Doppler Institute: Activities in 2005

Without being scared by the unlucky number, let us tell you what we did in our thirteenth year.

1 Basic information

1.1 Members to date

Č. Burdík, *Dept of Mathematics, FNSPE, Czech Technical Univ, Prague*
G. Chadzitaskos, *Dept of Physics, FNSPE, Czech Technical Univ, Prague*
J. Dittrich, *Nuclear Physics Institute, AS, Prague/Řež*
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M. Havlíček, *Dept of Mathematics, FNSPE, Czech Technical Univ, Prague*
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P. Šeba, *Institute of Physics, AS, Prague*
P. Šťovíček, *Dept of Mathematics, FNSPE, Czech Technical Univ, Prague*
J. Tolar, Director, *Dept of Phys, FNSPE, Czech Technical Univ, Prague*
M. Znojil, *Nuclear Physics Institute, AS, Prague/Řež*

1.2 Advisory board

S.A. Albeverio, *Universität Bonn, Germany*
J.E. Avron, *Technion, Haifa, Israel*
M.S. Birman, *St. Petersburg University, Russia*
J.-M. Combes, *Université de Toulon et du Var, France*
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E.H. Lieb, *Princeton University, USA*
L.A. Pastur, *Centre de Physique Théorique, Marseille, France*
J. Patera *Université de Montréal, Canada*

1.3 Current grant support

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1. AS CR Grant No. 100480501 **Solvable models of nanosystems**. J. Dittrich, P. Exner (responsible), H. Kovařík, D. Krejčiřík, J. Kříž, P. Šeba, M. Tater

2. AS CR Grant No. 1048302 **Quantum theory and pseudo-Hermitean Hamiltonians**. M. Znojil (responsible)

3. Ministry of Education Grant LS 527 **Particle Physics Center**. L. Hlavatý

2 Survey of activities

2.1 Edited volumes

1. M. Znojil, ed.: *Proceedings of the 3rd International Workshop "Pseudo-Hermitian Hamiltonians in Quantum Physics" (Istanbul, June 2005)*, Czech. J. Phys. **55** (2005), No. 9.
2. Č. Burdík, O. Navrátil, S. Pošta, eds.: *Proceedings of the 14th International Colloquium "Integrable Systems and Quantum Symmetries" (Prague, June 2005)*, Czech. J. Phys. **55** (2005), No. 11.
3. Č. Burdík, S. Pošta, eds.: *Proceedings of the 8th International Conference "Path Integrals. From Quantum Information to Cosmology" (Prague, June 2005)*, JINR Publ., Dubna 2005.

2.2 Publications in journals

1. J. Asch, R. Benguria, P. Šťovíček: *Asymptotic properties of the differential equation* $h^3(h''+h')=1$, Asympt.Anal. **41** (2005), 23–40.
2. J. Asch, I. Hradecký, P. Šťovíček: *Propagators weakly associated to a family of Hamiltonians and the adiabatic theorem for the Landau Hamiltonian with a time-dependent Aharonov-Bohm flux*, J. Math. Phys. **46** (2005), 053303.
3. B. Bagchi, H. Bíla, V. Jakubský, S. Mallik, C. Quesne, M. Znojil: $\mathcal{PT}$-*symmetric supersymmetry in a solvable short-range model*, Int. J. Mod. Phys. **A**, to appear; `quant-ph/0503035`.

4. B. Bagchi, A. Banerjee, E. Caliceti, F. Cannata, H. B. Geyer, C. Quesne, M. Znojil: *CPT-conserving Hamiltonians and their nonlinear supersymmetrization using differential charge-operators*, Int. J. Mod. Phys. **A**, to appear; `hep-th/0412211`.
5. H. Bíla, V. Jakubský, M. Znojil, B. Bagchi, S. Mallik, C. Quesne: *Weakly non-Hermitian square well*, Czech. J. Phys. **55** (2005), 1075–1076.
6. H. Bíla, V. Jakubský, M. Znojil: *Comment on 'Solution of the Dirac equation for the Woods-Saxon potential with spin and pseudospin symmetry' [J. Y. Guo and Z-Q. Sheng, Phys. Lett. A 338 (2005) 90]*, Phys. Lett. **A**, to appear; `math-ph/0510097`.
7. Č. Burdík, S. Krivonos, A. Shcherbakov: $N = 4$ *supersymmetric Eguchi-Hanson model in* $d = 1$, Czech. J. Phys. **55** (2005), No. 11
8. Č. Burdík, O. Navrátil: *A method for construction of the matrix solvable models*, J. Phys. **A38** (2005), 1533–1542.
9. Č. Burdík, O. Navrátil: *Normal ordering for deformed Heisenberg algebra involving the reflection operator*, J. Phys. **A38** (2005), 2305–2310.
10. Č. Burdík, O. Navrátil: *The q-boson-fermion realizations of quantum superalgebra* $U_q(osp(2/1))$, *Yad. Fiz.* **68** (2005), 1–3.
11. Č. Burdík, O. Navrátil, S. Pošta: *On three-particle matrix Calogero model*, *Phys. Lett.* **A**, to appear
12. E. Caliceti, F. Canata, M. Znojil, A. Ventura: *Construction of* $\mathcal{PT}$*-asymmetric non-Hermitian Hamiltonians with CPT-symmetry*, Phys. Lett. **A335** (2005), 26–30.
13. J. Dittrich, V.I. Inozemtsev: *Analytic proof of the Sutherland conjecture*, Yad. Fiz. **68** (2005), 1721–1723.
14. P. Exner: *An isoperimetric problem for point interactions*, J. Phys. **A38** (2005), 4795–4802.
15. P. Exner: *An isoperimetric problem for leaky loops and related mean-chord inequalities*, J. Math. Phys. **46** (2005), 062105
16. P. Exner: *Sufficient conditions for the anti-Zeno effect*, J. Phys. **A38** (2005), J. Phys. **A38** (2005), L449–454.
17. P. Exner, E.M. Harrell, M. Loss: *Inequalities for means of chords, with application to isoperimetric problems*, Lett. Math. Phys., to appear; `math-ph/0508060`.
18. P. Exner, T. Ichinose: *A product formula related to quantum Zeno dynamics*, Ann. H. Poincaré **6** (2005), 195–215.
19. P. Exner, S. Kondej: *Scattering by local deformations of a straight leaky wire*, J. Phys. **A38** (2005), 4865–4874.

20. P. Exner, H. Kovařík: *Spectrum of the Schrödinger operator in a perturbed periodically twisted tube*, Lett.Math.Phys. **73** (2005), 183–192.
21. P. Exner, O. Post: *Convergence of spectra of graph-like thin manifolds*, J. Geom. Phys. **54** (2005), 77–115.
22. P. Exner, V.A. Zagrebnov: *Bose-Einstein condensation in geometrically deformed tubes*, J. Phys. **A38** (2005), L463–470.
23. U. Guenther, F. Stefani, M. Znojil: *MHD α^2-dynamo, Squire equation and $\mathcal{PT}$-symmetric interpolation between square well and harmonic oscillator*, J. Math. Phys. **46** (2005), 063504.
24. L. Hlavatý: *Classical solution of a sigma model in curved background*, Phys. Lett. **B625** (2005), 285–290.
25. V. Jakubský, M. Znojil: *An explicitly solvable model of the spontaneous $\mathcal{PT}$-symmetry breaking*, Czech. J. Phys. **55** (2005), 1113–1116.
26. V. Jakubský, M. Znojil, E.A. Luis, F. Kleefeld: *Trigonometric identities, angular Schrödinger equations and a new family of solvable models*, Phys. Lett. **A334** (2005), 154–159.
27. C. Quesne, B. Bagchi, S. Mallik, H. Bíla, V. Jakubský, M. Znojil: *$\mathcal{PT}$-supersymmetric partner of a short-range square well*, Czech. J. Phys. **55** (2005), 1161–1166.
28. J. Tolar, P. Hájíček: *Can differently prepared mixed states be distinguished?*, Phys. Lett. **A**, to appear; `quant-ph/0309158`.
28. M. Znojil: *An asymptotic intertwining of the undelayed and delayed Fibonacci numbers*, Int. J. Pure Appl. Math. **19** (2005), 525–539.
30. M. Znojil: *Solvable $\mathcal{PT}$-symmetric model with a tunable interspersion of non-merging levels*, J. Math. Phys. (2005), 062109.
31. M. Znojil: *Perturbation method for non-square Hamiltonians and its application to polynomial oscillators*, Phys.Lett. **A341** (2005), 67–80.
32. M. Znojil: *$\mathcal{PT}$-symmetric quantum toboggans*, Phys. Lett. **A342** (2005), 36–47.
33. M. Znojil: *Solvable relativistic quantum dots with vibrational spectra*, Czech. J. Phys. **A55** (2005), 1187–1192.
34. M. Znojil: *Multiparametric oscillator Hamiltonians with exact bound states in infinite-dimensional space*, Rendiconti dell Circ. Mat. Palermo, Serie II, Suppl. **75** (2005), 333–346.
35. M. Znojil: *Coupled-channel version of $\mathcal{PT}$-symmetric square well*, J. Phys. **A39** (2005), 441–455.
36. M. Znojil, V. Jakubský: *Solvability and $\mathcal{PT}$-symmetry in a double-well model with point interactions*, J. Phys. **A38** (2005), 5041–5056.

37. H. Bíla, M. Tater, M. Znojil: *Comment on "Comparison of quantal and classical behavior of PT-symmetric systems at avoided crossings" [A. Nananyakkara, Phys. Lett. A 334 (2005) 144]*, Phys. Lett. **A**, to appear

2.3 Proceedings, submitted papers, etc.

1. P. Exner: *von Neumann way to treat systems of a mixed dimensionality*, Rep. Math. Phys. **55** (2005), 79–92.
2. P. Exner: *Point interaction polygons: an isoperimetric problem*, Proceedings of the Conference "Mathematical Results in Quantum Mechanics" (QMath9, Giens 2004); Springer Lecture Notes, to appear.
3. P. Exner: *Necklaces with interacting beads: isoperimetric problems*, Proceedings of the "International Conference on Differential Equations and Mathematical Physics" (Birmingham 2005), AMS "Contemporary Mathematics" Series; `math-ph/0508061`.
4. P. Exner, R. Frank: *Absolute continuity of the spectrum for periodically modulated leaky wires in* $\mathbb{R}^3$, submitted to Ann. H. Poincaré; `math.SP/0508525`.
5. P. Exner, P. Hejčík, P. Šeba: *Approximations by graphs and emergence of global structures*, submitted to J. Phys. **A**; `quant-ph/0508226`.
6. P. Exner, T. Ichinose, S. Kondej: *On relations between stable and Zeno dynamics in a leaky graph decay model*, Proceedings of the Conference "Operator Theory and Mathematical Physics" (Bedlewo 2004), to appear; `quant-ph/0504060`.
7. P. Exner, T. Ichinose, H. Neidhardt, V.A. Zagrebnov: *New product formulæ and quantum Zeno dynamics with generalized observables*, submitted to Int. Eq. Operator Th.; `math-ph/0411036`.
8. P. Exner, O. Turek: *Approximations of permutation-symmetric vertex couplings in quantum graphs*, Proceedings of the Conference "Quantum Graphs and Their Applications" (Snowbird 2005), AMS "Contemporary Mathematics" Series; `math-ph/0508046`.
9. L. Hlavatý, L. Šnobl: *Transformations of conformally invariant sigma-models*, Proceedings of the XXV International Winter School "Geometry and Physics" (Srní 2005), Suppl. Rend. Circ. Mat. Palermo, to appear
10. L. Hlavatý, M. Turek: *Flat coordinates and dilaton fields for conformal sigma models*, `hep-th/0512082`.

11. J. Hrivňák, P. Novotný, J. Patera, J.Tolar: *Graded contractions of the Pauli graded $sl(3,\mathbb{C})$*, submitted to Linear Algebra and Applications; `math-ph/0309033`.
12. A. Odzijewicz, A. Tereskiewicz, G. Chadzitaskos, I. Jex: *Explicitly solvable models of two-mode coupler in Kerr-media*, submitted to J. Mod. Opt.
13. J. Kříž, K. Martiník, P. Šeba, V. Tošnerová: *Force plate measurement of human hemodynamics*, `physics/0507135`.
14. Y. Nishimura, T. Cheon, P. Šeba: *Metastable congested states in multisegment traffic cellular automaton*, `physics/0507122`.
15. J. Tolar: *On distinguishability of differently prepared mixed states*, in Proceedings of IV International Symposium "Quantum Theory and Symmetries (QTS-4)" (Varna 2005), Heron Press, Sofia; pp. 1-5.

2.4 Seminars

2.4.1 Regular seminar

February 1

A. Tereskiewicz (Bialystok): Integrable Hamiltonians describing parametric conversion systems

February 1-2

Ray J. Rivers (Imperial College London): From point-particle Hamiltonians to field theories to non-linear Schrodinger equations I-III

March 22

A.P. Isaev (JINR): Multiloop Feynman integrals and conformal quantum mechanics

March 29

T. Langerová (CTU): Transfer functions for Bell inequalities

April 19

H. Lavička (CTU): Imitation structure in Minority Game on networks

April 26

M. Znojil: Hilbert spaces with unusual scalar products

May 3

V. Jakubský (NPI): $\mathcal{PT}$-invariant point interactions

May 10

S. Stenholm (KTH Stockholm): Entropy and time reversal in dynamical systems

May 17

P. Winternitz (CRM Montreal): Symmetries of linear and non-linear difference systems

May 24

M. Krbálek (CTU): Statistical distributions of traffic data and number variance of a Dyson gas

May 31

P. Soldán (CTU): Bose-Einstein condensation: from atoms to molecules

September 6

L. Šnobl (CTU): Surfaces associated with Grassmannian sigma models on Minkowski space

September 13

H. Toncrová (CTU): Simulation of a DNA damaging

September 13

M. Tušek (CTU): Singular perturbation of the free Hamiltonian in two dimensions

September 13

T. Kalvoda (CTU): A geometric interpretation of bound and free states

September 20

M. Gajdoš (CTU): Generalized perturbation series in quantum chromodynamics

September 20

J. Hýbl (CTU): Use of Baker-Campbell formulae for coordinate transformations in Drinfeld doubles

September 27

P. Lenhard (CTU): Deformations and contractions of Lie algebras

October 3-5

A. Vančura (Kaiserslautern): Einsten's gravitation theory ideas – a small continuation

October 11

J. Lukierski (Wroclaw): Noncommutative space-time and quantum relativistic symmetries

October 18

L. Hlavatý: Poisson-Lie duality in action (an explicit determination of the sigma model in a curved spacetime)

October 25

Y. Miyamoto (Chofu): Generation and detection of optical beams with orbital angular momentum

November 1

M. Krbálek (CTU): Statistical variances of transport data and number variance of a Dyson gas

November 8

A. Sergyeyev (Opava): Maximal superintegrability of Benenti systems

November 15

V. Rittenberg (Bonn): Stochastic models with conformal invariance

December 6

F. Slanina (IP AS): Brownian motors

2.4.2 The "Quantum Circle" seminar

March 1

Pavel Exner: Two-dimensional isoperimetric problems with singular interactions

March 8

Hynek Kovařík (Stuttgart): Stability of Schroedinger operator in twisted tubes

March 15

Olaf Post (RWTH Aachen): Branched quantum waveguides with Dirichlet boundary conditions: the decoupling case

March 22

David Krejčiřík (NPI): Nodal set of the Laplacian

March 24

Fredéric Klopp (Université Paris 13): Exponential sums related to the Kronnig-Penney model in a constant electric field

April 19

Rupert Frank (KTH Stockholm): On the absolute continuity of the spectrum of partially periodic operators

April 26

Martin Fraas (Charles University): Properties of δ-sphere interactions

May 3

Petr Šeba: Mechanical manifestations of human haemodynamics

May 16

Sylwia Kondej (TU Chemnitz): On quantum dynamics in a leaky graph decay model

May 17

Natasha Orlova (Laboratory of Theoretical Physics, JINR): Kirhhoff's theorem and correlation functions in the Abelian sandpile model

May 24

Taksu Cheon (Kochi University of Technology): Classical and quantum in solvable Hilbert-space game theory

May 31

Ondřej Turek (CTU): The meaning of quantum graph vertices

June 14

John Klauder (University of Florida, Gainesville): Projection operator approach to quantum constraints

August 23

Leszek Sirko (Polish Academy of Sciences, Warsaw): Investigation of the distributions of Wigner's reaction matrix for irregular graphs with absorbtion

September 5

Timo Weidl (Mathematisches Institut, Universität Stuttgart):

October 25

Saverio Pascazio (Bari): Interference of mesoscopic particles: quantum-classical transition

November 1

Pierre Duclos (UTV Toulon): Three quantum charged particles interacting through delta potentials

November 29

Norbert Röhrl (Universität Stuttgart): Numerical results on eigenvalues of curved waveguides in magnetic fields

December 6

David Krejčiřík (NPI): Hardy inequalities in strips on ruled surfaces

December 13

Jaroslav Novotný (CTU): CP universal processes for two qubits and the UNOT

2.5 Meetings

The 14th Student Winter School (Horní Polubný, January 24–30) organized by G. Chadzitaskos

The 14th Colloquium "Integrable Systems and Quantum Symmetries" (Prague, June 16-18), organized by Č. Burdík with the participation of L. Amico, N. Atakishiyev, D. Baleanu, A. Ballesteros, N. Beisert, M. Blaszak, V. Caudrelier, O. Defterli, S. Delillo, A. Doikou, R. Flume, Y. Friedman, A. Frydryszak, F. Gohmann, L. Gow, N. Gromov, J. Hietarinta, A. Horzela, J. Hu, T. Ioannidou, A. Isaev, L. Jonke, E. Kapuscik, A. Klimek, A. Kluemper, H. Konno, S. Krivonos, E. Langmann, D. Larsson, Z. Ma, A. Marciano, M. Milekovic, S. Moskaliuk, F. Mueller-Hoissen, G. Nyong, E. Paal, A. Popowicz, P. Puusemp, O. Ragnisco, E. Ragoucy, P. Saksida, N. Sawado, A. Sergyeyev, A. Shcherbakov, B. Si Lakhal, S. Silvestrov, M. Staudacher, P. Sutcliffe, P. Suurvarik, D. Talalaev, V. Tolstoy, K. Wolf, J. Wu, Z. Yu, Z. Zakirova, A. Zuevskiy, and others.

The 8th International Conference "Path Integrals. From Quantum Information to Cosmology" (Prague, June 6-10), co-organized by Č. Burdík with the participation of G. Alber, F. Ankerhold, F. Bastianelli, M.S. Blasone, J. Boháčik, F. Brosens, Huai-Yang Cui, J. Devreese, V. Dohm, H.-T. Elze, G. Falco, L. Fishman, V. Fleurov, D. Fujiwara, A. Garg, T. Gill, M.C. Gomes Eleuterio da Luz, E. Gozzi, M. Gutzwiller, Z. Haba, L. Hartmann, J. Hegseth, T. Ichinose, A. Inomata, S. Ivanov, W. Janke, J.R. Klauder, H. Kleinert, E. Kochetov, B. Kuckert, N. Kumano-go, Y. Lobanov, C. Malyshev, D. Mauro, T. Miyanaga, S. Moskaliuk, P. Muratore-Ginanneschi, A. Pelster, I. Pinto, C. Predescu, R. Rivers, R. Rosenfelder, F. 54 Scardigli, E. Shavgulidze, F. Scholtz, L.S. Schulman, A. Singer, D. Sokolovski, F. Steiner, A. Tagliacozzo, J. Tempere, G. Vitiello, V. Yarunin, W. Zachary, K. Ziegler, B. Zupnik, and others

The 3rd and 4th workshop "Pseudo-Hermitian Hamiltonians in Quantum Physics" in Koc University, Istanbul (June 20-22) and Stellenbosch, South Africa (November 22-25), respectively, were co-organized by M. Znojil

2.6 Students

Graduate:

H. Bíla (Charles U., supervised by M. Znojil); "Pseudo-Hermitean Hamiltonians in quantum theory"

M. Fraas (Charles U., supervised by P. Exner); "Solvable models of quantum systems with contact interactions"

P. Hejčík (University of Hradec Králové, supervised by P. Šeba, in collaboration with T. Cheon from Kochi University of Technology); "Quantum chaotic systems and associated time series"

I. Hradecký (CTU, supervised by P. Šťovíček); "Adiabatic analysis of a model with time-dependent Aharonov-Bohm fluxes"

J. Hrivnák (CTU, supervised by J. Tolar); "Graded contractions of Lie algebras"

V. Jakubský (CTU, supervised by M. Znojil); "Pseudo-Hermitean quantum physics"

O. Lev (CTU, supervised by P. Šťovíček); "Semiclassical analysis of quantum operator matrix elements"

P. Luft (CTU, supervised by G. Chadzitaskos); "Quantization and coherent states"

P. Novotný (CTU, supervised by J. Tolar); "Graded contractions of Lie algebras"

M. Turek (CTU, supervised by L. Hlavatý); "Geometric properties of dual sigma models"

P. Vytřas (CTU, supervised by P. Šťovíček); "A many-body system in a strong magnetic field"

5th course:

J. Hýbl (CTU, supervised by L. Hlavatý); "Use of Baker-Hausdorff-Campbell formula for coordinate transforms in Drinfeld doubles"

T. Kalvoda (CTU, supervised by P. Šťovíček); "Geometric interpretation of bound and free states"

S. Petráš (CTU, supervised by J. Tolar); "Quantum systems on 2-dimensional configuration manifolds with magnetic fields"

O. Turek (CTU, supervised by P. Exner); "Approximations of quantum graph vertices"

4rd course:

A. Černý (CTU, supervised by L. Hlavatý); "Clasification of the Lie algebras and its application for solving the Einstein equations"

3rd course:

J. Lipovský (CTU, supervised by P. Exner); "Resonances in quantum graphs"

P. Siegl (CTU, supervised by M. Znojil); "$\mathcal{PT}$-symmetric version of supersymmetric quantum mechanics"