Book of Abstracts
IX International Symposium on Exotic Nuclei

Petrozavodsk, Russia
September 10–15, 2018

Organized by:

- JINR (Dubna)
- RIKEN (Wako-shi)
- GANIL (Caen)
- NSCL (Michigan)
- GSI (Darmstadt)
- PetrSU (Petrozavodsk)

Two great events of 2018:

- FIFA World Cup
- EXON 2018

May

Mo	Tu	We	Th	Fr	Sa	Su
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

June

Mo	Tu	We	Th	Fr	Sa	Su
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

July

Mo	Tu	We	Th	Fr	Sa	Su
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

August

Mo	Tu	We	Th	Fr	Sa	Su
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

September

Mo	Tu	We	Th	Fr	Sa	Su
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

October

Mo	Tu	We	Th	Fr	Sa	Su
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

JOINT INSTITUTE FOR NUCLEAR RESEARCH

IX INTERNATIONAL SYMPOSIUM ON EXOTIC NUCLEI (EXON 2018)

Petrozavodsk, Russia, September 10–15, 2018

Book of Abstracts

Organized by

JINR, Dubna
RIKEN, Wako-shi
GANIL, Caen
NSCL, Michigan
GSI, Darmstadt
PetrSU, Petrozavodsk

Dubna • 2018

УДК [539.172.17+539.143] (063)
ББК 22.383.5я431
I69

Co-Chairmen:

Yu. Oganessian	*JINR, Dubna*
H. En'yo	*RIKEN, Wako-shi*
A. Navin	*GANIL, Caen*
Ch. Scheidenberger	*GSI, Darmstadt*
G. Bollen	*MSU, Michigan*

International Organizing Committee:

V. Matveev	*Russia*
G. Trubnikov	*Russia*
T. Uesaka	*Japan*
M. Lewitowicz	*France*
B. Sherrill	*USA*
S. Yennello	*USA*
A. Maj	*Poland*
A. Jokinen	*Finland*
Z. Vilakazi	*South Africa*

Local Organizing Committee:

Yu. Penionzhkevich	*Chairman*
Yu. Sobolev	*Scientific secretary*
S. Dmitriev	*JINR, Dubna*
D. Kamanin	*JINR, Dubna*
S. Pakuliak	*JINR, Dubna*
V. Ivanshin	*JINR, Dubna*
E. Kuznetsova	*JINR, Dubna*
A. Voronov	*PetrSU, Pertozavodsk*

Cover by *Evgeni Cherepanov.*
The contributions are reproduced directly from the originals presented by the Organizing Committee.

IX International Symposium on Exotic Nuclei (EXON 2018): Book of Abstracts
I69 (Petrozavodsk, Russia, September 10–15, 2018). — Dubna: JINR, 2018. — 132p.

ISBN 978-5-9530-0496-1

IX Международный симпозиум по экзотическим ядрам (EXON 2018): Тезисы докладов (Петрозаводск, Россия, 10–15 сентября 2018 г.). — Дубна: ОИЯИ, 2018. — 132 с.

ISBN 978-5-9530-0496-1

ISBN 978-5-9530-0496-1

PROJECTRS AND EXPERIMENTAL FACILITIES

TOPOLOGICAL TYPOLOGY OF NUCLEI

A.V. Yushkov, V.V. Dyachkov, Y.A. Zaripova, Ya.V. Sidorov

Scientific Research Institute of Experimental and Theoretical Physics, Almaty, Republic of Kazakhstan

With the experimental discovery of spatially isolated multiclusters in nuclei [1-3], nuclear physics and its main section - the physics of the structure of the nucleus - acquires a new impulse and a new content that differs sharply from the historical neutron-proton model of Ivanenko-Heisenberg. The generally accepted hypothetical homogeneity of the radial distribution of nuclear matter in our days is fragmented into a whole series of new topological typifications. In this paper, we propose a new classification of nuclear geometry for seven types of the topological structure of the atomic nucleus, which are experimentally justified with varying degrees of uniqueness and reliability.

The topological type I (spherical nuclei - ***spheroids***), naturally corresponds to even-even double magic nuclei and nuclei with filled Heptert-Mayer shells. For example, the *spherooids*: ${}^{4}_{2}He_2$, ${}^{14}_{6}O_8$.

Topological types II and III (elongated and flattened - ***spheroids*** or ellipsoids of rotation) seem to fill the bulk of the isotope matrix in the Z-N coordinates along "Valley of Stability". For example, *prolate spheroids*: ${}^{18}Ne$, ${}^{22}Ne$; *oblate spheroids:* ${}^{12}C$, ${}^{26}Si$.

The topological type IY (the ***toroid*** is a nucleus with zero nuclear density in the center) has been historically searched for a long time, but it has not yet been experimentally reliably established. The first candidates for this form of the nucleus, calculated theoretically, are sulfur isotopes. For example, *toroids:* ${}^{32}S$, ${}^{34}S$.

The topological type Y (***saturnoid*** (our term) is a nucleus with an increased nuclear density in the center) has not yet been experimentally established. For example, *saturnoids*:${}^{70}Ge$, ${}^{72}Ge$, ${}^{74}Ge$, ${}^{76}Ge$, ${}^{78}Se$, ${}^{80}Se$, ${}^{82}Se$, ${}^{84}Se$. It should be noted historically the first predictions of Migdal A. B. on the realism of nuclear superdensity in the form of a π-condensate. The most natural confirmation of this effect was proposed to consider the superdensity of the nucleon and helium-4 (α-particle), which are 5-7 times higher than the "normal" nuclear density(ρ_0= 0,147 Fm^{-3}).

The topological type of YI **simplexes** are strongly clustered nuclei with masses of intra nuclear clusters of nuclear matter from 1 to 4: ${}^{9}Be$, ${}^{11}B$, ${}^{12}C$, ${}^{13}C$, ${}^{14}C$, ${}^{24}Mg$. These are recently experimentally discovered nuclei with a pronounced multi-cluster structure on α-particle beams.

Topological type YII planetoid - nucleus with a well-distinguished core and in a remote orbit that has valence nucleons. These are discoveries on beams of heavy ions of exotic nuclei with a planetary structure: ${}^{6}He$, ${}^{6}Be$, ${}^{10}Be$, ${}^{10}C$, ${}^{11}Li$, ${}^{12}Be$, ${}^{20}C$, ${}^{22}C$, ${}^{24}C$.

Thus, the newest discoveries of new forms in radial distributions of nuclear density pose essentially new requirements for conducting beam research on the structure of the nucleus. This is the increased angular accuracy of the spectrometers, a reduced pitch in the angle for increasing the accuracy of the angular distributions of the differential cross sections, and a minimal statistical error for the detection of thin angular fluctuations of the cross sections, which carry information about exotic nuclei and their clusters.

CLUSTERIZATION AND CRYSTALLIZATION OF COMPLEX NUCLEI

Y.A. Zaripova, V.V. Dyachkov, A.V. Yushkov

Scientific Research Institute of Experimental and Theoretical Physics, Almaty, Republic of Kazakhstan

The review gives the main aspects of the fundamentally new nuclear physics. A new paradigm of nuclear phenomena is substantiated. In it, the composition and structure of complex nuclei are re-examined in a new way, nuclear forces and nuclear interactions are re-introduced in a new way. In addition, the mechanisms of nuclear reactions are considered in a new way and a new topology of nuclear space is proposed.

Theoretical and experimental facts about the clustering of nuclei are discussed and experimental proofs of their real existence are considered. A method for measuring and identifying each type of cluster in one experiment and in one mass spectrum is described.

The sum of the experimental facts in favor of the solid model of the nucleus and the ordering of its structure into a quasi crystalline lattice is generalized. Systematics of the geometric parameters of the nuclei - radii, surface diffusion and shape deformation is given throughout the "Valley of Stability". It is shown that super dense nuclei whose density significantly exceed the mean (normal) density $n_o = 0{,}147\ fm$ exist. These are nuclei from ^{4}He to ^{32}S, while the maximum density (super density) is demonstrated by the ^{4}He nucleus (α-particle). This suggests two "bricks" of nuclear composition - nucleons and α-particles, and the densest spherical packing's in a binary nuclear system: in fact, the ratio of their radii is theoretically equal to 0.4142. And the ratio of the radii of nucleons and α-particles is exactly equal to $\frac{r_p}{r_\alpha} = \frac{0.7\ fm}{1.68\ fm} = 0.417$. And if we follow this theory, then the "Island of stability", we propose to search not at Z = 114, but at *Z = 128*.

Facts and generalizations are presented in favor of constructing a new nuclear theory in the basis of the topology of a curvilinear non-Euclidean space. Inside the nucleus volume and in the near-nuclear space, this is a Riemannian space with a geodesic in the form of an ellipse with positive curvature $\kappa > 0$. The closed Riemannian space in the micro world of nuclei is the area inside the "Valley of Stability". On the edges of this valley the Riemannian space opens into a flat Euclidean space with zero curvature $\kappa = 0$. Outside the nucleus, the Riemannian space at the Fermi boundary is rectified. Then the zero curvature undergoes a discontinuity and goes over into the Lobachevski space with negative curvature $\kappa < 0$, and the corresponding instability of the nuclear structure, which serves as the fundamental cause of radioactivity.

EXPERIMENTAL FOUNDATIONS OF NUCLEAR PHYSICS IN NON-EUCLIDEAN SPACES

V.V. Dyachkov, Y.A. Zaripova, A.V. Yushkov

Scientific Research Institute of Experimental and Theoretical Physics, Almaty, Republic of Kazakhstan
E-mail: slava_kpss@mail.ru

An attempt is made to present a number of experimental data obtained at the accelerator, in the spirit of a new nuclear paradigm, which we called "Riemannian nuclear physics". Within the framework of the new paradigm, the deletion of the notion of "wave function" and there is no requirement to solve the equation of motion in the form of the Schrödinger equation. That is, under the pressure of all the new experimental facts we have to state that on the basis of only quantum mechanical views, it is impossible to describe the world of nuclei, and, consequently, the entire microcosm. Such a return to the deterministic Newtonian paradigm and the Hamiltonian equations of motion is associated with the accumulated contradictions of the quantum-mechanical paradigm with experimental data. In the present paper, a system of proofs of the necessity of turning to non-Euclidean geometry for atoms, nuclei and elementary particles is consistently cited. The basis representations of the new Riemannian nuclear physics were first presented by us in [1, 2].

In the Riemannian space [3], the radius of curvature $\varkappa$ of the m-plane of an elliptic space is $\varkappa = \frac{1}{R^2}$, where R – root-mean-square radius of the nucleus. The stratification of a Riemannian space is considered as an alternative to the quantization of the nuclear and near-nuclear orbits of clusters and nucleons, respectively. Such stratification allows us to divide the Riemannian space into even and odd spheres with the corresponding radii.

The aim of the paper is to consider the geometry of the nucleus under the assumption of its curvature and stratification as an alternative to quantum mechanics. Such an approach could remove a number of contradictions, for example, the absence of electron emissions when they move along closed orbits in an atom or valence nucleons in the nucleus. In the Riemannian space of a geodesic, that is, a straight line permitting such a nonradiative motion, the ellipse is just that. The stratification of the m-sphere, in our opinion, is similar to shells and therefore explains the quantum nature of nuclear levels. Thus, the discrete quantum nature of nuclear parameters can be obtained without going beyond classical physics.

It would seem that the problem remains in de Broglie waves. However, this problem is solved in a natural way due to the Riemannian nature of the nuclear and near-nuclear space: incident beams of accelerated particles or neutrons bend their trajectories in curvilinear space like classical optical lenses with subsequent interference. In this interpretation, the concept of dualism of waves and particles for the microcosm is superfluous.

Apparently, it makes sense, in the framework of the Riemannian paradigm, to identify nuclear-spectroscopic levels with near-nuclear spatial closed (elliptical) layers. This will allow calculating their curvature by normalizing to the first layer tangential to the core surface. Drawing an analogy with the notation in nuclear spectroscopy, the spatial layers are also denoted as s-, p-, d-, f-, g-, h-layers.

In our work in the measured angular distributions of elastically scattered alpha particles with an energy of 10 MeV / nucleon, using the parametrized phase analysis method, the areas of nuclear space are identified: with positive curvature $\varkappa>0$ (Riemannian space), with zero curvature $\varkappa=0$ (Euclidean space) and with negative curvature $\varkappa<0$ (Lobachevsky space). On this basis, a hypothesis, that the fundamental cause of nuclear radioactivity is a transitional spatial layer from positive to negative curvature, has been advanced.

1. Yushkov A.V., Dyachkov V.V., Zaripova Y.A. New regularities in nuclear physics and microcosm structures // XXI International Scientific and Practical Conference "Relevant issues of Innovation Development in the New Millennium", 2015. – Monthly scientific journal. – №9(20). – P. 35-40.

2. Dyachkov V.V., Zaripova Y.A., Yushkov A.V. Cluster structure of nuclei and new spatial regularities // KazNU Bulletin. Physics series. – №2(57). – 2016. – P. 88-97.

3. Rosenfeld B.A. Non-Euclidean spaces. – M.: Nauka, 1969. – 548 p.

Научное издание

IX International Symposium on Exotic Nuclei
(EXON 2018)
Book of Abstracts

IX Международный симпозиум по экзотическим ядрам
(EXON 2018)
Тезисы докладов

E7-2018-33

Ответственный за подготовку сборника к печати *Ю. Г. Соболев*.

Сборник отпечатан методом прямого репродуцирования
с оригиналов, предоставленных оргкомитетом.

Подписано в печать 16.07.2018.
Формат 60×84/8. Бумага офсетная. Печать офсетная.
Усл. печ. л. 15,35. Уч.-изд. л. 13,66. Тираж 235 экз. Заказ № 59432.

Издательский отдел Объединенного института ядерных исследований
141980, г. Дубна, Московская обл., ул. Жолио-Кюри, 6.
E-mail: publish@pds.jinr.ru
www.jinr.ru/publish/