POSTER REPORTS (DLNP)

1.

Temerbulatova N., Budzynski M., Filosofov D., Karaivanov D., Kochetov O. I., Milanova M., Tsvetkov M., Velichkov A.

Study of the temperature dependence of hyperfine interactions by γγ-TDPAC in the sample of tungstate - $Hf_{0.5}Zr_{0.5}W_2O_8$

The ZrW_2O_8 has a negative coefficient of thermal expansion in a wide temperature range from 0.3 to 1050 K, which makes it relevant in its application in electronics and ceramics industry to produce composite materials with or without a very low thermal expansion. Zr and Hf are analogues therefore the $Hf_{0.5}Zr_{0.5}W_2O_8$ has the same properties as ZrW_2O_8.

The study of hyperfine interactions in the sample of tungstate – $Hf_{0.5}Zr_{0.5}W_2O_8$ synthesized by solid state reaction from oxides of Hf, Zr and W was performed by the method of TDPAC using ^{181}Hf (^{181}Ta) as a probe nucleus. Radioactive isotope-^{181}Hf was produced directly in the sample by its irradiation with thermal neutrons at the IBR-2 pulse nuclear reactor (FLNP, Dubna, Russia). The study was performed in the temperature interval 300 K to 1260 K.

Sharp and unusual change in the electric field gradient and its asymmetry at around 430 K are observed. They indicate the reversible transition from low to high temperature phase (α ⇌ β). Over 1050 K the TDPAC spectra show irreversible decomposition of the sample to initial oxides.

Исследование температурной зависимости сверхтонких взаимодействий в образце вольфрамата - $Hf_{0.5}Zr_{0.5}W_2O_8$ методом γγ-ВУК

2.

Atanaska Marinova, Valery Radchenko, Elena Kurakina and Dmitry Filosofov

Te-Sb Generator systems for producing pure ^{119}Sb

One of the promising radionuclides for Targeted Auger Therapy is ^{119}Sb. Its appropriate half-life of 38.5h, absence of other accompanying emissions and number and energy of auger electrons makes it suitable for Targeted Radionuclide Therapy.

Therefor obtaining this radioisotope efficiently and in pure form is of great significance. In the current work were reviewed several methods for the construction of radionuclides generator systems for the obtaining of ^{119}Sb from ^{119m}Te. The systems are based on Extraction chromatography, Ion Exchange chromatography and Liquid - Liquid Extraction chromatography (LLE). The resins used in these systems are TEVA, WBEC, Dowex 50x8 and for LLE were used β, β'-dichloroethyl ether as extraction organic phase with different aqueous phases. An evaluation of propose generator systems is made.

Te-Sb Генераторные системы для производства чистого ^{119}Sb

3.
<u>**Genko M. Marinov,**</u> **Atanaska P. Marinova, Dmitry V. Filosofov**

New systems based on extracting sorbents for the purification of low – background materials

In modern research among the most interesting is the topic of low – background studies. As suitable for this kind of research are the double-beta decay isotopes ^{96}Zr and ^{150}Nd. Recently two resins UTEVA (Uranium and TEtraValent Actinides), selective for tetravalent elements and hexavalent elements, and DGA (TODGA), selective for trivalent and tetravalent elements, were studied for the isolation of pure elements from irradiated targets. Isotopes of K(I), Ra(II), Ac(III), Th(IV), Pa(IV),(V) and U(IV),(VI) representing almost all valences are naturally available and often encountered as impurities in low – background research. Their natural presence makes the development of methods for purification from all valences elements necessary. Purification from impurities is an essential step in the preparation of low – background materials.

In this work is presented the purification of REE from actinide impurities. The effect of large amounts of REE nitrates on the sorption of Th is studied in different concentrations of nitric acid on the resin UTEVA. The possibility for the separation of Zr from Ac, Ra, Hf and Th on UTEVA resin with nitric acid solutions is also reviewed.

DGA(TODGA) resin has proven to be a very useful extractant. Therefore this resin was studied for the separation of Ac(III) from REE(III) and the additional separation of individual light REE which produced excellent results.

The use of those two extractants and the data for their capability can successfully be applied in the obtaining of pure materials for low – background research.

Новые системы на основе экстрагирующих сорбентов для очистки низкофоновых материалов

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Perturbed Angular Correlation method at investigation of the complexes ^{111}In with deferoxamine as a potential usage for Sb chelation

In recent years, Auger-electron-emitting isotopes become very effective in therapy of micrometastases and small tumors due to very short range in biological tissue (few nm to μm). ^{119}Sb ($T_{1/2}$ = 38.5 h) Auger-emitter is one of the promising candidates suitable for radiotherapeutic application [1]. However, chelation chemistry of antimony is remaining unknown. γγ-Perturbed Angular Correlation (PAC) is a unique method in investigation of the local environment of the probe in liquids especially with a chelator in the system. Thus, this technique appeared very useful for measuring the precursors of the radiopharmaceuticals being used in Nuclear Medicine. ^{118m}Sb ($T_{1/2}$ = 5 h) is the only antimony isotope that can be measured by γγ-PAC (intermediate half-life $t_{1/2}$ = 21.7 ns, nuclear spin I= -5, quadrupole moment Q = ± 0.16, dipole moment μ= – 0.30, cascade 253-1091 keV). This isotope is available to be produced at ISOLDE CERN.

^{111}In ($T_{1/2}$= 2.8 d) is one of the most used radionuclides in diagnostics, also being very popular in measurements by γγ-Perturbed Angular Correlation (PAC) spectroscopy due to its parameters such as $t_{1/2}$ = 85 ns, I = +5/2, Q = +0.68, μ = – 0.7656, cascade 171-245 keV [2]. The results obtained in this study can be potentially applied on the investigation of the complexes with Sb isotopes with the same chelator in terms of the valency number of In (III) and Sb(III, V).

In present work, complexes of ^{111}In with deferoxamine (DFO) 10^{-4} mol/l at ionic strength 0.5 are studied. ^{111}In produced by irradiation of Sb target by high energy protons (600 MeV) during 2 hours. The novel scheme of separation, consisted of 3 steps, is performed. The stability constants of the In complexes are determined and compared with the literature ones. For the first time, ^{118m}Sb time-dependent PAC spectra are obtained.

References

[1]   H. Thisgaard and M. Jensen, "Production of the Auger emitter 119Sb for targeted radionuclide therapy using a small PET-cyclotron," *Appl. Radiat. Isot.*, vol. 67, no. 1, pp. 34–38, 2009.

[2]   A. Jancso *et al.*, "TDPAC and β-NMR applications in chemistry and biochemistry," *J. Phys. G Nucl. Part. Phys.*, vol. 44, no. 6, p. 064003, 2017.

5.
N.A. Mirzayev, A. Marinova, G. Marinov, D. V. Filosofov

Ion exchange behavior of dowex resin in ammonium acetate solution used in nuclear medicine.

Ammonium acetate is often used as a buffer for coupling a radionuclide with a chelator that promotes sequential binding to the antibody for synthesis of radiopharmaceuticals. Acetate media has no chemically and biologically adverse for body by their range of Ph. The distribution coefficients of alkali metals, alkaline earths metals, transition metals, poor metals, non-metals, lanthanide series, and actinide series elements on cation-exchange resins (Dowex 50w-x8) was determined in ammonium acetate solution. The concentrations of the ammonium acetate solutions used ranged from 0.1 to 5 M. A broad survey of the cation exchange behaviors of 60 elements in CH_3OOCNH_4 solution is presented. The results are also summarized in the form of "Periodic Tables" The determined sorption for all elements is discussed and analyzed. This data is significant for more efficient separations and purifications of these elements.

Ионообменное поведение смолы dowex в растворе ацетата аммония, используемом в ядерной медицине.

6.
N. Rumyantseva

Upgrade of the GERDA experiment

The GERDA (GERmanium Detector Array) experiment at the Laboratori Nazionali del Gran Sasso of INFN, Italy, is designed to search for neutrinoless double beta decay of Ge-76. In GERDA for the first time ever detectors are directly immersed in liquid argon which works as a cooling medium and as an additional active shield against external radioactivity. Phase II data taking started in December 2015. The desired background of 0.001 counts/(keV kg yr) has been reached and the design sensitivity of 10^26 years has been recently achieved. GERDA Phase II is the first background free experiment aimed for 0vbb search.

The sensitivity of GERDA could be additionally improved by reducing the background of the experiment and adding of novel enriched germanium detectors, that look as good candidates for future tonne-scale experiment. The reduction of the background should be achieved by exchanging of existing cables by new ones with better radiopurity and the replacement of active liquid argon veto by improved version.

Модификация эксперимента GERDA

7.

E. Shevchik

A new design of LAr-veto for LEGEND-200 experiment

GERDA experiment (LNGS, Italy) has set the world's best limit of the neutrinoless double beta decay half-life of Ge-76 mainly due to the active background suppression techniques including a LAr-veto. A future modernization oh the GERDA setup within the LEGEND-200 collaboration where the whole germanium detectors mass is going to be increased up to 200 kilograms will require the background index to be decreased in an order. As a result the efficiency of a LAr-veto to be increased. Few possible options of LAr-veto that allow to improve light collection and decrease contribution from radioactive isotopes contained in the veto materials are presented.

Разработка аргонового вето для эксперимента LEGEND-200

POSTER REPORTS (BLTP)

8.
I.S. Rogov

Evolution of dinuclear system in charge asymmetry coordinate in spontaneous fission process of even-even uranium isotopes

The application of the dinuclear system model is discussed to describe the spontaneous fission process. The widths of cluster decay and spontaneous fission for even-even uranium isotopic chain are calculated within the same approach. The model describes well the experimental data on half-lives.

Эволюция двойной ядерной системы по координате зарядовой асимметрии для описания спонтанного деления четно-четных изотопов урана.

9.

S.V. Sidorov

Skyrme-TQRPA calcultions of electron capture and beta-decay rates of hot nuclei.

The impact of thermal effects on electron capture and beta-decay rates is studied for the case of nucleus ^{56}Ni embedded in hot and dense matter of a massive collapsing star. Calculation of GT transition strengths is performed in framework of Skyrme+TQRPA theory. It is shown that the increase of temperature makes possible low- and negative energy GT transitions, otherwise blocked due to Pauli principle at zero temperature, which results in the increase of weak interaction rates. The obtained beta-decay and electron capture rates are compared with large-scale shell model calculations.

10.

A.N. Bezbakh

Quasiparticle structure of superheavy nuclei in alpha-decay chains of ^{285}Fl and ^{291,293}Lv

Two mean-field potentials, Woods-Saxon and Skyrme based potentials, are used to calculate the energies of low-lying one-quasiparticle states. The spectra of the low-lying states and the alpha-decay spectra of nuclei belonging to the alpha-decay chains of ^{285}Fl and ^{291,293}Lv are calculated and compared with the available experimental data. As shown, the alpha-decay spectra could be different in the alpha-decay chain and at the direct production of the nucleus in a fusion reaction.

11.

N.N. Arsenyev

Pygmy and Giant dipole resonances in ^{48,50}Ca and ^{68,70}Ni

Starting from the quasiparticle random phase approximation based on the Skyrme interaction SLy5, we study the effects of phonon-phonon coupling (PPC) on the E1 strength distributions of neutron-rich calcium and nickel isotopes. Using the same set of parameters, we describe available experimental data for ^{48}Ca, ^{68}Ni and give prediction for ^{50}Ca, ^{70}Ni. The inclusion of the PPC results in the formation of low-energy 1^- states of ^{48}Ca. There is an impact of the PPC effect on low-energy E1 strength of ^{48}Ca. The effect of the low-energy E1 strength on the electric dipole polarizability is discussed. We predict a strong increase of the summed E1 strength below 10 MeV, with increasing neutron number from ^{48}Ca (^{68}Ni) till ^{50}Ca (^{70}Ni).

Пигми и гигантский дипольный резонансы в ^{48,50}Ca и ^{68,70}Ni

12.

D. Janseitov

The cluster states in light nuclei

The radii of the excited states of ^{11}B 8.56 MeV ($3/2^-$) and ^{13}C 8.86 MeV ($1/2^-$) nuclei were determined by the Modified diffraction model (MDM). The radii of these two levels are enhanced relatively that the ground states of ^{11}B and ^{13}C, confirming the suggestion that the 8.56 and 8.86 MeV excited states could be an analogues of the Hoyle state in ^{12}C and have a cluster structure.

13.

D. Valiolda

The Coulomb breakup of halo nucleus of ^{11}Be

The aim of work is theoretical study of Coulomb breakup of halo nuclei in nonstationary quantum approach. The energy of ground and first exotic states of ^{11}Be were calculated by using the potential of Woods-Saxon form with taking into account the spin-orbital interaction. In addition, the root-mean-square (rms) radius of the ^{11}Be nucleus was calculated numerically. The rms radius of the core is one of the most fundamental and important of its characteristics. This work is the initial stage of work on the investigation of the breakup of halo nuclei in the quantum-mechanical approach. A detailed investigation is planned to research the effect of breakup of the halo nucleus, using the numerical method for solving the nonstationary Schrodinger equation.

14.

E.V. Mardyban

Shape phase transitions in atomic nuclei with increase of the angular momentum

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

15.

E.A. Koval

Resonances in two-dimensional dipolar scattering induced by short range interaction

The aim of the paper is a theoretical investigation of the short-range interaction impact on two-dimensional dipole-dipole scattering resonances emergence. The strong dependence of the identical bosons and identical fermions scattering cross section on short-range interaction radius was revealed for a wide range of collision energies. The critical tilt angle of the first dipole as a function of the second dipole orientation is determined for the case of arbitrarily oriented dipoles: the dipolar scattering resonances arise only at exceeding at this angle. Energy dependences of the dipolar scattering cross section in the vicinity of resonant and non-resonant short-range radius values for bosons and fermions significantly differ.

16.
A.A. Korobitsin

Ultracold clusters in the framework of Faddeev equtions

The spectrum of the neon three-atomic system has been calculated using the Faddeev differential equations in the total angular momentum representation. The modern realistic potential models are used to describe the Ne-Ne interatomic interaction. The results obtained are compared with previous published results. The effective computational scheme has been developed to increase the speed of calculation and use multithreading.