

| №   | Название статьи   | Авторы   | Год  | Название журнала  | Краткая аннотация  | Ссылка  |
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| <b>2021</b>                                   |   |  |      |   |  |   |
| <b>Кафедра теоретической и ядерной физики</b> |   |  |      |   |  |   |
| 1.  | New measurements and analysis of elastic scattering of $^{13}\text{C}$ by $^9\text{Be}$ nuclei in a wide energy range | Nassurlla M., Burtebayev N., Karakozov B.K., Sakuta S. B., Boztosun I., Amangeldi N., Morzabayev A. K., Yergaliuly G., Alimov D. K., Burtebayeva J., Nassurlla Maulen, Mauey B., Kucuk Y., Hamada Sh., Khojayev R. | 2021 | European Physical Journal A, Volume 57, Issue 7, July 2021, Номер статьи 231, Q2<br><a href="https://doi.org/10.1140/epja/s10050-021-00539-z">https://doi.org/10.1140/epja/s10050-021-00539-z</a> | The angular distributions of $^{13}\text{C}$ elastically scattered by $^9\text{Be}$ nuclei were measured at $E_{\text{Lab}}(^{13}\text{C}) = 16.25$ and $19.5$ MeV. The measured angular distributions were analyzed via the optical model and the DWBA within the coupled reaction channels methods. In addition to this, the previously obtained data were reanalyzed at energies $E_{\text{Lab}} = 22.75, 28.12, 36.15, 57.77$ and $72.88$ MeV. The aim of the study was to elucidate the role of the $\alpha$ -cluster transfer mechanism in the large-angle scattering. As a result of these calculations, the optimal parameters of the potentials and their energy dependence were obtained for $^{13}\text{C}+^9\text{Be}$ nuclear system. The data at the backward angles are fairly well reproduced. The spectroscopic amplitudes were extracted for the $^{13}\text{C} \rightarrow ^9\text{Be} + \alpha$ configuration at various energies. The results are compared with previously reported values.   | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 2.  | The spin-parities of the 13.35 MeV state and high-lying excited states around 20 MeV in $^{12}\text{C}$ nucleus       | Demyanova A., Starastin V., Ogloblin A., Danilov A., Dmitriev S., Trzaska W., Heikkinen P., Belyaeva T., Goncharov S., Maslov V., Sobolev Yu., Gurov Yu., Chernyshev B., Burtebaev N., Janseitov D., Khlebnikov S. | 2021 | European Physics Journal A, Volume 57, Issue 6, June 2021 Номер статьи 204, Q2<br><a href="https://doi.org/10.1140/epja/s10050-021-00515-7">https://doi.org/10.1140/epja/s10050-021-00515-7</a>   | A study of the $^{11}\text{B}(^3\text{He},d)^{12}\text{C}$ reaction at incident $^3\text{He}$ energy $E_{\text{lab}} = 25$ MeV has been performed at the K-130 cyclotron at the University of Jyväskylä, Finland. Differential cross sections have been measured for the 13.35 MeV state and for the states with excitation energy around 20 MeV in $^{12}\text{C}$ . The data were analyzed with the DWBA method. A tentative assignment, $4^-$ , is given for the state at 13.35 MeV in a joint study of the reaction and inelastic scattering of $\alpha$ -particles with the energy of 110 MeV. For the state at 20.98 MeV, the possible spin-parity $3^-$ and the isospin $T = 0$ are assigned for the first time. Our model description of the broad state at 21.6 MeV is consistent with the previous assignments of isospin $T = 0$ and spin-parity of $2^+$ or $3^-$ . The excited state at 22.4 MeV may have possible spin-parities of either $6^+$ or $5^-$ . The collected statistics was insufficient to solve this question. Rotational bands which can exist in $^{12}\text{C}$ were presented. | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 3.  | Approximate perfect fluid solutions with quadrupole moment  | Medeu Abishev, Nurzada Beissen, Farida Belissarova, Kuantay Boshkayev, Aizhan Mansurova, Aray  | 2021 | International Journal of Modern Physics D, Q2   | We investigate the interior Einstein's equations in the case of a static, axially symmetric, perfect fluid source. We present a particular line element that is specially suitable for the investigation of this type of interior gravitational fields. Assuming that the deviation from spherically symmetry is small, we linearize the corresponding line element and field  | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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|    |  | Muratkhan, Hernando Quevedo and Saken Toktarbay  |      | <a href="https://doi.org/10.1142/S0218271821500966">https://doi.org/10.1142/S0218271821500966</a>   | equations and find several classes of vacuum and perfect fluid solutions. We find some particular approximate solutions by imposing appropriate matching conditions.  |   |
| 4. | The morphology of the X-ray afterglows and of the jetted GeV emission in long GRBs | Ruffini R. , Moradi R. , Rueda J.A. , Li L. , Sahakyan N. , Chen Y.-C. , Wang Y. , Aimuratov Y. , Becerra L. , Bianco C.L. , Cherubini C. , Filippi S. | 2021 | Monthly Notices of the Royal Astronomical Society 504(4), Q1<br><br><a href="https://doi.org/10.1093/mnras/stab724">https://doi.org/10.1093/mnras/stab724</a>         | We recall evidence that long gamma-ray bursts (GRBs) have binary progenitors and give new examples. Binary-driven hypernovae (BdHNe) consist of a carbon-oxygen core (COcore) and a neutron star (NS) companion. For binary periods $\sim 5$ min, the COcore collapse originates the subclass BdHN I characterized by (1) an outstanding supernova (SN; the 'SN-rise'); (2) a black hole (BH), born from the NS collapse by SN matter accretion, leading to a GeV emission with luminosity $L_{\text{GeV}} = A_{\text{GeV}} t^{-\alpha_{\text{GeV}}}$ , observed only in some cases; and (3) a new NS (vNS), born from the SN, originating from the X-ray afterglow with $L_{\text{X}} = A_{\text{X}} t^{-\alpha_{\text{X}}}$ , observed in all BdHN I. We record 378 sources and present for four prototype GRBs 130427A, 160509A, 180720B, and 190114C: (1) spectra, luminosities, SN-rise duration; (2) AX, $\alpha_X = 1.48 \pm 0.32$ , and (3) the vNS spin time evolution. We infer (i) $A_{\text{GeV}} = 1.19 \pm 0.04$ and (ii) the BdHN I morphology from time-resolved spectral analysis, three-dimensional simulations, and the GeV emission presence/absence in 54 sources within the Fermi-Large Area Telescope boresight angle. For 25 sources, we give the integrated and time-varying GeV emission, 29 sources have no GeV emission detected and show X/gamma-ray flares previously inferred as observed along the binary plane. The 25/54 ratio implies the GeV radiation is emitted within a cone of half-opening angle $\approx 60^\circ$ from the normal to the orbital plane. We deduce BH masses of 2.3-8.9 $M_\odot$ and spin of 0.27-0.87 by explaining the GeV emission from the BH rotational energy extraction, while their time evolution validates the BH mass-energy formula. | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 5. | $\alpha$ -attractors from supersymmetry breaking                                   | Yermek Aldabergenov, Auttakit Chatrabhuti, Hiroshi Isono   | 2021 | European Physical Journal C 81 (2021) 2, 166, Q1<br><br><a href="https://doi.org/10.1140/epjc/s10010-021-01140-0">https://doi.org/10.1140/epjc/s10010-021-01140-0</a> | We construct new models of inflation and spontaneous supersymmetry breaking in de Sitter vacuum, with a single chiral superfield, where inflaton is the superpartner of the goldstino. Our approach is based on hyperbolic Kähler geometry, and a gauged (non-axionic) U(1) R symmetry rotating the chiral scalar field by a phase. The U(1) R gauge field combines with the angular component of the chiral scalar to form a massive vector, and single-field inflation is driven by   | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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|    |  |  |      | 052-021-08947-7   | the radial part of the scalar. We find that in a certain parameter range they can be approximated by simplest Starobinsky-like (E-model) $\alpha$ -attractors, thus predicting $n_s$ and $r$ within $1\sigma$ CMB constraints. Supersymmetry (and R-symmetry) is broken at a high scale with the gravitino mass $m_{3/2} \gtrsim 10^{14}$ GeV, and the fermionic sector also includes a heavy spin-1/2 field. In all the considered cases the inflaton is the lightest field of the model.  |   |
| 6. | Nilpotent superfields for broken abelian symmetries                                    | Yermek Aldabergenov, Auttakit Chatrabhuti, Hiroshi Isono | 2021 | European Physical Journal C 81 (2021) 6, 523, Q1<br><a href="https://doi.org/10.1140/epjc/s10052-021-09320-4">https://doi.org/10.1140/epjc/s10052-021-09320-4</a> | We find new solutions to real cubic constraints on $N=1$ chiral superfields transforming under global abelian symmetries. These solutions describe the low-energy dynamics of a goldstino interacting with an axion (both belonging to the same chiral superfield) with non-linearly realized supersymmetry. We show the relation between our model and the approach of Komargodski and Seiberg for describing goldstino-axion dynamics which uses orthogonal nilpotent superfields.  | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 7. | Testing Primordial Black Holes as Dark Matter in Supergravity from Gravitational Waves | Yermek Aldabergenov, Andrea Addazi, Sergei V. Ketov      | 2021 | Physics Letters B 814 (2021) 136069, Q1<br><a href="https://doi.org/10.1016/j.physletb.2021.136069">https://doi.org/10.1016/j.physletb.2021.136069</a>            | We explore the Gravitational Waves (GW) phenomenology of a simple class of supergravity models that can explain and unify inflation and Primordial Black Holes (PBH) as Dark Matter (DM). Our (modified) supergravity models naturally lead to a two-field attractor-type double inflation, whose first stage is driven by Starobinsky scalaron and the second stage is driven by another scalar belonging to a supergravity multiplet. The PBHs formation in our supergravity models is efficient, compatible with all observational constraints, and predicts a stochastic GW background. We compute the PBH-induced GW power spectrum and show that GW signals can be detected within the sensitivity curves of the future space-based GW interferometers such as LISA, DECIGO, TAIJI and TianQin projects, thus showing predictive power of supergravity in GW physics and their compatibility. | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 8. | Quasinormal modes in the field of a dyon-like dilatonic black hole.                    | Malybayev A. N., Boshkayev K. A., Ivashchuk V. D.        | 2021 | The European Physical Journal C, 2021, Volume 81, Issue 5, article id.475, Q2   | Quasinormal modes of massless test scalar field in the background of gravitational field for a non-extremal dilatonic dyonic black hole are explored. The dyon-like black hole solution is considered in the gravitational 4d model involving two scalar fields and two 2-forms. It is governed by two 2-dimensional dilatonic coupling vectors $\lambda_i$ obeying $\lambda_i(\lambda_1 + \lambda_2) > 0$ , $i=1, 2$ . The first law of black hole thermodynamics is given and the Smarr relation is verified. Quasinormal modes for a massless scalar (test) field in the eikonal approximation are obtained and analysed. These modes depend upon a  | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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|    |   |  |      | <a href="https://doi.org/10.1140/epjc/s10052-021-09252-z">https://doi.org/10.1140/epjc/s10052-021-09252-z</a>   | <p>dimensionless parameter <math>a</math> (<math>0 &lt; a \leq 2</math>) which is a function of <math>\lambda_i</math>. For limiting strong (<math>a = +0</math>) and weak (<math>a = 2</math>) coupling cases, they coincide with the well-known results for the Schwarzschild and Reissner–Nordström solutions. It is shown that the Hod conjecture, connecting the damping rate and the Hawking temperature, is satisfied for <math>0 &lt; a \leq 1</math> and all allowed values of parameters.</p>  |  |
| 9. | <p>Testing generalized logotropic models with cosmic growth</p> | <p>Boshkayev K., Konysbayev T., Luongo O., Muccino M., Pace F.</p> | 2021 | <p>Physical Review D, 2021, Volume 104, Issue 2, article id.023520, Q1<br/> <a href="https://doi.org/10.1103/PhysRevD.104.023520">https://doi.org/10.1103/PhysRevD.104.023520</a></p> | <p>We check the dynamical and observational features of four typologies of logotropic dark energy models, leading to a thermodynamic cosmic speed up fueled by a single fluid that unifies dark energy and dark matter. We first present two principal Anton-Schmidt fluids where the Grüneisen parameter is free to vary and then fixed to the special value . We also investigate the pure logotropic model, corresponding to . Finally, we propose a new logotropic paradigm that works as a generalized logotropic fluid, in which we split the role of dark matter and baryons. We demonstrate that the logotropic paradigms may present drawbacks in perturbations, showing a negative adiabatic sound speed which make perturbations unstable. We thus underline which model is favored over the rest. The Anton-Schmidt model with is ruled out while the generalized logotropic fluid seems to be the most suitable one, albeit weakly disfavored than the model. To fix numerical constraints, we combine low- and higher-redshift domains through experimental fits based on Monte Carlo Markov Chain procedures, taking into account the most recent Pantheon supernovae Ia catalog, Hubble measurements, and data points based on the linear growth function for the large scale structures. We also consider two model selection criteria to infer the statistical significance of the four models under examination. We conclude there is a statistical advantage to handle the Anton-Schmidt fluid with the Grüneisen parameter free to vary and/or fixed to . The generalized logotropic fluid indicates suitable results, more statistically favored than the other models until the sound speed is positive, becoming unstable in perturbations elsewhere. We emphasize that the paradigm works statistically better than any kind of logotropic and generalized logotropic models, while the Chevallier-Polarski-Linder parametrization is statistically comparable with logotropic scenarios. Finally, we propose that generalizing the Grüneisen parameter by including the effects of temperature</p> | <p><a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a></p> |

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|     |   |   |      |   | would guarantee the sound speed to be positive definite at all redshifts.  |   |
| 10. | Luminosity of accretion disks in compact objects with a quadrupole    | Boshkayev K.,<br>Konysbayev T., Kurmanov E., Luongo O., Malafarina D., Quevedo H.                     | 2021 | Physical Review D, 2021, Volume 104, Issue 8, article id.084009, Q1<br><a href="https://doi.org/10.1103/PhysRevD.104.084009">https://doi.org/10.1103/PhysRevD.104.084009</a>                  | We consider the circular motion of test particles in the gravitational field of a static and axially symmetric compact object described by the metric. To this end, we calculate orbital parameters of test particles on accretion disks such as angular velocity ( $\Omega$ ), total energy ( $E$ ), angular momentum ( $L$ ), and radius of the innermost stable circular orbit ( $r_{\text{ISCO}}$ ) as functions of the mass ( $M$ ) and quadrupole ( $Q$ ) parameters of the source. The radiative flux, differential, and spectral luminosity of the accretion disk, which are quantities that can be experimentally measured, are then explored in detail. The obtained results are compared with the corresponding ones for the Schwarzschild and Kerr black holes in order to establish whether black holes may be distinguished from the metric via observations of the accretion disk's spectrum.                                   | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 11. | Effects of non-vanishing dark matter pressure in the Milky Way Galaxy | Boshkayev K.,<br>Konysbayev T., Kurmanov E., Luongo O., Malafarina D., Mutalipova K., Zhumakhanova G. | 2021 | Monthly Notices of the Royal Astronomical Society, 2021, Volume 508, Issue 1, pp.1543-1554, Q1<br><a href="https://doi.org/10.1093/mnras/stab2571">https://doi.org/10.1093/mnras/stab2571</a> | We consider the possibility that the Milky Way's dark matter halo possesses a non-vanishing equation of state. Consequently, we evaluate the contribution due to the speed of sound, assuming that the dark matter content of the galaxy behaves like a fluid with pressure. In particular, we model the dark matter distribution via an exponential sphere profile in the galactic core, and inner parts of the galaxy whereas we compare the exponential sphere with three widely used profiles for the halo, i.e. the Einasto, Burkert and Isothermal profile. For the galactic core, we also compare the effects due to a dark matter distribution without black hole with the case of a supermassive black hole in vacuum and show that present observations are unable to distinguish them. Finally we investigate the expected experimental signature provided by gravitational lensing due to the presence of dark matter in the core. | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 12. | Tracing Dark Energy History with Gamma-Ray Bursts                     | M. Muccino, L. Izzo, O. Luongo, K. Boshkayev, L. Amati, M. Della Valle, G. B. Pisani, E. Zaninoni.    | 2021 | The Astrophysical Journal (2021), 908:181 (11pp), Q1<br><a href="https://doi.org/10.3847/1538-4357/abd254">https://doi.org/10.3847/1538-4357/abd254</a>                                       | Observations of gamma-ray bursts up to $z \sim 9$ are best suited to study the possible evolution of the universe equation of state at intermediate redshifts. We apply the Combo relation to a sample of 174 gamma-ray bursts to investigate possible evidence of evolving dark energy parameter $w(z)$ . We first build a gamma-ray burst Hubble's diagram and then we estimate the set $(\Omega_m, \Omega_\Lambda)$ in the framework of flat and non-flat $\Lambda$ CDM paradigm. We then get bounds over the $w$ CDM model, where $w$ is thought to evolve with redshift, adopting two priors over the Hubble constant in tension at $4.4\sigma$ , i.e., $H_0 =$   | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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|     |   |   |      |   | (67.4 0.5) km s <sup>-1</sup> Mpc <sup>-1</sup> and H 0 = (74.03 1.42) km s <sup>-1</sup> Mpc <sup>-1</sup> . We show our new sample provides tighter constraints on $\Omega_m$ since at $z \leq 1.2$ we see that $w(z)$ agrees within $1\sigma$ with the standard value $w = -1$ . The situation is the opposite at larger $z$ , where gamma-ray bursts better fix $w(z)$ that seems to deviate from $w = -1$ at $2\sigma$ and $4\sigma$ level, depending on the redshift bins. In particular, we investigate the $w(z)$ evolution through a piecewise formulation over seven redshift intervals. From our fitting procedure we show that at $z \geq 1.2$ the case $w < -1$ cannot be fully excluded, indicating that dark energy's influence is not negligible at larger $z$ . We confirm the Combo relation as a powerful tool to investigate cosmological evolution of dark energy. Future space missions will significantly enrich the gamma-ray burst database even at smaller redshifts, improving de facto the results discussed in this paper. |   |
| 13. | Traversable wormholes with vanishing sound speed in f(R) gravity                        | Capozziello S., Luongo O., Mauro L.   | 2021 | European Physical Journal Plus, 2021, 136(2), 167, Q2<br><a href="https://doi.org/10.1140/epjp/s13360-021-01104-9">https://doi.org/10.1140/epjp/s13360-021-01104-9</a>                  | We derive exact traversable wormhole solutions in the framework of f(R) gravity with no exotic matter and with stable conditions over the geometric fluid entering the throat. For this purpose, we propose power-law f(R) models and two possible approaches for the shape function $b(r)/r$ . The first approach makes use of an inverse power-law function, namely $b(r)/r \sim r^{-1-\beta}$ . The second one adopts Padé approximants, used to characterize the shape function in a model-independent way. We single out the P(0, 1) approximant where the fluid perturbations are negligible within the throat, if the sound speed vanishes at $r = r_*$ . The former guarantees an overall stability of the geometrical fluid into the wormhole. Finally, we get suitable bounds over the parameters of the model for the above discussed cases. In conclusion, we find that small deviations from general relativity give stable solutions.   | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 14. | Comparative role of the ${}^7\text{Li}(n, \gamma)$ reaction in Big Bang nucleosynthesis | Burkova, N.A., Dubovichenko, S.B., Dzhazairov-Kakhramanov, A.V., Nurakhmetova, S.Z. | 2021 | Journal of Physics G: Nuclear and Particle Physics, 2021, V 48(4), 045201 (21pp), Q1<br><a href="https://doi.org/10.1088/1361-6471/abe2b5">https://doi.org/10.1088/1361-6471/abe2b5</a> | Within the framework of the modified potential cluster model with forbidden states and their classification according to Young diagrams, the possibility of describing experimental data on the total cross sections of the neutron radiative capture on ${}^7\text{Li}$ is considered. It is shown that the model used and the methods for constructing potentials make it possible to correctly describe the behavior of experimental cross sections at energies of 1 MeV to 1.5 MeV, where experimental data are available. Based on the calculated total cross sections up to 5 MeV, the reaction rate is calculated and its analytical approximation is carried out. Resonance structure of ${}^7\text{Li}(n,$   | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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|     |   |   |      |   | $\gamma$ ) <sup>8</sup> Li cross section and its impact on the reaction rate is examined. It is shown that the <sup>7</sup> Li(n, $\gamma$ ) <sup>8</sup> Li reaction dominates at $T_9 < 0.1$ as opposed to the burning of <sup>7</sup> Li in the <sup>7</sup> Li( <sup>3</sup> H, n) <sup>9</sup> Be and <sup>7</sup> Li( <sup>4</sup> He, $\gamma$ ) <sup>11</sup> B reactions, but comparable to (d, $\gamma$ ), (d, p), and (p, $\gamma$ ) at $T_9 \sim 1$ .   |   |
| 15. | <sup>12</sup> B(n, $\gamma$ ) <sup>13</sup> B reaction as an alternative path to astrophysical synthesis of <sup>13</sup> C isotope | Dubovichenko, S.B., Burkova, N.A., Dzhazairov-Kakhramanov, A.V., Yertaiuly, A.  | 2021 | Nuclear Physics A, 2021, V 1011, P. 122197 (17pp), Q2<br><a href="https://doi.org/10.1016/j.nuclphysa.2021.122197">https://doi.org/10.1016/j.nuclphysa.2021.122197</a>                            | The total cross sections of the neutron radiative capture on <sup>12</sup> B at astrophysical energies to the ground state of <sup>13</sup> B, have been calculated in the energy range of 10 <sup>-8</sup> to 10 MeV within the framework of a modified potential cluster model with the classification of orbital states according to Young diagrams. Reaction rates in the temperature range of 0.01 to 10 T <sub>9</sub> , and their analytical parameterizations were obtained. The calculated rates of <sup>12</sup> B(n, $\gamma$ ) <sup>13</sup> B exceed the previous results obtained by other approaches by approximately to one order of magnitude. Cross sections and reaction rates of <sup>12</sup> C(n, $\gamma_{0+1+2+3}$ ) <sup>13</sup> C are calculated and compared to the n <sup>10</sup> B, n <sup>11</sup> B, n <sup>12</sup> B, and p <sup>12</sup> C reaction rates. It is proposed that the obtained rates of the <sup>12</sup> B(n, $\gamma$ ) <sup>13</sup> B reaction may be suggested for the discussion of novel scenarios of stable isotope <sup>13</sup> C synthesis when p-captures on <sup>12</sup> C are not present.  | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 16. | Scattering of $\alpha$ -particles and <sup>3</sup> He by <sup>24</sup> Mg nuclei at energies about 50–60 MeV                        | Bahtiyar Sadykov, Timur Zholdybayev, Nassurlla Burtebayev, Bek Duisebayev, Maulen Nassurlla, Jumazya Burtebayeva, Marzhan Nassurlla, Stanislav Sakuta, Andrey Pan | 2021 | European Physical Journal A Volume 57, Issue 4, April 2021, Номер статьи 130, Q1<br><a href="https://doi.org/10.1140/epja/s10050-021-00415-w">https://doi.org/10.1140/epja/s10050-021-00415-w</a> | Differential cross sections of elastic and inelastic scattering with excitation of states of the rotational band of the ground state of <sup>24</sup> Mg were measured at an $\alpha$ -particle energy of 50.5 MeV and <sup>3</sup> He 60 MeV. The angular distributions were analyzed using an optical model and a coupled channel method. A number of potentials with significantly different geometries are obtained, which describe well the elastic scattering at the measured angular range. The collective model was used in the calculations via the coupled channel method. In addition to the ground state, three low-lying states of <sup>24</sup> Mg, 2 <sup>+</sup> (1.368 MeV), 4 <sup>+</sup> (4.122 MeV), and 4.238 MeV (2 <sup>+</sup> ), were included in the coupling scheme. The values of quadrupole ( $\beta_2$ ) and hexadecapole ( $\beta_4$ ) deformation parameters were extracted. According to the analysis of scattering of $\alpha$ -particles, they are 0.52 and 0.05. For <sup>3</sup> He, they are 0.75 and 0.07, respectively. The extracted parameters correspond to the previously obtained values from the scattering of protons, deuterons and $\alpha$ -particles. | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 17. | Radiation resistance of single-mode optical fibres  | Kashaykin P.F., Tomashuk A.L., Vasiliev S.A., Ignatyev A.D., Shaimerdenov A.A.,   | 2021 | Nuclear materials and   | Single-mode optical fibres (SMFs) are required for ITER in-vessel applications as transport fibres to deliver the signal at wavelength $\lambda = 1.55 \mu\text{m}$ from/to optical fibre sensors. The paper describes the first comparison study of radiation  | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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|     | with view to in-reactor applications                                   | Ponkratov Y.V., Kulsartov T.V., Kenzhin Y.A., Kh. Gizatulin S., Zholdybayev T.K., Chikhray Y.V., Semjonov S.L. |      | energy, V.27, P.100981, Q2<br><a href="https://doi.org/10.1016/j.nme.2021.100981">https://doi.org/10.1016/j.nme.2021.100981</a>                         | resistance of six pure-silica-core SMFs of different manufacturers performed in the process of fission-reactor irradiation in the conditions corresponding to the whole ITER lifetime (fast-neutron fluence, flux, $\gamma$ -dose and dose rate of up to $1.8 \cdot 10^{20} \text{n/cm}^2$ , $1.08 \cdot 10^{14} \text{n}/(\text{cm}^2 \cdot \text{s})$ , 2.32 GGy and 1.39 kGy/s, respectively, temperature of 170–190 °C and vacuum pumping). Polyimide- and acrylate-coated SMFs failed mechanically during the irradiation; therefore, only metal-coated fibres can be considered for the in-vessel applications. Induced optical loss in all three metal-coated SMFs (copper- and aluminum-coated ones) at the fast-neutron fluence of $1 \cdot 10^{20} \text{n/cm}^2$ was found to lie in the range $\sim 1.5\text{--}4$ dB/m, the lower value of this range allowing the employment of at least 10-m-long transport fibre lengths in the in-vessel applications, assuming the dynamic range of 30 dB. The temperature-dependent microbending optical loss in metal-coated SMFs is discussed, of which the contribution to the total induced loss may be comparable in value to the radiation-induced absorption of light. Neither radiation-induced luminescence, nor Cerenkov emission was detected in the SMFs in the near-infrared range. |   |
| 18. | Linear energy density and the flux of an electric field in proca tubes | V. Dzhunushaliev, V. Folomeev and Tlemisov, A  | 2021 | Symmetry, Volume 13, Issue 4, April 2021, Номер статьи 640, Q2<br><a href="https://doi.org/10.3390/sym13040640">https://doi.org/10.3390/sym13040640</a> | In this work, we study cylindrically symmetric solutions within SU(3) non-Abelian Proca theory coupled to a Higgs scalar field. The solutions describe tubes containing either the flux of a color electric field or the energy flux and momentum. It is shown that the existence of such tubes depends crucially on the presence of the Higgs field (there are no such solutions without this field). We examine the dependence of the integral characteristics (linear energy and momentum densities) on the values of the electromagnetic potentials at the center of the tube, as well as on the values of the coupling constant of the Higgs scalar field. The solutions obtained are topologically trivial and demonstrate the dual Meissner effect: the electric field is pushed out by the Higgs scalar field. © 2021 by the authors.   | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 19. | Nonperturbative quantization approach for QED on the Hopf bundle       | V. Dzhunushaliev and V. Folomeev,  | 2021 | Universe 7, (2021) no.3, 65, Q2   | We consider the Dirac equation and Maxwell's electrodynamics in $\mathbb{R} \times S^3$ spacetime, where a three-dimensional sphere is the Hopf bundle $S^3 \rightarrow S^2$ . In both cases, discrete spectra of classical solutions are obtained. Based on the solutions obtained, the quantization of free, noninteracting Dirac and Maxwell fields is carried out. The method of nonperturbative quantization of interacting Dirac and Maxwell  | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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|     |  |  |      | <a href="https://doi.org/10.3390/universe7030065">https://doi.org/10.3390/universe7030065</a>  | fields is suggested. The corresponding operator equations and the infinite set of the Schwinger–Dyson equations for Green’s functions is written down. We write a simplified set of equations describing some physical situations to illustrate the suggested scheme of nonper-turbative quantization. Additionally, we discuss the properties of quantum states and operators of interacting fields. © 2021 by the authors.   |   |
| 20. | Mass gap for a monopole interacting with a nonlinear spinor field  | Vladimir Dzhunushaliev, Nassurlla Burtebayev, Vladimir Folomeev, Jutta Kunz, Albina Serikbolova, and Abylaikhan Tlemisov | 2021 | PHYSICAL REVIEW D 104, 056010 (2021), Q1<br><a href="https://doi.org/10.1103/PhysRevD.104.056010">https://doi.org/10.1103/PhysRevD.104.056010</a>                        | Within SU(2) Yang-Mills theory with a source of the non-Abelian gauge field in the form of a classical spinor field, we study the dependence of the mass gap on the coupling constant between the gauge and nonlinear spinor fields. It is shown that the total dimensionless energy of the monopole interacting with the nonlinear spinor fields depends only on the dimensionless coupling constant.   | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 21. | Static and collapsing configurations supported by the spinor fluid | Vladimir Dzhunushaliev and Vladimir Folomeev   | 2021 | Phys. Rev. D 103, 123017 (2021) - Published 15 June 2021, Q1<br><a href="https://doi.org/10.1103/PhysRevD.103.123017">https://doi.org/10.1103/PhysRevD.103.123017</a>    | We study a gravitating spherically symmetric nonrelativistic configuration consisting of a spinor fluid whose effective equation of state is derived from a consideration of a limiting system supported by a massive nonlinear spinor field. For such a configuration, we find a two-parametric family of static regular solutions describing compact objects whose masses and sizes are determined by the central density of the spinor fluid and the mass of the spinor field. Using the similarity method, we consider a gravitational collapse of an initially uniform system consisting of the spinor fluid. We estimate the general characteristics of the collapse and show that a resulting nonuniform distribution of the fluid occurs that may serve as a core for the creation of equilibrium starlike configurations. | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 22. | Axially symmetric Proca-Higgs boson stars                          | Vladimir Dzhunushaliev and Vladimir Folomeev   | 2021 | Phys. Rev. D 104, 104024 (2021) - Published 9 November 2021, Q`<br><a href="https://doi.org/10.1103/PhysRevD.104.104024">https://doi.org/10.1103/PhysRevD.104.104024</a> | We consider strongly gravitating configurations consisting of coupled real Higgs scalar field and vector (Proca) field of mass $\mu P$ . For such a system, we find static regular axially symmetric solutions describing asymptotically flat configurations which may be referred to as Proca-Higgs miniboson stars, since their total mass and spatial dimension are of order $M2P1/\mu P$ and $\mu-1P$ , respectively. The system possesses an axially symmetric dipole field and may be regarded as a Proca dipole.  | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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| 23. | Masking singularities in Weyl gravity and Ricci flows                          | V. Dzhunushaliev and V. Folomeev              | 2021 | Eur.Phys.J.C 81 (2021) 5, 387, Q1<br><a href="https://doi.org/10.1140/epjc/s10052-021-09188-4">https://doi.org/10.1140/epjc/s10052-021-09188-4</a>      | Within vacuum Weyl gravity, we obtain a solution by which, using different choices of the conformal factor, we derive metrics describing (i) a bounce of the universe; (ii) toroidal and spherical wormholes; and (iii) a change in metric signature. It is demonstrated that singularities occurring in these systems are “masked”. We give a simple explanation of the possibility of masking the singularities within Weyl gravity. It is shown that in the first and third cases the three-dimensional metrics form Ricci flows. The question of the possible applicability of conformal Weyl gravity as some phenomenological theory in an approximate description of quantum gravity is discussed.  | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 24. | Nonperturbative quantization approach for QED on the Hopf bundle               | V. Dzhunushaliev and V. Folomeev,             | 2021 | Universe 7, (2021) no.3, 65, Q2<br><a href="https://doi.org/10.3390/universe7030065">https://doi.org/10.3390/universe7030065</a>                        | We consider the Dirac equation and Maxwell’s electrodynamics in $\mathbb{R} \times S^3$ spacetime, where a three-dimensional sphere is the Hopf bundle $S^3 \rightarrow S^2$ . In both cases, discrete spectra of classical solutions are obtained. Based on the solutions obtained, the quantization of free, noninteracting Dirac and Maxwell fields is carried out. The method of nonperturbative quantization of interacting Dirac and Maxwell fields is suggested. The corresponding operator equations and the infinite set of the Schwinger–Dyson equations for Green’s functions is written down. We write a simplified set of equations describing some physical situations to illustrate the suggested scheme of nonperturbative quantization. Additionally, we discuss the properties of quantum states and operators of interacting fields. | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 25. | Linear energy density and the flux of an electric field in proca tubes         | V. Dzhunushaliev, V. Folomeev and Tlemisov, A | 2021 | Symmetry, Volume 13, Issue 4, April 2021, Номер статьи 640, Q2<br><a href="https://doi.org/10.3390/sym13040640">https://doi.org/10.3390/sym13040640</a> | In this work, we study cylindrically symmetric solutions within SU(3) non-Abelian Proca theory coupled to a Higgs scalar field. The solutions describe tubes containing either the flux of a color electric field or the energy flux and momentum. It is shown that the existence of such tubes depends crucially on the presence of the Higgs field (there are no such solutions without this field). We examine the dependence of the integral characteristics (linear energy and momentum densities) on the values of the electromagnetic potentials at the center of the tube, as well as on the values of the coupling constant of the Higgs scalar field. The solutions obtained are topologically trivial and demonstrate the dual Meissner effect: the electric field is pushed out by the Higgs scalar field.                                  | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 26. | Solid-phase synthesis and study of the structural, optical, and photocatalytic | B.K.Karakozov, A.L.Kozlovskiy,                | 2021 | Journal of Materials Science:   | This paper presents the results of a study of the structural, optical, and photocatalytic properties of ceramics based on ATiO <sub>3</sub> titanates, A = Ca, Sr, Ba. Using the method of X-ray  | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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|     | properties of the ATiO <sub>3</sub> , A = Ca, Sr, Ba ceramic          | D.M.Janseitov,<br>M.V.Zdorovets  |      | Materials in Electronics, V. 32, 24436–24445, Q2<br><a href="https://doi.org/10.1007/s10854-021-06921-3">https://doi.org/10.1007/s10854-021-06921-3</a>                 | phase analysis, it was found that in the case of ceramics obtained from a mixture of BaCO <sub>3</sub> and TiO <sub>2</sub> after annealing, the structure is a mixture of two phases, rhombohedral BaTiO <sub>3</sub> and impurity orthorhombic BaTi <sub>4</sub> O <sub>9</sub> . In the case of ceramics obtained from a mixture of CaCO <sub>3</sub> and TiO <sub>2</sub> , the structure is a mixture of two phases of the orthorhombic phase and rutile TiO <sub>2</sub> . In the case of ceramics obtained from a mixture of SrCO <sub>3</sub> and TiO <sub>2</sub> , the structure is a mixture of two phases of the SrTiO <sub>3</sub> orthorhombic phase and the Ti <sub>2</sub> O <sub>5</sub> orthorhombic phase. At the same time, all synthesized ceramics have a high crystallinity degree and order of the crystal structure. An analysis of the optical properties showed that the main changes are associated with the difference in the band gap, which is due to the presence of different phases in the structure of ceramics. Based on the results of photocatalytic reactions, the order of photocatalytic activity of the synthesized ceramics was determined: SrTO <sub>3</sub> /T <sub>2</sub> O <sub>5</sub> > CaTO <sub>3</sub> /TO <sub>2</sub> > BaTO <sub>3</sub> .   |   |
| 27. | Statistical analysis of object congestion in the geostationary region | A. Serebryanskiy, Ch. Akniyazov, B. Demchenko, A. Komarov, Ch. Omarov, I. Reva, M. Krugov, V. Voropaev | 2021 | Acta Astronautica Volume 182, May 2021, P. 424-431, Q1<br><a href="https://doi.org/10.1016/j.actaastro.2021.02.014">https://doi.org/10.1016/j.actaastro.2021.02.014</a> | The results of the statistical analysis of the number of near-miss events (NME) in the distance range from 1 km up to 200 km between objects on the geostationary orbits (GSO) for the period from 2011 to 2020, obtained from approximations based on catalogs of orbital elements, are presented. It was shown that the overall increase in the number of NMEs resulting from the filling of geostationary orbits due to new launches and the detection of new space debris (SD) fragments, is characterized by an asymmetry in the distribution of the average daily number of events in longitude - the number of average daily NMEs at 75°E is higher than at longitude 255°E. An analysis of the dependence of the average daily number of NMEs on the minimum distance between objects as a function of the catalog epoch showed that the average daily number of NMEs at the distances of up to 1 km increased from 0.22 events per day in 2011 to 0.35 events per day in 2020. If we take a distance of 20 m as a collision measure, then according to 2020, the probability of such an event in the GSO is one event in 8 years. The analysis showed that if the current dynamics of population growth at the GSO continues in the future, then by 2030 there will be a situation in which a collision may occur every 5 years, and by 2040 every 3 years. | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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| 28. | Analysis of lutetium-177 production at the WWR-K research reactor              | Sairanbayev D.,<br>Koltochnik S.,<br>Shaimerdenov A.,<br>Chakrova Y., Gurin A.,<br>Kenzhin Y. | 2021 | APPLIED<br>RADIATION<br>AND<br>ISOTOPES 169<br>(2021) 109561,<br>Q2<br><br><a href="https://doi.org/10.1016/j.apradiso.2020.109561">https://doi.org/10.1016/j.apradiso.2020.109561</a> | Production of lutetium-177 using direct nuclear reaction $^{176}\text{Lu}(n,\gamma)^{177}\text{Lu}$ by WWR-K reactor neutrons on enriched $\text{LuCl}_3$ (up to 82% of $^{176}\text{Lu}$ ) is described. Calculations were performed by MCNP6 transport code. Two different irradiation positions of the WWR-K research reactor were considered. Estimates of the maximum specific activity of the lutetium-177 are obtained for the reactor irradiation positions located: (a) in the reactor core centre, (b) in the core periphery. In these positions, thermal neutron flux is two times different. Experimental data was shown that k-factor is 1.5 for considered irradiation positions. The study shows that for the position located in the core center, the estimated maximum specific activity of lutetium-177 is 819 GBq/mg, is to be achieved after 15 days of irradiation. For the position located in the core periphery, specific activity of lutetium-177 is 561 GBq/mg, is to be achieved after 20 days of irradiation. Ratio of Lu-177m to Lu-177 specific activity is not more than 0.025 for both irradiation positions.   | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 29. | Creative thinking as a driver for students' transition to university 4.0 model | Murzagaliyeva A.,<br>Jugembayeva B.   | 2021 | Thinking Skills and Creativity, 2021, 41, 100919, Q1<br><br><a href="https://doi.org/10.1016/j.tsc.2021.100919">https://doi.org/10.1016/j.tsc.2021.100919</a>                          | The dynamics of the modern world and the transformation of the labor market put forward new requirements for education, aimed today at the formation of the necessary skills and the development of the ability to innovate, which becomes the basis of a new paradigm of education, embedded in the University 4.0 model. The purpose of the article is to study the readiness of students for creative and innovative activities in the context of the transition to the University 4.0 model on the example of [BLINDED] University. A study of the intellectual prerequisites of readiness for innovative activities of 236 physics students was carried out before and after training. At the beginning of the experiment, psychological testing was carried out to determine the characteristics of thinking and the creative component of a personality using valid psychodiagnostic techniques. Students completed training sessions for 1 month; the training included solving logical and situational tasks, business games, and brainstorming. The training was aimed at developing cognitive shifting, concentration of attention (a high level of intellectual lability before training was observed in 24.6% of students, after training - in 40.7% of students), inductive, logical, practical thinking (a high level of these indicators before training was found in 23.3% of students, after training - in 36.9% of | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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|     |  |   |      | students), imagination (the number of students with a high level of image changed from 28.4% to 51.7%), creative, entrepreneurial, and managerial abilities (a high level of which after the training was shown by 11.0% of students, in comparison with 6.4% before the training). The results of the study showed a statistically significant improvement in all the parameters. The results obtained allow concluding that it is necessary to revise and improve curricula and programs to bring them in line with the new paradigm of education within the framework of the University 4.0 model with the obligatory addition of moral, ethical, and spiritual components. The novelty/value of this research lies in the study of the intellectual prerequisites of students for innovative activities and the proof of the possibilities of their development in the process of studying at a university. |  |   |
| 30. | Testing Primordial Black Holes as Dark Matter in Supergravity from Gravitational Waves | Bogachev, A.A., Kozulin, E.M., Knyazheva, G.N., Itkis, I.M., Itkis, M.G., Novikov, K.V., Kumar, D., Banerjee, T., Diatlov, I.N., Cheralu, M., Kirakosyan, V.V., Mukhamejanov, Y.S., Pan, A.N., Pchelintsev, I.V., Tikhomirov, R.S., Vorobiev, I.V., Maiti, M., Prajapat, R., Kumar, R., Sarkar, G., Trzaska, W.H., Andreyev, A.N., Harca, I.M., Vardaci, E. | 2021 | Physical Review C, 2021, 104(2), 024623, Q1<br><a href="https://doi.org/10.1103/PhysRevC.104.024623">https://doi.org/10.1103/PhysRevC.104.024623</a>  | Background: Observation of asymmetric fission of Hg180 has led to intensive theoretical and experimental studies of fission of neutron-deficient nuclei in the lead region. Purpose: The study of asymmetric and symmetric fission modes of Hg180,190 and Pb184,192,202 nuclei. Methods: Mass-energy distributions of fission fragments of Hg180,190 and Pb184 formed in the Ar36+Sm144,154 and Ca40+Sm144 reactions, respectively, at energies near the Coulomb barrier have been measured using the double-arm time-of-flight spectrometer CORSET and compared with previously measured Pb192,202 isotopes produced in the Ca48+Sm144,154 reactions. The mass distributions for Hg180,190 and Pb184,192,202 together with old data for Ir187, Au195, Hg198, Tl201, Bi205,207, Po210, and At213 [J. Nucl. Phys. 53, 1225 (1991)] have been decomposed into symmetric and asymmetric fission modes. The total kinetic-energy distributions for different fission fragment mass regions have been analyzed for Hg180,190 and Pb184. Results: The stabilization role of proton numbers at $Z \approx 36, 38, Z \approx 45, 46,$ and $Z = 28/50$ in asymmetric fission of excited preactinide nuclei has been observed. The high ( $\approx 145$ -MeV) and the low ( $\approx 128$ -MeV) energy components have been found in the total kinetic-energy distributions of Hg180,190 fission fragments corresponding to the fragments with proton numbers near $Z \approx 46$ and $Z \approx 36,$ respectively. In the case of fission of Pb184 only the low-energy component ( $\approx 135$ MeV) for the fragments with masses corresponding to the proton | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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|     |  |   |      |   | numbers $Z \approx 36$ and 46 has been found. Conclusions: The studied properties of asymmetric fission of Hg180,190 and Pb184,192,202 nuclei point out the existence of well deformed proton shell at $Z \approx 36$ and less deformed proton shell at $Z \approx 46$ .  |   |
| 31. | The rise of muon content in extensive air showers after the 3 PeV knee of the primary cosmic ray spectrum according to data of the Tien Shan mountain installation | A.L. Shepetov, S.B. Shaulov, O.I. Likiy, V.A. Ryabov, T.Kh. Sadykov, N.O. Saduev, V.V. Zhukov | 2021 | Astroparticle Physics 133 (2021) 102642, Q2<br><a href="https://doi.org/10.1016/j.astropartphys.2021.102642">https://doi.org/10.1016/j.astropartphys.2021.102642</a>                    | We put together the experimental results on muon component of extensive air showers (EAS) which were gained with various techniques at the detector complex of the Tien Shan mountain station. According to this comparison, the problem of the EAS muon content in the range of primary cosmic ray energies (1–100)PeV seems to be more complicated than it was usually supposed. Generally, from the models of nuclear interaction it follows that the EAS which have produced gamma-hadron families in the Tien Shan X-ray emulsion chamber did preferably originate from interaction of the light cosmic ray nuclei, such that their muon abundance must be $\sim 1.5$ times below an average calculated over all showers. In contrary, the experimental muon counts in the EAS with families demonstrate a (1.5–2)-fold excess above the average, and this difference starts to be observable in the showers with the energy above the 3PeV knee of the primary cosmic ray spectrum. Later on, the rise of muon production in EAS after the knee was confirmed at Tien Shan by another experiment on detection of the neutrons stemmed from interaction of cosmic ray muons. Thus, the results obtained by the two completely different methods do mutually agree with each other but contradict to the common models of hadron interaction. | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 32. | Search and research of $K^- K^- NN^-$ antikaonic clusters  | Roman Ya. Kezerashvili, Shalva M. Tsiklauri, <b>Nurgali Zh. Takibayev</b>                     | 2021 | Progress in Particle and Nuclear Physics Volume 121, November 2021, 103909, Q1<br><a href="https://doi.org/10.1016/j.pnpnp.2021.103909">https://doi.org/10.1016/j.pnpnp.2021.103909</a> | This review presents the current status of experimental searches and theoretical studies of antikaonic four-body $\bar{K}NNN$ and $\bar{K}\bar{K}NN$ clusters. Theoretical approaches within the framework of non-relativistic potential models used for the investigation of four-body $\bar{K}NNN$ and $\bar{K}\bar{K}NN$ clusters, such as the variational, Faddeev equations, and hyperspherical harmonics are considered. The results of calculations for the binding energies and the widths obtained within these methods by employing diverse sets of nucleon–nucleon, effective $\bar{K}N$ , and antikaon–antikaon interactions are presented, discussed, and compared with the calculations using the method of hyperspherical harmonics in momentum representation. The presented results demonstrate that the quasibound state energy of antikaonic four-body $\bar{K}NNN$ and $\bar{K}\bar{K}NN$ clusters is not sensitive to the $NN$ interaction, and show a very strong dependence on the $\bar{K}N$  | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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|     |   |   |      |  | potential. Despite the strong short-range repulsion due to the NN interaction in $K^-ppp$ and $K^-K^-pp$ and the weak $\bar{K}\bar{K}$ repulsion in $K^-K^-pp$ , the antikaonic clusters $K^-ppp$ and $K^-K^-pp$ are strongly bound.  |   |
| 33. | Experiments on tritium generation and yield from lithium ceramics during neutron irradiation                                  | Blynskiy P., Chikhray Y., Kulsartov T., Gabdullin M., Zaurbekova Z., Kizane G., Kenzhin Y., Tolenova A., Nesterov E., Shaimerdenov A. | 2021 | International Journal of Hydrogen Energy, V. 46, № 13. P. 9186-9192, Q2<br><a href="https://doi.org/10.1016/j.ijhydene.2020.12.224">https://doi.org/10.1016/j.ijhydene.2020.12.224</a> | The vacuum extraction method with a mass spectrometry registration of tritium is presented in paper. It can provide a full-range analysis of gas phase composition in the chamber with samples under neutron irradiation. Lithium ceramics $Li_2TiO_3$ in the form of pebbles with lithium enrichment on $^6Li$ isotope of 96% was examined. The paper shows the results of reactor experiments on study the extraction of tritium-containing molecules from lithium ceramics $Li_2TiO_3$ at various temperatures and reactor power levels at the WWR-K research reactor (Almaty, Kazakhstan). The time dependences of tritium yield from the ampoule with ceramics during reactor irradiation were obtained. Near-surface concentrations of tritium and hydrogen atoms on the ceramics surface under reactor irradiation were estimated.   | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 34. | Analysis of reactor experiments to study the transfer processes of generated tritium in lithium cps (capillary-porous system) | Askerbekov, S., Kenzhina, I., Kulsartov, T., Kadyrzhanov, K., Nesterov, E, et al.   | 2021 | International Journal of Hydrogen Energy, 2021, Q2<br><a href="https://doi.org/10.1016/j.ijhydene.2021.03.163">https://doi.org/10.1016/j.ijhydene.2021.03.163</a>                      | To date, there have been many studies on the possibility of using lithium CPS as a plasma-facing material in fusion reactors. For use such liquid-lithium systems in fusion reactors, it is necessary to determine the interaction parameters of the surface facing the plasma with the working gases under conditions simulating the real operation of the facility, i.e. under conditions of neutron and gamma radiation. Therefore, this paper is devoted to the study of the processes of hydrogen isotopes interaction with lithium CPS under reactor irradiation. The experiments presented in work were carried out at the IVG1.M research reactor by using dynamic sorption method with the presence of deuterium under the lithium CPS sample. The results of reactor experiments simulation, in particular, the distribution of tritium concentration in lithium volume and traps, and the flows of tritium released through the inner surface of the CPS into the experimental chamber at different temperatures are presented. Based on the simulation results, the following interaction parameters of tritium with lithium were determined: temperature dependences of tritium capture constant by lithium and the dissociation constant of LiT. The obtained model can be applied for analysis of tritium generation and release from different lithium-containing materials used as | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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|     |  |   |      |   | a filling of CPS structure (for example, lithium and tin-lithium eutectics).   |   |
| 35. | Structures of the excited states in $^9\text{Be}$ studied by scattering of 23 MeV deuterons  | Starastsin, V., Demyanova, A., Danilov, A., Janseitov D., Adamian, G., Antonenko, N., et al.        | 2021 | European Physical Journal A, 2021, 57(12), 334, Q2<br><a href="https://doi.org/10.1140/epja/s10050-021-00643-0">https://doi.org/10.1140/epja/s10050-021-00643-0</a> | An experiment on the scattering of 23 MeV deuterons by $^9\text{Be}$ nucleus was carried out. Differential scattering cross sections are obtained for the following states: g.s., 1.68 MeV, 2.43 MeV, 2.78 MeV, 3.05 MeV, 3.82 MeV, 4.70 MeV, 5.59 MeV, 6.38 MeV, 6.76 MeV and 7.94 MeV. The obtained data were analyzed using the distorted wave Born approximation (DWBA) and modified diffraction model (MDM). It was confirmed that the positive parity band $K^\pi = 12+$ based on the 1.68 MeV, $12+$ state is formed by the 3.05 MeV, $52+$ ; 4.70 MeV, $32+$ and 6.76 MeV, $92+$ states. It was proposed that the 3rd band ( $K^\pi = 12-$ ) based on the 2.78 MeV, $12-$ state may be formed by the 5.59 MeV, $32-$ and 7.94 MeV, $52-$ states. The radii of these band states ( $K^\pi = 12+$ and $K^\pi = 12-$ ) are increased compared to the ground state. Besides, it is found that the 3.82 MeV state has $J^\pi = 32-$ and does not belong to any of the rotational bands considered above. Possibly, it is formed as a one-particle state near the excited $^8\text{Be}$ core with the spin $J_c = 2$ .   | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |
| 36. | Asymmetric and symmetric fission of excited nuclei of Hg 180,190 and Pb 184,192,202 formed in the reactions with Ar 36 and Ca 40,48 ions | Bogachev, A.A., Kozulin, E.M., Knyazheva, G.N., Harca, I.M., Vardaci, E., Mukhamejanov Y.S., et al. | 2021 | Physical Review C, 2021, 104(2), 024623, Q2<br><a href="https://doi.org/10.1103/PhysRevC.104.024623">https://doi.org/10.1103/PhysRevC.104.024623</a>                | Background: Observation of asymmetric fission of Hg180 has led to intensive theoretical and experimental studies of fission of neutron-deficient nuclei in the lead region. Purpose: The study of asymmetric and symmetric fission modes of Hg180,190 and Pb184,192,202 nuclei. Methods: Mass-energy distributions of fission fragments of Hg180,190 and Pb184 formed in the Ar36+Sm144,154 and Ca40+Sm144 reactions, respectively, at energies near the Coulomb barrier have been measured using the double-arm time-of-flight spectrometer CORSET and compared with previously measured Pb192,202 isotopes produced in the Ca48+Sm144,154 reactions. The mass distributions for Hg180,190 and Pb184,192,202 together with old data for Ir187, Au195, Hg198, Tl201, Bi205,207, Po210, and At213 [J. Nucl. Phys. 53, 1225 (1991)] have been decomposed into symmetric and asymmetric fission modes. The total kinetic-energy distributions for different fission fragment mass regions have been analyzed for Hg180,190 and Pb184. Results: The stabilization role of proton numbers at $Z \approx 36, 38, Z \approx 45, 46,$ and $Z = 28/50$ in asymmetric fission of excited preactinide nuclei has been observed. The high ( $\approx 145$ -MeV) and the low ( $\approx 128$ -MeV) energy components have been found in the total kinetic-energy distributions of Hg180,190 | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a> |

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|   |  |   |      |  | fission fragments corresponding to the fragments with proton numbers near $Z \approx 46$ and $Z \approx 36$ , respectively. In the case of fission of Pb184 only the low-energy component ( $\approx 135$ MeV) for the fragments with masses corresponding to the proton numbers $Z \approx 36$ and 46 has been found. Conclusions: The studied properties of asymmetric fission of Hg180,190 and Pb184,192,202 nuclei point out the existence of well deformed proton shell at $Z \approx 36$ and less deformed proton shell at $Z \approx 46$ .  |   |
| 37.   | The prolonged gamma ray enhancement and the short radiation burst events observed in thunderstorms at Tien Shan  | A. Shepetov V. Antonova<br>O. Kalikulov O.<br>Kryakunova A. Karashtin<br>V. Lutsenko S. Mamina K.<br>Mukashev V. Piscal M.<br>Ptitsyn V. Ryabov T.<br>Sadykov N. Saduev N.<br>Salikhov Yu. Shlyugaev L.<br>Vildanova V. Zhukov A.<br>Gurevich | 2021 | Atmospheric Research, 2021, 248, 105266, Q1<br><br><a href="https://doi.org/10.1016/j.atmosres.2020.105266">https://doi.org/10.1016/j.atmosres.2020.105266</a> | We report the observation results of the hard radiation flashes which accompanied the lightning discharges above the mountains of Northern Tien Shan. Time series of the counting rate intensity, numerical estimations of absolute flux, and energy distribution of accelerated electrons and of (20–2000) keV gamma rays were obtained at the height of 3700 m a. s. l., immediately within thunderclouds, and in closest vicinity ( $\approx 100$ m) to discharge region. Two different kinds of radiation emission events are presented here: a relatively prolonged rise of gamma ray intensity with minute-scale duration (the thunderstorm ground enhancement, TGE) which has preceded a negative field variation, and a short sub-millisecond radiation burst, which accompanied a close lightning discharge in thundercloud. It was revealed also an indication to positron generation in thunderclouds at the time of gamma ray emission, as well as modulation of the neutron counting rate in Tien Shan neutron monitor which was operating at a (1.5–2) km order distance from the region of lightning development. | <a href="https://www.kaznu.kz/ru/25338/page/">https://www.kaznu.kz/ru/25338/page/</a>   |
| <b>Кафедра теплофизики и технической физики</b> |  |   |      |  |  |   |
| 38.   | Computer technologies of 3d modeling by combustion processes to create effective methods of burning solid fuel and reduce harmful dust and gas emissions into the atmosphere | Askarova, A., Bolegenova, S., Maximov, V., Bolegenova S., Askarov, N., Nugymanova, A.   | 2021 | Energies   | Using numerical methods, studies have been carried out to determine the effect of the introduction of the technology of two-stage combustion of high-ash Karaganda coal on the main characteristics of heat and mass transfer processes in the furnace of the BKZ-75 boiler at Shakhinskaya TPP (Kazakhstan). Various regimes of supplying additional air into the combustion space, the volume of which varied from 0% (traditional basic version) to 30% of the total volume of air required for fuel combustion, have been investigated using 3D computer modeling methods. The performed computational experiments made it possible to obtain the distributions of the total velocity vector, temperature fields, concentration fields of carbon monoxide CO and nitrogen dioxide NO <sub>2</sub> over the entire volume of the furnace and at the outlet from it. The   | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85106281778&amp;origin=resultlist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85106281778&amp;origin=resultlist&amp;sort=plf-f</a> |

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|     |  |                                |      |   | introduction of the two-stage combustion technology made it possible to optimize the combustion of high-ash coal, since in this case there is an increase in the temperature in the torch core and a decrease in it at the outlet from the furnace, which has a significant effect on the chemical processes of the formation of combustion products. Based on the results obtained, it can be concluded that an increase in the percentage of air supplied through additional injectors to 18% leads to a decrease in the concentrations of carbon monoxide CO by about 36%, and nitrogen dioxide NO <sub>2</sub> by 25% compared to the base case. A further increase in the volume of additional air leads to a deterioration in these indicators. The results obtained will make it possible to optimize the combustion of low-grade fuel in the furnace of the BKZ-75 boiler, increase the efficiency of fuel burnout, reduce harmful emissions into the atmosphere, and introduce a two-stage combustion technology at other coal-fired TPPs.   |   |
| 39. | Numerical method to predict ice accretion shapes and performance penalties for rotating vertical axis wind turbines under icing conditions | Baizhuma, Z., Kim, T., Son, C. | 2021 | Journal of Wind Engineering and Industrial Aerodynamics | This paper proposes a numerical method to predict the ice accretion shapes and aerodynamic performance of rotating vertical axis wind turbine (VAWTs) under icing conditions. A multiple reference frame (MRF) and sliding mesh technique (SMT) are combined to efficiently reflect the unsteady icing effects on rotating wind turbines. The SMT calculates the flow field considering the rotational and unsteady effects of the VAWTs. The MRF can efficiently clarify the rotational effects of the droplet field and ice accretion. Using the MRF technique, a series of icing simulations is implemented in which the ice shapes are updated at azimuth angle intervals of 36°. Using the proposed method, ice shapes in agreement with those obtained in icing wind tunnel tests can be obtained. Moreover, ice that is evenly distributed over the blade surface under glaze ice conditions can be examined instead of only the forms concentrated on the leading-edge, such as ice horns. The overall output power of an ice-covered VAWT is noted to be significantly reduced. Massive flow separation is induced owing to the increased airfoil thickness at azimuthal angles between 0° and 180°. Nevertheless, the performance of the thickened airfoil is enhanced owing to the delayed flow separation via dynamic stall in azimuthal angles between 180° and 270° | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85111317123&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85111317123&amp;origin=resultslist&amp;sort=plf-f</a> |

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| 40. | Numerical simulations on static Vertical Axis Wind Turbine blade icing         | Manatbayev, R., Baizhuma, Z., Bolegenova, S., Georgiev, A.                          | 2021 | Renewable Energy | <p>During the last decade, there was an increased interest in wind turbine icing. Most of the icing studies are related to horizontal axis wind turbine icing (HAWT). Vertical axis wind turbine (VAWT) icing is seldomly reported in the literature. Compared to the HAWT blade VAWT blade operates under various angles of attack. Therefore, ice accretion shapes on static VAWT blade must be considered under different angles of attack. In the present study, a novel approach to predict ice accretion shapes on VAWT is described. Ice accretion shapes are obtained at a range of angles of attack between <math>-25^{\circ}</math> and <math>25^{\circ}</math> using FENSAP-ICE which is the state-of-art icing simulation tool. Moving reference frame (MRF) was used to consider rotating effect on droplet field. The present method helped to draw the following conclusions. Firstly, the whole leading edge is covered by ice. Secondly, in rime ice conditions smooth ice shape is obtained, which does not significantly affect aerodynamic performance. Whereas in glaze ice conditions bumpy ice shapes causing massive flow separation and lift force degradation. Finally, iced VAWT loses up to 60% of power performance due to rime ice conditions. In glaze ice conditions VAWT is unable to produce power.</p> | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85100894785&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85100894785&amp;origin=resultslist&amp;sort=plf-f</a> |
| 41. | Parameters of heat treatment of coal to obtain combustible volatile substances | Mergalimova, A., Ongar, B., Georgiev, A., Kalieva K., Abitaeva, R., Bissenbayev, P. | 2021 | Energy           | <p>The article discusses the theoretical and practical foundations of the study of the possibility of obtaining volatile combustible substances released during special heat treatment of coal, with the aim of replacing ignition fuel oil at thermal power plants. The results of an experimental study of the coals of the Saryadyr field of three Kazakhstan deposits with the aim of obtaining volatile combustible substances, as well as the possibility of using these combustible substances as starting fuel, are presented. The results of calculating the heat of combustion of the gas obtained from the presented coal samples at different heating temperatures showed that with an increase in the heating temperature, the heat of combustion of combustible gases obtained from coal samples also increases. For all the coal samples under consideration, the maximum value of the heat of combustion is traced at a heating temperature of <math>600^{\circ}\text{C}</math>. The greatest value is observed for the coal of the Shubarkul deposit - <math>22.1\text{ MJ/m}^3</math>, and the minimum value for the brown coal of the Saryadyr deposit is <math>13.5\text{ MJ/m}^3</math>. According to the results of experimental studies, we</p>  | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85101809011&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85101809011&amp;origin=resultslist&amp;sort=plf-f</a> |

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|   |  |  |      |                                    | can conclude that of the three presented coals for producing combustible gas, the most suitable are the coals of the Shubarkul and Maikuben deposits. For use in the boiler unit as a starting fuel, it is sufficient to heat coal to temperatures of 350–450 °C.   |   |
| <b>Кафедра физики твердого тела и нелинейной физики</b> |  |  |      |                                    |   |   |
| 42.   | Intelligent autonomous street lighting system based on weather forecast using LSTM | Tukymbekov, D., Saymbetov, A., Nurgaliyev, M., ...Dosymbetova, G., Svanbayev, Y. Kuttybay N. | 2021 | <b>Energy</b><br>Q1 in Engineering | Existing traditional street lighting systems are characterized by a high level of energy consumption compared to automated intelligent systems that offer different operating modes depending on traffic and power system load. The most promising energy sources systems are hybrid installations that switch the load to the grid in adverse weather conditions. Such systems may increase the energy efficiency of the street lighting system, but they are not completely autonomous. In this case, the most important problem is to provide the street lighting system with energy in adverse weather conditions. In this paper, an autonomous street lighting system with adaptive energy consumption based on weather forecast was shown. The proposed street lighting system is completely independent of traditional power sources and is completely powered by solar panels. The main energy consumers of a street lighting system are lamps. The consumption of lamps can be changed to the minimum brightness level required by outdoor lighting standards. Forecasts of energy generation by solar panels can be obtained using LSTM. It is based on weather and solar radiation forecasts data for the coming days. The brightness levels of lamps are calculated and changed using the methods proposed in this paper. The probability of reaching the critical level of batteries does not exceed 0.10% and fluctuates around 0.05% most of the time when simulating for 1000 days under random weather conditions. Simulation of energy consumption by the street lighting system using the proposed method shows stable and sustainable performance in Almaty, Kazakhstan. The obtained results in this work can be used for designing autonomous street lighting and outdoor lighting systems. | <a href="https://www.scopus.com/record/display.uri?id=2-s2.0-85106395161&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?id=2-s2.0-85106395161&amp;origin=resultslist&amp;sort=plf-f</a> |
| 43.   | Physical processes during the formation of silicon-lithium p-i-n structures        | Saymbetov, A., Muminov, R., Japashov, N., Zholamanov, B., Jing, Z.                           | 2021 | <b>Materials</b>                   | In this paper, we described a method of double-sided diffusion and drift of lithium-ions into monocrystalline silicon for the formation of the large-sized, p-i-n structured Si(Li) radiation   | <a href="https://www.scopus.com/record/display.uri">https://www.scopus.com/record/display.uri</a>   |

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|     | using double-sided diffusion and drift methods   | Nurgaliyev, M Kuttybay N.  |      | Q2 in Materials Science                        | detectors. The p-i-n structure is a p-n junction with a doped region, where the “i-region” is between the n and the p layers. A well-defined i-region is usually associated with p or n layers with high resistivities. The p-i-n structure is mostly used in diodes and in some types of semiconductor radiation detectors. The uniqueness of this method is that, in this method, the processes of diffusion and drift of lithium ions, which are the main processes in the formation of Si(Li) p-i-n structures, are produced from both flat sides of cylindrical-shaped monocrystalline silicon, at optimal temperature (T = 420°C) conditions of diffusion, and subsequently, with synchronous supply of temperature (from 55 to 100°C) and reverse bias voltage (from 70 to 300 V) during drift of lithium ions into silicon. Thus, shortening the manufacturing time of the detector and providing a more uniform distribution of lithium ions in the crystal volume. Since, at present, the development of manufacturing of large-sized Si(Li) detectors is hindered due to difficulties in obtaining a uniformly compensated large area and time-consuming manufacturing process, the proposed method may open up new possibilities in detector manufacturing. | i?eid=2-s2.0-85114868997&origin=resultslist&sort=plf-f  |
| 44. | Dual-axis schedule tracker with an adaptive algorithm for a strong scattering of sunbeam | Saymbetov, A., Mekhilef, S., Kuttybay, N., ...Dosymbetova, G., Svanbayev, Y. Nurgaliyev, M | 2021 | <b>Solar Energy</b><br>Q1 in Materials Science | The efficiency of photovoltaic panels is one of the main challenges of solar energy today. The sharp decline in solar cell performance in cloudy weather is the most significant limiting factor for the transition to a green economy. As a result, today's priority task is the development of various algorithms to improve the performance of solar cells in cloudy weather. This paper compares the performance of dual-axis schedule tracker and dual-axis schedule tracker with an adaptive algorithm for a strong scattering of the sun's rays by clouds. A comparative analysis of the manufactured trackers operation in adverse weather conditions was performed and with the use of small solar panels, an effective method was proposed for determining the minimum flow of solar energy entering the surface of photovoltaic installations with strong cloud scattering. The developed dual-axis method of tracking the sun is 41% more efficient than the dual-axis schedule tracker. The energy produced by trackers with high-power panels for three months in the previous three years was  | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85108003152&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85108003152&amp;origin=resultslist&amp;sort=plf-f</a> |

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|     |  |  |      |   | also estimated using available meteorological data in Almaty, Kazakhstan. The results obtained can be used to design solar trackers in areas with a high probability of intense solar energy scattering on clouds.  |   |
| 45. | Period bouncer cataclysmic variable EZ Lyn in quiescence   | Amantayeva, A., Zharikov, S., Page, K.L., Khokhlov, S., Ibraimov, M. | 2021 | <b>Astrophysical Journal</b><br>Q1 in Physics and Astronomy | We report the study of the accretion disk structure of the period bouncer cataclysmic variable EZ Lyn (SDSS J080434.20+510349.2) in quiescence based on our new time-resolved photometric and spectroscopic observations and data extracted from archives. The object magnitude now is $V = 17.95(5)$ , close to its brightest before the first superoutburst in 2006. We confirmed the presence of the small eclipse in the optical light curve. The spectra obtained in quiescence at different epochs look similar. However, the contribution of the disk and intensities of emission lines are strongly varied. We singled out pure accretion disk spectra and found that the Balmer decrement $H\alpha:H\beta:H\gamma:H\delta = 1.61:1.0:0.76:0.59$ is comparable with one at bright accretion disks in longer period cataclysmic variables. The decrement suggests that emission lines are excited collisionally in an optical thin part of the disk with average density and temperature of $\log N_0 = 12.5(2)$ and $T = (10-15) \times 10^3$ K. Based on the photometric data and our modeling techniques, we redetermined the mass of $M_{WD} = 0.85(1) M_e$ and the current effective temperature $T_{WD,eff} = 11,250(50)$ K of the white dwarf. The secondary has mass of $M_2 = 0.042(14) M_e$ . The system inclination is $79.0^\circ(2)$ . The mass accretion rate is about $\dot{M} \approx (0.3-3.0) \times 10^{-12} M_\odot \text{ yr}^{-1}$ . The disk luminosity, together with results from light-curve modeling, suggests a low effective temperature $\sim 2500$ K of the continuum emitting region, where also the spiral arm pattern is hosted. | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85115938228&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85115938228&amp;origin=resultslist&amp;sort=plf-f</a> |
| 46. | Exponential distribution of lifetimes for transient bursting states in coupled noisy excitable systems | Albanbay, N., Medetov, B., Zaks, M.A.                                | 2021 | <b>Chaos</b><br>Q1 in Mathematical Physics                  | The phenomenon of transient bursting, caused by additive noise in a set of two coupled FitzHugh-Nagumo oscillators, is studied by direct numerical integration and by measurements in the analog electronic circuit. In the parameter region where the unique global attractor of the deterministic system is the state of rest, introduction of low or moderate intensity fluctuations into the voltage dynamics results in the onset of a transient bursting state: sequences of intermittent bursts  | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85114711096&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85114711096&amp;origin=resultslist&amp;sort=plf-f</a> |

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|     |   |  |      |  | (patches of spikes), followed by ultimate relaxation to the equilibrium. Like genuine deterministic bursting, this behavior has its origin in the slow-fast character of the underlying dynamics. Trajectories that in the deterministic variant would converge to the state of rest can, under the action of noise, escape the local basin of attraction of the equilibrium and experience a bursting episode, before being dynamically reinjected into the region around the equilibrium. Under frozen parameter values and fixed noise intensity, the number of bursts preceding the ultimate decay strongly varies for different realizations of the additive random signal. The average duration of the transient bursting stage, bounded for weak noise, diverges when the intensity of fluctuations is raised. For sufficiently large ensembles of realizations, the lifetimes of transient bursting states, both in simulations and in the analog circuit, obey the exponential distribution. We relate this distribution to the probability for a stochastic trajectory to temporarily escape from the local basin of attraction of the equilibrium.  | tslist&sort=pl<br>f-f   |
| 47. | Extended HNCO, SiO, and HC3N emission in 43 southern star-forming regions | He, Y.-X., Henkel, C., Zhou, J.-J., ...Komesh, T., Sailanbek, S. | 2021 | <b>Astrophysical Journal, Supplement Series</b><br><br>Q1 in Space and Planetary Science | We have selected 43 southern massive star-forming regions to study the spatial distribution of HNCO 404-303, SiO 2-1, and HC3N 10-9 line emission and to investigate their spatial association with the dust emission. The morphology of HNCO 404-303 and HC3N 10-9 agrees well with the dust emission. HC3N 10-9 tends to originate from more compact regions than HNCO 404-303 and SiO 2-1. We divided our sources into three groups: those in the Central Molecular Zone (CMZ), those associated with bubbles (Bubble), and the remaining sources, which are termed "normal star-forming regions"(NMSFR). These three groups, subdivided into three different categories with respect to line widths, integrated intensities, and column densities, hint at the presence of different physical and chemical processes. We find that the dust temperature $T_d$ , and the abundance ratios $N_{\text{HNCO}}/N_{\text{SiO}}$ and $N_{\text{HNCO}}/N_{\text{HC3N}}$ show a decreasing trend toward the central dense regions of CMZ sources, while $N_{\text{HC3N}}/N_{\text{SiO}}$ moves in the opposite direction. Moreover, a better agreement is found between $T_d$ and $N_{\text{HC3N}}/N_{\text{SiO}}$ in Bubble and NMSFR category sources. Both outflow and inflow activities | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85101657393&amp;origin=resultlist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85101657393&amp;origin=resultlist&amp;sort=plf-f</a> |

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|     |   |   |      |   | have been found in eight of the 16 bubble and NMSFR sources. The low outflow detection rate indicates either that in these sources the SiO 2-1 line wing emission is below our sensitivity limit or that the bulk of the SiO emission may be produced by the expansion of an H II region or supernova remnant, which has pushed molecular gas away, forming a shock and yielding SiO.  |   |
| 48. | Effects of non-vanishing dark matter pressure in the Milky Way Galaxy | Boshkayev, K.,<br>Konysbayev, T.,<br>Kurmanov, E.,<br>Mutalipova, K.,<br>Zhumakhanova, G. | 2021 | <b>Monthly Notices of the Royal Astronomical Society</b><br><br>Q1 in Space and Planetary Science | We consider the possibility that the Milky Way's dark matter halo possesses a non-vanishing equation of state. Consequently, we evaluate the contribution due to the speed of sound, assuming that the dark matter content of the galaxy behaves like a fluid with pressure. In particular, we model the dark matter distribution via an exponential sphere profile in the galactic core, and inner parts of the galaxy whereas we compare the exponential sphere with three widely used profiles for the halo, i.e. the Einasto, Burkert and Isothermal profile. For the galactic core, we also compare the effects due to a dark matter distribution without black hole with the case of a supermassive black hole in vacuum and show that present observations are unable to distinguish them. Finally we investigate the expected experimental signature provided by gravitational lensing due to the presence of dark matter in the core. | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85118303500&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85118303500&amp;origin=resultslist&amp;sort=plf-f</a> |
| 49. | Luminosity of accretion disks in compact objects with a quadrupole    | Boshkayev, K.,<br>Konysbayev, T.,<br>Kurmanov, E.,<br>...Malafarina, D.,<br>Quevedo, H.   | 2021 | <b>Physical Review D</b><br><br>Q1 in Physics and Astronomy                                       | We consider the circular motion of test particles in the gravitational field of a static and axially symmetric compact object described by the metric. To this end, we calculate orbital parameters of test particles on accretion disks such as angular velocity ( $\Omega$ ), total energy ( $E$ ), angular momentum ( $L$ ), and radius of the innermost stable circular orbit ( $r_{\text{ISCO}}$ ) as functions of the mass ( $M$ ) and quadrupole ( $Q$ ) parameters of the source. The radiative flux, differential, and spectral luminosity of the accretion disk, which are quantities that can be experimentally measured, are then explored in detail. The obtained results are compared with the corresponding ones for the Schwarzschild and Kerr black holes in order to establish whether black holes may be distinguished from the metric via observations of the accretion disk's spectrum.                                   | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85116372484&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85116372484&amp;origin=resultslist&amp;sort=plf-f</a> |

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| 50. | Bound mass of Dehnen models with a centrally peaked star formation efficiency | Shukirgaliyev, B., Otebay, A., Sobolenko, M., Kalambay M., Spurzem, R., Just, A. | 2021 | <b>Astronomy and Astrophysics</b><br><br>Q1 in Physics and Astronomy | Context. Understanding the formation of bound star clusters with a low star formation efficiency (SFE) is important for improving our knowledge of the star-formation history of galaxies. In N-body models of star-cluster evolution after gas expulsion, the Plummer model with an outer power law density profile has been used in a broad range of studies. Aims. Here, we study the impact of the density profile slopes on the survivability of the low-SFE star clusters after instantaneous gas expulsion. We compare cases when a stellar cluster exhibits a Plummer profile to those with Dehnen profiles, including cuspy ones of different slopes at the time of formation. Methods. We determined the corresponding density profile of the residual gas for a given global SFE, assuming that our model clusters formed with a constant efficiency per free-fall time and, hence, with a shallower density profile for the gas than that of the stars. We performed direct N-body simulations of evolution of clusters initially in virial equilibrium within the gas potential following gas removal. Results. We find that the violent relaxation lasts no longer than 20 Myr, independently of the density profile power law slopes. Dehnen model clusters survive after violent relaxation with significantly lower SFEs when the global SFE measured within the Jacobi radius or within a half-mass radius. Dehnen $\gamma = 0$ model clusters show a similar final bound fraction with the Plummer model clusters if the global SFE is measured within ten scale radii. The final bound fraction increases with the $\gamma$ values for a given global SFE. Conclusions. We conclude that Dehnen clusters better resist the consequences of the violent relaxation that follows the instantaneous gas expulsion, as compared to the Plummer clusters. Therefore, the shallower the outer density slope of the low-SFE clusters, the better their prospects for survival after gas expulsion. Among the Dehnen clusters, we find that the steeper the inner slope, the higher the bound mass fraction that is retained, following the violent relaxation for a given global SFE. | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85117103291&amp;origin=resultlist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85117103291&amp;origin=resultlist&amp;sort=plf-f</a> |
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| 51. | Preparation and characterization of F-, O-, and N-containing carbon nanoparticles for pH sensing          | Lisnyak, V.V., Zaderko, A.N., Mariychuk, R., Mussabek, G.K., Zhylybayeva, N., Tananiko, O.Y. | 2021 | <b>Applied Nanoscience (Switzerland)</b><br><br>Q1 in Materials Science (miscellaneous) | A novel sensing system was designed for pH measurements based on the enhanced and quenched photoluminescence (PL) and UV-Vis absorption of the diluted water solutions of F-, O-, and N-containing carbon nanoparticles (FON-CNPs). These FON-CNPs were solvothermally synthesized, dissolved, ultra-filtrated, and separated by thin-layer chromatography. The total fluorine content in them was found to be 1.2–1.5 mmol per gram. Their TGA showed a total weight loss of 52.7% because of the thermal decomposition and detachment of the surface groups and the partial burning of the functionalized shell on the carbon core at temperatures below 1200 °C. TEM and Raman data confirmed the presence of graphitic structures in the carbon core. From the results of ATR FTIR and UV-Vis spectroscopies, we showed that a carbon shell incorporates different functional groups covering the carbon core. The surface groups of the carbon shell include carboxyl, phenolic, and carbonyl groups. Heterocyclic N-containing and amino groups and trifluoromethyl groups supporting the hydrophobicity were also found. We suggested the possible reasons for the pH responses obtained with the sensing system considering them dependent on the de-protonation of functional groups with pH change. | <a href="https://www.scopus.com/record/display.uri?id=2-s2.0-85101098654&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?id=2-s2.0-85101098654&amp;origin=resultslist&amp;sort=plf-f</a> |
| 52. | Corrosion and Mechanical Properties of the Fe-W-Wo <sub>2</sub> and Fe-Mo-MoO <sub>2</sub> Nanocomposites | Yar-Mukhamedova, G., Ved', M., Sakhnenko, N., Karakurkchi, A., Yermolenko, I.                | 2021 | <b>Advances in Materials Science and Engineering</b><br><br>Q2 in General Engineering   | Analyzing of composition electrolytic coatings' application for the metal surface protection is considered. It is established that using different components for coatings' modification gives possibility to obtain surfaces with expanding exploitation properties, in particular, with improved wearing and anticorrosion resistance. The new approach for protecting details which are made from cast irons by obtaining two kinds of composition coatings from binary alloys iron-molybdenum and iron-tungsten is proposed. It is found that the modification of iron by refractory metals up to 37 wt. % leads to a noticeable change in the microstructure of the coatings' surface. It is established that the incorporation of refractory metals into the iron matrix is a good way to increase the microhardness of the surface by 2.5-3.5 times and rising of the wear resistance by 40%, as well as decreasing the friction coefficient by 3-4 times in comparison with the cast iron   | <a href="https://www.scopus.com/record/display.uri?id=2-s2.0-85108425225&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?id=2-s2.0-85108425225&amp;origin=resultslist&amp;sort=plf-f</a> |

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|     |   |  |      |  | substrate. The research results can be used for surfaces hardening and protection in different industries.  |   |
| 53. | The prolonged gamma ray enhancement and the short radiation burst events observed in thunderstorms at Tien Shan | Shepetov, A., Antonova, V., Kalikulov, O., Mukashev, K. M., Zhukov, V., Gurevich, A.       | 2021 | <b>Atmospheric Research</b><br><br>Q1 in<br><br>Atmospheric Science                  | We report the observation results of the hard radiation flashes which accompanied the lightning discharges above the mountains of Northern Tien Shan. Time series of the counting rate intensity, numerical estimations of absolute flux, and energy distribution of accelerated electrons and of (20–2000) keV gamma rays were obtained at the height of 3700 m a. s. l., immediately within thunderclouds, and in closest vicinity ( $\leq 100$ m) to discharge region. Two different kinds of radiation emission events are presented here: a relatively prolonged rise of gamma ray intensity with minute-scale duration (the thunderstorm ground enhancement, TGE) which has preceded a negative field variation, and a short sub-millisecond radiation burst, which accompanied a close lightning discharge in thundercloud. It was revealed also an indication to positron generation in thunderclouds at the time of gamma ray emission, as well as modulation of the neutron counting rate in Tien Shan neutron monitor which was operating at a (1.5–2) km order distance from the region of lightning development. | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85091258561&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85091258561&amp;origin=resultslist&amp;sort=plf-f</a> |
| 54. | Electrostatic energy analyzer for nanotechnology applications   | Guseinov, N.R., Ilyin, A.M.  | 2021 | <b>Journal of Electron Spectroscopy and Related Phenomena</b><br><br>Q2 in Radiation | Electrostatic energy analyzers are key instruments in the wide field of the Electron Spectroscopy, and the Auger Electron Spectroscopy is one of commonly used technique within this area. The paper presents a new energy analyzer based on combination of a face-field and CMA configurations and some experimental Auger spectra obtained from nanostructures synthesized. The data obtained show that the presented analyzer's energy resolution and design parameters are superior to the data of the well known standard CMA.   | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85097347019&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85097347019&amp;origin=resultslist&amp;sort=plf-f</a> |
| 55. | Bound mass of Dehnen models with a centrally peaked star formation efficiency                                   | Shukirgaliyev, B., Otebay, A., Sobolenko, M., Naurzabayeva, Aisha Zh.Spurzem, R., Just, A. | 2021 | <b>Astronomy and Astrophysics</b><br><br>Q1 in Physics and Astronomy                 | Context. Understanding the formation of bound star clusters with a low star formation efficiency (SFE) is important for improving our knowledge of the star-formation history of galaxies. In N-body models of star-cluster evolution after gas expulsion, the Plummer model with an outer power law density profile has been used in a broad range of studies.   | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85117103291&amp;origin=resultslist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85117103291&amp;origin=resultslist&amp;sort=plf-f</a> |

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|     |  |   |      |   | <p>Aims. Here, we study the impact of the density profile slopes on the survivability of the low-SFE star clusters after instantaneous gas expulsion. We compare cases when a stellar cluster exhibits a Plummer profile to those with Dehnen profiles, including cuspy ones of different slopes at the time of formation. Methods. We determined the corresponding density profile of the residual gas for a given global SFE, assuming that our model clusters formed with a constant efficiency per free-fall time and, hence, with a shallower density profile for the gas than that of the stars. We performed direct N-body simulations of evolution of clusters initially in virial equilibrium within the gas potential following gas removal. Results. We find that the violent relaxation lasts no longer than 20 Myr, independently of the density profile power law slopes. Dehnen model clusters survive after violent relaxation with significantly lower SFEs when the global SFE measured within the Jacobi radius or within a half-mass radius. Dehnen <math>\gamma = 0</math> model clusters show a similar final bound fraction with the Plummer model clusters if the global SFE is measured within ten scale radii. The final bound fraction increases with the <math>\gamma</math> values for a given global SFE. Conclusions. We conclude that Dehnen clusters better resist the consequences of the violent relaxation that follows the instantaneous gas expulsion, as compared to the Plummer clusters. Therefore, the shallower the outer density slope of the low-SFE clusters, the better their prospects for survival after gas expulsion. Among the Dehnen clusters, we find that the steeper the inner slope, the higher the bound mass fraction that is retained, following the violent relaxation for a given global SFE.</p> | tslist&sort=pl<br>f-f   |
| 56. | Methods of stability control of perovskite solar cells for high efficiency | Muradov, A., Frolushkina, D., Samusenkov, V., Zhamanbayeva, G., Kot, S. | 2021 | <b>Energies</b><br><br>Q1 in Control and Optimization | The increasing demand for renewable energy devices over the past decade has motivated researchers to develop new and improve the existing fabrication techniques. One of the promising candidates for renewable energy technology is metal halide perovskite, owing to its high power conversion efficiency and low processing cost. This work analyzes the relationship between the structure of metal halide perovskites and their properties along with the effect of alloying and other factors on device stability, as well as causes and mechanisms   | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85106883894&amp;origin=resultlist&amp;sort=plf-f">https://www.scopus.com/record/display.uri?eid=2-s2.0-85106883894&amp;origin=resultlist&amp;sort=plf-f</a> |

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|  |   |   |      |                    | of material degradation. The present work discusses the existing approaches for enhancing the stability of PSC devices through modifying functional layers. The advantages and disadvantages of different methods in boosting device efficiency and reducing fabrication cost are highlighted. In addition, the paper presents recommendations for the enhancement of interfaces in PSC structures.  |   |
| <b>Кафедра физики плазмы, нанотехнологий и компьютерной физики</b> |   |   |      |                    |  |   |
| 57.  | Physical properties of carbon nanowalls synthesized by the ICP-PECVD method vs. the growth time | Yerlanuly, Y., Zhumadilov, R., Nemkayeva, R., Uzakbaiuly, B., Beisenbayev, A.R., Bakenov, Z., Ramazanov, T., Gabdullin, M., Ng, A., Brus, V.V., Jumabekov, A.N. | 2021 | Scientific Reports | Investigation of the physical properties of carbon nanowall (CNW) films is carried out in correlation with the growth time. The structural, electronic, optical and electrical properties of CNW films are investigated using electron microscopy, Raman spectroscopy, X-ray photoelectron spectroscopy, ultraviolet photoelectron spectroscopy, UV-Vis spectroscopy, Hall Effect measurement system, Four Point Probing system, and thermoelectric measurements. Shorter growth time results in thinner CNW films with a densely spaced labyrinth structure, while a longer growth time results in thicker CNW films with a petal structure. These changes in morphology further lead to changes in the structural, optical, and electrical properties of the CNW.                  | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85116056299&amp;doi=10.1038%2fs41598-021-97997-8&amp;origin=inward&amp;txGid=0f28de9e469d19d4f54d72cfe d185744">https://www.scopus.com/record/display.uri?eid=2-s2.0-85116056299&amp;doi=10.1038%2fs41598-021-97997-8&amp;origin=inward&amp;txGid=0f28de9e469d19d4f54d72cfe d185744</a> |
| 58.  | Plasma with carbon nanoparticles: Advances and application                                      | Orazbayev, S., Yerlanuly, Y., Utegenov, A., Moldabekov, Z., Gabdullin, M., Ramazanov, T.  | 2021 | Nanotechnology     | This article is devoted to the study of the glow intensity of radio-frequency capacitive discharge plasma with nanoparticles for further use in lighting devices. The process of carbon nanoparticles synthesis in the radiofrequency discharge was investigated, and the influence of plasma parameters on the formation and growth of the material was also studied. A method for determining the diameter of nanoparticles based on self-bias voltage and electron density is considered. It is revealed that the diameter of nanoparticles has a considerable influence on the optical properties of the plasma, in particular, on the emission intensity. Based on the obtained data, laboratory samples of lighting devices with improved luminous intensities were developed. | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85114038832&amp;doi=10.1088%2f1361-6528%2fac1a40&amp;origin=inward&amp;txGid=c35e0963d1526835fe6e890bf2081692">https://www.scopus.com/record/display.uri?eid=2-s2.0-85114038832&amp;doi=10.1088%2f1361-6528%2fac1a40&amp;origin=inward&amp;txGid=c35e0963d1526835fe6e890bf2081692</a>   |

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| 59. | Ion core effect on scattering processes in dense plasmas  | Ramazanov, T.S., Kodanova, S.K., Nurusheva, M.M., Issanova, M.K.   | 2021 | Physics of Plasmas                       | A pseudopotential approach was used to study the effect of an ionic core on the electron-ion scattering in dense plasmas. Screening of the ion charge is taken into account using the density response function in the long wavelength limit. Additionally, the effect of electronic non-ideality is included using the compressibility sum-rule connecting the local field correction and the exchange-correlation part of the electronic free energy density. Using a screened pseudopotential, we have computed electron-ion scattering phase shifts, the total elastic scattering cross section, and the transport cross section. It is found that the ionic core leads to the strong decrease in the scattering cross sections. Additionally, it is shown that the transport cross section has a non-monotonic dependence on the variation of the ionic core field parameters. | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85114484339&amp;doi=10.1063%2f5.0059297&amp;origin=inward&amp;txGid=90d8223bd333a22a83364e3dc49db404">https://www.scopus.com/record/display.uri?eid=2-s2.0-85114484339&amp;doi=10.1063%2f5.0059297&amp;origin=inward&amp;txGid=90d8223bd333a22a83364e3dc49db404</a>                           |
| 60. | Hydrogen sorption properties of new magnesium intermetallic compounds with MgSnCu <sub>4</sub> type structure | Matysina, Z.A., Gavrylyuk, N.A., Kartel, M., Veziroglu, A., Veziroglu, T.N., Pomytkin, A.P., Schur, D.V., Ramazanov, T.S., Gabdullin, M.T., Zolotareno, A.D., Zolotareno, A.D., Shvachko, N.A. | 2021 | International Journal of Hydrogen Energy | A statistical theory of the MgCeCo <sub>4</sub> -H <sub>2</sub> system has been developed for hydrogenation and phase transitions under pressure. The free energy value is calculated. The equation of thermodynamic equilibrium is obtained. The temperature of the order-disorder phase transition is estimated. Isotherms and Isoplethes of hydrogen absorption-desorption are constructed. The possibility of a hysteresis effect is established. The temperature dependence of the hydrogen solubility is found taking into account the phase transition configuration heat capacity. The calculated and experimental graphs of the sorption isotherm are of a similar nature.   | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85111345322&amp;doi=10.1016%2fj.ijhydene.2021.05.069&amp;origin=inward&amp;txGid=7e9cab38e25195c71d2bc4f1fade6958">https://www.scopus.com/record/display.uri?eid=2-s2.0-85111345322&amp;doi=10.1016%2fj.ijhydene.2021.05.069&amp;origin=inward&amp;txGid=7e9cab38e25195c71d2bc4f1fade6958</a> |
| 61. | Rotation of dust particles in an inhomogeneous weak magnetic field in a DC glow discharge                     | Abdirakhmanov, A.R., Bastykova, N.K., Kodanova, S.K., Ramazanov, T.S.  | 2021 | Physics of Plasmas                       | We report an explanation for the opposite direction of the rotation of the charged dust particles above and below the Helmholtz coil in an inhomogeneous weak magnetic field in the direct current glow discharge. Experiments with monodispersed melamine-formaldehyde particles were performed in an argon plasma in an inhomogeneous weak magnetic field (with the induction values 4, 12, and 18 ). The linear and angular velocities of rotational motion of the clusters of dust particles formed in regions with an inhomogeneous weak magnetic field above and below the Helmholtz coil were analyzed. The peculiarity is that the  | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85109217286&amp;doi=10.1063%2f5.0052905&amp;origin=inward&amp;txGid=0ce0bdb6d9a">https://www.scopus.com/record/display.uri?eid=2-s2.0-85109217286&amp;doi=10.1063%2f5.0052905&amp;origin=inward&amp;txGid=0ce0bdb6d9a</a>   |

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|     |  |  |      |  | directions of rotation in these areas are opposite, whereas there is no rotational motion in the region of a uniform magnetic field. To explain these observations, the theoretical model that takes into account the magnetic field inhomogeneity and provides good agreement with experimental data is presented.   | d1ad2b804135368fc2b93   |
| 62. | The study of deuterium permeability of film-forming inhibitors with the addition of fullerenes           | Akhanova, N., Yerlanuly, Y., Batryshev, D., Kulsartov, T., Chikh-ray, Y., Ramazanov, T., Veziroglu, A., Schur, D., Kang, W., Gabdullin, M.   | 2021 | International Journal of Hydrogen Energy | In this work, the results of the hydrogen permeability study of a composite film-forming inhibitor are considered. Film-forming inhibitor consists of polyether urethane and synthesized fullerenes C60 and C70 in pure form. Two types of samples were used: uncoated and coated stainless steels with composite polyether urethane/fullerene varnish. The experimental work was based on the study of the dependence of the permeation reduction factor on the temperature in the reactor. For the coated sample, the minimum temperature was 623 K at which the deuterium flux was registered. Here we assume that at temperatures below 573 K the output pressure caused by the deuterium flow through the sample is less than 10–10 Pa. The rate of steady-state flow through a coated sample is significantly lower than for an uncoated one at temperatures 573–673 K. The deuterium penetration rates through the two samples increase and reach similar stationary values starting at 723 K. | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85097894465&amp;doi=10.1016%2Fj.ijhydene.2020.11.241&amp;origin=inward&amp;txGid=aae659c2a5a53a3f1d1d80093b054717">https://www.scopus.com/record/display.uri?eid=2-s2.0-85097894465&amp;doi=10.1016%2Fj.ijhydene.2020.11.241&amp;origin=inward&amp;txGid=aae659c2a5a53a3f1d1d80093b054717</a> |
| 63. | Methods of theoretical calculations and of experimental researches of the system atomic hydrogen – metal | Zolotareno, A.D., Zolotareno, A.D., Veziroglu, A., Veziroglu, T.N., Shvachko, N.A., Pomytkin, A.P., Schur, D.V., Gavrylyuk, N.A., Ramazanov, T.S., Akhanova, N.Y., Gabdullin, M.T. | 2021 | International Journal of Hydrogen Energy | All the main directions of energy development suggest or already implement the use of hydrogen. In addition, the interaction of low-energy hydrogen atoms with metals is also of considerable interest, both from the point of view of fundamental research and in connection with the operation of large tokamaks and thermonuclear reactors. The paper presents a literature review of the features of the interaction of hydrogen with metals. It is shown that metal-hydrogen reactions, which lead to the formation of metal hydrides, are considered as a special type of such interaction. Modern methods of experimental study of heterogeneous reactions, topochemistry of metal - hydrogen reactions, dependences of the rate of interaction on pressure and temperature are considered, models of surface processes occurring during the interaction of hydrogen with a metal are discussed. A kinetic   | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85103978732&amp;doi=10.1016%2Fj.ijhydene.2021.03.065&amp;origin=inward&amp;txGid=92b8196a2165514c0f5031d3127ffa2a">https://www.scopus.com/record/display.uri?eid=2-s2.0-85103978732&amp;doi=10.1016%2Fj.ijhydene.2021.03.065&amp;origin=inward&amp;txGid=92b8196a2165514c0f5031d3127ffa2a</a> |

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|     |   |   |      |  | method for studying the mechanism of interaction of atomic hydrogen with hydride-forming metals is proposed.   |   |
| 64. | The use of ultrapure molecular hydrogen enriched with atomic hydrogen in apparatuses of artificial lung ventilation in the fight against virus COVID-19 | Zolotareno, A.D., Zolotareno, A.D., Veziroglu, A., Veziroglu, T.N., Shvachko, N.A., Pomytkin, A.P., Gavrylyuk, N.A., Schur, D.V., Ramazanov, T.S., Gabdullin, M.T | 2021 | International Journal of Hydrogen Energy | COVID-19 is a disease caused by the SARS-CoV virus. It stands for severe acute respiratory syndrome, which affects the lungs. The process of replication and progression of the COVID-19 virus causes the formation of an excessive amount of reactive oxygen species and inflammation. Many studies have been carried out that have demonstrated that hydrogen has strong anti-inflammatory properties. It reduces hypotension and other symptoms by reducing inflammation and oxidative stress. Oxygen mixture, enriched with Hydrogen, - helps to reduce the resistance of the respiratory tract and frees up access to the pulmonary alveolus, which improves the penetration of oxygen into the lungs. Since hydrogen is an antioxidant, it helps to reduce the burden on the immune system, helps to maintain the body's health and its ability to quickly recover. When electrolyzers are used to produce an oxygen-hydrogen mixture, alkaline mist and other impurities can enter the patient's lungs and cause poisoning and chemical burns. For this reason, the use of atomic hydrogen obtained from metal hydride sources for ventilation of the lungs will be more effective for treating COVID-19 than a molecular hydrogen-oxygen mixture from an electrolyzer. A functional diagram of a metal hydride source of atomic hydrogen to an artificial lung ventilator is shown. It is possible to create a series of hydrogen storage tanks of various capacities. | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85103313236&amp;doi=10.1016%2fj.ijhydene.2021.03.025&amp;origin=inward&amp;txGid=d692cabda662848d3f0a5e8eacc9518">https://www.scopus.com/record/display.uri?eid=2-s2.0-85103313236&amp;doi=10.1016%2fj.ijhydene.2021.03.025&amp;origin=inward&amp;txGid=d692cabda662848d3f0a5e8eacc9518</a> |
| 65. | Insights on Desired Fabrication Factors from Modeling Sandwich and Quasi-Interdigitated Back-Contact Perovskite Solar Cells                             | Shalenov, E.O., Dzhumagulova, K.N., Seitkozhanov, Y.S., Ng, A., Valagiannopoulos, C., Jumabekov, A.N.   | 2021 | ACS Applied Energy Materials             | A numerical simulation method is used to investigate the optical and electrical properties of both conventional sandwich and quasi-interdigitated back-contact (QIBC) perovskite solar cells (PSCs). The results reveal the fundamental physics of PSCs with different architectures, exhibiting their difference in working principle and device properties. A two-dimensional optical model, which takes into account both the electromagnetic and electronic properties of various device layers, is selected to accurately describe the device optical properties and to achieve more comprehensive simulations of solar cell properties under different device working  | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85101677308&amp;doi=10.1021%2facsami.2021.02120&amp;origin=inward&amp;txGid=4d7b9f29ef0902cd52">https://www.scopus.com/record/display.uri?eid=2-s2.0-85101677308&amp;doi=10.1021%2facsami.2021.02120&amp;origin=inward&amp;txGid=4d7b9f29ef0902cd52</a>                                     |

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|     |   |  |      |              | <p>conditions. Different carrier recombination mechanisms for two kinds of PSC architectures are also compared. The conditions under which the electrical properties of the perovskite photo-absorber layer enable QIBC PSCs to operate competitively or exhibit better device performance compared to the sandwich PSCs are examined in detail. The case of QIBC PSCs with various combinations of charge-selective layers is analyzed to provide an insight into materials selection for achieving high-efficiency QIBC PSCs. It is found that power conversion efficiencies more than 25% can be potentially achieved for CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub>-based QIBC PSCs after careful optimization of materials selection and device fabrication. The findings of this work can be used as a guideline for the design and fabrication of high-performance QIBC PSCs.</p>  | 18cf43aac3f8f5  |
| 66. | Self-bias voltage formation and charged particle dynamics in multi-frequency capacitively coupled plasmas | Masheyeva, R.U., Dzhumagulova, K.N., Myrzaly, M., Schulze, J., Donkó, Z. | 2021 | AIP Advances | <p>In this work, we analyze the creation of the discharge asymmetry and the concomitant formation of the DC self-bias voltage in capacitively coupled radio frequency plasmas driven by multi-frequency waveforms as a function of the electrode surface characteristics. For the latter, we consider and vary the coefficients that characterize the elastic reflection of electrons from the surfaces and the ion-induced secondary electron yield. Our investigations are based on particle-in-cell/Monte Carlo collision simulations of the plasma and on a model that aids the understanding of the computational results. Electron reflection from the electrodes is found to slightly affect the discharge asymmetry in the presence of multi-frequency excitation, whereas secondary electrons cause distinct changes to the asymmetry of the plasma as a function of the phase angle between the harmonics of the driving voltage waveform and as a function the number of these harmonics.</p> | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85111049031&amp;origin=resultslist&amp;sort=plf-f&amp;src=s&amp;nlo=&amp;nlr=&amp;nls=&amp;sid=0d429ca8af0dab7edbfa74eb7579cc4f&amp;sot=aut&amp;stdt=cl&amp;cluster=scoprefnameuid%2c%22Ramazanov%2c+T.S.%236701328029%22%2cf%2c%22Gabdullin%2c+M.T.%231280522940">https://www.scopus.com/record/display.uri?eid=2-s2.0-85111049031&amp;origin=resultslist&amp;sort=plf-f&amp;src=s&amp;nlo=&amp;nlr=&amp;nls=&amp;sid=0d429ca8af0dab7edbfa74eb7579cc4f&amp;sot=aut&amp;stdt=cl&amp;cluster=scoprefnameuid%2c%22Ramazanov%2c+T.S.%236701328029%22%2cf%2c%22Gabdullin%2c+M.T.%231280522940</a> |

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| 67. | Axial-symmetric diffraction radiation antenna with a very narrow funnel-shaped directional diagram | Sirenko, Y., Sautbekov, S., Sautbekova, M., Yashina, N., Burambayeva, N., Begimova, A | 2021 | Applied Sciences (Switzerland) | The paper is focused on reliable modeling and analysis of axially symmetric radiators with a very narrow (throat) funnel-shaped radiation pattern. When such a diagram is formed, a wave analogue of Smith–Purcell coherent radiation is realized—the surface wave of a radial dielectric waveguide ‘sweeps out’ with its exponentially decaying part a concentric periodic grating, the fundamental spatial harmonic of which, propagating without attenuation in a direction close to the symmetry axis of the structure, generates a radiation field with the required characteristics. | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85118776501&amp;doi=10.3390%2fapp112110381&amp;origin=inward&amp;txGid=349ec0d7c4260f12f19adef9305eb688">https://www.scopus.com/record/display.uri?eid=2-s2.0-85118776501&amp;doi=10.3390%2fapp112110381&amp;origin=inward&amp;txGid=349ec0d7c4260f12f19adef9305eb688</a> |
| 68. | Analogy approach in solving the problem of a moving electric dipole                                | Sautbekov, S.S., Baisalova, K.N., Sirenko, Y.K.                                       | 2021 | AIP Advances                   | Using the principle of permutational duality as well as the analogical approach of both electrical and magnetic dipoles, it is possible to obtain a new relativistic magnetic type vector potential of an arbitrarily moving electric point dipole. The specific cases of the magnetic vector potential in the   | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85117146041">https://www.scopus.com/record/display.uri?eid=2-s2.0-85117146041</a>   |

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|     |   |   |      |                           | calculation of fields have been considered, and the obtained results have been compared with the research of other scholars.  | &origin=resul<br>tlist&sort=pl<br>f-<br>f&src=s&nlo<br>=&nlr=&nls=<br>&sid=838b4fc<br>5c991f904c6b<br>161f2029aaef<br>7&sot=aut&s<br>dt=cl&cluster<br>=scopubyr%2<br>c%222021%2<br>2%2ct&sl=18<br>&s=AU-<br>ID%2824725<br>586300%29&<br>relpos=1&cite<br>Cnt=0&searc<br>hTerm=  |
| 69. | The evaluation of an asymptotic solution to the sommerfeld radiation problem using an efficient method for the calculation of sommerfeld integrals in the spectral domain | Bourgiotis, S., Frangos, P., Sautbekov, S., Pshikov, M. | 2021 | Electronics (Switzerland) | A recently developed high-frequency asymptotic solution for the famous “Sommerfeld radiation problem” is revisited. The solution is based on an analysis performed in the spectral domain, through which a compact asymptotic formula describes the behavior of the EM field, which emanates from a vertical Hertzian radiating dipole, located above flat, lossy ground. The paper is divided into two parts. We first demonstrate an efficient technique for the accurate numerical calculation of the well-known Sommerfeld integrals. The results are compared against alternative calculation approaches and validated with the corresponding Norton figures for the surface wave. In the second part, we introduce the asymptotic solution and investigate its performance; we compare the solution with the accurate numerical evaluation for the received EM field and with a more basic asymptotic solution to the given problem, obtained via the application of the Stationary Phase Method. Simulations for various frequencies, distances, altitudes, and ground characteristics are illustrated and inferences for the applicability of the solution are made. Finally, special cases leading to analytical field | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85106971055&amp;origin=resul&lt;br/&gt;tlist&amp;sort=pl&lt;br/&gt;f-&lt;br/&gt;f&amp;src=s&amp;nlo&lt;br/&gt;=&amp;nlr=&amp;nls=&lt;br/&gt;&amp;sid=838b4fc&lt;br/&gt;5c991f904c6b&lt;br/&gt;161f2029aaef&lt;br/&gt;7&amp;sot=aut&amp;s&lt;br/&gt;dt=cl&amp;cluster&lt;br/&gt;=scopubyr%2&lt;br/&gt;c%222021%2&lt;br/&gt;2%2ct&amp;sl=18&lt;br/&gt;&amp;s=AU-&lt;br/&gt;ID%2824725">https://www.scopus.com/record/display.uri?eid=2-s2.0-85106971055&amp;origin=resul<br/>tlist&amp;sort=pl<br/>f-<br/>f&amp;src=s&amp;nlo<br/>=&amp;nlr=&amp;nls=<br/>&amp;sid=838b4fc<br/>5c991f904c6b<br/>161f2029aaef<br/>7&amp;sot=aut&amp;s<br/>dt=cl&amp;cluster<br/>=scopubyr%2<br/>c%222021%2<br/>2%2ct&amp;sl=18<br/>&amp;s=AU-<br/>ID%2824725</a> |

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|     |   |   |      |                               | expressions close as well as far from the interface are examined.  | 586300%29&relpos=2&citeCnt=0&searchTerm=  |
| 70. | Plasma Diagnostics on Pulse Plasma-Focus Generators and Their Features as Alternative Fusion Reactors | Zhukeshov, A.M., Moldabekov, Z.M., Ibraev, B.M., Amrenova, A.U., Gabdullina, A.T. | 2021 | Fusion Science and Technology | This paper is devoted to discussing the technical characteristics of pulsed plasma-focus (PF) generators and their features as fusion reactors as an alternative for stationary thermonuclear installations. First, the authors present results of experimental data obtained on the Pulse Plasma Accelerator-30 (PPA-30) and dense PF-4 devices. The pulse discharge current and jumped parameters and the energy distribution along and across the axis on the 31-kJ (at 30 kV and 69 $\mu$ F) PPA-30 device were determined. It is indicated that plasma already is completely ionized at the kilo-ampere range and its inductance is small. The maximum energy density of the plasma was equal to 230 J/cm <sup>2</sup> and a macrofocusing effect was observed. Second, the emission parameters of the PF-4 device were determinate. The neutron yield was equal to about 107 imp/shot. The variation of the axial and radial neutron yield was observed. Further, the problems of neutron yield on PF devices and options for the development of a fusion reactor taking into account other technical capabilities of PF are discussed. It is proposed to develop the design of PF in such a way as to take into account the peculiarities of the interaction of particles with an electric and magnetic field. In this situation, the important indicator is not the temperature of the plasma, but the geometry of the electrode system to provide a directed flow of particles. | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85107419794&amp;doi=10.1080%2f15361055.2021.1916273&amp;origin=inward&amp;txGid=b876eb07aabd38db0bd34baba6bd812">https://www.scopus.com/record/display.uri?eid=2-s2.0-85107419794&amp;doi=10.1080%2f15361055.2021.1916273&amp;origin=inward&amp;txGid=b876eb07aabd38db0bd34baba6bd812</a> |
| 71. | An Al and Cu layers with microporous deposited using pulsed arc spraying                              | Zhukeshov, A.M., Fermakhan, K., Gabdullina, A.T., Useinov, B.M.                   | 2021 | Materials Letters             | The pulsed vacuum arc plasma have been using as media for spraying of copper and aluminum cathodes. The product of cathode erosion was deposited on the substrates made from crystalline silicon and stainless steel. A porous metal thick layers on the silicon substrate, that consist of spherical hollow particles were obtained. The continuous growing films and large particles on the metal surface as well as a number of cavities on the silicon surface were observed. The process of larger micron-sized particles formed from hundreds of nanoscale ones was observed. The difference of layer structure  | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85106953722&amp;doi=10.1016%2fj.matlet.2021.130028&amp;origin=inward&amp;txGid=88">https://www.scopus.com/record/display.uri?eid=2-s2.0-85106953722&amp;doi=10.1016%2fj.matlet.2021.130028&amp;origin=inward&amp;txGid=88</a>   |

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|     |                                |                                 |      |  | on surfaces can be explain that a morphology of the original surface affects the size of the deposited particles. The role of cathode drops and buffer plasma in deposition process discussed.  | ce35d58411a35f7b1d1e2b5ada784d  |
| 72. | A New Passive Lossless Snubber | Dzhunusbekov, E., Orazbayev, S. | 2021 | IEEE Transactions on Power Electronics | Galvanically isolated photovoltaic (PV) microinverters based on single-stage flyback topology have advantages: simplicity, better reliability, and low cost. But isolated flyback topology comes with voltage stresses on semiconductor switches caused by transformer leakage inductance. An improved regenerative snubber has been proposed to meet the ever-growing demand for higher efficiency of PV microinverters. The proposed topology is the inductor-capacitor-diode (LCD) snubber with flying capacitor modified to reduce circulating currents. Theoretical analysis reveals a number of advantages. Experimental results are presented to verify the performance. | <a href="https://www.scopus.com/record/display.uri?eid=2-s2.0-85100798764&amp;doi=10.1109/2FTPEL.2021.3056189&amp;origin=inward&amp;txGid=4be07c690f735e67c441ad811098f7f9">https://www.scopus.com/record/display.uri?eid=2-s2.0-85100798764&amp;doi=10.1109/2FTPEL.2021.3056189&amp;origin=inward&amp;txGid=4be07c690f735e67c441ad811098f7f9</a> |