

Doppler Institute: Activities in 1996

It became a habit to summarize our activities at the end of a calendar year. Below you will find a report on the fourth year of our existence.

1 Basic information

1.1 Members to date

Č. Burdík, *Dept of Mathematics, FNSPE, Czech Technical University, Prague*
J. Dittrich, *Nuclear Physics Institute, AS, Prague/Řež*
P. Exner, *Nuclear Physics Institute, AS, Prague/Řež*
M. Havlíček, *Dept of Mathematics, FNSPE, Czech Technical University, Prague*
L. Hlavatý, *Dept of Physics, FNSPE, Czech Technical University, Prague*
P. Šeba, *Nuclear Physics Institute, AS, Prague/Řež*
P. Šťovíček, *Dept of Mathematics, FNSPE, Czech Technical University, Prague*
J. Tolar, Director, *Dept of Physics, FNSPE, Czech Technical University, Prague*
M. Znojil, *Nuclear Physics Institute, AS, Prague/Řež*

1.2 Advisory board

S.A. Albeverio, *Ruhr-Universität Bochum, Germany*
J.E. Avron, *Technion, Haifa, Israel*
M.S. Birman, *St. Petersburg University, Russia*
J.-M. Combes, *Université de Toulon et du Var, France*
H.D. Doebner, *Technische Universität Clausthal, Germany*
M. Flato, *Université de Dijon, France*
J.R. Klauder, *University of Florida, Gainesville, USA*
E.H. Lieb, *Princeton University, USA*
L.A. Pastur, *Low-Temperature Physics Institute, Kharkov, Ukraine*
J. Patera *Université de Montréal, Canada*

1.3 Current grant support

According to the statutes, DI members receive their salaries from the academic institutions to which they belong. The research performed in DI has been supported by the following research grants:

1. GA AS Grant No.148409
Schrödinger operators and quantum chaos
J. Dittrich, P. Exner (responsible), M. Tater, P. Šeba
expired by the year end
2. GA CR Grant No.202–96–0218
Rigorous models of integrable and chaotic systems
Č. Burdík, J. Dittrich, P. Exner, M. Havlíček, L. Hlavatý, M. Tater, P. Šeba,
P. Šťovíček, J. Tolar (responsible), M. Znojil
till the end of 1998

In addition, the education of students for and through research was supported by the grant No. 3296018 of the Czech Universities Development Fund 1996

DI undergraduate and graduate research project
Č. Burdík, M. Havlíček, J. Tolar (responsible).

2 Survey of activities

2.1 Publications in journals

1. S. Albeverio, F. Haake, P. Kurasov, M. Kus, P. Šeba: *S-matrix, resonances and wave function for transport through billiards with leads*, J. Math. Phys. **37** (1996), 4888–4903.
2. Č. Burdík, O. Navrátil: *Boson realizations of Yangians $Y(sl(2))$ and $Y(sl(3))$* , Czech J. Phys. **B 46** (1996), 145–150.
3. Č. Burdík, O. Navrátil: *Vertex operators for two parametric deformations of $U_{q,s}(sl(2))$* , Czech J. Phys. **B 46** (1996), No. 12.
4. P. Duclos, P. Šťovíček: *Floquet Hamiltonians with pure point spectrum*, Commun. Math. Phys. (1996),
5. P. Exner: *Contact interactions on graph superlattices*, J. Phys. **A29** (1996), 87–102.
6. P. Exner: *Weakly coupled states on branching graphs*, Lett. Math. Phys. **38** (1996), 313–320.
7. P. Exner: *A duality between Schrödinger operators on graphs and certain Jacobi matrices*, Ann. Inst. H. Poincaré: Phys. Théor. (1996), to appear
8. P. Exner, R. Gawlista: *Band spectra of rectangular graph superlattices*, Phys. Rev. **B53** (1996), 7275–7286.
9. P. Exner, R. Gawlista, P. Šeba, M. Tater: *Point interactions in a strip*, Ann. Phys. **252** (1996), 133–179.
10. P. Exner, P. Šeba: *Point interactions in dimension two and three as models of small scatterers*, Phys. Lett. **A222** (1996), 1–4.
11. P. Exner, P. Šeba, M. Tater, D. Vaněk: *Bound states and scattering in quantum waveguides coupled laterally through a boundary window*, J. Math. Phys. **37** (1996), 4867–4887.
12. P. Exner, S.A. Vugalter: *Asymptotic estimates for bound states in quantum waveguides coupled laterally through a narrow window*, Ann. Inst. H. Poincaré: Phys. Théor. **65** (1996), 109–123.
13. P. Exner, S. A. Vugalter: *Bound states in a locally deformed waveguide: the critical case*, Lett. Math. Phys. (1996), to appear
14. F. Haake, P. Šeba, H.–J. Stoeckmann, U. Stoffregen: *Microwave billiards with broken time reversal invariance*, J. Phys. **A29** (1996), 5745–5757.
15. M. Havlíček, A.U. Klimyk and E. Pelantová: *Nonstandard deformations $U_q(so_3)$ and $U_q(so_4)$: tensor products of representations, q -oscillator realizations and root of unity*, Czech. J. Phys., to appear
16. L. Hlavatý, L. Kundu: *Quantum integrability of nonultralocal models through Baxterisation of quantised braided algebra*, Int. J. Mod. Phys. **11** (1996), 2143.
17. P. Šeba: *Random matrix theory and mesoscopic fluctuations*, Phys. Rev. **B53** (1996), 13024–13028.

18. P. Šeba, K. Życzkowski, J. Zakrzewski: *Statistical properties of random scattering matrices*, *Phys. Rev.* **E54** (1996), 2438–2446.
19. P. Šťovíček: *Antiholomorphic representations for orthogonal and symplectic quantum groups*, *J. of Algebra* **184** (1996), 71–101.
20. P. Šťovíček, R. Twarock: *Representations of $U\mathfrak{h}(SU(N))$ derived from quantum flag manifolds*, *J. Math. Phys.*, to appear
21. J. Tolar, J. Trávníček: *Graded contractions of symplectic Lie algebras in collective models*, *J. Math. Phys.*, to appear
22. M. Znojil: *The most general iteration scheme for Lippmann–Schwinger–type equations*, *Phys. Lett.* **A211** (1996), 319–326.
23. M. Znojil: *Nonlinearized perturbation theories*, *J. Nonlin. Math. Phys.* **3** (1996), 51–62.
24. M. Znojil: *Jacobi polynomials and bound states.*, *J. Math. Chem.* **19** (1996), 205–213.
25. M. Znojil: *Harmonic oscillations in a quasi–relativistic regime*, *J. Phys.* **A29** (1996), 2905–2917.
26. M. Znojil: *Comment on the letter “A new efficient method for calculating perturbation energies using functions which are not quadratically integrable” by L. Skála and J. Čížek*, *J. Phys.* **A29** (1996), 5253–5256.
27. M. Znojil: *Circular vectors and toroidal matrices*, *Rendiconti del Circolo Matematico di Palermo Serie II – Suppl.* 39 (1996), 143–148.
28. M. Znojil: *Screened Coulomb potential $V(r) = (\alpha + \beta r)/(\gamma + \delta r)$ in a semirelativistic Pauli–Schrödinger equation*, *J. Phys.* **A29** (1996), 6443–6553.
29. M. Znojil: *Double well model $V(r) = ar^2 + br^4 + cr^6$ with $a < 0$ and perturbation method with triangular propagators*, *Phys.Lett.* **A222** (1996), 291–298.
30. M. Znojil: *One–dimensional Schrödinger equation and its “exact” representation on a discrete lattice.*, *Phys. Lett.* **A**, to appear
31. M. Znojil: *Perturbation theory for quantum mechanics in its Hessenberg–matrix representation*, *Int. J. Mod. Phys.* **A**, to appear

2.2 Proceedings, submitted papers, etc.

1. J. Asch, P. Duclos, P. Exner: *Stark–Wannier Hamiltonians with pure point spectrum*, Proceedings of the Conference on Partial Differential Equations (Potsdam 1996), to appear
2. F.Bentosela, P.Exner, V.A.Zagrebnov: *A mechanism of porous–silicon luminescence*, submitted
3. Č. Burdík, ed.: *Papers of Fifth Colloquium “Quantum groups and Integrable Systems”*, *Czech. J. Phys.*, vol. **46** (1996), No. 12, and vol **47** (1997), No. 1.
4. Č. Burdík, Ch. Frougny, J.P. Gazeau and R. Krejcar: *β –integers and canonical Meyer quasilattices for quasicrystals*, submitted
5. Č. Burdík, R. Krejcar, and O. Navrátil: *Boson realizations of Yangians $Y(B_2)$* Proceedings of the Intl Conference on Problems of Quantum Field Theory (Alushta 1996), JINR E2–96–369; pp.100–103.

6. G. Chadzitaskos, J. Tolar: *Quantization on Z_M and coherent states over $Z_M \times Z_M$* , J. Phys. **A30**, to appear
7. G. Chadzitaskos, J. Tolar: *Finite-dimensional *-product and matrix algebras*, Czech J. Phys. **46** (1996), 151–154.
8. J. Dittrich, P. Duclos, N. Gonzalez: *d'Alembert field driven by a periodically moving wall*, Proceedings of the Intl Conference on Problems of Quantum Field Theory (Alushta 1996), JINR E2–96–369; pp.166–169.
9. J. Dittrich, V.I. Inozemtsev: *On the two-magnon bound states for the quantum Heisenberg chain with variable range exchange*, submitted
10. P. Duclos, P. Exner, B. Meller: *Exponential bounds on curvature-induced resonances in a two-dimensional Dirichlet tube*, submitted
11. P. Exner: *Magneto-resonances on a lasso graph*, submitted
12. P. Exner, P. Šeba: *Resonance statistics in a microwave cavity with a thin antenna*, submitted
13. M. Havlíček, J. Patera and E. Pelantová: *On the fine gradings of simple classical Lie algebras*, in Proceedings of the Intl Conf. on Symmetries in Physics (Dubna 1996), to appear
14. L. Hlavatý: *Solution of constant Yang–Baxter system in the dimension two*, in Proceedings of the Intl Colloquium “Group Theoretical Methods in Physics” (Goslar 1996), to appear
15. J. Tolar: *Graded contractions of Lie algebras: some physical applications*, in “Lie Theory and Its Applications in Physics”, World Scientific, Singapore 1996.
16. M. Znojil: *Perturbation theory with Hessenberg Hamiltonians*, Proceedings of the II Int. Workshop on Integrable Systems (Dubna 1996), to appear
17. M. Znojil: *An open problem in the applied functional integration*, Proceedings of the NATO ASI on functional integration (Cargèse 1996), to appear
18. M. Znojil: *Quasi-exact solvability as an anti-Lanczosean termination*, Proceedings of Int. Workshop “Algebraic Approaches to Quantum Dynamics” (Toronto 1996), to appear

2.3 Seminars

During the teaching period, regular seminars were held on Tuesday afternoons. The list of speakers is the following:

January 30

M. Tater (NPI): Quantum chaos I

February 6

M. Tater (NPI): Quantum chaos II

February 13

M. Tater (NPI): Quantum chaos III

February 20

L. Hlavatý: Lax pairs

February 27

Č. Burdík: Bosonisation of affine quantum algebra $U_q(\tilde{sl}(2))$

March 5

Č. Burdík: Bosonisation of affine quantum algebra $U_q(\tilde{sl}(2))$ II

March 12

P. Exner: Asymptotic properties of bound states in quantum waveguides

March 19

G. Chadzitaskos (CTU): Coherent states in q -deformed quantum mechanics

March 26

G. Chadzitaskos (CTU): A simple example of discrete quantum mechanics

April 2

G. Chadzitaskos (CTU): Coherent states in Hilbert space of a finite dimension

April 16

E. Ivashkevich (JINR Dubna): Self-organized criticality in Abelian sandpiles

April 23

J.-P. Gazeau (Paris VI): Quasicrystals

April 30

J. Niederle (IP CAS): Conformal symmetry in physics and astrophysics

May 7

V. Souček(): Conformally invariant operators on 4-dimensional spacetimes

May 14

Travniček (API CAS): Graded contractions of symplectic algebras in algebraic theory of collective models of atomic nuclei

May 30

W. Schleich (Ulm): Paul trap endoscopy: measurement of the vibratory quantum state of a single ion

May 30

P. Winternitz (Montreal): Maximal simple subalgebras of the algebra of diffeomorphisms of an n -dimensional space

June 4

P. Duclos (Toulon): Rayleigh perturbation formula for dense point spectrum

June 6

M. Hillery (City U. of NY): Bell's theorem and beyond

September 17

D. Sternheimer (Dijon): Quantization by deformation

September 30

J. Voigt (Dresden): Schrödinger equation and heat equation with absorption

October 8

M. Havlíček: Maximal Abelian subgroups of diagonalizable automorphisms of the classical complex Lie algebras

October 15

A. Vančura (Kaiserslautern): The Bernoulli family of Basel

October 18

W. Karwowski (Wroclaw): Schrödinger operators with perturbations supported by null sets

October 29

A. Zeilinger (Innsbruck): The physical reality in the quantum experiment

November 5

H. Paul (Berlin): “Interference” and “which way” information

November 12

E. Husstad (Trondheim): Finite approximation of Weyl systems

November 19

E. Pelantová (CTU): Grading of the classical Lie algebras

November 26

D.V. Shirkov (JINR Dubna): Renormalization group method in theoretical and mathematical physics

December 3

P. Šeba: Wave chaos — theory and experiment

December 10

Č. Burdík: Algebraic properties of β -numbers and quasicrystals

2.4 Meetings

6th Student Winter School (Polubný, January 26 – February 1)

The 5th Colloquium “Quantum groups and Integrable Systems” (Prague, June 21–23)

The program included, in particular, the following lectures:

2.5 Teaching activities

2.5.1 Courses and student seminars

In addition to the regular curriculum duties (for the DI members coming from CTU), the following teaching activities have been organized:

1. *Selected topics of mathematical physics* (Charles University, Exner)
2. The seminar *Quantum groups* (CTU, Hlavatý)
3. The seminar *Quasicrystals* (CTU, Burdík)

2.5.2 Students

Graduate:

- P. Trávníček (supervized by J. Tolar)
the thesis “Physical applications of graded contractions” presented at CTU in 1996
- N. Gonzalez (thesis at CTU and Université de Toulon, supervized by J. Dittrich and P. Duclos)
“Scalar field on a time-periodic domain”
- V. Jásenský (supervized by L. Hlavatý)
“Yang–Baxter equations”
- P. Lindovský (thesis at Charles University and Université de Toulon, supervized by P. Duclos and P. Exner)
“Spectral properties of Dirichlet layers”

Graduated in 1996:

- M. Vaic (CTU, E. Pelantová);
diploma thesis *Gradations of $sl(6, C)$* .
- R. Krejcar (CTU, Č. Burdík);
diploma thesis *Physical applications of graded contractions*.

5th course:

- A. Bóna (CTU, J. Tolar);
diploma work *Quantum theory of quasi-two-dimensional systems*.
- M. Čermák (CTU, L. Hlavatý);
diploma work *Discussion of a system of equations following from a Lax pair analogous to KdV*.
- J. Fiala (CTU, F. Maršík);
diploma work *Application of optimal control methods to transport processes*.
- D. Vaněk (CTU, P. Exner);
diploma work *Spectral and scattering properties of serial structures*.

4th course:

- D. Krejčířík (Charles U., P. Exner);
diploma work *Spectral properties of laterally coupled waveguides*.
- Z. Masáková (CTU, E. Pelantová; in collaboration with Université de Montréal);
review and research work *Mathematical models of quasicrystals on line and in the plane*.
- S. Pošta (CTU, E. Pelantová);
review and research work *Mathematical models of quasicrystals on line and in the plane*.

3rdth course:

- M. Malinský (CTU, J. Dittrich);
review *Spontaneous symmetry violation in quantum systems.*
- J. Novotný (CTU, I. Jex);
review *Density matrices in quantum theory.*
- R. Otec (CTU, J. Tolar);
review *Quantum mechanics in a finite-dimensional Hilbert space.*
- K. Smolek (CTU, P. Exner);
review *Quantum dot with a perturbed boundary.*
- L. Šnobl (CTU, L. Hlavatý);
review *Yang-Baxter equations.*
- O. Váňa (CTU, L. Krlín);
review *Magnetic field in a tokamak.*