CURRICULUM VITAE of SERGEY B. LEVIN

Present position:

Major teacher, Division of Mathematical and Computational Physics, Department of Physics St.-Petersburg State University Tel.: +7-812-428-4534 Fax: +7-812-428-7240 E-mail: sergey.levin@pobox.spbu.ru

Date of birth:

22 January, 1969.

Place of birth:

Leningrad (St.Petersburg), Russia.

Marital state:

Married.

Citizenship:

Russian citizen.

Current residence:

196066 Moscowskij av., 197, apt.27, St.-Petersburg, Russia.

Education:

Student of Department of Computational & Mathematical Physics, Physical Faculty, Leningrad (St.Petersburg) State University. 1986-1992 Ms.Sc., 1992 Postgraduate student of Department1992-1996Ph.D.,of Mathematical and Computational1998Physics, Physical Faculty, Leningrad(St.Petersburg)State University.

Academic degrees:

Ms.Sc. in Computational & Mathematical Physics (Leningrad (St.Petersburg) State University, 1992). Title: "Two-clusters few-body scattering in generalized string-flip model". Supervisor: Dr. Yu.B.Melnikov Referees: Prof. A.A.Kvitsinskii (Leningrad University);

PhD in Mathematical Physics (St.Petersburg State University, 1998). Title: "Boundary conditions method and energy-dependent interactions in scattering and annihilation problem for $\bar{p}N$ and $\bar{p}d$ systems". Supervisor: Prof. Yu.A.Kuperin Referees: Prof. O.D.Dal'karov (Physical Institute of the Academy of Science of Russia, Moscow); Prof. I.Yu.Popov (St.Petersburg Institute of Precise Mechanics and Optics, St.Petersburg);

Leading Organization: Joint Institute of Nuclear Research, Dubna

Docent in Physics (Stockholm University, Sweden, April, 2006).

Professional appointments:	
1992-1996	Postgraduate student, Leningrad (St.Petersburg)
	State University;
1992-2000	Employee of the Department of Mathematical
•	and Computational Physics,
•	Institute for Physics, St.Petersburg
	State University, St.Petersburg;
2000-present	Researcher,
	Department of Mathematical
	and Computational Physics,
	Institute for Physics, St.Petersburg
	State University, St.Petersburg;
2007-present	Major Teacher
	Department of Mathematical
	and Computational Physics,
	Institute for Physics, St.Petersburg
	State University, St.Petersburg;
1998-2001	Postdoc position,
	Department of Atomic
	and Molecular Physics,
	SCFAB, Stockholm University,
	Stockholm;
2002-2006	Assistant Professor.
	Department of Atomic
	and Molecular Physics,
	SCFAB, Stockholm University,
	Stockholm;

Visiting appointments

- Postdoctoral position at the Department of Atomic and Molecular Physics, Stockholm University, Stockholm, Sweden Head of the Department Prof. M.Larsson, September 1998–August 2001.
- Guest researcher at the Department of Physics, Gutenberg University of Mainz, Mainz, Germany Host Prof. E.O.Alt, September–November 2001.
- Guest researcher at Harvard-Smithsonian Center for Astrophysics, Harvard University, Boston, USA Host Dr. Kate Kirby, February–March 2002
- Guest researcher at NORDITA, Niels Bohr Institute, Copenhagen, Denmark Host Prof. Ben Mottelson, 2 March -3 March, 2004
- Guest researcher at MTA KFKI Research Institute for Particle and Nuclear Physics, Budapest, Hungary Host Prof. Janos Revai, 4 September -6 September, 2004
- Guest researcher at Aurhus University, Department of Physics, Aurhus, Denmark
 Host Prof. Aksel Jensen, 25 September -30 September, 2005; February 2008;

Publications:

1. Yu.A.Kuperin, S.B.Levin and Yu.B.Melnikov, Resonance Scattering of Two N-Body Clusters in Generalized String-Flip Model. *In: Invited talks of the international workshop "Mathematical Aspects of the Scattering Theory and Applications* St.Petersburg, p.54 (1991).

2. Yu.A.Kuperin, S.B.Levin, Yu.B.Melnikov, Baryon-baryon scattering in a generalized string-flip model with spin-spin interaction. *IPRT-Preprint* # 01.93 (1993).

3. Yu.A.Kuperin, S.B.Levin, Yu.B.Melnikov, Generalized string-flip model for quantum cluster scattering. *J.Math.Phys.* 35(1), pp.71-95 (1994).

4.Yu.A.Kuperin, S.B.Levin, Yu.B.Melnikov, Quantum Scattering for Two Clusters with Spin-Spin Interaction in a String-Flip Model. *Il Nuovo Cimento* 107(A), 12, pp.2823-2835 (1994).

5. Yu.A.Kuperin, S.B.Levin, Yu.B.Melnikov, Generalized String-Flip Model for two-cluster 2N-body Scattering, p.433. 14-th International Conference on Few-Body Problems, 26-31 May, 1994. Contributed Papers. (Editor: F.Gross)

6. Yu.A.Kuperin, S.B.Levin, Yu.B.Melnikov, E.A.Yarevsky, $\bar{p}N$ Scattering with Annihilation Channel in Extended Hilbert Space Model. *Few-Body Systems Suppl.*, 8, 462-467, 1995

7. Yu.A.Kuperin, S.B.Levin, Yu.B.Melnikov, E.A.Yarevsky, Numerical analysis of $\bar{N}N$ systems with annihilation channel and charge-exchange process. *IPRT*-*Preprint* # 105.95 (1995).

8. Yu.A.Kuperin, S.B.Levin, E.A.Yarevsky, Modified Faddeev equations for $\bar{p}d$ system with annihilation channel. *IPRT-Preprint* # 112.95 (1995).

9. Yu.A.Kuperin, S.B.Levin, Yu.B.Melnikov, E.A.Yarevsky, Numerical analysis of the $\bar{p}N$ system with continuous set of resonances in annihilation channel. (*Russian J. Nuclear Phys.*) 9, (**59**), pp. 1703-1705, 1996

10. S.B.Levin, E.A.Yarevsky, $\bar{p}p$ and $\bar{p}n$ Scattering with Annihilation Channel, Hyperfine Interactions, (101), pp. 511-515 (1996)

11. Yu.A.Kuperin, S.B.Levin, E.A.Yarevsky, $\bar{p}d$ scattering with Annihilation Channel in frames of Faddeev equation scheme, *Book of Abstracts*, 15-th International Conference on Few-Body Problems in Physics, (1997)

12. Yu.A.Kuperin, S.B.Levin, Yu.B.Melnikov, B.S.Pavlov, Quantum Lorentz Gas Problem: Effective Equations and Spectral Analysis. *Int.J.Computers Math. Applic.*, v.34, N 5/6 (1997), pp.599-612 13. Yu.A.Kuperin, S.B.Levin, Yu.B.Melnikov, E.A.Yarevsky, Application of Extension Theory to Antiproton-Nucleon Systems with Continuous Set of Resonances in Annihilation Channel. *Int.J. Computers Math. Applic.*, v.34, N 5/6 (1997), pp.559-570

14. S.B.Levin, Boundary conditions method and energy-dependent interactions in scattering and annihilation problem for $\bar{p}N$ and $\bar{p}d$ systems, *Ph.D. Thesis's*, St.Petersburg State University, 1998

15. Yu.A.Kuperin, S.B.Levin, The three-body scattering problem with annihilation channels, *Teor.Mat.Fiz.*, 118(1), pp. 74-94, (1999); translated *Teor.Math.Phys.*, 118(1), pp. 60-76, (1999);

16. N.Elander, S.Levin, E.Yarevsky, An Smooth Exterior Complex Dilated Full Angular Momentum Three Dimensional Finite Element Method for Computing Resonances in Triatomic Molecules - Applied to the NeICl van der Waals complex, *Phys.Rev.A*, v.64, p.012505-012508, (2001)

17. T.Alferova, S.Andersson, N.Elander, S.Levin, E.Yarevsky, Finite element three-body studies of bound and resonant states in atoms and molecules, *Advances in Quantum Chemistry*, v.40, p.323-344, (2001)

18. N.Elander, S.Levin, E.Yarevsky, Dependence of the *NeICl* van der Waals complex resonance width on the total angular momentum, *Nuclear Phys. A*, v.684, p.678, (2001)

19. N.Elander, S.Levin, E.Yarevsky, Low non-zero total angular momentum resonant levels in the *NeICl* van der Waals complex, *Nuclear Phys. A*, v.689, p.541, (2001)

20. S.B.Levin, S.L.Yakovlev, N.Elander, Asymptotic structure of the three-body Coulomb Green's function for the case of two charged particles, *CP603*, *Mesons and Light nuclei: 8-th Conference, edited by J.Adam et al.* **AIP 0-7354-0047-4**, (2001)

21. S.B.Levin, E.O.Alt, S.L.Yakovlev, Integral representation for the two-body Coulomb wave function, *Mainz University Preprint* MZ-TH/01-30, (2001)

22. T.Alferova, S.Andersson, N.Elander, S.Levin, and E.Yarevsky, Resonances in three-body systems studied by a full angular-momentum, smooth-exterior complex-scaling finite-element method, *Few-Body Systems* v.31, pp.177-182, (2002)

23. S.B.Levin, E.O.Alt, S.L.Yakovlev, Coulomb Fourier transformation: application to three-body Hamiltonians with one attractive Coulomb interaction, *Few-Body Systems Suppl.* 14, 221-222, (2003)

24. N.Elander, S.Levin, E.Yarevsky, An smooth exterior complex dilated full an-

gular momentum three dimensional finite element method, applied to double excited states of helium, *Phys.Rev.A*, v.67, p.062508, (2003)

25. S.B. Levin, E.O. Alt and S.L. Yakovlev, *Integral Representation for the Two-Body Coulomb Wave Function*, in: Selected topics in theoretical physics and astrophysics. - Dubna: JINR, 2003, 167 p.; ISBN 5-9530-0022-7.

26. M.Salci, S.Levin, N.Elander A search for bound and quasi-bound states in the spin-polarized atomic tritium trimer. *Phys.Rev.A*, v.69, 044501 (2004)

27. E.O.Alt, S.B.Levin, S.L.Yakovlev, Coulomb-Fourier transformation: a novel approach to three-body scattering with charged particles. *Phys.Rev. C*, v.69, 034002, (2004)

28. V.B.Belyaev, S.B.Levin, S.L.Yakovlev, Three charged particles in the continuum. Astrophysical examples. *J.Phys. B*, v.37, 1369-1380, (2004)

29. E.O.Alt, S.B.Levin, S.L.Yakovlev, Coulomb-Fourier representation approach to three-body scattering with charged particles. *Nucl.Phys. A*, v.737, 283-286, (2004)

30. S.B.Levin, Description of the Hydrogen-electron collision by the Coulomb Fourier transform method, Nucl. Instruments & Methods in Physics Research B, v.233, 172-175, (2005)

31. V.B.Belyaev, S.B.Levin, S.L.Yakovlev, The continuum spectrum wave function of the system of two heavy and one light charged particles, *AIP Few-Body Problems in Physics, Conference proceedings, Melville, New York,* v.768, 427-429, (2005)

32. K.Stockel, O.Eidem, H.Cederquist, H.Zettergren, R.Schuch, P.Reinhed, C.L.Cocke, S.B.Levin, V.N.Ostrovsky and H.T.Schmidt, Two-center interference in fast proton-H₂ electron transfer and excitation processes, *Phys.Rev.A*, v.72, 050703(R), (2005).

33. M.Salci, E.Yarevsky, S.Levin and N.Elander, A finite element investigation of the ground states of the helium trimers ${}_{2}^{4}He_{3}$ and ${}_{2}^{4}He_{2}-{}_{2}^{3}He$, *Int.J.Quant.Chem.*, v.107(2), 464-468, (2007)

34. O.M.Deryuzhkova, S.B.Levin, S.L., S.L.Yakovlev, Closed form representation for a projection onto infinitely-dimensional subspace spanned by Coulomb bound states. *J.Phys. B*, v.39, 4767-4773, (2006)

35. L.V.Gortinskaja, A.E.Kurasov, N.A.Malina, I.Yu.Popov, E.S.Tesovskaja, S.B.Levin, Many particles problems for quantum layers, Proceed. of International Conference Days on Diffraction 2006

36. S.Levin, S.Yakovlev, On account of Coulomb excitations of a target for the three-body break-up, *Proceedings of 20th European Conference on Few-Body Problems in Physics, 9-14 September 2007, Pisa, Italy*, Few-Body Systems, (2007)

37. V.B.Belyaev, S.B. Levin and E.Truhlik, Adiabatic movement of three charged particles in continuum at astrophysical conditions, *in: Models and Methods in Few- and Many-Body Systems*, - Edited by S.A.Sofianos, UNISA, University of South Africa Press, (2007), ISBN 978-1-86888-457-5.

38. H.T.Schmidt, D.Fischer, M.Gudmundsson, Z.Berenyi, C.L.Cocke, N.Naag, H.Hohansson, A.Kallberg, S.Levin, P.Reinhed, U.Sassenberg, R.Schuch, H.Cederquist, A.Simmonsson, K.Stochel, Evidence of Wave-Particle Duality for Single Fast Hydrogen Atoms, *Phys.Rev.Lett*, **101**, 083201, (2008)

39. S.B.Levin, S.L.Yakovlev, On account of Coulomb excitations of a target for the three-body break-up, Few-Body Systems, 44, 249-251, (2008)

40. V.S.Buslaev and S.B.Levin, Uniform asymptotic of eigenfunctions for the three-body Schrödinger operator in one-dimensional case, *Proceedings of Joint Physics/Mathematics Workshop on Quantum Few-Body Systems, March* 19-20, 2007, Aarhus, Denmark, ISBN: 978-0-7354-0517-2, AIP Conf.Proc., v.998, pp.101-112, (2008)

41. V.S.Buslaev and S.B.Levin, Asymptotic behavior of the eigenfunctions of many-particle Schrödinger operator. I. One-dimensional particles; in: Selected topics in mathematical physics, Dedicated to Prof. Mikhail Shlëmovich Birman on his 80th birthday, - Amer.Math.Soc.Transl. (2)v.225, pp.55-71, (2008)

42. M. Salci, S. Levin, N. Elander, E. Yarevsky, A theoretical study of the rovibrational levels of the bosonic van der Waals neon trimer, J.Chem.Phys., v.129, pp.134304-1-134304-7, (2008)

43. N. Elander, S. Levin, E. Yarevsky, Convergence and quantum number assignment studies of rovibrational eigenstates in a model of predissociating NeICl van der Waals complex, International Journal of Quantum Chemistry, 109(3), 459–468, (2009)

44. J. Larson, S. Levin, *Effective Abelian and non-Abelian gauge potentials* in cavity QED, Phys.Rev.Lett, 103, 013602 (2009)

45. V.S.Buslaev, S.B.Levin, P.Neittaannmäki, T.Ojala New approach to numerical computation of the eigenfunctions of the continuous spectrum of three-particle Schrödinger operator. I One-dimensional particles, short-range pair potentials., J.Phys.A: Math.Theor. 43, (2010), 285205, (pp.17); arXiv:0909.4529v1 [math-ph], (2009).

46. В.С.Буслаев, С.Б.Левин, Асимптотическое поведение собственных функций трехчастичного оператора Шредингера. II Одномерные заряженные частицы. Алгебра и анализ, 22(3), (2010) pp.60-79

Research activity:

My research activity is mostly related to mathematical scattering theory and theory of resonances (few-body scattering theory and applications to atomic and molecular physics). The methods used are the classical methods of mathematical physics (asymptotic and functional analysis, operator theory) as well as modern methods, recently or relatively recently applied to scattering theory and theory of resonances (Complex Scaling Method, Coulomb Fourier Transform method, methods of Diffraction Theory).

In 1991 I started to study cluster scattering in frames of generalized stringflip model [1]. The generalization to systems with additional degrees of freedom was obtained. The most interesting result in this subject is related to the proved on mathematically rigorous level theorem which states, that the effective Hamiltonian for a system of two N-body clusters with string-flip interaction is form-invariant with respect to N and the effective configuration space is 2-dimensional for any N [2,3]. A spin-spin interaction is considered in frames of generalized string-flip model for baryon-baryon scattering [4]. Additional degrees of freedom related to Quark Compound Bag are included into consideration. The comparison with experimental data for NN-scattering is performed.

I am also interested in the problems of $N\bar{N}$ -scattering [6,7,10] and fewbody-scattering with annihilation channel [8,11]. The last problem is the subject of my Ph.D. thesis [14]. The exact expressions for scattering length, partial total and annihilation cross-sections for $\bar{p}n$, $\bar{p}p$ and $\bar{n}n$ systems are obtained in the frame of extended Hilbert space model with continuous spectrum of resonances treated as annihilation channel [13]. The numerical algorithm for scattering data calculation is suggested. The numerical calculations for $\bar{p}n$ and $\bar{p}p$ scattering data at angular momentum L = 0, 1, 2 are performed on this base [9]. The interaction parameters are fitted via two-body scattering data. A satisfactory agreement between experimental and theoretical data is obtained.

The scattering problem of three-body system with antiparticle in frames of Faddeev equation scheme was considered on example of $\bar{p}d$ system [14]. The additional annihilation channels were considered in frames coupling channels model. The uniqueness of Faddeev equations solution in nucleon channel was proved.

Since autumn 1998 I am working at the Division of Molecular Physics Stockholm University. We are studying the resonances and bound states in three-atomic molecules and atomic systems by the exterior complex scaling method [16-20,22,24,26] in the potential surfaces model. We are able now to obtain the resonance values for arbitrary total angular momentum J of the system [16]. The accuracy of the calculations is under control. We are developing the rigorous methods to estimate the contribution of intermediate resonance states in multi-channel chemical reactions, which is very important for control and predictions in atomic and molecular physics as well as in chemistry and biology [17,22].

Alternatively basing on the methods of diffraction theory we study the three-body scattering problem with rapidly decreasing at infinity pair potentials [39,40]. The method is based on analogies between few-body scattering problem and diffraction one of the plane wave on the system of half-transparent infinite screens. Mentioned formalism are believed to be useful for the few-body scattering problem of one and higher dimensions and for the case of long range pair potentials.

Support.

My work was supported by the State Committee of Science and Higher School under Grant # PH-22-3, by the Fundamental Research Foundation of Russia, by the International Science Foundation under Grant NX1300, by the International Soros Science Education Program under Grant # a289-f, by the Academy of Science of Sweden, by the Wener Gren Foundation, by the Swedish Natural Science Council under personal Grant 629-2002-8331, by Deutscher Akademischer Austauschdienst and by US Department of Energy in frames of the personal Grant of Harvard-Smithsonian Center for Astrophysics.

Conferences and workshops attended:

1991:

International Workshop "Mathematical Aspects of the Scattering Theory and Applications St.Petersburg, Russia.

1992:

XI International Seminar on High Energy Physics Problems "Relativistic Nuclear Physics & Quantum Chromodynamics Dubna, Russia, (selected talk, 20 min)

1993:

International Workshop "Symmetry Methods in Physics" in memory of Prof. Ya.A.Smorodinsky, Dubna, Russia.

1994:

European Conference for PhD students in Physical Science, Montpelier, France.

1995:

International Symposium on Muon Catalyzed Fusion, $\mu CF-95$, Dubna Russia.

1995:

International Conference on Nucleon-Antinucleon Physics $NAN-95,\,{\rm Moscow},\,{\rm Russia}$

1997:

15-th International Conference on Few-Body Problems in Physics, Groningen, Netherlands.

1997:

Fourth Summer School in Nuclear Physics, Falsterbo, Sweden, (20 min talk)

1999:

International Conference in Dissociative Recombination, Sweden.

2000:

16-th International Conference on Few-Body Problems in Physics, Taipei, Tai-

wan, (selected talk, 18 min)

2000:

17-th European Conference on Few-Body Problems in Physics, Evora, Portugal, (selected talk, 20 min)

2000:

The International Conference devoted to the Memory of Sofia Kovalevskaja, Stockholm, Sweden, (selected talk, 20 min)

2001:

8-th International Conference: Mesons and Light Nuclei, Prague, Czech Republic, (selected talk, 20 min)

2002:

18-th European Conference on Few-Body Problems in Physics, Bled, Slovenia, (selected talk, 10 min)

2002:

V-International Congress on Mathematical Modeling, Dubna, Moscow region, Russia, (selected talk, 20 min)

2003:

XXIII-International Conference on Photonic, Electronic and Atomic Collisions, Stockholm, Sweden,

2003:

International Conference in Computational Physics devoted to the Memory of Prof. S.P.Merkuriev, St-Petersburg, Russia, (invited talk, 30 min)

2004:

19th European Conference on few-Body Problems in Physics, 23-27 August 2004, Groningen, Netherlands, (selected talk, 20 min)

2004:

8-th Workshop on Fast Ion-Atom Collisions, 1-3 September 2004, Debrecen, Hungary, (invited talk, 10 min)

2005:

XXIV-International Conference on Photonic, Electronic and Atomic Collisions, 20-26 July 2005, Rosario, Argentina,

2005:

Workshop in Spectral Theory of Partial Differential Equations, 22 September 2005, KTH, Stockholm, Sweden, (invited talk, 45 min)

2006:

International Summer School on Few-Body Problems in Physics, August 2006, Dubna, JINR, Russia, (3 invited lectures, 45 min each)

2007:

Joint Physics/Mathematics Workshop on Quantum Few-Body Systems, March 19-20, 2007, Aarhus, Denmark, (invited talk, 30 min)

2007:

20th European Conference on few-Body Problems in Physics, September 2007, Pisa, Italy, (selected talk, 20 min)

2008:

Invited talk at the seminar of the Laboratory of Theoretical Physics, Joint Institute for Nuclear Research, March 1, 2008, Dubna, Russia, (1 hour)

2009:

International Conference in Spectral Theory, August 3-7, 2009, Euler Institute, St-Petersburg, Russia

2009:

19th International Conference on few-Body Problems in Physics, August 31-September 5, 2009, Bonn, Germany

Teaching activity (St.Petersburg State University):

Examination of 2,4 year students (1993-1998, 2006-):

- mathematical physics
- numerical methods

Seminars given for 1-2 year students (1992-1998, 2006-):

- numerical methods and computing
- higher mathematics
- computer systems

Seminars given for 3 year students (2009-): - practicum in computational physics

Lecture courses given for 5 year students (2009-): - Concepts of Computational Physics

Lecture courses given for 2 year students (2008-): - Computer facilities and systems

Lecture courses given for 3 year students (2002): - additional chapters of algebra and mathematical analysis

Lecture courses given for 5 year students (2006): - scattering theory

Lecture courses given for 10-11 year students of high school in frames of the agreement with University (1995-1998): - programming, computer science and numerical methods

Jury of Master thesis's of Anna Mikhilova (1995) of Master thesis's of Tatiana Smirnova (1995)

Teaching activity (Stockholm University):

Seminars given for 3 year students (2004-2006): - methods of mathematical physics

.

Supervision of PHD student Moses Salci (2002-2006), Licentiat seminar passed on February 25, 2005 PHD Defense passed on October 6, 2006

Half-Supervision of Diploma Worker Oscar Eidem (2005),

Jury of Licentiate thesis's of Anita Neau (2000) of Licentiate thesis's of Dragan Nicolich (2003)

Committee Member on PHD Defense of Ivaylo Minkov (2006)