Doppler Institute: Activities in 1995

As before, we use the end-of-year opportunity to present a short summary of our activities. At our third anniversary some of our grants expired, but we have managed to obtain support for the next three-year period — hence there is a life ahead.

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 institution to which they belong. The research performed in DI has been supported by the following research grants:

1. CTU Internal Grant No.8154
   Quantum symmetries: mathematical models and physical applications
   Č. Burdík, G. Chadzitaskos, M. Havlíček (responsible for the project), L. Hlavatý, P. Šťovíček, J. Tolar
   expired by the year end

2. GA AS Grant No.148409
   Schrödinger operators and quantum chaos
   J. Dittrich, P. Exner (responsible), M. Tater, P. Šeba
   till the end of 1996

3. GA CR Grant No.202–93–1314
   Nonlinear models in quantum physics
   Č. Burdík, J. Dittrich, P. Exner, M. Havlíček, L. Hlavatý, M. Tater, P. Šeba, P. Šťovíček, J. Tolar (responsible), M. Znojil
   expired by the year end

4. 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

In addition, the education of students for and through research was supported by the grant No. 0275 of the Czech Universities Development Fund 1995
Research of undergraduate and graduate students at the Doppler Institute
M. Havlíček, L. Hlavatý, J. Tolar (responsible).

1.4 Long-time visitors

P. Moylan (Pennsylvania State University), guest professor of CTU, June–December, cosponsored by the J. William Fulbright Foundation: research at DI and regular curriculum course *Functional analysis.*

2 Survey of activities

2.1 Publications in journals

3. P. Duclos, P. Exner: *Curvature–induced bound states in quantum waveguides in two and three dimensions*, Rev.Math.Phys. **7** (1995), 73–102.

4. P. Duclos, P. Exner, P. Šťovíček: *Curvature–induced resonances in a two–dimensional Dirichlet tube*, Ann.Inst.H.Poincaré **62** (1995), 81–101.

5. P. Duclos, P. Šťovíček: *Floquet Hamiltonians with pure point spectrum*, Commun.Math.Phys., to appear

6. P. Exner: *Lattice Kronig–Penney models*, Phys.Rev.Lett. **74** (1995), 3503–3506.

7. P. Exner: *The absence of the absolutely continuous spectrum for δ' Wannier–Stark ladders*, J.Math.Phys. **36** (1995), 4561–4570.

8. P. Exner: *A quantum pipette*, J.Phys. **A28** (1995), 5323–5330.

9. P. Exner: *Contact interactions on graph superlattices*, J.Phys. **A**, to appear

10. P. Exner: *A duality between Schrödinger operators on graphs and certain Jacobi matrices*, Ann.Inst. H.Poincaré, to appear

11. P. Exner, R. Gawlista: *Band spectra of rectangular graph superlattices*, Phys. Rev. **B**, to appear

12. P. Duclos, P. Exner, B. Meller: *Exponential bounds on curvature–induced resonances in a two–dimensional Dirichlet tube*, submitted to J.Funct.Anal.

13. P. Exner, P. Šeba, M. Tater, D.Vaněk: *Bound states and scattering in quantum waveguides coupled laterally through a boundary vindow*, submitted to J.Math.Phys.

14. P. Exner: *Weakly coupled states on branching graphs*, submitted to Lett.Math. Phys.

15. P. Hájíček, A. Higuchi, J. Tolar: *Group quantization of parametrized systems, II. Pasting Hilbert spaces*, J.Math.Phys. **36** (1995), 4639–4666.

16. L.Hlavatý: *Algebraic framework for quantization of nonultralocal models*, J. Math.Phys. **36** (1995), 4882–4897.

17. L. Hlavatý, L. Kundu: *Quantum integrability of nonultralocal models through Baxterisation of quantised braided algebra*, Int.J.Mod.Phys., to appear

18. L. Hlavatý: *Solution of constant Yang–Baxter system in the dimension two*, submitted to J.Phys. **A**

19. C. Jagger, P. Šťovíček, A. Thomason: *Multiplicities of subgraphs*, Combinatorica, to appear

20. P. Moylan: *Harmonic Analysis on Spannors*, J.Math.Phys. **36** (1995), 2826–2876.

21. P. Moylan: *An elementary account of the factor of 4/3 in the electromagnetic mass*, Amer.J.Phys. **63** (1995), 818–820.

22. P. Šťovíček: *Antiholomorphic representations for orthogonal and symplectic quantum groups*, J. of Algebra, to appear

23. J. Tolar, J. Trávníček: *Graded contractions and the conformal group of space-time*, J.Math.Phys. **36** (1995), 4489–4506.

24. M. Znojil: *Non–numerical of the number of bound states in some screened Coulomb potentials*, Phys.Rev. **A51** (1995), 128–135.

25. M. Znojil: *Minimal relativity and Hulthén potentials*, Phys.Lett. **A203** (1995), 1–4.

26. M. Znojil: *Bound–state method with elementary–product wavefunctions*, J. Phys. **A28** (1995), 6265–6276.

27. M. Znojil: *The most general iteration scheme for the Lippmann–Schwinger–type equations*, submitted to J.Phys. **A**

28. M. Znojil: *Relativistic kinetic energy as an operator continued fraction*, submitted to J.Phys. **A**

29. M. Znojil: *Harmonic oscillator in a quasi–relativistic regime*, submitted to J.Phys. **A**

30. M. Znojil: *Jacobi polynomials and bound states*, submitted to J.Math.Chem.

2.2 Seminars

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

January 12
    V.G. Kac (MIT): Quantum groups and their representations
February 14
    M. Beneš (CTU): A model for first–order phase transitions in crystallic substances
February 21
    J.–P. Gazeau (Paris 7): Quasicrystals
February 28
    L. Hlavatý: Braided groups in non–ultralocal integrable models
March 7
    J.F. Cornwell (St. Andrews): Kac–Moody algebras and their automorphisms
March 14
    M. Tater (NPI): Bound states in laterally coupled waveguides
March 21
    P. Exner: Contact interactions on lattice graphs
March 28
    A.U. Klimyk (Kiev): Spectra of representation operators for quantum groups and q–oscillator algebras
April 4
    E. Pelantová (CTU): τ–integers and five–fold Meyer sets in the plane
April 11
    M.A. Antonec (Nizhni Novgorod): Critical phenomena for infinitely divisible distributions on lattices
April 18
    J. Vanžura (Brno University): Braided quantum groups

April 25

    M. Tater (NPI): Bound states in laterally coupled waveguides II

May 9

    M.S. Birman (Sankt Petersburg): On the discrete spectrum of the Schrödinger operator in two–dimensional case

May 9

    V.S. Buslaev (Sankt Petersburg): Bloch solutions of difference equations and the spectrum of Hofstadter–type operators

May 16

    N. Gonzalez (Marseille): Wave reflection on a moving boundary

May 23

    P. Bóna (Bratislava): A possible interpretation of nonlinear quantum mechanics

May 30

    A. Uhlmann (Leipzig): Riemannian metrics and phase transport in state spaces

June 6

    V. Sotnikov (AS Prague): Excitation of sideband emissions in the ionospheric plasma

June 14

    M. Blažek (Bratislava): Fundamental equations governing multifractality in chaotic phenomena

June 19

    M. Grmela (EP Montréal): Hamiltonian structures in macroscopic dynamics

July 18

    J.R. Klauder (Gainesville): Poisson distributions: Antidote for triviality

October 10

    I. Jex (Berlin): Theory and applications of symmetric multiports

October 24

    P. Moylan (Pennsylvania): Singleton representations of the q–deformed anti–de Sitter algebra

October 31

    P. Šeba: Quantum chaos

November 14

    V. Jásenský (CTU): An integrable hierarchy of classical evolution equations

November 21

    B. Jurčo (Olomouc University): Quantum groups and integrable systems

November 28

    A.U. Klimyk (Kiev): Spectra of representation operators for quantum groups and q–oscillator algebras II

December 5

    J. Asch (Toulon): Lower bounds on the width of Stark–Wannier type resonances

December 12
> S.A. Vugalter (Nizhni Novgorod): Many–particle Schrödinger operators with a magnetic field. Spectral asymptotics

December 19
> B. Jurčo (Olomouc University): Quantum groups and integrable systems II

2.3 Meetings

4th Student Winter School (Mariánská, February 5–12)

The 4rd Colloquium "Quantum groups" (Prague, June 22–24)
> The program included, in particular, the following lectures:

> *J.–P. Gazeau* (Paris 7): Non–commutative geometry and quantum groups in quasicrystalline studies

> *M. Chaichian* (Helsinki): q–path integrals

> *S. Ktitorov* (S.Petersburg): Harper's operator, theta function, magnetic symmetry and quantum groups

> *P. Mašlanka* (Lodz): Representations of the generalized oscillator algebra

> *P. Minneart* (Bordeaux): Nonstandard deformations of the conformal algebra

> *R.J. McDermont* (Aberdeen): Squeezed states parametrized by elements of a noncommutative algebra

> *P. Prešnajder* (Bratislava): Remarks on the fuzzy quantum theory

> *Ch. Quesne* (Bruxelles): Generalized deformed oscillator algebras with a Hopf algebraic structure

> *S. Sciuto* (Torino): Quantum algebraic structure of twisted XXZ chain

> *V.N. Tolstoy* (Moscow): Yangian double

> *J.Van der Jeugt* (Gent): An exponential map for representations of $U_{p,q}(gl(2))$

> together with contributions by *A. Alekseev, P. Aschieri, R. Asherova, Č. Burdík, P. Caban, L. Castellani, V. Dobrev, A. Dzumadildaev, Ch. Chryssomalakos, A. Isaev, A.U. Klimyk, M. Klimek, J. Lukierski, V. Lyakhovsky, A.J. MacFarlane, P. Moylan, A.A. Nowicki, P. Podles, Z. Popowicz, A. Schüler, K.A. Smolinski, A.V. Tsiganov* and *A. Vladimirov.*

2.4 Teaching activities

2.4.1 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 quantum theory* (Charles University, Exner)

2. *Quantum groups* (CTU, Hlavatý)

3. *Applications of cohomology in physics* (CTU, Tolar)

4. The seminar *Quantum groups* (CTU, Havlíček, Hlavatý)

2.4.2 Students

Graduate:

N. Gonzalez (thesis at CTU and Université de Toulon, P. Duclos supervisor);
seminar lecture May 16, 1995: *Wave reflection on a moving boundary.*

V. Jásenský (CTU, L. Hlavatý);
seminar lecture November 14, 1995: *An integrable hierarchy of classical evolution equations.*

O. Navrátil (CTU, M. Havlíček);
article Burdík Č. – Navrátil O.: *Boson realization of Yangians $Y(sl(2))$ and $Y(sl(3))$,* Czech. J. Phys. B (1996), No. 2–3.

P. Trávníček (CTU, J. Tolar);
articles Tolar J. – Trávníček P.: *Graded contractions and the conformal group of Minkowski space-time,* J. Math. Phys. 36 (1995), 4489–4506;
*Graded contractions of $so(4,2)$,*in: "Quantization, Coherent States and Complex Structures" (eds. J.-P. Antoine et al.), Plenum, New York 1995;
Graded contractions of the symplectic Lie algebra $sp(3)$ and collective models, to be published.

P. Lindovský (Charles University, P. Exner)

Graduated in 1995:

E. Šerešová (CTU, P. Exner);
diploma thesis *Point perturbations in mesoscopic systems.*

5th course:

R. Krejcar (CTU, Č. Burdík);
research work *Quantization and Yangians $Y(sl(2))$, $Y(sl(3))$;*
diploma thesis *Representations of loop algebras in classical and quantum cases.*

M. Vaic (CTU, E. Pelantová);
diploma thesis *Gradation of $sl(6,C)$.*

4th course:

A. Bóna (CTU, J. Tolar);
> review and research work *Quantum theory of quasi-two-dimensional systems.*

M. Čermák (CTU, P. Exner);
> review and research work *Spectrum of a quantum dot with perturbed boundary.*

J. Fiala (CTU, F. Maršík);
> review and research work *Quantitative properties of systems of ordinary non-linear differential equations describing dissipative processes.*

D. Vaněk (CTU, P. Exner);
> review and research work *Bound states in laterally coupled quantum waveguides;*
>
> article Exner P. – Šeba P. – Tater M. – Vaněk D.: *Bound states and scattering in quantum waveguides coupled laterally through a boundary window,* submitted to J. Math. Phys.

3rd course:

N. Masáková (CTU, E. Pelantová);
> review *Mathematical models of quasicrystals.*

S. Pošta (CTU, E. Pelantová);
> review *Mathematical models of quasicrystals.*