Doppler Institute: Activities in 1997

It became a habit to summarize our activities at the end of a calendar year. Here we are again with a report on the fifth 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*

M. Flato, *Université de Dijon, France*

J.R. Klauder, *University of Florida, Gainesville, USA*

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 till the end of 1998

2. AS CR Grant No. K 1019601
   Topical problems of mathematics and mathematical physics
   M. Havlíček, L. Musílek (responsible), J. Tolar.

3. In addition, the education of students for and through research was supported by the grant No. 1065 of the Czech Universities Development Fund 1997
   Student research in mathematical physics
   A. Bóna, J. Tolar (responsible),
   and by the grant No. 3297008 of the CTU Development Fund
   Student research in the international cooperation of the Doppler Institute
   Č. Burdík, M. Havlíček, J. Tolar (responsible).

2   Survey of activities

2.1   Publications in journals

1. F. Bentosela, P. Exner, V.A. Zagrebnov: *A mechanism of porous–silicon luminiscence*, Phys. Rev. **B56**, to appear

2. L. Dąbrowski, P. Šťovíček: *Aharonov–Bohm effect with δ-type interaction*, J. Math. Phys. 39 (1998), to appear

3. J. Dittrich, P. Duclos, N. Gonzalez: *Stability and instability of the wave equation solutions in a pulsating domain*, Rev. Math. Phys., to appear

4. J. Dittrich, V.I. Inozemtsev: *On the second–neighbour correlator in 1D XXX quantum antiferromagnetic spin chain*, J. Phys. A: Math. Gen. **30** (1997), L623–626.

5. J. Dittrich, V.I. Inozemtsev: *On the two-magnon bound states for the quantum Heisenberg chain with variable range exchange*, Mod. Phys. Lett. **B11** (1997), 453–459.

6. P. Duclos, P. Exner, B. Meller: *Exponential bounds on curvature–induced resonances in a two–dimensional Dirichlet tube*, Helv.Phys. Acta, to appear

7. P. Duclos, P. Šťovíček, M. Vittot: *Perturbation of an eigenvalue from a dense point spectrum*, J. Phys. A: Math. Gen. **30** (1997), 7167–7185.

8. P. Exner: *Magnetoresonances on a lasso graph*, Found. Phys. **27** (1997), 171–190.

9. P. Exner: *A duality between Schrödinger operators on graphs and certain Jacobi matrices*, Ann. Inst. H. Poincaré: Phys. Théor. **66** (1997), 359–371.

10. P. Exner, A.F. Sadreev, P. Šeba, P. Feher, P. Středa: *Topologically induced vortex magnetance of a quantum device*, Phys. Rev. Lett. **80** (1998), No. 5.

11. P. Exner, P. Šeba: *Resonance statistics in a microwave cavity with a thin antenna*, Phys. Lett. **A228** (1997), 146–150.

12. P. Exner, M. Tater: *Evanescent modes in a multiple scattering factorization*, Czech. J. Phys. **48** (1998), to appear

13. P. Exner, S.A. Vugalter: *Bounds states in a locally deformed waveguide: the critical case*, Lett. Math. Phys. **39** (1997), 59–68.

14. P. Exner, S.A. Vugalter: *Bound–state asymptotic estimates for window–coupled Dirichlet strips and layers*, J. Phys. **A30** (1997), 7863–7878.

15. M. Havlíček, A.U. Klimyk, 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. **47** (1997), 13–16.

16. M. Havlíček, J. Patera, E. Pelantová: *On the fine gradings of simple classical Lie algebras,* Int. J. Mod. Phys. **12** (1997), 189–194.

17. L. Hlavatý: *Classification of quantized braided groups in the dimension two*, Int. J. Mod. Phys. **A12** (1997), 5161–5169.

18. L. Hlavatý: *Yang–Baxter systems, solutions and applications*, Tr. J. Phys., to appear

19. P. Šeba, F. Haake, M. Kus, M. Barth, U. Kuhl, H.–J. Stoeckmann: *Distribution of the wavefunction inside chaotic partially open systems*, Phys. Rev **E56** (1997), 2680–2686.

20. H.J. Stoeckmann, P. Šeba: *The joint energy distribution function for the Hamiltonian $H = H_0 + iWW^+$ for the one channel case*, J. Phys. A: Math. Gen., in print

21. P. Šťovíček, R. Twarock: *Representations of $U_h(SU(N))$ derived from quantum flag manifolds,* J. Math. Phys. **38** (1997), 1161–1182.

22. J. Tolar, G. Chadzitaskos: *Quantization on Z_M and coherent states over $Z_M \times Z_M$*, J. Phys. A: Math. Gen. **30** (1997), 2509–2517.

23. J. Tolar, J. Trávníček: *Graded contractions of symplectic Lie algebras in collective models,* J. Math. Phys. **38** (1997), 49–56.

24. J. Tolar, J. Trávníček: *Graded contractions of $sp(3, I\!R)$,* Rep. Math. Phys. **46** (1997), 343–357.

25. M. Znojil: *Perturbation theory for quantum mechanics in its Hessenberg–matrix representation*, Int. J. Mod. Phys. **A12** (1997), 299-304.

26. M. Znojil: *Asymmetric bound states via the quadrupled Schrödinger equation,* Phys. Lett. **A230** (1997), 283–287.

27. M. Znojil: *r^D oscillators with arbitrary $D > 0$ and perturbation expansions with Sturmians*, J. Math. Phys. **38** (1997), 5087–5097.

28. 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., to appear

29. M. Znojil: *A new faster method for solving the Schrödinger equations*, J. Phys. A: Math. Gen., 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 Differential Equations, Asymptotic Analysis, and Mathematical Physics (Potsdam 1996); Akademie Verlag, Berlin 1997; pp. 10–25.

2. 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.

3. Č. Burdík , Ch. Frougny , J.P. Gazeau and R. Krejcar: *β–integers and canonical Meyer quasilattices for quasicrystals,* submitted

4. P. Duclos, P. Šťovíček, M. Vittot: *Perturbation of an eigenvalue from a dense point spectrum: a general Floquet Hamiltonian*, submitted

5. P. Exner: *Laterally coupled quantum waveguides*, Proceedings of the Conference on Differential Equations and Mathematical Physics (Atlanta 1997); to appear

6. P. Exner: *Window coupled quantum wires: spectral and scattering properties*, Proceedings of the Conference "Frontiers in Quantum Physics" (Kuala Lumpur 1997); to appear

7. P. Exner, P. Šeba: *Probability current tornado loops in three-dimensional scattering*, submitted

8. M. Havlíček, P. Moylan: *Representations of the Poincare Lie algebra from an embedding into an extension of the Lie field of so(1,4)*, in Proceedings XXI Int. Colloq. "Group Theoretical Methods in Physics", World Scientific, Singapore 1997; pp.243–245.

9. M. Havlíček, J. Patera and E. Pelantová: *On the maximal Abelian subgroups of diagonalizable automorphisms of simple classical Lie algebras*, in Proceedings XXI Int. Colloq. "Group Theoretical Methods in Physics", World Scientific, Singapore 1997; pp.115–120.

10. P. Šeba, K. Życzkowski, J. Zakrzewski: *Random matrix approach to "nonuniversal' conductance*, submitted

11. M.Znojil: *Double delta expansions – an open problem*, in "Functional Integration Basics and Applications" (Cargése 1996), ed. by C. deWitt-Morette, P. Cartier and A. Folacci, NATO ASI, Series B: Physics, Vol. 361 (Plenum, New York, 1997); p. 424.

12. M.Znojil: *Perturbation theory for quantum mechanics in its Hessenberg–matrix representation*, Proceedings of Int. Workshop "Classical and Quantum Integrable Systems" (Dubna 1996), to appear

2.3 Seminars

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

December 16
    S. Pošta (CTU): Representations of a quantum deformation of so(3)
December 9
    J. Fischer (IP AS): Summation of power expansions in quantum field theory
December 2
    L. Šnobl (CTU): Bethe Ansatz and Yang-Baxter equations
November 28
    A. Zeilinger (Innsbruck): Quantum locality and teleportation
November 18
    C. Schulte (Clausthal): Quantum mechanics on special topologically nontrivial manifolds
November 12, 13
    U. Leonhardt (Ulm): State reconstruction in quantum mechanics I, II
November 11
    P. Duclos (Toulon): KAM type method in quantum mechanics revisited
November 4
    A.U. Klimyk (Kiev): Infinite-dimensional representations of quantum algebras and their applications
October 21
    Z. Masáková (CTU): Mathematical properties of quasicrystals

October 14

    A. Vančura (Kaiserslautern): Faster than light?

October 7

    R. Krejcar (CTU): Z_τ quasilattices applied to description of five-fold quasicrystals (with the example of Penrose tiling)

September 30

    I. Jex (CTU): From Schroedinger to Mathieu equation in atomic optics

September 9

    H. de Guise (Montreal): Graded contractions of representations

May 27 – June 10

    A. Perelomov (Zaragoza): Quantum integrable systems 1–5

May 20

    P. Bóna (Bratislava): Pragmatism in the foundations of quantum theory

May 20

    L.S. Schulman (Clarkson U., Potsdam): Time arrow and quantum measurement

April 29

    N. Gonzalez (Toulon): Introduction to diffeomorphisms of the circle

April 24

    N. Imoto (NTT Research, Tokyo): Quantum information processing

April 22

    O. Váňa (CTU): Geometry of the Legendre transformation

April 15

    M. Konopka (Bratislava): Photonic band gaps

April 8

    A. Bóna (CTU): Geometry of the configuration space of an anyon system

April 2

    P. Lahti (Turku): Symmetry groups in quantum mechanics and the theorem of Wigner on the symmetry transformations

March 25

    J. Patera (Montreal): Quasicrystals

March 11

    P. Středa (IP AS): Quantum Hall effect

February 25

    R. Babilon (Charles University): Penrose tiling

2.4   Meetings

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

The 6th Colloquium "Quantum groups and Integrable Systems" (Prague, June 19–21)

    attended by H. Ahmedov, D. Arnaudon, J. Avan, A. Ballesteros, A. Borowiec, T. Brzeziński, V.K. Dobrev, J. Donin, I.H. Duru, L. Frappat, C. Gardner,

P. Grozman, P.M. Hajac, I. Heckenberger, L. Hellström, F.J. Herranz, M. Houari, M. Irac–Astaud, A. Kempf, M. Klimek, P.P. Kulish, A. Lavrenov, D. Leites, J. Lukierski, S. Majid, P. Moylan, J. Negro, Z. Oziewicz, J.C. Perez Bueno, G. Rideau, M. Rossi, I. Shchepochkina, K. Schmüdgen, A. Schüler, S.D. Silvestrov, P. Sorba, A.A. Stolin, V.N. Tolstoy, J. van der Jeugt, S. Zakrzewski, and others

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. *Applications of cohomology in physics* (CTU, Tolar)
3. Seminar *Quantum Sigma–Models* (CTU, Jásenský, Hlavatý)
4. Seminar *Quasicrystals* (CTU, Burdík, Pelantová)

2.5.2 Students

Graduate:

P. Trávníček (supervised by J. Tolar)
the thesis "Physical applications of graded contractions" presented at CTU in 1997

N. Gonzalez (thesis at CTU and Université de Toulon, supervized by J. Dittrich and P. Duclos)
the thesis "L'équation des ondes dans une domaine dépendant du temps" presented on September 15 at UTV

V. Jásenský (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"

M. Konôpka (thesis at Comenius University, Bratislava, supervised by V. Bužek and I. Jex)
"Exact solutions for non–linear Hamiltonians"

Graduated in 1997:

A. Bóna (CTU, J. Tolar);
diploma thesis *Quantum theory of quasi–two–dimensional systems.*

M. Čermák (CTU, L. Hlavatý);
diploma thesis *Lax formulation of non–linear differential equations.*

J. Fiala (CTU, F. Maršík);
 diploma thesis *Fluid flow in elastic tubes.*
D. Vaněk (CTU, P. Exner);
 diploma thesis *Spectral and scattering properties of serial structures.*

5th course:

D. Krejčiřík (Charles U., P. Exner);
 diploma work *Spectral properties of laterally coupled waveguides.*
Z. Masáková (CTU, E. Pelantová; in collaboration with Université de Montreal);
 diploma work *Properties of cut–and–project quasicrystals*
A. Doreen (Université de Montréal, J. Patera and E. Pelantová);
 diploma work *Mathematical properties of quasicrystals.*
S. Pošta (CTU, M. Havlíček);
 diploma work *Representations of $U_q(so_3)$*

4th course:

M. Kratochvíl (Charles U., P. Šeba);
 diploma work *Chaotic features in quantum transport*
M. Malinský (CTU, J. Hořejší);
 review and research work *Anomalies in quantum field theory.*
J. Novotný (CTU, I. Jex);
 review and research work *Density matrices in quantum physics.*
R. Otec (CTU, J. Tolar);
 review and research work *Quantum mechanics in a finite–dimensional Hilbert space.*
K. Smolek (CTU, P. Exner);
 review and research work *Quantum dot with a perturbed boundary.*
L. Šnobl (CTU, L. Hlavatý);
 review and research work *Bethe ansatz and Yang–Baxter equations.*
O. Váňa (CTU, P. Šťovíček);
 review and research thesis *Time–dependent Hamiltonians*

3rd course:

L. Klouda (CTU, V. Jásenský);
 review *Quantum sigma–models.*
J. Souček (CTU, V. Jásenský);
 review *Quantum sigma–models.*
A. Čech (CTU, P. Šeba);
 review *Quantum chaos.*