JOINT INSTITUTE FOR NUCLEAR RESEARCH

BLTP

Havana

‘25 December

THEORY IN MOTION

В ожидании_e.

Dmitry Kazakov

BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS



Dubna

SCIENTIFIC DIVISIONS OF BLTP

PARTICLE PHYSICS



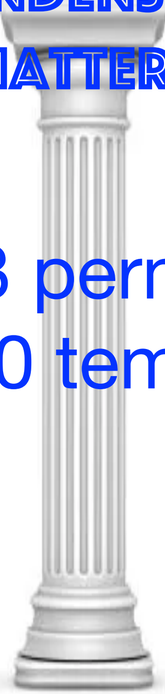
49 perm
+51 temp

NUCLEAR PHYSICS



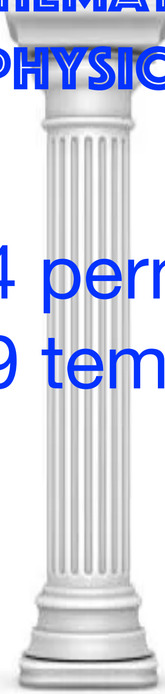
38 perm
+34 temp

CONDENSED MATTER



23 perm
+20 temp

MATHEMATICAL PHYSICS



24 perm
+9 temp

SCIENTIFIC DIVISIONS

Particle Physics	Nuclear Physics	Condensed Matter	Mathematical Physics
Standard Model and its extension	Nuclear Properties at the Border of Stability	Complex materials and nanostructures	Quantum groups and integrable systems
QCD & Collider Physics	Low-Energy Dynamics of Nuclear Systems	Strongly correlated systems	Supersymmetry
Heavy and Exotic Hadrons	Quantum Few-Body Systems	Contemporary problems of statistical physics	Quantum gravity, cosmology and strings
Hadron matter at extreme conditions	Relativistic Nuclear Physics	QFT Methods in Condenced matter	
Neutrino Physics			

BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS

Scientific Staff: 248

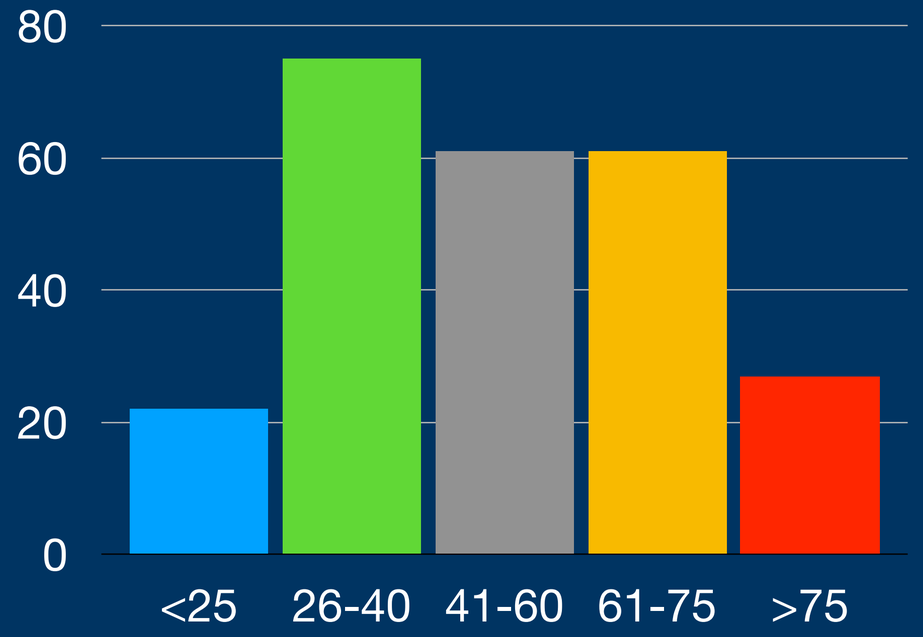
- Doctor of science — 98
- Candidate of science — 102
- Graduate and Post-graduate students — 35

- Russian Federation - 186
- Kazakhstan - 10
- Vietnam - 7
- Belarus - 6
- Romania - 5
- Armenia - 4
- Egypt - 4
- India - 4 ❄
- Slovakia - 4
- Bulgaria - 3
- Poland - 2 ❄

- Azherbadjan - 1
- Brasil - 1 ❄
- Germany - 1 ❄
- Iran - 1 ❄
- Japan - 1 ❄
- Mongolia - 1
- Pakistan -1 ❄
- South Korea- 1 ❄
- Tadzhikistan - 1 ❄

❄ - Non-member state

Age distribution



BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS

SCIENTIFIC ACTIVITY

	2019	2020	2021	2022	2023	2024*	Total
Journal Papers	308	370	285	305	335	**350**	**1953**
Proceedings	193	155	90	97	95	**85**	**715**
Monographs	4	1	0	2	2	2	**11**
Organized Conferences	11	0	3	7	8	7	**36**
Organized Schools	4	0	1	2	2	3	**12**
Seminars	77	90	92	76	96	89	**520**
Grants RFBR individual	15	16	6	3	1	0	-----
Grants RSF	3	3	3	5	7	7	-----
Grants Basis		2		2		2	

Thesis Defence: Since 2020

- Candidate of Science ~ 28
- Doctor of Science ~ 15

BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS

Meetings in BLTP

2018

January 29 - February 2
XIVth Winter School on Theoretical Physics
Partition Functions and Automorphic Forms

April 16 - 18
II International Workshop
Simulations of HIC for NICA energies

April 18 - 19
Colloqium on
Nonequilibrium phenomena in strongly correlated systems

May 27 - June 2, Roshchino, Valdai District, Russia
20th International Seminar on
High Energy Physics "Quarks-2018"

June 3 - 9, Bourgas, Bulgaria
International Conference
Nuclear Structure and Related Topics (NSRT18)

July 9 - 12
International workshop
Low Dimensional Materials: Theory, Modelling and Experiment

July 9 - 13, Prague, Czech Republic
The 32nd International Colloquium on
Group Theoretical Methods in Physics

July 22 – August 1
Helmholtz International Summer School
Modern Colliders - Theory and Experiment 2018
and Workshop
Calculations for Modern and Future Colliders

August 5 - 10
International School Advanced Methods of Modern Theoretical Physics:
Integrable and Stochastic Systems

August 13 - 16
International Workshop
Supersymmetry in Integrable Systems (SIS'18)

August 20 - 31
Helmholtz International Summer School
Matter under Extreme Conditions in Heavy-Ion Collisions and Astrophysics

August 27 - 31, Peterhof, Russia
VI International Conference
Models in Quantum Field Theory (MQFT-2018)
in memory of prof. A.N. Vasiliev

September 2 - 7, Saint-Petersburg, Russia
BLTP/JINR - KLFTP/CAS Joint Workshop
Physics of Strong Interacting Systems

September 4 - 6
II International Workshop
Lattice and Functional Techniques for Exploration of Phase Structure and Transport Properties in Quantum Chromodynamics

September 17 - 22
The XXIV International Baldin Seminar on High Energy Physics Problems
Relativistic Nuclear Physics and Quantum Chromodynamics

October 8 - 11, INR RAS, Moscow, Russia
XV International Seminar on
Electromagnetic Interactions of Nuclei (EMIN-2018)

November 4 - 9, Somerset West, South Africa
5th South Africa - JINR Symposium
Advances and Challenges in Physics within JINR and South Africa

2019

January 28 - February 1
XV Winter School on Theoretical Physics
Complex Systems and Advanced Materials

March 20 - 22
International Workshop
Infinite and finite nuclear matter

June 2 - 8
XIV International Workshop
Particle Correlations and Femtoscopy (WPCF2019)

July 14 - 20
BLTP/JINR - APCTP/Korea Joint Workshop
Modern problems in nuclear and elementary particle physics

July 8 - 12, Prague, Czech Republic
The XXVIth International Conference on
Integrable Systems and Quantum Symmetries

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

July 28 - August 2
International School
Advanced Methods of Modern Theoretical Physics: Integrable and Stochatic Systems

August 4 - 17
Helmholtz International Summer School
Cosmology, Strings, New Physics

August 26 - 31, Yerevan, Armenia
International Workshop
Supersymmetries and Quantum Symmetries (SQS19)

September 1 - 10, Sinaia, Romania
VIIIth International Pontecorvo
Neutrino Physics School

September 2 - 7
XVIIIth International Workshop on
High Energy Spin Physics (DSPIN-19)

September 9 - 13
International Bogolyubov Conference
Problems of Theoretical and Mathematical Physics
(dedicated to the 110th anniversary of the birth of N.N. Bogolyubov (1909-1992))

September 16 - 19
II International workshop
Theory of Hadronic Matter under Extreme Conditions

September 22 – 28, Varna, Bulgaria
XXIII International School on
Nuclear Physics, Neutron Physics and Applications

October 27 - November 1, Guangzhou, China
BLTP/JINR - KLTP/CAS Joint Workshop
Physics of Strong Interacting Systems

BOGOLIUBOV ETICAL PHYSICS

2018

January 29 - February 2
XIVth Winter School on Theoretical Physics
Partition Functions and Automorphic Forms

April 16 - 18
II International Workshop
Simulations of HIC for NICA energies

April 18 - 19
Colloqium on
Nonequilibrium phenomena in strongly correlated systems

May 27 - June 2, Roshchino, Valdai District, Russia
20th International Seminar on
High Energy Physics "Quarks-2018"

June 3 - 9, Bourgas, Bulgaria
International Conference
Nuclear Structure and Related Topics (NSRT18)

July 9 - 12
International workshop
Low Dimensional Materials: Theory, Modelling and Experiment

July 9 - 13, Prague, Czech Republic
The 32nd International Colloquium on
Group Theoretical Methods in Physics

July 22 – August 1
Helmholtz International Summer School
Modern Colliders - Theory and Experiment 2018
and Workshop
Calculations for Modern and Future Colliders

August 5 - 10
International School Advanced Methods of Modern Theoretical Physics:
Integrable and Stochastic Systems

August 13 - 16
International Wo
Supersymmetry

August 20 - 31
Helmholtz Intern
Matter under E
Heavy-Ion Colli

August 27 - 31,
VI International
Models in Quan
in memory of pr

September 2 - 7,
BLTP/JINR - KL
Physics of Stron

September 4 - 6
II International
Lattice and Fur
Exploration of
Properties in Q

September 17 - 2
The XXIV Intern
on High Energy
Relativistic Nuc
Chromodynami

October 8 - 11,
XV International
Electromagnetic
(EMIN-2018)

November 4 - 9,
5th South Africa
Advances and Challenges in Physics within JINR and South Africa



2019

ical Physics
nced Materials

atter

emtoscopy

Joint Workshop
r and

epublic
nference on
antum

mer School
he Limits: from
rks

ern Theoretical
chatic Systems

mer School
ysics

August 26 - 31, Yerevan, Armenia
International Workshop
Supersymmetries and Quantum Symmetries (SQS19)

September 1 - 10, Sinaia, Romania
VIIIth International Pontecorvo
Neutrino Physics School

September 2 - 7
XVIIIth International Workshop on
High Energy Spin Physics (DSPIN-19)

September 9 - 13
International Bogolyubov Conference
Problems of Theoretical and Mathematical Physics
(dedicated to the 110th anniversary of the birth of N.N. Bogolyubov (1909-1992))

September 16 - 19
II International workshop
Theory of Hadronic Matter under Extreme Conditions

September 22 – 28, Varna, Bulgaria
XXIII International School on
Nuclear Physics, Neutron Physics and Applications

October 27 - November 1, Guangzhou, China
BLTP/JINR - KLTP/CAS Joint Workshop
Physics of Strong Interacting Systems

BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS

Meetings in BLTP

2020

May 18 - 22, Almaty, Kazakhstan
International Conference
Astroparticle and Nuclear Physics

June 7 - 13, Pereslavl-Zalessky, Russia
The 21st International Seminar on High Energy Physics **Quarks-2020**

June 29 - July 3
International Conference
Low Dimensional Materials: Theory, Modelling and Experiment

July 6 - 10, Prague, Czech Republic (postponed to 2021)
The XXVIIth International Conference on
Integrable Systems and Quantum Symmetries

July 13 - 18, Yeosu, Republic of Korea
14thInternational Workshop
Modern problems in nuclear and elementary particle physics

July 20 - 24, Yerevan, Armenia (postponed to 2021)
XVIIIth International Conference
Symmetry Methods in Physics (SYMPHYS)

July 26 - 31, Gyumri, Armenia
BLTP/JINR - KLTP/CAS Joint Workshop
Physics of Strong Interacting Systems

July 26 - 31
International School
Advanced Methods of Modern Theoretical Physics: Integrable and Stochatic Systems

August 16 - 26 (postponed to 2021)
Helmholtz International Summer School
Matter under Extreme Conditions in Heavy-Ion Collisions and Astrophysics

August 27 - September 5 (postponed to 2021)
Helmholtz International Summer School
Hadron Structure, Hadron Matter and Lattice QCD

August 31 - September 4, Saint-Petersburg, Russia
The 7th International Conference
Models in Quantum Field Theory
dedicated to the 80-th anniversary of professor A.N.Vasiliev

August 31 - September 3
III International Workshop
Lattice and Functional Techniques for QCD

September 14 - 19 (postponed to 2021)
XXVth International Baldin Seminar
Relativistic Nuclear Physics and Quantum Chromodynamics

September 21 - 25
II International Workshop
Infinite and Finite Nuclear Matter (INFINUM-2020)

September 21 - 25, Khabarovsk, Russiai (postponed to 2022)
IVth International Workshop on
Few-Body Systems

October 22
Workshop (in Russian)
Dark Matter: theoretical proposals and experimental searches

2021

February 1 - 7
XVI DIAS-TH BLTP Winter School on Theoretical Physics
Actual Cosmology

July 12 - 17
International Conference
Low Dimensional Materials: Theory, Modelling and Experiment (LDM2021)

August 1 - 6 **(postponed to 2022)**
International School
Advanced Methods of Modern Theoretical Physics:
Integrable and Stochatic Systems

August 22 - 27
International Workshop
Geometry, Integrability and Supersymmetry (GIS21)

September 6-11 **(postponed to 2022)**
International Workshop
Supersymmetries and Quantum Symmetries - SQS'21

October 11 - 14
International Conference
Advances in Quantum Field Theory

October 11 - 15, Prague, Czech Republic **(postponed to 2022)**
The XXVIIth International Conference
Integrable Systems and Quantum Symmetries

BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS

2020

May 18 - 22, Almaty, Kazakhstan
International Conference
Astroparticle and Nuclear Physics

June 7 - 13, Pereslavl-Zalessky, Russia
The 21st International Seminar on High Energy Physics **Quarks-2020**

June 29 - July 3
International Conference
Low Dimensional Materials: Theory, Modelling and Experiment

July 6 - 10, Prague, Czech Republic
(postponed to 2021)
The XXVIIth International Conference on **Integrable Systems and Quantum Symmetries**

July 13 - 18, Yeosu, Republic of Korea
14thInternational Workshop
Modern problems in nuclear and elementary particle physics

July 20 - 24, Yerevan, Armenia
(postponed to 2021)
XVIIIth International Conference
Symmetry Methods in Physics (SYMPHYS)

July 26 - 31, Gyumri, Armenia
BLTP/JINR - KLTP/CAS Joint Workshop
Physics of Strong Interacting Systems

July 26 - 31
International School
Advanced Methods of Modern Theoretical Physics: Integrable and Stochatic Systems

August 16 - 26 (postponed
Helmholtz International Su
Matter under Extreme Co
Ion Collisions and Astrop

August 27 - September 5 (p
Helmholtz International Su
Hadron Structure, Hadro
QCD

August 31 - September 4, S
Russia
The 7th International Confe
Models in Quantum Field
dedicated to the 80-th anniv
A.N.Vasiliev

August 31 - September 3
III International Workshop
Lattice and Functional Te

September 14 - 19 (postpon
XXVth International Baldin
Relativistic Nuclear Physi
Chromodynamics

September 21 - 25
II International Workshop
Infinite and Finite Nuclea
(INFINUM-2020)

September 21 - 25, Khabar
(postponed to 2022)
IVth International Worksho
Few-Body Systems

October 22
Workshop (in Russian)
Dark Matter: theoretical
experimental searches



gust 22 - 27
rnational Workshop
ometry, Integrability and Supersymmetry
S21)

tember 6-11 **(postponed to 2022)**
rnational Workshop
persymmetries and Quantum Symmetries -
S'21

ober 11 - 14
rnational Conference
vances in Quantum Field Theory

ober 11 - 15, Prague, Czech Republic
stponed to 2022)
XXVIIth International Conference
egrable Systems and Quantum Symmetries

BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS

2022

Meetings in BLTP

January 31 - February 4
XVII International DIAS-BLTP Winter School
Supersymmetry and Integrability

April 24-30, Almaty, Kazakhstan
International Workshop on
Elementary Particles and Nuclear Physics

July 10 - 17, Yerevan, Armenia
XVIII International Conference
Symmerty Methods in Physics (SymPhys-XVIII)

July 18 - 21
International Conference on
Quantum Field Theory, High-Energy Physics, and Cosmology

July 24 - August 2
Dubna International Advanced School
Moscow International School of Physics 2022

August 8 - 13
International Workshop
Supersymmetries and Quantum Symmetries (SQS'22)

October 10—14, St.Petersburg
7-th International Conference
Models in Quantum Field Theory
Dedicated to 80-th anniversary of A.N.Vasiliev

October 17 - 22
International Conference
Modern problems of condensed matter theory

October 28—November 3, Cairo, Egypt
Workshop on ***Theoretical Physics***

BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS

2022

Meetings in BLTP

January 31 - February 4
XVII International DIAS-BLTP Winter School
Supersymmetry and Integrability

April 24-30, Almaty, Kazakhstan
International Workshop on
Elementary Particles and Nuclear Physics

July 10 - 17, Yerevan, Armenia
XVIII International Conference
Symmerty Methods in Physics (SymPhys-XVIII)

July 18 - 21
International Conference on
Quantum Field Theory, High-Energy Physics, and Cosmology

July 24 - August 2
Dubna International Advanced S
Moscow International School

August 8 - 13
International Workshop
Supersymmetries and Quantu (SQS'22)

October 10—14, St.Petersburg
7-th International Conference
Models in Quantum Field Theory
Dedicated to 80-th anniversary of A.N.Vasiliev

October 17 - 22
International Conference
Modern problems of condense

October 28—November 3, Cai
Workshop on ***Theoretical Ph***

International Conference

Quantum Field Theory • High-Energy Physics • Cosmology

18-21 July 2022 • BLTP JINR • Dubna

Tracks

- Quantum Field Theory and Gravity
- Collider Physics and 3D Hadron Structure
- QCD at high temperature and density
- Neutrino and Non-Accelerator Physics
- Dark matter and Cosmology

Organizing Committee

D. Kazakov (JINR) – co-chairman
V. Rubakov (INR RAS) – co-chairman
E. Boos (SINP MSU) – co-chairman
A. Bednyakov (JINR) – scientific secretary
A. Isaev (JINR)
D. Levkov (INR RAS)
A. Mukhaeva (JINR)
A. Pikelner (JINR)
M. Smolyakov (SINP MSU)

Plenary talks

-Progress in multiloop calculations
Roman Lee, BINP

-Recent results from LHC experiments
Alexey Myagkov, NRC KI-IHEP

-Progress in understanding of physics at high temperature and density
Andrei Leonidov, LPI RAS

-Neutrino oscillation results and search for neutrino sterile states
Alexander Olshevskiy, JINR

-High-energy neutrino astrophysics
Sergey Troitsky, INR RAS

-Dark Matter and Cosmology
Dmitry Gorbunov, INR RAS

-Gravitational-wave astronomy: astrophysical and cosmological inference
Kostantin Postnov, SAI MSU

Registration: https://indico.jinr.ru/e/qft2022 **Contacts:** qft@theor.jinr.ru



BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS

Meetings in BLTP

2023

February 20 - 22
JINR-Armenian Workshop
Supersymmetry in Integrable Systems (SIS'23)

February 27 - March 3
International Workshop
Infinite and Finite Nuclear Matter (INFINUM-2023)

March 20 - April 3, UC JINR
School on Physics of Quark-Gluon Matter

July 9 - 15, Pohang, Republic of Korea
BLTP/JINR - APCTP/Korea Joint Workshop
Modern Problems in Nuclear and Particle Physics

July 11 - 15
International Workshop
Superconducting and Magnetic Hybrid Structures

July 23 - 28
International School
Advanced Methods of Modern Theoretical Physics: Integrable and Stochastic Systems

September 3 - 9, Yerevan, Armenia
Joint BLTP JINR - KLTP CAS Workshop
Physics of Strong Interactions

September 4 - 8
XIX International Workshop
High Energy Spin Physics (DSPIN-23) dedicated to the 90-th anniversary of prof. A.V. Efremov

September 18 - 23
XXVth International Baldin Seminar on High Energy Physics Problems
Relativistic Nuclear Physics and Quantum Chromodynamics

October 17 - 18
International Seminar
Selected Problems in Quantum Field Theory dedicated to the memory of prof. E.A. Kuraev

2024

January 29 - February 3
DIAS-TH Winter School
Many-particle systems: from quarks to stars

February 11 - 17
International School
Nuclear Theory and Astrophysical Applications

February 19 - 23
International Workshop
Problems of the Modern Mathematical Physics – PMMP

April 1 - 5
Scientific session of Nuclear Physics section of Physics Division of RAS
Physics of Fundamental Interactions

May 20 - 24, Pereslavl-Zalessky
22th International Seminar on
High Energy Physics "Quarks-2024"

July 1 - 5
74th International Conference on Nuclear Physics
Nucleus-2024: Fundamental problems and applications

July 15 - 19
International Conference
Modern Problems of Condensed Matter Theory

July 21 - 26
International School
Advanced Methods of Modern Theoretical Physics: Integrable and Stochastic Systems

July 29 - August 3
International Workshop
Supersymmetries and Quantum Symmetries - SQS'24

September 29 - October 4, Khabarovsk
IV International School-Workshop on
Few-Body Systems

BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS

Meetings in BLTP

2023

February 20 - 22
JINR-Armenian Workshop
Supersymmetry in Integrable Systems (SIS'23)

February 27 - March 3
International Workshop
Infinite and Finite Nuclear Matter (INFINUM-2023)

March 20 - April 3, UC JINR
School on Physics of Quark-Gluon Matter

July 9 - 15, Pohang, Republic of Korea
BLTP/JINR - APCTP/Korea Joint Workshop
Modern Problems in Nuclear and Particle Physics

July 11 - 15
International Workshop
Superconducting and Magnetic Hybrid Structures

Jul
Int
Ad
Ph

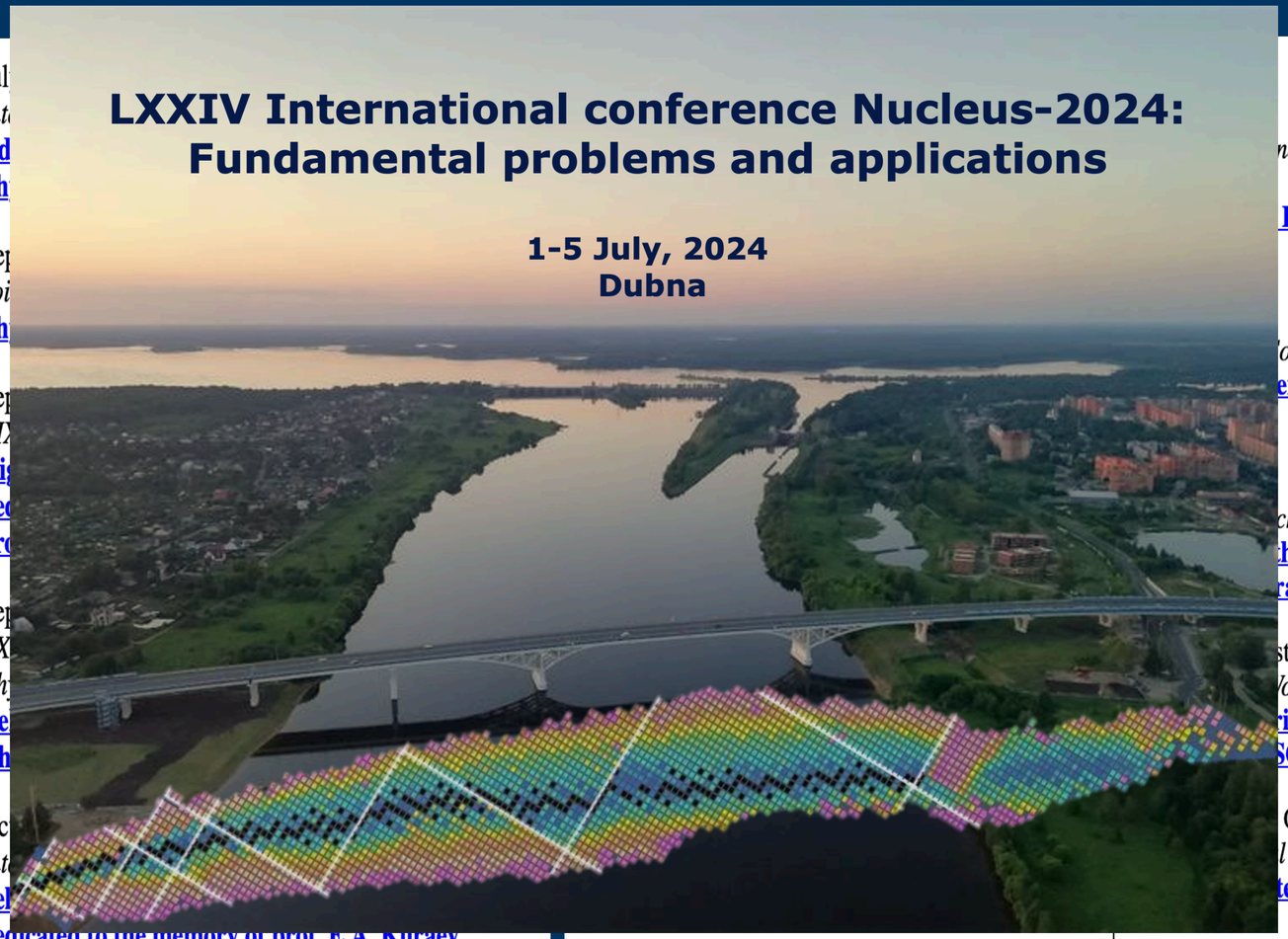
Sep
Joi
Ph

Sep
XI
Hig
dec
pro

Sep
XX
Ph
Re
Ch

Oc
Int
Sel
dedicated to the memory of prof. E.A. Kuraev

2024



nal Conference on Nuclear
Fundamental problems and

onference
ems of Condensed Matter

chool
hods of Modern Theoretical
rable and Stochastic Systems

st 3
Workshop
ries and Quantum
SQS'24

October 4, Khabarovsk
l School-Workshop on
tems

BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS

2025

Meetings in BLTP

February 10 - 14
International Workshop
Problems of Modern Mathematical Physics (PMMP25)

April 21 - 24
Workshop
Universal description of Lie algebras, Vogel theory, applications

May 12 - 16
International Workshop
Infinite and Finite Nuclear Matter (INFINUM-2025)

May 19 - 20
Workshop
Quantum and Low-Dimensional Magnetism

June 5
Workshop
Physics at future high-energy electron-positron collider

June 23 - 27
South Africa - JINR Workshop on
Theoretical and Computational Physics

June 30 - July 4
International School
Complex Systems and Advanced Material

July 7 - 10
International workshop
Superconducting and Magnetic Hybrid Structures

July 20 - 25
International School
Advanced Methods of Modern Theoretical Physics: Integrable and Stochastic Systems

August 8 - 9
Workshop
Interplay of gravity and strong interactions

August 11 - 15
International Conference
Advances in Quantum Field Theory (AQFT'25)

August 17 - 22, Almaty, Kazakhstan
BLTP/JINR - ITP/CAS Joint Workshop
Physics of Strong Interacting Systems

September 15 - 20
The XXVIth International Baldin Seminar on High Energy Physics Problems
Relativistic Nuclear Physics and Quantum Chromodynamics

October 20 - 24, Yerevan, Armenia
International Workshop
Symmetries: Bulgaria-Armenia-Dubna - SymBAD'25

BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS

2025

Meetings in BLTP

February 10 - 14
International Workshop
Problems of Modern Mathematical Physics (PMMP🔲25)

April 21 - 24
Workshop
Universal description of Lie algebras, Vogel theory, applications

May 12 - 16
International Workshop
Infinite and Finite Nuclear Matter (INFINUM-2025)

May 19 - 20
Workshop
Quantum and Low-Dimensional Magnetism

June 5
Workshop
Physics at future high-energy electron-positron collider

June 23 - 27
South Africa - JINR Workshop on
Theoretical and Computational Physics

June 30 - July 4
International School
Complex Systems and Advanced Material

July 7 - 10
Internat
Superco
Structu

July 20 -
Internat
Advanc
Physics:

August 8
Worksho
Interpla
interact

August
Internat
Advanc
(AQFT'

August
BLTP/JI
Physics

Septemb
The XX
High En
Relativi
Chromo

October
Internat
Symmet
SymBAD 25



BOGOLIUBOV LABORATORY OF THEORETICAL PHYSICS

2025

Meetings in BLTP

February 10 - 14
International Workshop
Problems of Modern Mathematical Physics (PMMP25)

April 21 - 24
Workshop
Universal description of Lie algebras, Vogel theory, applications

May 12 - 16
International Workshop
Infinite and Finite Nuclear Matter (INFINUM-2025)

May 19 - 20
Workshop
Quantum and Low-Dimensional Magnetism

June 5
Workshop
Physics at future high-energy electron-positron collider

June 23 - 27
South Africa - JINR Workshop on
Theoretical and Computational Physics

June 30 - July 4
International School
Complex Systems and Advanced Material

July 7 - 10
Internat
Superco
Structu

July 20 -
Internat
Advanc
Physics:

August 8
Worksho
Interpla
interact

August
Internat
Advanc
(AQFT'

August
BLTP/JI
Physics

Septemb
The XX
High En
Relativi
Chromo

October
Internat
Symmet
SymBAD 25





EDUCATIONAL ACTIVITY

January 30 - February 7
2nd Winter School on Theoretical Physics

Advanced Level

Dubna International Advanced School of Theoretical Physics

2022

January 31 - February 4
XVII International DIAS-BLTP Winter School
Supersymmetry and Integrability

July 24 - August 2
Dubna International Advanced School
Moscow International School of Physics 2022

2023

March 20 - April 3, UC JINR
School on Physics of Quark-Gluon Matter

July 23 - 28
International School
Advanced Methods of Modern Theoretical Physics: Integrable and Stochastic Systems

2024

January 29 - February 3
DIAS-TH Winter School
Many-particle systems: from quarks to stars

February 11 - 17
International School
Nuclear Theory and Astrophysical Applications

July 21 - 26
International School
Advanced Methods of Modern Theoretical Physics: Integrable and Stochastic Systems

EDUCATIONAL ACTIVITY

January 30 - February 7
[2nd Winter School on Theoretical Physics]

Advanced Level

Dubna International Advanced School of Theoretical Physics

2022

January 31 - February 4
XVII International DIAS-BLTP Winter School
Supersymmetry and Integrability

July 24 - August 2
Dubna International Advanced School
Moscow International School of Physics 2022

2025

March 20 - April 3, UC JINR
School on Physics of Quark-Gluon Matter

June 30 - July 4
International School
Complex Systems and Advanced Material

July 20 - 25
International School
Advanced Methods of Modern Theoretical Physics: Integrable and Stochastic Systems

July 23 - 28
International School
Advanced Methods of Modern Theoretical Physics: Integrable and Stochastic Systems

2024

January 29 - February 3
DIAS-TH Winter School
Many-particle systems: from quarks to stars

February 11 - 17
International School
Nuclear Theory and Astrophysical Applications

July 21 - 26
International School
Advanced Methods of Modern Theoretical Physics: Integrable and Stochastic Systems

EDUCATIONAL ACTIVITY

Basic Level

Chair of
Fundamental and applied problems of microworld physics
Head. Prof. D.Kazakov

Chair of
Elementary particle physics
Head. Prof. V.Matveev

Chair of
Fundamental problems of microworld physics
Head. Prof. A.Arbuzov

State University DUBNA

Department of Natural and Engineering sciences

Al-Farabi Kazakh National University, Almaty, Kazakhstan



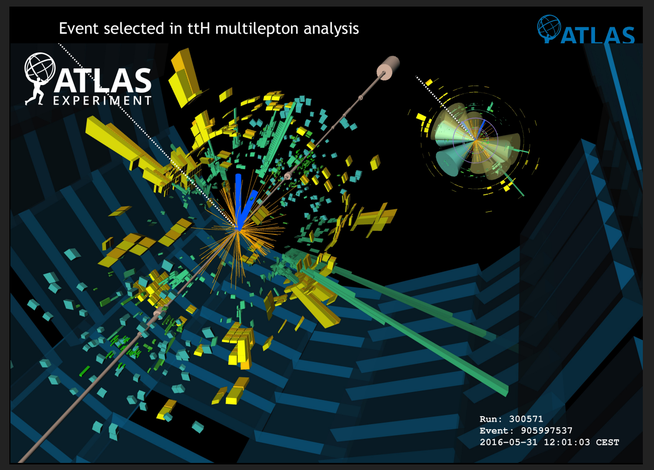
University of Pavol Jozef Safarik, Kosice, Slovakia

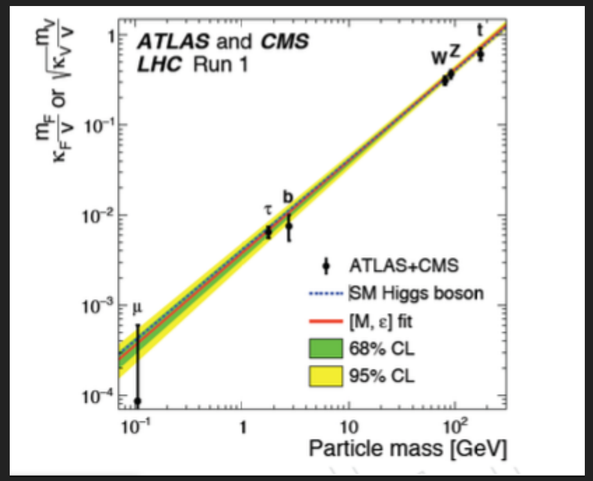
PARTICLE PHYSICS: MAIN EFFORTS

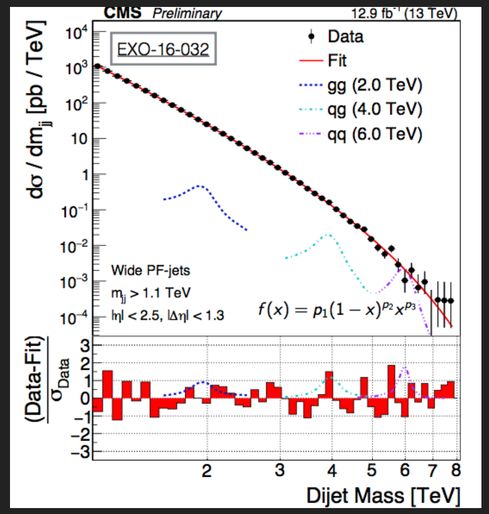
- LHC related physics/New physics BSM

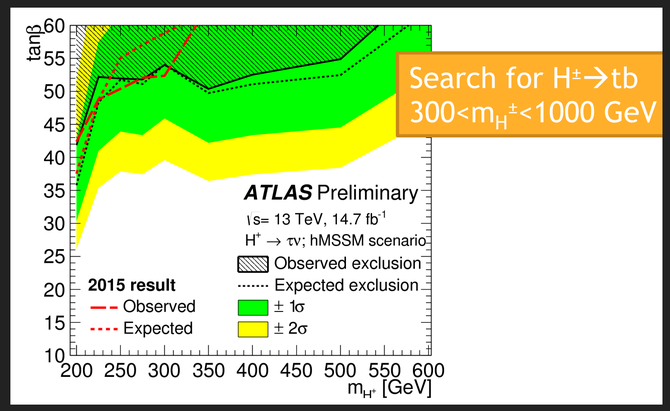
PARTICLE PHYSICS: MAIN EFFORTS

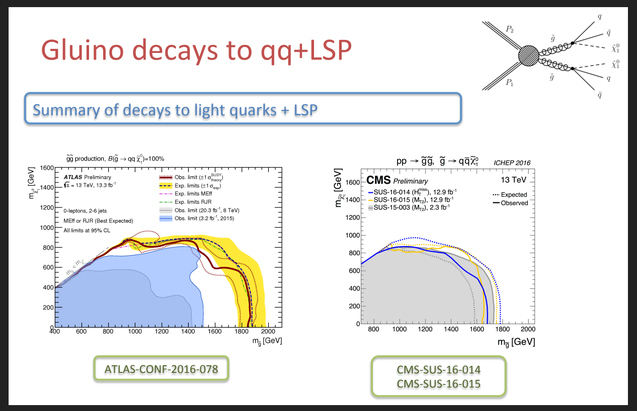
- LHC related physics/New physics BSM

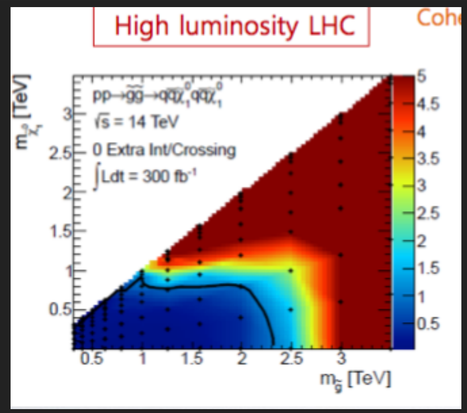






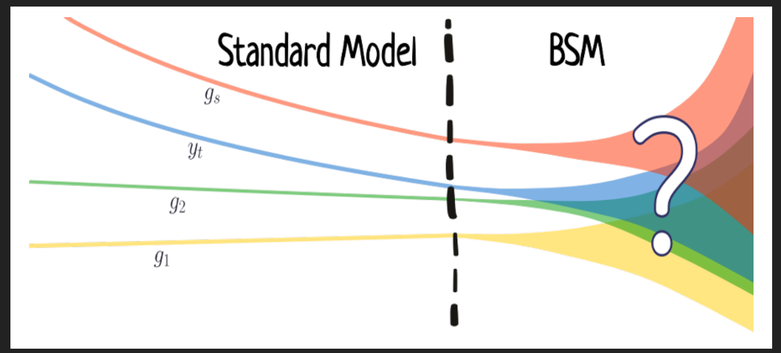






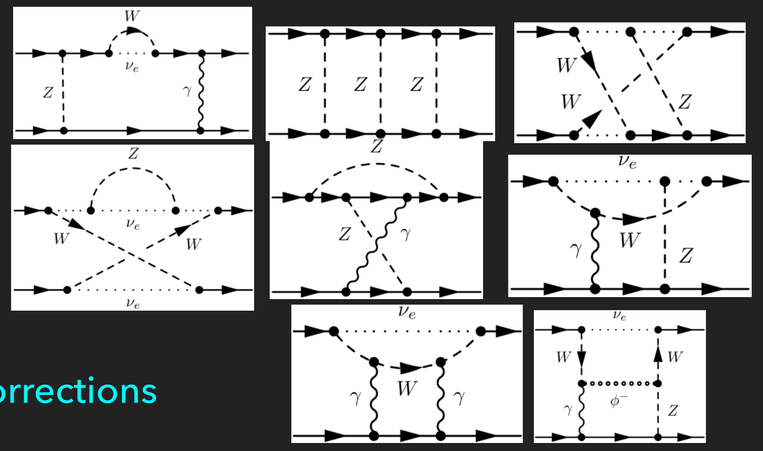
PARTICLE PHYSICS: MAIN EFFORTS

- LHC related physics/New physics BSM
- Multiloop/leg calculations and precision physics



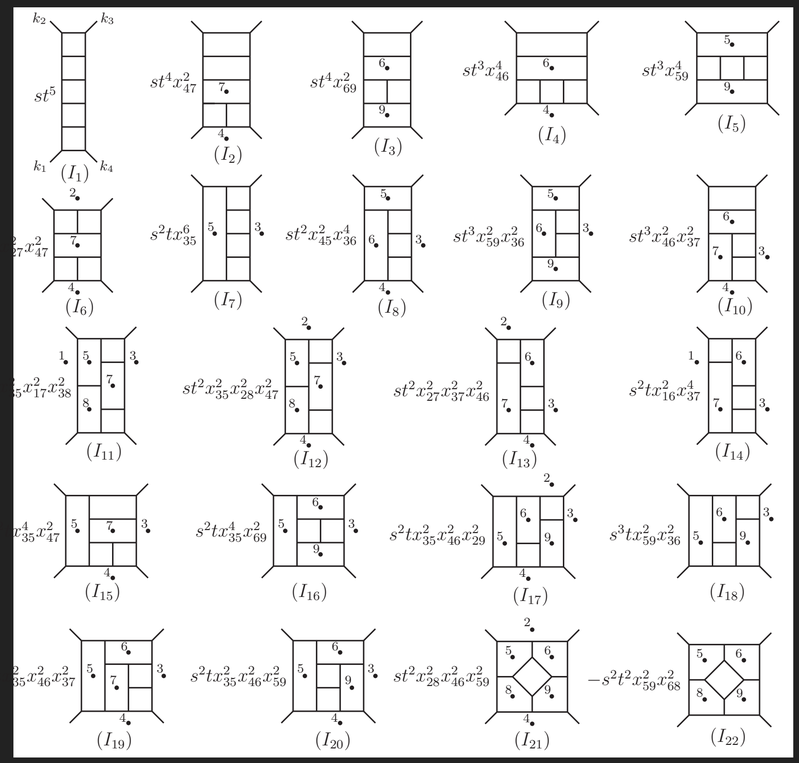
PARTICLE PHYSICS: MAIN EFFORTS

- LHC related physics/New physics BSM
- Multiloop/leg calculations and precision physics

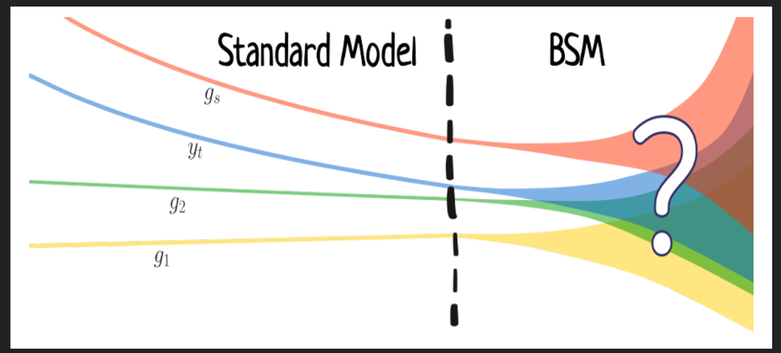


D-Y corrections

Amplitudes in SYM Theories



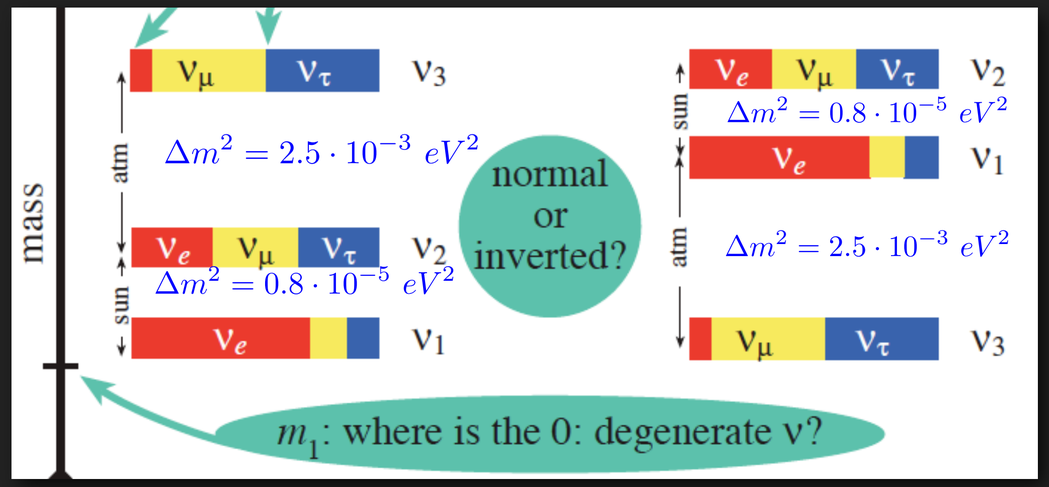
State-of-the-art RG calculations:
from the Standard Model to New Physic



PARTICLE PHYSICS: MAIN EFFORTS

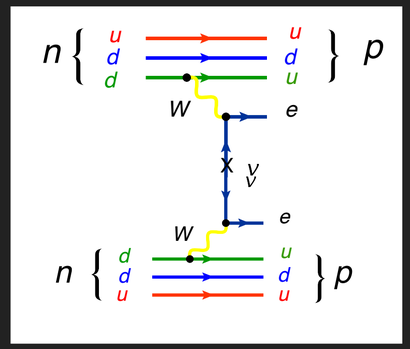
- LHC related physics/New physics BSM
- Multiloop/leg calculations and precision physics
- Neutrino physics

Mass hierarchy



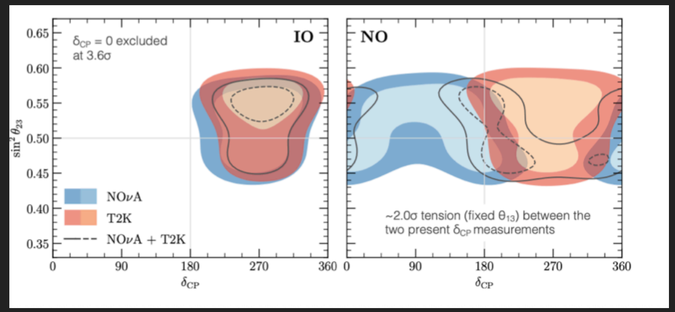
Dirac or Majorana

0νββ decay



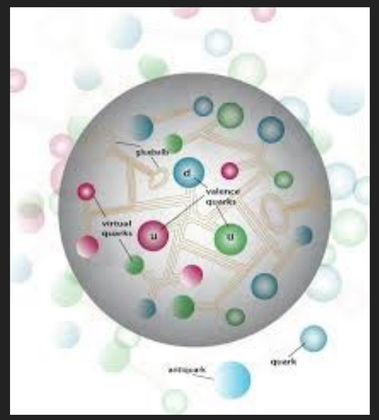
Only Majorana

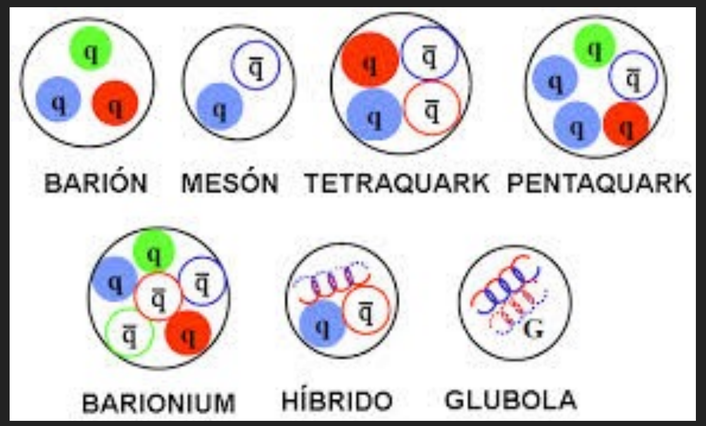
Neutrino mass ordering and CP violation

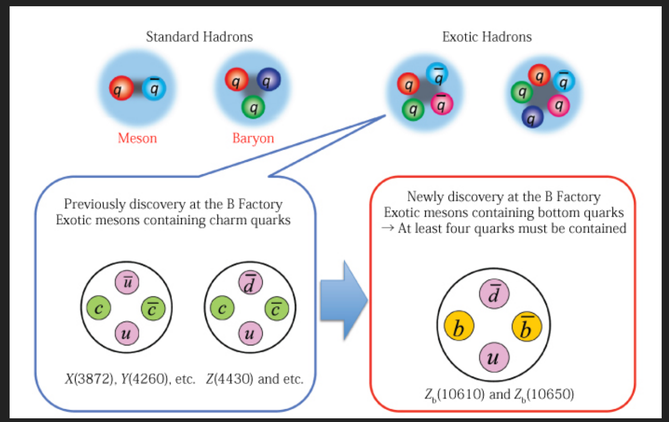


PARTICLE PHYSICS: MAIN EFFORTS

- LHC related physics/New physics BSM
- Multiloop/leg calculations and precision physics
- Neutrino physics
- Exotic hadrons/Confinement



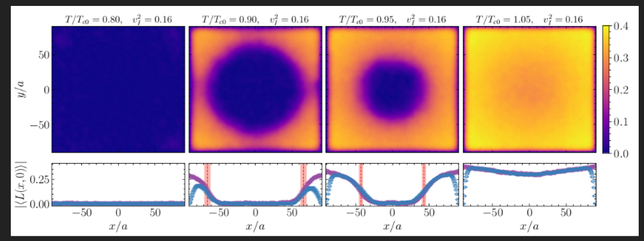


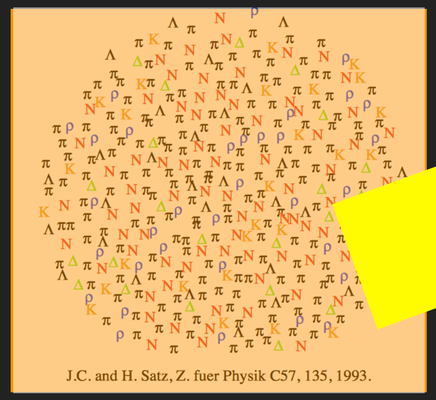


PARTICLE PHYSICS: MAIN EFFORTS

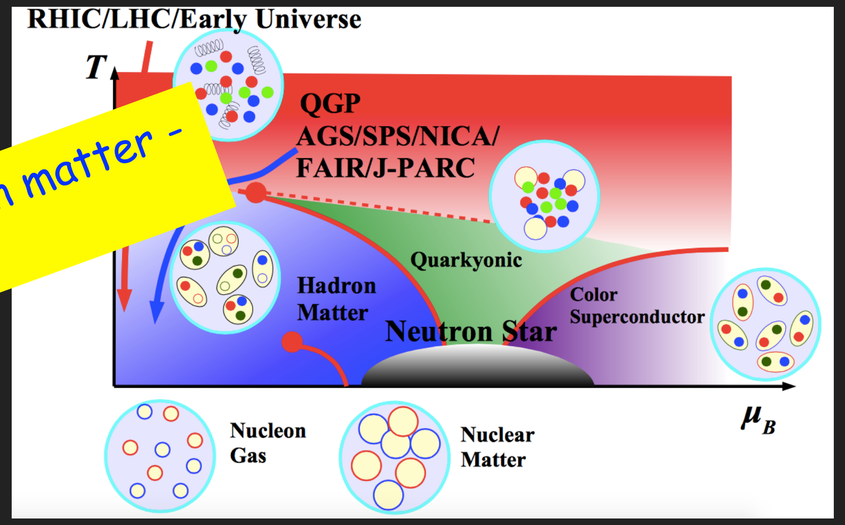
- LHC related physics/New physics BSM
- Multiloop/leg calculations and precision physics
- Neutrino physics
- Exotic hadrons/Confinement
- Hadronic matter at extreme conditions/Heavy Ions

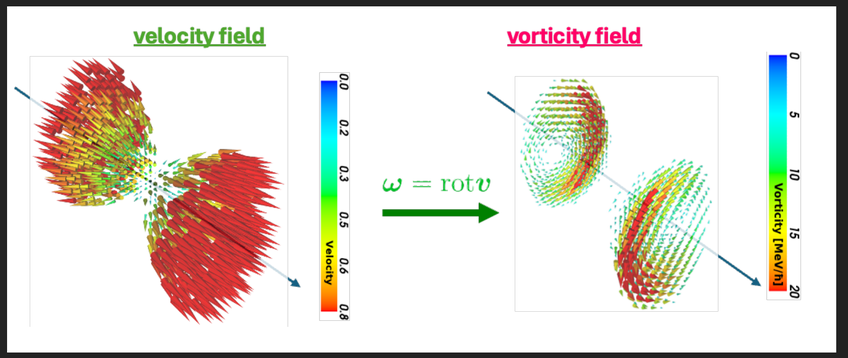
New Mixed Inhomogeneous Phase in Vortical Gluon Plasma





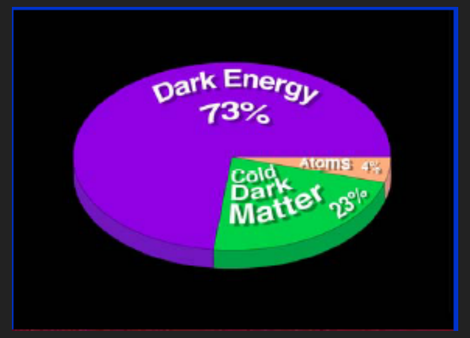
Dense hadron matter - new phase?

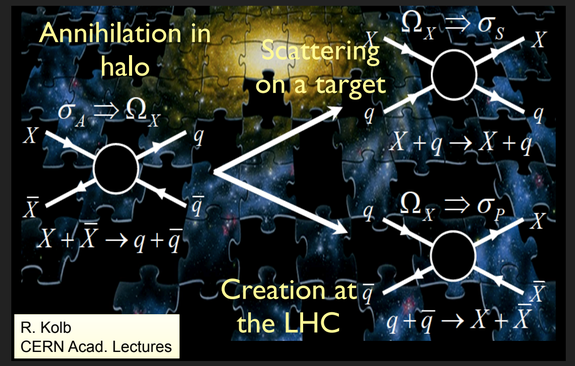


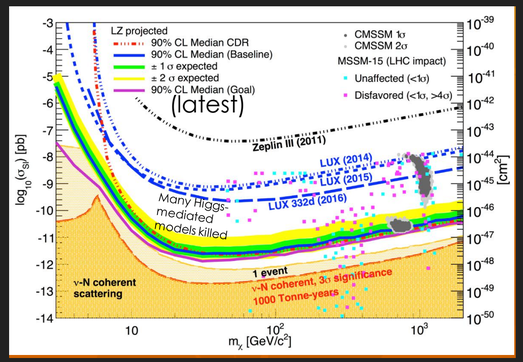


PARTICLE PHYSICS: MAIN EFFORTS

- LHC related physics/New physics BSM
- Multiloop/leg calculations and precision physics
- Neutrino physics
- Exotic hadrons/Confinement
- Hadronic matter at extreme conditions/Heavy Ions
- Cosmology & Astrophysics/Dark Matter

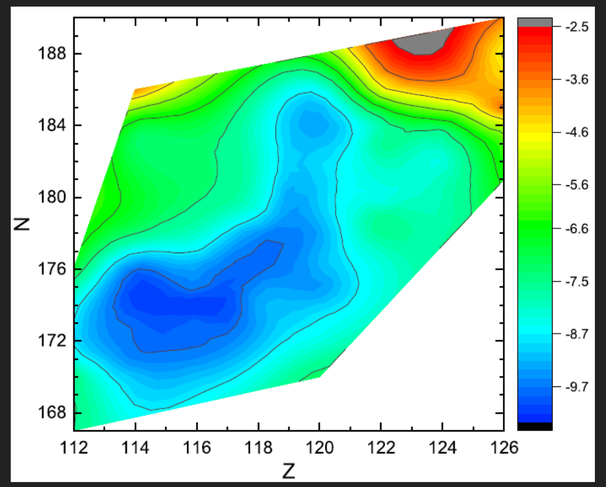




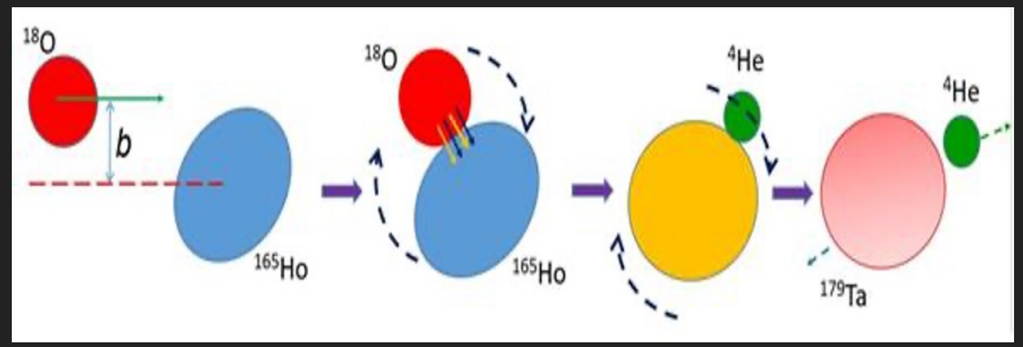


NUCLEAR PHYSICS: MAIN EFFORTS

- Superheavy nuclei



The sketch of the incomplete fusion mechanism as a very asymmetric quasifission in the case of the $^{18}O+^{93}Nb$ reaction.

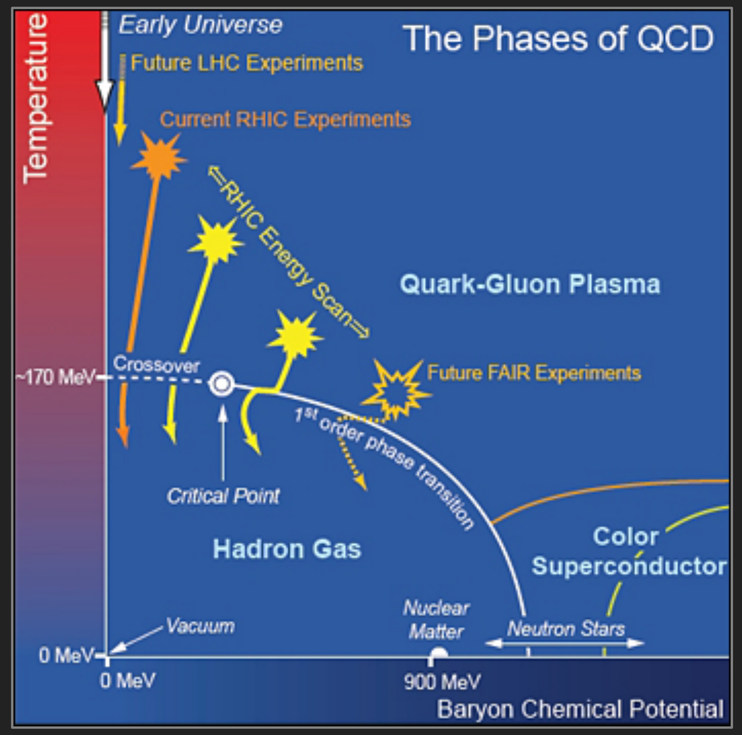


New isotopes of heaviest nuclei with Z=112 - 117 can be synthesized in ^{48}Ca-induced actinide-based fusion reactions with emission of charged particles.

Shaping the archipelago of stability by the competition of proton or and neutron shell clustersıo The new kind of shell dynamics is most clearly seen in the shift of the proton shell closures from Z=114 to Z=120 when increasing the neutron number from N=174 to N=184.

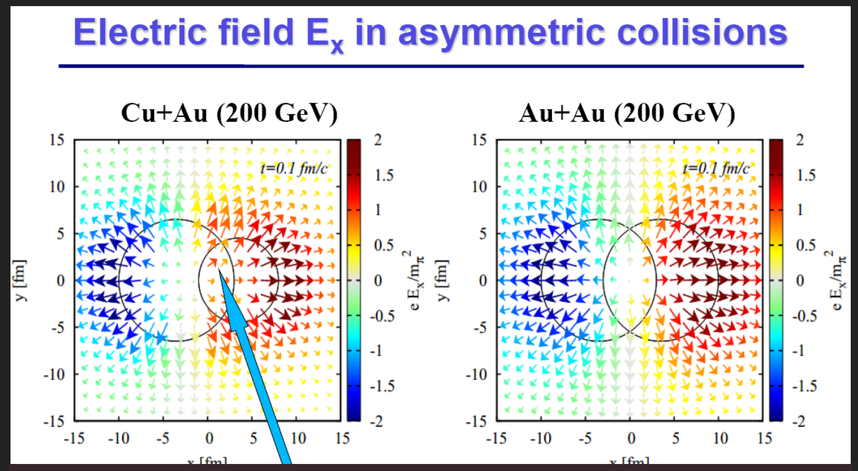
NUCLEAR PHYSICS: MAIN EFFORTS

- Superheavy nuclei
- Heavy ion collisions (NICA)



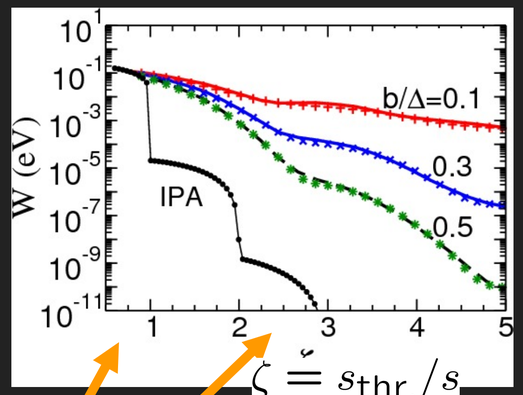
Hydrodynamical approach:
Elliptic flow
Freeze-out scenario
Strong electromagnetic fields in HIC

Study of multiplicity of hadron distributions in relativistic nuclei collisions NICA in order to find a signal of possible phase transitions



NUCLEAR PHYSICS: MAIN EFFORTS

- Superheavy nuclei
- Heavy ion collisions (NICA)
- Non-linear processes in high intensity magnetic fields



Peculiarities of nuclei interactions in strong E-M fields

$$\gamma + Laser \rightarrow e^+ + e^-$$

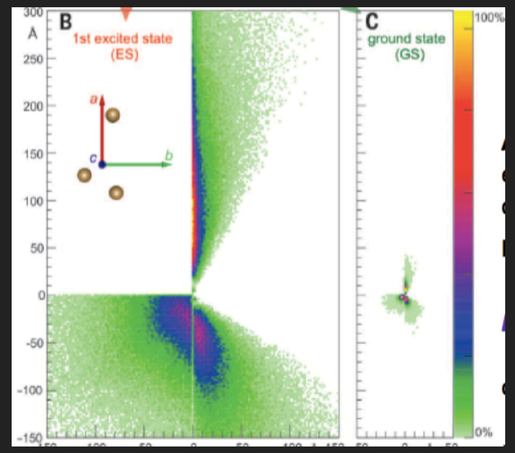
The short pulses "generate" high momentum components which produce a great amplifier effect for the multi-photon, sub-threshold events. Enhancement may reach many orders of magnitude depending on field intensity and the beam shape

Above-threshold region $s \geq s_{thr.}(\zeta \leq 1)$

Sub-threshold region $s < s_{thr.}(\zeta > 1)$

NUCLEAR PHYSICS: MAIN EFFORTS

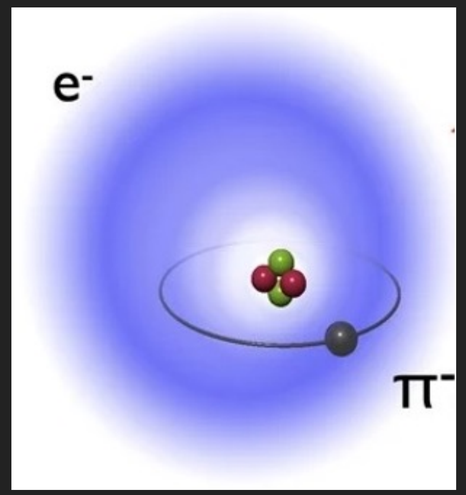
- Superheavy nuclei
- Heavy ion collisions (NICA)
- Non-linear processes in high intensity magnetic fields
- Three-body clusters in atomic collisions

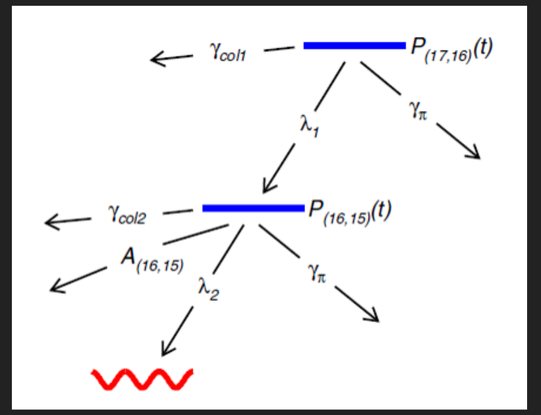


Structure of exited and ground states of 4He_3

Search for a possibility of geometric resonances in atomic systems in the process of tunneling fusion of composite quantum suystems

Efimov bound states of three identical bosons. First examples: trimers of He_3

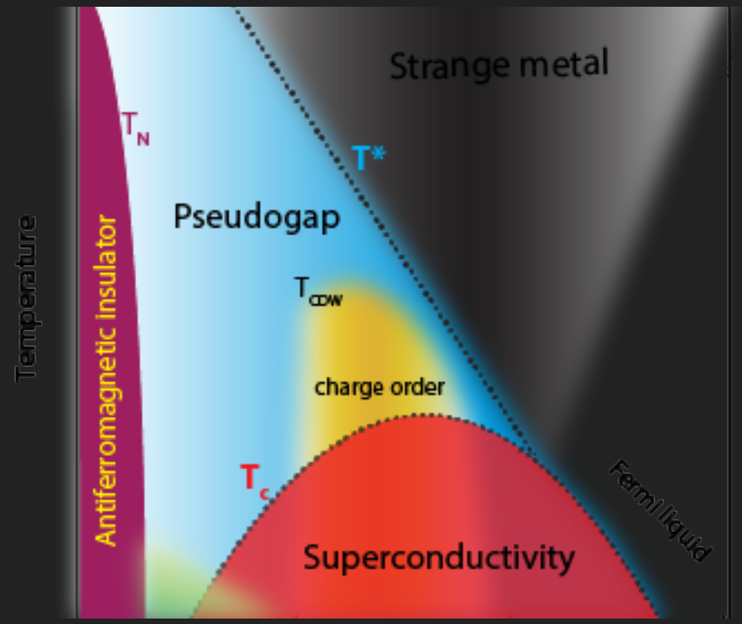




Precision physics: Pionic Helium

CONDENSED MATTER PHYSICS: MAIN EFFORTS

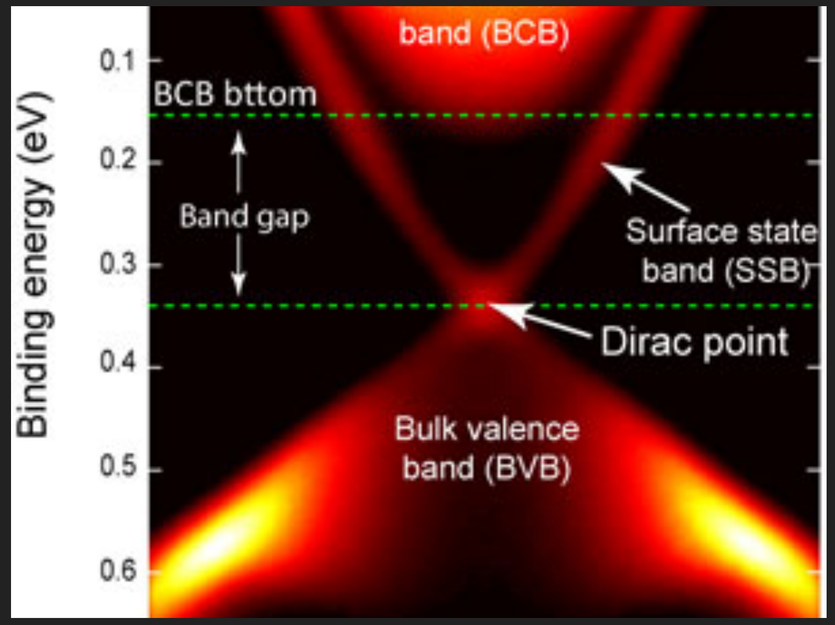
- high-temperature superconductors

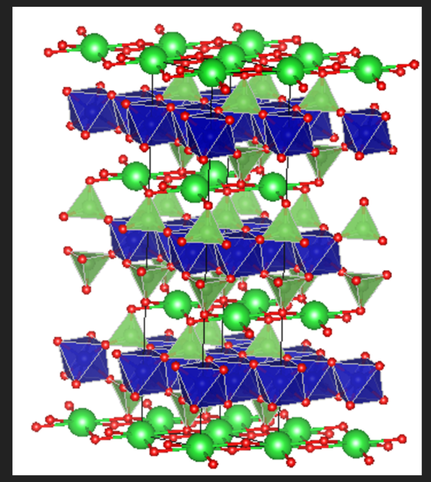


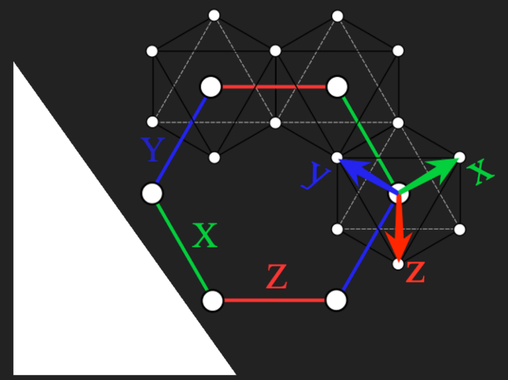
The properties of cuprate high temperature superconductors are tuned by 'doping' in holes or electrons

CONDENSED MATTER PHYSICS: MAIN EFFORTS

- high-temperature superconductors
- topological insulators





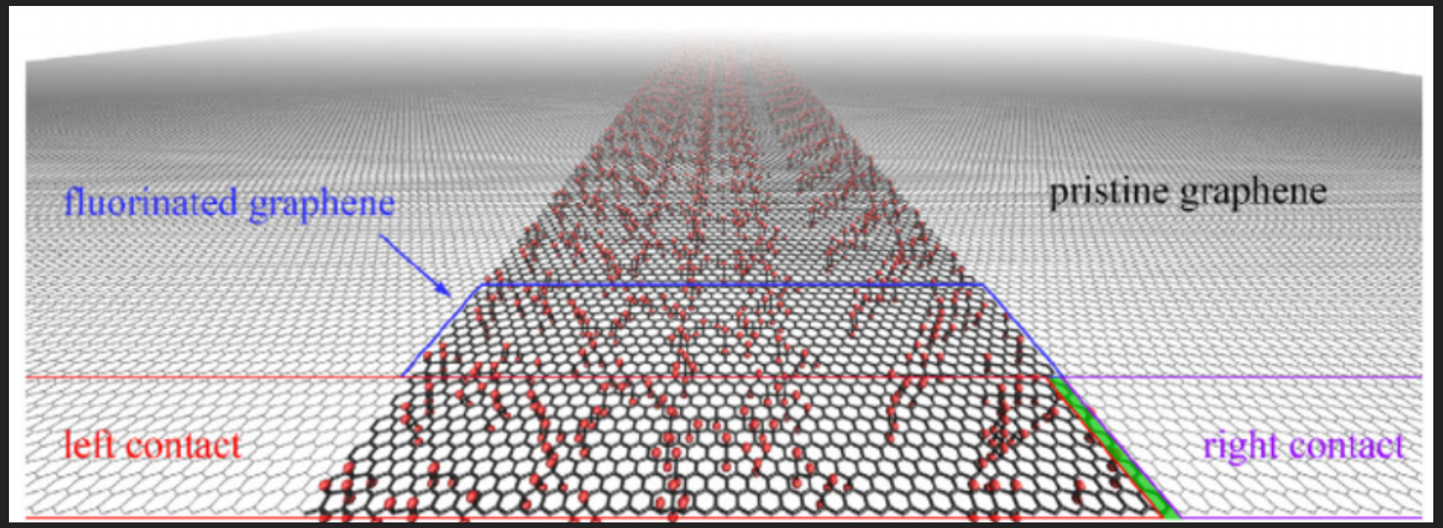


The general electronic structure of bulk and surface states in several prototypical topological insulators

CONDENSED MATTER PHYSICS: MAIN EFFORTS

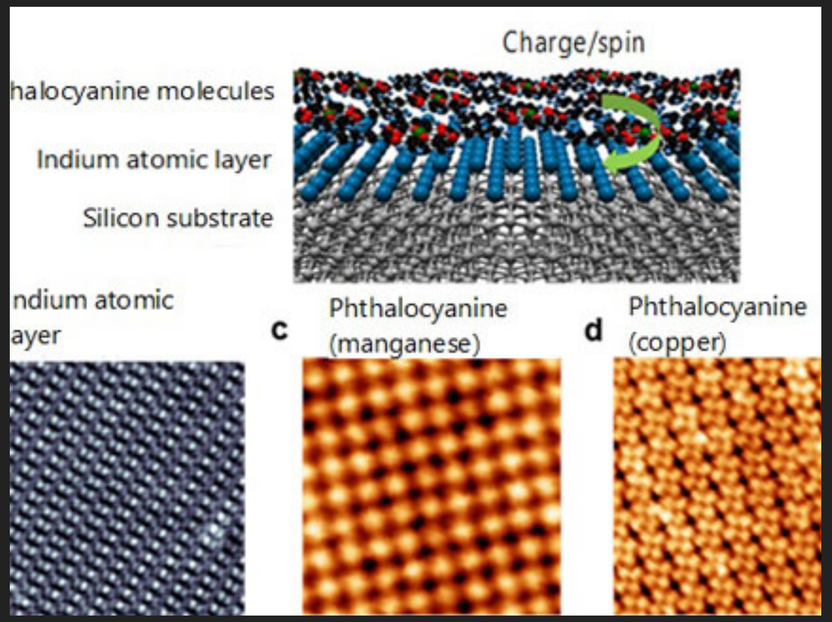
- high-temperature superconductors
- topological insulators
- low dimensional quantum magnetics

Effects of grain boundaries and defects on anisotropic magnon transport in textured $Sr_{14}Cu_{24}O_{41}$



CONDENSED MATTER PHYSICS: MAIN EFFORTS

- high-temperature superconductors
- topological insulators
- low dimensional quantum magnetics
- layered superconductors and nanostructures



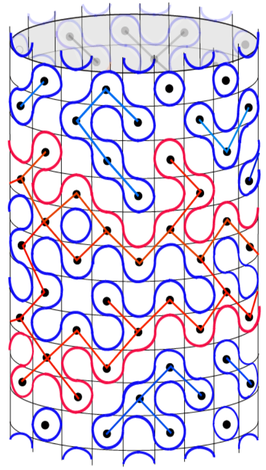
a) Schematic diagram of a heterostructure comprising organic molecules and a superconducting atomic layer. (b)-(d) Scanning tunneling microscope images of samples. (b) Indium atomic layer (superconducting layer). (c) Phthalocyanine molecular layer grown on the indium atomic layer (manganese atom at the center of each molecule). (d) Phthalocyanine molecular layer grown on the indium atomic layer (copper atom at the center of each molecule)

CONDENSED MATTER PHYSICS: MAIN EFFORTS

- high-temperature superconductors
- topological insulators
- low dimensional quantum magnetics
- layered superconductors and superconducting nanostructures
- exactly solvable random walk models

Logarithmic conformal theory

Noncontractible loops in the dense O(n) polymer model



$$\nu_c(2N) = \frac{3\Gamma\left(\frac{N}{2}\right)\Gamma\left(\frac{3N}{2}+\frac{1}{2}\right)}{4\Gamma\left(\frac{3N}{2}\right)\Gamma\left(\frac{N+1}{2}\right)} + \frac{\pi^2 2^{-2N} 3^{2-3N}\Gamma(3N)}{\Gamma\left(\frac{N}{2}+\frac{1}{6}\right)^2\Gamma\left(\frac{N}{2}+\frac{5}{6}\right)^2\Gamma(N)} - \frac{5}{2}$$

$$= \frac{1}{8}, \frac{17}{160}, \frac{913}{8960}, \frac{3953}{39424}, \frac{14569}{146432}, \frac{3945737}{39829504}, \ldots$$

$$\nu_{nc}(2N) = \frac{2^{2(N-2)}\Gamma(N)}{N\pi^2\Gamma(3N)}\left(3^{3N}\Gamma\left(\frac{N}{2}+\frac{1}{6}\right)^2\Gamma\left(\frac{N}{2}+\frac{5}{6}\right)^2 - \frac{12\pi^2\Gamma\left(\frac{3N}{2}\right)^2}{\Gamma\left(\frac{N}{2}\right)^2}\right)$$

$$= \frac{1}{8}, \frac{11}{320}, \frac{421}{26880}, \frac{1403}{157696}, \frac{4189}{732160}, \frac{952067}{238977024}, \ldots$$

MATHEMATICAL PHYSICS: MAIN EFFORTS

- Inregrable systems in higher dimensions/gauge theories

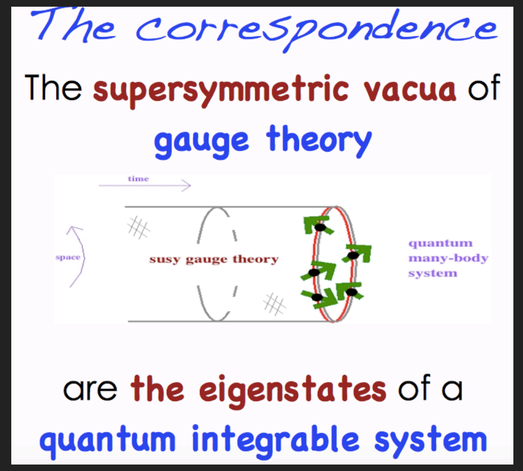
SuperSymmetry - extension of Lorentz invariance of relativistic theory

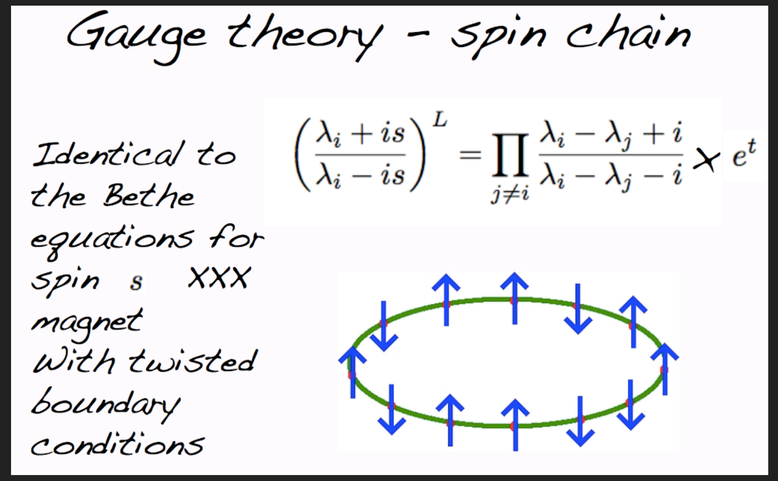
$$Q\,|\,boson>=|\,fermion> \qquad Q\,|\,fermion>=|\,boson>$$

$$[b,b]=0, \quad \{f,f\}=0 \Rightarrow$$

$$\{Q^i_\alpha, \overline{Q}^j_{\dot\beta}\} = 2\delta^{ij}(\sigma^\mu)_{\alpha\dot\beta}P_\mu$$

Extended SUSY is believed to be a unique exactly solvable QFT. The only self-consistent off-shell superfield formalism for extended super- symmetries was discovered in BLTP and is called the Harmonic Superspace Approach





MATHEMATICAL PHYSICS: MAIN EFFORTS

- Inregrable systems in higher dimensions/gauge theories
- Conformal field theory beyond 2 dimensions

N=4 D=4 Supersymmetric Yang-Mills Theory

$$L = \mathrm{tr}\left\{ -\frac{1}{2g^2} F_{\mu\nu} F^{\mu\nu} + \frac{\theta_I}{8\pi^2} F_{\mu\nu} \tilde{F}^{\mu\nu} - i\bar{\lambda}^a \bar{\sigma}^\mu D_\mu \lambda_a - D_\mu X^i D^\mu X^i + g C_i^{ab} \lambda_a [X^i, \lambda_b] + g \bar{C}_{iab} \bar{\lambda}^a [X^i, \bar{\lambda}^b] + \frac{g^2}{2} [X^i, X^j]^2 \right\}$$

Follows from compactification of N=1 D=10 SYM Theory

$$L = \mathrm{tr}\left\{ \frac{1}{g^2} F_{IJ} F^{IJ} - i\bar{\lambda} \Gamma^I D_I \lambda \right\}$$

Preserves conformal invariance at quantum level

There is evidence that $N = 4$ supersymmetric Yang–Mills theory has an integrable structure in the planar large N limit.

Exponentiation of scattering amplitudes in planar N=4 YM

$$\mathcal{M}_n = \exp\Big[\sum_{l=1}^{\infty} a^l \Big(f^{(l)}(\epsilon) M_n^{(1)}(l\epsilon) + C^{(l)} + \mathcal{O}(\epsilon) \Big)\Big]$$

$$\mathcal{M}_4|_{\text{finite}} = \exp\Big[\frac{1}{8}\gamma_K(a)\, \ln^2\Big(\frac{s}{t}\Big) + \text{const.}\Big]$$

MATHEMATICAL PHYSICS: MAIN EFFORTS

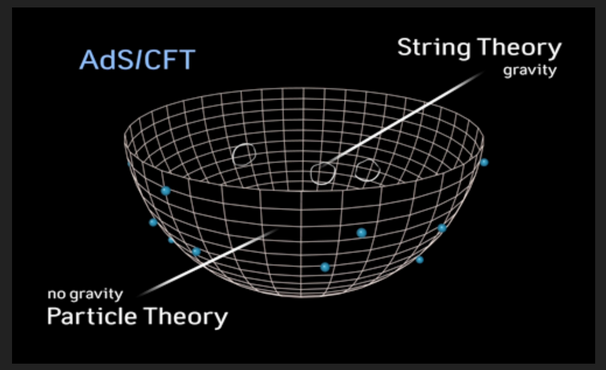
- Inregrable systems in higher dimensions/gauge theories
- Conformal field theory beyond 2 dimensions
- Dual string theory/field theory correspondence (AdS/CFT)

- 4d N=4 SYM is equivalent to IIB string on $AdS_5 \times S^5$:

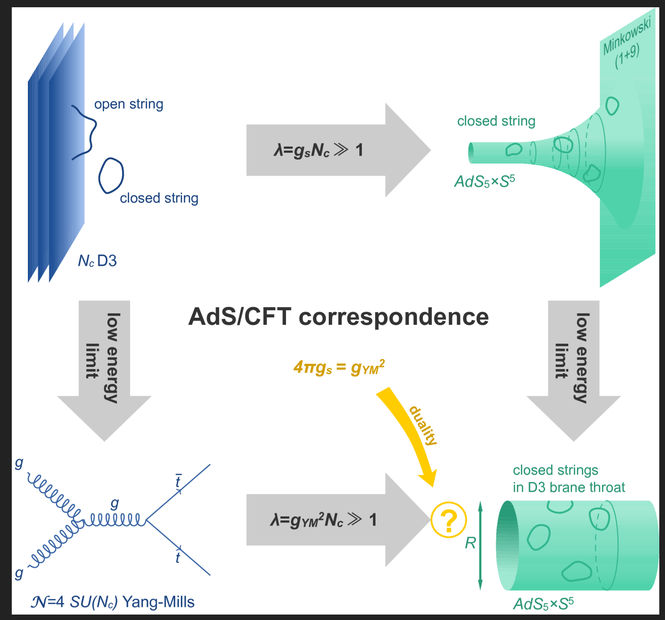
$$g^2_{YM} \sim g_s\,, \quad \alpha'/R^2_{AdS} \sim \lambda^{-1/2} \qquad \boxed{\lambda = g^2_{YM} N}$$

- Perturbative string picture is valid when

$$g_s \ll 1\,, \quad \lambda \gg 1$$

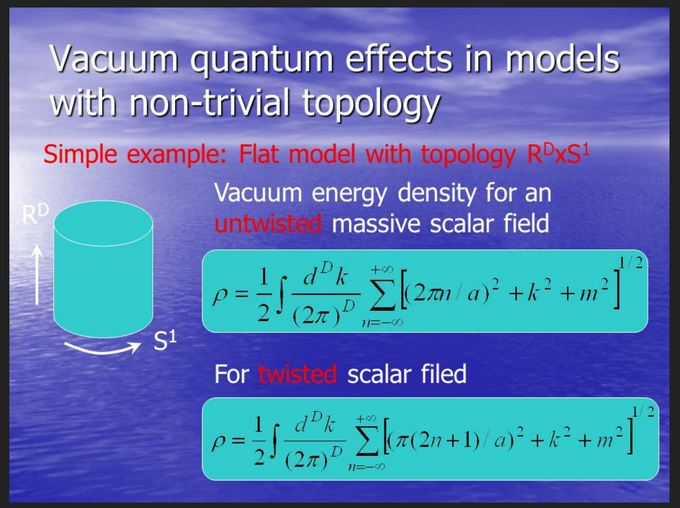


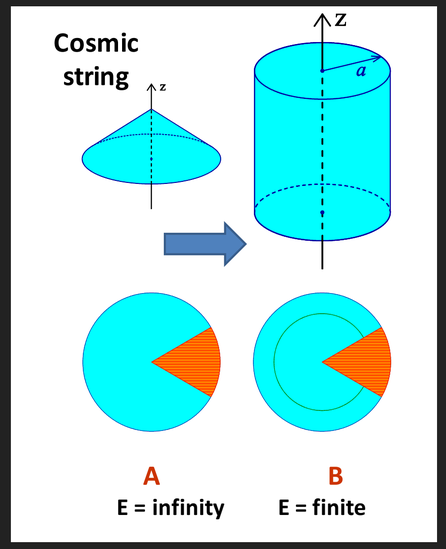
Weak coupling in QFT <-> Strong coupling in String Theory



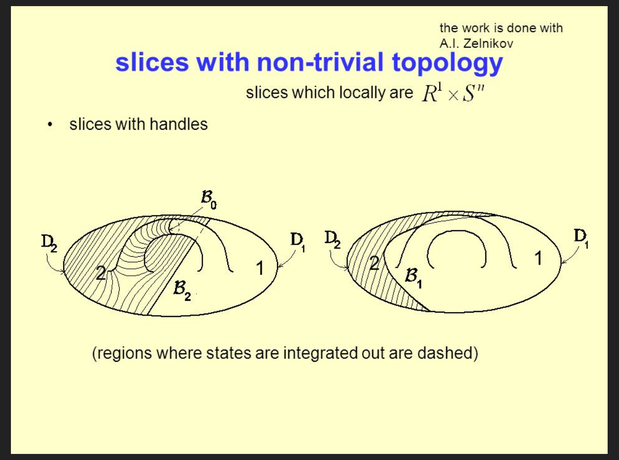
MATHEMATICAL PHYSICS: MAIN EFFORTS

- Inregrable systems in higher dimensions/gauge theories
- Conformal field theory beyond 2 dimensions
- Dual string theory/field theory correspondence (AdS/CFT)
- Vacuum fluctuation in non-trivial topological background



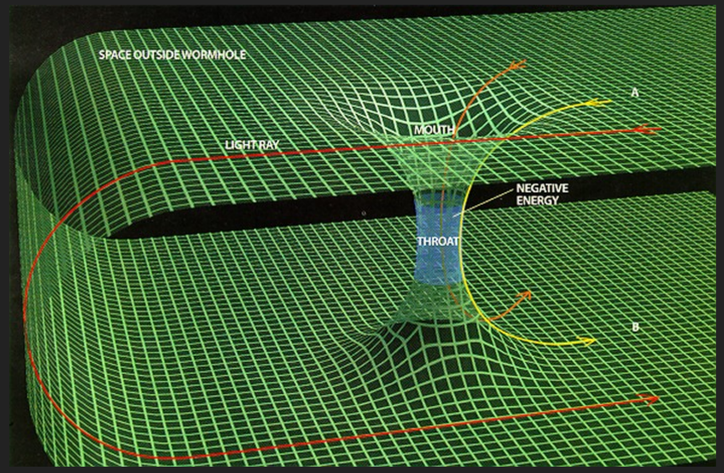


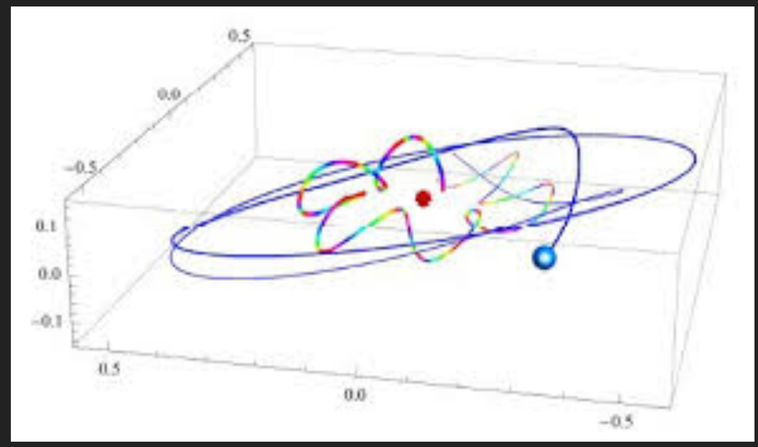
CONIC SINGULARITY



MATHEMATICAL PHYSICS: MAIN EFFORTS

- Inregrable systems in higher dimensions/gauge theories
- Conformal field theory beyond 2 dimensions
- Dual string theory/field theory correspondence (AdS/CFT)
- Vacuum fluctuation in non-trivial topological background
- Cosmological and black hole solutions in supergravity

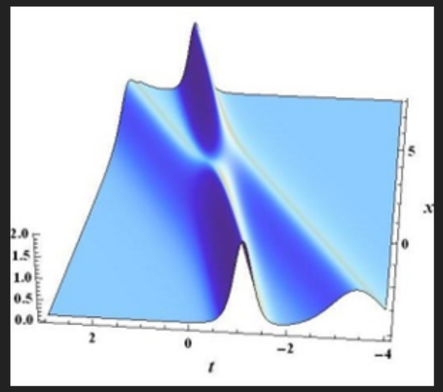


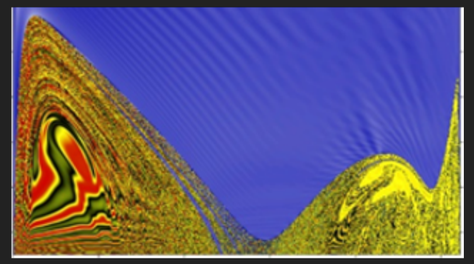


MATHEMATICAL PHYSICS: MAIN EFFORTS

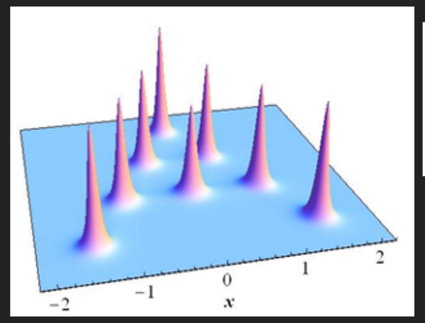
- Cosmological and black hole solutions in supergravity

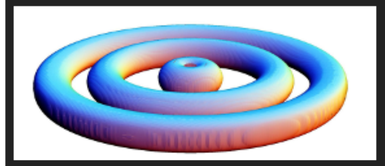
Kinks in 1+1 dim

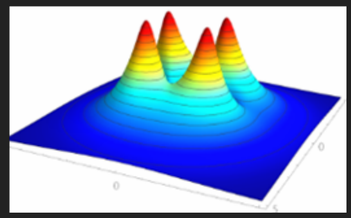




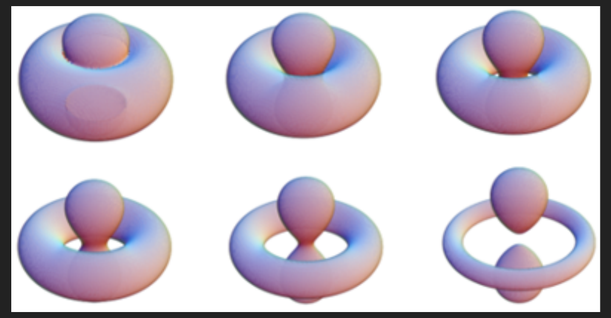
Q-balls

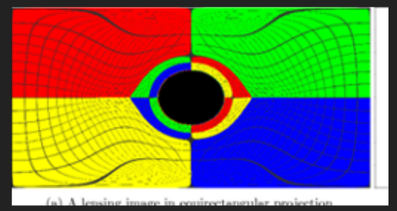




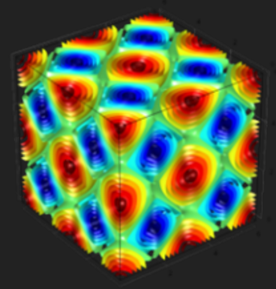


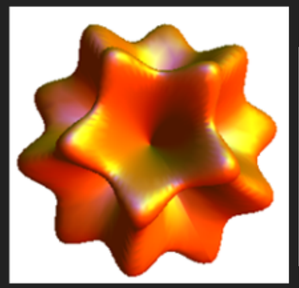
Boson stars and black holes

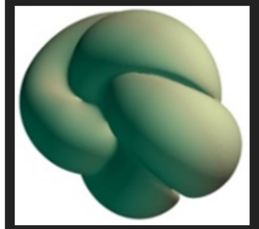




Skirmions & hophions







RESUME

Future development is based on:

- Large qualified personnel
- Wide range of research directions
- Exceptional possibilities of an international center
- Basis for recruitment of young personnel
- Working infrastructure