| № | Название статьи | Авторы | Год | Название журнала | Краткая аннотация | Ссылка |
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| | | | | **2019** | | |
| | | | | **Кафедра теоретической и ядерной физики** | | |
| 1. | No-scale supergravity with new Fayet-Iliopoulos term | Aldabergenov, Y. | 2019 | Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics, 2019, 795, стр. 366–370, Q2 https://doi.org/10.1016/j.physletb.2019.03.068 | We find a new class of N=1 no-scale supergravity models with F- and D-term supersymmetry breaking, using a new Fayet-Iliopoulos term. The minimal setup contains one U(1) vector multiplet and one neutral chiral multiplet parametrizing SL(2,R)/U(1) manifold, with constant superpotential and linear gauge kinetic function. In our construction the FI term is field-dependent, and one can obtain flat vanishing potential (Minkowski vacuum) with broken SUSY, and global SL(2,R) invariance (self-duality) of the bosonic equations of motion. The spectrum of the model includes a massive spin-1/2 field as well as a vector, a scalar, and a pseudo-scalar – all classically massless. We discuss several modifications/extensions of the model as well as the introduction of matter fields. We also find a two-field extension of already existing no-scale model. | https://www.kaznu.kz/ru/25336/page/ |
| 2. | Generalized dilaton–axion models of inflation, de Sitter vacua and spontaneous SUSY breaking in supergravity | Aldabergenov, Y., Chatrabhuti, A., Ketov, S.V. | 2019 | European Physical Journal C, 2019, 79(8), 713, Q2 https://doi.org/10.1140/epjc/s10052-019-7225-2 | We propose the unified models of cosmological inflation, spontaneous SUSY breaking, and the dark energy (de Sitter vacuum) in N= 1 supergravity with the dilaton–axion chiral superfield T in the presence of an N= 1 vector multiplet with the alternative Fayet–Iliopoulos term. By using the Kähler potential as $K= - \alpha \log (T+ \bar{T})$ and the superpotential as a sum of a constant and a linear term, we find that viable inflation is possible for $3 \leq \alpha \leq \alpha_{max}$ where $\alpha_{max} \approx 7.235$. Observations of the amplitude of primordial scalar perturbations fix the SUSY breaking scale in our models as high as $10^{13}$GeV. In the case of $\alpha > 3$ the axion gets the tree-level (non-tachyonic) mass comparable to the inflaton mass. | https://www.kaznu.kz/ru/25336/page/ |
| 3. | Polonyi-Starobinsky supergravity with inflaton in a massive vector multiplet with DBI and FI terms | Abe, H., Aldabergenov, Y., Aoki, S., Ketov, S.V. | 2019 | Classical and Quantum Gravity, 2019, 36(7), 075012, Q2 | We propose the Starobinsky-type inflationary model in the matter-coupled N = 1 four-dimensional supergravity with the massive vector multiplet that has inflaton (scalaron) and goldstino amongst its field components, whose action includes the Dirac-Born-Infeld-type kinetic term and the generalized (new) Fayet-Iliopoulos-type term, without gauging the R-symmetry. The N = 1 chiral matter ('hidden sector') is described by the modified Polonyi model needed for spontaneous supersymmetry breaking after inflation. We | https://www.kaznu.kz/ru/25336/page/ |

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| | | | | https://doi.org/10.1088/1361-6382/ab0901 | compute the bosonic action and the scalar potential of the model, and show that it can accommodate the positive (observed) cosmological constant (as the dark energy) and the spontaneous supersymmetry breaking at high scale after the Starobinsky inflation. | |
| 4. | Modified born-infeld-dilaton-axion coupling in supersymmetry | Aldabergenov, Y., Ketov, S.V. | 2019 | Symmetry, 2019, 11(1), 14, Q2<br><br>https://doi.org/10.3390/sym11010014 | We propose the supersymmetric extension of the modified Born-Infeld-axion-dilaton non-linear electrodynamics that has confined static abelian solutions used for describing the electromagnetic confinement in the presence of axion and dilaton fields, as well as charged matter. The supersymmetric extension also has the non-trivial scalar potential that implies the upper bounds on the matter fields. | https://www.kaznu.kz/ru/25336/page/ |
| 5. | Leading-order relativistic corrections to the rovibrational spectrum of H2 + and HD+ molecular ions | Aznabayev, D.T., Bekbaev, A.K., Korobov, V.I. | 2019 | Physical Review A, 2019, 99(1), 012501, Q2<br><br>https://doi.org/10.1103/PhysRevA.99.012501 | High-precision variational calculations of the operators for the relativistic corrections in the leading $m\alpha^4$ order are presented. The rovibrational states in the range of the total orbital angular momentum L=0-4 and vibrational quantum number v=0-10 for the H2+ and HD+ molecular ions are considered. We estimate that about 10 significant digits are obtained. This high precision is required for making theoretical predictions for transition frequencies at the level of 10-12 relative uncertainty. | https://www.kaznu.kz/ru/25336/page/ |
| 6. | The Erez-Rosen solution versus the Hartle-Thorne solution | Boshkayev, K., Quevedo, H., Nurbakyt, G., Malybayev, A., Urazalina, A. | 2019 | Symmetry, 2019, 11(10), 1324, Q2<br><br>https://doi.org10.3390/sym11101324 | In this work, we investigate the correspondence between the Erez-Rosen and Hartle-Thorne solutions. We explicitly show how to establish the relationship and find the coordinate transformations between the two metrics. For this purpose the two metrics must have the same approximation and describe the gravitational field of static objects. Since both the Erez-Rosen and the Hartle-Thorne solutions are particular solutions of a more general solution, the Zipoy-Voorhees transformation is applied to the exact Erez-Rosen metric in order to obtain a generalized solution in terms of the Zipoy-Voorhees parameter $\delta = 1 + sq$. The Geroch-Hansen multipole moments of the generalized Erez-Rosen metric are calculated to find the definition of the total mass and quadrupole moment in terms of the mass m, quadrupole q and Zipoy-Voorhees $\delta$ parameters. The coordinate transformations between the metrics are found in the approximation of ~q. It is shown that | https://www.kaznu.kz/ru/25336/page/ |

| | | | | | the Zipoy-Voorhees parameter is equal to $\delta = 1 - q$ with $s = -1$. This result is in agreement with previous results in the literature. | |
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| 7. | Time evolution of rotating and magnetized white dwarf stars | Becerra, L., Boshkayev, K., Rueda, J.A., Ruffini, R. | 2019 | Monthly Notices of the Royal Astronomical Society, 2019, 487(1), стр. 812–818, Q1 https://doi.org10.1093/mnras/stz1394 | We investigate the evolution of isolated, zero and finite temperature, massive, uniformly rotating and highly magnetized white dwarf stars under angular momentum loss driven by magnetic dipole braking. We consider the structure and thermal evolution of white dwarf isothermal cores taking also into account the nuclear burning and neutrino emission processes. We estimate the white dwarf lifetime before it reaches the condition either for a type Ia supernova explosion or for the gravitational collapse to a neutron star. We study white dwarfs with surface magnetic fields from 106 to 109 G and masses from 1.39 to 1.46 $M_\odot$ and analyse the behaviour of the white dwarf parameters such as moment of inertia, angular momentum, central temperature, and magnetic field intensity as a function of lifetime. The magnetic field is involved only to slow down white dwarfs, without affecting their equation of state and structure. In addition, we compute the characteristic time of nuclear reactions and dynamical time scale. The astrophysical consequences of the results are discussed. | https://www.kaznu.kz/ru/25336/page/ |
| 8. | A model for a dark matter core at the Galactic Centre | Boshkayev, K., Malafarina, D. | 2019 | Monthly Notices of the Royal Astronomical Society, 2019, 484(3), стр. 3325–3333, Q1 https://doi.org10.1093/mnras/stz219 | We consider a toy model for the supermassive compact object at the Galactic centre that does not require the presence of a black hole. We assume a matter distribution of weakly interacting particles with a density profile inferred from dark matter profiles in the outer regions. We show that rotation curves close to the centre of the Milky Way Galaxy can be explained within this model. We also show that the motion of test particles (stars) at distances of the order of 100 au cannot be distinguished from the motion of corresponding particles in the Schwarzschild geometry. However, differences arise at shorter distances, suggesting that it could be possible to observationally test the validity of the model in the near future. | https://www.kaznu.kz/ru/25336/page/ |
| 9. | Extended logotropic fluids as unified dark energy models | Boshkayev, K., D'Agostino, R., Luongo, O. | 2019 | European Physical Journal C, 2019, 79(4), 332, Q2 | We study extended classes of logotropic fluids as unified dark energy models. Under the hypothesis of the Anton–Schmidt scenario, we consider a universe obeying a single fluid model with a logarithmic equation of state. We investigate the thermodynamic and dynamical consequences of an extended | https://www.kaznu.kz/ru/25336/page/ |

| | | | | https://doi.org10.1140/epjc/s10052-019-6854-9 | version of the Anton–Schmidt cosmic fluids. Specifically, we expand the Anton–Schmidt pressure in the infrared regime. The low-energy case becomes relevant for the universe as regards acceleration without any cosmological constant. We therefore derive the effective representation of our fluid in terms of a Lagrangian depending on the kinetic term only. We analyze both the relativistic and the non-relativistic limits. In the non-relativistic limit we construct both the Hamiltonian and the Lagrangian in terms of density $\rho$ and scalar field $\vartheta$, whereas in the relativistic case no analytical expression for the Lagrangian can be found. Thus, we obtain the potential as a function of $\rho$, under the hypothesis of an irrotational perfect fluid. We demonstrate that the model represents a natural generalization of logotropic dark energy models. Finally, we analyze an extended class of generalized Chaplygin gas models with one extra parameter $\beta$. Interestingly, we find that the Lagrangians of this scenario and the pure logotropic one coincide in the non-relativistic regime. | |
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| 10. | Measurement and analysis of 10B + 12C elastic scattering at energy of 41.3 MeV | Burtebayev, N., Nassurlla, M., Sabidolda, A., Kemper, K.W., Ibraheem, A.A., Janseitov, D, et al. | 2019 | International Journal of Modern Physics E 28(4),1950028, Q2 https://doi.org/10.1142/S0218301319500289 | Angular distribution of the $^{10}$B $+^{12}$C elastic scattering was measured at Elab($^{10}$B) = 41.3MeV. Experimental data showed a significant increase in differential cross-sections at backward angles. The optical model with phenomenological potentials reproduces well the experimental cross-sections in the region of the angles of the forward hemisphere, but is not able to explain the increase in cross-sections at large angles. The distorted wave Born approximation method was used to reproduce the experimental data at large angles ($> 90°$) by taking into consideration a deuteron transfer. Spectroscopic amplitude has been extracted for the configuration $^{12}$C $\rightarrow$ $^{10}$B + d from the analysis. | https://www.kaznu.kz/ru/25336/page/ |
| 11. | Mechanism of the $^{11}$B($\alpha$,t) $^{12}$C reaction at an energy of 40 MeV, role of exchange processes and collective excitations | Burtebayev, N., Sakuta, S.B., Nassurlla, M., Wolińska-Cichocka, M., Khojayev, R. | 2019 | European Physical Journal A, 2019, 55(3), 38, Q2 https://doi.org/10.1140/epja/i2019-12712-8 | The differential cross sections of triton from the $^{11}$B($\alpha$,t) reaction with transitions to the ground ($0^+$) and excited states of the $^{12}$C nucleus at E $_x$ = 4. 44 MeV ($2^+$), 7.65 MeV ($0^+$), 9.64 MeV ($3^-$) and 14.08 MeV ($4^+$) have been measured at an $\alpha$-particles energy of 40 MeV. Analysis of the measured angular distributions was carried out in the framework of the coupled reaction channels method considering the contribution of the $^8$Be cluster exchange mechanism. It is shown that the direct mechanism with proton transfer dominates at an energy of 40 MeV, and the heavy particle | https://www.kaznu.kz/ru/25336/page/ |

| | | | | | transfer is noticeable only at large angles. An exception is the transition to the 14.08 MeV ($4^+$) state, which is possible only by the transfer of the $^8$Be cluster. It is established that the couplings between the excited states of $^{12}$C, arising from the nonsphericity of the nucleus, have little effect on the ($\alpha$, t) reaction cross sections in the forward hemisphere, but strongly affect the cross sections at large angles. | |
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| 12. | New results for neutron radiative capture on $^{10}$Be at energies between 25.3 meV and 10.0 MeV | Dubovichenko, S.B., Burkova, N.A., Afanasyeva, N.V., Dzhazairov-Kakhramanov, A.V., Tkachenko, A.S. | 2019 | Astroparticle Physics, 2019, 104, стр. 91–101, Q2  https://doi.org/10.1016/j.astropartphys.2018.09.003 | Using the framework of the modified potential cluster model, we succeed in correctly describing the available experimental data for neutron radiative capture on $^{10}$Be total cross sections at low, astrophysical and thermal energies. Unlike our earlier work, the present calculations are based on new experimental data for Coulomb dissociation provided by Prof. T. Aumann and Prof. T. Nakamura. The energy range was extended from $10^{-5}$ to $10^4$ keV for the theoretical cross sections, covering a range of temperatures between 0.01 and 10 $T_9$. The role of the halo asymptotics of the extra-core neutron in $^{11}$Be was also taken into account. The parametrization of the reaction rates for the processes $^{10}$Be(n,$\gamma_{0+1}$)$^{11}$Be are obtained in an analytical form that is convenient for future calculations of different scenarios involving element synthesis in r-processes, as widely discussed in the context of boron and beryllium chains in our previous work. | https://www.kaznu.kz/ru/25336/page/ |
| 13. | Energy conditions for a T2 wormhole at the center | Dzhunushaliev, V., Folomeev, V., Kleihaus, B., Kunz, J. | 2019 | Physical Review D, 2019, 100(8), 084008, Q1  https://doi.org/10.1103/PhysRevD.100.084008 | Within general relativity, we determine the conditions needed for the existence of a toroidal T2 wormhole. For this purpose, we employ the requirements of the positiveness of the second derivatives of the relevant components of the metric, which describe an increase in the linear sizes (or the area) of the cross section of the throat. The corresponding inequalities for the central energy density and pressures of the matter and for the metric are obtained. | https://www.kaznu.kz/ru/25336/page/ |
| 14. | Rotating wormhole solutions with a complex phantom scalar field | Chew, X.Y., Kleihaus, B., Kunz, J., Dzhunushaliev, V., Folomeev, V. | 2019 | Physical Review D, 2019, 100(4), 044019, Q1  https://doi.org/10.1103/PhysRevD.100.044019 | We consider rotating wormhole solutions supported by a complex phantom scalar field with a quartic self-interaction, where the phantom field induces the rotation of the spacetime. The solutions are regular and asymptotically flat. A subset of solutions describing static but not spherically symmetric wormholes is also obtained. | https://www.kaznu.kz/ru/25336/page/ |

| 15. | Dirac star in the presence of Maxwell and Proca fields | Dzhunushaliev, V., Folomeev, V. | 2019 | Physical Review D, 2019, 99(10), 104066, Q1 https://doi.org/10.1103/PhysRevD.99.104066 | We consider configurations consisting of a gravitating nonlinear spinor field $\psi$, with a nonlinearity of the type $\lambda(\bar{\psi}\psi)2$, minimally coupled to Maxwell and Proca fields through the coupling constants QM [U(1) electric charge] and QP, respectively. In order to ensure spherical symmetry of the configurations, we use two spin-1/2 fields having opposite spins. By means of numerical computations, we find families of equilibrium configurations with a positive Arnowitt-Deser-Misner (ADM) mass described by regular zero-node asymptotically flat solutions for static Maxwell and Proca fields and for stationary spinor fields. For the case of the Maxwell field, it is shown that, with increasing charge QM, the masses of the objects increase and diverge as the charge tends to a critical value. For negative values of the coupling constant $\lambda$, we demonstrate that, by choosing physically reasonable values of this constant, it is possible to obtain configurations with masses comparable to the Chandrasekhar mass and with effective radii of the order of kilometers. It enables us to speak of an astrophysical interpretation of such systems, regarding them as charged Dirac stars. In turn, for the system with the Proca field, it is shown that the mass of the configurations also grows with increasing both $|\lambda|$ and the coupling constant QP. Although in this case the numerical calculations do not allow us to make a definite conclusion about the possibility of obtaining masses comparable to the Chandrasekhar mass for physically reasonable values of $\lambda$, one may expect that such masses can be obtained for certain values of free parameters of the system under consideration. | https://www.kaznu.kz/ru/25336/page/ |
| 16. | Dirac stars supported by nonlinear spinor fields | Dzhunushaliev, V., Folomeev, V. | 2019 | Physical Review D, 2019, 99(8), 084030, Q1 https://doi.org/10.1103/PhysRevD.99.084030 | We study configurations consisting of a gravitating spinor field $\psi$ with a nonlinearity of the type $\lambda(\bar{\psi}\psi)2$. To ensure spherical symmetry of the configurations, we use two spin-12 fields forming a spin singlet. For such systems, we find regular stationary asymptotically flat solutions describing compact objects. For negative values of the coupling constant $\lambda$, it is shown that, by choosing physically reasonable values of this constant, it is possible to obtain configurations with masses comparable to the Chandrasekhar mass. It enables us to speak of an astrophysical interpretation of the obtained systems, regarding them as Dirac stars. | https://www.kaznu.kz/ru/25336/page/ |

| 17. | Non-Abelian Proca-Dirac-Higgs theory: Particlelike solutions and their energy spectrum | Dzhunushaliev, V., Folomeev, V., Makhmudov, A. | 2019 | Physical Review D, 2019, 99(7), 076009, Q1  https://doi.org/10.1103/PhysRevD.99.076009 | We study a system consisting of a non-Abelian SU(2) Proca field interacting with nonlinear scalar (Higgs) and spinor fields. For such a system, it is shown that particlelike solutions with finite energy do exist. It is demonstrated that the solutions depend on three free parameters of the system, including the central value of the scalar field $\xi 0$. For some fixed values of $\xi 0$, we find energy spectra of the solutions. It is shown that for each of the cases under consideration, there is a minimum value of the energy $\Delta = \Delta(\xi 0)$ [the mass gap $\Delta(\xi 0)$ for a fixed value of $\xi 0$]. The behavior of the function $\Delta(\xi 0)$ is studied for some range of $\xi 0$. | https://www.kaznu.kz/ru/25336/page/ |
| 18. | Thin-shell toroidal wormhole | Dzhunushaliev, V., Folomeev, V., Kleihaus, B., Kunz, J. | 2019 | Physical Review D, 2019, 99(4), 044031, Q1  https://doi.org/10.1103/PhysRevD.99.044031 | We consider a topologically nontrivial thin-shell wormhole with a throat in the form of a T2 torus. It is shown that (i) such a wormhole is stable with respect to excitations of the throat; (ii) not all energy conditions are violated for such wormholes; (iii) if any of the energy conditions is violated, this violation occurs only partially in some region on the throat, and in other regions the violation is absent. Also, we discuss the differences between spherical S2 wormholes and toroidal T2 wormholes under investigation. | https://www.kaznu.kz/ru/25336/page/ |
| 19. | The motion of color-charged particles as a means of testing the non-Abelian dark matter model | Dzhunushaliev, V., Folomeev, V., Protsenko, N. | 2019 | International Journal of Modern Physics D, 2019, 28(1), Q2  https://doi.org/10.1142/S0218271819500172 | A possibility is discussed to experimentally test a dark matter model supported by a classic non-Abelian SU(3) Yang-Mills gauge field. Our approach is based on the analysis of the motion of color-charged particles in the background of color electric and magnetic fields using the Wong equations. Estimating the magnitudes of the color fields near the edge of a galaxy, we employ them in obtaining the general analytic solutions to the Wong equations. Using the latter, we calculate the magnitude of the extra acceleration of color-charged particles related to the possible presence of the color fields in the neighborhood of Earth. | https://www.kaznu.kz/ru/25336/page/ |
| 20. | Clusterization and strong coupled-channels effects in deuteron interaction with $^9$Be nuclei | Urazbekov, B.A., Denikin, A.S., Lukyanov, S.M., Kuterbekov, K.A., Zholdybayev, T., et al. | 2019 | Journal of Physics G: Nuclear and Particle Physics, 2019, 46(10), 105110, Q2 | Angular distributions of protons, deuterons, tritons and alpha particles emitted in the $d + {}^9$Be reaction at $E_{lab} = 19.5$ and 35.0 MeV have been measured. The elastic scattering channel is analysed in the framework of both the optical model and the coupled-channel approach. The interaction potential of the $d + {}^9$Be system is calculated in the framework of the Double-Folding model using the $\alpha + \alpha + n$ three-body wave function of the $^9$Be nucleus. The (d, p) and (d, t) one-nucleon-transfer reactions are analysed within the coupled-reaction-channel | https://www.kaznu.kz/ru/25336/page/ |

| | | | | | approach. The spectroscopic amplitudes for the different nuclear cluster configurations are calculated. Differential cross sections for the reaction channel $^9Be()^7Li$ are calculated including all possible reaction mechanisms within the coupled-reaction-channel method. Corresponding contributions to the cross sections are analysed. | |
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| 21. | Hydrogen isotopic effect during the graphite high-temperature corrosion in water vapours | Chikhray, Y., Askerbekov, S., Kenzhina, I., Nesterov, E., Varlamova, N., et al. | 2019 | International Journal of Hydrogen Energy, 2019, 44(55), стр. 29365–29370, Q2<br><br>https://doi.org/10.1016/j.ijhydene.2019.03.013 | This paper presents the results on a study the processes of physicochemical interactions of water with graphite. The main regularities of the formation of $H_2$, HD and $D_2$ molecules on the graphite surface were determined. It was shown that the fraction of $D_2$ and HD in the gaseous outcome increases in the process of heating, and the quasi-equilibrium state of the graphite's absorption of hydrogen isotopes at the initial stages of interaction is significant: the flow of dissolved atoms into the sample volume is higher than the desorption flow. We suppose that this is due to the higher rate of dissolution of hydrogen atoms in the volume of graphite. We also estimated also the separation factor for the graphite surface-volume system for hydrogen atoms, which was 1.53 for the selected experimental conditions. The temperature dependence of the effective rate constant $K_s$ for the formation of hydrogen isotope molecules in the interaction of graphite with water vapour in the range of 1100 °C–1200 °C was determined. It turned out that $K_S(D_2) > K_S(HD) > K_S(H_2)$. | https://www.kaznu.kz/ru/25336/page/ |
| Кафедра теплофизики и технической физики | | | | | | |
| 22. | Plasma processing of uranium-containing solid fuels | Messerle, V.E., Ustimenko, A.B. | 2019 | Fuel | This paper presents the results of thermodynamic and experimental investigation of plasma processing of uranium-containing Nizhneilli brown coal (NBC) of 12% ash content and Estonian dictyonema shale (EDS) of 88% ash content. The essence of plasma processing of the uranium-containing solid fuels (SF) is in the conversion of the organic mass of SF into synthesis gas, with the simultaneous release of uranium-containing compounds into the gas phase, followed by the production of uranium-free ash. Thermodynamic analysis showed that the gaseous phase of the SF plasma pyrolysis and steam gasification products consists, basically, of synthesis gas with a concentration of up to 95.2 vol% at 1800 K. At this temperature, uranium-containing compounds completely pass into the gas phase in the form of uranium oxides. Experiments on plasma pyrolysis and steam gasification of EDS were | https://www.scopus.com/record/display.uri?eid=2-s2.0-85059945599&origin=resultslist&sort=plf-f |

| | | | | | performed in entrained-flow plasma reactor. Plasma-steam gasification of EDS allowed producing the synthesis gas yield of 86%, the carbon gasification degree of 70.4%, and degree of uranium release to the gaseous phase of 83.6%. The results of the research testify to the insensitivity of the plasma processing technology to the quality of the SF used. The study showed that the integrated indices of plasma gasification of uranium-containing SF are higher than those of plasma pyrolysis. | |
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| | | | | **Кафедра физики твердого тела и нелинейной физики** | | |
| 23. | Effects of infall and outflow on massive star-forming regions | Li, Q., Zhou, J., Esimbek, J., Komesh, T., Sailanbek, S. | 2019 | **Monthly Notices of the Royal Astronomical Society**<br><br>Q1 in Space and Planetary Science | A total of 188 high-mass outflows have been identified from a sample of 694 clumps from the Millimetre Astronomy Legacy Team 90 GHz survey, representing a detection rate of approximately 27 per cent. The detection rate of outflows increases from the proto-stellar stage to the H II stage, but decreases again at the photodissociation (PDR) stage suggesting that outflows are being switched off during the PDR stage. An intimate relationship is found between outflow action and the presence of masers, and water masers appear together with 6.7 GHz methanol masers. Comparing the infall detection rate of clumps with and without outflows, we find that outflow candidates have a lower infall detection rate. Finally, we find that outflow action has some influence on the local environment and the clump itself, and this influence decreases with increasing evolutionary time as the outflow action ceases. | https://www.scopus.com/record/display.uri?eid=2-s2.0-85077226985&origin=resultslist&sort=plf-f |
| 24. | H 2 CO and H110α Observations toward the Aquila Molecular Cloud | Komesh, T., Esimbek, J., Baan, W., ...Tang, X., Manapbayeva, A. | 2019 | **Astrophysical Journal**<br><br>Q1 in Physics and Astronomy | The formaldehyde $H_2CO(1_{10}-1_{11})$ absorption line and H110α radio recombination line have been observed toward the Aquila Molecular Cloud using the Nanshan 25 m telescope operated by the Xinjiang Astronomical Observatory CAS. These first observations of the $H_2CO$ $(1_{10}-1_{11})$ absorption line determine the extent of the molecular regions that are affected by the ongoing star formation in the Aquila molecular complex and show some of the dynamic properties. The distribution of the excitation temperature $T_{ex}$ for $H_2CO$ identifies the two known star formation regions W40 and Serpens South as well as a smaller new region Serpens 3. The intensity and velocity distributions of $H_2CO$ and $^{13}CO(1-0)$ | https://www.scopus.com/record/display.uri?eid=2-s2.0-85064443989&origin=resultslist&sort=plf-f |

| | | | | | do not agree well with each other, which confirms that the $H_2CO$ absorption structure is mostly determined by the excitation of the molecules resulting from the star formation rather than by the availability of molecular material as represented by the distribution. Some velocity-coherent linear [13]CO(1-0) structures have been identified in velocity channel maps of $H_2CO$ and it is found that the three star formation regions lie on the intersect points of filaments. The H110α emission is found only at the location of the W40 H ii region and spectral profile indicates a redshifted spherical outflow structure in the outskirts of the H ii region. Sensitive mapping of $H_2CO$ absorption of the Aquila Complex has correctly identified the locations of star formation activity in complex molecular clouds and the spectral profiles reveal the dominant velocity components and may identify the presence of outflows. | |
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| 25. | Parametric solutions of the Gylden–Meshchersky problem | Bekov, A.A., Momynov, S.B | 2019 | **International Journal of Non-Linear Mechanics**<br><br>Q1 in Applied Mathematics | In this paper, we have obtained the parametric solutions of the Gylden–Meshchersky problem. The role of the $τ(θ)$ parameter, which obeys the Martin–Chiara law, is played by the function of the angular characteristics of motion — the polar angle θ of the trajectory. The solutions found can be represented as an evolving ellipse with a variable parameter and eccentricity. The obtained solutions and the laws of $μ(τ)$ are of interest for studying the evolution of binary systems and some applied problems in astronomy, which require to take into account the relation between the gravitational parameter $μ(t)$, changing with time, and the angular characteristics of motion. | https://www.scopus.com/record/display.uri?eid=2-s2.0-85068170636&origin=resultslist&sort=plf-f |
| 26. | Molecular environs and triggered star formation around the large Galactic infrared bubble N24 | Li, X., Esimbek, J., Zhou, J., ...Li, D., Alimbetova, D. Sailanbek, S | 2019 | **Monthly Notices of the Royal Astronomical Society**<br><br>Q1 in Space and Planetary Science | A multi-wavelength analysis of the large Galactic infrared bubble N24 is presented in this paper in order to investigate the molecular and star-formation environment around expanding HII regions. Using archival data from Herschel and ATLASGAL, the distribution and physical properties of the dust over the entire bubble are studied. Using the Clumpfind2d algorithm, 23 dense clumps are identified, with sizes and masses in the range 0.65-1.73 pc and 600- 16 300 $M_\odot$, respectively. To analyse the molecular environment in N24, observations of NH3 (1,1) and (2,2) were carried out | https://www.scopus.com/record/display.uri?eid=2-s2.0-85083984603&origin=resultslist&sort=plf-f |

| | | | | | using the Nanshan 26-m radio telescope. Analysis of the kinetic temperature and gravitational stability of these clumps suggests gravitational collapse in several of them. The mass-size distributions of the clumps and the presence of massive young protostars indicate that the shell of N24 is a region of ongoing massive-star formation. The compatibility of the dynamical and fragmentation timescales and the overabundance of young stellar objects and clumps on the rim suggest that the 'collect-and-collapse' mechanism is in play at the boundary of the bubble, but the existence of the infrared dark cloud at the edge of bubble indicates that a 'radiation-driven implosion' mechanism may also have played a role there. | |
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| **Кафедра физики плазмы, нанотехнологий и компьютерной физики** | | | | | | |
| 27. | Quantum hydrodynamics for plasmas - Quo vadis ? | Bonitz, M., Moldabekov, Z.A., Ramazanov, T.S. | 2019 | Physics of Plasmas | Quantum plasmas are an important topic in astrophysics and high pressure laboratory physics for more than 50 years. In addition, many condensed matter systems, including the electron gas in metals, metallic nanoparticles, or electron-hole systems in semiconductors and heterostructures, exhibit - to some extent - plasmalike behavior. Among the key theoretical approaches that have been applied to these systems are quantum kinetic theory, Green function theory, quantum Monte Carlo, semiclassical and quantum molecular dynamics, and more recently, density functional theory simulations. These activities are in close contact with the experiments and have firmly established themselves in the fields of plasma physics, astrophysics, and condensed matter physics. About two decades ago, a second branch of quantum plasma theory emerged that is based on a quantum fluid description and has attracted a substantial number of researchers. The focus of these studies has been on collective oscillations and linear and nonlinear waves in quantum plasmas. Even though these papers pretend to address the same physical systems as the more traditional papers mentioned above, the former appear to form a rather closed community that is largely isolated from the rest of the field. The quantum hydrodynamics (QHD) results have - with a few exceptions - not found application in | https://www.scopus.com/record/display.uri?eid=2-s2.0-85072160817&doi=10.1063%2f1.5097885&origin=inward&txGid=81efb850d6557fa445382c5a6fe1f98a |

| | | | | | astrophysics or in experiments in condensed matter physics. Moreover, these results practically did not have any impact on the former quantum plasma theory community. One reason is the unknown accuracy of the QHD for dense plasmas. In this paper, we present a novel derivation, starting from reduced density operators that clearly point to the deficiencies of QHD, and we outline possible improvements. It is also to be noted that some of the QHD results have attracted negative attention being criticized as unphysical. Examples include the prediction of "novel attractive forces" between protons in an equilibrium quantum plasma, the notion of "spinning quantum plasmas," or the new field of "quantum dusty plasmas." In the present article, we discuss the latter system in some detail because it is a particularly disturbing case of formal theoretical investigations that are detached from physical reality despite bold and unproven claims of importance for, e.g., dense astrophysical plasmas or microelectronics. We stress that these deficiencies are not a problem of QHD itself, which is a powerful and efficient method, but rather are due to ignorance of its properties and limitations. We analyze the common flaws of these works and come up with suggestions to improve the situation of QHD applications to quantum plasmas. | |
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| 28. | Theoretical studies of lithium–aluminum amid and ammonium as perspective hydrogen storage | Schur, D.V., Veziroglu, A., Zaginaychenko, S.Y., Matysina, Z.A., Veziroglu, T.N., Gabdullin, M.T., Ramazanov, T.S., Zolonarenko, A.D., Zolonarenko, A.D. | 2019 | International Journal of Hydrogen Energy | A statistical theory of the phase transformation of lithium-aluminum amide with the release of ammonia has been developed. The free energies values of the phases were calculated, and their dependences on temperature, pressure, hydrogen concentration, and energy parameters were established. Phase diagram is built. The equations of the thermodynamic equilibrium state are calculated. The isoprocesses in the phases are investigated. The coefficients of squareness and uniformity of isotherms are obtained. The feature of the hydrogen concentration on temperature dependence in the phases has been established. | https://www.scopus.com/record/display.uri?eid=2-s2.0-85070826877&doi=10.1016%2fj.ijhydene.2019.07.205&origin=inward&txGid=c6f07363641f53f817567aac407c0a29 |

| 29. | Langmuir probe measurements in nanodust containing argon-acetylene plasmas | Ussenov, Y.A., von Wahl, E., Marvi, Z., Ramazanov, T.S., Kersten, H. | 2019 | Vacuum | This paper presents the results regarding the influence of cyclic growth of nanoparticles from the gas phase on the parameters of a low-temperature plasma. The measurements were carried out in an asymmetric RF (13.56 MHz) discharge in mixtures of argon and acetylene gases. The main plasma parameters such as the electron temperature, electron density and plasma potential were determined by a Langmuir probe and compared with the discharge self-bias voltage signal. The contamination problem of the electric probe tip in a reactive plasma due to the sticking of nanoparticles and radicals was minimized by applying a rapid "complex" sweep pattern of the probe voltage. The method based on the oscillation of the probe voltage with a frequency higher than the frequency of dust particles. The measurement results show a decrease in the electron density during the cyclic growth due to their absorption on the surface of the nanoparticles. On the contrary, the electron temperature and plasma potential increase. Additionally, a laser light scattering system was used to evidence the presence of the dust particle cloud in the vicinity of the probe position. | https://www.scopus.com/record/display.uri?eid=2-s2.0-85064950147&doi=10.1016%2fj.vacuum.2019.04.051&origin=inward&txGid=3d00cbb85cdf09625a637936650de94f |
| 30. | Transport control of dust particles by pulse-time modulated RF in dusty plasmas | Lin, J., Hashimoto, K., Togashi, R., Utegenov, A., Hénault, M., Takahashi, K., Boufendi, L., Ramazanov, T. | 2019 | Journal of Applied Physics | Transport of dust particles was studied in radio frequency (RF) plasmas. Dust particles of two sizes were injected in the plasmas. The plasmas were generated by applying a pulse-time modulated RF voltage. The pulse-time modulation made it possible to change the electron temperature in the plasmas. The electron temperature dominates the charges of the dust particles and the electric fields around the sheath where the dust particles are levitated. The equilibrium position of the dust particles can be determined by forces on them derived from the charges and the electric fields. In this research, it was clearly shown to change the position of the dust particles and drop them from the plasmas by the pulsed-time modulation. Furthermore, the modulated RF plasma worked as sieves of the dust particles. It was possible to drop larger dust particles from the plasma, while smaller ones remain in the plasmas. | https://www.scopus.com/record/display.uri?eid=2-s2.0-85069945177&doi=10.1063%2f1.5093349&origin=inward&txGid=8104877b82da3e0ffa7c120a85d8ccaa |

| 31. | Dynamical structure factor of strongly coupled ions in a dense quantum plasma | Moldabekov, Z.A., Kählert, H., Dornheim, T., Groth, S., Bonitz, M., Ramazanov, T.S | 2019 | Physical Review E | The dynamical structure factor (DSF) of strongly coupled ions in dense plasmas with partially and strongly degenerate electrons is investigated. The main focus is on the impact of electronic correlations (nonideality) on the ionic DSF. The latter is computed by carrying out molecular dynamics (MD) simulations with a screened ion-ion interaction potential. The electronic screening is taken into account by invoking the Singwi-Tosi-Land-Sjölander approximation, and it is compared to the MD simulation data obtained considering the electronic screening in the random phase approximation and using the Yukawa potential. We find that electronic correlations lead to lower values of the ion-acoustic mode frequencies and to an extension of the applicability limit with respect to the wave-number of a hydrodynamic description. Moreover, we show that even in the limit of weak electronic coupling, electronic correlations have a nonnegligible impact on the ionic longitudinal sound speed. Additionally, the applicability of the Yukawa potential with an adjustable screening parameter is discussed, which will be of interest, e.g., for the interpretation of experimental results for the ionic DSF of dense plasmas. | https://www.scopus.com/record/display.uri?eid=2-s2.0-85065870741&doi=10.1103%2fPhysRevE.99.053203&origin=inward&txGid=2583a01f588435b321d611a186babfb5 |
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| 32. | Obtaining of superhydrophobic surface in RF capacitively coupled discharge in AR/CH4 medium | Orazbayev, S., Gabdullin, M., Ramazanov, T., Dosbolayev, M., Omirbekov, D., Yerlanuly, Y | 2019 | Applied Surface Science | The aim of this work was to obtain superhydrophobic surfaces in a plasma medium. The experiment was carried out using the Plasma-Enhanced Chemical Vapor Deposition (PECVD) method in two different modes: constant and pulsing. The surface roughness was obtained by applying nanoparticles synthesized in a plasma in a mixture of argon and methane. The resulting particles were deposited on the surface of silicon and glass materials. The dependence of the contact angle on the nanoparticle application cycle on the surface was obtained. The contact angle increased linearly depending on the number of cycles, until it reached 160° at 150–160th cycles, after that the increase in cycles does not affect the contact angle, since the saturation process is in progress. Also the effect of the working gas composition on the hydrophobicity of the surface was studied. At low concentrations of methane (1%) only particles are synthesized in the working gas, and | https://www.scopus.com/record/display.uri?eid=2-s2.0-85044288787&doi=10.1016%2fj.apsusc.2018.03.118&origin=inward&txGid=836c6f47f3a6fe4b576c4d3a3cb0ad5d |

| | | | | | hydrophobicity is unstable, with an increase in methane concentration (7%) nanofilms are synthesized from nanoclusters, and surface hydrophobicity is relatively stable. In addition, a pulsing plasma mode was used to obtain superhydrophobic surfaces. A nanofilm consisting of nanoclusters with a diameter of 4–10 nm was synthesized. The hydrophobicity of the sample showed that the strength of the nanofilm was stable in comparison with the sample obtained in the first mode, but the contact angle was lower. The obtained samples were examined using SEM, SPM, optical analysis, and their contact angles were determined. The experiment was carried out at various plasma parameters. It was found that when a superhydrophobic surface is treated with a buffer plasma (argon), it becomes superhydrophilic. | |
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| 33. | Self-diffusion in two-dimensional quasimagnetized rotating dusty plasmas | Hartmann, P., Reyes, J.C., Kostadinova, E.G., Matthews, L.S., Hyde, T.W., Masheyeva, R.U., Dzhumagulova, K.N., Ramazanov, T.S., Ott, T., Kählert, H., Bonitz, M., Korolov, I., Donkó, Z. | 2019 | Physical Review E | The self-diffusion phenomenon in a two-dimensional dusty plasma at extremely strong (effective) magnetic fields is studied experimentally and by means of molecular dynamics simulations. In the experiment the high magnetic field is introduced by rotating the particle cloud and observing the particle trajectories in a corotating frame, which allows reaching effective magnetic fields up to 3000 T. The experimental results confirm the predictions of the simulations: (i) superdiffusive behavior is found at intermediate timescales and (ii) the dependence of the self-diffusion coefficient on the magnetic field is well reproduced. | https://www.scopus.com/record/display.uri?eid=2-s2.0-85060165036&doi=10.1103%2fPhysRevE.99.013203&origin=inward&txGid=b34aea0eb85fa4c69603719e4cc8fd4e |
| 34. | The vector potential of a point magnetic dipole | Sautbekov, S. | 2019 | Journal of Magnetism and Magnetic Materials | The retarded vector potential of a point magnetic dipole possessing an arbitrary time dependence and undergoing an accelerated relativistic motion is derived. A novel expression for the angular distribution of the radiated power of an arbitrarily moving magnetic dipole is obtained. In particular, the case of an uniformly accelerated particle with a constant magnetic moment is considered. The resulting equations are verified by showing that the fields reduce to less general forms found in the literature. | https://www.scopus.com/record/display.uri?eid=2-s2.0-85064468119&origin=resultslist&sort=plf-f&src=s&nlo=&nlr=&nls= |

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| 35. | Plasma-grain interaction mediated by streaming non-Maxwellian ions | Sundar S., Moldabekov Z.A. | 2019 | Physical Review E | A comprehensive parametric study of plasma-grain interaction for non-Maxwellian streaming ions in steady-state employing particle-in-cell simulations is delineated. Instead of considering the intergrain interaction potential to be the linear sum of isolated grain potentials, we incorporate the numerical advancement developed fully for grain shielding by including nonlinear contributions from the plasma and shadowing effect. The forces acting on grains versus intergrain distance, streaming velocity of the ions, and impact of trapped ions density (number) are characterized for non-Maxwellian ions in the presence of charge-exchange collisions. It is found that the nonlinear plasma response considerably modifies the plasma-grain interaction. Unlike the stationary plasma case, for two identical grains separated by a distance in the presence of streaming ions, the electrostatic force is neither repulsive for all grain separations nor equivalent to the force due to one isolated grain. Inadequacy of the linear response formalism in dealing with the systems having very large grain charges is also discussed. The smallest intergrain separation for which the role of the shadow effect can be ignored is reported. | |

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