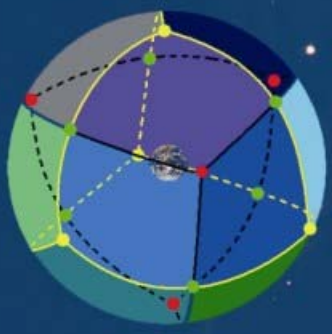
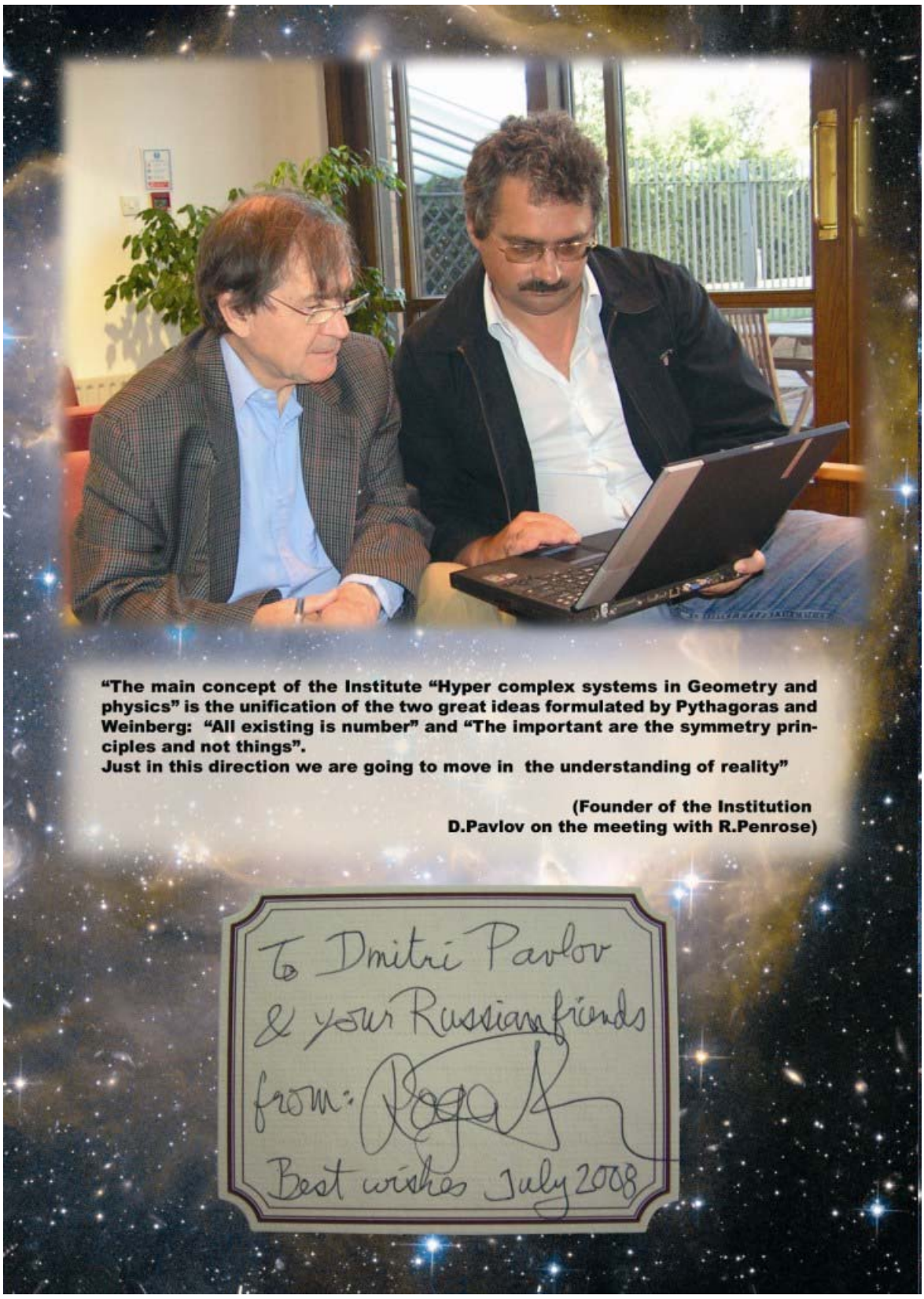
Научно-исследовательский институт гиперкомплексных систем в геометрии и физике



Research Institute Of Hypercomplex Systems In Geometry And Physics


"The main concept of the Institute "Hyper complex systems in Geometry and physics" is the unification of the two great ideas formulated by Pythagoras and Weinberg: "All existing is number" and "The important are the symmetry principles and not things".
Just in this direction we are going to move in the understanding of reality"
(Founder of the Institution
D.Pavlov on the meeting with R.Penrose)
To Dmitri Pavlov
& your Russian friends
from:
Best wishes July 2008

(The Institute building in Fryazino)

The Research Institute "Hyper complex systems in geometry and physics" is a unique non-state scientific institution that has no analogues in our country. Its team works together for almost ten years, but the Institute was officially registered less than a year ago.

The staff of the Institute includes mathematicians and physicists – both theoreticians and experimentalists, – whose activity is related to hyper complex algebras, Finsler geometries associated to them and to their applications to the fundamental physical problems – first of all to the problem of of the global anisotropy of space-time which is one of the most interesting directions in modern science.

The principal innovation brought by the Institute into the traditional Finsler research is the linking the geometry with algebra and numbers, first of all with hyper complex ones, that have the infinite dimensional sets of analytical functions that have as invariants not only length and angle but also their specifically Finsler extensions.

The main goal of the Institute is the theoretical and experimental research of the anisotropic space-time continuum and of the algebraic, geometrical and physical consequences of the change of the Minkowsky metric to the anisotropic Finsler metric, particularly, to the Berwald-Moor metric function.

The fundamental theoretical basis for the construction of physics on the base of space-time with the Berwald-Moor metric is the existence of the same properties for the corresponding spaces at the low velocity limit and for Galileo space, i.e. the existence of correspondence with the classical mechanics.

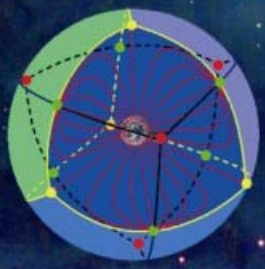
The doubtless advantages of the plane Finsler space with the Berwald-Moor metric over Galileo and Minkowsky spaces are its natural connection with the algebra of commutative associative hyper complex numbers that is analogous to the algebra of complex numbers in many ways but works already in four-dimensional space-time and the existence of the infinite dimensional groups of continuous non-linear symmetries related to the Finsler generalizations of the conformal transformations instead of the finite dimensional ones present in the quadratic spaces.

Director of the Institute
V.O.Gladyshev

Chairman of the Trustee Council of the Institute
D.G.Pavlov

Director of the Institute
V.Gladyshev with R.Penrose

The Institute staff in the Teaching Center "Forest Lake"



The staff of the Institute includes 25 people, several dozens of physicist and mathematicians throughout the world take active part in its research.

Beginning from 2000, the Institute team published several hundreds of papers, two monographs are to appear soon, collections of selected papers have been published.

In 2007 we won the RFBR grant for two years. It is based on the joint program of Russian and Romanian Academies Sciences in the field of mathematics.

The researchers of the Institute gave talks on Finsler geometry with Berwald-Moor metric at tens of conferences and seminars in Russia, Azerbaijan, Egypt, France, Germany, Hungary, India, Italy, Kazakhstan, Romania, Spain, UK, USA, and Uzbekistan.

The scientific research and International conferences organized by RI HCSGP are supported by:

- **The United Physical Society of Russian Federation;**
- **Moscow Physical Society;**
- **Russian Gravitational Society;**
- **Hyper Complex Society of Russian Federation**
- **International Gravitational Society (ISGR&G);**
- **Balkan Society of Geometers;**
- **Britain Society for the Philosophy of Science.**

The Institute acts in collaboration with the Department of Physics of Bauman MSTU, with the Department of algebra and geometry of "Transilvania" University (Brasov, Romania) and with the Department of mathematics of Polytechnic University (Bucharest, Romania).

In the field of physical interpretations and extension of the Relativity Theory there is a fruitful collaboration with Oliver Lodge Laboratory of the Physical Faculty of the University of Liverpool (UK), of Department Theoretical Physics High Energy of Research Institute of Nuclear Physics in Lomonosov MSU, the Department of theoretical physics of the Physical Faculty of Lomonosov MSU.

"In order to make the Institute developments universally recognized, they should be performed on the highest level, to say nothing of their experimental testing"

RAS Academician
V.G.Kadyshevsky

During the last five years the Institute team organized and supported:

- Scientific web-site www.polynumbers.ru (since 2002)

- Monthly scientific seminar
http://polynumbers.ru/section.php?lang=ru&genre=37 (since 2002)

- Specialized periodical journal "Hyper Complex Numbers in Geometry and Physics"
http://polynumbers.ru/section.php?lang=ru&genre=3 (appears since 2004)

- Student papers competition. The winners get the nominal scholarships
http://polynumbers.ru/section.php?lang=ru&genre=14 (since 2004)

- International foundation for Finsler geometry research
http://polynumbers.ru/section.php?lang=ru&genre=77 (works since 2005)

"From the point of view of physical applications, the existence of vast variety of analytical functions in the Finsler spaces related to the hyper complex numbers seems very promising"

RAS Academician
V.A.Matveev

Beginning from 2004 the Institute regularly
"Finsler Extensions of Relativity Theory" (FE

Due to the participation of scientist from mo
Institute became known in the world as one
sler spaces and searching for their physical

On these conferences there is not only the c
involving of physicists and mathematician fr

The Conferences take place in Russia and Eg

The traditional emblem of FERT is an image
top – the symbol which is closely connected
sional Finsler space with Berwald-Moor metr

Moscow-2004

" I wish the Conference FERT-2007 every success and I regret that I can't participate in it because of the earlier appointment in Oxford.
I hope that in the near future I will be able to come to Russia. My best wishes to all the participants and organizers, I believe that this Conference will improve the state of science..."

With best regards,
Roger Penrose,
September 2007

Moscow-2

Cairo-2006

holds the International Conferences
RT).

re than 20 countries, the team of our
of the main groups investigating Fin-
applications.

communication of specialists but the
om the other fields of science.

gypt in turn.

of two Great pyramids joined top to
to the symmetries of the four dimen-
ic.

Cairo-2005

007

Cairo-2008

Among the achievements of the Institute team there are:

- **The proof of the existence of natural links between the hyper complex numbers and Finsler geometries that are analogous to the links between the geometry of the Euclidian plane and complex numbers;**
- **The development of the principally new axioms for Finsler spaces that provide the using of the numerous metric invariants including angle and its generalizations (in the approaches used before even the notion of angle was unavoidably contradictive);**
- **The discovery of multi-dimensional spaces that have only time dimensions and no space dimensions;**
- **The development of the principally new axioms for Finsler spaces that provide the using of the numerous metric invariants including angle and its generalizations (in the approaches used before even the notion of angle was unavoidably contradictive);**
- **The discovery of multi-dimensional spaces that have only time dimensions and no space dimensions;**
- **The development of the generalized complex potential method for the multi-dimensional hyper complex spaces with Finsler geometries;**
- **The development of the transfer rules for the passage from the abstract coordinates to the observable ones in Finsler spaces;**
- **The generalization of the geometrical field theory for Finsler spaces;**
- **The discovery of the correspondence between the geometry with the Berwald-Moor metric and the geometry of Galileo spaces, which makes it possible to use Finsler geometry to describe real physical phenomena alongside with the use of pseudo Riemannian geometry;**
- **The construction of the transfer rules for the passage from the Finsler geometries to the Riemannian and pseudo Riemannian geometries connected with them;**
- **The derivation of the transformations in the space with the Berwald-Moor metric that play the same role as Lorenz transformations in the Minkowsky space;**
- **The proof that the classical Lorenz group is the subgroup of the complexified conformal group of the Finsler space with the Berwald-Moor metric;**
- **The development of the geometrical field theory for the four dimensional space-time with the Berwald-Moor metric in which the gravitational and electromagnetic fields are unified. With this Maxwell equations appear to be the particular case of such unified field, and Einstein equations appear to become the coupling equations between the gravitational field and the matter;**
- **The construction of the list of phenomena that could be hopefully observed in experiment and that could give an answer to the question which of the two geometries – Minkowsky or Berwald-Moor – better corresponds to the real World;**
- **Proved existence of fractals on double numbers.**

The authors of the main results obtained in the Institute G.I.Garas'ko (left) and G.Yu.Bogoslovsky.

Lecture during the spring-2008 school

Students of the spring-2008 school

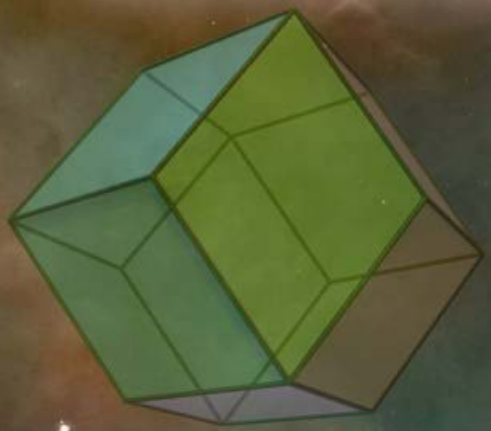
In May, 2008, and then in October-December, 2008, the schools on the foundations of Finsler geometry for young scientists, post graduate students and students were organized in the Teaching Center "Forest Lake" near Korolev.

The schedule of these schools included lectures on Finsler geometry and on the theory of hyper complex algebras and also on accompanying disciplines like the theory of functions of complex variables, Riemannian geometry, Differential geometry etc.

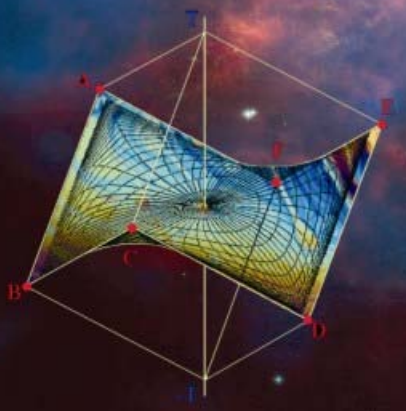
All the students of the autumn school were provided the financial support to take part in the Conference FERT-2008 in Cairo where they could communicate with the specialists who gave the talks there.

The majority of the young people who have graduated the school remarked in the forms they completed after graduation that in their future research they are going to use the possibilities provided by Finsler geometries and hyper complex algebras.

Such schools are planned to become regular. The nearest one will take place during July 20 – August 15, 2009, and its students will obtain the financial support to visit the International "Symmetry" Festivity which will be held in Hungary on July 31 – August 4.



Among the main problems to be investigated in the Institute in future there are:
- the search for the correspondence and for the parameter of the limit transition
between the Finsler geometry based on the Berwald-Moor metric and pseudo Riemannian geometry of the general relativity;
- the construction of the complete classification of metric invariants of the Finsler spaces with the Berwald-Moor metric and the investigation of the continuous non-linear transformations related to them;
- the construction of the theory of functions of the double number variable. This theory extends the known theory of functions of the complex variable to the hyper complex numbers with the zero divisors;
- the development of the theory of functions of the double number variable for the commutative associative hyper complex algebras of arbitrary dimensions;
- the construction of the multi dimensional hyper complex algebraic fractals generalizing the known two-dimensional Mandelbrot and Julia sets;
- the development of the geometric theory, unifying the gravitational and the electromagnetic fields in the four-dimensional space with the Berwald-Moor metric;
- the investigation of the compatibility of the principles of the quantum mechanic
with the geometry of spaces with Berwald-Moor metric;
- the performance of the experiments and astrophysical observations aimed to prove or disprove the validity of the transfer from the pseudo Riemannian concepts of the geometry of the real space-time to the Finsler ones.



In the observatory of the astrophysical institute (Almaty, Kazakhstan)

"There are the ideas that the space-time could be anisotropic. In this case we will have to pass to Finsler structure.
We will have to change the algebraic concepts and, using algebra, work with geometry.
We speak of the hyper complex numbers and also of the numbers used by D.Pavlov in his research.
We have to look at these problems more openly"

Professor Garry Gibbons,
Cambridge, UK

"The Institute has established the scientific contacts throughout the world including the Universities in Oldenburg and Bremen in Germany. The reports of the new scientific results of Dr.Pavlov's team inevitably inspire the audience and attract the essential interest to their topic. Dr.Pavlov's initiative is an example for others.
I use this opportunity to congratulate the staff of the new Institute with all my heart. I wish the Institute a great success and outstanding scientific results".

Professor Jutta Kunz,
Oldenburg, Germany.

"The Institute especially devoted to the investigation of the hyper complex systems provides the unique opportunity to work at the border of Mathematics and Physics and to exchange the most advanced ideas in these fields.
Judging by my personal experience, I am sure that the atmosphere in it will be always friendly and hospitable"

Professor Peter Rowlands
Liverpool, UK

"The foundation of the Institute attracted attention of many leading scientists throughout the world. I am sure that the Institute activity will result in the acquaintance of the scientific community with the wide spectrum of the applications of the Berwald-Moor metric and Finsler geometry as a whole"

Professor Vladimir Balan
Bucharest, Romania

"Red Square" Nebulae

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