BLTP Bogolubov Laboratory of Theoretical Physics

in 2003 – 2009

- **FIELDS AND PARTICLES:**

  Particle theory

  Quantum field theory

  Modern mathematical physics

- **THEORY OF NUCLEI AND OTHER FINITE SYSTEMS**

- **THEORY OF CONDENSED MATTER**

PARTICLES

- **Development of nonperturbative methods**
  - **Lattice**
  - **Collective variables (instantons, vacuum condensates, chiral approach,...)**
  - **Analytical methods and duality**
- **QCD-based Phenomenology**
- **Development of the Standard Model**

Support for current and future experiments at JINR, IHEP, CERN, DESY, GSI, FNAL, BNL, ...

Support for current and future experiments with the JINR participation

• SUSY partners, • Higgs	CMS, ATLAS, DØ, CDF
• ν-physics, • CP-violation	NOMAD, NA-48, DØ, CDF
• Heavy quark physics	CMS, ATLAS, DØ, CDF, HERMES-B, H1
• High energy, small-x • Very high multiplicity	CMS, ATLAS, DØ, CDF
• Hadron spin and flavor structure • New PDF and PFF • Spin and polarization in QCD	COMPASS, NOMAD, STAR, HERMES, HERMES-N
• Quark-Gluon Plasma	ALICE, STAR, HADES
• Spin effects in few-nucleon systems	STRELA, MRS, BES, DELTA-SIGMA, KAPPA. SPIN,EXCHARM-2, NIS
• Multiquark states and cumulative processes	SPHERA, GIBS, MARUSYA
• Rare processes	EXCHARM, NIS

FIELDS

- **Fundamental symmetries**
- **Unification of fields and forces including gravitation**

- **New methods for old symmetries (gauge, SUSY)**
- **New symmetries (quantum, qft on noncommutative manifolds, …)**
- **Integrable models**
- **Unified theories (superstrings, p-branes, …)**
- **New cosmological models**

The ant nebula seen by the Hubble Space Telescope.

- **Astroparticle physics**
- **New cosmological scenarios**

These trends are tightly connected with both particle physics and modern mathematical physics. The well established and recognized group of young researchers in modern mathematical physics should be unified in a new theme.

THEORY OF NUCLEI AND OTHER FINITE SYSTEMS

- **Nuclear structure off the valley of stability and clustering phenomena**

  New generation of nuclear models (beyond the mean field approximation and RPA); cluster models for heavy nuclei (a unified view on the fission, cluster radioactivity, fusion, superheavy nuclei, exotic nuclear shapes etc).

  Theoretical support of the FLNR projects.

- **Dynamics of resonance phenomena in few-body systems**

  Approaches going beyond the scope of a two-body formalism on the basis of rigorous dynamic equations.

- **Relativistic nuclear dynamics and properties of hot and dense nuclear matter**

  QCD motivated strong interaction models and their extensions.

  Theoretical support of projects HADES, FASA.

THEORY OF CONDENSED MATTER

Development of analytical and numerical methods in studies of complex many-body systems

- **Strongly Correlated Systems**

  - copper-oxide superconductors
  - manganites (colossal magneto-resistance)
  - heavy-fermion systems
  - low-dimensional conductors

- **Dynamical Systems: chaos, integralability and self-organization**

  - avalanche dynamics
  - propagation of signals in non-linear and non-stable media
  - irreversible processes in the non-equilibrium statistical physics

- **Disordered Structures:**
  glasses, topological defects, nanostructures

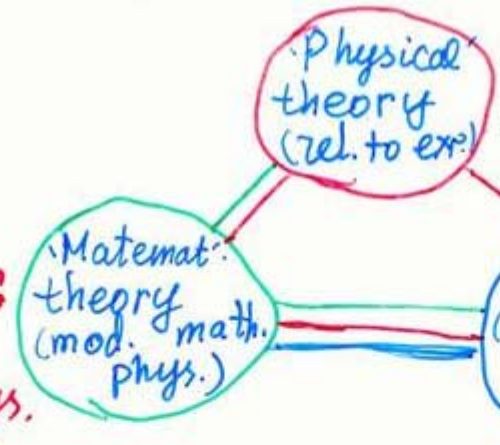
  - topological defects in the glassy state
  - dielectric and metal glass dynamics
  - topological defects in nanostructures (fullerenes, nanotubes, nanocones)

- **Mesoscopic and Coherent**
  Phenomena in Quantum Systems

  - quantum wells, wires, dots
  - atomic traps, Bose-Einstein condensation
  - photon confinement in band-gap material

The proposed studies will support experimental investigations of condensed matter physics in JINR.

Triality Principle for BLTP



Collab. with JINR labs.!

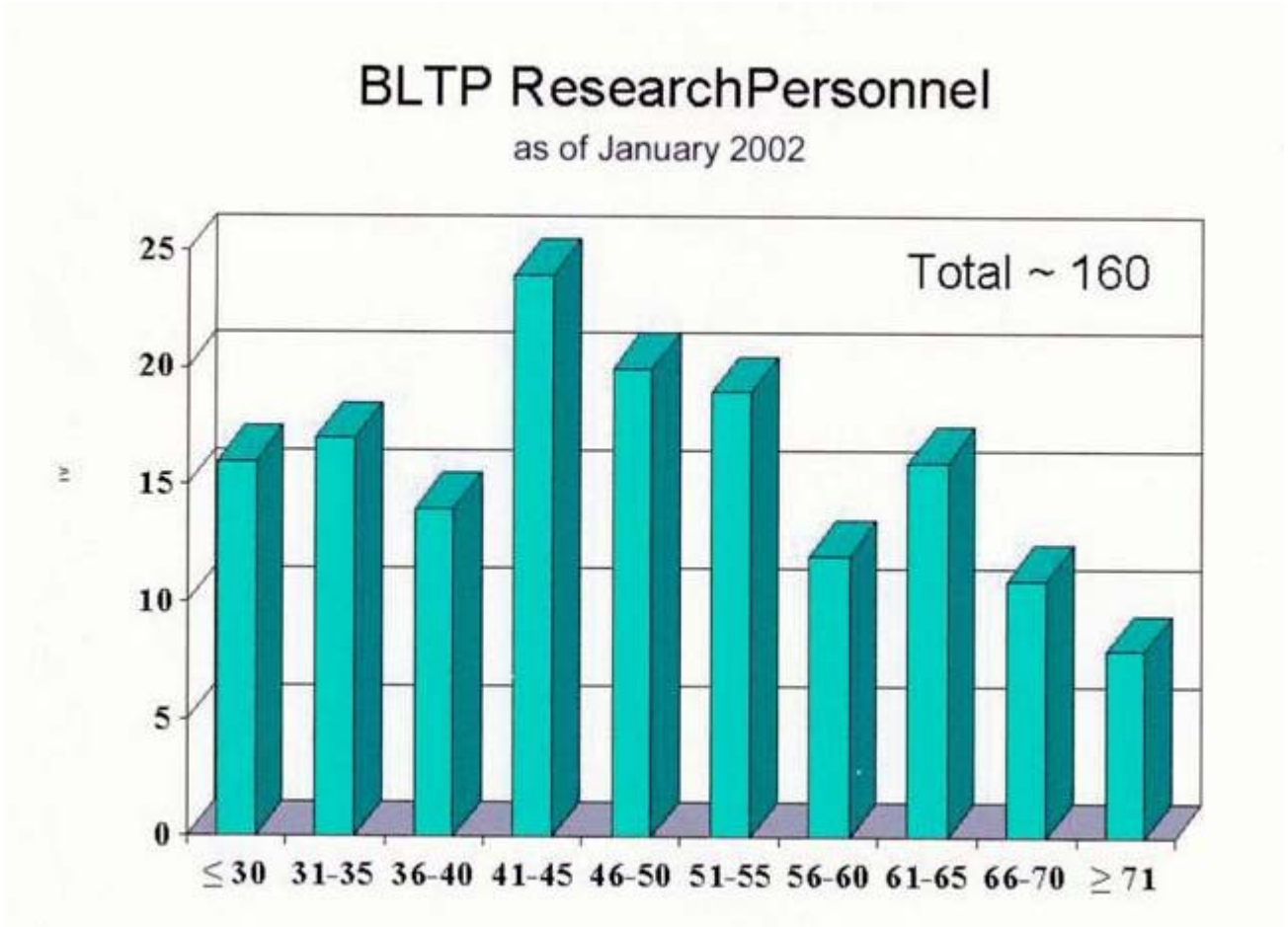
New theme: Modern. Math. Phys.

Intern. 'chair' in modern theor. physics

Recommendations of the [redacted] 6 y. ago { Adv. Comm. in Theor. Phys.

1. To establish study in modern. math. phys. (conformal field th., string th., etc.)
2. .. in lattice gauge theory (incl. comput. on supercomp.)
3. ... in astroparticle physics and cosmology

General: to promote young active scientists to perman. positions


BLTP ResearchPersonnel
as of January 2002
Total ~ 160
25
20
15
10
5
0
≤ 30
31-35
36-40
41-45
46-50
51-55
56-60
61-65
66-70
≥ 71

Summary

- *A high level of traditional, well-established methods of theoretical research is needed to support the proposed experiments.*
- *The trend for the future is to study unusual phenomena and forms of matter especially in astrophysics and cosmology. This requires new conceptual ideas and development of new methods (nonperturbative, nonlinear, noncommutative, ...).*

Important components:

- ***Infrastructure (building, computers, communication, ...).***
- ***Proper financing.***
- ***Development of cooperation with the Member States and other countries.***
- ***Recruiting young scientists, students and post-graduates to the work.***
- ***Foundation of the Chair of modern theoretical physics under BLTP!?***
- ***Organization of international schools, conferences, and workshops with the support of the research Funds.***

INTERNATIONAL SCHOOL on

NONCOMMUTATIVE GEOMETRY & FIELD THEORY

June 18–28, 2001

INTERNATIONAL WORKSHOP

QUANTUM GRAVITY & SUPERSTRINGS

June 18–24, 2001

Dubna, *Russia*

Organized by
the Bogoliubov Laboratory of Theoretical Physics (BLTP) of the JINR

Photo: Sergei Filippov

TOPICS OF THE WORKSHOP

- Noncommutative geometry and field theory
- M-theory and strings
- Extra dimensions and branes
- Integrable models in quantum gravity and gauge theories

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SUPPORT:
Heisenberg-Landau Program
Bogoliubov-Infeld Program

INTERNATIONAL WORKSHOP

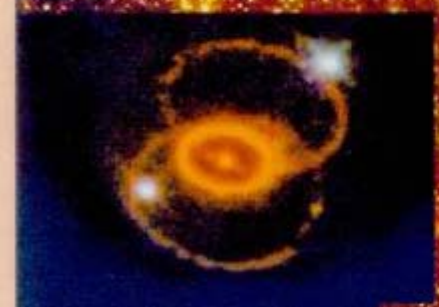
HOT POINTS IN ASTROPHYSICS

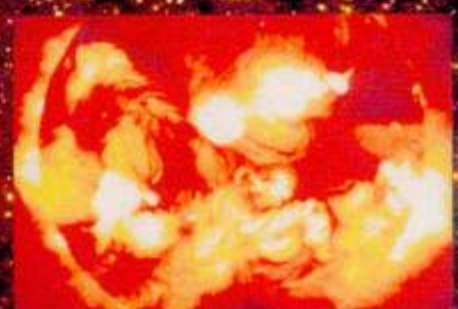
22-26 AUGUST 2000, DUBNA, RUSSIA

Supported by:
UNESCO, RFBR, administration of JINR
and Heisenberg-Landau programm

Main Topics:

- Early Universe
- Hot Universe and cosmology
- Binary systems





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- Prof. Wehrse R. (ITA, Heidelberg, Germany)
- Novikova V.K. (JINR, Dubna, Russia) – coordinator

Research Workshop

Calculations for Modern and Future Colliders

10-22 July

Supported by BMBF, HLP, and RFBR