Doppler Institute: Activities in 1998

It became a habit to summarize our activities at the end of a calendar year. Here we are again with a report on the sixth 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, *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*
H.D. Doebner, *Technische Universität Clausthal, Germany*
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E.H. Lieb, *Princeton University, USA*
L.A. Pastur, *Université Paris VII*
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 CR Grant No. 202/96/0218
   Rigorous models of integrable and chaotic systems
   Č. Burdík, G. Chadzitasos, J. Dittrich, P. Exner, M. Havlíček, L. Hlavatý, E. Pelantová, P. Šeba, P. Šťovíček, M. Tater, J. Tolar (responsible), M. Znojil
   expired at the end of 1998

2. AS CR Grant No. 1048801
   Spatially restricted quantum systems
   J. Dittrich, P. Exner (responsible), P. Šeba, M. Tater

3. AS CR Grant No. 1048804
   Transport properties of electron wave structures
   P. Exner, P. Šeba (responsible), P. Středa, M. Tater

4. The projects **ME099** and **ME170** of the Ministry of Education of the Czech Republic supporting a collaboration with Russia and Japan
   J. Dittrich, P. Exner (responsible), P. Šeba, P. Šťovíček, M. Tater,

5. College Development Fund Grant No. 23981266
   Solvable models – research work of students of mathematical physics
   L. Hlavatý (responsible)

2 Survey of activities

2.1 Edited volumes

1. Č. Burdík, A.A. Vladimirov, eds.: *Quantum Groups and Integrable Systems*, Proceedings of the 7th International Colloquium on Quantum Groups (Prague, June 18–20, 1998), Czech. J. Phys. **48** (1998), pp. 1261–1516.

2. J. Dittrich, P. Exner, M. Tater, eds.: *Mathematical Results in Quantum Mechanics*, Proceedings of a conference held in Prague, June 22–26, 1998; Operator Theory : Advances and Applications, Birkhäuser Verlag, Basel; to appear

2.2 Publications in journals

1. J. Asch, P. Duclos, P. Exner: *Stability of driven systems with growing gaps. Quantum rings and Wannier ladders*, J. Stat. Phys. **92** (1998), 1053–1069.
2. F. Bentosela, P. Exner, V.A. Zagrebnov: *A mechanism of porous–silicon luminiscence*, Phys. Rev. **B53** (1998), 1382–1385.
3. F. Bentosela, P. Exner, V.A. Zagrebnov: *Electron trapping by a current vortex*, J. Phys. **A31** (1998), L305–311.
4. Č Burdík, Ch. Frougny, J.-P. Gazeau, R. Krejcar: *β numbers as natural counting systems for quasicrystals*, J. Phys. **A31** (1998), 6449–6472.
5. Č. Burdík, O. Navrátil: *The q-boson realization of the quantum group $U_q(B_n)$*, Czech. J. Phys. **48** (1998), 1301–1306.
6. G. Chadzitaskos, A. Odziewicz: *Para-Grassmann star-product calculation*, Lett. Math. Phys. **43** (1998), 199–209.
7. L. Dąbrowski, P. Štovíček: *Aharonov–Bohm effect with δ-type interaction*, J. Math. Phys. 39 (1998), to appear
8. J. Dittrich, P. Duclos, N. Gonzalez: *Stability and instability of the wave equation solutions in a pulsating domain*, Rev. Math. Phys. **10** (1998), 925–962.
9. P. Duclos, P. Exner, B. Meller: *Exponential bounds on curvature–induced resonances in a two–dimensional Dirichlet tube*, Helv. Phys. Acta **71** (1998), 133–162.
10. P. Duclos, P. Štovíček, M. Vittot: *Perturbation of an eigen-value from a dense point spectrum: a general Floquet Hamiltonian*, Ann. Inst. H. Poincaré, to appear
11. P. Exner, A.F. Sadreev, P. Šeba, P. Středa, P. Feher: *Strength of topologically induced magnetic moments in a quantum device*, Phys. Rev. Lett. **80** (1998), 1710–1713.
12. P. Exner, P. Šeba: *Probability current tornado loops in three-dimensional scattering*, Phys. Lett. **A245** (1998), 35–39.
13. P. Exner, M. Tater: *Evanescent modes in a multiple scattering factorization*, Czech. J. Phys. **48** (1998), 617–624.

14. F.M. Fernández, R. Guardiola, J. Ros, M. Znojil: *Strong-coupling expansion for the $\mathcal{PT}$-symmetric oscillators $V(x) = a(ix)+b(ix)^2+c(ix)^3$*, J. Phys. **A31** (1998), 10105–10112.
15. R. Gebarowski, P. Šeba, K. Życzkowski, J. Zakrzewski: *Quantum chaotic scattering in the strip: from diffusion to localization*, Eur. Phys. J. **B6** (1998), 399–409.
16. M. Havlíček, J. Patera, E. Pelantová: *On Lie gradings II*, Lin. Algebra and its Appl. **277** (1998), 97–125.
17. M. Havlíček, S. Pošta, A.U. Klimyk: *On representations of cyclically symmetric algebra $U_q(so(3))$*, J. Math. Phys., to appear
18. M. Havlíček, S. Pošta, A.U. Klimyk: *Representations of q-deformed algebra $U_q(so(3))$*, Czech. J. Phys., to appear
19. L. Hlavatý, L. Šnobl: *Solution of the Yang-Baxter system for quantum doubles*, Int. J. Mod. Phys. **A**, to appear
20. E. Persson, K. Pichugin, I. Rotter, P. Šeba: *Interfering resonances in a microwave billiard*, Phys. Rev. **E58** (1998), 8001–8004.
21. H.J. Stoeckmann, P. Šeba: *The joint energy distribution function for the Hamiltonian $H = H_0+iWW^+$ for the one channel case*, J. Phys. **A31** (1998), 3439–3448.
22. P. Šťovíček: *A construction of representations of quantum groups: an example of $U_q(so(5))$*, Czech. J. Phys. **48** (1998), 1501–1506.
23. P. Šťovíček: *A construction of representations and quantum homogeneous spaces*, Lett. Math. Phys., to appear
24. P. Šťovíček, O. Váňa: *Differential cross section for the Aharonov-Bohm effect with nonstandard boundary conditions*, Europhys. Lett. **44** (1998), 403–408.
25. M. Znojil: *Quantum exotic: a repulsive and bottomless confining potential*, J. Phys. **A31** (1998), 3343–3355.
26. M. Znojil, R. Roychoudhury: *Spiked and screened oscillators $V(r) = Ar^2 + B/r^2 + C/r^4 + D/r^6 + F/(1 + gr^2)$ and their elementary bound states*, Czech. J. Phys. **48** (1998), 1–8.

2.3 Proceedings, submitted papers, etc.

1. F. Bentosela, R.M. Cavalcanti, P. Exner, V.A. Zagrebnov: *Anomalous electron trapping by localized magnetic fields*, submitted to J. Phys. **A**
2. F. Bentosela, P. Exner, V.A. Zagrebnov: *Anomalous electron trapping by magnetic flux tubes and electric current vortices*, Proceedings of the Conference "Mathematical Results in Quantum Mechanics" (Prague 1998); Operator Theory : Advances and Applications, Birkhäuser Verlag, Basel; pp. 191–196.
3. Č. Burdík, O. Navrátil: *The q–boson realizations of the quantum groups $U_q(D_n)$,* submitted to J. Phys. **A**.
4. P. Duclos, P. Šťovíček, O. Váňa: *About a resolvent formula,* Proceedings of the Conference "Mathematical Results in Quantum Mechanics" (Prague 1998); Operator Theory : Advances and Applications, Birkhäuser Verlag, Basel; pp. 221–226.

5. P. Exner: *Laterally coupled quantum waveguides*, Advances in Differential Equations and Mathematical Physics (Atlanta 1997); AMS "Contemporary Mathematics" Series, vol. 217, Providence, R.I., 1998; pp. 69–82.
6. P. Exner: *Window coupled quantum wires: spectral and scattering properties*, Proceedings of the Conference "Frontiers in Quantum Physics" (Kuala Lumpur 1997); Springer, Singapore 1998; pp. 170–188.
7. P. Exner, E.M. Harrell, M. Loss: *Optimal eigenvalues for some Laplacians and Schrödinger operators depending on curvature*, Proceedings of the Conference "Mathematical Results in Quantum Mechanics" (Prague 1998); Operator Theory : Advances and Applications, Birkhäuser Verlag, Basel; pp. 47–53.
8. P. Exner, S.A. Vugalter: *On the number of particles which a curved quantum waveguide can bind*, submitted to J. Math. Phys.
9. M. Havlíček, J. Patera, E. Pelantová: *On fine gradings of real forms of* $sl(n, C)$, in: "Lie Theory and Its Applications in Physics", Goslar 1997, World Scientific, Singapore 1998.
10. M. Havlíček, J. Patera, E. Pelantová: *On Lie gradings of real forms*, in: "Symmetry Methods in Physics", Dubna 1997, Russian J. Nucl. Phys. **10** (1998).
11. M. Havlíček, S. Pošta, P. Winternitz: *Nonlinear superposition formulas based on nonprimitive action*, submitted to J. Math. Phys.
12. L. Hlavatý: *All SU(2) chiral models have spectral dependent Lax formulation*, solv-int/9803017, submitted to Phys. Lett. A.
13. D. Krejčiřík: *Birman-Schwinger analysis for bound states in a pair of parallel quantum waveguides with a semitransparent boundary*, Proceedings of the Conference "Mathematical Results in Quantum Mechanics" (Prague 1998); Operator Theory : Advances and Applications, Birkhäuser Verlag, Basel; pp. 281–287.
14. J. Patera, J. Tolar: *On gradings of Lie algebras and representations*, in: "Lie Theory and Its Applications in Physics II", Proc. of the Clausthal Workshop, 1997 (invited talk). (H.-D. Doebner, V.K. Dobrev, J. Hilgert, eds.) World Scientific, Singapore, to appear.
15. J. Tolar: *Graded contractions of Lie algebras of physical interest*, in: "Algebraic Methods and Theoretical Physics", Proc. of a symposium in honour of J. Patera and P. Winternitz for their 60th birthday, Montréal 1997, (L. Pelletier, ed.) to appear.
16. J. Tolar: *Quantum mechanics in finite–dimensional Hilbert spaces: Factorization properties,* in: "Coherent States, Quantization and Gravity", Proceedings of XVIIth Workshop on Geometric Methods in Physics, Białowieża 1998, to appear in Rep. Math. Phys.
17. M. Znojil: *Perturbation theory with nondiagonal propagators and its use in the intermediate-coupling regime*, "IX. Int. Conf. Recent Progress in Manybody Theories", July 21 - 25, 1997 in Sydney, Australia, (to appear in proceedings ed. D. Neilson, World Scientific, Singapore).

18. M. Znojil: *Triangular representation of Hamiltonians and generalized Gauss hypergeometric series,* in: III. Int. Workshop "Classical and Quantum Integrable Systems", June 29 - July 3, 1998 in Yerevan, Armenia (to appear in proceedings, ed. G. Pogosyan).
19. M. Znojil: *A new perturbative approach to anharmonic $V(r)$*, submitted to Phys. Lett. A.
20. M. Znojil: *Polynomial oscillators as perturbations of multiple square wells,* submitted to J. Math. Phys.
21. M. Znojil: *Generalized parity, generalized two-term recurrences and quasi–hypergeometric bound states in "unsolvable" potentials,* submitted to J. Math. Phys.
22. M. Znojil: *Comment on "The strong coupling expansion ..." by Fernandez and Guardiola,* submitted to J. Phys. A: Math. Gen.

2.4 Seminars

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

December 8
J. Tolar: The Chinese remainder theorem and quantum mechanics

November 26
A.U. Klimyk (Kiev): Infinite-dimensional representations of quantum algebras

November 24
D. Baleanu (Dubna): Killing-Yano symmetry and Nambu mechanics

November 10
P. Duclos (Toulon): Stability of periodically driven systems

November 3
U. Grimm (Chemnitz): Electrons in quasicrystals

October 27
P. Exner: Small-obstacle scattering and probability current vortices

October 20
P. Zizler (CTU): Wavelets and their applications

October 13
A. Vančura (Kaiserslautern): Do neutrinos have a nonzero mass?

October 6
R. Krejcar (CTU): Z_β-quasilattices and quasicrystals

September 1
A. Arai (Sapporo): Representation-theoretic aspects of a gauge theory on a non-simply connected space

July 21
T. Ichinose (Kanazawa): Norm estimate for Kac's tranfer operator with applications to the Lie-Trotter product formula

June 2
J. Schmiedmayer (Innsbruck): Atoms in singular fields

May 12
E.M. Harrell (Atlanta): Optimizing the eigenvalues of Schrödinger equations with potential energy determined by curvature

May 5
L. Hlavatý: Chiral models

April 28
D. Krejčiřík (Charles University): Parallel waveguides with a semitransparent boundary

April 14
T. Digernes (Trondheim): Finite-dimensional approximations of quantum systems

April 7
W. Lücke (Clausthal): Gisin nonlocality of Bialynicki-Birula's and Mycielski's nonlinear quantum mechanics

March 31
L. Rob (Charles University): Detection of quanta of a cosmic origin

March 24
M. Welk (Leipzig): Differential calculus on quantum spheres and quantum homogeneous spaces

March 17
V. Jásenský (CTU): Integrability and Seiberg-Witten theory (an introduction)

March 10
W. Renger (Clausthal): Limiting absorption principle for singularly perturbed operators

March 3
O. Váňa (CTU): Krein formula and its applications in determining spectral properties of Schrödinger operators

February 23
M. Malínský (CTU): The theoretical limiting Higgs boson mass in generalized standard models

February 16
C. Juszczak (Wroclaw): Classification of low-dimensional Lie super-bialgebras osp(1,2) and super-e(2)

2.5 Meetings

7th Student Winter School (Polubný, January 25–31)

The 7th Colloquium "Quantum groups and Integrable Systems" (Prague, June 18–20)
attended by V. Abramov, N. Aizawa, D. Arnaudon, J.F. Cariñena, J. Cornwell, O.F. Dayi, A. Della Selva, I.S. Duru, B. Drabant, T. Ernst,

L. Feher, A.T. Filippov, L. Frappat, X. Gomez, I. Heckenberger, T. Hodges, M. Irac-Astaud, A. Isaev, A. Jacobs, P.R. Johnson, V.P. Karassiov, R.M. Kashaev, A. Kempf, R. Kerner, O.M. Khudaverdian, M. Klimek, A.U. Klimyk, J. Krause, P.P. Kulish, L.C. Kwek, A. Lavrenov, F. Leitenberger, D. Leites, J. Lukierski, V. Lyakhovsky, V. Lyubashenko, N.J. MacKay, S. Majid, F. Müller-Hoissen, A. Nowicki, P. Parashar, M.J. Przybylska, P. Pyatov, C. Quesne, O. Ragnisco, Z. Rakic, N. Reshetikhin, P. Saponov, K. Schmüdgen, A. Schüler, S. Silvestrov, V. Souček, H. Steinacker, V.N. Tolstoy, L. Turowska, N. Vansteenkiste, A. Vladimirov, M. Welk, S.L. Woronowicz, S. Zakrzewski, Ch. Zhang, and others

The conference "Mathematical Results in Quantum Mechanics" (QMath7) (Prague, June 18–20)
with invited talks by J.E. Avron, J. Bellissard, M.S. Birman, G. Casati, J.-M. Combes, F. Gesztesy, E.H. Lieb, L.A. Pastur, R. Seiler, B. Simon, J. Yngvason,
plenary talks by Y. Colin de Verdière, E.M. Harrell, R. Hempel, A. Jensen, S.T. Kuroda, Ph.-A. Martin, E. Mourre, R. del Rio,
and 110 session talks.
More details can be found at the conference page,
http://www.ujf.cas.cz/˜exner/cf98.html.

2.6 Teaching activities

2.6.1 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. *Mathematical methods of the quantum theory* (Charles University, Exner)
2. *Applications of cohomology in physics* (CTU, Tolar)
3. Seminar *Symmetries of differentail equations* (CTU, Hlavatý)
4. Seminar *Solvable models of mathematical physics* (CTU, Hlavatý)
5. Seminar *Quasicrystals* (CTU, Burdík, Pelantová)

2.6.2 Students

Graduate:

V. Jásenský (CTU, supervized by L. Hlavatý)
"Quantum sigma–models"
R. Krejcar (CTU, supervized by Č. Burdík);
"Canonical Meyer quasilattices of quasicrystals"

N. Navrátil (CTU, supervized by Č. Burdík);
"Boson realizations of Lie algebras, superalgebras and quantum groups"

Z. Masáková (CTI, supervized by E. Pelantová; in collaboration with Université de Montreal – J. Patera);
"Properties of quasicrystals"

S. Pošta (CTU, supervized by M. Havlíček);
"Representations of quantum groups"

D. Krejčiřík (Charles U., supervized by P. Exner);
"Spectral properties of quantum layers"

H. Kovařík (Charles U., supervized by P. Exner);
"Soft and magnetic quantum waveguides"

J. Kříž (Charles U., supervized by J. Dittrich);
"Neumann waveguides"

Graduated in 1998:

D. Krejčiřík (Charles U., P. Exner);
presented diploma work *Spectral properties of laterally coupled waveguides.*

Z. Masáková (CTU, E. Pelantová);
presented diploma work *Properties of cut–and–project quasicrystals*

S. Pošta (CTU, M. Havlíček);
presented diploma work *Representations of* $U_q(so_3)$

5th course:

M. Malinský (CTU, J. Hořejší);
diploma work *Anomalies in quantum field theory.*

R. Otec (CTU, J. Tolar);
diploma work *Quantum mechanics in a finite–dimensional Hilbert space*

K. Smolek (CTU, M. Tater);
diploma work *Resonance effects in quantum system depending periodically on time*

L. Šnobl (CTU, L. Hlavatý);
diploma work *Quantum doubles.*

O. Váňa (CTU and UTV, P. Štovíček and P. Duclos);
diploma work *Floquet Hamiltonian spectrum and the Krein formula*

4th course:

L. Klouda (CTU, L. Hlavatý);
review and research work *Quantum sigma–models.*

J. Souček (CTU, L. Hlavatý);
review and research work *Quantum sigma–models.*

A. Čech (CTU, M. Havlíček);
review and research work *Fairlie algebra.*

T. Pecha (CTU, M. Havlíček);
review and research work *Quantum computers.*

3rd course:

J. Šála (CTU, E. Pelantová);
review *Properties of quasicrystals*