, *The V International School on Symmetry in Integrable Systems and Nuclear Physics (SISNP-V)*, July 16 – 22, 2017, Tsaghkadzor, Armenia, poster presentation.

13. O.P. Klimenko, E.A.Kolganova, A.A. Korobitsin, and W. Sandhas, “Helium trimer via Faddeev differential equation”, *International School & Workshop on Critical Stability of Quantum Few-Body Systems* , October 9 – 20, 2017, Dresden, Germany, oral presentation.

14. E. A. Kolganova, “Efimov states in asymmetric trimers”, *International symposium on New Developments in Methods and Applications of Few-body Physics: in Memory of Professor SA Sofianos*, May 2 – 5, 2017, Johannesburg, South Africa, invited talk.

15. E. A. Kolganova, “Scattering length calculations via Faddeev approach”, *International School & Workshop on Critical Stability of Quantum Few-Body Systems*, October 9 – 20, 2017, Dresden, Germany, invited talk.

16. E. A. Kolganova, “Efimov properties of ^{7}Li^{4}He$_2$ system”, *International Session-Conference of the Section of Nuclear Physics of the Physical Sciences Department of the Russian*

Academy of Sciences "Physics of Fundamental Interactions" dedicated to the 50th anniversary of Baksan Neutrino Observatory, June 6 – 8, 2017, Nalchik, Russia, oral presentation.

17. E. A. Kolganova, "3-atomic asymmetric systems within Faddeev equations", *XVII International Conference on Symmetry methods in Physics (SYMPHYS-XVII)*, July 9 – 15, 2017, Yerevan, Armenia, oral presentation.

18. E. A. Kolganova, "Efimov properties of some 3-body systems", *11th APCTP-BLTP JINR-PNPI NRC KI-SPbU Joint Workshop "Modern Problems in Nuclear and Elementary Particle Physics"*, July 25–31, 2017, Peterhof, St.Petersbur, Russia, oral presentation.

19. E. A. Kolganova, "Three-particle systems and Efimov physics", *BLTP/JINR - SKLTP/CAS Joint Workshop on Physics of Strong Interacting Systems*, November 26 – December 1, 2017, Shenzhen, China, oral presentation.

20. V. N. Kondratyev , "Exploring the Universe by cosmic observatories", (22-25 June 2017, The International Conference-Humboldt Kolleg "Limits of Knowledge", Poland, Cracow), section talk.

21. V. N. Kondratyev, "Nucleosynthesis at magnetorotational instabilities in supernova explosion", (10 – 15 July 2017, XVII International Conference on Symmetry methods in Physics (SYMPHYS-XVII), Yerevan State University, Yerevan, Armenia), section talk.

22. V. N. Kondratyev, "Short soft Γ-ray burst spectral evolution", (13 – 20 August, 2017, 7-th Odessa International Astronomical Gamow Conference-School, Odessa AO, Odessa, Ukraine), poster presentation.

23. V.N. Kondratyev, "Nuclear burning in stars" (16 – 23 July 2017, V International School on Symmetry in Integrable Systems and Nuclear Physics (SISNP-V), Tsakhkadzor, Armenia), lectures.

24. V.N. Kondratyev, "Prestellar Universe: Nucleosynthesis and composition" (16 – 23 July 2017, V International School on Symmetry in Integrable Systems and Nuclear Physics (SISNP-V), Tsakhkadzor, Armenia), lectures.

25. V. N. Kondratyev "Dynamical charateristics of Short soft Γ-ray bursts", (18 – 22 December, 2017, All-Russian Conference "High energy Astrophysics: Today and Tomorrow HEA – 2017", IKI RAS, Moscow, Russia), poster presentation.

26. V. N. Kondratyev, U. M. Nurtaeva, A. Z. Zhomartova, and T. V. Mishenina, "Nucleosynthesis at dynamo active supernova explosion", (13–20 August 2017, 7-th Odessa International Astronomical Gamow Conference, Odessa, Ukraine), section talk.

27. A. A. Korobitsin and E. A. Kolganova, "Neon three–atomic clusters within Faddeev approach", The XXI International Scientific Conference of Young Scientists and Specialists (AYSS-2017) (02 – 06 October 2017, Laboratory of Information Technologies, JINR, Dubna), oral presentation.

28. A. A. Korobitsin and E. A. Kolganova, "Neon three - atomic clusters within Faddeev approach", 46th meeting of the PAC for Nuclear Physics (15 June 2017, JINR, Dubna), poster presentation.

29. A.A.Korobitsin and E.A.Kolganova, "Theoretical study of the neon clusters", *International School & Workshop on Critical Stability of Quantum Few-Body Systems, Max Planck Institute for the Physics of Complex Systems*, October 9 – 20, 2017, Dresden, Germany, oral presentation.

30. A.A.Korobitsin and E.A.Kolganova, "Theoretical study of the neon clusters", *ILXVII International Conference on Nuclear Physics "Nucleus-2017"*, September 12 – 15, 2017, Almaty, Kazakhstan, oral presentation.

31. E. A. Koval, "Short-range Interaction Impact on Two-dimensional Dipolar Scattering", International Conference "Mathematical Modeling and Computational Physics, 2017" (MMCP 2017) (3 – 7 July 2017, Laboratory of Information Technologies, JINR, Dubna), poster presentation

32. E. A. Koval, "Excited states of two-dimensional hydrogen atom in tilted magnetic field: Quantum chaos", IV International Conference on Quantum Technologies (ICQT2017) (12 – 16 July 2017, Russian Quantum Center, Moscow), poster presentation

33. E. A. Koval and O. A. Koval, "Two-dimensional exciton spectrum in GaAs quantum well in tilted magnetic field", The 49th Conference of the European Group on Atomic Systems (EGAS'49) (17 – 21 July 2017, Durham University, Durham, UK), poster presentation

34. E.V.Mardyban and T.M. Shneidman, E.A.Kolganova, and R.V.Jolos, "Phase transitions in heavy nuclei", *The V International School on Symmetry in Integrable Systems and Nuclear Physics (SISNP-V)* (16–22 July, 2017, Tsaghkadzor, Armenia), poster presentation.

35. E.V.Mardyban and T.M. Shneidman, E.A.Kolganova, and R.V.Jolos, "Description of alternating parity bands in heavy nuclei using supersymmetric quantum mechanics", *International School & Workshop on Critical Stability of Quantum Few-Body Systems* (October 9 – 20, 2017, Dresden, Germany), oral presentation.

36. V. S. Melezhik "Matematical modeling of resonant processes in confined geometry of atomic and atom-ion traps",International Conference "Mathematical Modeling and Computational Physics, 2017" (MMCP2017) (3 –7 July 2017, JINR,IFIN-HH, and Slovak Academy of Sciences, Dubna, Russia), plenary talk.

37. V. S. Melezhik,"Quantum-semiclassical approach for treating excitation and ionization of hydrogen-like atoms and ions in collisions with heavy particle",International Scientific Conference "Analytical and computational methods in probability theory and its applications" (ACMPT-2017) (23 – 26 October 2017, MSU and RUDN, Moscow, Russia), oral presentation.

38. V. S. Melezhik and A. Negretti, "Micromotion effect in atom-ion confinement-induced resonances",26th Annual International Laser Physics Workshop (17 – 21 July 2017, Kazan E K Zavoisky Physical-Technical Institute (KPhTI), Kazan, Russia), invited talk.

39. V. S. Melezhik, and S. Saeidian, "Multichannel scattering problem with nonseparable angular part as boundary-value problem",RO-LCG 2017 Conference "Grid, Cloud and High-Performance Computing in Science" (25 – 27 October 2017, IFIN-HH, LCG RO, Sinaia, Romania), invited talk.

40. A. K. Motovilov, "Bounds on variation of spectral subspaces of a self-adjoint Hamiltonian under symmetric and J-symmetric perturbations", XVII International Conference on Symmetry methods in Physics (SYMPHYS-XVII), July 9 – 15, 2017, Yerevan, Armenia, oral presentation.

41. A. K. Motovilov, "On equivalence of the complex rotation resonances and scattering matrix resonances", International symposium on New Developments in Methods and Applications of Few-body Physics: in Memory of Professor SA Sofianos, May 2 – 5, 2017, Johannesburg, South Africa, invited talk.

42. A. K. Motovilov, "Solvability of the operator Riccati equation in the Feshbach case", The Fifth Najman Conference on Spectral Theory and Differential Equations (10–15 September 2017, Opatija, Croatia), section talk.

43. U. M. Nurtaeva and V. N. Kondratyev "Zeeman effect at explosive nucleosynthesis", (18 – 22 December 2017, All-Russian Conference "High energy Astrophysics: Today and Tomorrow HEA –2017", IKI RAS, Moscow, Russia), poster presentation.

44. U. M. Nurtaeva and V. N. Kondratyev, "Zeeman effect at explosive nucleosynthesis", (14 – 17 November, 2017, XV Kurchatov School, KI, Moscow, Russia), oral presentation

45. Y.V. Popov and K.A. Kouzakov, "(e,3e) electron momentum spectroscopy: Method to see ee-correlations in the target", Int. Workshop on Electron Correlations: from Gases to Solids (ElCoGS 2017) (08 – 09 June 2017, Roma, Italy), oral presentation.

46. D. S. Valiolda, "Coulomb breakup of the halo nucleus ^{11}Be", Euroschool on Exotic Beams (28 August – 02 September 2017, Cabourg, France), poster presentation.

47. D. S. Valiolda, S. A. Zhaugasheva and D. M. Janseitov, "Study of the Coulomb breakup of halo nuclei", XXII International School on Nuclear Physics, Neutron Physics and Applications (10 - 16 September 2017, Varna, Bulgaria), oral presentation.

48. D. S. Valiolda, S. A. Zhaugasheva and D. M. Janseitov, "Study of the Coulomb breakup of halo nuclei in quantum mechanical approach", The XXI International Scientific Conference of Young Scientists and Specialists (AYSS-2017) (02 - 06 October 2017, Dubna, Russia), poster presentation.

49. S. I. Vinitsky, "Kantorovich approach for analysis of spectral and optical characteristics of quantum dots", Conference Devoted to the 75 Anniversary of E.M. Kazaryan Russian-Armenian University, February 23-24, 2017, Yerevan, Armenia, invited talk.

50. S. I. Vinitsky, A. Gusev, G. Chuluunbaatar, O. Chuluunbaatar, "High-accuracy finite element method for the 2D parametric elliptic boundary-value problems", International Conference Mathematical Modeling and Computational Physics, 2017 (MMCP 2017) July 3 – 7, 2017 Dubna, oral presentation.

51. S. I. Vinitsky, “Adiabatic approach for a trimer of identical atoms”, XVII International Conference on Symmetry methods in Physics (SYMPHYS-XVII), July 10 – 15, Yerevan, Armenia, oral presentation.

52. S. I. Vinitsky, “Closed coupled channel method and adiabatic representation for solving quantum boundary value problems”, International School Symmetry in Integrable Systems and Nuclear Physics July 16 - 23, Tsakhkadzor, Armenia, lecture.

53. S. I. Vinitsky, A. A. Gusev, O. Chuluunbaatar, P. M. Krassovitskiy, “Quantum transparency of barriers for composite systems and ions”, International Scientific Forum “Nuclear Science and Technologies”, dedicated to the 60th anniversary of the Institute of Nuclear Physics, September 12 – 15, 2017, Almaty, Republic of Kazakhstan , oral presentation.

54. A.A. Gusev, V.P. Gerdt, O. Chuluunbaatar, G. Chuluunbaatar, S.I. Vinitsky, V.L. Derbov, A. Góźdź, “Symbolic-Numerical Algorithms for Solving the Parametric Self-adjoint 2D Elliptic Boundary-Value Problem Using High-Accuracy Finite Element Method”, *The 19th International Workshop on Computer Algebra in Scientific Computing, September 18 – 22, 2017, Beijing, China*, oral presentation.

55. S. I. Vinitsky, A.A. Gusev, O. Chuluunbaatar, V.L. Derbov, L.L. Hai, and P.M. Krassovitskiy, “Three-body scattering model: parametric basis surface functions”, Saratov Fall Meeting - 17, Workshop on Laser Physics and Photonics XIX (September 26 – 29, 2017 Saratov, Russia), oral presentation.

56. A.A. Gusev, V.P. Gerdt, O. Chuluunbaatar, G. Chuluunbaatar, S.I. Vinitsky, V.L. Derbov, A. Góźdź, and P. M. Krassovitskiy, “Solving quantum mechanical problems using finite element and Kantorovich methods”, Grid, Cloud and High-Performance Computing in Science, RO-LCG 2017, Sinaia, Romania, October 26 – 28, 2017, oral presentation.

57. A. Z. Zhomartova and V. N. Kondratyev, ”Structure and composition of ultra-magnetic nuclei in statistical equilibrium ”, (18 – 22 December 2017, All-Russian Conference ”High energy Astrophysics: Today and Tomorrow HEA –2017”, RAS Institute of Space Research, Moscow, Russia), poster presentation.

58. A. Z. Zhomartova and V. N. Kondratyev, ”Structure and composition of ultra-magnetic nuclei in statistical equilibrium”, (14 – 17 November, 2017, XV Kurchatov School, Kurchatov Institute, Moscow, Russia), oral presentation.

4.2 Seminar talks

1. A. A. Korobitsin, “The rare gas clusters” (14 February 2017, Seminar on Few-Body Systems, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).

2. E. A. Koval, “Two-dimensional two-body systems with anisotropic interactions in external fields” (19 September 2017, Seminar on Few-Body Systems, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).

3. E. A. Koval, “Two-dimensional two-body systems with anisotropic interactions in external fields” (22 September 2017, Seminar in the Laboratory of Quantum Optical Technologies, Moscow State University, Moscow).

4. E. A. Koval, “Two-body systems with anisotropic interactions in external fields in two spatial dimensions” (On materials of the Candidate Thesis) (9 October 2017, Seminar on Nuclear Theory, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).

5. A.V. Malykh, “Universal low-energy description of few two-component particles with contact interactions”, (29 May 2017, Seminar on Nuclear Theory, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).

6. A.K. Motovilov, “Energy-dependent interactions and perturbation problem for invariant subspaces”, (13 March 2017, Seminar on Nuclear Theory, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).

7. U. M. Nurtaeva and V. N. Kondratyev, ”Zeeman effect at explosive nucleosynthesis” (31 October 2017, Seminar on Few-Body Systems, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).

8. Yu.V. Popov. “Dynamics of atomic hydrogen in strong laser field: Perturbation series”, (28 November 2017, Seminar on Few-Body Systems, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).

9. A.Z. Zhomartova and V.N. Kondratyev, ”Structure and composition of ultra-magnetic nuclei in statistical equilibrium” (31 October 2017, Seminar on Few-Body Systems, Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna).

5 Teaching

1. E. A. Kolganova: PhD adviser of O. Klimenko, Dubna State University.

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

3. E. A. Kolganova: Diploma co-adviser of G.Nikoghosyan (master thesis), student of Yerevan State University, Armenia.

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

5. E. A. Kolganova: Dozent of the Dubna University, lecture course “Mathematical modeling and numerical methods” (February–June and September–December, 2017).

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

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

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

9. E. A. Koval: seminars, colloquia for students of the Dubna University on course “Physics of macrosystems”.

10. V. S. Melezhik: Professor of the Dubna State University, lecture course “General physics” (all the academic year), lecture course “Modern problems and methodology of physics” (September–December 2017).

11. V. S. Melezhik: Ph. D. Thesis adviser of E.A. Koval, Ph. D. student of the State University “Dubna”, Dubna.

12. 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.

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

14. V. S. Melezhik: Ph. D. Thesis adviser of D. Dzhanseitov, Jr.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 5th year students (September – December 2017).

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 Organizing Committee The International Session-Conference of SNP PSD RAS “Physics of Fundamental Interactions” (6 – 8 June, 2017, Nalchik, Russia).

6. E. A. Kolganova: Vice-Chairperson, The XVII International Conference on Symmetry methods in Physics (9 – 15 July, 2017, Yerevan, Armenia).

7. E. A. Kolganova: Member of Organizing Committee International School on Symmetry in Integrable Systems and Nuclear Physics (16 – 23 July, 2017, Tsaghkadzor, Armenia).

8. E. A. Kolganova: Member of Organizing CommitteeVIIth International Pontecorvo Neutrino Physics School (20 – 31 August, 2017, Prague, Czech Rep.).

9. E. A. Kolganova: Member of Organizing Committee The XVIIth International workshop on High Energy Spin Physics (DSPIN-15) (11 – 15 September, 2017, BLTP, JINR).

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

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

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

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

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

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

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

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

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

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

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

21. Yu.V. Popov: Member of the Scientific Council of Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University.

22. S. I. Vinitsky: Member of Organizing Committee, XVII International Conference on Symmetry methods in Physics (SYMPHYS-XVII), July 10 - 15, Yerevan, Armenia.

23. S. I. Vinitsky: Member of International Program Committee, Saratov Fall Meeting - 17, Workshop on Laser Physics and Photonics XIX (SFM 17, September 26-29, 2017 Saratov, Russia)

24. S.I. Vinitsky: Editor of Izvestiya of Saratov University. New Series: Series Physics.

25. S.I. Vinitsky: Editor-in-Chief of Mathematical Modelling and Geometry .

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