Załącznik nr 3 do wniosku o przeprowadzenie postępowania habilitacyjnego

Author's review of his own writings

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2. Posiadane dyplomy, stopnie naukowe

Degree of Doctor of Philosophy in physics, University of Warsaw, Faculty of Physics, year 1999, title of dissertation: „Properties of the neutron-rich nuclei at the edge of known nuclei area."

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3. Informacje o dotychczasowym zatrudnieniu w jednostkach naukowych

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4. Wskazanie osiągnięcia* wynikającego z art. 16 ust. 2 ustawy z dnia 14 marca 2003 r. o stopniach naukowych i tytule naukowym oraz o stopniach i tytule w zakresie sztuki (Dz. U. nr 65, poz. 595 ze zm.):

a) tytuł osiągnięcia naukowego

Structure of exotic, neutron-rich fission fragments of mass around A = 110.

b) Jednotematyczny cykl publikacji przedstawiających osiągnięcie naukowe

[A1] **J. Kurpeta**, W. Urban, A. Płochocki, J. Rissanen, J. A. Pinston, V. -V. Elomaa, T. Eronen, J. Hakala, A. Jokinen, A. Kankainen, P. Karvonen, I. D. Moore, H. Penttilä, A. Saastamoinen, C. Weber, J. Äystö, “Low-spin excitations in the ^{109}Tc nucleus”, Physical Review C 86, 044306 (2012)

[A2] **J. Kurpeta**, A. Jokinen, H. Penttilä, A. Płochocki, J. Rissanen, W. Urban, J. Äystö, “Trap-assisted studies of odd, neutron-rich isotopes from Tc to Pd”, Hyperfine Interactions DOI 10.1007/s10751-012-0616-5, published online 4 April 2012

[A3] **J. Kurpeta**, W. Urban, A. Płochocki, J. Rissanen, J. A. Pinston, V. -V. Elomaa, T. Eronen, J. Hakala, A. Jokinen, A. Kankainen, P. Karvonen, I. D. Moore, H. Penttilä, A. Saastamoinen, C. Weber, J. Äystö, “Signatures of oblate deformation in the ^{111}Tc nucleus”, Physical Review C 84, 044304 (2011)

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[A7] **J. Kurpeta**, J. Rissanen, V.-V. Elomaa, T. Eronen, J. Hakala, A. Jokinen, P. Karvonen, I.D. Moore, H. Penttilä, A. Płochocki, S. Rahaman, S. Rinta-Antila, J. Ronkainen, A. Saastamoinen, T. Sonoda, J. Szerypo, W. Urban, Ch. Weber, J. Äystö, „Progress in trap assisted β decay spectroscopy of ^{115}Ru”, Acta Physica Polonica B 41, 469 (2010)

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c) omówienie celu naukowego/artystycznego ww. pracy/prac i osiągniętych wyników wraz z omówieniem ich ewentualnego wykorzystania.

Scientific purposes

Presented research is aimed on getting knowledge on the structure of neutron-rich nuclei in the region of mass A = 110, located on the edge of the presently known nuclei, far away from beta stability. The nuclei of interest are far away from the well theoretically described region of nucleon magic numbers. Experimental data on such nuclei form a base for testing and improving of theoretical models. Number of nuclei, which can exist as bound systems, is presently estimated as about 6000, of which about a half is known (but rarely completely). A great majority of undiscovered nuclei are the neutron-rich ones and the exact location of the nuclear cohesion limits is still a challenge for nuclear physics.

Most of the presented results concern odd nuclei. The structure of their excited levels is more complex as compared to even nuclei thus deeper insight into nuclear structure is possible.

The investigated extremely neutron-rich nuclei are located close to the astrophysical process of rapid neutron capture (so called r-process). The *r*-process is involved in production of about half of chemical elements heavier than iron. It is taking place in cataclysmic astrophysical events which generate very intensive neutron fluxes. Knowledge of nuclear structure and in particular nuclear deformation close to the *r*-process path is necessary for better understanding of nucleosynthesis in the Universe and the measured beta decay energies and half-lives are direct input parameters in modeling of the *r*-process. The universal abundance curve is well reproduced if one assumes a weakening of the well known shell model gaps in very neutron-rich nuclei. There are astrophysical models which predict existence of neutron-rich nuclei in the inner crusts of neutron stars.

To get new information on the neutron-rich nuclei of refractory elements near mass number A = 110, located at the boundary of known nuclei, fast on-line separation method was used together with Penning type ion traps. A novel connection of on-line separation and tremendous mass resolution of ion traps resulted in achievements not available with other methods.

Observation of gamma transitions after beta decay of nuclei, which were produced in fission of actinides, provides information on low-energy and low-spin structure of nuclear levels. Those levels form the band heads of high-spin bands and help in identification of single particle configurations in the structure of the investigated nuclei. The results of beta decay studies are complementary to observation (with multiple coincidence method) of prompt gamma rays emitted by ^{248}Cm and ^{252}Cf fission fragments.

The method of stopping and transport of reaction products in a gas stream, used in the IGISOL (Ion Guide Isotope Separator On-Line) system, can deliver ions of refractory elements, which can not be effectively produced in another kinds of ion sources. In connection with mass separation in an ion trap it is possible to get new data on isotopes of refractory elements. These data are necessary for calculations of decay heat in spent nuclear fuel.

Achievements

The achievements presented below resulted from my experimental works carried out according to proposals [D9], [D8] and [D5] in which I am the first author. I published the results in papers [A1 – A3], [A6 – A8] and [A10] in which I am the first author and in papers [A4, A5] in which I am the second author. The data I used in paper [A9] come from other experiments.

In measurements carried out according to proposal [D9] the IGISOL mass separator was for the first time used together with a Penning ion trap to get monoisotopic beams of ^{113}Tc and ^{115}Ru nuclei for nuclear spectroscopy. Nuclei of interest were produced in the fission of a natural uranium target induced by 25 MeV protons. In the chamber of the IGISOL mass separator fission products are stopped and transported in flowing gas, most often helium. Simultaneously, the high charge state of the fission fragments is reseted to +1 and the high ionization potential of helium doesn't allow for complete neutralization. The beam of the singly charged fission products is guided by electromagnetic fields to a separation magnet and at the same time gas medium is removed by a highly effective pumping system. Mass resolving power $M/\Delta M \approx 500$ of a dipol magnet in the IGISOL system is sufficient to filter out the fission products of a demanded mass number A. The resulting beam of isobars is directed to a beam cooler and buncher system to reduce energy spread and release the beam in short bunches suitable for a Penning trap. The JYFLTRAP setup consists of two coaxial Penning traps connected by a narrow aperture. The first of the traps is used for preparation of monoisotopic beams of selected nuclei for, among others, nuclear spectroscopy applications. The other trap is designed to perform nuclear mass measurements with a high precision. The tremendous resolving power of a Penning trap reaching 50000 is sufficient to select ions of only one isotope out of an isobaric beam. A bunch of ions of selected A is injected to the first trap, it starts the cycle of preparation of a beam containing ions of only one isotope, called a monoisotopic beam.

A bunch of isobars is first cooled in the trap, next an electric dipole excitation pushes all the ions to large radius orbits (away from trap axis). Excitation with electric quadrupole field increases kinetic energy of ions of the selected (in resonance with the excitation frequency) mass. Thus the ions experience more collisions with gas filling the trap, consequently lose kinetic energy and accumulate on the trap axis. At the end of trap cycle a potential is applied to push the ions out of the trap. Only the ions located at the axis can pass a channel (2 mm in diameter) and leave the trap. This way only the ions of one isobar were released from the trap after a separation cycle of about 100 ms. For spectroscopy studies only the first trap of the JYFLTRAP system was used and the monoisotopic beam was implanted into a movable tape closed in a vacuum chamber.

During measurements the tape was moved at regular time intervals to remove the long-lived decay products. The point of beam implantation was surrounded by scintillation material used as a beta particle detector. The germanium detectors of gamma radiation were placed close to the vacuum chamber holding the beta detector. One of the gamma detectors was equipped with a thin beryllium window to measure low-energy gamma-rays. In an experiment under my supervision the novel separation method was used to gather new data on ^{115}Ru beta decay [A10] and feasibility for investigation of even more exotic ^{111}Mo was proven [A10]. Also half-life of ^{113}Tc was measured with much better accuracy then before, the result was published in [A2].

Mass measurements of exotic ^{111}Mo and ^{114}Tc nuclei in a Penning trap were made in the frame of [D5] proposal. The results were significantly different from model predictions published in Atomic Mass Evaluation 2003 (G. Audi, Nucl. Phys. A 729, 337 (2003)). The above mass measurements were a base to find the previously unknown beta decay energies (Q_β) of ^{111}Mo [A3] and ^{114}Tc [A4] nuclei. The experimental Q_β values were used in calculation of beta feedings and log *ft* values presented in [A3, A4]. It is worth noting that for each of the ^{111}Mo and ^{114}Tc nuclei, spectroscopy data and nuclear masses were measured in the same experimental setup using respectively the first and the second ion trap of JYFLTRAP system.

According to proposal [D5] decay of an extremely exotic nucleus ^{111}Mo was investigated by coincidence β-γ i γ-γ spectroscopy. Nucleus of ^{111}Mo contains 11 neutrons more than ^{100}Mo, which due to its half-life of 1,15x10^{19} years is regarded as the last neutron-rich, stable isotope of molybdenum. Using a monoisotopic beam of ^{111}Mo from a Penning trap new excited states, fed by beta decay of ^{111}Mo, were discovered in ^{111}Tc. Spectroscopy measurements for a monoisotopic beam of a less exotic ^{111}Tc were made as well to ensure unambiguous identification of gamma lines produced by decay of A = 111 isobars and Z greater than molybdenum (see Fig. 2 w [A3]). The newly discovered excited states in ^{111}Tc fed by ^{111}Mo beta decay may be interpreted as manifestation of oblate deformation (flattened shape with two principal axis much longer than the third one). Majority of nuclei with quadruple deformation show a prolate (elongated shape with two principal axis much shorter that the third one) type shape. The more valuable is the first experimental suggestion of a rarely occurring oblate deformation for neutron-rich nuclei of mass about A = 110 [A3]. Stable oblate deformation was predicted already for nuclei in that region of a nuclide chart by some model calculations (see [3] in [A3]). Recently published (references [4, 5] in [A3]) model predictions allow for mixing of prolate and oblate configurations also. A level corresponding to an oblate or mixed prolate-oblate solutions may be 3/2+ of 30.7 keV energy, this case is discussed in [A1]. The wide range of spins of the excited states in ^{111}Tc populated by beta decay of ^{111}Mo [A3] indicate existence of a beta decaying isomeric state in ^{111}Mo, which was not observed before.

Coincident β-γ and γ-γ spectroscopy of beta decaying monoisotopic samples of ^{109}Mo provided new information on the excited states in ^{109}Tc. The data were gathered in two experiments carried out according to the proposals [D5] and [D8], ^{109}Mo nuclei were produced in 25 MeV deuteron induced fission of a natural uranium target. In the first run ^{109}Mo ions were implanted in collection tape every 111 ms. The tape was moved every 300 s and so one can observe high intensity of gamma rays from the long-lived isobars of the ^{109}Mo decay chain. In the second run the ions were implanted every 121 ms and tape was moved after 9 subsequent implantations so every about 1 second. Thus the activity of long-lived A = 109 isobars was effectively removed. The measurements for two very different tape moving intervals help in half-life based identification of gamma lines, because the ratio of gamma intensities observed in the two experiments depends on beta decay half-lives. The data gathered for 300 s tape moving interval in connection with calculated relative feedings let one to estimate ground state feeding by beta decay, for details see [A1]. About half of ^{109}Mo beta decay intensity was found to feed the ground and two lowest excited states in ^{109}Tc [A1]. The scheme of excited states in ^{109}Tc was constructed based on coincidence relations of gamma transitions following the beta decay of ^{109}Mo. In particular coincidence with K x-ray lines enabled the discovery of new gamma transitions populated in the ^{109}Mo decay and helped to identify gamma lines from the less exotic nuclei in the beta decay chain. In ^{109}Tc 13 new excited states were discovered, a few transitions known from prompt-γ spectroscopy of ^{248}Cm spontaneous fission were confirmed. In coincident γ-K X measurements experimental internal conversion coefficients were found for a few low-energy transitions. The experimental conversion coefficients, feedings and log *ft* values for beta decay and similarities in the decay schemes of ^{107}Mo and ^{109}Mo made a base for assignment of spins and parities for many states in ^{109}Tc. The most probable spin of the ^{109}Mo ground state is 5/2+ in accord with the literature. Three newly discovered 7.0, 18.0 i 50.4 keV states in ^{109}Tc one can interpret as single-particle proton configurations 3/2-[301], 5/2-[303] and 1/2+[431], which were expected here based on systematic predictions. The nonobservation of the 50.4 keV transition remains unexplained. Another three levels at 333.1, 358.6 and 423.8 keV in ^{109}Tc, for which proposed spins are 3/2+, 7/2+ and 5/2+, one can interpret as K = 1/2 members of a triaxial band built on top of the ground-state configuration π 5/2+[422]. Such levels are well reproduced in ^{107}Tc and ^{109}Tc by quasiparticle + rotor (QPRM) model calculations, for comparison see Fig. 10 in [A1]. There are levels in ^{107}Tc and ^{109}Tc at 850.7 and 745.0 keV, respectively, which have very similar decays. They can be interpreted as 7/2+[413] configurations with K = 7/2, originating from the π g9/2 orbital. These levels are very well reproduced by QPRM model, see [A1]. Excitation schemes of ^{107}Tc and ^{109}Tc are very similar but differ clearly from the scheme of the neighbouring ^{111}Tc [A3]. This breakdown of the systematics is interpreted as transition from prolate to oblate deformation. There is a clear need for further studies, both experimental and theoretical, of low-energy excitations in ^{107}Tc, ^{109}Tc and ^{111}Tc nuclei. Especially important would be firm spin and parity assignments to the levels in all three technetium isotopes.

The combination of data from spontaneous fission and beta decay gave new information on low-spin level structure in ^{113}Ru and ^{113}Rh [A9]. The neutron-rich nuclei of ruthenium and rhodium are located in the region of low-lying intruder states, triaxial deformation and shape coexistence. The nuclei of interest were made as fragments of ^{238}U proton-induced fission. The fission fragments were mass separated with the IGISOL system to get a beam of A = 113 isobars. The beta decays of nuclei in the A = 113 isobaric chain were studied by β-γ and γ-γ coincidence spectroscopy, this way one collected information on the low-spin excited states in ^{113}Ru and ^{113}Rh populated in the beta decay of ^{113}Tc and ^{113}Ru. The excited states in ^{113}Ru and ^{113}Rh nuclei, produced in spontaneous fission of ^{248}Cm, were also studied by high-fold coincidence spectroscopy of prompt-γ rays. The EUROGAM 2 array of Anti-Compton spectrometers was used. The studies yielded information on gamma transition cascades coming from the high spin states. Complementary data from beta decay and spontaneous fission let one make new spin assignments to the states in ^{113}Ru. The 0.5 s isomeric state in ^{113}Ru, known from an earlier paper [33][1], was assigned spin 7/2- [A9] (instead of previously

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[1] The numbers refer to items on the list of publications in annexe 5

postulated 11/2-). This state was also confirmed to be a head of a rotational band. The ground state of ^{113}Ru was assigned spin 1/2+ instead of 5/2+ previously suggested on a systematical basis [A9]. The structure of even-odd ^{113}Ru nucleus was reproduced in a Core-Quasiparticle Coupling (CQPC) model assuming occurrence of triaxial deformation [A9]. The results presented in [A9] show how the combination of prompt-γ (EUROGAM 2) and beta decay (IGISOL) spectroscopy data can help in investigation of the complex spectra of odd-nuclei.

The success of the first application of an ion trap to get a monoisotopic beam of ^{115}Ru [A10] encouraged one to continue the trap assisted studies of the exotic nuclei of mass A = 115. The measurements carried out according to proposal [D8], due to more efficient separation in the ion trap, yielded new data on ^{115}Ru beta decay. The preliminary results presented in a conference report [A7], suggested a discovery of a new isomeric state and possibility to correct the half-life value of ^{115}Ru known from the literature. The low statistics of the collected data and short (as compared to the measured half-life) time base of 111 ms required additional experimental study of ^{115}Ru beta decay. Once more the IGISOL mass separator coupled to a Penning trap was used to mass separate the fission fragments of ^{238}U to prepare monoisotopic samples of ^{115}Ru. The ^{115}Ru half-life of 740(80) ms was earlier measured with only the IGISOL separator (J. Äystö et al., Phys. Rev. Lett. 69, 1167 (1992)) whereas preliminary measurements with an ion trap suggested a shorter value [A7]. Thus for ^{115}Ru half-life measurement a time base of 1 s was used. The experimental data were collected with a standard analog acquisition system and in parallel with a digital data acquisition system which was built in the frame-work of [B1] research grant. The experiment was carried out using the beam time granted for proposal [D5]. The half-life of ^{115}Ru was measured as 318(19) ms [A6] so considerably different from the previously published by J. Äystö et al. The overestimated half-life in a study using only IGISOL separator was due to overlap of two gamma transitions: the most intense line fed in ^{115}Ru decay and a line of like energy fed in decay of ^{115}Pd isobar. The combination of IGISOL system and an ion trap let one get a monoisotopic beam of ^{115}Ru, free from the dominating component of less exotic (produced with higher cross sections) isobars, and measure a real half-life of ^{115}Ru. It is worth noting, that beta decay half-lives at the edge of known nuclei are very important input parameters for models of nuclear structure and path of astrophysical *r*-process.
Observation of beta decay of ^{115}Ru monoisotopic samples let one discover an isomeric state in ^{115}Ru populated directly in fission thus confirming a suggestion presented in [A7]. The experimental data [A6] indicate the presence of 3/2+ level located 61.7 keV above the 1/2+ ground state in ^{115}Ru and the 7/2- isomeric state located about 20 keV (excluding K-shell conversion of the isomeric transition) above the 3/2+ level. In such interpretation the 7/2- isomer depopulates by an unobserved M2 transition to the 3/2+ state, which depopulates further via a mixed M1+E2 61.7 keV transition to the 1/2+ ground state. The time decay pattern of the 61.7 keV line let one estimate the half-life of the 7/2- isomeric state as 76(6) ms. A similar isomeric state was discovered in ^{113}Ru [33] with the IGISOL separator alone thus using a beam of mixed A = 113 isobars. The 61.7 keV level in ^{115}Ru might be interpreted as due to the 3/2+[402] Nilsson orbital of prolate deformation. However the trend set by location of the 3/2+ and 7/2- levels in ^{111}Ru and ^{113}Ru suggests that the 3/2+[402] prolate orbital should appear above 7/2- in ^{115}Ru. The 3/2+ level may appear below the 7/2- isomer in ^{115}Ru if one employ the 3/2+[431] Nilsson orbital of oblate deformation. More firm interpretation of the states in ^{115}Ru needs new experimental data on this very neutron-rich nucleus located at the border of presently known nuclei.

The analysis of gamma lines coincidences resulted in considerable extension of the excited level scheme in ^{115}Rh populated by ^{115}Ru beta decay [A5] as compared to the preliminary schemes published in [A10, A7]. As a result the 3/2+ 696.0 keV, 1/2+ 730.9 keV and 5/2+ 935.0 keV states were proposed to be the members of K = 1/2 intruder band originating above the Z = 50 shell gap and corresponding to 1/2+[431] prolate Nilsson orbital. Based on the extension of the ^{115}Ru decay scheme one estimated the beta-strength distribution for the Gamow-Teller beta decay occurring here. The beta-strength distributions of ^{111}Ru, ^{113}Ru, ^{113m}Ru show clear maxima related to feeding to the 3-quasiparticle states of about 2 MeV energy. For ^{115}Ru decay the beta-strength is almost uniformly distributed with no clear maximum, as shown in the comparison in Fig. 7 in [A5]. It suggests a change in nuclear structure of the mother (Ru) or daughter (Rh) nucleus while going from A = 113 to A = 115 isobars. The change in nuclear structure is also supported by comparison of the ^{113}Ru and ^{115}Ru beta decay schemes. In the ^{115}Ru beta decay scheme [A5] there is almost no ground state transitions in contrast to the decay scheme of the neighbouring ^{113}Ru nucleus [28].
The data presented in [A5] allow for 3/2+ spin for the ^{115}Ru ground state instead of previously postulated 1/2+ [A6]. Assuming spin 3/2+ requires the isomeric state spin to change from 7/2- to 9/2- and for the intermediate 61.7 keV state to change from 3/2+ to 5/2+. In case of increasing the spin values by one unit the above interpretation in terms of oblate Nilsson orbitals is still valid. Oblate quadrupole deformation in the very neutron-rich nuclei around mass number A = 110 is predicted by theoretical calculations of F.R. Xu, P.M. Walker, R. Wyss, Phys. Rev. C 65, 021303 (2002). On the other hand P. Sarriguren and J. Pereira in Phys. Rev. C 81, 064314 (2010) predict no clear potential minimum for oblate shape and consequently the competition of prolate and oblate shapes.
Therefore it is necessary to perform more experiments using separation of fission fragments in an ion trap, the future of this method is presented in [A2].

The experimental data gathered for the ^{115}Ru monoisotopic beam let one to study the less exotic isobars in the beta decay chain too. The ^{115}Ru nuclei decay with a half-life of 318(19) ms [A6] to the states in ^{115}Rh which beta decays to the states in ^{115}Pd with a half-life of 0.99 s. The ^{115}Ru ions were implanted in a tape moved every 300 seconds thus the ^{115}Rh, produced in beta decay, was feeding the excited states in ^{115}Pd for time of many half-lives. It was possible to make coincidence measurements of the gamma transitions in ^{115}Pd and construct a scheme shown in [A8]. The scheme confirmed all the previously known states and transitions fed in beta decay. A line 38.8 keV known from prompt-γ spectroscopy was confirmed also. The results presented in [A8] confirm assignment of spin 1/2+ to the ground state of ^{115}Pd and consequently spin 7/2- to the 89.1 keV isomer. The systematics of levels presented in [A8] point to a correlation of the 2+ excitations in even-even isotopes and the negative parity excitations in odd mass isotopes of ruthenium and palladium. Similar correlations may be possible in molybdenum isotopes, so far hardly known due to their very exotic character. The systematics presented in [A8] suggest occurrence of oblate deformation in very neutron-rich isotopes of palladium.

The method of on-line mass separation with the IGISOL system is used to produce beams of extremely neutron-rich nuclei for elements like technetium, ruthenium, rhodium and palladium. The isotopes of these elements due to their high melting points are difficult to produce with other types of ion sources. The coupling of the IGISOL system and an ion trap to produce monoisotopic beams of selected nuclei considerably enhances the sensitivity and selectivity of nuclear spectroscopy studies. The prospects of the future studies using the advantages of monoisotopic beams of exotic nuclei are presented in [A2]. They include complementary spectroscopy data coming from beta decay and prompt-γ studies, accurate measurements of beta decay half-lives, investigation of angular correlation and polarization of gamma rays, conversion electron studies, identification of isomeric states and transitions as well as estimation of ground state feedings in beta decay.

The data on ^{113}Tc and ^{113}Ru beta decay [28, 33] gathered with the IGISOL separator in connection with prompt-γ spectroscopy of ^{248}Cm fission fragments let one identify a new band in ^{113}Ru and assign new spin values in ^{113}Ru and ^{113}Rh, as reviewed above and described in details in [A9]. In a given nucleus, the structures of excited states populated in beta decay and spontaneous fission differ significantly. Most often beta decay populates low-spin (close to the spin of the decaying nucleus) and low-energy states. Whereas spontaneous fission fragments are produced in high-spin and high-energy states which usually de-excite by long cascades of gamma transitions thus carrying information on the band structure of excited levels. The beta decay data provides information on the band heads, especially their location relative to the ground state.

Reinvestigation of ^{115}Ru beta decay half-life [A6] clearly shows the advantages of using a Penning trap as an additional stage of mass separation.

Another research methods which will benefit from clean, monoisotopic samples of exotic nuclei are the measurements of angular correlations and polarization of gamma rays. The multipole order of a gamma transition can be found by measuring its angular distribution, preferably with a large array of germanium detectors. Distinguishing between the electric and the magnetic multipoles is possible via determination of the linear polarization of the gamma radiation, using Compton scattering of gamma rays. Information on the character (E or M) and multipolarity of gamma transitions is very helpful for proper interpretation of the excited level schemes.

Beta decay process often populates excited states which de-excite by gamma transitions or via the competing process of internal conversion. The internal conversion coefficient of a gamma transition carries information on its parity and multipole order. The traditional conversion electron spectroscopy is considerably improved by measuring conversion electrons from monoisotopic samples inside a Penning trap where the emitted electrons does not suffer from interactions with any surrounding material.

Identification of isomeric states in trap-assisted beta decay spectroscopy was already presented when discussing the discovery of the isomers in ^{115}Ru [A6] and ^{114}Tc [A4].

Feeding to the ground state in beta decay can not be determined in spectroscopy measurement using only gamma spectrometers and thin (transmission) beta counters. At JYFLTRAP system the number of ions released from the trap can be counted before they reach the detector setup. As the beam is purely monoisotopic thus the number of ions released from the trap combined with the beta and gamma intensities measured by the detection setup can be used to estimate the total beta decay intensity. Consequently, one can estimate the ground-state branching, which is relevant for the determination of beta feedings and log *ft* values to the other excited levels.

For extremely neutron-rich nuclei, to be studied with the monoisotopic beams, there is increasing probability of neutron emission. Thus using a neutron detector for studying beta-delayed neutron emission is a logical extension of the trap-assisted beta decay spectroscopy. New, exciting prospects for spectroscopy of isomeric decays are related to a new method of preparing clean samples of selected isomeric states. First such measurement with the JYFLTRAP facility was successfully carried out for niobium [5].

The study of exotic, neutron-rich nuclei around mass A = 110 will continue after reconstruction of the IGISOL separator and the ion traps system JYFLTRAP on the beam of the new MCC30/15 cyclotron in the laboratory of University of Jyväskylä. The increased intensities of proton and deuteron beams from the new cyclotron should provide monoisotopic beams of isobars, whose daughters are the most exotic of the presently known nuclei [A2]. The planned studies will be conducted according to the accepted proposals [D1, D3] in which I am the first author.

Summary of achievements

The presented achievements definitely proves that coupling of the IGISOL mass separator to the ion traps constitutes a new method of producing clean, monoisotopic beams of neutron-rich nuclei, located at the limits of the range of contemporary research methods. The beams consisting of only one, selected nucleus are the best radioactive samples for studies with coincidence β-γ and γ-γ spectroscopy. Spectroscopy of ^{111}Mo monoisotopic beams enabled discovery of rarely occurring oblate deformation in ^{111}Tc and discovery of a new isomeric state in the extremely exotic nucleus ^{111}Mo. Investigation of the beta decay chain of the A = 115 nuclei resulted in discovery of a new isomer in ^{115}Ru, finding a new decay half-life of ^{115}Ru, extension of the level scheme in ^{115}Rh, studying the states in ^{115}Pd populated by ^{115}Rh decay and finding reasons for occurrence of oblate deformation in the very neutron-rich isotopes of palladium. A new isomer in ^{114}Tc nucleus was discovered as well and the beta decay energy values were for the first time found for ^{111}Mo and ^{114}Tc. The achieved results come from a series of experiments carried out according to the proposals [D9], [D8] and [D5] in which I am the first author. The studies were using the IGISOL mass separator and the JYFLTRAP ion trap system in laboratory of the University of Jyväskylä in Finland. Moreover for ruthenium and rhodium nuclei of mass A = 113 one presented research possibilities resulting from combination of complementary data coming from beta decay and prompt-γ spectroscopy.

5. Omówienie pozostałych osiągnięć naukowo - badawczych (artystycznych).

Achievements after PhD degree

I participated in spectroscopy investigations of niobium isotopes with the IGISOL mass separator coupled to the JYFLTRAP ion trap system. An important achievement of that run was mass separation (in a Penning trap) of isomeric states differing in mass by about 300 keV. For A = 100 nuclei it is equivalent to mass resolution of about 3 parts per million. Usually a neutron-rich nucleus beta decay to excited states in a daughter which de-excite by gamma transitions. In some nuclei there are two beta decaying states of a very similar energy and half-life thus it is not possible to distinguish their decay paths experimentally. It is especially important for very exotic nuclei, which beta decay energies of about 10 or more MeV, are very large as compared to typical energies of isomeric states of at most a few hundreds keV. Consequently the differences in the half-lives of the isomeric and the ground states are very difficult to measure. As a rule in the daughter nucleus one observes a mixture of gamma transitions populated in the beta decay of the isomeric and the ground states. A new method for separating different states of nuclei, recently developed at the JYFLTRAP installation, let one separate the 313 keV (5+) isomeric state from the 1+ ground state of ^{100}Nb. The coincidence β-γ and γ-γ measurements were made separately for the beta decay of the isomeric and ground state of ^{100}Nb. The results are presented in [5].

The monoisotopic samples of ^{115}Ru were prepared with a Penning trap in the experiment I carried out according to proposal [D5]. The ^{115}Ru ions were implanted into a transport tape which was moved about every 300 s to remove accumulated daughter activities. Due to a relatively long accumulation time, a remarkable amount of data related to the less exotic daughters of ^{115}Ru was collected. The results related to the ^{115}Ru decay were published in [A5, A6, A7] and the results related to the ^{115}Rh decay in [A8]. The beta decay of ^{115}Pd and isomer ^{115m}Pd let one study the excited levels in ^{115}Ag. The beta-decay schemes for both states were considerably extended, especially the scheme following the decay of ^{115m}Pd which was practically unknown before. Several different structures in ^{115}Ag were identified including rotational bands, nonrotational levels and a set of levels at about 2 MeV which may a three-quasiparticle nature. The results are presented in details in [2].

In the course of experiments I led according to proposal [D5], energy of the 2.0 s isomer in ^{98}Y was measured using the JYFLTRAP system. The experimental energy of the isomer (not published so far) is significantly different from the present estimate of 410(30) keV found in the literature. This kind of measurements are very well complementing the estimates of isomeric states energies coming from gamma spectroscopy.

In the year 2008 I proposed to study ^{85}As nucleus [D6] with the Lohengrin isotope separator working on neutron beam from a research reactor at the Institut Laue-Langevin in Grenoble (France). The ^{85}As neutron-rich nucleus has 5 protons outside the Z = 28 closed shell and two neutrons outside the N = 50 closed shell. Nuclei in this region of a nuclide chart are a subject of intensive theoretical and experimental studies due to the vicinity of ^{78}Ni, which should be a doubly magic nucleus (Z = 28 and N = 50). The decay of ^{85}As populates excited states in ^{85}Se via beta transformation and excited states in ^{84}Se via beta delayed neutron emission. Spectroscopy of ^{85}As decay products provides information on nuclear structure at an extreme N/Z ratios and in case of odd nuclei on the single-particle properties of low-energy states. Nuclei of ^{85}As were produced in fission of ^{238}U induced with neutrons from a nuclear reactor. Fission fragments were filtered based on their mass-to-ionic charge ratio A/q in the Lohengrin separator tuned for mass A = 85. Usually such separation leaves some ions of another mass due to similar value of A/q ratio. Therefore the measurement was made at three q values to identify gamma lines from unwanted masses. To obtain half-life information on the investigated nuclei, an electrostatic chopper was used to deliver the ion beam to the measurement point at desired time intervals. As in the trap-assisted experiments in the measurement point the beam was implanted into a movable, plastic collection tape which was periodically moved to remove the long-lived activity. An ionization chamber was used to identify the energy of the fission products. The implantation point was surrounded by thin beta counters and germanium detectors for registering gamma rays. The coincidence β-γ and γ-γ spectroscopy was used to construct the scheme of levels and transitions in ^{85}Se populated in beta decay of ^{85}As [4]. Some data coming from prompt-γ spectroscopy of ^{248}Cm and ^{252}Cf spontaneous fission fragments was used too. Using data from beta decay and prompt-γ spectroscopy let one assign the spin and parity values to low-energy states in ^{85}Se. The 5/2- spin of the ^{85}As ground state was confirmed. The results also indicate that the excited states in ^{85}Se, which decay with emission of the delayed neutrons, have spins of at least 3/2. The detailed results are presented in [4].

The successful measurement of ^{85}As beta decay at the Lohengrin separator was a good reason to prepare another proposal for that facility. The proposal [D4], in which I am the first author, was accepted in the year 2010 at the Institut Laue-Langevin in Grenoble. The aim of the proposed study is a measurement of gamma and electron coincidences to find the internal conversion coefficients of transitions fed by ^{107}Mo and ^{109}Mo beta decays. It will enable to assign reliably the spin and parities to the low-energy excited states. It is a way to complement the beta decay data on ^{109}Mo which were obtained in my earlier trap-assisted studies [A1].

The previous results on the A = 113 decay chain [A9] and for the ^{85}As beta decay [4] show great research potential of using the complementary beta decay and prompt-γ spectroscopy data. Therefore I prepared the proposal [D2] to investigate the fission fragments of mass about A = 110 by prompt-γ spectroscopy. The expected data will complement my earlier beta decay studies in that mass region. The nuclei of interest will be produced in ^{241}Pu fission induced by thermal neutrons from a source at the research reactor at Institut Laue-Langevin. Measurements of multiple prompt-γ coincidences of the fission fragments will be made with the EXOGAM spectrometer. The proposal [D2], in which I am the first author, was accepted in the year 2012.

Since the year 2008 I am a leader of a computational project [B2] in the Interdisciplinary Centre for Mathematical and Computational Modelling (ICM) at the University of Warsaw. The project is focused on numerical simulation of supersonic gas jets which appear in a working ion source of the IGISOL mass separator. This ion source is used for separation of nuclear reaction products to form the beams of radioactive isotopes. The IGISOL system is able to deliver the beams of refractory elements which can not be effectively produced in other types of ion sources. Using a gas stream for stopping and transporting of reaction products provides fast operation which is necessary for delivering beams of short-lived (orders of milliseconds) isotopes. Efficiency and speed of the IGISOL ion source is crucial for operation of all systems using its ion beam like laser spectroscopy and the JYFLTRAP ion traps. The purpose of the project is to investigate influence of the nozzle shape and gas pressure on the behavior of the supersonic gas jets in order to find the best working conditions of the ion source. To keep the simulation results in accord with reality, they are verified by comparing with experimental observations of gas jets carried out at the University of Jyväskylä. The results of simulations were presented during ICM's reporting session [C2], in a publication [7] and are described in a master's thesis prepared under my supervision.
In the year 2008 at the University of Jyväskylä I participated in two measurements aimed on converting of a deuteron beam to a neutron one by using light water, heavy water and carbon targets. The experiments were carried out according to proposal [D7]. Generation of neutron beams of intermediate energy (a few MeV) is relevant for production of neutron-rich nuclei in neutron-induced fission, for complementing cross-section data bases, for material science, etc. Systematic studies of neutrons produced by irradiation thick (stopping) targets with light charged particles is important for the next generation facilities producing radioactive beams like the project SPIRAL-II. Angular and energy distributions of neutrons produced by the interaction of 40 MeV deuterons in carbon, light water and heavy water were measured. The activation method was used which is able to define the envelope of the continuous neutron spectrum produced in a thick target. In activation method metal foils are activated by neutrons produced by irradiation of a target (a selected converter) by a beam from an accelerator. For the aluminum, cobalt, nickel, indium and bismuth foils the cross-sections for typical (n, xn), (n, p) and (n, α) reactions channels are tabulated thus one

can find the envelope of the neutron energy spectrum. The radiation emitted by the activated foils was off-line measured with gamma spectroscopy methods. The data obtained for carbon converter were in accord with the results of time-of-flight method found in the literature, which proved the principle of the measurements.

In the year 2004 I took part in feasibility tests of producing the beams of neutron-rich nuclei from calcium ($Z = 20$) to nickel ($Z = 28$) with the IGISOL mass separator at the University of Jyväskylä. Several elements between calcium and nickel are refractory thus it is difficult to obtain their beams from conventional isotope separators. The beams of neutron-rich isotopes of refractory elements can be obtained from the IGISOL facility by separation of proton- or deuteron-induced fission fragments of heavy actinides. However, production cross sections decrease rapidly for mass numbers below $A = 70$. So instead of fission it is better to use quasi- and deep-inelastic reactions, such as ^{197}Au(^{65}Cu,X)Y. The main problem with them, from the IGISOL point of view, is the high kinetic energy of the products which must be thermalized in a relatively small volume filled with He-gas. Therefore a specialized stopping chamber was built for the quasi- and deep-inelastic reactions. The products of ^{65}Cu beam reacting with ^{197}Au target were stopped in helium, separated from gas and directed to a dipole magnet for separation of the $A = 63$ isobars. The resulting radioactive beam was investigated with β-γ coincidence spectroscopy using a germanium gamma-ray detector and the silicon detectors for registering beta particles. The decay of ^{63}Co was observed. This way, it was shown for the first time that the IGISOL system can be successfully applied for separation of the quasi- and deep-inelastic reaction products. This achievement opens a new area of neutron-rich beams which can be obtained with the IGISOL facility. The results and details of the studies were published in [19, 20].

In the years 2003 and 2004 I was involved in the studies of matter penetration by heavy ions carried out in Gesellschaft fur Schwerionenforschung (GSI) in Darmstadt (Germany). The beams of uranium ions delivered by the synchrotron (SIS) were used. The distributions of charge-state and energy-loss of uranium ions penetrating various solid and gas targets were measured with the fragment separator (FRS). The results presented in [18] show the difference in ionization in solid and gas media. This so called gas-solid effect is observed for partly ionized heavy ions traveling at a given speed through solids and gases - stopping power of such ions is higher in solids. This effect is not yet fully understood and the gathered data are relevant for development of model descriptions. The experiments were carried out according to proposal [D10] in the frame of European collaboration [B3] (shortly termed as IONCATCHER).

In the year 2002 I lead a research project [B4] focused on the alpha and beta decays of the exotic polonium and bismuth isotopes in mass chains $A = 215$ and $A = 217$ using the ISOLDE mass separator at CERN (Switzerland). The method of pulsed release of reaction products in connection with resonant laser ionization let one investigate the previously unavailable isotopes of polonium and bismuth. Preliminary results of these studies I presented in my PhD dissertation in the year 1999. In the $A = 215$ mass chain a new level scheme in ^{215}Bi was confirmed as well as a new level structure in ^{215}Po fed by the decay of an isomeric state in ^{215}Bi. The half-life of this state was estimated as 36.9(6) seconds. This isomer can be assigned the following configuration $\{ [(\nu\, g_{9/2})^5 \otimes \nu\, i_{11/2}]_{10+} \otimes \pi\, h_{9/2} \}_{25/2-\ldots 29/2-}$. Moreover, the scheme of levels and gamma transitions in ^{215}Po populated by decay of the 9/2- ground state of ^{215}Bi was extended. In the decay chain of $A = 217$ isobars a new, exotic nucleus ^{217}Bi was discovered and its half-life was estimated as 98.5(8) s. In the beta decay of ^{217}Bi two previously known levels and transitions in ^{217}Po were confirmed. The results also indicate a discovery of two new gamma transitions and one new excited level in this very exotic nucleus. The half-life of ^{217}Po alpha decay was measured as 1.53(3) s, previously it was given in the literature as less then 10 s. The coincidence data revealed an excited state in ^{213}Pb populated directly in the alpha decay of ^{217}Po. The beta decay of ^{213}Pb (produced in the alpha decay of ^{217}Po) let one significantly extend the scheme of levels and transitions in ^{213}Bi. Wherever there were sufficient experimental data, the beta feedings to nuclear levels and log *ft* values were calculated. It was done to get a better insight into the structure of nuclear levels involved in beta decay. The obtained information on the structure of the exotic neutron-rich nuclei is a valuable input for both experimental and theoretical research. It is also an input data for model calculations of astrophysical r-process, which is one of the mechanisms in nucleosynthesis of elements heavier than iron. The results for ^{215}Bi decay are presented in [27] and for ^{217}Bi and ^{217}Po in [26].

Achievements in the studies started before and completed after PhD degree

In the years 1997 to 2007 I took part in preparation and execution of experiments at the WIGISOL facility and I also participated in data analysis. WIGISOL is a mass separator of the IGISOL type which is installed on a cyclotron beam in the Heavy Ion Laboratory (HIL) at the University of Warsaw. At he begin of my work at the WIGISOL separator I was involved in spectroscopy studies of gamma and beta radiation. The results of the investigations I participated in, were used to prepare a proposal which was later accepted in the frame of european collaboration IONCATCHER [B3]. In the years 2001 to 2005 I worked at the WIGISOL facility for the [B3] project. I participated in the efficiency tests of WIGISOL separator with the use of cyclotron beam, mainly ^{14}C on the ^{232}Th target and in the tests using an alpha decaying recoil source ^{223}Ra. I also took part in the efficiency and speed tests of ion extraction from the stopping chamber of the WIGISOL ion source and in the studies of plasma effect induced by heavy ion beam. The results are summarized in [23]. Next I was involved in the measurements of astatine, francium and actinium isotopes with alpha particles spectroscopy, which resulted in identification of an alpha decaying isomeric state in ^{216}Fr [15]. The details of the activities at the WIGISOL facility, in which I participated, are described in the HIL annual reports shown on my list of publications (see annexe 5).

For the IONCATCHER collaboration, in the Interdisciplinary Centre for Mathematical and Computational Modelling (ICM) at the University of Warsaw, I was carrying on computer simulation of gas flow through the ion source of the WIGISOL separator. The results of simulations I presented during the IONCATCHER collaboration meetings [C8] and [C11] as well as during the ICM's reporting session [C10]. I prepared numerical simulations of supersonic gas flow through a Laval type nozzle, which can be used in the IGISOL separator ion source. I presented the results as a seminar [C9] in the Max-Planck-Institut für Quantenoptik in Garching (Germany).

In the frame of polish-flemish collaboration [B5] (in the years 1997 – 2000) I was involved in experiments at the ISOLDE mass separator in CERN (Switzerland). An important experimental achievement was application of a novel method of pulsed-release of reaction products to investigate the neutron-rich nuclei around ^{208}Pb, the method is presented in [32]. The use of the pulsed release enabled study of beta decay of the neutron-rich ^{216}Bi and estimation of its half-life [30]. In the same way one investigated the alpha decay of a neutron-deficient ^{200}Fr and the heavier odd isotopes ^{201,203,205}Fr and ^{196,197,199}At [21]. The method of pulsed-release combined with resonant laser ionization of reaction products enabled the first observation of very exotic ^{218}Bi decay [22]. The same combination of separation methods was used for the study of the neutron-rich nuclei of thallium, lead and bismuth [24]. The above methods were also applied to study the alpha decay of isomeric states in the neutron-deficient ^{185}Pb, the relative yield of the investigated isomeric states was adjusted by scanning of the hyperfine atomic structure with a narrow-band laser [29].

In the Cyclotron Research Centre in Louvain-la-Neuve (Belgium) as an employee of the University of Leuven I participated many times in experimental studies of exotic nuclei at the LISOL mass separator using the method of resonant laser ionization. this method was used for separation of even, neutron-rich isotopes of cobalt ^{66,68,70}Co, which beta decay revealed many new excited states in ^{66,68,70}Ni. The decay of low-spin (3+) states in ^{68}Co and ^{70}Co was observed for the first time and the beta decay half-lives were measured too. The results and their interpretation is presented in [31].

Achievements before PhD degree

Before getting my PhD degree I was involved in experimental studies of neutron-rich, radioactive nuclei located at that time at the border of the known regions of the nuclide chart. I studied the nuclei of mass numbers $A \approx 110$ and $A = 150$ which were produced in fission of ^{238}U induced by 25 MeV protons and separated with the IGISOL facility. I also studied the nuclei of mass $213 < A < 217$ produced in spallation of ^{232}Th target induced by 1 GeV protons. In the latter case separation was done with the ISOLDE facility using the method of pulsed-release of reaction products [32]. I was using nuclear spectroscopy methods to register single and coincidence spectra with gamma and X ray as well as beta and alpha particles spectrometers. I did most of analysis work, on data coming from the experiments I participated in, achieving the following results. In the isobaric $A = 113$ chain a decay scheme of ^{113}Tc was built, a new isomeric state in ^{113}Ru was discovered [33], the beta decay scheme of ^{113}Ru was considerably extended and the intensity distributions of Gamow-Teller transitions for the decays of the ground and isomeric states were found [28]. The ^{150}Ce beta decay scheme was extended. In the heavy nuclei region a new isotope ^{217}Bi was discovered and its half-life was estimated. For the first time the ^{217}Po half-life in alpha decay was estimated. The investigation of ^{216}Bi beta decay resulted in extending of its decay scheme and finding a new half-life value. The gathered data indicated a discovery of a new isotope ^{215}Pb or an unknown isomeric state in ^{215}Pb or in ^{215}Bi (later it was found to be an isomer in ^{215}Bi). The ^{215}Bi decay scheme was extended by adding a previously unknown high-spin cascade. The ^{213}Pb beta decay scheme was considerably extended and respective strength distribution of Gamow-Teller transitions was calculated. A preliminary physical interpretation of the results was done by comparison to systematical data and simple nuclear models. I presented the above achievements in my PhD dissertation, earlier partial information were shown in conference materials and in the annual reports of the Physics Department at the University of Jyväskylä (given in the list of publications in annexe 5). The studies were partially supported by my participation in the research projects [B6] and [B7].

Thanks to a scholarship from the Center for International Mobility, from February to December 1995 I was carrying on my PhD studies at the University of Jyväskylä. I participated in starting up and tests of the IGISOL mass separator and in the first experiments focused on the search for new isotopes. The results obtained for the beta decays of ^{108}Nb and ^{103}Y were published in [34] and [35], respectively. The results of the

^{106}Ru structure studies were later presented in [14].

In the year 1994 after I began my PhD studies, I participated in the studies of radiative electron capture in ^{137}La in collaboration with the University of Aarhus (Denmark). The measurements were carried out in the laboratory of the Nuclear Spectroscopy Division at the University of Warsaw and the results were published in [36].

Participation in research projects

[B1] „Badanie egzotycznych, neutrono-nadmiarowych produktów rozszczepienia w obszarze masowym 80 < A < 120 z użyciem separacji izotopów on-line i pułapek jonowych oraz wielodetektorowych spektrometrów antykomptonowskich.", research project number N N202 007334 granted by the Ministry of Science and Higher Education, 16 V 2008 – 15 II 2012, **leader**

[B2] "Badanie naddźwiękowych dżetów gazowych w źródle jonów typu IGISOL", computational grant number G33-2 granted by the Interdisciplinary Centre for Mathematical and Computational Modelling at the University of Warsaw, active since II 2008, **leader**

[B3] HPRI-CT-2001-50022 european collaboration "European network on developing techniques for effective slowing down, stopping in a gas cell, and extraction of radioactive ions" 1 XII 2001 - 31 V 2005, participant

[B4] "Badanie nowych, egzotycznych jąder w łańcuchach rozpadu A=215, 217", grant number 2 P03B 034 22, granted by the State Committee for Scientific Research, 1 II 2002 - 31 XII 2002 , **leader**

Project started before and completed after PhD degree

[B5] Polish-Flemish Bilateral Scientific and Technological Collaboration "Studies of nuclei far off beta-stability", XII 1997 - XII 2000, collaboration of the University of Leuven (Belgium) and the University of Warsaw, participant

Before PhD degree

[B6] "Badanie jąder bardzo dalekich od stabilności przy zastosowaniu wiązek radioaktywnych", grant number 2 P302 148 06 granted by the State Committee for Scientific Research, 1 I 1994 – 31 XII 96, participant

[B7] "Struktura jąder atomowych z obszarów deformacji oktupolowej", grant number 2 P03B 001 11 granted by the State Committee for Scientific Research, 1 VI 1996 – 31 XII 1998, participant

Presentations in national and international research centers

[C1] JYFL (Department of Physics at the University of Jyväskylä) Users Meeting 2012, Finland, lecture „Beta decay spectroscopy of exotic nuclei with IGISOL and JYFLTRAP", 8 III 2012

[C2] Users Reporting Session of the Interdisciplinary Centre for Mathematical and Computational Modelling at the University of Warsaw, Będlewo, Poland, poster „Naddźwiękowy przepływ gazu w źródłach jonów – symulacje i eksperyment" 23 - 26 III 2011

[C3] Faculty of Physics and Applied Informatics at the University of Łódź, Łódź, Poland, seminar „Pułapki jonowe w spektroskopii gamma i monitorowaniu środowiska" 26 III 2010

[C4] XXXI MAZURIAN LAKES CONFERENCE ON PHYSICS 2009, Piaski, Poland, lecture „Trap-assisted beta decay spectroscopy of refractory elements at the IGISOL" 3 IX 2009

[C5] Department of Physics at the University of Jyväskylä, Finland, seminar „Spectroscopy of exotic, neutron-rich nuclei with IGISOL and JYFLTRAP" 14 II 2008

[C6] JYFL Users Meeting 2008, Finland, lecture „Trap-assisted beta decay spectroscopy at IGISOL: ^{115}Ru and ^{111}Mo" 23 V 2008

[C7] JYFL Users Meeting 2007, Jyväskylä, Finland, lecture „Trap-assisted spectroscopy of ^{113}Tc and ^{115}Ru at IGISOL" 23 II 2007

[C8] The 4rd HITRAP IONCATCHER NIPNET Joint Collaboration Meeting, Munich, Germany, poster „Fluid flow simulations for the WIGISOL gas cell" 24-28 V 2005

[C9] Max-Planck-Institut für Quantenoptik, Garching, Germany, seminar „Fluid flow simulations for the gas cells at high pressure difference" 24 V 2005

[C10] Users Reporting Session of the Interdisciplinary Centre for Mathematical and Computational Modelling at the University of Warsaw, Goniądz, Poland, poster „Symulacja przepływu helu przez komorę na wiązce ciężkich jonów" II 2005

[C11] The 3rd Joint Collaboration Meeting HITRAP-IONCATCHER-NIPNET, Kraków, Poland, lecture „Example of fluid flow simulations for the WIGISOL gas cell", 5 VI 2004

[C12] University of Munich, Garching, Germany, lecture „Ion trajectory simulation requirements for the HIGISOL development" 28 IX 2002

Before PhD degree

[C13] University of Leuven, Leuven, Belgium, seminar „The β^- decay in A = 113 isobaric chain", 1999

Proposals of experiments accepted by the experts teams in international research centers

[D1] "Trap assisted decay spectroscopy of the very neutron-rich molybdenum nuclei around mass A=110", proposal number I179, University of Jyväskylä, Finland, to be scheduled, **leader**

[D2] „Gamma spectroscopy of neutron-rich fission fragments in the A~110 region" proposal number 3-07-270, Institut Laue-Langevin, Grenoble, France, to be scheduled, **leader**

[D3] "Trap-assisted beta-decay spectroscopy of the very neutron-rich elements around mass A=110 and A=140", proposal number I148, University of Jyväskylä, Finland, to be scheduled, **leader**

[D4] „Measurement of electron-gamma coincidences and conversion coefficients for gamma rays following beta-decay of ^{109},^{107}Mo at the Lohengrin." proposal number 3-01-569, Institut Laue-Langevin, Grenoble, France, scheduled in March 2013, **leader**

[D5] "Trap-assisted beta-decay spectroscopy of the very neutron-rich refractory elements around A=110", proposal number I137, University of Jyväskylä, Finland, experiment carried out in two parts: in September 2008 and in January and February 2010, **leader**

[D6] „Beta decay spectroscopy of an exotic, neutron-rich isotope ^{85}As at LOHENGRIN." proposal number 3-01-543, Institut Laue-Langevin, Grenoble, France, experiment carried out in June 2009, **leader**

[D7] „Measurement of neutron yield from carbon, light-water and heavy-water converter targets bombarded by 40 MeV deuterons", proposal number A52, University of Jyväskylä, Finland, experiment carried out in March and June 2008, participant

[D8] „Trap-assisted beta-decay spectroscopy of the very neutron-rich refractory elements around A=110", proposal number I125, University of Jyväskylä, Finland, experiment carried out in February 2008, **leader**

[D9] „Beta-decay spectroscopy of the very neutron-rich refractory elements around A=110", proposal number I104, University of Jyväskylä, Finland, experiment carried out in June 2006, **leader**

[D10] „Penetration of heavy ions through matter in the energy range (40...100) MeV/u", Gesellschaft für Schwerionenforschung, Darmstadt, Germany, experiment carried out in December 2003 and February 2004, participant

Scientific publications according to Web of Science[2]
(for the 7 February 2013)

h-index: 10
number of publications: 37
sum of the times cited: 262
sum of times cited without self-citations: 216

35 of all my publications presented in annexe 5 is found on the Journal Citation Reports (JCR) list according to part A of the scientific journal list in an annexe to the information of the Ministry of Science and Higher Education announced on the 21 December 2012

Awards

From the Rector of the University of Warsaw for „scientific achievements in research of changing nuclear structure when departing from the path of stability" in the year 2012

From the Director of the Institute of Experimental Physics at the University of Warsaw for „outstanding activity in conducting scientific research confirmed by numerous publications" in the year 2010.

Jan Kurpeta
Jan Kurpeta

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[2] In the Web of Science data base in the record for Nucl. Phys. A 746, 663c (2004) my last name is misspelled and the 2012 annual set of Hyperfine Interactions is not included the data base. Thus the publications [A2] and [23] are missing in the report generated by the Web of Science.