Doppler Institute: Activities in 1994

During the second year of its existence, scientific life of the Doppler Institute for Mathematical Physics at Czech Technical University, Prague, became more regular. Below we give a short summary of our activities.

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. 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, BRD*

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, *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 statues, DI members receive their salaries from those academic institution to which they belong. The research performed in DI has been supported by the following projects:

1. CTU 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

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

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

2   Survey of activities

2.1   Publications

2.1.1   Books and edited volums:

1. J. Blank, P. Exner, M. Havlíček: *Hilbert–Space Operators in Quantum Physics* ; $xiii + 594$ p.; American Institute of Physics, New York 1994.
2. M. Demuth, P. Exner, H. Neidhardt, V.A. Zagrebnov, eds.: *Mathematical Results in Quantum Mechanics*, Proceedings of a conference held at Blossin, May 17–21, 1993; 356 p.; Operator Theory : Advances and Applications, vol.70, Birkhäuser Verlag, Basel 1994.

2.1.2   Papers and contributions to conference proceedings:

1. J.-P. Antoine, P. Exner, P. Šeba, J. Shabani: *A mathematical model of heavy–quarkonia mesonic decays*, Ann.Phys. **233** (1994), 1–16.
2. J.-P. Antoine, P. Exner, P. Šeba, J. Shabani: *A Fermi–type rule for contact embedded–eigenvalue perturbations*, Proceedings of the Conference on Mathematical Results in Quantum Mechanics (Blossin 1993); Birkhäuser Verlag, Basel 1994; pp.79–87.
3. J.E. Avron, P. Exner, Y. Last: *Periodic Schrödinger operators with large gaps and Wannier–Stark ladders*, Phys.Rev.Lett. **72** (1994), 896–899.
4. J.F. Brasche, P. Exner, Yu.A. Kuperin, P. Šeba: *Schrödinger operators with singular interactions*, J.Math.Anal.Appl. **184** (1994), 112–139.

5. Č. Burdík, O. Navrátil: *Boson realizations of the quantum groups B_2 (C_2)*, Czech J.Phys **B**, in press

6. G. Chadzitaskos, J. Tolar: *Quantum mechanics on Z_M and representations of q–deformed Heisenberg-Weyl algebras,* in "Coherent States and Kähler Manifolds" (J.–P. Antoine and A. Odzijewicz, eds.), World Scientific, Singapore 1994.

7. P. Duclos, P. Exner: *Curvature–induced bound states in quantum waveguides in two and three dimensions*, Rev.Math.Phys., in print

8. P. Duclos, P. Exner, P. Šťovíček: *Curvature–induced resonances in a two–dimensional Dirichlet tube*, Ann.Inst.H.Poincaré, in print

9. P. Duclos, P. Exner, P. Šťovíček: *Resonances at bends of a two–dimensional quantum waveguide*, in "Stochastic Processes, Physics and Geometry" (S.Albeverio et al., eds.), World Scientific, in press

10. P. Exner, E. Šerešová: *Appendix resonances on a simple graph*, J.Phys. **A**, in print

11. P. Exner, M. Tater: *A one–band model for a weakly coupled quantum–wire resonator*, Phys.Rev. **B**, in print

12. P. Hájíček, A. Higuchi, J. Tolar: *Group quantization of parametrized systems, II. Pasting Hilbert spaces*, Phys.Rev. **D**, in print

13. L. Hlavatý: *Generalized algebraic framework for open spin chains*, J.Phys. **A27** (1994), 5645–5653

14. L. Hlavatý: *Quadratic algebras and open spin chains,* in Proceedings of the XXX. Winter School of Physics, Karpacz 1994.

15. L. Hlavatý: *Quantized braided groups*, J.Math.Phys. **35** (1994), 2560–2569.

16. M. de Montigny, J. Patera, J. Tolar: *Graded contractions and kinematical groups of spacetime*, J.Math.Phys. **35** (1994), 405–425.

17. P. Šťovíček: *Scattering on several solenoids*, Proceedings of the Conference on Mathematical Results in Quantum Mechanics (Blossin 1993); Birkhäuser Verlag, Basel 1994; pp.108–112.

18. P. Šťovíček: *Scattering on a finite chain of vertices*, Duke Math.J., in press

19. M. Znojil : *An analytic estimate of the number of bound states in the Lennard-Jones potentials*, Phys.Lett. **A188** (1994), 113–116.

20. M. Znojil : *Singular Potentials: Algebraization*, Proceedings of the Conference on Mathematical Results in Quantum Mechanics (Blossin 1993); Birkhäuser Verlag, Basel 1994; pp.37–43.

21. M. Znojil : *Two-sided estimates of energies and the "forgotten" exactly solvable potential $V(r) = -a^2 r^{-2} + b^2 r^{-4}$*, Phys.Lett. **A189** (1994), 1–6.

22. M. Znojil : *A new form of re-arrangement of the Rayleigh-Schrödinger perturbation series.*, Czech.J.Phys. **B44** (1994), 545–556.

23. M. Znojil: *Re–construction of polynomial potentials with a perturbation–interpolation constraint*, in "Quantum Inversion Theory and Applications" (H.V. von Geramb, ed.), Lecture Notes in Physics 427, Springer, New York 1994.

24. M. Znojil : *Classification of oscillators in the Hessenberg–matrix representation*, J.Phys. **A27** (1994), 4945–4568.

2.2 Seminars

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

February 15

    P. Trávníček (CTU, Prague): Graded contractions of the $so(4,2)$ Lie algebra

February 22

    L. Hlavatý (DI): Open spin chains and quadratic algebras

March 1

    V. Severa (Charles U., Prague): Quantum chains with the $U_q(sl(2))$ symmetry

March 8

    J. Dittrich (DI): A relativistic Fermi accelerator

March 15

    J. Slovák (Charles U., Prague): Nonlinear partial differential equations invariant with respect the Poincaré and conformal groups in $n+1$ dimensions

March 22

    P. Jizba (CTU, Prague): Canonical quantization of a nonlinear σ–model (a bosonic string)

March 29

    J.E. Avron (Technion, Haifa): Integers and chaos in adiabatic quantum transport

April 5

    T. Schweder (University of Oslo): Scenario modelling for management of environment or renewable resources in the presence of considerable uncertainty

April 12

    A. Kundu (University of Bonn): Generation of a class of quantum integrable discrete–time (or relativistic) periodic Toda chains

April 26

    J.-P. Gazeau (Paris V): Semigroups for quasicrystals

May 2

    H.D. Doebner (TU Clausthal): Nonlinear Schrödinger equation

May 6

    A.M. Perelomov (ITEP Moscow and CERN): Quantum integrable systems of N particles on a line

May 10

    P. Prešnajder (Comenius U., Bratislava): Gauge fields on a noncommutative sphere

May 17

    J. Vanžura (Masaryk U., Brno): Leibnitz algebras

May 24

    P. Jizba (CTU, Prague): Canonical quantization of a nonlinear σ–model (a bosonic string) II

October 4

> P. Winternitz (CRM, Montréal): Infinite symmetry groups of integrable systems

October 18

> R. Grodzicki (CRM, Montréal): A description of reflection–generated polytopes in hyperbolic space using decorations of Coxeter diagrams

October 25

> P. Exner (DI): Wannier–Stark systems with singular interactions

November 1

> S.A. Ktitorov (Ioffe Inst., St. Peterburg): Harper–Hofstadter operator and calculation of its spectral invariants.

November 8

> J.Bohard (Paris VII): Kolmogorov theory of the persistence of invariant tori for Hamiltonian systems under perturbation

November 15

> P. Bóna (Comenius U., Bratislava): Remarks on measurement and universality of quantum mechanics

November 22

> P. Trávníček (AS, Prague): Graded contractions and the conformal spacetime group

November 29

> L. Trlifaj (Physical Inst., AS, Prague): A solution for a hierarchy of periodic Toda lattices

December 6

> V. Kornyak (JINR, Dubna): An algoritm for analysis of the structure of finitely presented Lie algebras

December 12

> J.-M. Combes (Marseille and Toulon): Localization for random Schrödinger operators on $L^2(\mathbf{R}^d)$

December 13

> J.L. Bello (Queen Mary College, London): Field–antifield formalism for infinitely reducible field theories

December 13

> P. Duclos (Marseille and Toulon): Spectral stability: the method of big divisors

December 19

> M. Vittot (C.P.T. Marseille): On the Kolmogorov–Arnold–Moser theorem

December 20

> V.P. Gerdt (JINR, Dubna): Computer algebra and non–linear equations

December 20

> M. Rouleux (Marseille and Toulon): Feshbach resonances in the semiclassical limit

2.3 Meetings

DI student workshop (Mariánská, January 29 – February 5)

The 3rd Colloquium "Quantum groups" (Prague, June 23–25)
    The program included, in particular, the following lectures:

N. Andruskiewitsch: Compact involutions on semisimple quantum groups,

J.A. de Azcarraga: Some aspects of noncommutative geometry and q–Minkowsky spaces,

F. Bonechi: Quantization deformation of the Heisenberg group,

L. Dabrowski: Regular representations of $U_q(g)$: reduction and q–derivative intertwiners,

J.U.H. Petersen: Quantum affine Kac-Moody algebras at roots of unity,

P. Prešnajder: Dirac operator and gauge fields on the noncommutative sphere,

A.A. Vladimirov: Braided differential bialgebras

S.L. Woronowicz: Hopf algebras: are they quantum groups?

as well as talks by *D. Arnaudon, R.M. Asherova, Č. Burdík, G. Chadzitaskos, B. Drabant, D. Ellinas, G.Fiore, J. Hietarinta, H. Hinrichsen, A.P. Isaev, A. Kempf, M. Klimek, J. Lukierski, S. Majid, P. Mašlanka, Z. Oziewicz, P. Podles, P.N. Pyatov, M.J. Rodriguesz–Plaza, K.A. Smolinski, J. Sobczyk, W. Weich,* and *A. Zapletal.*

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, Burdík, Hlavatý)

2.4.2 Students

Graduate:

Gonzalez (Université de Toulon, thesis codirected by J. Dittrich
    and P. Duclos)
Navrátil (CTU, supervized by Havlíček)
Trávníček (CTU, supervized by Tolar)

Graduated in 1994:

Severa (Charles U., diploma thesis *Cyclic representations of quantum groups* supervized by Burdík)

Szilarsky (CTU., diploma thesis *Differential geometry on quantum groups* supervized by Burdík)

5th course:

Jásenský (CTU, diploma supervizor Hlavatý)

Šerešová (CTU, diploma supervizor Exner)

4th course:

Krejcar (CTU, Havlíček)

3rd course:

Bóna (CTU, Tolar)

Čermák (CTU, Exner)

Fiala (CTU, Tolar)

Přidal (CTU, Hlavatý)

Vaněk (CTU, Exner)