WELCOME
to the Helmholtz International Summer School
Quantum Field Theory at the Limits: from Strong Fields to Heavy Quarks
Dubna, July 22-August 2, 2019

Oleg Teryaev,
Head of “Fundamental Interactions Theory” Research Group,
Bogoliubov Laboratory of Theoretical Physics,
Joint Institute for Nuclear Research
JINR today

Being a worldwide centre for fundamental physics research, JINR sets ambitious goals, which assumes the corresponding high level of international cooperation and integration into the global and first of all the European research programmes, and wide developing of the multidisciplinary research, including innovation studies and also the modern advanced educational programmes.

18 Member States (incl. 5 from EU):
- Azerbaijan
- Armenia
- Belarus
- Bulgaria
- Vietnam
- Georgia
- Kazakhstan
- Cuba
- DPRK
- Moldova
- Mongolia
- Poland
- Russia
- Romania
- Slovakia
- Uzbekistan
- Ukraine
- Czech Republic

About 800 research partners in 62 countries

6 Associate Members (incl. 3 from EU):
- Hungary, Germany, Egypt, Italy, Serbia, SAR
Theoretical Physics at JINR

Multidisciplinary research:
- Theory of Fundamental Interactions
- Theory of Nuclear Structure and Nuclear Reactions
- Theory of Condensed Matter
- Modern Mathematical Physics: Strings and Gravity, Supersymmetry, Integrability
- Research and Educational Project “Dubna International Advanced School of Theoretical Physics” (DIAS-TH)

Journals (390) & Conf. Proc. (170) ~ 560
Monographs ~ 4

Educational Activity:
More than 40 lecture courses at UC JINR, DIAS-TH, Moscow U., Dubna U., MIPT, etc.

Fundamental Interactions of Fields and Particles
Leaders: D.I. Kazakov
O.V. Troyan

Participating countries and international organizations:
Armenia, Azerbaijan, Belarus, Bulgaria, Canada, CERN, Chile, China, Czech Republic, Finland, France, Georgia, Germany, Hungary, ICTP, Italy, Japan, Kazakhstan, Mexico, Mongolia, Netherlands, Norway, Portugal, Poland, Republic of Korea, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland, USA, Ukraine, United Kingdom, Uzbekistan, Vietnam.

Issues addressed and main goals of research:
The main aim of the research within the theme is the construction of theoretical models and their application to the description of properties of elementary particles and their interactions. This research includes the following directions of activity.

The development of quantum field theory formalism in gauge and supersymmetric theories. Construction and investigation of the models of particle physics beyond the Standard Model. Theoretical support of experiments at the Large Hadron Collider on the search of new physics and the study of the properties of the Higgs boson.

Calculation of radiative corrections to the processes of particle creation within the Standard Model and its extensions. Investigation of neutrino properties and neutrino oscillations. Investigation of the hadron properties within quantum chromodynamics and phenomenological quark models. Study of the hadrons spin structure with the help of generalized and transverse momentum dependent parton distributions and theoretical support of NICA/SPD program.

Study of heavy quark properties and exotic hadrons. Lattice simulations for obtaining nonperturbative results in gauge theories. Investigation of dense hadronic matter and theoretical support of the NICA/MPD program.

Theoretical support of a wide range of current and future experiments at JINR, IBHEP, CERN, GSI, JLab and other physics centers.
### Directions of BLTP Research

<table>
<thead>
<tr>
<th>1. Quantum field theory and physics beyond the Standard Model</th>
<th>D.I. Kazakov, A.V. Gladyshev, A.V. Bednyakov</th>
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<tbody>
<tr>
<td><strong>• Anatoly Kotikov (JINR)</strong></td>
<td><strong>&quot;Calculation of massive Feynman diagrams&quot;</strong></td>
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<th>2. QCD parton distributions for modern and future colliders</th>
<th>I.V. Anikin, O.V. Teryaev</th>
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<tr>
<td>VBLHEP</td>
<td>Yu.I. Ivanishin, A.P. Nagaitsev, I.A. Savin, R. Tsenov</td>
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<tr>
<td><strong>• Igor Anikin (JINR)</strong></td>
<td><strong>&quot;LCSR for Nucleon Gravitational Form Factors&quot;</strong></td>
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<th>3. Strong interactions phenomenology and precision physics</th>
<th>M.A. Ivanov, V.I. Korobov, A.E. Dorokhov</th>
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<tr>
<td><strong>• Mikhail Ivanov (JINR)</strong></td>
<td><strong>Nonleptonic decays of doubly charmed baryons&quot;</strong></td>
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<th>4. Theory of Hadronic Matter under extreme conditions</th>
<th>D. Blaschke, V.V. Braguta, E.E. Kolomeitsev, S.N. Nedelko</th>
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<tr>
<td><strong>• David Blaschke (JINR Dubna &amp; Uni Wroclaw)</strong></td>
<td><strong>&quot;Particle production in strong, time-dependent fields&quot;</strong></td>
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<th>5. Theory of electroweak interactions and neutrino physics</th>
<th>A.B. Arbuzov, V.A. Naumov, F. Simkovic</th>
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<tr>
<td><strong>• Aidos Issadykov (JINR &amp; INP Almaty)</strong></td>
<td><strong>&quot;Study of B_c decays&quot;</strong></td>
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The table above lists the research directions and participating researchers at BLTP.
Opportunities at BLTP

<table>
<thead>
<tr>
<th>Element</th>
<th>Atomic Number</th>
<th>Symbol</th>
<th>Mass</th>
<th>Period</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dubnium</td>
<td>105</td>
<td>Db</td>
<td>267.09</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

D.I. Mendeleev’s Periodic table of elements
NICA: heavy ions and hadrons
Large External Fields and Heavy Quarks@NICA

• Heavy-Ion collisions largest ever magnetic fields ($\sim m_\pi^2$): contribute to particles polarization

• Heavy quarkonia production: tool for studies of nucleons 3D/Spin structure
WELCOME!

• HAVE A NICE STAY IN DUBNA AND VERY FRUITFUL SCHOOL!
NICA/MPD – Nuclotron-based heavy ions Collider fAcility and Multi-Purpose Detector

Aim – experimental study of dense QCD matter and search for signals of mixed phase and critical point in heavy ions collisions
Phase diagram:
From ALICE to NICA/MPD