GROUP 23

XXIII International Colloquium on

Group Theoretical Methods in Physics

Dubna 2000

Joint Institute for Nuclear Research

JOINT INSTITUTE FOR NUCLEAR RESEARCH

XXIII INTERNATIONAL COLLOQUIUM

ON

GROUP THEORETICAL METHODS IN PHYSICS

July 31 - August 5, 2000, Dubna, Russia

Sponsors:

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CONTENTS

Chapter 1

GENERAL INFORMATION

1.1. Location

The Colloquium will be held at the *Bogoliubov Laboratory of Theoretical Physics Joint Institute for Nuclear Research* from July 31 to August 05, 2000. The Colloquium opens on July 31 at 10.00 in the Conference Hall of the Bogoliubov Laboratory of Theoretical Physics (first floor).

The Conference Secretariat will be located at the Bogoliubov Laboratory of Theoretical Physics on the first floor, room No 238.

1.2. Badges

Name badges serve as a pass to the Institute site where the Bogoliubov Laboratory of Theoretical Physics is situated.

1.3. Proceedings

All contributions will be reviewed but only a limited number will be selected for the Proceedings. Two volumes of the Proceedings will be devoted to Symposia Quantum Groups and Integrable Systems the other two volumes to the remainder.

The deadline for submission of papers is October 31, 2000.

For any information concerning publication please contact by

e-mail: group23@thsun1.jinr.ru

Please use LaTeX format 12pt, 150x220mm. Size restrictions: talks at plenary session - 15, for 20-30 min. contributions - 10 pages, for poster session - 6 pages.

The cost of each volume Proceedings will be US$25. We kindly request that you make and pay your order for the Proceedings volumes during the conference at the conference desk.

1.4. Accommodation

The Conference participants will be housed at the Hotel Dubna (buildings 1 and 2) located within walking distance of the Bogoliubov Laboratory of Theoretical Physics.

1.5. Meals

Meals will be served at the Hotel Dubna Restaurant (breakfast and lunch).

Breakfast 8:00 - 8:30

Lunch 12:00 - 14:00

1.6. Copy-Service

We offer a copying service at the conference desk. Price per pages is 0.1 US$ or 3 Russian rubles.

1.7. Special Events

The following events are free of charge to all participants and their accompanying persons.

- Monday, July 31, 20:00 h
  Welcome Reception in the Cafeteria of the Laboratory of Theoretical Physics
- Thursday, August 1, 20:00 h
  Wigner Medal Ceremony and Michel Memorial Lecture in the Culture House "Mir".

1.8. Accompanying Program

The cost of all items for accompanying person (see the following page) are included in the registration fee.

1.9. Transportation to the Airport

If you require transport to the airport, please fill in a car reservation form and hand it to the Secretariat not later than two days before your departure. If it is necessary to confirm your flight, please contact the Conference Secretary.

Accompanying Programme

Monday, July 31	Tuesday, August 1	Wednesday, August 2	Thursday, August 3	Friday, August 4
10:00 - 15:00 Excursion around the cities of Dubna and Dmitrov. Meeting point: In front of Hotel Dubna (building 1 and 3) Price: USD 10	9:00 - 20:00 Excursion to Moscow Museums (Tretyakov Gallery and Pushkin Museum). Meeting point: In front of the Hotel Dubna (building 1 and 3) Price: USD 20		6:00 - 22:00 Excursion to Suzdal Meeting point: In front of Hotel Dubna (building 1 and 3) Price: USD 50	9:00 - 15:00 Excursion to Sergiev Posad (Center of the Russian Orthodox Church) Meeting point: In front of the Hotel Dubna (building 1 and 3) Price: USD 20

Chapter 2

PROGRAMME INFORMATION

2.1. Topics-sessions-rooms

Session	Room
Plenary	Conference Hall of Bogoliubov Laboratory of Theoretical Physics (BLTP)
A	Conference Hall of Bogoliubov Laboratory of Theoretical Physics
B	Blokhintsev Lecture Hall of Bogoliubov Laboratory of Theoretical Physics
C	Green Lecture Hall of Bogoliubov Laboratory of Theoretical Physics
D	Conference Hall of Laboratory of Nuclear Problems (LNP)
Poster	Foyer of Conference Hall of Bogoliubov Laboratory of Theoretical Physics

2.2. Session-topics and Symposia

The Programme of Colloquium includes the following Symposia:

- *Symposium on quantum groups.*
- *Symposium on group theory and integrable systems.*
- *Symposium on group theory and path integrals.*

and topics:

- Lie groups, representation theory and special functions;
- Infinite-dimensional symmetries and supersymmetries;
- Symmetries of nonlinear systems and quantum chaos;
- Superstrings and quantum gravity;
- Foundations of quantum mechanics;
- Particle physics;

- Symmetries in nuclear, atomic and molecular physics;
- Quantum and nonlinear optics;
- Condensed matter and statistical physics.
- Semigroups and microphysical irreversibility.

	Monday July 31	**Tuesday August 1**	**Thursday August 3**	**Friday August 4**	**Suterday August 5**
A	Quantum Groups	Quantum Groups	Quantum Groups	Quantum Groups	
B	Integrable Systems	Integrable Systems	Integrable Systems	Integrable Systems	Infinite-dim. Sym. & SUSY
C	Quantum Optics	Superstrings & Quant. Gravity	Foundation of QM	Path Integrals	Symmetries in Nuc., At. & Mol. Physics
D	Condensed Matter	Condensed Matter	Lie Groups RT & SF	Lie Groups RT & SF	
Cofee Break					
A	Quantum Groups	Quantum Groups	Quantum Groups	Infinite-dim. Sym. & SUSY	
B	Integrable Systems	Integrable Systems	Integrable Systems	Integrable Systems	
C	Nonlinear systems & Quantum chaos	Quantum Optics	Path Integrals	Foundation of QM	
D	Particle Physics	Particle Physics	Semigroups & Mic. Irr.	Lie Groups RT & SF	

2.3. Wigner Medal Ceremony and Michel Memorial Lecture

Tuesday, August 1, 2000, 20:00 h, Culture House "Mir"

Tentative programme:

Wigner Medal Ceremony

- *Introductory Remarks by Arno Bohm.*
- *Tribute to the Awardees by V.I. Man'ko.*
- *Acceptance Speech by L. O'Raifeartaigh.*

Michel Memorial Lecture

- *Michel Memorial Lecture by L. O'Raifeartaigh.*

All accompanying persons are kindly invited to attend as well.

2.4 Plenary Sessions

Monday, July 31

10.00	**Opening**
Chairperson:	**D. Rowe**
10.20	**Heinz-Dietrich Doebner** (Germany) *Non-linear extensions of quantum theory - prospects and difficulties.*
11.10	**Richard Askey** (USA) *The world of q.*

Tuesday, August 1

Chairperson:	**H.-D. Doebner**
9.00	**Richard Kerner** (France) *Ternary generalizations of algebraic and differential tools in mathematical physics.*
9.50	**Marcos Moshinsky** (Mexico) *The Sturm-Coulomb problem in a magnetic field and its implications for quantum chaos.*

10.40 — 11.10 Coffee Break

11.10	**David Rowe** (Canada) *Quasi-dynamical symmetry; an organizational mechanism for emergent collective phenomena.*

Wednesday, August 2

Chairperson:	**T. Miwa**
9.00	**Yuri Berest** (USA) *Integrable systems and noncommutative algebraic geometry.*
9.50	**Vladimir Korepin** (USA) *Determinant representations in integrable models.*

10.40 — 11.10 Coffee Break

11.10	**Ivan Todorov** (Bulgaria) *Monodromy representations of the braid group.*

Thursday, August 3

Chairperson:	**L. Bonora**
9.00	**Arno Bohm** (USA) *Semigroups representations of Poincaré transformations and time asymmetric quantum theory.*
9.50	**Luigi Accardi** (Italy) *The stochastic limit of quantum theory: emergence of new statistics and interacting commutation relations.*

10.40 — 11.10 Coffee Break

11.10	**Sergei Kilin** (Belarus) *Quanta and Information.*

Friday, August 4

Chairperson:	I. Todorov
9.00	**Tetsuji Miwa** (Japan) *Combinatorics of coinvariants.*
9.50	**Victor Kac** (USA) *Classification of infinite-dimensional simple linearly compact Lie superalgebras and the standard model.*

10.40 — 11.10 Coffee Break

11.10	**Loriano Bonora** (Italy) *Instantons and scattering in Yang-Mills theory.*

Saturday, August 5

Chairperson:	A.N. Sissakian
11.30	**Michail Semenov-Tyan-Shansky** (France) *q-deformed W-algebras, Drinfeld-Sokolov reduction and algebras of q-difference operators.*
12.20	**Alexander T. Filippov** (JINR) *Integrable models of quantum gravity and their symmetries.*
13.10	**Closing**

2.5 Monday, July 31: Parallel Sessions

Symposium on Quantum Groups (A)

Chairperson: V. Dobrev

14.00	**Mariano A. del Olmo** (Spain) *Induced representations of quantum kinematical algebras.*	30 min
14.30	**Natig M. Atakishiyev** (Mexico) *Bases for representations of quantum algebras.*	30 min

15.00 — 15.15 Break

Chairperson: M.A. del Olmo

15.15	**Bertfried Fauser** (Germany) *Bases for representations of quantum algebras.*	30 min
15.45	**Harold Steinacker** (Germany) *Quantum Anti-de Sitter space and sphere at roots of unity.*	30 min

16.15 — 16.45 Coffee Break

Chairperson: R. Mir-Kasimov

16.45	**Anatolii U. Klimyk** (Ukraine) *q-Laplace operator and q-harmonic polynomials on quantum vector space.*	30 min
17.15	**Yuri F. Smirnov** (Mexico) *Quantum algebra $u_q(3)$: Gelfand-Graev formulas.*	30 min

17.45 — 18.00 Break

Chairperson: A.U. Klimyk

18.00	**Severin Posta** (Czech Republic) *On representations of nonstandard deformation $U_q(so3)$.*	20 min
18.20	**Raisa M. Asherova** (Russia) *On the general analytical formula for $U_q(3)$ Clebsch-Gordan coefficients.*	20 min
18.40	**Sigitas Alisauskas** (Lithuania) *3nj coefficients of $u_q(2)$ and multiple ordinary and basic hypergeometric series.*	20 min

Symposium on Group Theory and Integrable Systems (B)

Chairperson: P. Winternitz

14.00	**Igor V. Komarov** (Russia) *Kowalevski's top and its generalizations in classical and quantum mechanics.*	30 min
14.30	**Andrey Tsiganov** (Russia) *Maupertuis principle and integrable systems.*	30 min

15.00 — 15.15 Break

Chairperson: E. Kalnins

15.15	**Pavel Winternitz** (Canada) *Generalized Lie symmetries and superintegrable systems in quantum mechanics.*	30 min
15.45	**Costas Daskaloyannis** (Greece) *Polynomial Poisson algebras for two dimensional classical superintegrable systems and polynomial associative algebras for quantum superintegrable systems.*	30 min

16.15 — 16.45 Coffee Break

Chairperson:	I.V. Komarov	
16.45	**Ernie G. Kalnins** (New Zealand) *Completeness of Multiseparable Superintegrability in $E(2C)$.*	30 min
17.15	**Jonathan M. Kress** (New Zealand) *Multiseparability and Superintegrability in Three Dimensions.*	30 min
	17.45 — 18.00 Break	
Chairperson:	**C. Daskaloyannis**	
18.00	**Armen Nersessian** (JINR) *How to relate the oscillator and Coulomb systems on (pseudo)spheres?*	20 min
18.20	**Yurii A. Kurochkin** (Belarus) *An algebraic treatment of the MIC-Kepler problem on the sphere S^3.*	20 min
18.40	**Andrey M. Shirokov** (Russia) *Quantum Bound States Embedded in Continuum and Their Classical Analogues.*	20 min

Quantum and Nonlinear Optics (C)

Chairperson:	K.B. Wolf	
14.00	**Allan I. Solomon** (UK) *Canonical Transformations, Quantum Optics and Quantum Groups.*	30 min
14.30	**Valery P. Karassiov** (Russia) *Lie-algebraic methods in quantum optic: new approaches and results.*	30 min
	15.00 — 15.15 Break	
Chairperson:	**V.P. Karassiov**	
15.15	**Andrei Klimov** (Mexico) *Lie-type transformation and effective Hamiltonians in quantum optics.*	30 min
15.45	**Christiane Quesne** (Belgium) *Spectrum generating algebra and coherent states of the C_λ-extended oscillator.*	30 min

16.15 — 16.45 Coffee Break

Symmetries of Nonlinear Systems and Quantum Chaos (C)

Chairperson:	R.G. Nazmitdinov	
16.45	**V.K. Mel'nikov** (JINR) *On equations solvable by the Invetse scattering method.*	30 min
17.15	**Alexander V. Bogdanov** (Russia) *Thermodynamics of homogeneous and nonhomogeneous spaces consideration in framework of representation by stochastic density matrix.*	30 min
	17.45 — 18.00 Break	
Chairperson:	**A.V. Bogdanov**	
18.00	**Rashid G. Nazmitdinov** (JINR) *Soft chaotic systems: octupole deformed nuclei and metallic clusters.*	20 min
18.20	**Valentin Turin** (Russia) *Wave packets, squeezed states and uncertainty relation.*	20 min
18.40	**O. Rosas-Ortiz** (Mexico) *Solitonic deformations in susy quantum mechanics?*	20 min

Condensed Matter and Statistical Physics (D)

Chairperson:	N.M. Plakida	
14.00	**Chin-Kun Hu** (Taiwan) *Universal scaling functions and amplitude ratios for critical systems: A brief review.*	30 min
14.30	**Michael I. Monastyrsky** (Russia) *Minimal surfaces and fluctuations of membranes with high genus.*	30 min
	15.00 — 15.15 Break	
Chairperson:	**Y. Sobouti**	
15.15	**Owen Leon de Lange** (South Africa) *Anisotropy and inhomogenity in an asymmetric next-to-nearest neighbors Ising-type model.*	20 min
15.35	**Hongchen Fu** (UK) *Dynamical group approach to BEC tunnelling.*	20 min
15.55	**Yu.P. Rybakov** (Russia) *3D Topological excitations in non-Heisenberg magnetics.*	20 min

16.15 — 16.45 Coffee Break

Particle Physics (D)

Chairperson:	I.S. Sogami	
16.45	**Jean Pierre Gazeau** (France) *A survey of recent results for quantum field theory in de Sitter space.*	30 min
17.15	**Taro Kashiwa** (Japan) *Two-loop Gap Equation in the Nambu-Jona-Lasinio Model Coupled to $SU(2)$ Gauge Fields with Constant Backgrounds.*	30 min
	17.45 — 18.00 Break	
Chairperson:	**N. Russell**	
18.00	**Rolf Dahm** (Germany) *Noncompact symmetry groups and Dirac theory.*	20 min
18.20	**German S. Sharov** (Russia) *New classes of solutions in string meson and baryon models.*	20 min
18.40	**Marco Picariello** (Italy) *Higher order Wess-Zumino consistency conditions in gauge theories.*	20 min

2.6 Monday, July 31, Poster Session

M.K. Atakishiyeva (Mexico) *On a Mellin transform of the generalized Hermite polynomials.*
Igor Bogolubsky (JINR) *D-dimensional solitons in easy-axis Heisenberg magnets.*
Christophe R. Laforge (Belgium) *Symbolic computation of symmetry adapted functions and application infullerite surface phase transition .*
V. N. Plechko (JINR) Free fermion interpretation of two-dimensional Ising model.
E.P. Yukalova (JINR) *On the problem of turbulent crystal.*

2.7 Tuesday, August 1: Parallel Sessions

Symposium on Quantum Groups (A)

Chairperson:	**Yu.F. Smirnov**	
14.00	**Valery N. Tolstoy** (Russia) *Super-Drinfeldians and super-Yangians of Lie superalgebras of type $A(n\|m)$.*	30 min
14.30	**Eric Ragoucy** (France) *Yangians and W-algebras.*	30 min
	15.00 — 15.15 Break	
Chairperson:	**E. Ragoucy**	
15.15	**Naruhiko Aizawa** (Germany) *Twist of Lie Algebras by a rank 3 subalgebra.*	20 min
15.35	**David N. Ananikian** (Russia) *Chains of twists for simplectic Lie algebras.*	20 min
15.55	**Maria A. Lledo** (Italy) *Star products on coadjoint orbits.*	20 min

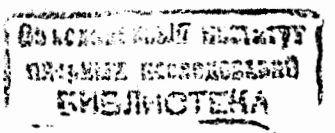
16.15 — 16.45 Coffee Break

Chairperson:	**N. Aizawa**	
16.45	**Gaetano Fiore** (Italy) *Unbraiding the braided tensor product.*	30 min
17.15	**Maxim L. Nazarov** (UK) *Singularities of the Rational R-matrices.*	30 min
	17.45 — 18.00 Break	
Chairperson:	**N.M. Atakishiyev**	
18.00	**Rufat Mir-Kasimov** (JINR) *Poincare Lie algebra and noncommutative differential calculus.*	30 min
18.30	**Nikolai A. Gromov** (Russia) *Possible contractions of quantum orthogonal groups.*	30 min

Symposium on Group Theory and Integrable Systems (B)

Chairperson:	**L. Feher**	
14.00	**Alexander Turbiner** (Mexico) *Solvablility of Integrable Systems.*	30 min
14.30	**Uday Sukhatme** (USA) *Supersymmetry and Solvable Periodic Potentials.*	30 min
	15.00 — 15.15 Break	
Chairperson:	**A. Mikhailov**	
15.15	**Boris Zakhariev** (JINR) *New exactly solvable quantum models.*	20 min
15.35	**Miloslav Znojil** (Czech Republic) *Solvable PT symmetric Hamiltonians.*	20 min
15.35	**Peter E. Zhidkov** (JINR) *Eigenvalue expansions associated with nonlinear Schrödinger equations.*	20 min

16.15 — 16.45 Coffee Break



Chairperson:	S. Nishiyama	
16.45	**D. Lebedev** (Russia) *Integral representations for the eigenfunctions of quantum open and periodic Toda chains from QISM formalism.*	30 min
17.15	**Alexander Sorin** (JINR) Lax pair formulation of the N=4 Toda chain (KdV) hierarchy in N=4 superspace.	30 min
	17.45 — 18.00 Break	
Chairperson:	**U. Sukhatme**	
18.00	**Simon Codriansky** (Venezuela) *Nambu dynamical system. The case of many triplets.*	20 min
18.20	**Adem Dalgic** (Turkey) *Class of Solvable Potentials Related to SO(2.2).*	20 min
18.40	**Gul-Mirza Kerimov** (Turkey) *Intertwining Operators and S-matrix.*	20 min

Superstrings and Quantum Gravity (C)

Chairperson:	K. Kerner	
14.00	**Luis J. Boya** (Spain) *Exceptional Groups in Physics.*	30 min
14.30	**Mikhail Olshanetsky** (Russia) *Gauge Lie Algebroid in W-Gravity and in the Poisson Sigma-Model.*	30 min
	15.00 — 15.1500 Break	
Chairperson:	**L.J. Boya**	
15.15	**Victor N. Pervushin** (JINR) *Time-Reparametrization Invariant Dynamics of the Early Universe.*	20 min
15.35	**Mohammad V. Takook** (Iran) *Conformal linear gravity in de Sitter space.*	20 min
15.55	**Anatoly Konechny** (USA) *M(atrix) theory compactifications on noncommutative tori and noncommutative toroidal orbifolds.*	20 min

16.15 — 16.45 Coffee Break

Quantum and Nonlinear Optics (C)

Chairperson:	A. Solomon	
16.45	**Kurt Bernardo Wolf** (Mexico) *Discretization of paraxial optial systems - by sensors in a polar array on the screen.*	30 min
17.15	**Young Kim** (USA) *Symmetries shared by particle physics and optical sciences.*	30 min
	17.45 — 18.00 Break	
Chairperson:	**C. Quesne**	
18.00	**V.I. Yukalov** (JINR) *Coherent structures in nonlinear optics.*	20 min
18.20	**Sergey M. Chumakov** (Mexico) *The Jaynes-Cummings model without the rotating wave approximation.*	20 min
18.40	**Alexei V. Chizhov** (JINR) *Unitary transformation of quantum states by lousy four-port devices.*	20 min

Condensed Matter and Statistical Physics (D)

	Chairperson:	**Chin-Kun Hu**	
14.00	**Nikolai M. Plakida** (JINR) *Constraints imposed by strong electron correlations on the symmetry of the superconducting gap.*		30 min
14.30	**Yousef Sobouti** (Iran) *Symmetries and eigensolutions of Liuville's equation.*		30 min
	15.00 — 15.15 Break		
	Chairperson:	**Y. Sobouti**	
15.15	**Victor G. Yarzhemsky** (Russia) *Shubnikov group symmetry and the structure of superconducting order parameter in unconventional superconductors.*		20 min
15.35	**Zorka Papadopolos** (Germany) *The Dehn invariant and the inflation rules for the tiles of the icosahedral tilings.*		20 min
15.55	**Bahruz R. Gadjiev** (JINR) *Kinetic theory of phase transition $I\bar{4}2d \rightarrow Fdd$.*		20 min

16.15 — 16.45 Coffee Break

Particle Physics (D)

	Chairperson:	**J.P. Gazeau**	
16.45	**Ikuo S. Sogami** (Japan) *Unifying Chiral Symmetry for Gauge and Higgs Fields.*		30 min
17.15	**Neil Russell** (USA) *Tests of Spacetime Symmetry with Particle Traps.*		30 min
	17.45 — 18.00 Break		
	Chairperson:	**T. Kashiwa**	
18.00	**Guennadi A. Kozlov** (JINR) *New extra gauge group(s) and (super)heavy bosons.*		20 min
18.20	**Igor L. Solovtsov** (JINR) *Relativistic S-factor in quantum chromodynamics.*		20 min
18.40	**Everton M. C. Abreu** (Brasil) *Interference phenomena, chiral bosons and covariance.*		20 min

2.8 Tuesday, August 1, Poster Session

Angel Ballasteros (Spain) *The $su_q(2)$ algebra in the off-diagonal basis and applications in quantum optics.*
Vladimir P. Bykov (Russia) *Specific features of the Coulomb field quantization.*
Oleg Chalykh (UK) *Macdonald polynomials and related integrable systems.*
Nikolai A. Chernikov (JINR) *Four models of the gravitational field of a star.*
Gagik Yu. Kryuchkyan (Armenia) *Controlling quantum trajectories and time-ordering in nonlinear systems.*
Margarita Man'ko (Russia) *Quantum-tomography method in information processing and fractional Fourier transform.*
Alfonso Mondragon (Mexico) *CP-violating phase and mixing angles from flavors symmetry breaking.*
Veronica Riquer (Mexico) *Bound states in relativistic quantum mechanics.*
Igor Samsonov (Russia) *Low energy effective action of hypermultiplet in arbitrary representation of any gauge group.*
James Gareth Wood (Australia) *Bounds on integrals of the Wigner function.*
Robert M. Yamaleev (JINR) *Generalized relativistic dynamics.*

2.9 Thursday, August 3: Parallel Sessions

Symposium on Quantum Groups (A)

Chairperson: J. Lukierski

14.00	**Alexander Stolin** (Sweden) *Integrable Models and a new Hopf algebra structure on $U_q(sl_2)$.*	30 min
14.30	**George Pronko** (Russia) *On Baxter Q-operator.*	30 min

15.00 — 15.15 Break

Chairperson: H. Steinacker

15.15	**Deepak Parashar** (UK) *Coloured extension of $GL_q(2)$ and its dual algebra.*	20 min
15.35	**Vitaly Tarasov** (Russia) *Difference equations compatible with trigonometric KZ differential equations.*	20 min
15.55	**Mikhail Yurishchev** (Russia) *Double q-state Potts chain: obvious S_q and hidden λ^q symmetries.*	20 min

16.15 — 16.45 Coffee Break

Chairperson: C. Burdik

16.45	**Alexei Isaev** (JINR) *Quantization of r-matrices related to Belavin-Drinfeld triples.*	30 min
17.15	**Stanislav Pakuliak** (JINR) *On the factorization of the universal $\mathcal{R}$-matrices.*	30 min

17.45 — 18.00 Break

Chairperson: G. Pronko

18.00	**Pavel Pyatov** (JINR) *Dynamical R-matrices in dimension 3.*	20 min
18.20	**Nadezhda Bazunova** (Estonia) *Exterior calculus with $d^3 = 0$ on free associative algebra in the cases of one and n generators.*	20 min
18.40	**Haji Ahmedov** (Turkey) *Z_p-graded* GL(n) *from* $GL_q(n)$.	20 min

Symposium on Group Theory and Integrable Systems (B)

Chairperson: B.G. Konopelchenko

14.00	**Alexander Mikhailov** (UK) *Integrable ODE's on associative algebras.*	30 min
14.30	**Alexander P. Veselov** (UK) *Integrable Schroedinger operators with magnetic fields and differential geometry in two dimensions.*	30 min

15.00 — 15.15 Break

Chairperson: A.P. Veselov

15.15	**Laszlo Feher** (Hungary) *On the structure of the Calogero-Moser r-matrices.*	30 min
15.45	**Boris G. Konopelchenko** (Italy) *Integrable hierarchies via D-bar dressing method.*	30 min

16.15 — 16.45 Coffee Break

Chairperson:	A. Sorin	
16.45	**Seiya Nishiyama** (Japan) *RPA Equation Embedded Into Infinite-Dimensional Fock Space F_∞.*	30 min
17.15	**Jamil Daboul** (Israel) *Time-dependent Hamiltonians with conserved Runge-Lenz vectors.*	30 min
	17.45 — 18.00 Break	
Chairperson:	**J. Daboul**	
18.00	**Taras V. Skrypnyk** (Ukraine) *Quasigraded Lie algebras, hyperelliptic curves and integrable systems.*	20 min
18.20	**Konstantin V. Rerikh** (JINR) *Birational symmetry and integrability of functional equations defined by birational maps.*	20 min
18.40	**A.D. Donkov** (Bulgaria) *The Exact Solution of the Cauchy Problem for a Generalized "Vinear" Vectorial Fokker-Plank Equation:Algebraic approach.*	20 min

Foundations of Quantum Mechanics (C)

Chairperson:	E. Kapuscik	
14.00	**Jeeva S. Anandan** (USA) *Symmetries, quantum geometry, and the fundamental interactions.*	30 min
14.30	**Vladimir I. Man'ko** (Russia) *Phase-space reference frames as fundamental tool to describe both classical and quantum states by probability distribution.*	30 min
	15.00 — 15.15 Break	
Chairperson:	**J.S. Anandan**	
15.15	**Alexei L. Shelepin** (Brazil) *Galilean covariant algebras of quantum mechanical observable.*	20 min
15.35	**Andrzej Horzela** (Poland) *Wigner's problem and noncanonical quantizations.*	20 min
15.55	**Jerzy Kowalski-Glikman** (Poland) *Testing dispersion relations of quantum κ-Poincaé algebra on cosmological ground.*	20 min

16.15 — 16.45 Coffee Break

Symposium on group theory and path integrals (C)

Chairperson:	A. Dynin	
16.45	**Vladimir Yarunin** (JINR) *Non-translation invariant Path Integral for Bose-condensate.*	30 min
17.15	**Evgueny Kochetov** (JINR) *Geometric derivation of CP^1 sigma-model for 1D antiferromagnet.*	30 min
	17.45 — 18.00 Break	
Chairperson:	**E. Kochetov**	
18.00	**J. Manjavidze** (JINR) *Topology and perturbation theory.*	20 min
18.20	**Dietmar Ebert** (Germany) *Dual formulation of SU(2)-gluodynamics and confinement.*	20 min
18.40	**Akira Inomata** (USA) *Path integration for a q-deformed free particle.*	20 min

Lie Groups, Representation Theory and Special Functions (D)

Chairperson:	S. Weigert	
14.00	**Jiri Patera** (Canada) *New poblems and possibilities resulting from the recent classification of gradings of classical simple Lie algebras.*	30 min
14.30	**Edita Pelantova** (Czech Republic) *On Fine Gradings and their Symmetries.*	30 min
	15.00 — 15.15 Break	
Chairperson:	**J. Patera**	
15.15	**Stefan Weigert** (Switzerland) *Contracting the Wigner-Kernel of the group $SU(2)$ to the Wigner-Kernel of the Heisenberg-Weyl group.*	30 min
15.45	**Andrzej Frydryszak** (Poland) *Grassmannian Special Functions and Graded Heisenberg Group.*	30 min

16.15 — 16.45 Coffee Break

Semigroups and Microphysical Irreversibility (D)

Chairperson:	A. Bohm	
16.45	**Alfonso Mondragon** (Mexico) *Doublets and degeneracy of resonances: Jordan forms and Jordan-Gamov vectors.*	30 min
17.15	**Rafael M. de la Madrid** (Spain) *Descprition of the Lippmann-Schwinger kets within the rigged Hilbert space formalism.*	20 min
	17.35 — 17.50 Break	
Chairperson:	**A. Mondragon**	
17.50	**Ioannis E. Antoniou** (Belgium) *Irreversible extension of dynamic evolution of unstable systems.*	30 min
18.20	**Raymond Scurek** (USA) *The propagation of unstable particles.*	20 min
18.40	**Nathan Harshman** (USA) *Resonance mass and width and the Poinca'e semigroup.*	20 min

2.10 Thursday, August 3: Poster Session

Roland M. Avakian (Armenia) *Gravitational field of flat plate.*
M. Damnjanović (Yugoslavia) *Wigner-Eckart theorem for induced representations.*
Bertfried Fauser (Germany) *Regularization of non-linear spinor field theories by discrete symmetries.*
Ashot S. Gevorkyan (Russia) *Classical nonintegtrability and quantum chaos in three-body systems.*
Gennadii Kotel'nikov (Russia) *Method of replacing the variables for generalized symmetry of D'Alembert equation.*
Olga Man'ko (Russia) *Group of canonical transformations in classical and quantum statistical mechanics and probability representation of quantum kinetics.*
Kishor Chandra Pati (India) *Satake Diagrams and Iwasawa Decomposition of Twisted Kac-Moody Algebras.*
Thalanayar S. Santhanam (USA) *Higher-order uncertainty relations.*
Haik A. Sarkisyan (Armenia) *One-particle states in parabolic quantum dot with regard to the boundary conditions.*
Olga P. Solovtsova (JINR) *D-function in nonperturbative expansion technique.*
Sergei I. Vinitsky (JINR) *On implementation of the polynomial Lie algebra methods for solving a class of nonlinear models of quantum optics: exact results and analytical approximations.*
Valeri S. Zamiralov (Moscow) *New version of Hara theorem in the framework of GIM model.*

2.11 Friday, August 4: Parallel Sessions

Symposium on Quantum Groups (A)

Chairperson: B. Fauser

14.00	**Jerzy Lukierski** (Poland) *Local QFT on noncommutative space-time with Hopf algebra structure.*	30 min
14.30	**Cestmir Burdik** (Czech Republic) *BRST charge for deformed Lie algebras.*	30 min

15.00 — 15.15 Break

Chairperson: G. Fiore

15.15	**Leonid O. Chekhov** (Russia) *Quantum Teichmuller spaces and 3D geometry.*	20 min
15.35	**Waldemar Berej** (Poland) *$SO_q(5)$ and q-deformed pairing.*	20 min
15.55	**Victor Gershun** (Ukraine) *Sigma-models on the quantum group manifolds in low undeformed space-time dimensions and variational calculus.*	20 min

16.15 — 16.45 Coffee Break

Infinite–Dimensional Symmetries and Supersymmetries (A)

Chairperson: J.F. Gomes

16.45	**Ziemowit Popowicz** (Poland) *Dispersionless Supersymmetric Two Boson Hierarchy.*	30 min
17.15	**David J. Fernandez C.** (Mexico) *Non-linear oscillator algebras and higher order supersymmetry.*	30 min

17.45 — 18.00 Break

Chairperson: Z. Popowicz

18.00	**Maxim Kudinov** (USA) *N-extended supersymmetric quantum mechanics of one-particle.*	20 min
18.20	**Jose Francisco Gomes** (Brazil) *Axial-Vector T-duality in non Abelian Toda affine Toda models.*	20 min
18.40	**Boris Zupnik** (JINR) *Solving $N = 3$ super-Yang-Mills equations in harmonic superspace.*	20 min

Symposium on Group Theory and Integrable Systems (B)

Chairperson: V. Korepin

14.00	**Lochlain O'Raifeartaigh** (Ireland) *Astrophysical application of Hamilton-Jacobi group.*	30 min
14.30	**Vladimir P. Pavlov** (Russia) *Invariant description of local symmetries.*	30 min

15.00 — 15.15 Break

Chairperson: L. O'Raifeartaigh

15.15	**Michel Grundland** (Canada) *Symmetry properties and explicit solutions of the generalized Wierstrass system.*	30 min
15.45	**Vladimir V. Mangazeev** (Australia) *A_3 Jack polynomials: An exact construction of the separating operator.*	30 min

16.15 — 16.45 Coffee Break

Chairperson:	**A. Tsiganov**	
16.45	**Herman Boos** (Russia) *Some exact results for three-dimensional Zamolodchikov model.*	30 min
17.15	**Vladimir I. Inozemtsev** (JINR) *Invariants of linear combinations of transpositions.*	30 min
	17.45 — 18.00 Break	
Chairperson:	**V.V. Mangazeev**	
18.00	**Marcel Novaes** (Brazil) *Classical and Algebraic Hamiltonians with SU(3) Symmetry.*	20 min
18.20	**Alina A. Suzko** (JINR) *Exactly soluble potentials for Schrödinger equation.*	20 min
18.40	**D. Mladenov** (JINR) *Classical mechanics on $GL(n, R)$ group and Euler-Sutherland model.*	20 min

Symposium on Group Theory and Path Integrals (C)

Chairperson:	**A. Inomata**	
14.00	**Hiroshi Kuratsuji** (Japan) *Perspective of coherent state path integrals.*	30 min
14.30	**Junya Shibata** (Japan) *Method of Collective Degrees of Freedom in Spin Coherent State Path Integral.*	30 min
	15.00 — 15.15 Break	
Chairperson:	**V. Yarunin**	
15.15	**Alexander Dynin** (USA) *Convergent Feynman-type integrals for coherent matrix elements for quantum evolution of interacting fields in any space-time dimension.*	30 min
15.45	**Sergey Storchak** (Russia) *Reduction procedure in path integrals on manifold with group action.*	30 min

16.15 — 16.45 Coffee Break

Foundations of Quantum Mechanics (C)

Chairperson:	**V.I. Man'ko**	
16.45	**Richard Hagen** (USA) *Irreversible extension of dynamical evolution of unstable systems.*	30 min
17.15	**Alvaro De Souza Dutra** (Brasil) *Non-singular expressions for the ground state of some anharmonic oscillators.*	30 min
	17.45 — 18.00 Break	
Chairperson:	**R. Hagen**	
18.00	**Edward Kapuscik** (Poland) *Z-description of relativistic spin.*	20 min
18.20	**Sebastian Salamo** (Venezuela) *On Scattering for some hypergeometric Natanzon potentials.*	20 min
18.40	**Jan Naudts** (Belgium) *Covariance in QM and QFT.*	20 min

Lie Groups, Representation Theory and Special Functions (D)

Chairperson: **V.A. Soroka**

14.00	**Alexandre Yu. Orlov** (Japan) *Fermionic representation for basic hypergeometric functions related to Schur polynomials.*	30 min
14.30	**Ady Mann** (Israel) *Three-dimensional curves and analytic solutions for two-level systems.*	30 min

15.00 — 15.15 Break

Chairperson: **A.Yu. Orlov**

15.15	**Vladimir Gerdt** (JINR) *Completion to involution as a general method for computing Lie symmetries of differential equations.*	20 min
15.35	**Georgy I. Burde** (Israel) *On the use of the Lie group technique for finding approximate solutions of differential equations.*	20 min
15.55	**Stepan S. Moskaliuk** (Ukraine) *On the tree method in category theory.*	20 min

16.15 — 16.45 Coffee Break

Chairperson: **T. Palev**

16.45	**Vyacheslav A. Soroka** (Ukraine) *Lie-Poisson (Kirillov) odd bracket on Grassmann algebra.*	30 min
17.15	**Laurence Boyle** (UK) *Character tables as arrays.*	30 min

17.45 — 18.00 Break

Chairperson: **L. Boyle**

18.00	**Joris Van der Jeugt** (Belgium) *Quasiboson representations of $sl(n+1)$ and generalized quantum statistics.*	20 min
18.20	**Sonia G. Schirmer** (UK) *Kinematical bounds on optimization of observable for quantum systems, the question of their dynamical realizability and Lie groups.*	20 min
18.40	**Reidun Twarock** (Germany) *A new model for quasicrystals via an affine extension of the noncrystallographic Coxeter groups.*	20 min

2.12 Friday, August 4: Poster Session

Keivan Aghababaei Samani (Iran) *Topological Quantum Mechanical Symmetries*
Andrzej Borowiec (Poland) *Algebraic vector fields.*
Yurii V. Dumin (Russia) *Using the generalized spherical functions for solving the spherically-symmetric dynamo problem.*
Samvel G. Haroutiunyan (Armenia) *The possibility of pseudo-ring structures formation in DNA-cisplatinum complexes.*
Gohar H. Haroutyunian (Armenia) *Scalar field effect of selfgraviting configuration structure.*
Nelly P.Konopleva (Russia) *VI Hilbert's problem and infinite Lie groups*
Vladimir V. Kornyak (JINR) *Computation of cohomology of Lie superalgebras with antibracket.*
Valery M.Koryukin (Russia) *Quasigroups and the use of them in the theory of the gauge fields.*
Oleg S.Kosmachev (JINR) *Physical interpretation of some Clifford algebras*
Luke Francis McAven (Japan) *Looking for a unified Dna/Rna genetic algebra.*
Bozidar Nikolic (Yugoslavia) *Vibronic (in)stability of diperiodic systems.*
N.S. Shavokhina (JINR) *The Dirac equation in the Lobachevsky space-time.*

2.13 Saturday, August 5: Parallel Sessions

Infinite–Dimensional Symmetries and Supersymmetries (B)

Chairperson:	D.J. Fernandez C.	
9.00	**Alexander.D. Popov** (JINR) *Holomorphic BF theories and their symmetries.*	30 min
9.30	**Dmitri Leites** (Sweden) *Real forms of simple Lie superalgebras of vector fields.*	30 min
10.00	**Boris Samsonov** (Russia) *New higher order irreducible supersymmetric quantum models.*	20 min
10.20	**Vasiliy V. Kuratov** (Russia) *Graded contractions of Virasoro algebras.*	20 min
10.40	**Igor V. Kostyakov** (Russia) *Geometry of affine root systems.*	20 min

11.00 — 11.30 Coffee Break

Symmetries in Nuclear, Atomic and Molecular Physics (C)

Chairperson:	German S. Sharov	
9.00	**Regina Maria Ricotta** (Brazil) *Supersymmetric quantum mechanics, the variational method and a new shape invariant potential.*	30 min
9.30	**Boris Zhilinskii** (France) *Symmetry, Invariants, Topology in Molecules.*	30 min
10.00	**Ivanka Milosevic** (Yugoslavia) *Modified group projectors: Tight binding method.*	20 min
10.20	**Jose Eduardo Hornos** (Brazil) *New symmetries for the genetic code.*	20 min
10.40	**Denis Proskurin** (JINR) *The canonical adiabatic approach of the three-body problem with induced gauge fields.*	20 min

11.00 — 11.30 Coffee Break

Chapter 3

ABSTRACTS

3.1 Plenary Sessions

3.PL

The Stochastic Limit of Quantum Theory: Emergence of New Statistics and Interacting Commutation Relations

Luigi Accardi

University of Roma Torvergata, Roma, Italy

The stochastic limit of quantum theory is a new technique, combining scattering theory (long times and cumulative effects) with perturbation theory (small parameter). The two aspects compensate each other leading to an increasing hierarchy of nontrivial physical effects.

In the past fifteen years the method has been applied to a variety of problems among which: nonlinear optical hamiltonians, polaron problem, non relavistic QED, Anderson model in solid state physics, stochastic bosonization in higher dimensions, the quantum Boltzmann equation, quantum Glauber dynamics, ...

The basic idea of the method and some application to statistical mechanics and quantum field theory will be discussed. In particular the emergence, from the stochastic limit, of new statistics and of associated new algebraic structures (interacting Fock space and interacting commutation relations) will be discussed.

[1] L. Accardi, Y.G. Lu, I. Volovich: Quantum Theory and its Stochastic Limit. to be published in the series Texts and monographs in Physics, Springer Verlag (2000); Japanese translation, Tokyo–Springer (2000)

[2] L. Accardi, S.V. Kozyrev, I.V. Volovich Dynamics of dissipative two–state systems in the stochastic approximation. Phys. Rev. A 56 N. 3 (1996) quant-ph/9706021.

[3] L. Accardi, S.V. Kozyrev and I.V. Volovich: Dynamical origins of q-deformations in QED and the stochastic limit Journal of Physics A, Math. Gen. 32 (1999) 3485–3495; q-alg/9807137

31.PL

The World of q

Richard Askey

University of Wisconsin, Madison, WI, U.S.A.

The study of q-series started with Euler. For a long time only a small part of it was used even by mathematicians. That has changed in the last 25 years, thanks to developments both in physics and mathematics. A survey of q-extensions of the classical orthogonal polynomials will be given. This will include some of the ways they can be used to derive results useful in mathematical physics.

2.PL

Integrable Systems and Noncommutative Algebraic Geometry

Yuri Berest

Department of Mathematics, Cornell University, Ithaca, USA

In recent years, there have been a number of important applications of methods and techniques from Algebraic Geometry to the study of noncommutative algebras. For certain classes of algebras the merging of ideas of Algebraic Geometry and Noncommutative Ring Theory turns out to be so natural and successful that one can speak of a noncommutative generalization of Algebraic Geometry.

In my talk (based on recent joint work with G. Wilson) I will try to illustrate the relevance of this approach in connection with problems of Mathematical Physics (or to be specific, with the theory of integrable systems). I will discuss new fairly surprising relations between the following four objects: (1) Hilbert schemes of points on the complex affine plane, (2) Ideal class spaces of the first Weyl algebra, (3) Calogero-Moser Hamiltonian systems, and (4) the so-called Adelic Grassmannian introduced by G.Wilson [Invent. Math. 98]. As an application, I will explain how a well-known class of algebraic solutions to the KP integrable hierarchy can be described in terms of "noncommutative line bundles", or more precisely, rank one torsion-free coherent sheaves on Artin's quantum projective plane. If time permits some conjectures and open problems will be also mentioned.

3.PL

Semigroup Representations of Poincaré Tranformations and Time Asymmetric Quantum Theory

Arno Bohm

Department of Physics, University of Texas, Austin, USA

Stable relativistic elementary particles are defined by Wigner's unitary irreducible representations $[j, m^2]$ of the Poincaré group. In scattering, the UIR's $[j, \mathsf{s}]$ appear with $m_0^2 \leq \mathsf{s} < \infty$, where s is the center of mass energy squared. Relativistic resonances and decaying particles are characterized by the spin j and a complex number s_R, $[j, \mathsf{s}_R]$, which is the pole position of the S-matrix $S_j(\mathsf{s})$. The decomposition of this complex number s_R into resonance mass and resonance width and the correct definition of mass m and width Γ of a relativistic resonance have been debated in connection with the definition of the Z-boson mass. We shall present minimally complex representations of the Poincaré transformations which are characterized by this $[j, \mathsf{s}_R]$. They describe resonances in analogy to stable particles and

settle the ambiguity in the definition of resonance mass and width. Most remarkably, they form a semigroup, expressing microphysical irreversibility.

4.PL

Instantons and Scattering in Yang-Mills Theory.

Loriano Bonora

SISSA, Via Beirut 2, 34014, Trieste, Italy

A new class of instantons in Yang-Mills theories is presented. They satisfy generalized Hitchin equations and preserve half supersymmetry. Physically they represent classical configurations which interpolate between initial and final scattering states. In the particular case of 2D Yang-Mills theory it is shown that in the strong coupling limit one obtains in this way a full description of superstring theories.

31.PL

Non-linear extensions of quantum theory-prospects and difficulties.

Heinz-Dietrich Doebner

ASI Clausthal-Zellerfeld, Germany

5.PL

Integrable models of quantum gravity and their symmetries.

Alexander T. Filippov

Laboratory of Theoretical Physics, JINR, Dubna, Russia

4.PL

Classification of Infinite-Dimensional Simple Linearly Compact Lie Superalgebras and the Standard Model

Victor Kac

MIT, Cambrige, USA

1.PL

Ternary Generalizations of Algebraic and Differential Tools in Mathematical Physics.

Richard Kerner

Universite Paris VI, Paris, France

We present an overview of many recent generalizations of various important algebras appearing in mathematical physics, whose common feature is the introduction of cubic constitutive relations.

Such relations lead to ternary algebras, some of which can be identified or represented with algebras of differential operators with a Z_3 grading.

The so-called Nambu mechanics is one of the best-known examples of the generalization of this kind. The Yang-Baxter relations provide another example of important ternary relations.

Then we present some later developments of ternary and Z_3 graded algebras, which include the operators realizing the cubic root of Klein-Gordon and Dirac equations, or the cubic root of the supersymmetry translations.

Finally, we discuss possible ternary generalizations of Clifford algebras and of the exterior differential calculus. Gauge theories based on these differential algebras and their possible applications will be presented, too, as well as other realizations of the nilpotent differential operators of the order higher than two.

3.PL

Quanta and Information.

S.Ya. Kilin

B.I. Stepanov Institute of Physics, National Academy of Science, Minsk, Belarus

An unification of two previously separated fields - quantum physics and classical information theory - is discussed. It is hard to predict all possible results of the unification. Presently, at its initial stage, we can see that once again the Nature is giving us a lesson, presenting a new physical resource which has demanded for its description the notions and methods that were out of the huge arsenal of mathematical methods. This resource - quantum entanglement - revolutionizes our understanding of the world and opens a window for the unpredictable power of Hilbert space of distant quantum objects, the power that promises to be the basis for the next generation of computers which will be able to solve many mathematical problems presently untouchable. Besides, the number theory has been enriched due to the introduction, from physics, the notion of qubit - a new measure of quantum information instead of the classical bit. This may possibly be the third revolution in number theory after Pythagor's adventure of the irrational numbers and the introduction of complex numbers by Gauss and his contemporaries, a revolution that has come in accordance with Fourier's note that the investigation of Nature is the richest source of mathematical adventures.

To understand the importance of quantum entanglement and describe its ability, some notions of information theory and the way of reasoning have been used, and information sense of the wave function has been stressed once more. The information science language has become an important part in the description of quantum world objects. This kind

of thinking and presentation of reality brought back old fundamental problems like symmetries and separability of quantum systems. For example, the Pauli principle forbids to use all power of Hilbert space of interacting, and therefore, separately non perturbable, spins. We understood that entangled systems could serve as a new resource for information storage and handling, but at the same time, the quantum entanglement of all with all is a reason of main obstacle to quantum computation – decoherence. The solution of the problem of quantum computers creation lies in our abilities to find methods for the decoherence harnessing. It seems now that the solution of the grand challenge problem will require great consolidated efforts. But the results are worth the efforts.

And finally, there are a lot of indications that a new physical view on Nature is being formed now. Of some use is the point of view that Nature communicates information encoded by means of a number of "languages". One of these languages is quantum mechanics, and it is the quantum information that tries to find, as a branch of Science, the structure of this language, which can help us to decode the Nature's messages and to adopt the power of quantum coding to the practical benefits of Society.

2.PL

Determinant Representations in Integrable Models

Vladimir Korepin

YITP, SUNY at Stony Brook, USA and POMI at St. Peterburg Russia

I will start with analysis of quantum integrable models. Several important objects [norms of eigenfunctions, scalar products, form-factors] can be represented as determinants.

Correlation functions can be represented as determinants of Fredhom integral operators of a special form, this helps to relate classical and quantum integrable models. The derivation of determinant representations leads us naturally to new the new developments in clasical statistical mechnics.

One has to introduce six vertex model with domain wall boundary conditions, which is interesting also for pure mathematics.

4.PL

Combinatorics of coinvariants.

Tetsuji Miwa

Department of Mathematics, Faculty of Sciences, Kyoto University, Kyoto, Japan

1.PL

The Sturm-Coulomb problem in a magnetic field and its implications for quantum chaos.

Marcos Moshinsky

Instituto de Física-UNAM. Apartado Postal 20-364, 01000 México, D. F. México

The Sturm-Coulomb problem is an integtrable one as its symmetry group is $O(4)$. When we apply to it a magnetic field this symmetry is broken and is reduced to a $O(2)$ group. The problem is then non-integrable but we can derive its matrix representation in a basis in which the Sturm-Coulomb problem alone is diagonal. We use this matrix representation to obtain the corresponding eigenvalues and their nearest neighbor spacing (NNS) distribution. From the histogram of the latter we discuss the presence or absence of quantum chaos as function of the intensity H of the magnetic field and the angular momentum m in the direction of this field.

1.PL

Quasi-Dynamical Symmetry; An Organizational Mechanism for Emergent Collective Phenomena

David J. Rowe

Department of Physics, University of Toronto, Toronto, ON M5S 1A7, Canada

Emergent phenomena are collective behaviours of many-body systems which cannot easily be anticipated even when the basic building blocks of the system and the interactions between them are well known. Such phenonemena are common in many systems. Indeed, because of their collective properties, they are often among the most dramatic. To understand how the dynamical motions of the elementary building blocks of the system are coordinated, requires an organizational principle. I shall show that quasi-dynamical symmetry provides the desired organizational mechanism. Quasi-dynamical symmetry is an extension of the idea of dynamical symmetry to admit the possibility of large symmetry breaking interactions and thereby explain why simple collective phenomena persist even when the dynamical symmetries of the models which explain them are badly broken.

5.PL

q-deformed W-algebras, Drinfeld-Sokolov reduction and algebras of q-difference operators.

M. Semenov-Tyan-Shansky

Laboratoire Gevrey de Mathématique physique, Université de Bourgogne, Dijon, France
and Steklov Mathematical Institute, St.Petersburg, Russia

q-deformed Poisson-Virasoro algebra and its generalizations which have arised in the study of the center of the quantized universal enveloping algebras of loop algebras at the critical value of the central charge admit several alternative constructions based on the study of q-pseudodifference operators. An extension of the Drinfeld-Sokolov theory to this setting proves to be non-trivial and leads to a new class of elliptic r-matrices. We shall also describe a direct generalization of the Gelfand-Dickey theory (which leads to the same elliptic Poisson brackets) and an interpolating construction based on the q-deformed algebra of 'complex size matrices'. Nontrivial consistency conditions make all constructions almost completely rigid and yield a non-technical explanation for the resulting formulae.

2.PL

Monodromy representations of the braid group.

I.T. Todorov

Institute for Nuclear Research and Nuclear Energy, Bulgarian Academy of sciences, Bulgaria

Chiral conformal blocks in a rational conformal field theory are a far going extension of Gauss hypergeometric function. The associated monodromy representations of Artin's braid group capture the essence of the modern view on the subject that originates in ideas of Riemann and Schwarz. Physically, such monodromy representations correspond to a new type of braid group statistics which may manifest itself, e.g., in some exotic (second Landau level) quantum Hall states. The associated primary fields satisfy R-matrix exchange relations. The description of the internal symmetry of such fields requires an extension of the concept of a group, thus giving room to quantum groups and their generalizations.

The talk is intended as a review of the subject - with a natural emphasis on the developments in which the author has participated.

3.2 Symposium on Quantum Groups

3.A

Z_p-graded GL(n) from $GL_q(n)$.

H. Ahmedov

Feza Gursey Institute, P.O. Box 6, 81220 Cengelkoy-Istanbul, Turkey

From $GL_q(n)$ at p^{th} roots of unity we define Z_p grading of GL(n) and its subgroups.

1.A

Twist of Lie Algebras by a rank 3 subalgebra.

N. Aizawa

Arnold Simmerfeld Institut. Clausthal-Zellerfeld, Germany

Non-standard deformation of Lie algebras by twisting is discussed based on a six dimensional subalgebra. This is an extension of the socalled extended twists introduced by Kulish et al. This new twisiting is applicable to classical Lie algebras $sl(n), so(n)$ and $sp(2n)$ with $n \geq 4, 5$ and $n \geq 2$, respectively. It is also discussed a relation between the twisted $so(3,2)$ and non-standard quantum $so(3,2)$ by Herranz.

31.A

$3nj$ coefficients of $u_q(2)$ and multiple ordinary and basic hypergeometric series.

S. Ališauskas

Institute of Theoretical Physics and Astronomy, Vilnius 2600, Lithuania

Different triple sum formulas for $9j$ coefficients, as well as the multiple sum expressions [with 4 or 5 separate sums of the ${}_4F_3(1)$ or ${}_4\phi_3$ type] for the $12j$ coefficients of the second and the first kind (without or with braiding), of the SU(2) group and quantum algebra $u_q(2)$ are derived, using the usual expansions in terms of q-$6j$ coefficients and eliminating sums over the j type parameters, i.e., the q-generalizations of the very well-poised (Dougall's) hypergeometric ${}_4F_3(-1)$, ${}_5F_4(1)$ (or ${}_6\phi_5$), and ${}_6F_5(-1)$ series. The mutual rearrangement of the derived triple sum formulas are considered. New double sum formulas for the stretched q-$9j$ coefficients (and rearrangements of the q-versions of some Kampé de Fériet series) are derived, as well as the triple, double, or single sums (in terms of basic hypergeometric series) for different versions of stretched and doubly stretched q-$12j$ coefficients.

1.A

Chains of twists for simplectic Lie algebras.

D.N. Ananikian, P.P. Kulish, V.D. Lyakhovsky

St.Petersburg State University, St.Petersburg, Russia

Trying to construct chains of twists for simplectic series of Lie algebras one faces some serious difficulties connected with the specific structure of this series. It was possible to construct only the improper chains of twists. In the present paper this problem is solved. For chains of regular injections $U(sp(1)) \subset \ldots \subset U(sp(N-1)) \subset U(sp(N))$ of Hopf algebras the sets of maximal extended Jordanian twists F_{E_k} are cosidered. We prove that the twist $F_{B_{0<k}}$ composed of the factors F_{E_k} exists for $sp(N)$. It is demonstrated that in the process of twisting the space of the primitive subalgebra $sp(N-1)$ is deformed. The general form for such deformation is found. This construction generalizes the results obtained for orthogonal classical Lie algebras and demonstrates the universality of primitivization effect for subalgebras. Using such twisting procedures one can obtain the explicit quantizations for a wide calass of classical r-matrices. As an example the case of $U(sp(1)) \subset U(sp(2)) \subset U(sp(3))$ is considered.

31.A

On the general analytical formula for $U_q(3)$ Clebsch-Gordan coefficients.

R.M. Asherova, Yu.F. Smirnov and V.N. Tolstoy

Institute of Physics and Power Engineering, Obninsk, Russia
Skobeltsyn Institute of Nuclear Physics, Moscow State University, Moscow, Russia
Instituto de Ciencias Nucleares, UNAM, Mexico

The general analytical formula for the Clebsch-Gordan coefficients of the quantum algebra $U_q(3)$ is derived. It is the straigtforward q-deformed extension of the results found earlier in Refs. [1-3] for the standard Lie algebra $U(3)$ in the works [1-3]. This general formula gives rather simple expression for multiplicity free Clebsch-Gordan coefficients.

[1] Z.Pluhar, Yu.Smirnov, V.Tolstoy, *Development of $SU(3)$ Symmetry Technique*, preprint, Charles University, Prague, 1982.
[2] I.Guseva, Yu.Smirnov, V.Tolstoy, Yu.Kharitonov, preprint, LIYAF-678, Leningrad, 1981.
[3] Z.Pluhar, Yu.Smirnov, V.Tolstoy, *J.Phys. A: Math. Gen.* **19**, 21 (1986).

31.A

Bases for representations of quantum algebras

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We derive an explicit expression for the eigenfunctions and the corresponding eigenvalues of the q-difference operator $[q^{1/4}J_+(q) + q^{-1/4}J_-(q)]\,q^{J_3(q)/2}$ in an arbitrary irreducible representation of the algebra $su_q(2)$. The general form of the intertwining operator $A^J(q)$, which is a q-extension of the classical $su(2)$-operator a^J, $J_1 a^J = a^J J_3$, is also found. The matrix elements of $A^J(q)$ are expressed in terms of the dual q-Kravchuk polynomials.

3.A

Exterior calculus with $d^3 = 0$ on free associative algebra in the cases of one and n generators.

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We construct an exterior calculus with d satisfying $d^3 = 0$ on free associative algebra $\mathcal{A}$ in case one and n generators. Since $d^2 \neq 0$, the algebra of differential forms is generated not only by the first order differentials but also by second order differentials. We study the structure of a bimodule of second order differentials and in case of one generator show that the condition of homogeneity of the commutation relation between first and second order differentials leads to the $q-$differential calculus on anyonic line. In case of n generators we find the homomorphism ξ such that the commutation relations between second order differentials and elements of $\mathcal{A}$ are similar to the commutation relations between first order differentials and elements of $\mathcal{A}$.

4.A

$SO_q(5)$ and q-deformed pairing.

W. Berej

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A simple solvable model based on the algebra $SO(5)$ was introduced in the sixties to study the isovector pairing between neutrons and protons occupying a single j shell. Following the results of A. Chakrabarti for the $SO_q(5)$ algebra and its irreducible representations we define the q-deformed analogue of the pairing Hamiltonian for the nucleons and discuss some of its properties.

4.A

BRST charge for deformed Lie algebras.

Č. Burdík

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We define Cartan differential calculus on the Hopf algebra $\mathcal{A}$ by considering the Heisenberg double of two exterior Hopf algebras: one of which is an exterior extension of $\mathcal{A}$ (i.e. $\mathcal{A}$ is extended by adding the algebra of differential forms over $\mathcal{A}$) and another one is an extension of dual algebra $\mathcal{A}^*$ (the algebra of vectors fields and internal derivatives over $\mathcal{A}$). We study the possibility to define the BRST operator for deformed Lie algebras with quadratic terms in the defining relations. These algebras appear as the algebras of vector fields in the context of the covariant differential calculus on $\mathcal{A}$. The BRST operator for $U_q(gl(N))$ is constructed explicitly.

4.A

Quantum Teichmuller spaces and 3D geometry.

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Teichmüller spaces of complex structures of 2D Riemann surfaces with holes are coordinatized in terms of graphs. The physical observables, i.e., the lengths of closed geodesics on the Riemann surface are parameterized through these coordinates. The Poisson relations and their natural quantization is proposed. The Poisson algebra of geodesics as well as the skein relations between them are the Goldman–Turaev relations. The action of the mapping class group is constructed and the quantum mapping class transformations that satisfy the pentagon relation are found. For the selected basis of geodesics, the classical and quantum Nelson–Regge algebras appear. The quantum version of this algebra is a quantum deformation $SO_q(n)$ algebra for the Riemann surfaces of arbitrary genus and one and two punctures. These algebras are also algebras of observables of 3D Chern–Simons theories.

31.A

Induced representations of quantum kinematical algebras.

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We present in this communication a systematic method for constructing induced representations of quantum algebras. Our procedure uses the concepts of module and comodule, and is based on the existence of a pair of Hopf algebras with a nondegenerate pairing and dual bases. As an application we obtain the induced representations of some quantum deformations of the Poincaré and Galilei algebras in (1+1) dimensions.

31.A

Seurch for Quantum Clifford–Hopf Algebras.

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Quantum Clifford algebras – i.e. Clifford algebras of bilinear forms – showed up to be extremely useful in a more algebraic and geometric motivated approach to quantum field theory. Their usage prevents a certain type of singularity to occur. But, a second algebraic structure important in quantum field theory are Hopf algebras, used mainly in statistical physics, integrable systems and recently in the theory of renormalization of perturbative quantum field theories. There is a deep hope that Hopf algebra structures can provide a generic and mathematical rigorous way to renormalization theory.

The present paper provides strong evidence, that the no-go theorem of Rota for the construction of Clifford-Hopf algebras might not be true for quantum Clifford algebras. Quantum Clifford bigebras are constructed, the need of an antipode, thereby defining a Hopf algebra structure, is outlined.

1.A

Unbraiding the braided tensor product.

Gaetano Fiore

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We show that the braided tensor product of two module algebras A_1, A_2 of a quasitriangular Hopf algebra H is equal to the ordinary tensor product of A_1 with an algebra isomorphic to A_2, provided there exists a realization of H within A_1. In other words, under this assumption there exists a transformation of generators which 'decouples' A_1, A_2 (i.e. makes them commuting). As applications of the theorem we consider the braided tensor product of two or more quantum group covariant quantum Euclidean spaces or deformed Heisenberg algebras.

4.A

Sigma- models on the quantum group manifolds in low undeformed space-time dimensions and variational calculus.

V.D. Gershun

NSC Kharkov Institute of Physics and Technology, Kharkov, Ukraine

WZNW $SLq(2,R)$ model and sigma-models on the $SLq(2,R)$, $SLq(2,R)/Uq(1)$, $Cq(2I0)$ quantum group manifolds in low undeformed space-time dimensions are considered. The Lagrangian formalism over the quantum group manifolds is discussed. The infinitesimal transformations of the generating elements of the quantum matrix qroup are obtained. The variational calculus on the $SLq(2,R)$ group is considered.

1.A

Possible contractions of quantum orthogonal groups.

N.A. Gromov, I.V.Kostyakov, V.V.Kuratov

Department of Mathematics, Syktyvkar, Russia

The contracted quantum orthogonal groups are regarded as the algebras of noncommutative functions generated by elements $J_{ik}t_{ik}$, where J_{ik} are some products of of the nilpotent commutative generators of Pimenov algebra $\mathbf{D}(\iota)$. Hopf algebra structure is more rigid as compared with Lie algebra (group) one. Possible contractions of quantum orthogonal groups depend essentiallly on the choice of primitive elements of the Hopf algebra. All such choices are considered for quantum group $SO_q(N)$ and all allowed contractions in Cayley–Klein scheme are obtained. The quantum deformations of the kinematical groups have been investigated and have shown that the quantum analog of the (complex) Galilei group $G(1,3)$ do not exist.

3.A

Quantization of r-matrices related to Belavin-Drinfeld triples.

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An explicit quantization of r-matrices classified by Belavin-Drinfeld triples is provided. It was done by constructing the twisting element F as an operator in square of the Drinfeld-Jimbo quantum universal enveloping algebra. The operator F has been represented as an ordered product of special canonical elements which are defined by the powers of the one-to-one map from the Belavin-Drinfeld triple. Each canonical element of our formula can be factorized further in the spirit of S.Khoroshkin and V.Tolstoy factorized expression for universal R-matrices. Some special examples of Belavin-Drinfeld triples have been considered and corresponding universal twisting operators F are obtained explicitly.

31.A

q-Laplace operator and q-harmonic polynomials on quantum vector space.

A.U. Klimyk, N.Z. Iorgov

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q-Harmonic polynomials on the quantum vector space $\mathcal{V}_n$, generated by q-commuting elements $x_1, x_2, \cdots, x_n$, are studied. They are defined as solutions of the equation $\Delta_q p = 0$, where p is a polynomial of $x_1, x_2, \cdots, x_n$ and the q-Laplace operator Δ_q is determined in terms of q-derivatives on $\mathcal{V}$. A q-analogue of the classical associated spherical harmonics are constructed in explicit form. They constitute an orthonormal basis in the space of q-harmonic polynomials. A q-analogue of separation of variables is given. There are many ways of q-separation of variables. As in the classical case, they are described by using the tree method. Representations of the nonstandard q-deformed algebra $U_q'(\mathrm{so}_n)$ (which plays a role of the rotation group $SO(n)$ in the case of classical harmonic polynomials) on the space of q-harmonic polynomials are explicitly constructed.

1.A

Star products on coadjoint orbits.

Maria A. Lledo

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We study star products on the polynomials of coadjoint orbits of compact Lie groups induced by the multiplication in the enveloping algebra. Their relation to differential star products, and to Kontsevich's and Fedosov's constructions is analysed.

4.A

Local QFT on noncommutative space–time with Hopf algebra structure.

J. Lukierski

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We consider quantum deformations of $D = 4$ relativistic symmetries with Hopf subalgebra of translations describing quantum Minkowski spaces. The case with commuting fourmomentum generators is considered and as the examples we present the κ-deformation of scalar, $\lambda\phi^4$ theory and quantum electrodynamics. The relation with commonly used star product technique is described. The supersymmetric extension of presented scheme is outlined. The results have been obtained with P. Kosiński and P. Maślanka.

1.A

Poincaré Lie algebra and noncommutative differential calculus.

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A realization of Poincare Lie algebra in terms of noncommutative differential calculus was constructed. Corresponding relativistic quantum theory was considered.

1.A

Singularities of the Rational R-matrices.

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Take the rational R-matrix corresponding to the tensor product of any two evaluation modules over the Yangian $\mathrm{Y}(gl_N)$. Under the action of the general linear Lie algebra gl_N this tensor product splits into irreducible components according to the Littlewood-Richardson rule. The R-matrix commutes with this action. We compute the eigenvalues of R-matrix, corresponding to certain multiplicity-free components of this tensor product. We use these eigenvalues to detect the singularities of the rational R-matrix.

3.A

On the factoriazation of the universal $\mathcal{R}$-matrices.

S. Pakuliak, J. Ding, S. Khoroshkin

Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna, Russia

The factorization of the universal $\mathcal{R}$-matrix corresponding to so called Drinfeld Hopf structure is described on the example of quantum affine algebra $U_q(\widehat{sl}_2)$. As a result of factorization procedure we deduce certain differential equations on the factors of the universal $\mathcal{R}$-matrix, which allow to construct uniquely these factors in the integral form.

3.A

Coloured Extension of $GL_q(2)$ and its Dual Algebra.

D. Parashar

Department of Mathematics and Statistics, The University of Edinburgh, Edinburgh, U.K.

We address the problem of duality between the coloured extension of the quantised algebra of functions on a group and that of its quantised universal enveloping algebra *i.e.* its dual. In particular, we derive explicitly the algebra dual to the coloured extension of $GL_q(2)$ using the coloured RLL relations and exhibit its Hopf structure. This leads to a coloured generalisation of the R-matrix procedure to construct a bicovariant differential calculus on the coloured version of $GL_q(2)$. The treatment furnished is general enough to be applicable to the coloured extensions of multiparametric and higher dimensional quantum groups.

31.A

On representations of nonstandard deformation $U_q(so3)$.

S. Posta

Czech Technical University Prague, Prague, Czech Republic

3.A

On Baxter Q-operator.

G. Pronko

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We discuss the construction of Baxter's Q-operator for the homogenious XXX-spin chain. The suggested approach leads to the one-parametric family of Q-operators, satisfying to the wronskian-type relations. Also we have found the generalization of Baxter operators, which defines the nondiagonal part of the monodromy. Further we discuss the construction of Baxter Q-operators for Toda chain.In this case we give the construction of two basic Q-operators and the derivation of the general Wronskian-type relations for these operators. Also we have found the relation of the basic Q-operators with Bloch solutions of the quantum linear problem.

3.A

Dynamical R-matrices in dimension 3.

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Wuth the aim to find out dynamical analougs of the non-canonical constant R-matrices (i.e., the R-matrices corresponding to the non-trivial Belavin-Drinfeld triples) the solutions of the dynamical Yang-Baxter equations are studied in dimension 3. The dynamical R-matrices satisfying the so-called "ice condition" and the Hecke condition are classified. The

results obtained lie beyond the scope of the present classification scheme for dynamical R-matrices.

1.A

Yangians and W-algebras.

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Yangians, which play a great role in the study of integrable systems, are shown to be deeply related to finite W-algebras. This conection allows to carry many informations from one field to the other, such as R-matrices for W-algebras, classification of representations. It reflects also in physical systems, as in the 2d Nonlinear Schrodinger Equation.

The generalisation of this approach, both for twisted Yangians and super Yangians, is also presented.

31.A

Quantum algebra $Uq(3)$: Gelfand-Graev formulas.

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The discrete seria of unitary irreducible representations of the noncompact quantum algebra $Uq(2,1)$ are studied. Two bases of these irreps are considered. One of them corresponds to the reduction $Uq(2,1) \to Uq(2) \times U(1)$. The second basis is connected with the reduction $Uq(2,1) \to U(1) \times Uq(1,1)$ wich was not investigated earlier even fer the standard Lie algebra $U(2,1)$. The matrix elements of the $Uq(2,1)$ generators in both bases are calculated, i.e. the q-analogs of the Gelfand-Graev formulas are obtained. Also the transformation brackets connecting two bases are found. They appear to be an analytical continuation of the Racah coefficients for the $SUq(2)$ algebra.

31.A

Field Theory on the q-deformed Fuzzy Sphere

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We study the q-deformed fuzzy sphere, which is related to D-branes on SU(2) WZW models, for both real q and q a root of unity. We construct for both cases a differential calculus which is compatible with the star structure, study the integral, and find a canonical frame of one-forms. We then consider actions for scalar field theory, as well as for Yang-Mills and Chern-Simons-type gauge theories. The zero curvature condition is solved.

3.A

Integrable Models and a new Hopf algebra structure on $U_{q(sl_2)}$.

A. Stolin

Department of Mathematics, University of Goteborg, Sweden

3.A

Difference equations compatible with trigonometric KZ differential equations.

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Let g be a simple Lie algebra and h be the Cartan subalgebra. Consider the trigonometric KZ differential equations associated with g for a function $u(z_1, \dots z_n)$ taking values in an n-fold tensor product of g-modules. The KZ equations depend on a parameter $\lambda \in h$. They have the form

$$\partial_{z_i} u = \Big(\sum_{\substack{j=1 \\ j \neq i}}^{n} r^{(ij)}(z_i/z_j) + \lambda^{(i)} \Big) u, \quad i = 1, \dots n,$$

where $r^{(ij)}(z_i/z_j)$ are the trigonometric classical r-matrices.

We suggest a system of dynamical difference equations with respect to λ compatible with the KZ equations. The dynamical equations are constructed in terms of intertwining operators of g-modules.

1.A

Super-Drinfeldians and super-Yangians of Lie superalgebras of type $A(n|m)$.

V.N. Tolstoy

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Explicit describtion of super-Drinfeldians and super-Yangians of Lie superalgebras of the type $A(n|m)$ $(= sl(n+1|m+1))$ is given in terms of the Chevalley basis. Construction of a q-analog of Cartan-Weyl basis generators and their permutation relations for the quantum superalgebra $U_q(sl(n+1|m+1)$, which is a subalgebra of the super-Drinfeldian $D_{qr}(sl(n+1|m+1))$, are also presented.

3.A

Double q-state Potts chain: obvious S_q and hidden λ^q symmetries.

M. Yurishchev

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3.3 Symposium on Group Theory and Integrable Systems

4.B

Some exact results for three-dimensional Zamolodchikov model.

H. Boos, V. Mangazeev

Institute for High Energy Physics, Protvino, Russia

We discuss our recent results obtained for the three-layer case of Zamolodchikov model. Namely, we derive the functional relations for the eigenvalues of transfer matrices and get the Bethe ansatz equations from them. We analyse solutions to Bethe ansatz equations for two different regimes of spectral parameters. We accept a two-string hypothesis for the first regime and one-string hypothesis for the second one. In thermodynamic limit we derive the integral equations for the distribution densities and solve them exactly. We calculate the partition function and check the compatibility of this result with the functional relations. We also do some numeric checkings of the plausability of our results.

1.B

Nambu dynamical system. The case of many triplets.

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The Nambu dynamical system defines a natural extension of Hamiltonian dynamics allowing for odd dimensional phase space.In an atempt to follow the geometric description description of a Hamiltonian system an extension of the Cartan calculus is presented that allows the geometric description of a Nambu system described in terms of many triplets. The extension is characterized by an exterior product that has mixed symmetry under exchange of its factors. With this extension it is shown that all powers of the canonical 3-form are invariant under the action of the vector field associated to the Nambu system.

3.B

Time-dependent Hamiltonians with conserved Runge-Lenz vectors

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We investigate the conservation of the formally time-dependent Runge-Lenz vector $\{\vec{\xi} \equiv \vec{\pi} x \mathbf{L} - m\alpha\hat{r}$ of Katzin and Levine, where $\vec{\pi} \equiv m(U(t)\mathbf{v} - \dot{U}(t)\mathbf{r}$. We show that the orbits are modulated ellipses, for which $\vec{\xi}$ is the usual *eccentricity vector* of the basic conserved ellipse. We show that the ξ_i and angular-momentum operators L_{ij} yield the positive part of affine Kac-Moody algebras. However, the role of the Hamiltonian H, which is not conserved, is now played by a new conserved scalar quantity, which we call H_0.

3.B

Class of solvable potentials related to $SO(2,2)$

A. Dalgic, G. Kerimov

University of Trakya, Edirne, Turkey

Scattering problems in one dimension related to unitary irreducible class I representations of the SO(2,2) group are discussed. The S-matrix for systems under consideration are calculated by using of theory of intertwining operators for semi-simple Lie groups. The wave functions are expressed in terms of unitary irreducible principal series representation matrix elements of SO(2,1) group in subgroup or mixed bases.

31.B

Polynomial Poisson algebras for two dimensional classical superintegrable systems and polynomial associative algebras for quantum superintegrable systems.

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The integrals of motion of the classical two dimensional superintegrable systems close in a restrained polynomial Poisson algebra, whose the general form is discussed. Each classical superintegrable problem has a quantum counterpart, a quantum superintegrable system. The Polynomial Poisson algebra is deformed to a polynomial associative algebra, the finite dimensional representations of this algebra are calculated by using a deformed parafermion oscillator technique. It is conjectured that, the finite dimensional representations of the polynomial algebra are determined by the energy eigenvalues of the superintegrable system. The calculation of energy eigenvalues is reduced to the solution of algebraic equations, which are universal for a large part two dimensional superintegrable systems.

3.B

The Exact Solution of the Cauchy Problem for a Generalized "Vinear" Vectorial Fokker-Plank Equation:Algebraic approach.

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The exact solution of the Cauchy problem for a generalized "linear" vectorial Fokker-Plank equation is found using the disentangling techniques of R.Feynman and algebraic (operational) methods.

3.B

On the structure of the Calogero-Moser r-matrices.

L. Feher, B.G. Pusztai

Department of Theoretical Physics, Szeged University, Hungary

We report our recent work math-ph/0005021, where a complete description of the non-dynamical r-matrices of the degenerate gl_n Calogero-Moser models has been derived by an analysis of the gauge transformations of the standard Lax representation. We also describe the connection between the results of our analysis and the degenerations of Hasegawa's treatment of the Ruijsenaars models based on a realization of the $R_{12}T_1T_2 = T_2T_1R_{12}$ relation with Belavin's elliptic R-matrix.

4.B

Symmetry properties and explicit solutions of the generalized Wierstrass system.

Michel Grundland

Universite' de Montreal, Canada

The Method of symmetry reduction is systematically applied to derive several classes of invariant solutions for the generalized Weierstrass system inducing constant mean curvature surfaces and to associated two-dimensional nonlinear sigma model. A classification of subgroups with generic orbits of codimension one of the Lie point symmetry group for these systems provides a tool for introducing symmetry variables and reduces the initial systems to different nonequivalent systems of ordinary differential equations. We perform a singularity analysis for them in order to establish whether these ordinary differential equations have the Painleve property. These ordinary differential equations can then be transformed to standard forms and next solved in terms of elementary and Jacobi elliptic functions. This results in a large number of new solutions and in some cases new interesting constant mean curvature surfaces are found. Furthermore, this symmetry analysis is extended to include conditional symmetries by subjecting the original systems to certain differential constraints. In this case, several types of nonsplitting algebraic, trigonometric and hyperbolic multi-soliton solutions have been obtained in explicit form. A new procedure for constructing solutions of the overdetermined system which is composed of the generalized Weierstrass system and the complex eikonal equations is studied.

4.B

Invariants of linear combinations of transpositions.

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It is shown that for some one-parameter set $\mathcal{H}_N$ of linear combinations of $N(N-1)/2$ elementary transpositions $\{P_{jk}\}$ $(1 \le j < k \le N)$ at arbitrary natural $N \ge 3$ one can construct a variety $\{I_m\}$ $(3 \le m \le N)$ of operators which commute with $\mathcal{H}_N$. Being applied to $SU(n)$ spin representations of the permutation group, this proves the integrability of 1D periodic spin chains with elliptic short-range interaction.

31.B

Completeness of Multiseparable Superintegrability in $E(2C)$.

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The property that Schrödingers equation with a given potential can separate in more than one coordinate system is intimately related with the notion of superintegrability. Examples of this type of potential are well known. (E.G. The Coulomb potential). The question arises as to just what is the exact relationship between these two ideas. In two dimensions we show that all nondegenerate superintegrable potentials which are superintegrable are also multiseparable. In addition we also establish that each of the potentials that we find generate a quadratic algebra.

1.B

Intertwining Operators and S-matrix.

G.A. Kerimov

International Centre for Physics and Applied Mathematics, Trakya University, Edirne, Turkey

Class of one-dimensional N-body systems related to semisimple Lie groups G is studied. The Hamiltonians of these systems are expressed in terms of Casimir operators (or, equivalently, Laplace-Beltrami operators on symmetric spaces) of underlining symmetry groups G. It turns out that the S-matrix for all these problems is related to the intertwining operators for groups G. This connection provides immediately the functional form of the S-matrix. Moreover, this connection allows to prove that the multiparticle S-matrix elements can be expressed in terms of two-particle ones.

31.B

Kowalevski's top and its generalizations in classical and quantum mechanics.

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We present a review of some results on Kowalevski's top (KT) in classical and quantum mechanics.

The following items are considered: (1) the generalized KT (GKT) on Lie algebras $so(4), e(3)$ and $so(3,1)$; (2) Kowalevski's gyrostat on these algebras; (3) Action of the GKT; (4) Quantum counterparts of the KT; (5) Semiclassical quantization of the GKT; (6) Generalization of the KT by Chaplygin and Goryachev at $l = 0$, its Lax representation.

Unsolved questions are also discussed.

3.B

Integrable hierarchies via D-bar dressing method.

B.G. Konopelchenko

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Within the framework of the D-bar dressing method the bilinear relations are derived which allow us to construct hierarchies of integrable equations in different parametrizations, their Darboux-Backlund transformations and to analyze various types of constraints for them in a very simple way. Scalar AKP, BKP and CKP hierachies are discussed.

31.B

Multiseparability and Superintegrability in Three Dimensions.

J.M. Kress, E.G. Kalnins

Department of Mathematics, University of Waikato, Hamilton, New Zealand

In complex two-dimensional Euclidean space, the Hamilton-Jacobi or Schrödinger equation with a given "nondegenerate" potential is maximally superintegrable if and only if it separates in more than one coordinate system. A similar statement for three dimensions is not known. In this talk, a start will be made on this problem by investigating the known separable Hamilton-Jacobi and Schrödinger systems to find those that are superintegrable.

31.B

An algebraic treatment of the MIC-Kepler problem on the sphere S^3.

Yu.A. Kurochkin, A.A. Bogush, V.V. Gritsev and V.S. Otchik

National Academy of Science of Belarus, Minsk, Republic of Belarus

The quantum-mechanical problem of motion in the dual charged Coulomb field modified by a centrifugal term (MIC-Kepler problem) is considered in the three-dimensional space of constant positive curvature S^3. Conserved operators are found, and their commutation relations are derived. It is shown that in the MIC-Kepler problem in the space S^3, conserved operators form a cubic algebra similar to that of the Kepler problem in the same space. This symmetry algebra is used to obtain the energy spectrum of the problem.

1.B

Integral representations for the eigenfunctions of quantum open and periodic Toda chains from QISM formalism.

D. Lebedev, S. Kharchev

Institute for Theoretical and Experimental Physics, Moscow, Russia

The integral representations for the eigenfunctions of N particle quantum open and periodic Toda chains are constructed in the framework of Quantum Inverse Scattering Method. Both periodic and open N-particle solutions have essentially the same structure being written as a generalized Fourier transform over the eigenfunctions of the $N-1$ particle open Toda chain with the kernels satisfying to the Baxter equations of the second and first order respectively. In the latter case this leads to recurrent relations which result to representation of the Mellin-Burnes type for solutions of an open chain. As byproduct, we obtain the Gindikin-Karpelevich formula for the Harish-Chandra function in the case of $GL(N,R)$ group.

4.B

A_3 Jack polynomials: An exact construction of the separating operator.

V. V. Mangazeev

The Australian National University, Canberra, Australia and
Institute for High Energy Physics, Protvino, Russia

We analyze a Calogero-Sutherland model for A_3 case. Using Sklyanin's conjecture on a separation of variables we obtain a system of partial differential equations for the kernel of the separating operator. We construct an exact integral representation for a solution of this system.

3.B

Integrable ODE's on associative algebras.

A. Mikhailov

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4.B

Classical mechanics on $GL(n,R)$ group and Euler-Sutherland model.

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The relations between the free motion on $GL^+(n,R)$ manifold and the dynamics of n-particle system with spin degrees of freedom on line interacting with pairwise $1/\sinh$ potential (Euler-Sutherland model) is discussed in the framework of Hamiltonian reduction. Two kinds of reductions of the degrees of freedom are considered: due to the continuous invariance and due to the discrete symmetry. It is shown that after projection on the corresponding invariant manifolds the resulting Hamiltonian represents the Euler-Sutherland model in both cases.

31.B

How to relate the oscillator and Coulomb systems on (pseudo)spheres?

A. Nersessian, G.S. Pogosyan

Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna, Russia

It is shown, that the oscillators on a sphere and pseudosphere are related, by the so-called Bohlin transformation, with the Coulomb systems on the pseudosphere: the even states of an oscillator yields the conventional Coulomb system on pseudosphere, while the odd states yield the Coulomb system on pseudosphere in the presence of magnetic flux tube, generating half spin. A similar relation is established for the oscillator on (pseudo)sphere specified by the presence of constant uniform magnetic field B_0 and the Coulomb-like system on pseudosphere specified by the presence of magnetic field $B(|x_3/\mathbf{x}|-\epsilon)/2r_0$. The coorrespondence between oscillator and Coulomb systems in the higher dimensions is also discussed.

3.B

RPA equation embedded into infinite-dimensional Fock space F_∞.

S. Nishiyama, T. Komatsu

Centro de Física Teórica, Universidade de Coimbra, 3000-Coimbra, Portugal and
Department of Physics, Kochi University, Kochi 780-8520, Japan

We attempt to embed Hartree-Fock (HF) u_n Lie algebra into gl_∞ with the aid of Laurent expansion of finite-dimensional fermion operators in terms of parameter z. Then the time dependent HF (TDHF) equation on the finite-dimensional Grassmannian is embeded into the infinite-dimensional Grassmannian. We give a formulation of the TDHF theory on the τ-functional space. To clear both algebraic and geometrical structures for integrable systems derived from the TDHF theory, particularly geometrical aspect of the random phase approximation (RPA) equation is exhibited from the viewpoint of symmetry of evolution equation. The RPA equation for an infinite-dimensional Grassmannian can be constructed. It gives us a simple geometrical interpretation that the collective sub-manifold is a rotator on curved surface.

4.B

Classical and algebraic Hamiltonians with $SU(3)$ symmetry.

M. Novaes, J.E.M. Hornos

Instituto de Física de São Carlos - Universidade de São Paulo - Brazil

We explicitly calculate the coherent state for an arbitrary representation of the $su(3)$ algebra, using the coset spaces $SU(3)/U(2)$ and $SU(3)/U(1)\mathrm{x}U(1)$. A classical Hamiltonian is obtained, for the symmetric representations, corresponding to the Casimir operator of the $su(2)$ connonicaly contained in $su(3)$ plus a Majorana-like term that is the Casimir operator for the non-cannonical $so(3)$ subalgebra. A parameter ϵ controls the coupling between the two symmetries. Our preliminary results show that the classical motion is integrable, regardless the value of ϵ.

4.B

Astrophysical application of Hamilton-Jacobi group.

Lochlain O'Raifeartaigh

School of Theoretical Pysics, Dublin Institute for Advanced Studies, 10 Burlington Rd, Dublin, Ireland

4.B

Invariant discription of local symmetries.

Vladimir P. Pavlov

Steklov Mathematical Institute, Moscow, 117966, Russia

3.B

Birational symmetry and integrability of functional equations defined by birational maps.

K.V. Rerikh

Bogoliubov Laboratory of Theoretical Physics, JINR, 141980 Dubna, Russia

31B

Quantum Bound States Embedded in Continuum and Their Classical Analogues.

A.M. Shirokov[1], *N.A. Sveshnikov*[1], *D.L. Pursey*[2]

[1] *Skobeltsyn Institute for Nuclear Physics, Moscow State University, Moscow, Russia*
[2] *Department of Physics and Astronomy, Iowa State University, Ames, IA 50011, USA*

Bound states embedded in continuum (BSEC) in quantum and classical systems are discussed. Mechanisms of formation of BSEC in quantum and classical cases are shown to be very different. As a result, as a rule, a system that supports BSEC in the quantum case does not support it in the classical case and vice versa.

We show that the trapping of a classical dipole by an external magnetic field can be treated as an nontrivial classical analogue of the quantum BSEC. The trapping of the dipole takes place when an integral of motion I takes a particular value only, the classical motion of the dipole becomes finite but there are no classical turning points in the system. The quantization of this problem and possible signals of BSECs are discussed.

3.B

Quasigraded Lie algebras, hyperelliptic curves and integrable systems.

T.V. Skrypnyk

Bogoliubov Institute for Theoretical Physics, Kiev, Ukraine

A new family of infinite-dimensional quasigraded Lie algebras is constructed. We indicate on the connection of these algebras with the hyperelliptic curves and explicitly find their central extensions. We also show, that constructed algebras in the case of zero central charge possess infinite number of invariant functions. Besides, they admit a decomposition into the direct sum of two subalgebras. These two facts together enables one to use them to construct new finite-dimensional (mechanical) and infinite-dimensional (field-theoretical) integrable systems. In such a way we find new integrable hamiltonian systems, wich are direct higher rank generalizations of the integrable systems of Steklov-Liapunov, associated with the $e(3)$ algebra and Steklov-Veselov associated with the $so(4)$ algebra. Low rank examples of infinite dimensional integrable systems are also discussed.

1.B

Lax pair formulation of the $N = 4$ Toda chain (KdV) hierarchy in $N = 4$ superspace.

A. Sorin, F. Delduc

Bogoliubov Laboratory of Theoretical Physics, JINR, 141980 Dubna, Russia

Lax pair and Hamiltonian formulations of the $N = 4$ supersymmetric Toda chain (KdV) hierarchy in $N = 4$ superspace are proposed. The general formulae for the infinite tower of its bosonic flows in terms of the Lax operator in $N = 4$ superspace are derived. A new $N = 4$ superfield basis in which the flows are local is constructed. A rigorous proof that the flows possess three nonequivalent complex conjugations and an infinite-dimensional group of discrete symmetries in $N = 4$ superspace is presented. A relation between the two descriptions of the hierarchy in $N = 4$ superspace used in the literature is established. The equivalence of all known $N = 2$ superfield representations of the $N = 4$ KdV hierarchy is demonstrated in $N = 4$ superspace.

1.B

Supersymmetry and solvable periodic potentials.

U. Sukhatme, A. Khare

Physics Department, University of Illinois at Chicago, Chicago, Illinois 60607-7059, USA

We use the formalism of supersymmetric quantum mechanics to considerably enlarge the limited class of analytically solvable one-dimensional periodic potentials. In particular, we derive and discuss the energy band structure of the Lamé potentials

$ma(a+1)sn^2(x,m)$ and the associated Lamé potentials

$$ma(a+1)sn^2(x,m)+mb(b+1)cn^2(x,m)/dn^2(x,m).$$

Their supersymmetric partners can often be computed, yielding new solvable potentials with exactly the same energy band structure.

4.B

Exactly soluble potentials for Schrödinger equation.

A.A. Suzko

Joint Institute for Nuclear Research, Dubna, Russia

Methods of algebraic Darboux and Bargmann transformations are useful techniques to obtain exactly soluble potentials in quantum mechanics. It is shown that Bargmann transformations, related to the inverse scattering problems, have much in common with the method of generating isospectral Hamiltonians. Factorization method and the technique of algebraic transformations is used for constructing a number of multiparameter exactly solvable models. A procedure is elaborated of constructing exactly soluble time-dependent models as a generalization of exactly soluble time-independent ones.

31.B

Maupertuis principle and integrable systems.

A. Tsiganov

St.Petersburg University, Petersburg, Russia

Usually solution of the Hamilton-Jacobi equation is an n-dimensional Lagrangian submanifold depending on the n values of integral of motion and some arbitrary parameters. Using these parameters (charges) we can relate various integrable models associated with the different parametric forms of the common Lagrangian manifold. These systems have many common properties and some different features in classical and quantum mechanics.

On the other hand, the same free parameters may be applied to the search of the separated variables.

1.B

Solvablility of integrable systems.

A. Turbiner

Nuclear Physics Institute, National University of Mexico, Mexico

A notion of exactly-solvable spectral problem is introduced. It is shown that all A-B-C-D Perelomov-Olshanetsky quantum integrable multidimensional Hamiltonians (rational and trigonometric), in other words, the Harish-Chandra theory emerge from a single quadratic polynomial in generators of the maximal affine subalgebra of the sl(n)-algebra taken in the simplest representation. The coefficients of the polynomial keeps memory about A-B-C-D origin of the problem we study. It appears due to a non-trivial insight to the above Hamiltonians from the viewpoint of the theory of symmetric polynomials. Corresponding isospectral spectral problems for finite-difference operators are presented. Underlying Fock space formalism giving rise this correspondence is uncovered. Anharmonic perturbations of above systems admitting an algebraic consideration are briefly mentioned.

3.B

Integrable Schröedinger operators with magnetic fields and differential geometry in two dimensions.

A.P. Veselov

Loughborough University, Loughborough, U.K.

Integrability of Schroedinger operators with magnetic fields in two dimensions in relation with differential geometry will be discussed. Some new examples of such operators found recently by E.V. Ferapontov and the speaker will be presented.

31.B

Generalized Lie symmetries and superintegrable systems in quantum mechanics.

P. Winternitz

Universite' de Montreal, Montreal, Canada

A classical or quantum Hamiltonian system with N degrees of freedom is called superintegrable if it allows more than N integrals of motion. A systematic search for such systems was initiated about 30 years ago. Here we show how the concept of superintegrability fits into classical Lie theory. We introduce vector fields, the second prolongation of which annihilates the Schroedinger equation on its solution set (for $N = 2$). If their coefficients depend on first derivatives of the wave function we obtain point symmetries. If they depend on higher derivatives, we obtain generalized Lie symmetries. In particular the presence of second derivatives leads to potentials that allow the separation of variables. The existence of two Lie symmetries of second order, or one of first and one of second order, is equivalent to superintegrability. The results reported here were obtained in collaboration with M.Sheftel and P.Tempesta.

1.B

New exactly solvable quantum models.

B. Zakhariev

Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna, Russia

1.B

Eigenvalue expansions associated with nonlinear Schrödinger equations.

P.E. Zhidkov

Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna, Russia

We consider a number of nonlinear Schrödinger-type eigenvalue (and also boundary-value) problems and establish results on basis properties in spaces like L_2 for systems of eigenfunctions (resp., solutions) of these problems. For example, consider the eigenvalue problem
$-u'' + f(u^2)u = \lambda u,\ u = u(x),\ x \in (0,1),$
$u(0) = u(1) = 0,\ ||u||_{L_2(0,1)} = 1$
where all quantities are real, $\lambda \in R$ is a spectral parameter, and f is a given function. Then, the result is that, under certain hypotheses on f of general type, this problem has a denumerable set of eigenfunctions which form a basis in the space $L_2(0,1)$.

1.B

Solvable PT symmetric Hamiltonians.

M. Znojil

NPI, 250 68 Řež, Czech Republic

Numerical experiments indicate that many non-Hermitian complex Hamiltonians with a parity × time-reversal symmetry possess a discrete and real spectrum which is bounded below. We shall discuss this mathematical peculiarity with a (promising though not yet fully clarified) physical applicability in quantum mechanics, field theory and particle physics. Main attention will be paid to a review and study of a variety of exactly solvable illustrative examples.

Note added in proof: Recently, one of the most surprising consequences of the replacement of Hermiticity by mere PT symmetry has been found within the Witten's supersymmetric quantum mechanics: After its PT symmetric generalization, the so called Witten index can vanish (i.e., one assigns a normalizable supersymmetric partner to all states including the ground state).

3.4 Symposium on Group Theory and Path Integrals

4.C

Convergent Feynman-type integrals for coherent matrix elements for quantum evolution of interacting fields in any space-time dimension.

A. Dynin

Department of Mathematics, Ohio State University, Columbus, Ohio 43221, USA.

Functional Schrödinger equations for coherent states of interacting fields are solved via convergent Feynman type integrals.

4.C

Dual formulation of $SU(2)$-gluodynamics and confinement.

D. Ebert[1], *D. Antonov* [2]

Institut für Physik, Humboldt-Universität, Berlin, Germany
[2] *INFN-Sezione di Pisa, Universita degli studi di Pisa, Dipartimento di Fisica, Pisa, Italy*

A dual version of $SU(2)$-gluodynamics with manifest monopole-like excitations, arising from the integration over singular gauge transformations, is formulated in the continuum limit. The resulting effective theory emerges due to the summation over the grand canonical ensemble of these excitations in the dilute gas approximation. This effective theory is then used for the construction of the effective potential of monopole loop currents and the string representation. Finally, the confining properties of this model are discussed.

4.C

Path integration for a q-deformed free particle.

A. Inomata, J.C. Kimball and C. Pigorsch

Department of Physics, State University of New York at Albany, Albany, NY 12222, USA

As for our curved space problem, I was not sure what you wanted. I thought about path integration in the u-variables. However, I failed. Instead, I was thinking about treating it semiclassically within the framework of supersymmetric quantum mechanics. Although I have not yet put my calculations together, we may discuss it while I am in Dubna. If you have something else in mind, please let me know. I will think about your idea.

4.C

Geometric derivation of nonlinear sigma model for the $1D$ antiferromagnet.

E. Kochetov

Bogoliubov Laboratory of Theoretical Physics, JINR, 141980, Dubna, Russia

It is argued that a purely geometric derivation of the long-range action for the $1D$ antiferromagnet is available in terms of a Kähler potential of the underlying phase-space manifold. The derivation allows for a natural extension to the $t-J$ model. In particular it follows that a relevant longwavelength action of the $t-J$ model at least at the susy ($J=2t$) point maintains the $su(2|1)$ invariance rather than the $so(5)$ one.

4.C

Perspective of coherent state path integrals.

H. Kuratsuji

Department of Physics, Ritsumeikan University, Kusatsu City, 525-8577, Japan

A brief review is given of path integral in the representation of generalized coherent state. The content is as follows:

(i) Introductory remark (based on personal viepoint);

(ii) Many-particle system and path integral in the unitary group coherent state;

(iii) Semiclassical quantuzation;

(iv) Geometric phase and coherent state path integral;

(v) Recent topics; atomic bose condensate using the Bloch state.

4.C

Topology and perturbation theory.

J. Manjavidze, A.N. Sissakian

Joint Institute for Nuclear Research, 141 980 Dubna, Russia

The fields nonlinear modes quantization scheme is described. It is shown first of all that the path integrals for absorption part of amplitudes are defined on the Dirac (δ-like) functional measure. This permits arbitrary transformation of the functional integral measure. New form of the perturbation theory achieved by mapping the quantum dynamics in the coset space W_G. It is shown that the transformed perturbation theory contributions are accumulated exactly on the boundary ∂W_G. The consequences of this result are illustrated by the Coulomb problem and sin-Gordon model. It is shown by explicit calculations that the semiclassical approximation for this models is exact since ∂W_C are 'empty'.

4.C

Method of collective degrees of freedom in spin coherent state path integral.

J. Shibata[1], *S. Takagi*[2]

[1] *Department of Physics, Tohoku University, Sendai 980-8578, Japan*

[2] *Fuji Tokoha University, Fuji, 417-0801, Japan*

We present a detailed field theoretic description of those collective degrees of freedom (CDF) which are relevant to study macroscopic quantum dynamics of a quasi-one-dimensional ferromagnetic domain wall. We apply spin coherent state path integral (SCSPI) in the proper discrete time formalism (a) to extract the relevant CDF's, namely, the center position and the chirality of the domain wall, which originate from the translation and the rotation invariances of the system in question, and (b) to derive effective action for the CDF's by elimination of environmental zero-modes with the help of the *Faddeev-Popov technique*. The resulting effective action turns out to be such that both the center position and the chirality can be formally described by boson coherent state path integral. However, this is only formal; there is a subtle departure from the latter.

4.C

Reduction procedure in path integrals on manifold with group action.

S. Storchak

Institute of High Energy Physics, Protvino, Russia

4.C

Non-translation invariant Path Integral for Bose-condensate.

V. Yarunin

Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna, Russia

Parallel Sessions

3.5 Lie Groups, Representation Theory and Special Functions

4.D

Character tables as arrays.

L.L. Boyle

University Chemical Laboratory, Canterbury, Kent, England

The construction of character tables is often approached by finding sets of matrices which form the irreducible representations of the group under study. The characters are then the traces of the matrices. In principle the matrices corresponding to any representations of dimension higher than 1 are not unique although the characters, being invariants, are unique. In this contribution the character table is regarded as an array which is restricted by certain conditions which were mostly defined by Frobenius and can be found conveniently listed in standard textbooks such as J.S.Lomont's *Applications of Finite Groups*. It is interesting to note that, in the case of groups of low dimension, very few arrays satisfy the group-theoretical conditions and hence the problem of generating the character tables is considerably reduced. In the case of groups of order 8, only 4 arrays satisfy the criteria while there are five distinct abstract groups. Even the character table such as that of the icosahedral rotation group which is the simple group of order 60, can be constructed very rapidly as an array.

Needless to say, advanced computational programs such as GAP have eliminated the need to construct the character tables of finite groups by hand although many will find it quicker to construct a table as an array faster than learning how to comprehend the manual in order to use GAP. However, the analysis presented is aimed at the problem of constructing the character tables of infinite groups of physical interest such as space groups where the principles underlying the construction of suitable arrays can be used to obtain the blocks.

4.D

On the use of the Lie group technique for finding approximate solutions of differential equations.

G.I. Burde

Ben-Gurion University, Jacob Blaustein Institute for Desert Research, Israel

An extension of the Lie group method is introduced to construct approximate solutions of partial and ordinary differential equations with a small parameter. The approach differs from that developed by Baikov, Gazizov and Ibragimov as the approximate symmetry group method (e.g., Baikov et al. (1989)). The method is used to obtain approximate solutions for some differential equations.

REFERENCES

Baikov V.A., Gazizov R.K. and Ibragimov N.H. 1989 Itogi Nauki i Tekhniki, Seriya Sovremennye problemy Mathematiki, Noveishie Dostizheniya **34** 85-147 (Engl. transl. 1991 *J. Sov. Math.* **55** 1450-85).

3.D

Grassmannian Special Functions and Graded Heisenberg Group.

A. Frydryszak

Institute of Theoretical Physics, Univeesity of Wroclaw, Wroclaw, Poland

I will discuss a generalization of the methods used in the description of representations of the Heisenberg group to the graded (supersymmetric) case, in particular the Grassmannian special functions of the Hermite and Laguerre type.

4.D

Completion to involution as a general method for computing Lie symmetries of differential equations.

V.P. Gerdt

Laboratory of Computing Techniques and Automation, JINR, 141980 Dubna, Russia

In this talk we present basic ideas, concepts and constructive methods for analysis and solving systems of differential equations based on their transformation (completion) to the canonical form called involutive. The practical importance of the involutive methods and algorithms is illustrated by their application to the Lie symmetry analysis of nonlinear differential equations. In particular, this allows one to find the size of Lie symmetry group without explicit integration of the determining system for the symmetry generators.

4.D

Three-dimensional curves and analytic solutions for two-level systems.

A. Mann, L. Carmel

Department of Physics, Technion - Israel Institute of Technology, Haifa 32000, Israel

A connection is exhibited between two-level quantum systems and curves in three-dimensional space, and association is found between three-parameter

families of two-level hamiltonians and special spatial curves dubbed canonical curves. Knowing a canonical curve facilitates analytic solutions of the associated hamiltonians. The general four-parameter set of two-level hamiltonians can be subdivided into sets of three-parameter families, with the members of each family sharing a common solution. The known (to us) analytically solvable models are associated with only three canonical curves. One can exploit these basic solutions to derive many other analytically solvable models. An algorithm for approaching new problems is formulated.

4.D

On the tree method in category theory.

S.S. Moskaliuk

Bogolyubov Institute for Theoretical Physics, Kiev, Ukraine

The remarkable feature of tree method is its "universality" in some sense. It means that tree conserves only general structural properties and ignores specific ones. So, the universality of such construction makes it natural to use the language of category theory. Some examples are presented.

4.D

Fermionic representation for basic hypergeometric functions related to Schur polynomials.

A.Yu. Orlov, D.M. Scherbin

Department of Mathematics, Faculty of Science, Kyoto University, Kyoto 606-85-02, Japan

We present the fermionic representation for the q-deformed hypergeometric functions related to Schur polynomials considered by S.Milne. For $q = 1$ these functions are also known as hypergeometric functions of matrix argument which are related to zonal spherical polynomias for $GL(N,C)/U(N)$ symmetric space. We show that these multivariate hypergeometric functions are tau-functions of the KP hierarchy, and at the same time they are the ratios of Toda lattice tau-functions. The variables of the hypergeometric functions are related to the higher times of those hierarchies via Miwa change of variables. The discrete Toda lattice variable shifts parameters of hypergeometric functions. Hypergeometric functions of type ${}_pF_s$ can be also viewed as group 2-cocycle for the ΨDO on the circle of the order $p - s \leq 1$ (the group times are higher times of TL hierarchy and the arguments of hypergeometric function). We get the determinant representation and the integral representation of special type of KP tau-functions, these results generalize some results of Milne about multivariate hypergeometric functions. We write down a system of partial differential equations for these tau-functions (string equations). We present also fermionic representation for special type of Gelfand-Graev hypergeometric functions.

3.D

New poblems and possibilities resulting from the recent classification of gradings of clasiccal simple Lie algebras.

J. Patera

Universite' de Montreal, Montreal, Canada

3.D

On Fine Gradings and their Symmetries.

E. Pelantová, M. Havlíček, J. Patera and J. Tolar

Department of Mathematics, Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University, 120 00 Prague 2, Czech Republic

In this talk fine gradings of $\mathrm{sl}(n,C)$ associated with the Pauli matrices in n dimensions are studied with the subsequent graded contractions of $\mathrm{sl}(n,C)$ in view. It is shown that the discrete symmetries of the grading involve the metaplectic representation of $\mathrm{SL}(2,GF[n])$ (where $n \geq 2$ is a prime). These symmetries may serve to simplify the system of contraction equations.

4.D

Kinematical bounds on optimization of observables for quantum systems, the question of their dynamical realizability and Lie groups

S.G. Schirmer

Quantum Processes Group, The Open University, Milton-Keynes, MK7 6AA, UK

The constraint of unitary evolution for non-dissipative quantum systems imposes kinematical bounds on the expectation value of arbitrary observables for mixed-state quantum systems. Using results for control systems on Lie groups, one can show that these kinematical bounds are dynamically realizable if the quantum system is completely controllable. For partially controllable systems the dynamical realizability of the kinematical bounds depends on the structure of the accessible sets of the associated control system on the unitary group $U(N)$. In this talk I shall review the results on kinematical bounds and dynamical realizability and outline the open questions that remain.

4.D

Lie-Poisson (Kirillov) odd bracket on Grassmann algebra.

V.A. Soroka, D.V. Soroka

Institute for Theoretical Physics, NSC "Kharkov Institute of Physics and Technology", 310108 Kharkov, Ukraine

A Lie–Poisson (Kirillov) odd bracket realized solely in terms of Grassmann variables is suggested. It is revealed that with the bracket, corresponding to a semi-simple Lie group, both a Grassmann–odd Casimir function and invariant (with respect to this group) nilpotent differential operators of the first, second and third orders are naturally related and enter into a finite–dimensional Lie superalgebra. A connection of the quantities, forming this Lie superalgebra, with the BRST charge, Δ–operator and operator for the ghost number is indicated.

4.D

A new model for quasicrystals via an affine extension of the noncrystallographic Coxeter groups.

R. Twarock

Arnold Sommerfeld Institut, 38678, Clausthal-Zellerfeld, Germany

4.D

Quasiboson representations of $sl(n+1)$ and generalized quantum statistics.

J. Van der Jeugt, T.D. Palev

Department of Applied Mathematics and Computer Science, University of Ghent, Ghent, Belgium

Generalized quantum statistics will be presented in the context of representation theory of Lie (super)algebras. This approach provides a natural mathematical framework, as is illustrated by the relation between para-Bose and para-Fermi operators and Lie (super)algebras of type B. Inspired by this relation, A-statistics and A-superstatistics are introduced, arising from representation theory of Lie (super)algebras of type A. The Fock representations for $A(n) = sl(n+1)$ provide microscopic descriptions of particular kinds of exclusion statistics, which may be called quasi-Bose statistics. In a similar way, the Lie superalgebra $A(n-1,0) = sl(n/1)$ leads to quasi-Fermi statistics. It is indicated that A-(super)statistics appears to be the natural statistics for certain lattice models (e.g. t-J model in high temperature superconductivity).

3.D

Contracting the Wigner-Kernel of the group $SU(2)$ to the Wigner-Kernel of the Heisenberg-Weyl group.

S. Weigert, J.P. Amiet

Institut de Physique, Université de Neuchâtel Rue A.-L. Breguet 1, CH-2000 Neuchâtel, Switzerland

A general relation between the Moyal formalisms for a spin and a particle is established. Once the formalism has been set up for a spin, the phase-space description of a particle is obtained from the "contraction" of the group of rotations to the group of translations in phase space. This is shown by explicitly contracting the Wigner-kernel for the group $SU(2)$ to the Wigner kernel of a particle, associated with the Heisenberg-Weyl group. In fact, only *one* out of 2^{2s} different possible kernels for a spin shows this behaviour.

3.6 Infinite-Dimensional Symmetries and Supersymmetries

4.A

Non-linear oscillator algebras and higher order supersymmetry.

D.J. Fernandez C.[1], V. Hussin[2]

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[2] *CRM, Université de Montréal, CP 6128, Montréal, H3C 3J7 Canada*

It is shown that the higher order supersymmetric partners of the harmonic oscillator Hamiltonian have natural annihilation and creation operators giving place to polynomial algebras. Departing from these non-linear algebras a linearized Fock representation can be found in which the modified annihilation and creation operators are the closest to the standard oscillator ones.

4.A

Axial-Vector T-Duality in Non Abelian Toda Affine Toda Models.

J.F. Gomes, E.P. Guevoughlanian, G.M. Sotkov and A.H. Zimerman

Instituto de Fisica Teorica, Sao Paulo, Brazil

The general construction of non abelian affine Toda models is proposed in terms of gauged 2-loop Wess-Zumino-Witten (WZW) model. The non abelian structure of the models allows two possible gaugings, axial and vector, leading to pairs of action dual to each other. It is shown by explicit construction (tau function) that both theories admit $U(1)$-electrically charged topological solitons and breathers. A sub class of self dual models was founded in connection with algebras $B_n^{(1)}, A_{2n}^{(2)}$ and $D_{n+1}^{(2)}$ leading to models recently discussed by Fateev.

5.B

Geometry of affine root systems.

I.V. Kostyakov, N.A. Gromov, V.V. Kuratov

Syktyvkar Branch of IMM, Syktyvkar, Russia

We define reflections and root systems in Carroll spaces. It is shown that the Cartan matrixes and reflections groups of these systems are affine. Such realization of affine root systems and their Weyl groups is very descriptive due to utilization of dual numbers.

4.A

N-Extended Supersymmetric Quantum Mechanics of one-particle.

M. Kudinov, V. Akulov, S. Catto

Baruch College and the Graduate School, City University of New York, New York, USA

Supersymmetric Quantum Mechanics (SQM) of one degree of freedom is determined by its generators, supercharge and Hamiltonian, which satisfy the superalgebra $\{Q,\bar{Q}\} = \mathcal{H}$, $\{Q,Q\} = \{\bar{Q},\bar{Q}\} = [Q,\mathcal{H}] = [\bar{Q},\mathcal{H}] = 0$. In this paper N-extended SQM is presented. That is, an explicit form of N supercharges Q_i are found which satisfy the superalgebra. The Hamiltonian of the extended SQM $\mathcal{H}$ is formed by $N+1$ Hamiltonians, which are isospectral with the exception of the lowest levels. The eigenfunctions and potentials for each Hamiltonian are determined by a single function called prepotential, and N arbitrary constants. The values of the constants are fixed by requiring the eigenfunctions to be normalizable.

5.B

Graded contractions of Virasoro algebras.

V.V. Kuratov, N.A. Gromov, I.V. Kostyakov

Syktyvkar Branch of IMM, Syktyvkar, Russia

Graded contractions of Virasoro algebra are described. The highest weight representations are constructed. The reducibility of representations is analysed. In contrast to standart representations the contracted ones are reducible unless some special cases. Moreover there is an exotic module with nullplane on five level. Some possible aplications are briefly discussed.

5.B

Real forms of simple Lie superalgebras of vector fields.

D. Leites[1], I. Shchepochkina[2]

[1] *Department of Mathematics, University of Stockholm, SE-106 91, Stockholm, Sweden*
[2] *Independent University of Moscow, Moscow, Russia*

We announced classification of simple Lie superalgebras of vector fields with polynomial coefficients with Weisfeiler filtration and on supercircles in Leites D., Toward classification of classical Lie superalgebras. In: Nahm W., Chau L. (eds.) *Differential geometric methods in theoretical physics* (Davis, CA, 1988), NATO Adv. Sci. Inst. Ser. B Phys., 245, Plenum, New York, 1990, 633–651 preliminarily and finally in Leites D., Shchepochkina I., Quivers and Lie superalgebras, Czech. J. Phys., vol. 47, n.12, 1997, 1221–1229 and hep-th 9702120. Here we classify the real forms of these algebras.

5.B

Holomorphic BF theories and their symmetries.

A.D. Popov, T. Ivanova

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We consider holomorphic BF theories which give a field-theoretic description of holomorphic structures on bundles over complex n-manifolds. The equivalence of Čech and Dolbeault descriptions of holomorphic bundles is used to develop a method for calculating hidden (nonlocal) symmetries of holomorphic BF theories. A special cohomological symmetry group and its action on the solution space are described.

4.A

Dispersionless supersymmetric two boson hierarchy.

Z. Popowicz

University of Wroctaw, Wroctaw, Poland

We analyze the dispesionless limits of the SUSY TB-B equation and the SUSY TB equation. We present the Lax descripoion for each of these models and shwos how they are conected with the B - extension of integrable models. We clarify the origin of the exotic charges in tehse models.

5.B

New higher order irreducible supersymmetric quantum models.

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Department of Quantum Field Theory, Tomsk State University, Tomsk, Russia

Detailed analysis of second order Darboux transformations for a growing potential of the Schrödinger equation based on transformation functions with eigenenergies higher then the ground state energy is given. New irreducible second-order Darboux transformations which produce regular potentials are found. It is shown that these transformations may both create one or two energy levels and delete one or two energy levels. On this ground new higher order irreducible supersymmetric quantum models are constructed. The main feature of our models is that they have properties inherent to models with both exact and broken supersymmetry at once. We obtain super-Hamiltonians that have two-fold degenerate ground state and nondegenerate excited states. Complete set of their eigenfunctions is given.

4.A

Solving $N = 3$ super-Yang-Mills equations in harmonic superspace.

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The general solution of the N=3, D=4 SYM-equations is analyzed in the framework of the SU(2)/U(1) harmonic superspace. The moduli superspace of general solutions is described by the auxiliary linear harmonic equation with the Grassmann-analytic matrix on-shell prepotential.

3.7 Symmetries of Nonlinear Systems and Quantum Chaos

31.C

Thermodinamics of homogeneous and nonhomogeneous spaces consideration in framework of representation by stochastic density matrix.

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Thermodynamical properties of randomly walking quantum harmonic oscillator are studied. The so called stochastic density matrix is introduced, which is defined as bilinear form of stochastic wave functionals with coefficients determining distribution over initial stationary states. Both the total nonequilibrium distribution function and nonequilibrium distribution functions for individual quantum states are found. For the case of homogeneous space the analitical representations are found for the entropy of the ground state, as well as for the ground state energy, the latter demonstrating both the broadening and the shift of the level. The method of stochastic density matrix is analized in the sense of its application to construction of nonequilibrium quantum statistical mechanics of gas chemically reacting with surfaces.

31.C

On equations solvable by the inverse scattering method.

V.K. Mel'nikov

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A new approach to the problem of finding nonlinear evolution equations solvable by the inverse scattering method for the linear differential operator L is proposed. The starting point of this approach is consideration of all possible evolution equations for the scattering data of the linear operator $\hat{L}$ we use in this problem. For a wide class of linear differential operators all nonlinear evolution equations are found the study of which is reduced to integration of ordinary differential equations describing the evolution of the scattering data of the operator $\hat{L}$ from this class.

31.C

Regular motion in soft chaotic systems: shell effects in octupole deformed nuclei and metallic clusters.

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Finite Fermi systems such as nuclei, metallic clusters and quantum dots exhibit many common properties. A prominent feature is regular single-particle motion, which can manifest itself as pronounced shell effects. Moreover, in these physical systems the interplay between regular motion and quantum signatures of classical chaos can be studied. A three-dimensional harmonic oscillator with general octupole terms is discussed as an example of a common model of mean field for nuclei, clusters and quantum dots. Whereas the problem is nonintegrable, the quantum mechanical spectrum nevertheless shows some shell structure for particular, yet fairly large strengths of octupole deformations. Shell structure which is found for particular combinations of the deformation parameters is explained in terms of dominant classical periodic orbits. Using the 'removal of resonances' method, explicit expressions in terms of the deformation parameters are obtained for effective winding numbers, which in turn generate the quantum shell structure.

31.C

Solitonic deformations in SUSY quantum mechanics?

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Recent studies confirm the presence of the so called *auto-Bäcklund transformation* (BT) in SUSY QM. The BT is a handy tool in non-linear physics and, as is well known, it is the key-stone in the construction of solitonic solutions for the Korteweg-de Vries equation. In this work we investigate the possible applications of the BT in SUSYQM.

31.C

Wave packets, squeezed states and uncertainty relation.

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New type of the wave packet which saves its shape in harmonic potential is proposed in [1]. Such packet shape is similar to the shape of the wave packet respected to the n-state of oscillator. The wave packet

corresponding to squeezed state of quantum oscillator is special case of proposed packet with $n = 0$. So, the coordinate of the center of the wave packet can oscillate with harmonic potential frequency. The width of proposed packet can oscillate with doubled frequency.

In [1] is shown that the time evolution of complex parameter F of such packet is given by the equation of the Riccati type. This equation analytically integrated for attractive and repulsive harmonic potentials. It is shown that the dependence between Re F and Im F is given by circle equation.

In this work the time dependencies for coordinate and momentum uncertainty were obtained for such general type packet. So Heisenberg's uncertainty relation were obtained. It is shown that minimum and maximum of uncertainty relation is linear function of n.

The parametric resonance for width amplification for such packet investigated.

The parametric excitation of oscillations in inverted pendulum (Capitsa pendulum) for proposed packet investigated. The numerical solution shows chaotic character of oscillations in such system. Strange attraktor for ReF and ImF dependence for this case obtained.

[1] "Dynamics of electron packets and photocounts", V.P. Bykov, V.O. Turin, SPIE Proceedings, Vol. 3736, pp.151-168, (1999).

3.8 Superstrings and Quantum Gravity

1.C

Exceptional Groups in Physics.

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The E series of exceptional groups is related to supergravity and superstrings. We conjecture a more central role for E_8 in M theory; the octonionic brane branch, related to OP^1, which starts at the Fubini-Nicolai instanton, and stops at $(D, p) = (11, 2)$ could be extended, keeping the signature arbitrary, to OP^2, which is naturally related to the last exceptional Jordan algebra and to E_8.

1.C

M(atrix) theory compactifications on noncommutative tori and noncommutative toroidal orbifolds.

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Department of Physics, UC Berkeley and LBNL

A.Connes, M.Douglas and A.Schwarz showed that noncommutative tori arise naturally in the study of M(atrix) theory compactifications. Later it was realized that noncommutative geometry appears in the framework of open string theory in a constant B-field background. I will describe how noncommutative geometry technique can be applied to the study of M(atrix) theory compactifications on noncommutative tori and on noncommutative toroidal orbifolds leading to various results regarding brane systems on these spaces and T-duality.

1.C

Gauge Lie algebroid in W-gravity and in the Poisson sigma- model.

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It is proved that the local gauge symmetries of W_3-gravity on Riemann curves of an arbitrary genus with marked points generate a Lie algebroid with symplectic action. It is a vector bundle over the phase space of W-gravity with an algebra of second order differential operators as the sections of the algebroid bundle. We construct the BRST operator for this system in the BFV formalism. It has a cubic degree in ghosts as in the Lie group action. The zero cohomology of the BRST operator describe the classical moduli space of the W_3-gravity, or equivalently

of the generalized deformations of complex structures on Riemann curves by the second order differential operators. The Chern-Simons explanation of this construction is presented. The algebroid gauge symmetries in the Poisson sigma model of Cattaneo-Felder leading to the Kontsevich quantization formulae have the similar structures as in the W-gravity.

1.C

Time-reparametrization invariant dynamics of the early universe.

V.N. Pervushin[1], *V.V. Papoyan*[2], *M. Pavlovsky*[3] *and V. Smirichinsky*[1]

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[2] *Yerevan State University, Yerevan, Armenia*
[3] *Soltan Institute for Nuclear Study, Poland*

The evolution parameter of the time-reparametrization invariant theory is one of the dynamic variables with a negative contribution to the energy constraint. Using this fact we construct two unconstrained Hamiltonian systems to discribe time-reparametrization invariant dynamics of the early Universe:
1) Dynamic unconstrained system (DUS) with the dynamic evolution parameter as the cosmic scale factor is responsible for creation and annihilation of Universe in the world field space.
2) Geometric unconstrained system (GUS) with the geometric time measured by the watch gives us the initial cosmological data in terms of the geometric field variables.
3) DUS and GUS are the connected by canonical Levi-Civita transformations which converts the energy constraint into a new momentum, and dynamic variables into the geometric one.

The Levi-Civita transformations for free fields in Friedmann-Robertson- Walker metric have the form of the Bogoliubov transformations of the quasiparticle variables (which diagonalize the equations of motion) to the particle variables (which diagonalize the Hamiltonian of the particles). We show that thiese transformations, in the case of the choice of initial data in the form of the quasiparticle vacuum, describe creation of matter in the Universe and all known stages of evolution (anisotropic, inflation, radiation, and dust) in their conformal version.

1.C

Conformal linear gravity in de Sitter space.

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In previous papers we have shown that one can construct a covariant quantization of the traceless rank-2 "massless" tensor field in de Sitter space-time (quantum linear gravity on a de Sitter background), which is free of any infrared divergence. In Minkowski space-time it is well known that the massless field is invariant under the conformal groupe $SO(2,4)$. In this paper we examine the same problem for the linear gravity on a de Sitter background. First, the conformal invariant field equation is given. The field solution and the quantum field are presented. Then we consider the null curvature limit.

Gazeau J. P., Renaud J., Takook M.V., Class. Quantum Grav, 17(2000)1415, gr-qc/9904023.
Takook M.V., gr-qc/0001052

3.9 Foundations of Quantum Mechanics

3.C

Symmetries, Quantum geometry, and the fundamental interactions.

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The modular kinetic energy-momentum introduced by Aharonov et al is generalized to an arbitrary gauge field. The requirement that this operator should belong to the symmetry group of the standard model, that is Poincare group$\times U(1) \times SU(2) \times SU(3)$, requires the introduction of the gravitational field and a unified description of all four fundamental interactions. This naturally suggests a generalization of this prescription for determining the geometrical fields corresponding to any symmetry group. It is proposed that the relations between quantum states defined by this operator may be regarded as a basis for a quantum geometry, even in the absence of a space-time manifold, which would be the case at Planck distances.

4.C

Non-singular expressions for the ground state of some anharmonic oscillators.

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In this work we present a general approach in order to construct non singular expressions for the ground state energy of some anharmonic oscillators. This is done by using the scaling symmetry present in these potentials, and then using the corresponding singular expressions coming from the strong coupling expansion. Finally, the resulting expressions are compared with the results coming from the singular expressions and also to exact numerical data.

4.C

Cutoff dependence of the Casimir effect.

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The problem of calculating the Casimir force on two conducting planes by means of the stress tensor is examined. The evaluation of this quantity is carried out using an explicit regularization procedure which has its origin in the underlying (2+1) dimensional Poincaré invariance of the system. The force between the planes is found to depend on the ratio of two independent cutoff parameters, thereby rendering any prediction for the Casimir effect an explicit function of the particular calculational scheme employed. Similar results are shown to obtain in the case of the conducting sphere.

3.C

On the Wigner approach to noncanonical quantizations.

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The Wigner problem, *i.e.* the search for quantum mechanical commutation relations consistent with Heisenberg evolution equations of a classical–like shape is studied. Within recently proposed generalization of the Wigner's approach the classical analogy is postulated for the shape of the evolution equations only and any form of the time evolution and symmetry generators is not *a priori* assumed. Instead of that the set of basic, physically justified algebraic relations is required to close as a Lie algebra. Such a problem is known to be explicitly solvable for simple dynamics and here is illustrated on the example of a system of two particles interacting harmonically. Noncanonical Lie algebras of fundamental quantum mechanical quantities, alternative to the standard one, are found and the solutions of the nonrelativistic problem suggest what algebras should be investigated in the relativistic case.

4.C

Galilean covariant Lie algebra of quantum mechanical observables.

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A Lie algebra unifying the noncanonical Lie algebra of quantum mechanical observables and the Lie algebra of the Galilei group is constructed.

3.C

Testing dispersion relations of quantum κ-Poincaé algebra on cosmological ground.

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Following the procedure proposed recently by Martin and Brandenberger we investigate the spectrum of the cosmological perturbations in the case when

the "trans–Plackian" dispersion relations are derived from the quantum κ-Poincaré algebra. We find that depending on the choice of initial conditions of the perturbations, the spectrum is either $n^3P \sim \frac{1}{n}$ for initial conditions minimizing energy density, or the flat one $n^3P \sim n^0$ for instantaneous Minkowski vacuum. This latter spectrum leads to the observed scale-invariant Harrison–Zel'dovich spectrum in the Friedmann epoch.

3.C

Phase-space reference frames as fundamental tool to describe both classical and quantum states by probability distribution.

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An ensemble of phase-space reference frames is discussed as a new aspect of classical and quantum theories. The state of both classical and quantum particles is shown to be described by the conventional positive probability-distribution function (for the particle's position in the ensemble) which is related to density matrix (wave function) by means of invertable integral transform in the quantum case. Evolution equations for states in classical statistical mechanics and conventional quantum mechanics are studied for the probability density describing the states. Complex transition amplitude (Feynman path integral) is shown to be replaced by the positive transition probability in an ensemble of phase-space reference frames completely describing quantum transitions. The approach is extended to quantum field theory.

4.C

Covariance in QM and QFT.

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Quantum systems are often described in terms of Lie groups and their representations. A richer formalism is obtained by considering the action of the physically relevant symmetry group on an algebra of classical observables. Two examples are given. Quantum mechanics of a nonrelativistic particle is recovered by considering the action of the Galilei group on functions of position. An advantage of the approach is that the state of the particle determines its mass and whether it has spin or not. The other example is the spacetime example of (Doplicher et al, 1994, 1995). The model is described by a trivial action of spacetime on an algebra of complex functions. It has nontrivial representations in which the position operators satisfy noncanonical commutation relations.

4.C

On Scattering for some hypergeometric Natanzon potentials.

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The $SO(2,1)$ treatment given for the bound states of the hypergeometric Natanzon potentials is enlarged to deal with the scattering sector. Two examples are treated in detail.

3.C

Z-description of relativistic spin.

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We consider a general approach to the derivation of relativistic wave equations for particles with arbitrary spin in different dimensions. For this purpose we study a scalar field $f(x,z)$ on the Poincaré group, where x are coordinates in Minkowski space and z, which parametrize elements of the Lorentz subgroup, correspond to spin degrees of freedom. This scalar field appears naturally in course of a analysis of regular representation of the Poincaré group. Automorphisms of the Poincaré group are studied and they are identified with some discrete transformations in the representation space (in particular, C, P, T transformations are discussed on this base). It is shown that usual spin-tensor fields arise in course of a decomposition of the unique scalar field. Doing a classification of the scalar functions, we obtain the relativistic wave equations. This approach allows one to derive both usual finite-component wave equations for spin-tensors and positive energy infinite-component wave equations.

3.10 Particle Physics

3.D

Intereference phenomena, chiral bosons and covariance.

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The concept of interference phenomena in quantum field theory, an anology with Young's double slit experiment, has been studied over the last few years in the light of the formalism introduced by Stone to solder two opposite manifestations of chirality. In this work we have introduced a general theory to describe the different coupling of gauge fields in chiral bosonized theories with first-class chiral constraint. Introducing, in this way, a new interpretation of interference, we have soldered this general action and applied it to various models with new results. Besides, we have tested the Lorentz invariance of this general theory and used the soldering formalism to fix conditions on the parameters to obtain manifested covariance of a self-dual model.

31.D

Noncompact symmetry groups and Dirac theory.

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The 16-dimensional Dirac algebra $\{\gamma^\mu\}$ can be identified with the symmetry group Sl(2,**H**) so that in addition to the properties of Clifford algebras one may apply the framework of Lie theory to decribe relativistic particle theories. This ansatz leads to a straightforward interpretation of the Dirac equation by identifying unitary transformations U(2, **H**) as a second quantization procedure. Moreover, it yields the compact symmetry groups SU(4) and SU(2) × SU(2) as an appropriate low energy approximation of the hadron spectrum when representing these noncompact symmetry tranformations on complex (spinor) spaces and thus allows to derive chiral (hadron) symmetry and the nonlinear pion interactions of the Weinberg model from first principles. Moreover, when identifying the hadron representations in the low energy regime with appropriate group representations, we are naturally lead to the known quark structure of nucleons, deltas and the lowlying nonstrange mesons.

31.D

A survey of recent results for Quantum Field Theory in de Sitter Space.

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We shall present a survey of rigourous quantization results obtained in recent works on quantum free fields in de Sitter space-time. For the "massive" case which is associated to principal series representations of the de Sitter group $SO(1,4)$, the construction is based on analyticity requirements on the Wightman two-point function. For the "massless" cases (*e.g.* minimally coupled or conformal), associated to the discrete series, the quantization schemes are of the Gupta-Bleuler-Krein type.

J-P. Gazeau and M.V. Takook, *"Massive" vector field in de Sitter space*, J. Math. Phys. to appear.
J-P. Gazeau, J. Renaud, and M.V. Takook, *Gupta-Bleuler quantization for minimally coupled scalar field in de Sitter space*, Class. Quant. Grav., 17, 1415, (2000), gr-qc/9904023.
P. Bartesaghi, J-P. Gazeau, U. Moschella, and M.V. Takook, *Dirac fields in the de Sitter model*, submitted.

31.D

Two-loop gap equation in the Nambu-Jona-Lasinio model coupled to $SU(2)$ gauge fields with constant backgrounds.

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Quantum corrections of the gauge fields to the gap equation, that is, two-loop effects are calculated in the Nambu–Jona-Lasinio model coupled to SU(2) Yang-Mills fields, when they have a constant background contribution. Calculations are performed in 3- and 4-dimensions with the help of Fock-Schwinger proper time method. We find that the nature of two-loop effects is exactly the same as the one-loop ones; the background magnetic fields enhance the chiral symmetry breaking even in the two-loop. We cannot observe any restoration effect found by Gusynin, Hong and Shovkovy.

1.D

New extra gauge group(s) and (super)heavy bosons.

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We give constraints on additional Z' bosons predicted in supersymmetric E_6 models at weak scale.

Because E_6 is a rank-six group, it can have two extra $U(1)$ factors besides the Standard Model gauge group. A superposition of two extra $U(1)$ groups may survive as the $U(1)'$ gauge symmetry at the Grand Unification Scale.

We consider the way of search and properties of Z' bosons which can be probed at the pp collider at CERN. In particular, we discuss the probability for Z' boson decay into Higgs and a heavy quark system.

31.D

Higher order Wess-Zumino consistency conditions in gauge theories

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For gauge theories, higher order Wess-Zumino consistency conditions are discussed in the framework of Algebraic Renormalization.

The requirements needed for the first order Wess-Zumino consistency conditions to hold true at the next order in perturbation theory are analyzed. The discussion is illustrated in the example of the massive Abelian Higgs-Kibble model.

It is shown that the Wess-Zumino consistency conditions are altered at the second order if the first order Slavnov–Taylor identities (STI) are broken. Moreover, in this case the second order STI breaking term actually turns out to be a non-local functional of the fields and of the external sources.

This in turn forbids a local cohomological characterization of the anomalous term beyond the first order in perturbation theory, in the case of anomalous gauge theories.

1.D

Tests of space-time symmetry with particle traps.

N. Russell

Physics Department, Northern Michigan University, USA

31.D

New classes of solutions in string meson and baryon models.

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For the relativistic string with massive ends (the meson model) and four various string baryon models with different symmetries q-qq, q-q-q, Y and Δ the classical dynamics beyond the usual rectilinear string rotations is considered. For the string meson model the two types of quasirotational motions (disturbances of the planar uniform rotations) are obtained. They are oscillatory motions in the form of stationary waves in the rotational plane and in the orthogonal direction. These solutions may be used for describing more wide spectrum of hadron excitations. This approach and the suggested method of determining an arbitrary motion of the system on the base of initial data let us solve the stability problem for the rotational motions for all mentioned string configurations and show that these motions for the Y and q-q-q models are unstable on the classical level.

1.D

Unifying chiral symmetry for gauge and Higgs fields.

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A new type of chiral symmetry which works to determine a form of generalized covariant derivative with both gauge and Higgs fields is found in the standard model of quarks and leptons. To explain the idea, detailed analysis will be given in the simplest non-trivail model system in which a fermion field interacts with a U(1) gauge field and a scalar field.

1.D

Relativistic S-factor in Quantum Chromodynamics.

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A relativistic Coulomb-like resummation factor in quantum chromodynamics based on the solution of the quasipotential equation in the relativistic configuration representation is suggested.

3.11 Symmetries in Nuclear, Atomic and Molecular Physics

5.C

New symmetries for the genetic code.

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5.C

Modified group projectors: Tight binding method.

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Modified group projector technique for induced representations [1] is applied to the tight-binding Hamiltonian (TBH). Transparent algorithm is proposed to calculate eigen values and eigen vectors with automatic assignation by complete set of conserved quantum numbers. Due to induced type structure the TBH, the application of the procedure is very efficient: only the interior representations [1] of the orbit stabilizers are essentially relevant for calculation. Thus, the crystal energy bands are obtained without summation over the lattice, while the eigen vectors are symmetry adapted generalized Bloch states. The method is applied to the π-bands of single wall carbon nanotubes (SWCNT). It is argued that the novel parities [2] prevent conductivity in all but in the armchair SWCNT.

[1] M. Damnjanovic and I. Milosevic, J. Phys. A **28** 1669 (1995).
[2] M. Damnjanovic, I. Milosevic, T. Vukovic and R. Sredanovic, J. Phys. A **32** 4097 (1999).

5.C

The canonical adiabatic approach of the three-body problem with induced gauge fields

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The Hilbert fiber bundle construction induced by the adiabatic expansion of the wave function of a three-body problem is considered. The canonical transformation of the problem is explicitly constructed to reduce the coupled adiabatic equations with induced gauge fields' potentials to equations involving only the open channels that we are interested in. To demonstrate the efficacy of this Canonical Adiabatic Approach (CAA), we choose the model of 3 particles on a line, with attractive δ-function potentials, since, for this case, exact results are known. The pictures of surface adiabatic functions which demonstrate sixfold symmetry of the problem are presented. We show that a nonlocal long-range effective potential, that depends on the relative momentum, and a polarization potential appear as essential parts of the CAA construction. Using the asymptotic behavior of this CAA long-range potential, we demonstrate the local convergence of the adiabatic expansion for a finite set of values of the radial variable. We show that the CAA provides the true asymptotic character of the wave functions and the correct behavior of the elastic scattering phase shifts.

5.C

Supersymmetric quantum mechanics, the variational method and a new shape invariant potential.

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Recently a new methodology based in the association of the variational method with the supersymmetric quantum mechanics formalism has been introduced. The approach has been successfully applied to determine the energy spectra of atomic systems using the Hulthén and the Morse potential in three dimensions and more recently using the Coulomb potential. Here, these latter results are presented, together with the hierarchy of a new potential, a generalization of the Hulthén potential, which presents, in one dimension, the property of shape invariance. This potential was found within the determination of the effective potential of the Coulomb potential.

5.C

Symmetry, invariants, topology in molecules.

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The qualitative description of the system of energy levels of such quantum finite particle systems as molecules is based on the analysis of the classical symbols corresponding to effective quantum Hamiltonians. Systematic study of the topology of reduced phase spaces and of the nonlinear group actions leads to the interpretation of several universal intramolecular phenomena (clustering of energy levels, redistribution of energy levels between branches,

...) in terms of simple mathematical notions (critical orbits of group actions, bifurcations of stationary points and periodic orbits, monodromy of classical integrable systems, topological Chern indices of fiber bundles). Rovibrational structure of molecules and Rydberg states of atoms and molecules will be used as concrete molecular examples. The presentation is dedicated to the memory of Louis Michel and is largely based on the material summarized in the special issue of Physics Reports "Symmetry, Invariants, Topology" (2000) edited by L. Michel.

3.12 Quantum and Nonlinear Optics

1.C

Unitary transformation of quantum states by lossy four-port devices.

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The unitary transformation that relates the output quantum state to the input one at a dispersive and absorbing four-port device is derived. For each frequency component, the transformation is shown to be regarded as a U(4) group transformation which is directly determined by the underlying complex refractive-index profile of the device. Each of these U(4) group transformations can be decomposed into U(2) group transformations which may be thought of as being realized by a particular lossless four-port device. Explicit formulas for the case of Fock states, coherent states, and phase-space functions are given.

The work is supported by the RFBR-BRFBR grant № 00-02-81023.

[1] L.Knöll, S.Scheel, E.Schmidt, D.-G.Welsch, A.Chizhov. Phys. Rev. A **59** 4716 (1999).

1.C

The Jaynes-Cummings model without the rotating wave approximation.

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We consider the JCM with counter-rotation terms and show that the perturbation theory used by Shirley (Phys. Rev. **138**, B797 (1965)) for the semiclassical case can be easily generalized to the quantum field case. We derive an effective Hamiltonian and obtain the intensity dependent Bloch-Siegert shift, similar to the dynamical Stark shift.

31.C

Lie-algebraic methods in quantum optic: new approaches and results.

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A new, based on using the concept of dual algebraic pairs, approach is developed to reveal hidden coherent structures associated with irreducible representations of dynamic symmetry algebras in quantum optics models with invariant Hamiltonians. Its

efficiency is manifested on examples in polarization optics, yielding a new description of polarization structure of light fields, including their partial tomography and an invariant treatment of unpolarized light (UL), and in nonlinear models of photon scattering and of matter-radiation interaction, giving new (cluster) formulations of model dynamics and appropriate quasiclassical solutions of spectral and evolution problems. We could answer in the affirmative on the Fresnel's problem of existence of deterministic waves of UL in the first case and to reveal periodic and quasiperiodic (related to effects like "collapses-revivals" of the Rabi oscillations) dynamic regimes in the latter one.

1.C

Symmetries shared by Particle Physics and Optical Sciences.

Y.S. Kim

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Group theory is relatively new in optical sciences, but the basic space-time symmetry of particle physics has been and will be the Lorentz or Poincaré group. For instance, the present form of quantum field theory can be regarded as a representation of the Poincaré group. However, in 1971, Feynman *et al.* stated that harmonic oscillators could serve as an alternative approach to hadronic structures. What they said is true only if the oscillator formalism can be constructed as a representation of the Poincaré group. It is shown that the symmetry of two coupled oscillators can provide the representation needed for constructing Feynman's covariant oscillator formalism. It is shown also that this symmetry of the coupled oscillators constitutes the basic language of two-photon coherent states often called squeezed states of photons. In addition, it is pointed out that lens optics, polarization optics, and reflections and refractions can all be formulated as representations of the Lorentz group.

31.C

Lie-type transformation and effective Hamiltonians in quantum optics.

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We apply the method of Lie transformations for approximate diagonalizing a wide class of nonlinear Hamiltonians describing different quantum optical models. Representing a quantum optical Hamiltonian in terms of generators of polinomial deformation of $su(n)$ algebra we find an explicit form of transformations which approximately diagonalize a given Hamiltonian. In the case when some physical parameters, dictated by the particular model, become small we can obtain an effective Hamiltonian that describes correctly the system dynamics for sufficiently long times. We apply this method to some relevant problems in quantum optics: three-wave mixing, k-th harmonic generation and the Dicke model, as well as to the problem of interaction of n-level systems with quantum fields, showing that it is possible to engeneer resonant interactions through non resonant prosesses.

31.C

Spectrum generating algebra and coherent states of the C_λ-extended oscillator.

C. Quesne

Physique Nucléaire Théorique et Physique Mathématique, Université Libre de Bruxelles, Brussels, Belgium

C_λ-extended oscillator algebras, generalizing the Calogero-Vasiliev algebra, where C_λ is the cyclic group of order λ, have recently proved very useful in the context of supersymmetric quantum mechanics and some of its variants. Here we determine the spectrum generating algebra of the C_λ-extended oscillator. We then construct its coherent states, study their nonclassical properties, and compare the latter with those of standard λ-photon coherent states, which are obtained as a special case. Finally, we briefly review some other types of coherent states associated with the C_λ-extended oscillator.

31.C

Canonical ttransformations, quantum optics and quantum groups.

A. Solomon

Quantum Processes Group, The Open University, Milton Keynes, UK

We show that the standard quantum optics states arise simply as automorphisms of the canonical commutation relations, i.e. quantum canonical transformations. These *standard* states include coherent and squeezed states as well as Kerr states. When we consider the analogous transformations for deformed commutation relations, we not only describe *q-analogues* of quantum optics states, but retrieve the defining relations for some basic quantum groups.

1.C

Covariant discretization of axis-symmetric linear optical systems.

K.B. Wolf, N.M. Atakishiyev and L.E. Vicent

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Three-dimensional linear (paraxial) optical systems act by canonical integral transforms on continuous object wavefields to form the image wavefields. We propose a discretization strategy for systems with axial symmetry, which replaces the continuous position coordinates by a discrete set of sensor points, and where wavefunctions transform covariantly with the group $\mathrm{Sp}(4,\Re) \supset \mathrm{SO}(2)_\theta \otimes \mathrm{Sp}(2,\Re)_r$. We examine polar arrays of sensors (*i.e.*, separated by angle and radius), and find the complete, orthonormal sets of 'discrete-radial-waveguide' *Meixner* functions; when the sensors come closer together, these tend to the Laguerre eigenmodes of the continuous waveguide. In particular, the fractional Hankel transforms are discretized to define the fractional Hankel-Meixner transforms, and similarly for all axis-symmetric linear optical maps. Coherent states appear in the discrete cylindrical waveguide. Covariant discretization leads to the same Wigner phase-space function both for the discrete and the continuum cases. This reinforces a Lie-theoretical model for the phase space of discrete systems.

1.C

Coherent structures in nonlinear optics.

V.I. Yukalov

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The phenomenon of turbulent photon filamentation occurs in lasers and other active optical media at high Fresnel numbers. A description of this phenomenon is suggested. The solutions to evolution equations are presented in the form of a bunch of filaments chaotically distributed in space and having different radii. The probability distribution of patterns is defined characterizing the probabilistic weight of different filaments. The most probable filament radius and filament number are found, being in good agreement with experiment.

3.13 Condensed Matter and Statistical Physics

31.D

Anisotropy and inhomogeneity in an asymmetric next-to-nearest neighbours Ising-type model.

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Monte Carlo simulations of the ASYNNNI model are used to study the distribution of Cu–O chains in YBCO–123. The Cu–O chains can be homogeneous or inhomogeneous, and isotropic or anisotropic, depending on the temperature and oxygen concentration. An order parameter is used to determine the phase diagram.

31.D

Dynamical group approach to BEC tunnelling

Hongchen Fu, A.I. Solomon

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We present a dynamical group approach to Bose-Einstein condensation and tunnelling between two condensates which interact via a minimal coupling term. First we consider the spectrum of one Bose-Einstein condensate and show that the mean-field dynamics is characterized by a semi-direct product of the $SU(1,1)$ and Heisenberg-Weyl groups. We then describe the dynamics of the tunnelling of the two coupled condensates in terms of a semi-direct product of $SO(3,2)$ and two independent Heisenberg-Weyl groups. From this we obtain the energy spectrum and eigenstates for the two interacting Bose-Einstein condensates. Finally, we study the Josephson current between the two coupled condensates.

1.D

Kinetic theory of phase transition $I\bar{4}2d \rightarrow Fdd$.

B.R. Gadjiev

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Generalization of the Landau-Khalatnikov equation describing the relaxation of the order parameter near the phase transition in weekly disorder systems is introduced as:

$$\gamma\eta = \int_0^t K(t-\tau)\frac{\delta f(\eta, P)}{\delta \eta}d\eta \qquad (1)$$

$$0 = \frac{\delta f(\eta,P)}{\delta P}.$$

Here the function $K(\tau)$ is a measure the dispersion and η is the order parameter and P is the polarization. Near the phase transition $I\bar{4}2d \Rightarrow Fdd$ according to symmetry argument the free energy $f(\eta, P)$ is represented by expression:

$$f(\eta, P) = \frac{1}{2}\alpha\eta^2 + \frac{\beta}{4}\eta^4 + \frac{1}{2}\omega_0^2 P^2 + \xi\eta P - PE, \quad (2)$$

where α is reduced temperature and E is external electric field. The $K(\tau)$ curves can be classified to Hausdorf-Bezikovich dimension of d_c. The influence of $K(\tau)$ with $d_c > 1, d_c = 1, d_c < 1$ on the process of relaxation of the order parameter to equilibrium state near phase transition $I\bar{4}2d \Rightarrow Fdd$ are considered. It has been shown that if $d_c < 1$ the equation (1) is the differential equation fractional order $0 < \nu < 1$. When $d_c = 1$, equation (1) have form of Markov's equation. When $d_c > 1$ equation (1) contains time derivative of arbitrary order. Temperature and frequency dependencies of the dynamically susceptibility and the dynamic form-factor of the structure $d_c < 1, d_c = 1, d_c > 1$ are determined.

31.D

Universal scaling functions and amplitude ratios for critical systems: A brief review.

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In this paper, I briefly review recent developments in the study of universal finite-size scaling functions (UFSSF's) and amplitude ratios for some critical systems. Using Monte Carlo methods, J.-A.Chen, C.-Y.Lin, F.-G.Wang, and I found that site and bond percolation on planar lattices and two-dimensional contiuum percolation have UFSSF's for their existence probability (or crossing probability), percolation probability, and probabilities for the appearance of n percolation clusters; Y.Okabe, et al. and I found that the Ising model on planar lattices have UFSSF's for their Binder parameter and magnetization distribution functions. By analytical methods, N.Sh.Izmailian and I found new amplitude ratios for critical Ising model on planar lattices and a one-dimensional quantum spin chains. These results give strong evidences that critical systems have higher symmetries than those away from the critical point.

31.D

Minimal surfaces and Fluctations of Membranes with high genus.

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The new geometrical approach to phase transitions and fluctuations of f membranes with nontrivial topology is elaborated. This method based on the relation between the Willmore surfaces in R^3 and minimal surfaces in S^3.In the scope of mean field theory we study the phase transition from Cubic to Sponge phase. We describe also the moduli space of Willmore surfaces and its connections with the nature of conformal diffusion.

1.D

The Dehn invariant and the inflation rules for the tiles of the icosahedral tilings.

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We introduce Dehn invariants as a useful tool in the study of the inflation of quasiperiodic space tilings. The tilings by "golden tetrahedra" are considered. We discuss how the Dehn invariants can be applied to the study of inflation properties of the six golden tetrahedra. We also use geometry of the faces of the golden tetrahedra to analyse their inflation properties. We give the inflation rules for decorated Mosseri–Sadoc tiles in the projection class of tilings $\mathcal{T}^{(MS)}$ (the tiles of $\mathcal{T}^{(MS)}$ are particular packages of the golden tetrahedra). The Dehn invariants of the Mosseri–Sadoc tiles provide two eigenvectors of the inflation matrix with eigenvalues equal to $\tau = \frac{1+\sqrt{5}}{2}$ and $-\frac{1}{\tau}$, and allow to reconstruct the inflation matrix uniquely.

1.D

Constraints imposed by strong electron correlations on the symmetry of the superconducting gap.

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On the basis of a microscopical theory of spin-fluctuation pairing formulated within the t-J model [1] constraint of no double occupancy is used to discuss a possible symmetry of the superconducting order parameter. For the tetragonal phase only d-wave pairing is compatible with the restriction while

an orthorhombic distortion results in $d + s$-mixed symmetry for the superconducting gap with nodes. A rigorous treatment of the constraints is achieved by applying the Hubbard operator technique. The Dyson equation in the noncrossing approximation is solved numerically and doping dependence of superconducting T_c is calculated for tetragonal and orthorhombic phases. Comparison with experiments for high-temperature copper-oxide superconductors is presented.

[1] Plakida N.M., Oudovenko V.S., Phys. Rev. B 59 (1999) 11949.

31.D

3D topological excitations in non-Heisenberg magnetics.

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The simplest biquadratic generalization of the Heisenberg spin Hamiltonian in the Tyablikov's form is suggested, the interaction of not only nearest atoms being taken into account. The quasiclassical description of the system is achieved by averaging the spin Hamiltonian, the spin coherent being used.In the continuous limit the energy of the system contains the standard sigma-model term and some new highly nonlinear terms that permits to obtain the lower estimate of the energy through the Hopf topological invariant. The existence of axially invariant topological excitations is proved by variational method.

1.D

Symmetries and eigenslutions of Liouville's equation.

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Let $\{q_j, p_j, j = 1, 2, 3\}$ be a collection of configuration and momentum coordinates, $U(q)$ a gravitational potential field, and $f(q, p, t)$ a distribution function. Liouville's equation,

$$i\partial f/\partial t = \mathcal{L}f = -i(p_j\partial/\partial q_j - \partial U/\partial q_j \partial/\partial p_j)f,$$

has been used by astronomers to study the dynamics and stability of stellar systems and star clusters. For a given U, we write down the infinitesimal coordinate transformations $\{q, p\} \rightarrow \{q + \varepsilon\xi(q, p), p + \varepsilon\eta(q, p)\}$ and find those ξ and η that leave Liouville's operator from invariant. Each pair of allowed (ξ, η) gives an operator $\chi = \chi^\dagger = \xi\partial/\partial q + \eta\partial/\partial p$ which commutes with $\mathcal{L}$. This enables one to look for simultaneous eigensolutions of $\mathcal{L}$ and χ's.

For spherically symmetric potentials, $\mathcal{L}$ is $O(3)$ symmetric. There exist three operators,

$$J_i = i\varepsilon_{ijk}(q_j\partial/\partial q_k + p_j\partial/\partial p_k),$$

which commute with $\mathcal{L}$ and have the angular momentum algebra. The eigennumber of J^2 and J_z are integers $j \geq 0$ and $-j < m < j$. Their eigenfunctions are obtainable in terms of the angular momentum vector $l_k = \varepsilon_{klm}q_l p_m$.

For $U = -q^{-1}$, $\mathcal{L}$ is $SO(4)$ symmetric. In addition to J_i there are three more operators which commute with $\mathcal{L}$. They exist because of the constancy of Rung-Lenz vector in Keplerian orbits. Among these six operators one can find four mutually commuting ones and write down the eigensolutions of $\mathcal{L}$ in terms of those of these four. See Dehghani et. al. (1995).

For a quadratic potential $U = \frac{1}{2}q_i q_j$, the symmetry group of $\mathcal{L}$ is $GL(3, C)$. Among the subgroups of $GL(3, C)$, are the compact groups $SU(3)$, $SO(3)$ and noncompact ones $SO(3, 1)$ and $SU(2, 1)$. One alternative to find the eigensolutions of $\mathcal{L}$ is through $SU(3)$. In the terminology of particle physicists, the smallest representations of $SU(3)$ are the triplet $[3] : \{f_i = p_i + iq_i, i = 1, 2, 3\}$ and antitriplet $[\bar{3}] : \{f_i^*\}$. The triplet $[f_1, f_2, f_3]$ has the isospin numbers $(\frac{1}{2}, -\frac{1}{2}, 0)$ and the hypercharge numbers $(\frac{1}{3}, -\frac{1}{3}, -\frac{2}{3})$. Higher representations of the group may be found by direct products of the triplets and antitriplets. See Sobouti el. al. (1992).

Dehghani, M.H., Sobouti, Y.: Astron. Astrophys., **299**, 293, 1995.
Sobouti, Y., Dehghani, M.H.: Astron. Astrophys., **259**, 128, 1992.

1.D

Space-group and induced representation approach to the nodal structure of a Cooper pair.

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Cooper pair is a zero total momentum two-electron state antisymmetrical with respect to permutation of electron coordinates.The application of induced representation technique (the Mackey theorem on symmetrized squares) makes it possible to investigate the nodal structure of a Copper pair. In the present work making use of induced representation of Shubnikov groups general theory for ferromagnetic and antiferromegnetic crystals is developed. It is shown that the lines of nodes for triplet pairs are connected with symmetry breaking from O_h point group to axial symmetry or ferromagnetic and antiferromagnetic transitions. Theoretical results are used to obtain from experimental nodal structure of antiferromagnetic UPt_3 the E_{2u} irreducible representation

for Cooper pair. For ferromegnetic superconductor Sr_2RuO_4 the unique Shubnikov group $4/mm'm'$ is obtained.

3.14 Semigroups and Microphysical Irreversibility

3.D

Irreversible extension of dynamical evolution of unstable systems.

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We have realised recently that irreversibility as a manifestation of the distinction between the forward and the backward evolution semigroup is a property which qualifies certain dynamical systems only. These systems admit extensions of evolution beyond the original Hilbert Space framework so that the extended time symmetric unitary evolution splits into two distinct semigroups. These systems, known also as intrinsically irreversible systems, have resonances and instabilitites which result in manifest irreversibility. The extension beyond the Hilbert Space is achieved in terms of Rigged Hilbert Space or more generally by completion.

3.D

Descprition of the Lippmann-Schwinger kets within the Rigged Hilbert Space formalism.

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The Lippmann-Schwinger kets of the square barrier Hamiltonian are explicitly constructed, and there with the S-matrix and the Moller operators. The expansions of the in- and out-states in terms of the Lippmann-Schwinger kets is also constructed.

3.D

Resonance Mass and Width and the Poincare Semigroup.

N.L. Harshman

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A current phenomenological question in relativistic scattering theory is how to extract the mass and width of a quasistable particle or resonance from the Breit-Wigner peak in the center-of-mass energy squared cross section. Motivated by this question, and building on previous work, we suggest using elements of the irreducible representation spaces of the Poincare semigroup to represent resonance states. Such elements, called relativistic Gamow vectors, specify the relation between the cross section and

the mass and width as well as give the exponential decay of quasistable particles, which is normally inserted by hand in "effective" theories. One advantage of such an approach is that it gives a model-independent way of separating the resonance from the background of a scattering experiment. In addition, the time asymmetric boundary conditions of scattering experiments can be formulated in a mathematically rigorous way.

3.D

Doublets and degeneracy of resonances: Jordan forms and Jordan-Gamov vectors.

Alfonso Mondragon

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3.D

The Propagation of Unstable Particles.

R. Scurek

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The complete momentum space propagator of field theory is transformed into a "proper time/velocity basis". In this basis, the particle corresponding to a stable field evolves through proper time via a simple phase factor, while a particle corresponding to an unstable field evolves with a phase factor times a simple exponential. The result also relates the lifetime and de Broglie frequency of an unstable particle to the propagator/S-matrix pole in a simple and unambiguous manner.

3.15 Poster Sessions

4.P

Topological quantum mechanical symmetries.

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The notion of a topologial quantum mechanical symmetry (topological symmetry (TS) in brief) is introduced. A topological symmetry is a generalization of supersymmetry and involves some topological invariants like Witten index. The algebraic structure of $\mathbb{Z}_2$ graded TS's of type (m_+, m_-) is obtained and it is shown that for TS's of type $(1,1)$ and $(2,1)$ they are identical to algebraic structure of supersymmetry and $p=2$ parasupersymmetry respectively. We also obtain the algebraic structure for $\mathbb{Z}_n$ graded TS's of type $(1,1,\cdots,1)$ and show that it is identical to fractional supersymmetry algebra.

31.P

On a Mellin transform of the generalized Hermite polynomials.

M. K. Atakishiyeva

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3.P

Gravitational field of flat plate.

R. Avakian, E.V. Chubarian, A. Yeranian

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The static gravitational field of the infinite flat plate is considered. In this case, vacuum Einstein equations give two different solutions, namely, Taub solution and flat solution.In the Taub case the solution has the singularity at the finite distance from the plate. In the flat case the gravitational field is uniform in the external region. These solutions are sewed with internal solutions, and configuration stability are investigated, too.

2.P

The $su_q(2)$ algebra in the off-diagonal basis and applications to quantum optics.

A. Ballesteros, S.M. Chumakov

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We consider the $su_q(2)$ algebra in the basis of eigenvectors of the off-diagonal operator wich corresponds to the J_x operator in the undeformed case.

Matrix elements of finite rotations (the deformed d-functions) are found. It is shown that the $su_q(2)$ algebra may be used as an approximate dynamical symmetry algebra for the quantum optical model of the three-wave interaction. It allows us to investigate the spectral and dynamical properties of this model.

31.P

Easy-axis Heisenberg antiferromagnet and (D+1)-dimensional solitons.

I.L. Bogolubsky, A.A. Bogolubskaya

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Easy-axis classical Heisenberg antiferromagnet is described by 3-component Lorentz-invariant sigma model with spontaneously broken Z(2) symmetry. For this model and its U(1) gauged counterpart soliton solutions are investigated in (D+1) space-time dimensions (D=1,2,3). Integrability of generalized sine-Gordon model obtained for D=1 is studied both analytically and numerically. Stable extended strings - vortices are found for D=2 which can be treated as soliton analogs of Abrikosov-Nielsen-Olesen strings in abelian Higgs model.

4.P

Algbraic vector fields.

Andrzej Borowiec

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1.P

Specific features of the Coulomb field quantization.

V.P. Bykov

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Simple account of the Coulomb field quantization procedure is given. The system of basis states, normalized in usual mode, is constructed; it was possible to carry out quantization procedure without exotic states with negative and zero norms or states with the indefinite metrics. The quantum mechanical state of the Coulomb field is constructed in framework of Lorentzian gauge. It is shown, that the Coulomb field is in the indefinitely squeezed state, in which the quantum mechanical uncertaintes of the field are absent.

State of the field is constructed, in which average values of all observables are equal to zero. Due to it this state can be described as relevant to lack of the field generally. Possible origin of the Lorentz condition is considered. It is shown, that it is possible to refuse from this condition as postulate of the theory - at some natural supposition about an initial state of the field the Lorentz condition arises as a result of the system evolution.

1.P

Macdonald polynomials and related integrable systems.

O. Chalikh

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For an arbitrary root system we construct explicitly eigenfunctions for the difference operators by Macdonald in case $t = q^m$, $m \in \mathbf{Z}$. This leads to a new formula for corresponding Macdonald polynomials. Another corollary is a new, more elementary proof of symmetry identity and evaluation formula, proved first by Cherednik. We also establish the algebraic integrability of Macdonald operators at $t = q^m$ ($m \in \mathbf{Z}$), generalizing the result by Etingof–Styrkas. Our approach works equally well for all root systems, including BC_n case and related Koornwinder polynomials. Moreover, we apply it for certain deformations of root systems where the previously known methods do not work.

1.P

Four Models of the Gravitational Field of a Star.

N.A. Chernikov

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In this report four models are being discussed, concerning the gravitational field of a star at rest and the equations of motion of the companion planet.

The first model has been created by Newton and the second model by Lobachevsky. The third model has been initiated by Einstein, further developed Schwarzschild and completed by Fock. The fourth model has been created by the author of this report.

In the second and in the fourth models the Lobachevsky geometry with the characteristic constant k is introduced in the background space. The constant k is the absolute measure of the length in the background space.

In the third and in the fourth models the Lobachevsky geometry with the characteristic constant c is introduced in the velocity space. The constant c is the absolute measure of the rapidity in the velocity space. It equals the light velocity.

In the first and in the third models the gravitational field of the star obeys the Einstein's equations. In the second and in the fourth models the gravitational field of the star obeys new equations, proposed by the author of this report.

3.P

Wigner-Eckart theorem for induced representations.

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Let $A_1, \ldots, A_a$ be the components of an irreducible tensor operator (in the space $\mathcal{H}$) of the irreducible representation $D^{(\mu)}$ (in $\mathcal{H}^{(\mu)}$) of the group G. Let $Y(\mu, \nu, \lambda)$ be the tensor of the Clebsch-Gordan coefficients of $D^{(\lambda)}$ and the duals of $D^{(\mu)}$ and $D^{(\nu)}$. It is shown that the operator $X = \sum_i Y(\mu, \nu, \lambda)_i A_i$ is an invariant of the group action in $\mathcal{H} \otimes \mathrm{Hom}(\mathcal{H}^{(\nu)}, \mathcal{H}^{(\lambda)})$; its average is the reduced matrix element of the Wigner-Eckart theorem (WET), and its partial trace pull-back [1] to the original space $\mathcal{H}$ gives the complete WET. If $\mathcal{H}$ is induced representation $D = d(H \uparrow G)$ space, the modified group projector technique [2] establishes WET in terms of subgroup H and its (interior) representations d only. This provides transparent structural insight and simplified calculations; results apply to finite and Lie groups.

[1] Damnjanovic M and Milosevic I, *J. Phys. A* **27** (1994) 4859; **28** (1995) 1669.
[2] M. Damnjanovic *J. Phys. A* **33** (2000) 2223; Damnjanovic M, Vukovic T and Milosevic I, *J. Phys. A* (2000) (to appear).

4.P

Using the generalized spherical functions for solving the spherically-symmetric dynamo problem.

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The problem of generation of the electric fields and currents in the expanding ball with anisotropic conductivity imbedded into external magnetic field is of importance in various branches of plasma, astro-, and geophysics and was widely studied by using the asymptotic and numerical methods. Aim of the present report is to show that the respective partial differential equation possesses an exact general solution in terms of the generalized spherical functions [1], which represent a generalization of the well-known Legendre polynomials. As a result, solution of the dynamo equation with any particular boundary conditions can be obtained by the exactly same way as for Laplace equation inside a spherical region.

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[1] Dumin, Yu.V. *Comput. Math. & Math. Phys.*, vol. **38**, no. 11, pp. 1824–1829 (1998).

3.P

Regularization of non-linear spinor field theories by discrete symmetries.

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Non-linear spinor field models, e.g. Heisenberg or Nambu-Jona-Lasinio models, are common in the phenomenology of solids and hadron physics. They also have been proposed by Heisenberg and Stumpf as fundamental theories from which the standard model of elementary particles can be derived. But non-linear spinor field models are faced with their divergent character which is known to be serious and non-renormalizable. Stumpf, in 82, introduced a method using discrete transformations to regularize such models for scalar interaction. In this article we extend the group theoretical method to more general theories and show that non-trivial interactions remain possible. The connection between higher order equations an first order regularized equation is given. The discrete transformations can be connected with the CPT transformation of QFT.

3.P

Classical nonintegrability and quantum chaos in three-body system.

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A new formulation of the theory of quantum mechanical multichannel scattering for three-body collinear systems is proposed. The essence of the new representation consists in reducing of the scattering problem to investigation of evolution of some wave package on Lagrange surface of three-body system, considered in a local frame moving along the extremal beam. The motion of the local frame is described by equation for geodesic trajectory. It is shown, that in this simple case the principle of quantum determinism breaks down generally speaking and quantum mechanics becomes micro-irreversible. The first principle calculations of the quantum chaos (wave chaos) are pursued on the example of an elementary chemical reaction $Li + (FH) \rightarrow (LiFH)^* \rightarrow (LiF) + H$.

4.P

The possibility of pseudo-ring structures formation in DNA-cisplatinum complexes.

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4.P

Scalar field effect of selfgraviting configurations structure.

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The tensor-scalar theory of gravity is a connecting bridge between the Mach principle and theories of gravity. The scalar field varied the structure of the selfgraviting matter in view of the fact that the gravitational "constant" turns into a variable. In the Einstein and Jordan-Brans-Dicke theories of gravity we must solve a different boundary problem. In the JBD theory singular central conditions is possible.

In this work the correct calculation of parameters of superdense configurations is realizied. The problem is solved for all possible boundary conditions. A small value of the scalar field and matter connection constant leads to result differing from analogous results in Einstein theory.

4.P

VI Hilbert's Problem and Infinite Lie groups.

Nelly P. Konopleva

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4.P

Computation of Cohomology of Lie Superalgebras with Antibracket.

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The cohomology of a Lie (super)algebra, containing most fundamental ("topological") information about the algebra, has many applications in mathematics and physics. We describe here an algorithm and its C implementation for computing the cohomology of Lie (super)algebras. The program can proceed both finite-dimensional algebras and infinite-dimensional graded algebras. We present some results of computation of cohomology for Lie superalgebras of vector fields based on the odd Poisson bracket (antibracket, Buttin bracket). These algebras as super-analogs of Poisson and Hamiltonian algebras have found many applications in modern theoretical and mathematical physics.

4.P

Quasigroups and the use of them in the theory of the gauge fields.

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As is known the question of the existence of the Higgs scalar fields is open to this day. In consequence of this for the construction of the gauge fields theory it is offered the method which is alternative to standard one. As the existence of the ineradicable the background fields does not allow to consider the geometrical structure of the space-time the trivial one then the gauge transformations must have the quasigroups structure. Among the gauge fields we extract the mixtures responsible for gravitational effects. Redefining the vacuum by the new connection it can "hide" the gravitational fields. As a result it can consider that the gravitational effects are induced by the metrical properties of the space-time. The other mixtures of the gauge fields and also the not gauge fields willbe the solutions of the field equations which contain the summands interpreted as the mass terms.

4.P

Physical interpretation of some Clifford algebras.

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3.P

Method of replacing the variables for generalized symmetry of D'Alembert equation.

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By symmetry of the partial differential equation $\hat{L}'\phi'(x') = 0$ with respect to the variables replacement $x' = x'(x)$, $\phi' = \phi'(\Phi\phi)$ it is advanced to understand the compatibility of engaging equations system $\hat{A}\phi'(\Phi\phi) = 0$, $\hat{L}\phi(x) = 0$, where $\hat{A}\phi'(\Phi\phi) = 0$ is obtained from the initial equation by replacing the variables, $\hat{L}' = \hat{L}$, $\Phi(x)$ is some weight function. If the equation $\hat{A}\phi'(\Phi\phi) = 0$ may be transformed to the form $\hat{L}(\Psi\phi) = 0$, where $\Psi(x)$ is the weight function, the symmetry will be named the standard Lie symmetry, otherwise the generalized symmetry.

It is shown that with the given understanding of the symmetry, D'Alembert equation for one component field is invariant with respect to any arbitrary reversible coordinate transformations $x' = x'(x)$. In particular, they contain the transformations of the conformal and Galilei groups realizing the type of standard and generalized symmetry for

$$\Phi(x) = \phi'(x' \to x)/\phi(x).$$

1.P

Controlling quantum trajectories and time-ordering in nonlinear systems.

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We report the counterintuitive effects of dissipation in quantum nonlinear systems which are in the contact with their environment. We demonstrate that the stochastic resonance (SR) phenomenon, well known for macroscopic nonlinear systems, can occur in a pure quantum regime for a wider class of microscopic systems described by an anharmonic oscillator driven by two forces. The analysis is based on quantum state diffusion approach which operates with quantum trajectories. Time-dependent synchronization of quantum trajectories as a result of correlation between quantum noise and nonlinear evolution has been obtained. This effect leads to the effective controlling of the dissipative dynamics, decoherence and quantum statistics of the system. It is shown, from point of view of quantum information, that SR can be described in terms of minimization of quantum von-Neuman entropy.

31.P

Symbolic computation of symmetry adapted functions and application infullerite surface phase transition .

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Since the discovery of the C60 molecule and mainly since the availability of macroscopic quantities, numerous experimental and theoretical works have been performed to analyze the properties of the molecule and its crystalline form, the fullerite. The remarkable symmetry of the molecule leads to considerable simplifications in the theoretical studies with the help of symmetry adpated rotational functions (SARF). We propose a symbolic algorithm dedicated to the construction of SARF. We will illustrate concretly the behavior of our algorithm to the cubic group for the manifolds of all degrees and all the irreductible representations. We will then show the use of this SARF to build efficient order parameter for the study of the orientational phase transition in the fullerite. Using Monte-Carlo method, we will then show how we were able to identify a new phase for the surface and how this new phase can explain ununderstood experimental datum.

1.P

Quantum-tomography method in information processing and fractional Fourier transform.

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The known analogy of time-dependent analytic signal $f(t)$ to the wave function $\psi(x)$ is used to apply in signal analysis the new tomographic approach developed recently in quantum mechanics and quantum optics; the approach being called noncommutative tomography of analytic signal. Previously suggested methods of time-frequency quasidistributions like Ville-Wigner function $W(t,\omega)$ describing analytic signal are related to the method of tomographic-probability-distribution function $w(t,\mu,\nu)$ which also describes analytic signal. The tomographic probability is shown to be connected with analytic signal by the integral transform. The kernel of this transform, which is related to the fractional Fourier transform, is proved to be mathematically identical to the Green function of the Schrödinger evolution equation for the quantum harmonic oscillator.

3.P

Group of canonical transformations in classical and quantum mechanics and probability representation of quantum kinetics.

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A group of linear canonical transformations (in homogeneous symplectic group) is related to the description of the state dynamics in quantum and classical kinetics. The connection of quantum Moyal equation for the Wigner quasidistribution function with the tomographic-probability evolution equation in the new probability-representation of quantum mechanics is elucidated. The classical limit of the Boltzman kinetic equation is discussed. The spin tomography where spin states are described by positive probabilities instead of complex spinors and Hermitian density matrices are elaborated.

4.P

Looking for a Unified Dna/Rna Genetic Algebra.

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1.P

The CP violating phase and the quark mixing angles from flavour permutational symmetry breaking.

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Hermitian quark mass matrices are derived from breaking the flavour permutational symmetry according to $S_L(3) \otimes S_R(3) \to S_L(2) \otimes S_R(2)$. The best symmetry breaking pattern is obtained from a fit of the predicted $|V_{ij}^{th}|$ to the experimentally determined $|V_{ij}^{exp}|$ moduli of the quark mixing matrix. The phase equivalence of $\mathbf{V}^{th}$ and the standard parametrization $\mathbf{V}^{PDG}$ is shown. We derive exact explicit expressions for the three mixing angles θ_{12}, θ_{13}, θ_{23}, and the CP violating phase δ_{13} in terms of the quark mass ratios $(m_u/m_t, m_c/m_t, m_d/m_b, m_s/m_b)$ and only two free parameters Z^* and Φ^* characterizing the preferred symmetry breaking pattern. The computed values for the CP violating phase and the mixing angles are: $\delta_{13}^* = 75°$, $\sin\theta_{12}^* = 0.221$, $\sin\theta_{13}^* = 0.0034$, and $\sin\theta_{23}^* = 0.040$, which coincide almost exactly with the central values of the experimentally determined quantities.

4.P

Vibronic (In)Stability of Diperiodic Systems.

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The Jahn-Teller (Pierls) instability within the framework of the adiabatic approximation is examined for all of the 80 diperiodic groups. For the first time the breakdown of the Jahn-Teller theorem has been observed for some diperiodic groups (J. Phys. A: Math. Gen. 31 (1998) 3625-48) For tetragonal group DG61 being the symmetry of the conducting CuO_2 layer of all HTS materials, the vibronic interaction is absent exactly for the electronic states enabling d-wave pairing. Also, the theorem fails for the hexagonal group DG80, which describes the symmetry of many heavy fermion superconductors, graphite layers etc.

3.P

Satake diagrams and Iwasawa decomposition of twisted Kac-Moody algebras.

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Satake diagrams of twisted Kac-Moody algebras can be constructed from their Dynkin diagrams which classify the real forms of these algebras. The involutive automorphisms determined from these diagrams are then used to obtain their Iwasawa decompositions. As a specific example We illustrate this procedure for $A_2^{(2)}$.

31.P

Free fermion interpretation of two-dimensional Ising model.

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The two-dimensional Ising model is reviewed as a theory of free fermions on a lattice. The discussion includes fermionization procedure for the density matrix, Gaussian fermionic integral representation for partition function, momentum-space fermions, Onsager's result, continuum-limit field theories, critical - point singularities, long - ranged fermionic correlations in a nonzero magnetic field. The approach is based on the use of the integrals over the anticommuting Grassmann variables.

1.P

Bound states in relativistic quantum mechanics.

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1.P

Low energy effective action of hypermultiplet in arbitrary representation of any gauge group

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We consider the model of hypermultiplet in arbitrary representation of any gauge group interacting with background super-Yang-Mills field within $N = 2$ harmonic superspace approach. A general form of holomorphic effective action is found in the case when background gauge field lies in Cartan subalgebra of gauge algebra. This corresponds to the situation when gauge symmetry in pure SYM theory

is spontaneously broken to the maximal Abelian subgroup. It is shown that resulting effective action is defined by the structure of weights of representation of a gauge algebra. A number of examples are considered for the hypermultiplets in fundamental and adjoint representations of the $SU(n)$, $SO(n)$, $Sp(n)$ gauge groups.

3.P

Higher-order uncertainty relations.

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3.P

One-particle states in parabolic quantum dot with regard to the boundary conditions.

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Modernization of parabolic confinement potential found to be necessary due to reviled violation of Kohn's theorem in semiconductor microcrystals. Truly, consideration of this potential as parabolic leads to preservation of high symmetry of oscillatory part of the Hamiltonian, $U(3)$, after transmission to the center mass system. It is clear, that changes of this kind of the potential lead to termination of high symmetry and make it impossible to diagonals oscillatory part of the hamiltonian. One of the causes of violation of Kohn's theorem can be deviation from the parabolic behavior of the confinement potential near semiconductor-dielectric boundary. Influence of the boundary on electronic states in microcrystal having parabolic confinement potential is studied in this manuscript. Dependencies of electron energy on microcrystal radius and frequency of confinement potential are also studied.

4.P

The Dirac equation in the Lobachevsky space-time.

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The product of the Lobachevsky space and the time axis is termed the Lobachevsky space-time. The Lobachevsky space is considered as a hyperboloid's sheet in the four-dimensional pseudo-Euclidean space. The Dirac-Fock-Ivanenko equation is reduced to the Dirac equation in two special forms by passing from Lamé basis in the Lobachevsky space to the Cartesian basis in the enveloping pseudo-Euclidean space.

3.P

D-function in nonperturbative expansion technique.

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The nonperturbative a-expansion method in quantum chromodynamics is applied to analyze the Adler D-function at low energy scale. An important role of quark mass effects is demonstrated.

3.P

On implementation of the polynomial Lie algebra methods for solving a class of nonlinear models of quantum optics: exact results and analytical approximations. [1]

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We discuss exact and approximate calculation methods to solve both spectral and time-evolution problems for a wide class of quantum-optical models (including multiphoton scattering and Dicke ones). For this end one exploits a symmetry adapted reformulation [1,2] of the models in terms of polynomial Lie algebras $su_{pd}(2)$ (connected with nonstandard q-deformations of algebras $su(2)$ [3]). Exact techniques use defining relations and differential realizations of $su_{pd}(2)$ algebras and lead to solving Jacobi-type finite-difference equations or singular ordinary differential equations in the Schroedinger picture [1-3] and nonlinear operator Bloch equations (describing dynamics on non-commutative Abelian manifolds) in the Heisenberg picture [2,3]. Solutions of these tasks determine new classes of orthogonal polynomials and operator analogs of the elliptic Weierstrass function [3]. Approximations [2-4] obtained with the help of generalized $su_{pd}(2)$ coherent states yield new analytical expressions for quasiclassical evolution operators of models under study which enable us to display a modulated quasi-periodic model dynamics [4] describing phenomena of the "collapses-revivals" type occurring in the Jaynes-Cummings

[1] Thanks to RFBR for supporting by Grant No. 00-02-81023 Bel 2000 a

models [5]. Some routines are developed for performing symbolic computer algebra calculations based on the method discussed. First implementations of the routines to evaluate eigenvalues and eigenvectors of the simplest examples are considered.

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1.P

Bounds on integrals of the Wigner function.

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The integral of the Wigner function over a subregion of the phase-space associated with a quantum system may be less than zero or greater than one. We consider the problem of determining the best possible bounds on the integral of the Wigner function over a given region of the phase-plane of any system with one degree of freedom. For a general class of subregions, we show that the problem of determining the bounds reduces to finding the greatest and least eigenvalues of an hermitian Fredholm integral operator corresponding to that subregion. In the case if an elliptical or annular subregion, an exact solution exists, and the bounds can be given explicitly. Extensions to more general distributions and symmetries are also considered; exact bounds are also given for the analogous problem in spin systems and these clearly resemble the bounds on the phase-plane, to which they are related by a contraction of Lie algebras.

1.P

Generalized Relativistic Dynamics.

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Relativistic equations of motion for the spinning particle with a charge are generalized within the framework of Nambu formalism of dynamics. The notion of sub-particles is introduced. The Lorentz-force equations of motion are composed from quaternionic equations of motions of two sub-particles. This scheme is generalized for the hyper-relativistic particle the equations of motions of which are composed from quaternionic equation of motion of n sub-particles.

31.P

On the problem of turbulent crystal.

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The possibility for the existence of turbulent crystals is analized. A nonuniform system is considered consisting of two phases with different densities of particles. At each given time the distribution of the phases in space is chaotic: each phase filling a set of regions with random shapes and locations. A chaotic diffusion process intermixes these regions by varying their shapes and locations in a random way. To investigate the statistical properties of such a system, it is exemplified by a lattice-gas model. Conditions are analysed when this chaotic lattice-gas model can become thermodynamically more stable than the usual model describing a pure one-phase system.

3.P

New version of Hara theorem in the framework of GIM model.

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Hara theorem on weak radiative hyperon decays, based on $SU(3)_f$ model, is revised in the framework of Glashow-Iliopoulos-Maiani model. Known result is used that the relevant part of the CP-invariant effective current$\times$ current Hamiltonian changes sign under simultaneous quark changes $d \leftrightarrow s$ and $u \leftrightarrow c$. The new formulation of the Hara theorem yields nonzero asymmetry of $\Sigma^+ \Rightarrow p + \gamma$ decay in contrast to original Hara result. The main results of the new version of the Hara theorem are: (i) It eliminates the old-standing contradiction between the unitary symmetry model prediction and experiment; (ii) It solves the old-standing problem of consistency between the unitary symmetry and quark model results. (iii) It enables us to make predictions for weak radiative decays of charmed baryons.

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