Curriculum Vitae

Pawel Hawrylak
University Research Chair in Quantum Theory of
Materials, Nanostructures and Devices
Department of Physics
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Areas of interest:
Electronic and Optical Properties of Semiconductor and graphene Quantum Dots; Computational Design of Materials at the Nanoscale; Graphene, Carbononics, 2D Crystals and Topological Insulators; Strongly Correlated Electrons; Quantum Information; Nanoelectronics, Nanospintronics, Nanophotonics; other areas of Theoretical Condensed Matter Physics

Education:
Ph.D., Condensed Matter Theory - University of Kentucky, Lexington, Ky, USA, 1984.
M.Sc (with Honours) - Wroclaw University of Technology, Wroclaw, Poland, 1979.

Professional Experience:

2014-present: Professor of Physics and University Research Chair in Quantum Theory of Materials, Nanostructures and Devices (2014-2024), University of Ottawa, Ottawa, Canada.

2023-2023 visiting professor, recipient of Humboldt Research Prize (reinvitation), Technical University of Munich (April 2023), Technical University of Dortmund (May 2023), University of Hamburg (June 2023).

2023-2023 visiting research professor (January-March 2023), Institute for Functional Intelligent Matter, National University of Singapore.

2022-2022 visiting scientist (June-July 2022), Donostia International Physics Center.

2022-2022 visiting professor, (January-May 2022), Wroclaw University of Science and Technology.

2013-2013 invited professor, World Premiere Institute for Advanced Materials, Brain Gain program, Tohoku University, Sendai, Japan (Oct-Dec 2013).

2012-2014: Group Leader, Quantum Theory Group, Security and Disruptive Technologies (SDT), Emerging Technologies Division, National Research Council of Canada (NRC), Ottawa. (plan, lead, and evaluate activities of 4 permanent staff scientists , 2-4 research associates/pdfs and 2-5 students).

2001-2012: Group Leader, Quantum Theory Group, Institute for Microstructural Sciences (IMS), National Research Council of Canada (NRC), Ottawa. (plan, lead, and evaluate activities of 4 permanent staff scientists, 2-4 research associates/pdfs and 2-5 students).

2001-2014, Principal Research Officer, Institute for Microstructural Sciences (IMS NRC).

2001-2005, Project Leader: Quantum Information Project leader at IMS NRC (plan, coordinate, and evaluate activities of ~20 experimentalists and theorists).

1998-2014, Adjunct Professor, University of Ottawa, Canada.

1998-2001, Nano-optics Project Leader at IMS NRC (plan, coordinate, and evaluate activities of ~12 experimentalists and theorists).

1994- 2001, Senior Research Officer, Institute for Microstructural Sciences (IMS NRC).

1992- 1996, Adjunct Professor, Brown University, Providence, R.I., USA.

1988 - 1997, Adjunct Professor, University of Colorado at Colorado Springs, USA.

1987-1994, Research Officer, Institute for Microstructural Sciences, IMS NRC.

1986-1987, Assistant Professor-Research, Brown University, Providence, R.I., Visiting Professor, Boston College, Newton, MA, USA.

1984-1986, Research Associate in Physics, Brown University, Providence, R.I., USA.

Awards, Honors:

2023- Humboldt Research Prize,(reinvitation), Humboldt Foundation, Germany

2014- Gold Medal with Diamonds, Senate, Wroclaw University of Technology.

2014- Doctor Honoris Causa, Materials Science, University of Crete.

2013- Queen Elizabeth Diamond Jubilee Medal for contribution to Canadian science, Government of Canada.

2012-2013 Senior Fellow, Canadian Institute for Advanced Research Nanoelectronics Programme.

2011- IMS NRC Outstanding Research Achievement Team Award for the organic photovoltaics project.

2010- Honorary Professor, Wroclaw University of Technology, Wroclaw, Poland.

2007- IMS NRC Outstanding Research Achievement Award for the optical detection of fractional charge.

2006- Fellow of the Royal Society of Canada: The Academies of Arts, Humanities and Science of Canada.

2006-2012 Fellow, Canadian Institute for Advanced Research Nanoelectronics Programme.

2005- “Professor Titular of Physical Sciences” by the President of Poland.

2003- NRC Outstanding Research Achievement Award for the development of "single spin transistor".

2002- Brockhouse Medal for outstanding contribution to Condensed Matter and Materials Physics (for Quantum Dots), Canadian Association of Physicists.

1999- Humboldt Research Prize, Humboldt Foundation, Germany.

1996- Fellow, American Physical Society, for contribution to theory of optical properties of low dimensional systems.

Appointments/Committees/Boards:

2023-2026 Polanyi Prize selection committee

2023-2024 Tesla Prize selection committee, Wroclaw University of Science and Technology

2023 - invited to nominate candidates for 2023 Nobel Prize in Physics.

2022 - 2024 Chair, 36th International Conference on the Physics of Semiconductors, ICPS2024, Ottawa July 2024.

2022- Director, Workshop on Quantum Circuits in 2D Materials (QC2DM), Ottawa, Canada, June 2022.

2020- 2024, Member, Lithuanian Research Council (LMT) “Science and Technology” evaluation panel.

2020-2024, Member, New Fellow Selection Committee, Royal Society of Canada

2019- Co-Director, Canada-Japan Workshop on Hybrid Quantum Systems, Ottawa, Canada, June 2019.

2019- invited to nominate candidates for 2020 Nobel Prize in Physics.

2019 - invited, Qingdao Academician Park and Forum, Qingdao, China

2019-2024 Member, Flanders Research Council (FWO) “Physics ” evaluation panel.

2017-2024 invited to nominate candidates for the Foundation for Polish Science (FNP) Prize.

2015-2016 Co-Editor, focus issue: *Carbononics*, Physica Status Solidi

2013- present; Editor - member of Editorial Board, Solid State Communications, Elsevier.

2013- Co-Chair, International Workshop “Nanostructured graphene”, Antwerp, May 2013.

2012- 2019 Member, European Research Council “Condensed Matter Physics” Starting Grant evaluation panel.

2011- Member, Rutherford Medal selection committee, Royal Society of Canada.

2011-Co-Chair, International Conference on Fundamental Optical Processes in Semiconductors – 2011, Lake Junaluska, North Carolina, USA, August 2011.

2011- Co-Director, Canadian Institute for Advanced Research 2011 Winter School on New Developments in Quantum Materials, Nanostructures and Information Processing, Whistler, BC, April 2011.

2010- Co-Director, Canada-France Symposium “Controlling spin at the nanoscale”, Ottawa, Canada, October 2010.

2009- Co-Director, Canada-Poland-Japan Symposium on Nanoscience, Wroclaw, Poland, October 2009.

2009-2015 Co-PI Extreme Photonics CREATE program, University of Ottawa.

2008-2011 Vice-Chair, International Union of Pure and Applied Physics (IUPAP) Commission on Semiconductors (C8).

2005-2011 Secretary and Vice-Chair, Selection Committee, Young Scientist Prize in Semiconductor Physics, International Union of Pure and Applied Physics (IUPAP) Commission on Semiconductors (C8).

2008 - Co-Director, workshop on "Computational approaches to semiconductor, carbon and magnetic nanostructures", Centre Europen de Calcul Atomique et Moleculaire (CECAM), Lyon, June 2008.

2007 - Co-Editor, with R. Laflamme, special issue of Physics in Canada on Quantum Information.

2007 - Co-Chair, International Workshop on Optical Properties of Low Dimensional Systems: Controlling Spins and Photons at the Nanoscale (OPLDS2007), Ottawa, Canada, May 2007.

2006 - 2008, Member, IUPAP Nanoscience Working Group.

2005 - 2013 Associate Editor, Solid State Communications, Elsevier.

2005 - Co-Director, Polish-Canadian workshop on Nanospintronics, Warsaw-Wroclaw, October 2005.

2005 - Co-Director, Canadian Institute for Advanced Research workshop “Controlling electrons, excitons and photons at the nanoscale”, Banff, Canada, March 2005.

2005-2008 Secretary, International Union of Pure and Applied Physics (IUPAP) Commission on Semiconductors (C8).

2005-2008 member, NSERC Grant Selection Committee, Condensed Matter, GSC28.

2004-2013 Secretary, Canadian IUPAP National Liaison Committee.

2004- Chair of the 3rd International Conference "Quantum Dots 2004", Banff, Alberta, Canada, May 2004.

2004 - Co-Director, workshop on "Modeling of self-assembled nanostructures", Centre Europen de Calcul Atomique et Moleculaire (CECAM), Lyon, June 2004.

2003 – Guest Editor, with S. Das Sarma, Special Issue of Solid State Communications, "Advances in studies of electrons in low dimensional systems".

2002 – 2011, Associate Member, International Union of Pure and Applied Physics (IUPAP) Commission on Low Temperature Physics (C5).

2002-2005 Member, International Union of Pure and Applied Physics (IUPAP) Commission on Semiconductors (C8).

2002- 2008 Associate Editor, Condensed Matter, Canadian Journal of Physics.

2000-2006 Associate, Canadian Institute for Advanced Research (CIAR) Nanoelectronics Programme.

2000- Member, Advisory Editorial Board - Materials Science Poland.

1999- Chair of the 13th International Conference on Electronic Properties of Two-Dimensional Electronic Systems (EP2DS), Ottawa, Canada, July 1999.

1996- member, Advisory Editorial Board - Physica E: Low dimensional systems.

1994- Chair, Program Committee for the International Conference on Superlattices, Microstructures, and Microdevices (ICSMM), Banff, Canada, August 1994.

1993- Co-chair, Workshop on Quantum Dots, IMS-NRC, Ottawa, June 1993.

1991– recipient of Max Planck Fellowship, MPI for Solid State Physics, Stuttgart.

Visiting Scientist: Technische Physik, Wuerzburg Universitat, Germany; High Magnetic Field Laboratory, Grenoble, France; Wroclaw University of Technology, Poland; Max Planck Institute for Solid State Physics, Stuttgart, Germany; Instituto de Fisica Gleb Wataghin, Campinas, Brazil; Tohoku University, Japan, Donostia International Physics Center, Spain. Institute for Functional Intelligent Matter, NUS, Singapore. UHamburg, TU Dortmund, TU Munich.

International Committees/Functions:

1. Member of the International Advisory Committee for the 37th International Conference on the Physics of Semiconductors, Tokyo, Japan, July 2026.
2. Member of the Advisory Committee for the 17h International Conference on Optics of Excitons in Confined Systems, OECS19, Warsaw, Poland, July 2025.
3. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2025.
4. Member of the International Advisory Committee for the International Conference on High Magnetic Fields in the Physics of Semiconductors, Warsaw, Poland, Sept. 2024.
5. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2024.
6. Member of the International Advisory Committee for the International Conference "Quantum Dots 2024", Munich, Germany, March 2024.
7. Chair of the International Program and Advisory Committee for the 36th International Conference on the Physics of Semiconductors, Ottawa, Canada July 2024.
8. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2023.
9. Member of the International Advisory Committee for the joint International Conference on Electronic Properties of Two-Dimensional Electronic Systems, EP2DS and Modulated Semiconductor Structures, MSS, Grenoble, France, 2023.
10. Member of the International Program Committee for the 35th International Conference on the Physics of Semiconductors, Sydney, Australia, June 2022.
11. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2022.

12. Member of the International Advisory Committee for the International Conference on Superlattices, Nanostructures and NanoDevices, Vietnam, July 2022.
13. Member of the International Advisory Committee for the International Conference on High Magnetic Fields in the Physics of Semiconductors, Hong Kong, China, July 2022.
14. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2020.
15. Member of the International Advisory Committee for the 11th International Conference on the Physics and Chemistry of Quantum Dots, Munich, Germany, May 2020 (Dec 2020).
16. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2019.
17. Member of the Advisory Committee for the 15h International Conference on Optics of Excitons in Confined Systems, OECS16, St.Petersburg, Russia, Sept. 2019.
18. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2018.
19. Member of the International Advisory Committee for the International Conference on High Magnetic Fields in the Physics of Semiconductors, Toulouse, France, July 2018.
20. Member of the International Program Committee for the 34th International Conference on the Physics of Semiconductors, Montpeliere, France, July 2018.
21. Member of the International Advisory Committee for the International Conference on Superlattices, Nanostructures and NanoDevices, Madrid, Spain, July 2018.
22. Member of the Advisory Committee for the 15h International Conference on Optics of Excitons in Confined Systems, OECS15, Bath, UK, Sept. 2017.
23. Member of the International Advisory Committee for the Congress of Polish Physicists (PTF),Wroclaw, Poland, Sept.2017.
24. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2017.
25. Member of the 20th International Conference on Electron Dynamics in Semiconductors, Optoelectronics and Nanostructures, Buffalo, NY, July, 2017.
26. Member of the International Advisory Committee for the joint International Conference on Electronic Properties of Two-Dimensional Electronic Systems, EP2DS-23, and Modulated Semiconductor Structures, MSS, PennState, USA, July 2017.
27. Member of the the International Advisory Committee for the International Conference on High Magnetic Fields in the Physics of Semiconductors, Sapporo, Japan, July 2016.
28. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2016.
29. Member of the International Advisory Committee for the 9th International Conference "Quantum Dots 2016", Jeju, Korea, May 2016.
30. Member of the International Advisory Committee for the 14h International Conference on Optics of Excitons in Confined Systems, OECS14, Jerusalem, Israel, October 2015.

31. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2015.
32. Member of the International Advisory Committee for the joint International Conference on Electronic Properties of Two-Dimensional Electronic Systems, EP2DS-22, and Modulated Semiconductor Structures, MSS, Sendai, Japan, July 2015.
33. Member of the International Advisory Committee for the 8th International Conference "Quantum Dots 2014", Pisa, Italy, May 2014.
34. Member of the International Advisory Committee for the International Conference on High Magnetic Fields in the Physics of Semiconductors, Panama City, Fl, USA, July 2014.
35. Member of the International Advisory Committee for the 26h International Conference on Low Temperature Physics, LT26, Buenos Aires, Argentina, August 2014.
36. Member of the International Advisory Committee for the 13h International Conference on Optics of Excitons in Confined Systems, OECS13, Rome, Italy, September 2013.
37. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2013.
38. Member of the International Advisory Committee for the International Workshop "Dubna Nano2012", Bogoliubov Institute for Theoretical Physics, Dubna, Russia, July 2012.
39. Member of the International Advisory Committee for the 7th International Conference "Quantum Dots 2012", Santa Fe, USA, May 2012.
40. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Krynica Zdroj, Poland, 2012.
41. Member of the International Advisory Committee for the International Conference on High Magnetic Fields in the Physics of Semiconductors, Chamonix, France, July 2012.
42. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Krynica Zdroj, Poland, 2011.
43. Member of the International Advisory Committee for the 6th International Conference and School on Spintronics and Quantum Information Technologies, SPINTECH, Japan, August 2011.
44. Member of the International Advisory Committee for the 25h International Conference on Low Temperature Physics, LT26, Beijing, China, August 2011.
45. Member of the International Advisory Committee for the 12h International Conference on Optics of Excitons in Confined Systems, OECS11, Paris, France, September 2011.
46. Member of the International Advisory Committee for the 7th International Conference on Low Dimensional Structures and Devices (LDSD), Telchac, Mexico, May 2011.
47. Member of the International Advisory Committee for the International Conference on Electronic Properties of Two-Dimensional Electronic Systems, EP2DS-20, Tallahassee, USA, July 2011.

48. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Krynica Zdroj, Poland, 2010.
49. Member of the International Advisory Committee for the 6th International Conference "Quantum Dots 2010", Nottingham, UK, April 2010.
50. Member of the International Advisory Committee for the International Workshop "Dubna Nano2010", Bogoliubov Institute for Theoretical Physics, Dubna, Russia, July 2010.
51. Member of the International Program Committee for the International Conference on Electronic Properties of Two-Dimensional Electronic Systems, EP2DS-19, Kobe, Japan, July 2009.
52. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Krynica Zdroj, Poland, 2009.
53. Member of the International Advisory Committee for the 5th International Conference and School on Spintronics and Quantum Information Technologies, SPINTECH, Krakow, Poland, July 2009.
54. Member of the International Advisory Committee for the International Workshop "Dubna Nano2008", Bogoliubov Institute for Theoretical Physics, Dubna, Russia, July 2008.
55. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2008.
56. Member of IUPAP Nanoscience Working Group organizing committee for IUPAP Workshop on Ultra cold nano-matter, Toronto, Canada, February 2008.
57. Member of the International Advisory Committee for the 25h International Conference on Low Temperature Physics, LT25, Leiden, Holland, 2008.
58. Member of the International Advisory Committee for the 5th International Conference "Quantum Dots 2008", Korea, May 2008.
59. Member of the International Advisory Committee for the International Conference on Electronic Properties of Two-Dimensional Electronic Systems, EP2DS-17, Genoa, Italy, July 2007.
60. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2007.
61. Member of the International Advisory Committee for the 4th International Conference "Quantum Dots 2006", Chamonix, France, May 2006.
62. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2006.
63. Member of the International Advisory Committee for the International Conference on Electronic Properties of Two-Dimensional Electronic Systems, EP2DS-16, Albuquerque, USA, 2005.
64. Member of the International Program Committee for the International Conference on Quantum Electronics 2005, Tokyo, Japan, July 2005.
65. Member of the International Advisory Committee for the International School on Physics of Semiconductor Compounds, Jaszowiec, Poland, 2005.
66. Member of the Program Committee for the 11th International Conference on Modulated Semiconductor Structures, MSS-11, Nara, Japan, 2003.
67. Member of the Program Committee for the International Conference "Quantum Dots 2002", Tokyo, Japan, 2002.

68. Member of the International Advisory Committee for the International Conference on High Magnetic Fields in Semiconductors, Oxford, UK, 2002.
69. Member of the International Program Committee for the International Conference on Electronic Properties of Two-Dimensional Electronic Systems, Prague, 2001.
70. Member of the Program Committee for the International Conference "Quantum Dots 2000", Munich, August 2000.
71. Member of the Program Committee for the Workshop on Infrared Emitters and Detectors, Ottawa, July 1997.
72. Member of the International Program Committee for the International Conference on Modulated Semiconductor Structures (MSS), Santa Barbara, CA, July 1997.
73. Member of the International Program Committee for the International Conference on Superlattices, Microstructures, and Microdevices (ICSMM), Liege, Belgium, July 1996.
74. Member of the International Program Committee for the International Conference on Hot Electrons in Semiconductors, Chicago, USA, July 1995.
75. Member of the Program Committee for the European Canadian Mesoscopic Initiative (ECAMI) Workshop, Glasgow, August, 1995.
76. Member of the International Advisory Committee for the International Conference on Electronic Properties of Two-Dimensional Electronic Systems, Nottingham, UK, August 1995.
77. Member of the International Advisory Committee for the International Conference on Electronic Properties of Two-dimensional Electronic Systems (EP2DS), Newport, R. I., USA, July 1993.

Distinguished, Named, Keynote and Plenary lectures at International Conferences and Institutes

1. Walter Schottky Colloquium, WSI, Munich, Germany (May 1997);

2. "Optical properties of quantum dots", Keynote Speaker, NATO Advanced Research Workshop, Jaszowiec, Poland, June 1999. (first opening NATO science workshop in Eastern Block).

3. “Quantum dots”, Plenary speaker, XV SIMPOSIO LATINO AMERICANO FISICA DE ESTADO SOLIDI, Cartagena de los Indias, Colombia, Nov.1999.

4. "Optical properties of quantum dots", Plenary speaker, Rutherford Advanced Research Workshop on Nanostructures - celebrating the life of Ernest Rutherford, Baron of Nelson. Queenstown, New Zealand, Feb.2001.

5. "Magneto-optics of inhomogeneous electron gas", Keynote speaker, NATO Advanced Research Workshop, St. Petersburg, Russia, June 2002.

6. "Quantum Dots", Brockhouse Plenary Lecture, Canadian Association of Physicists Congress, Quebec City, June 2002.

7. “Nanotechnology in semiconductors: controlling electrons, excitons, and photons on nanoscale”, Plenary Lecture, 13th Nanotechnology, Information, Devices Workshop, Athens, Greece, February 2004.

8. “Nanoscience with single electrons, spins and photons”, Plenary Talk, I Krajowa Konferencja Nanotechnologii, Wroclaw, Poland, April 2007.

9. 170th Zhong Guan Cun Forum on Condensed Matter Physics, Institute of Physics, Chinese Academy of Sciences, Beijing , China, Oct. 2009.

10. 101th Huang Kun Forum, Institute of Semiconductors, Chinese Academy of Sciences, Beijing, China, Oct. 2009.

11. “Electronic and Optical Properties of Semiconductor and Graphene Quantum Dots in High Magnetic Fields”, Plenary Lecture, 20th International Conference on High Magnetic Fields in Semiconductor Physics, Chamonix Mont Blanc, France, July 2012.

12. Peter Grunberg Colloquium, FZJ Julich,Germany, April 2013.

13. “Semiconductor and graphene quantum dots”, plenary lecture, EP2DS-MSS 2013, Wroclaw, Poland, July 2013.

14. “Graphene nanostructures”, Plenary Lecture, International Conference on Nano to Giga Challenges 2014, Tempe, AR, USA, March 2014.

15. “Graphene quantum dots”, Doctor Honoris Causa Faculty of Science Colloquium, University of Crete, Greece, Feb 2014.

16. “Dirac Fermions in confined geometry”, Institute Solvay Workshop: “Physics of graphene and graphene for physics”, Brussels, Sept 2017.

17. “Designing materials at the nanoscale”, Distinguished Lecture Series, Korea Advanced Institute of Science and Technology(KAIST), Daejon, Oct2017.

18. “Designing materials at the nanoscale”, Distinguished Lecture Series, Nanjing Tech, Nanjing, China, June 2019.

19. Prague Physics Colloquium, Institute of Physics, Czech Academy of Science, Prague, April 2023

20. Graphene quantum dots, Aachen Graphene Colloquium, May 2023

21. Photon Science Colloquium, uHamburg/Desy/MPI, June 2023.

22. Physics Friday Colloquium, Warsaw University, May 2023.

23. Light and Matter for Quantum, DFG Center, Aachen,Julich,Cologne, January 2024

Invited lectures at International Conferences

1. "Elementary Electronic Excitations at the Surface of a Semiconductor Superlattice and their Coupling to External Probes", ICTP Trieste, Italy, 1986 (given by G.F. Giuliani)

2. "Elementary Excitations in Two-dimensional Electron Gas Arrays", Many Body Theories, Argonne National Lab, USA, 1986 (given by J.J. Quinn)

3. "Nonlinear Response of Virtual Excitations in Semiconductor Superlattices", NATO Advanced Research Workshop, Mt. Tremblant, Quebec, Canada, 1989.

4. "Excitonic Effects in Optical Spectra of Modulation Doped Quantum Wells", NATO Advanced Research Workshop London, Ontario, Canada 1991.

5. "Acceptor Related Photoluminescence as a Probe of Many Electron States in Semiconductor Nanostructures", NATO Advanced Research Workshop, Napa Valley, California, USA, 1992.

6. "Reduced Carrier-Lattice Energy Transfer Rates in GaAs Quantum Wells in the Presence of Cold Plasmas: a Direct Measurement via Phonon Population Dynamics", NATO Advanced Research Workshop, St. Felipe de Gioux, Spain, 1992.

7. "Spectroscopy of Correlated Electrons in Quantum Dots", American Physical Society March Meeting, Pittsburgh, USA, 1994.

8. "Many Body Effects in Low-dimensional Semiconductor Structures", International School of Semiconductor Compounds, Jaszowiec, Poland, 1994.

9. "Interacting Electrons in Quantum Dots in Magnetic Fields", Technion Advanced Research Workshop, Israel, 1994.

10. "Electronic and Optical Properties of Self-assembled Quantum Dots", 9th International Winterschool on New Developments in Solid State Physics, Mauterndorf, Austria, 1996.

11. "Quantum Single Electron Transistor", 32nd International Winter School in Theoretical Physics, Karpacz, Poland, 1996.

12. "Optical Properties of a Two-dimensional Electron Gas", International Workshop on New Theoretical Developments in Two-dimensional Electron Gas, Scuola Normala Superiora, Pisa, 1996.

13. "Optical Spectroscopies of Correlated Electrons in Quantum Dots", Adriatico Research Conference on "Electron Liquid in Systems of Reduced Dimension", ICTP, Trieste, Italy, 1996.

14. "Optical probes of elementary excitations in quantum dots", 8th Brazilian Workshop on Semiconductor Physics, Aquas de Lindoia, Brazil,1997.

15. "Optical properties of Etched and Self-Assembled Quantum Dots in a Magnetic Field", 191 Meeting of Electrochemical Society, Montreal, Canada, 1997.

16. "Electronic properties of self-assembled quantum dots", Annual Congress, Canadian Association of Physicists, Calgary, Canada, 1997.

17. "Electronic correlations in semiconductor quantum dots", International Conference on Strongly Coupled Coulomb Systems, Boston, USA 1997.

18. "Quantum Phenomena in a Single Electron Transistor", 34nd International Winter School in Theoretical Physics, Karpacz, Poland, 1998.

19. "Optical Properties of Quantum Dots", International Workshop on Novel Physics in Semiconductor Nanostructures, INFM, Scuola Normala Superiora, Pisa, Italy 1998.

20. "Double quantum well physics in single p-SiGe quantum wells", International Workshop on "Double quantum wells", Torino, 1998, Italy.

21. "Optical properties of charged quantum dots", PHASDOM Meeting, Neuchatel, Switzerland, 1998.

22. "Spin and Correlations in quantum dots", Recontres de Moriond, Les Arcs, France, January 1999.

23. "Correlated electrons and excitons in quantum dots", French-Polish workshop on "Excitons in confined systems", Warsaw, Poland, February 1999.

24. "Quantum dots for Quantum Information Processing", Workshop on quantum dots for quantum computing, Naval Research Laboratory, Washington, DC, USA, Sept.1999.

25. "Spin structure of artificial atoms", Workshop on "Magneto-electronic materials", CAPEM, Buffalo,USA, Sept. 1999.

26. "Excitonic artificial atoms in quantum dots",11th International Winterschool on New Developments in Solid State Physics, Mauterndorf, Austria, February 2000.

27. "Quantum dots in intense laser fields: excitonic artificial atoms", International Conference on Atoms, Molecules, and Quantum Dots in Intense Laser Fields, Pisa, Italy, June 2000.

28. "Probing many-electron states by absorption/emission in semiconductor nanostructures", NATO Advanced Research Workshop on "Optical properties of semiconductor nanostructures", Wuerzburg, June 2000.

29. "Excitonic artificial atoms", CERION Workshop, Wuerzburg, July 2000.

30. "Hidden symmetries, decoherence free spaces, and excitonic artificial atoms", 3rd Caribean Workshop on Quantum Mechanics, Particles, and Fields, Havana, Cuba, Dec. 2000.

31. "Electrons and excitons in quantum dots", opening invited talk, International Workshop on Trions, Berlin, Germany, April 2001.

32. "Optical properties of self-assembled quantum dots", Pan-American Advanced Study Institute, Costa Rica, June 2001.

33. "Spin and electronic correlations in quantum dots", NATO Advanced Research Workshop on Theory of Phenomena in High Magnetic Fields, Les Houches, France, March 2002.

34. "Spin of electronic droplets in quantum dots", Rashba Symposium on Frontiers in Spintronics, Cambridge, MA, USA, June 2002.

35. "Excitonic artificial atoms for single photon sources", 5'th International Conference on Excitonic Processes in Condensed Matter, Darwin, Australia, July 2002.

36. "Manipulating charge and spin of single electrons and polarisation of single photons in quantum dots", ONR Workshop on Multifunctional Materials, Pucon, Chile, October 2002.

37. "Emission from highly excited self-assembled quantum dots in strong magnetic fields", Workshop on Quantum Optics in Semiconductors, Bremen, Germany, June 2003.

38. “Optical properties of coupled quantum dots”, Workshop on Quantum Optics in Semiconductors, Rugen, Germany, April 2004.

39. “Correlated states of electrons and holes in quasi-2D systems in strong magnetic fields”, International Workshop on Optical Properties of Low-dimensional Systems, Warsaw, Poland, June 2004.

40. “Single spin devices”, Workshop on Cooperative Phenomena in Optics and Transport in Nanostructures, Max Planck Institute for Complex Systems, Dresden, Germany, June 2004.

41. “Toward microscopic theory of self-assembled quantum dots”, Workshop on Modeling of Self-assembled quantum dots, CECAM, Lyon, France, June 2004.

42. “Microscopic theory of self-assembled quantum dots”, International Symposium on "Quantum Hall Systems and Quantum Materials", Hamburg, Germany, Sept. 2004.

43. “Multifunctionality of self-assembled quantum dots on patterned substrates”, ONR Workshop on Multifunctional Materials ||, Huatulco, Mexico, Oct.2004

44. “Pairing of spin excitons in quantum dots”, Advanced Heterostructures Workshop, Hapuna, Hawaii, Dec. 2004.

45. “Designing solid state quantum systems for quantum information processing”, International Workshop on Quantum Optics, Obergugl-Innsbruck, Austria, Feb.2005.

46. “Quantum dots, quantum computing, and attosecond pulses”, Attosecond Science Workshop, ITAMP, Harvard University, USA, May 2005.

47. “Optical processes in two-dimensional electron gas in the fractional quantum Hall regime”, W.I.Heraeus Seminar, Bad Honef Physik Centrum, Germany, June 2005.

48. “Fractionally Charged Quasiparticles in Confined 2D Electron Systems”, Tutorial Session, 34th International School on the physics of Semiconductor Compounds, Jaszowiec, Poland, June 2005.

49. “Pairing of spin excitons in lateral quantum dots”, International Workshop on Correlations in quantum systems: quantum dots, quantum gases and nuclei, Palma de Mallorca, Spain, Sept.2005.

50. “Nanospintronics with quantum dots”, Polish-Canadian Workshop on Nanospintronics, Wroclaw, Poland, Oct.2005

51. “Artificial atoms and molecules as elements of nano-spintronic circuit”, California NanoScience Institute and Canadian Institute for Advanced Research workshop “Seeing the end of the NanoRoadMap”, Santa Barbara, CA, USA, Nov.2005

52. “Nanospintronics with quantum dots”, International Workshop on Spin and Mesoscopic Physics, National Center for Theoretical Science, NCTU, Hsinchu, Taiwan, January 2006.

53. “Controlling magnetism in semiconductor quantum dots with magnetic ions”, ONR International Workshop in Multifunctional Materials, Bariloche, Argentina, March 2006.

54. “ Nanospintronics with quantum dots”, Spintronics Program, Kavli Institute for Theoretical Physics, UCSB, Santa Barbara, CA March 2006.

55. “Quantum information –future of Microelectronics?” International Workshop on Future of Microelectronics, Crete, Greece, June 2006.

56. “Nanoscale semiconductor structures”, International Workshop "Perspectives in Nanoscience and Nanotechnology", San Sebastian, Basque Country, Spain, September 2006.

57. “Quantum dots-laboratory for correlated electron systems”, 43rd Karpacz International School of Theoretical Physics, Ladek Zdroj, Poland, Feb.2007.

58. “Quantum information –future of Microelectronics?”, 14th Semiconducting and Insulating Materials Conference, Fayettville, AR, USA, May 2007.

59. “Simulating complex oxides on a chip”, European Workshop on MultiFunctional Materials, Haholmen , Norway, June 2007.

60. “Theory of semiconductor nanostructures in high magnetic fields”, International School: ”Magnetic Fields for Science”, Cargese, France, Sept.2007.

61. “Optical control of magnetism in semi-magnetic quantum dots”, International Workshop on Spin and Opto-electronics, Berlin, Germany, Sept.2007.

62. “Quantum dot molecules-laboratory for correlated electron systems”, International Symposium on Atomtronics, Orenas, Sweden, Nov. 2007.

63. “Electric field tuning of exciton-biexciton cascade in a single quantum dot for entangled photon pair generation”, MRS Symposium, Boston, MA,USA, Nov.2007.

64. “From spin excitations to quantum computation with semiconductor quantum dots”, Symposium on Magnetic Excitations in Semiconductors, SUNY Buffalo, NY, USA March 2008.

65. “Fracionally charged excitations in optical emission spectroscopy”, American Physical Society March Meeting, New Orleans, March 2008.

66. “Quantum dots – from biology to quantum computation”, NanoDubna2008, Dubna, Russia, July 2008.

67. “Electric field manipulation of multi-exciton complexes for entangled photon pair generation”, Workshop on complex nanostructures, MPI Dresden, Germany, July 2008.

68. “Multi-exciton complexes in InAs quantum dots”, 28th International Conference on the Physics of Semiconductors, Rio de Janeiro, Brazil, July 2008.

69. “Spin in optical properties of semiconductor and graphene quantum dots in a magnetic field”, International Workshop on Semiconductor and Carbon - Based Nanostructures in Magnetic Fields, Grenoble, France, Nov.2008.

70. “Optical control of magnetism in semi-magnetic quantum dots”, 13th Adavanced Heterostructure and Nanostructure Workshop, Hapuna Beach, Hawaii, Dec 2008.

71. “Theory of multi-milllion atom multifunctional nanostructures”, Multifunctional Materials Workshop, Copper Canyon, Mexico,January 2009.

72. “Quantum circuits based on electron spin”, 14th Brazilian Workshop on Semiconductor Physics, Curitiba, Brazil, March 2009.

73. “Carbononics: electronic, magnetic and optical properties of graphene nanostructures”, Canadian Institute for Advanced Research Workshop, Whistler, May 2009.

74. “Semiconductor quantum dots for quantum information processing”, TheoryCanada, Fredericton, NB, Canada, June 2009.

75. “Building semiconductor nanostructures with atoms”, Tutorial lecture, MRS Fall meeting, Boston, MA, USA, Nov.2009.

76. “Nanospintronics with semiconductor and graphene quantum dots”, XV Simposio en Ciencia de Materiales, CENTRO DE NANOCIENCIAS Y NANOTECNOLOGÍA UAM, Ensenada,Mexico, Feb.2010.

77. “Spintronics with semiconductor and graphene quantum dots”, 16th International Winterschool on New Developments in Solid State Physics: Low Dimensional Systems, "Mauterndorf 2010", Mauterndorf, Austria, Feb.2010.

78. “Quantum dots: from biology to quantum computing”, CIFAR-IoP CAS Workshop, Bejing, China, March 2010.

79. “Coded qubits based on electron spin in semiconductor and graphene quantum dots”, International Workshop on Quantum information processing with spins and superconductors, IQC, Waterloo, Canada, May 2010.

80. “Semiconductor and graphene quantum dots for quantum information processing”, 2010 CMOS Emerging Technologies Workshop, Whistler, BC, Canada, May 2010.

81. “Optical Detection of Spin Polarization in Quantum Dots, “International Workshop on “Ferromagnet-Semiconductor Hybrids”, Bochum, June 2010.

82. “QNANO: computational platform for electronic and optical properties of nanostructures”, CECAM Workshop on Advances in Empirical Electronic Structure Methods for Nanostructures , Manchester, UK, June 2010.

83. “Electronic correlations in graphene quantum dots”, International School in Theoretical Physics: Correlation and Coherence at multiple scales, Ustron, Poland, Sept.2010.

84. “Nanospintronics with quantum dots”, Nanomagnetism and spintronics, A colloquium at the 23rd Centre Jacques Cartier Meeting, Grenoble, France, Nov. 2010.

85. “Optical properties of graphene quantum dots”, Workshop on Innovative Devices and Structures (WINDS2010), Hapuna, Hawaii, December 2010.

86. “Electronic, magnetic and optical properties of graphene nanostructures”, Miniworkshop on Mesoscopic and Spin Physics 2011, National Center for Theoretical Science, Hsinchu, Taiwan, January 2011.

87. “Optical Properties of 2D and 0D Correlated Electron Systems”, International Symposium on Nanoscale Transport and Technology 2011, NTT BRL, Atsugi, Japan, January 2011.

88. “Optical properties of graphene quantum dots”, keynote speaker, Polish-German workshop on optical properties of semiconductor nanostructures, Wroclaw, Poland, February 2011.

89. “QNANO: computational platform for electronic properties of semiconductor and graphene nanostructures”, International Conference Computational and Mathematical Methods in Science and Engineering, Benidorm, Spain, June 2011.

90. “Strongly coupled Coulomb systems in graphene quantum dots”, 16th International Conference on Strongly Coupled Quantum Systems, Budapest, Hungary, July 2011.

91. “Hidden symmetry in optical properties of quantum dots”, International Conference on Fundamental Optical Processes in Semiconductors – 2011, Lake Junaluska, North Carolina, USA, August 2011.

92. “Graphene based integrated electronic, photonic and spintronic circuit”, Future Trends in Microelectronics (FTM-2012) Workshop, Corsica, France, June 2012.

93. “Semiconductor and graphene quantum dots”, International Conference Dubna2012, Bogoliubov Laboratory for Theoretical Physics, Dubna, Russia, July 2012.

94. “Atomistic theory of highly excited nanocrystals and quantum dot molecules”, International Workshop: Ordered and Non-Ordered Superstructures of Nanosized Objects: Preparation, Properties, Applications, and Modeling, Max Planck Institute for Complex Systems, Dresden, Germany, July 2012.

95. “Graphene based integrated electronic, photonic and spintronic circuit”, Workshop on Innovative Devices and Structures (WINDS2012), Hapuna, Hawaii, December 2012.

96. “Condensed Matter Physics at the nanoscale - challenges and opportunities”, University of Ottawa Christmas Symposium, Ottawa, Dec 2012.

97. “Graphene based integrated electronic, photonic and spintronic circuit”, SPIE Conference on Defense, Security and Sensing, Baltimore, April 2013.

98. “Topology, e-e interactions and spin blockade in semiconductor and graphene quantum dots”, Workshop on “Recent Progress in Nonequilibrium Quantum Many-Body Theory", Buffalo, May 2013.

99. “Computational approaches to electronic properties of million atom semiconductor and graphene nanostructures”, International Conference “Computational and Mathematical Methods in Science and Engineering”, Almeria, Spain, June 2013.

100. “Photonics with Graphene Quantum Dots”, CMOS Symposium on Emerging Technologies, MINATEC, Grenoble, France (July2014).

101. “Carbononics, e-e correlations and topology”, International Conference on Theoretical Physics: Coherence and Correlations at different length scales, Ustron, Poland (Sept 2014).

102. “Quantum strain sensor with a HgTe topological insulator quantum dot”, WINDS2014, Hapuna, HI, USA (Dec2014).

103. “Spintronics and valleytronics with 2D materials”, Spintronics60, Cancun, Mexico (Aug2015).

104. “Multifunctional graphene quantum dots, Workshop on Nanoscale Assemblies of Semiconductor Nanocrystals, Metal Nanoparticles and Single Molecules: Theory, Experiment and Application, Max Planck Institute for Complex Systems, Dresden, Germany, August 2015.

105. “Semiconductor and Graphene Quantum Dots for Quantum Information Processing”, Physical Science Symposium, Boston, USA(Sept 2015).

106. “Electronic Structure, Magneto-excitons and Valley Polarized Electron Gas in 2D Semiconductors MoS2 and WS2”, ISAN2015, Waikaloa, HI, USA (Dec2015).

107. “Screening and electron-electron interactions in low-dimensional systems”, Institute for Quantum Matter Symposium, UBC, Vancouver, April 2016.

108. “Electronic Structure, Optical properties and Valley Polarized Electron Gas in 2D Semiconductors, International Workshop on 2D Crystals, Sicily, May 2016.

109. “Electronic structure, optical properties and broken symmetry states in 2D crystals and their quantum dots”, Theory Canada 2016, Ottawa, June 2016.

110. “Electron-electron interactions in graphene clusters”, CMMSE2016, Cadiz, Spain, July 2016.

111. “Magnetoluminescence and Valley Polarized State of Two-dimensional Electron Gas in WS2 Monolayers”, International Conference on High Magnetic Fields in the Physics of Semiconductors, Sapporo, Japan, July 2016.

112. “Electronic structure, magnetoexcitons and Valley Polarized State of Two-dimensional Electron Gas in WS2 Monolayers”, 8th International Conference on Low Dimensional Systems and Devices (LDSD2016), Cancun, Mexico, Aug. 2016

113. “Graphene based integrated electronic, photonic and spintronic circuit”, Graphene Canada2016, Montreal, Canada, October 2016.

114. “Dirac Fermions and massive Dirac Fermions in confined geometry: quantum dots in 2D crystals”, 2nd International Conference on 2D Crystals, Vietnam, April 2017.

115. “Interference, topology and e-e interactions effects in quantum dot rings”, International Workshop on Interference effects in the transport characteristics of single molecules and molecular quantum dots, Max Planck Institute Dresden, April 2017.

116. “Optical properties and spontaneous light polarization in 2D crystals”, CMOS Symposium on Emerging Technologies, Warsaw, Poland, May2017.

117. “Carbononics: electronics, photonics and spintronics with graphene quantum dots”, Nanostructures: Physics and Technology 2017, St. Petersburg, Russia, June 2017.

118. “Nonequillibrium Quantum Transport and Optical Processes in Controlled Quantum Nanostructures from First Principles”, Pioneer Symposium, Korean Physical Society meeting, Oct 2017,Korea.

119. “Electronic Structure, Optical properties and Valley Polarized Electron Gas in 2D Semiconductors”, CECAM International Workshop on “2D Crystals for optoelectronics: computational perspective”, Rome, Dec 2017.

120. “Auger interaction and lasing in quantum dots in 2D crystals”, 3rd International Conference on 2D Crystals, Malta, May 2018.

121. “Electronic structure, magnetoexcitons and valley polarized electron gas in 2D crystals”, Future Trends in Microelectronics (FTM2018), Villasimus, Sardinia, Italy, June 2018.

122. “Semiconductor and graphene quantum dots-laboratory for correlated electrons”, European Winter School on Quantum Dots 4 Photonics, Wurzburg, Germany, Feb 2019.

123. “Excitons and band nesting in 2D crystals”, 4th International Conference on 2D Crystals, Hangzhou, China, June 2019.

124. “2D materials for optoelectronic devices”, 19th International Conference on Numerical Simulation of Optoelectronic Devices, Ottawa, July 2019.

125. “Excitonic Complexes in Semiconductor and Graphene Quantum Dots”, International School on Two-Dimensional Crystals and Photonics, Tbilisi, Georgia, Sept 2019.

126. “Synthetic hybrid quantum many-body systems with 2D materials”, International HQS Workshop, Matsue, Japan, Dec 1-4 2019.

127. “Room temperature multi-phonon upconversion photoluminescence in monolayer semiconductor WS2”, Photonic Heat Engines, Photonics West, San Francisco, USA, Feb 2020.

128. “Atomic scale electronics and photonics with quantum dots in 2D materials”, GrapheneCanada, Nov.2020

129. "Synthetic topological quantum matter with quantum dots", 11th International Conference on Quantum Dots, Munich , Germany, December 2020.
130. "Quantum Dots-Laboratory for correlated electron systems", International Conference on the Quantum Physics of Nanostructures and Beyond - from Fundamentals to Applications, ETH Zurich, September 2021.
131. "Designing Materials at the Nanoscale", International Faculty Development Program on Advanced Computational and Experimental Research in Physics, SRM Institute of Science and Technology, Chennai, India, (online) Sept 2021.
132. "Interacting electrons in 2D materials", Walter Schottky Institute, TUM, May 2022.
133. "Designing Materials at the Nanoscale", Colloquium, Wroclaw University of Science and Technology, Wroclaw, Poland, March 2022
134. "Designing Materials at the Nanoscale", Colloquium, Chemistry, Copernicus University, Torun, Poland, April 2022.
135. "Anderson resonances in Fock space - adding electrons to 2D materials in strong magnetic field", Workshop on "Semiconductors, nanostructures, 2D systems and Dirac matter", Grenoble, France, June 2022
136. "Designing Materials at the Nanoscale", Colloquium, Donostia International Physics Center, Donostia, June 2022.
137. Optical properties of low dimensional materials, 5th International Conference on Applications of Optics and Photonics, AOP2022, Guimaraes, Portugal, July 2022.
138. Designing materials at the nanoscale, V Colloquium on Computational Simulations in Science, Centro de Nanociencias y Nanotecnologia, UNAM, Ensenada, Mexico August 2022.
139. Designing Materials at the nanoscale, Society of Polish Physics Students, Nov2 2022 (online).
140. Correlations and topology in quantum dots in 2D materials, Quantum Geometric Advantage Workshop, Nanyang Technological University, Singapore, January 2023.

Invited lectures at Institutes/Universities

Canada

1. University de Montreal, Montreal, Canada (1994);
2. Simon Fraser University, Canada (1992);
3. University of Alberta, Edmonton, Canada(1996);
4. University of Ottawa, Ottawa, Canada (1992);
5. University of Ottawa, Ottawa, Canada (Sept 2009);
6. University de Sherbrooke, Sherbrooke, Canada (March 1998);
7. IEE EDS, Carleton University, Ottawa, Canada (2008);
8. CMP University of British Columbia,Canada (April 2011);
9. CMP McGill University, Montreal,Canada (Sept 2011).
10. CMP Queen's University (October 2011);

USA

11. ATT Bell Laboratories, USA (1994);

12. IBM T. J. Watson Research Center, USA(1989);
13. Brown University, Providence, USA(1994);
14. Boston College, Boston, USA(1986);
15. Indiana University, Bloomington, IN, USA(1986);
16. University of Colorado, Colorado Springs, CO, USA(1989);
17. Colorado State University, Fort Collins, CO, USA(1987);
18. State University of New York at Buffalo, USA(1993);
19. University of Tennessee, Knoxville, USA(1989);
20. University of Rochester, Rochester, USA(1996);
21. University of California, Santa Barbara, USA (2003);
22. Stanford University, Palo Alto,USA (May 2008);
23. Hewlett-Packard Labs, Palo Alto, USA (May2008);
24. Pennsylvania State University, College Station, PA (April 2008);
25. UCalifornia at Berkeley, Berkeley, CA (Nov2011);
26. Michigan State University, E. Lansing,MI (Nov2012);
27. University of Michigan, Ann Arbor, MI (Nov2012);
28. Columbia University, New York, NY (April 2013);
29. City University of New York College of Technology,NY(April 2013);
30. CMP Seminar, Notre Dame University, South Bend, IN (April 2014);
31. Center for Quantum Technology, uOklahoma, online (October 2020).

UK

32. Oxford University, Oxford, UK(Nov1992);
33. Oxford University, Oxford, UK(1997);
34. Imperial College, London, UK(Nov1992);
35. Exeter University, Exeter, UK(1996);
36. University of Sheffield, Sheffield, UK(1999);
37. Nottingham University, Nottingham, UK(1998);
38. Cavendish Laboratory, Cambridge University, UK(1999);

Germany/Austria

39. Max-Planck Institute, Stuttgart, Germany(1991);
40. Max-Planck Institute, Stuttgart, Germany(2000);
41. Ludwig-Maximillian University, Munich, Germany(2000);
42. Max-Planck Institute for Complex Systems, Dresden, Germany(1999);
43. RWTH Aachen, Germany(1998);
44. Wurzburg University, Germany(1999);
45. Wuppertal University, Wuppertal, Germany(1999);
46. Universitat Regensburg, Regensburg, Germany(2000;
47. Universitat Erlangen, Nurnberg, Germany(2000);
48. Universitat Hamburg, ITP, Hamburg, Germany (2003);
49. Universitat Regensburg, Regensburg, Germany2006);
50. Universitat Hamburg, ITP, Hamburg, Germany (2007);
51. Universitat Karlsruhe,ITP, Karlsruhe, Germany (2007);
52. Ludwig-Maximillian University, Munich, Germany(2008);
53. Walter Schottky Institute, Munich, Germany(2008);
54. Universitat Hamburg, ITP, Hamburg, Germany (2013);
55. Johannes Kepler University, Linz, (May 2013);

56. Technical University of Berlin, Berlin,Germany (July 2014).
57. RWTH Aachen Graphene Center colloquium (May 2023)

France

58. Saclay, Paris, France(1997);
59. High Magnetic Field Laboratory-Grenoble, France(1997);
60. CNRS-Bagneux, Bagneux Paris, France(2000);
61. CNRS C2N Lab, Paris, March 2019

Belgium

62. University of Antwerp, Antwerp, Belgium (2001);

Spain

63. Autonoma Universidad de Madrid, Madrid, Spain (2002);
64. CSIC, Madrid, Spain (2006);
65. Catalan Institute for Nanotechnology, Barcelona, Spain (Oct2012)
66. Autonoma Universidad de Madrid, Madrid, Spain (Oct2012);
67. University Jaime I, Castellon, Spain(Oct2012);

Brazil

68. University of Campinas, Campinas, Brazil (1997);
69. University of Brasilia, Brasilia, Brazil (March 2012);

Poland

70. Institute of Theoretical Physics, Warsaw University, Warsaw, Poland (1997)
71. Institute of Physics, Wroclaw University of Technology, Wroclaw, Poland (1999)
72. Institute of Physics, Wroclaw University of Technology, Wroclaw, Poland (2003)
73. Institute of Theoretical Physics, Warsaw University, Warsaw, Poland (2003)
74. Institute of Physics, Wroclaw University of Technology, Wroclaw, Poland (2005)
75. Institute of Physics, Wroclaw University of Technology, Wroclaw, Poland (2006)
76. Institute of Theoretical and Physical Chemistry, WUT, Wroclaw, Poland (2008)
77. Institute of Physics,Wroclaw University of Technology, Wroclaw, Poland (2009)
78. Institute of Physics, Jagiellonian University, Krakow, Poland (2016);
79. Institute of Physics, Marie Curie-Sklodowska University, Lublin, Poland (2019)

Japan

80. NTT BRL Atsugi, Japan (Nov.2004);
81. NTT BRL Atsugi, Japan (Jan.2006);
82. Tohoku University, Sendai, Japan (October 2008);
83. WPI on Advanced Materials, Tohoku U, Sendai (Nov 2013).
84. University of Tokyo, (Nov2013)

Physics Colloquia

1) University of Missouri, Columbia, USA (Nov 1994);
2) University of British Columbia, Vancouver, Canada (Feb 1999);
3) University of Georgia, Athens, USA (March 1999);
4) University of Miami, Miami, USA (Nov 1999);
5) Wurzburg University, Germany (May 2000);
6) ETH, Zurich, Switzerland (June 2000);
7) MacMaster University, Hamilton, Canada (May 2000);

8) University of Alberta, Edmonton, Canada (Nov 2001);
9) University of Waterloo, Waterloo, Canada (Sept 2002);
10) Vienna University of Technology, Vienna, Austria (Dec 2002);
11) Pontifica University de Santiago de Chile, Chile (Nov 2002);
12) University of Southern California, Los Angeles, USA (Jan 2003);
13) University of Central Florida, Orlando, USA (March 2004);
14) Clarkson University, Potsdam, NY (Nov 2004);
15) Ohio University, Athens, OH, USA (May 2004);
16) University of Toronto, Toronto, Canada (Oct 2004);
17) University of Wisconsin-Madison, Madison,WI (May 2005);
18) NIST, Gaithesburg, USA (May 2005);
19) Dalhousie University, Canada (Sept 2006);
20) NEST-Scuola Normala Superiora, Pisa, Italy (May 2006);
21) Nicolas Copernicus University, Torun, Poland (Oct 2006);
22) LPA Ecole Normal Superior, Paris, France (March 2007);
23) National Nanotechnology Laboratory, Lecce, Italy (July 2007);
24) Institute Neel, Grenoble, France (June 2008);
25) Institute for Nano Quantum Electronics, University of Tokyo, (Oct.2008);
26) University at Buffalo, Buffalo, USA, (Sept.2009);
27) Penn State University, State College, PA, USA (Sept.2009).
28) Fudan University, Shanghai, China (Oct.2009).
29) University of Vermont, Burlington, VT,USA.(Nov2010).
30) University of Georgia, Athens, GA, USA (March 2011).
31) HMFL Florida State University, Tallahasse, FL,USA (March 2011).
32) Paul Drude Institute, Berlin, Germany (July 2011).
33) University of Campinas, UNICAMP, Campinas SP, Brazil(March 2012).
34) University Federal de RJ, Rio de Janeiro, Brazil (March2012).
35) Institute for Quantum Information Science, University of Calgary(Sept2012).
36) Department of Physics,University of Alberta, Edmonton, Alberta(Sept2012).
37) Department of Physics, University of Tennessee, Knoxville,TN (Feb2013).
38) Joint Quantum Institute, NIST-UMaryland, Washington, DC (March 2013).
39) University of Campinas, UNICAMP, Campinas SP, Brazil(March 2014).
40) Center for Nanoscale Materials, Argonne Natl Lab, Chicago (April 2014).
41) SFB Integrated Nanostructures, HU zu Berlin, Berlin, Germany(July 2014).
42) Institute of Physics, Wroclaw University of Technology (Nov 2014).
43) Konwersatorium, Institute of Physics, PAN, Warsaw (Nov 2014).
44) Dept. of Physics, Technion, Haifa, Israel (Oct 2015).
45) Institute of Physics, Wroclaw University of Technology (May 2016).
46) University of Manitoba, Winnipeg, (Nov. 2017)
47) Izmir Institute of Technology, Izmir, Turkey, (May 2018)
48) ShanghaiTech, Shanghai, China, (June 2019).
49) Institute of Physics, Wroclaw University of Science and Technology (April 2022).
50) Donostia International Physics Center, Donostia,Spain(June 2022).
51) Warsaw University Physics Colloquium,(May 2023).
52) Hamburg University, Photon Science Colloquium (June 2023).

53) Light and Matter for Quantum, DFG Center colloquium, Aachen, Cologne, Julich, (Jan2024).

Grants

Co-investigator in the NSF supported Materials Research Group at Brown University in the area of Ultrafast Spectroscopy of Nanostructures.
Prof. A. Nurmikko - Principal investigator

Principal investigator- NATO High Technology Linkage Grant in the area of optical properties of semiconductor nanostructures with Wroclaw University of Technology.

Principal investigator-NRC-CNRS collaborative grant on "Many-body effects in optical properties of 2DEG"

Principal investigator- US Army Research Office grant for EP2DS-13

Principal investigator- Office of Naval Research grant for EP2DS-13

Principal investigator- IUPAP grant for EP2DS-13

Principal investigator-Canada/Germany ST Collaborative grant

Canadian Institute for Advanced Research/NRC VP - grant supporting RA ($25,000/year): computational nano-spintronics. 2000-2008

Principal investigator - NSERC Grant: Electronic properties of quantum dots ($13,000/year) 2003-2008

Principal Investigator (with M.Bayer) - NRC-Helmholtz grant (~ $900,000 over 3 years)- 2003 to 2006.

Principal investigator - NRC High Performance Computing project (total ~ $1,200,000 over 3 years shared by 5 groups): Computational platform for nanostructured and biological materials. 2002-2005.

Principal investigator (NRC, Darpa, ONR, IUPAP, CIAR, NINT, Evident) QD2004 Conference-$50,000

Principal investigator- Canadian Institute for Advanced Research/McGill/NRC- grant supporting RA ($50,000/year) : Computational Nanoscience. 2006-2008.

Principal investigator – QuantumWorks, NSERC ($48,000/year) 2007-2011.

Principal investigator (NRC, SUNY Buffalo, AFOSR) OPLDS2007 Workshop-$35,000

Principal Co-Investigator (with M. Potemski)– NRC-CNRS grant “Controlling spins at the nano-scale”, $600K/year total – 2008-2010 (50%).

Co- Investigator (with R.Williams)– NRC-NSERC-BDC grant “Nanostructured Single and Entangled Photon Sources for Quantum Information Processing”, $1mln /year total – 2008-2010 (10%).

Co- Investigator (with Y.Tao)– NRC-NSERC-BDC grant “Polymeric /inorganic semiconductor nano-composite materials for low cost photovoltaic applications”, $1mln/year total – 2008-2010 (10%)

Principal investigator - NSERC Discovery Grant: Nanospintronics with quantum dots ($30,000/year) 2009-2014.

Co – Principal Investigator – NSERC CREATE Extreme Photonics program (P.Corkum-PI) ($1.65mln over 5 years – 10%) 2010-2015.

Principal investigator - NSERC Discovery Grant: Electron-electron interactions and topology in semiconductor and graphene quantum dots ($36,000/year) 2014-2019.

Principal investigator – uOttawa start-up fund, $220,000 total, 2014-2019

Principal investigator – uOttawa Research Chair, $190,000 total, 2014-2019

Principal Investigator – NSERC ENGAGE grant – silicon-QNANO , QuantumSilicon.$25,000 total, 2017.

Principal Investigator – NSERC STRATEGIC grant – electron spin based Quantum Circuits in 2D Materials (QC2DM) , $1.2mln total ($891K uOttawa), 2018-2021.

Principal investigator - NSERC Discovery Grant: Synthetic many-body systems in artificial materials ($61,000/year) 2019-2025.

Principal investigator – uOttawa Research Chair, $190,000 total, 2019-2024

Principal investigator – ComputeCanada, $388,000 total computing allocation, 2019

Principal investigator – ComputeCanada, $133,000 total computing allocation, 2020

Principal investigator – ComputeCanada, $109,366 total computing allocation, 2021

Principal investigator – ComputeCanada, $42,094 total computing allocation, 2022

Principal investigator – ComputeCanada, $25,342 total computing allocation, 2023

Principal investigator – ComputeCanada, $28,356 total computing allocation, 2024
Principal investigator - Digital Research Alliance**,** $98,593 comput allocation 2025

Principal investigator - NRC IoT Challenge Program: QSP (Quantum Sensor Program) Polarisation-resolved single photon sensors using quantum circuits in 2D materials ($193,000/year) 2022-2025

Principal investigator - NRC Applied Quantum Computing Challenge Program: Advancing design of quantum computing devices based on topological quantum matter using noisy intermediate scale quantum computers ($100,000/year) 2023-2025.

Co-PI, (10%), NSERC Quantum Alliance Consortium PQS2D (Programmable quantum simulators based on 2D materials). ($1,000,000/year over 5 years) A. Luican-Mayer, PI

Co-PI, NSERC Create on Quantum Materials. G. Jabbour PI (10%)
(~$300,000/year over 5 years) 2023-2028

Co- PI ICPS2024, July 2024 (IUPAP 21,000 Euro; ONRG 20,000 USD; uOttawa, Carleton,NRC, $60,000)

Teaching/Education/Training Highly Qualified Personnel:

Undergraduate students who did undergraduate project in my group:
P.Wilson, L.Lamoroux, J. Cieniak, S. Guindon, G. Greer, R. Cheriton, A.Rene, A. Forte, J. Thibert-Leduc. L. Najera Baldo (UNAM))-scholarship Centro de Nanociencias y Nanotecnología, Universidad Nacional Autónoma de México, Y. Saleem,
M-A. Geoffrion-Lockhead, B. Puzantian, Lakshminarayanan Senadipalyam Ramesh, Matthew Albert.

Graduate students who worked/are working with me toward their PhD:

1. A.Wojs-PhD 1993-1996 (Wroclaw-Ottawa), now full Professor and Rector, Wroclaw University of Science and Technology,
2. L. A. Rego- PhD 1997-1998 (Campinas-Ottawa), FAPESP Scholarship, now full Professor, Universidad de Santa Catarina, Florianopolis, Brazil.
3. G. Narvaez-PhD 1999-2000 (Campinas-Ottawa), FAPESP Scholarship , now Patent Lawyer, Pepperina Consulting, Atlanta, US.
4. A. Wensauer-PhD 2002-2003(Regensburg-Ottawa), DAAD Scholarship, now at PreussenElektra GmbH, Germany.
5. M. Korkusinski- PhD 2000-2004 (Ottawa), now staff at SDT NRC.
6. W. Dybalski-Msc 2005- (Ottawa) – now Professor, Poznan University, Poland.
7. I. Puerto Gimenez – PhD 2007-2009 (La Laguna-Ottawa) now staff, Instituto Astrofisica de Canarias, Tenerife, Spain
8. Y-C. Hsieh- PhD 2007-2011 (Ottawa)- OGS Scholarship- now professor, Zhenjian University, PRChina.

9. P. Potasz – PhD 2009-2012 (Wroclaw - Ottawa) – Scholarship National Science Center Poland - now Assistant Professor, Copernicus University,Torun,Poland.
10. A. Trojnar – PhD 2008-2013 (Ottawa), uOttawa International Scholarship - now COO, IIONIT, Ottawa.
11. U. Mendes - PhD 2009-2014 (Campinas and Ottawa) – scholarship FAPESP - now Leader, CMC Quantum, Sherbrooke, PQ, Canada.
12. I. Ozfidan – PhD 2011-2015 (Ottawa), CREATE scholarship - now staff scientist, Electronic Arts, Vancouver, BC, Canada.
13. M. Vladisavljevic – Msc 2013-2014(Ottawa), now staff, MDA, Ottawa.
14. N. Rogers - Msc 2013 – 2015 (Ottawa), now Visiercorp, Ottawa
15. H. Faria – Msc 2013– 2014 (Campinas, Ottawa) - scholarship FAPESP- now PhD student, Campinas.
16. A. Amezaga – PhD 2014 – 2016, (U Chile, uOttawa), CONACyT scholarship, transfer to Carleton Medical Physics program.
17. L. Szulakowska – PhD 2016-2020 (Ottawa)- uOttawa International Scholarship; present, Quantinuum, Cambridge,UK.
18. A. Dusko –PhD 2014-2017 (uRio de Janeiro-uOttawa)-1 year CAPES scholarship in Ottawa, now staff, Xanadu,Toronto.
19. B. Jaworowski – PhD 2014-2019 (Wroclaw-Ottawa)- Scholarship National Science Center Poland - now PDF at iCFO, Spain.
20. M. Bieniek - Msc/PhD 2014-2022 (Wroclaw-Ottawa)- Scholarship National Science Center Poland – now PDF WUST, Wroclaw, Poland
21. S. Mekonnen – PhD 2016 –2018 (visiting student, uAdisAbaba)-scholarship Ethiopian Government – now Assoc. Prof. Arbaminch University, Ethiopia
22. Wafa Hadadi – Msc 2016 – 2019 (uOttawa), scholarship Saudi Government, now lecturer in Saudi Arabia
23. S. Getachev – PhD 2016 – (visiting student, uAdis Ababa)-scholarship Ethiopian Government
24. Jacob Manalo –PhD 2018-2022 (now CTO and founder CoreGI)
25. Yasser Saleem – PhD 2017-2023 (now PDF uDortmund)
26. David Gayowski – Msc 2020-2022 (now PhD student, uOttawa)
27. Benjamin Puzantian – Msc 2021 – 2022 (now PhD student, medical physics, uCarleton)
28. Alina Wania Rodrigues- PhD 2022 – present
29. Mahan Mohseni – PhD 2022 – 2023 (now PhD with S. Czischek)
30. Katarzyna Sadecka (Wroclaw-Ottawa) – PhD 2022 – present
31. Matthew Albert – Msc 2022 – 2024 (now PhD student uToronto)
32. Sina Abedi – PhD sept 2024- present

Research associates past/present:

1. B. van Zyl, 2001-2001 (now Prof. St.Xavier University, Canada)
2. J. Kyriakidis,2001-2002 (now CEO-co-founder, QRA, Halifax, Canada),
3. S.-J. Cheng, 2002-2003 (now Professor and Dean, NCTU Taiwan),
4. M. Florescu, 2002-2003 (now Assoc Prof, uSurrey-Guillford, UK),
5. W. Sheng, 2003-2006 (now Professor, Fudan University, Shanghai, China),
6. R. Abolfath, 2003-2006 (now asst prof, Howard U, Washington,DC, USA),

7. F. Qu, 2004-2005 (now Professor, University of Brasilia, Brasilia, Brazil),
8. M. Korkusinski, 2004-2005 (uOttawa) (now staff member at SDT NRC, Ottawa),
9. Y.P. Shim, 2006-2009 (now Asst.Prof, UTexas El Paso, USA) - QuantumWorks scholarship.
10. M. Zielinski, 2006-2009 (now Assoc. Prof, Copernicus University, Torun, Poland) - CIFAR scholarship.
11. F. Delgado, 2006-2008 (now Assoc. Prof., Fisica, uLaLaguna, Spain).
12. E. Kadantsev, 2008-2011, (now, software engineer, Sonus, Ottawa)-NRC-NSERC-BDC scholarship.
13. A.Sharma,2008-2010 (now staff scientist, Quantum Brilliance, Stuttgart, Germany) .
14. O. Voznyy, 2008-2011, (now assoc professor, physics, UToronto Scarborough) - NRC-NSERC-BDC scholarship.
15. D. Guclu, 2008-2012 (now Prof, Physics, Izmir Institute of Technology, Turkey)-CIFAR scholarship.
16. A. Delgado Gran, 2015-2018 (now, staff , XANADU, Toronto)
17. M. Cygorek, 2017-2019, Fyodor Lynen Humboldt Fellow (now asst.prof, TU Dortmund).
18. A. Dusko, 2019-present, QC2DM PDF (now staff, Xanadu, Toronto).
19. M. Cygorek, 2019-2020, QC2DM PDF (now asst.prof, TU Dortmund).
20. A. Altintas, 2020-2023, QC2DM PDF (now software developer, Toronto).
21. Daniel Miravet, 2021-present, PQS2D RA.
22. Hassan Allami, 2022-2024, PDF (now software developer)
23. L. Szulakowska, March 2023- Dec 2023,QSP PDF, (present, Quantinuum, Cambridge,UK)
24. Guan-Hao Peng, May 2024-present, PDF (Taiwan Science Foundation)
25. Ibsal Assi, Jan 2024-Jan2025,PDF
26. Iann Cunha, May 2024-present, PDF (now, Itau Quantum, Sao Paolo, Brasil)

Visitor Programme in Condensed Matter Theory Group at NRC and now uOttawa.
The following visitors worked with me on a variety of topics:
N. Pulsford (Philips Research, Holland); D. Pfannkuche (Max -Planck Institute, Stuttgart, Germany);M. Grabowski (U. of Colorado, USA); J. J. Palacios (AU Madrid, Spain); P. A. Schulz (Campinas, Brasil); A. S. Plaut (Exeter, UK); A. Wojs (TU Wroclaw, Poland); J. A. Brum (Campinas, Brasil); L. A. Rego (Campinas, Brasil); M. Potemski (HMFL Grenoble, France); A. Brown (U Alberta, Canada); L. Quiroga (ULA, Colombia), W. Czart (AMU, Poland). G. Narvaez (Campinas, Brasil), A.Wensauer (Regensburg, Germany), A.Olaya-Castro (Bogota, Columbia), C. Tejedor (Madrid, Spain), J.I.Climente (Castelano, Spain), A. Delgado (Havana, Cuba), F. Qu (Uberlandia, Brazil), A. Gladysiewicz (TU Wroclaw), H. Tamura (NTT Japan), A. Trojnar (TU Wroclaw), W. Sheng (Fudan), M. Bieniek(TU Wroclaw), L. Szulakowska (TU Wroclaw), D. Ziemann (HU Berlin), B. Jaworowski (TU Wroclaw), D. Pfannkuche (ITP, UHamburg), G. Kopidakis (Crete), P.Potasz (TU Wroclaw), N. Tit (UAEU), Sintayehu Hailemariam Mekonnen (Adis Ababa), Luis Najera Baldo (UNAM Ensenada), Yasser Salem (uOttawa), Shimelis Getachev (uAddisAbaba). D.Guclu (Izmir), S-J Cheng(Taiwan). P-K. Lo (Taiwan), A. Jamroz (UWarsaw), K. Sadecka, (WUST), W. Pasek (Torun).

Courses Taught:
Graduate Course in "Solid State Physics", Boston College, 1987;
Graduate Course:"Introduction to Artificially Structured Materials", Boston College, 1987.
Graduate Course “Physics of systems with reduced dimensions: Nanospintronics with quantum dots”, Wroclaw University of Technology, 2007/2008.
Graduate MiniCourse “Introduction to low dimensional systems”, Wroclaw University of Technology, 2010.
Graduate course, PHY8191: ”Physics of low dimensional systems”, uOttawa, Fall 2014.
Undergraduate course, PHY4390 ”Introduction to physics of semiconductors”, uOttawa, Winter 2016.
Undergraduate course, PHY4370 , ”Introduction to Quantum Mechanics II”, uOttawa, Fall 2016.
Graduate course, PHY8191: ”Physics of low dimensional systems”, Ottawa,Winter2017.
Undergraduate course, PHY4370 ”Introduction to Quantum Mechanics II”, uOttawa, Fall 2017.
Graduate course, PHY8191:”Physics of low dimensional systems”, uOttawa,Winter2018.
Undergraduate course, PHY4370, ”Introduction to Quantum Mechanics II”, uOttawa, Fall 2018
Undergraduate course, PHY3341,”Theoretical Physics I”, uOttawa, Fall 2018
Undergraduate course, PHY4370 ”Introduction to Quantum Mechanics”, uOttawa, Fall 2019.
Graduate Course, PHY5100, "Solid State Physics", uOttawa, Winter 2020.
Undergraduate course, PHY4370,Introduction to Quantum Mechanics, uOttawa, Fall 2020.
Graduate Course, PHY5110, "Solid State Physics beyond independent electron approximation", uOttawa, Winter 2021.
Undergraduate course, PHY4370 ”Introduction to Quantum Mechanics, uOttawa, Fall 2022.
Undergraduate course, PHY4370 ”Introduction to Quantum Mechanics, uOttawa, Fall 2023
Graduate Course, PHY5110, "Solid State Physics beyond independent electron approximation", uOttawa, Winter 2024
Graduate Course, PHY5390, "Intro quantum science and technology", uOttawa, Fall 2024
Graduate Course, PHY5100, "Solid State Physics", uOttawa, Winter 2025.

Personal:
Born July 5 1955, Wroclaw, Poland. Married, Two Adult Children
Citizenship: Canadian and Polish

Summary of Research Activities (1980-2025) .

~300 journal articles, including Nature (2), Science (1), Nature Physics (1), Nature Nanotechnology(1), Nature Communications (3), Nature Scientific Reports (3) , Physical Review Letters (31), and Physical Review (~120). 21 Review articles and book chapters, two books, one patent.
Google Scholar: h-index 71; number of citations ~ 20900
(http://mysite.science.uottawa.ca/phawrylak/member_pages/hawrylak/index-pawel.html)

Selected highly cited 10 papers and research areas

Theory of optical properties of 2D electron systems
Theory of electrons in quasi-two dimensional systems was developed and problems of Fermi edge singularity, fractionally charged excitons and Anderson resonances solved, with theory verified by experiments:

1. P.Hawrylak, "Optical properties of a two-dimensional electron gas: Evolution of spectra from excitons to Fermi-edge singularities", Phys. Rev.**B 44** (8), 3821 (**227** Google Scholar citations).

Artificial atoms, single spin transistor and spin qubits
Theory of artificial atoms made in gated lateral quantum dots in field effect transistor was developed and successfully compared with experiment by Ashoori and Stormer. It resulted in the development of transistor based on spin of a single electron, development of spin qubits and demonstration of entanglement.

2. P. Hawrylak, "Single Electron Capacitance Spectroscopy of Artificial Atoms: Theory and Experiment", Phys. Rev. Lett. **71**, 3347 (1993). (**289** Google Scholar citations).
3. M. Ciorga, A. S. Sachrajda, P. Hawrylak, C. Gould, P. Zawadzki, S. Jullian, Y. Feng and Z.Wasilewski, "Addition spectrum of a lateral dot from Coulomb and spin-blockade spectroscopy", Phys. Rev. **B 61**, R16315 (2000). (**602** Google Scholar citations).
4. M. Bayer, P. Hawrylak, K. Hinzer, S. Fafard, M. Korkusinski, Z. R. Wasilewski , O. Stern and A. Forchel, " Coupling and entangling of quantum states in quantum dot molecules", **Science 291**, 451 (2001). (**1050** Google Scholar citations).

Hidden symmetries - excitonic artificial atoms-quantum dot lasers
Theory of the electronic properties of semiconductor quantum dots and nanocrystals was developed. We predicted the existence of excitonic artificial atoms in self-assembled quantum dots (SADs) governed by hidden symmetries. This prediction was verified in a number of experiments, including **Nature 543** and served as a basis of quantum dot lasers. The theory of nanocrystals was developed which suggested to modify the growth of nanocrystals which in turn led to lasing, reported in **Nature 544**. The theory of semiconductor quantum dots was reported in a monograph Quantum Dots by Springer Verlag 1998.

5. P.Hawrylak, "Excitonic artificial atoms: engineering optical properties of quantum dots", Phys. Rev. **B60**, 5597 (1999). (**306** Google Scholar citations).
6. M. Bayer, G. Ortner, O. Stern, A. Kuther, A. A. Gorbunov, A. Forchel, P. Hawrylak, S.Fafard, K. Hinzer, T. L. Reinecke , S. N. Walck, J. P. Reithmaier, F. Klopf, and F.

Schäfer, “Fine structure of neutral and charged excitons in self-assembled In(Ga)As/(Al)GaAs quantum dots”, Phys. Rev. **B 65**, 195315 (2002). (**1546** Google Scholar citations).

7. M. Bayer, O. Stern, P. Hawrylak, S. Fafard, A. Forchel , "Hidden symmetries in the energy levels of excitonic artificial atoms in quantum dots", **Nature 543**, 923 (2000). (**564** Google Scholar citations).
8. Fengjia Fan, Oleksandr Voznyy, Randy P. Sabatini, Kristopher Bicanic, Michael M. Adachi, James R. McBride, Kemar Reid, Young-Shin Park, Xiyan Li, Ankit Jain, Rafael Quintero-Bermudez, Mayuran Saravanapavanantham, Min Liu, Marek Korkusinski, Pawel Hawrylak, Victor I. Klimov, Sandra J. Rosenthal, Sjoerd Hoogland, Edward H. Sargent , Facet-Selective Epitaxy Enables Continuous-Wave Lasing in Colloidal Quantum Dot Solids, **Nature 544**,75 (2017).(**437** Google Scholar citations)

Monograph : Lucjan Jacak, Pawel Hawrylak, and Arek Wojs, "Quantum Dots", Springer Verlag (1998). (**1253** Google Scholar citations).

Carbononics and 2D materials

Theory of two dimensional crystals, transition metal dichalcogenites (TMDCs) and graphene was developed. Spontaneous spin and valley symmetry broken states of interacting massive Dirac Fermions in a bilayer graphene quantum dot were predicted. Electronic properties of graphene quantum dots were predicted , verified by experiments by McGuire and by Lu. This advanced the field of carbononics-electronics, photonics and spintronics with graphene quantum dots, described in a monograph “Graphene quantum dots” by Springer Verlag.

9. ES Kadantsev, P Hawrylak, “Electronic structure of a single MoS2 monolayer”, Solid State Communications 152 (10), 909-913.)(2012) (**757** Google Scholar citations).
10. Marek Korkusinski, Yasser Saleem, Amintor Dusko, Daniel Miravet and Pawel Hawrylak, “Spontaneous spin and valley symmetry broken states of interacting massive Dirac Fermions in a bilayer graphene quantum dot”, ***Nano Lett.*** **23**, 7546 (2023).

Devrim Guclu, Pawel Potasz, Marek Korkusinski and Pawel Hawrylak,”Graphene Quantum Dots”, Springer-Verlag (2014).(**198** Google Scholar citations)

Designing materials at the nanoscale for quantum technologies: carbononics, nanophotonics, nanospintronics and quantum information-selected research

Light-matter interaction in 2D crystals

2D crystals are atomically thin materials with electronic and optical properties different from bulk [SSCom152 (10), 909(2012)]. In recent theory and experimental work we have suggested that electrons in a single layer of WS2 form **a new state of matter** – spontaneously valley polarized electron gas (VPEG) [Nature Nanotechnology 10, 603 (2015)]. Since valley degrees of freedom translate directly into polarization of light the VPEG leads to spontaneously circularly polarized emitted light despite excitation with unpolarized light. We developed a theory of electronic and optical properties of TMDCs, including band nesting, massive Dirac fermions, valley Landé and Zeeman effects [Physical Review B 97 (8), 085153(2018)] and understanding of excitons and trions in TMDCs and shown light up-conversion up to room temperature [Nature communications

10 (1), 107 (2019)]. Much work is needed to understand and confirm these preliminary findings.

Carbononics – integrating electronics, photonics and spintronics with graphene quantum dots

In a series of papers we have laid the foundations of carbononics – integrating electronics, photonics and spintronics in a single carbon material-graphene. We have shown how to engineer transport, optical and magnetic properties by size, shape, edge, sublattice, number of layers and carrier density. In particular, we have shown that the optical gap can be tuned continuously from THz to UV and magnetic moment can be generated by broken sublattice symmetry. Broken sublattice symmetry in triangular graphene dots with zigzag edges results in a degenerate shell - a synthetic strongly correlated system with magnetic phases. The magnetic moment can be tuned both by carrier density and by light. Excitons and charged excitons have been described and optical spectra connected to magnetic moment [Phys.Rev.Letters, 103, 246805 (2009). Phys. Rev. B 82, 155445 (2010); Phys. Rev. B 85, 075431 (2012); Phys. Rev. B87, 035425 (2013)]. Theory has been applied to colloidal graphene quantum dots and compared with experiment. Exciton and bi-exciton spectrum and bi-exciton-exciton cascade was predicted. Bi-exciton binding energy determined and compared with experiment. [Phys.Rev.B91,115314(2015), Nano Letters**15**, 5742 (2015)]. The work has been described in a Springer monograph "Graphene quantum dots" and in the invited Focus Issue "Carbononics" in the Physica Status Solidi (2016), which we co-edited with K.Ensslin and F. Peeters.

Nanophotonics - quantum dots for solar cells and lighting

Theory of optical properties of semiconductor nanocrystals and graphene quantum dots including Auger processes has been developed and applied to CdSe and PbSe nanocrystals. This theory, and developed computational tools, explicitly accounts for conversion of different multi-exciton complexes via Coulomb scattering and hence opens up path toward evaluation of multi-exciton generation by single photons [Phys. Rev. **B54**, 11397 (1996).Phys. Rev. **B 82**, 245304 (2010); Phys. Rev. B 84, 155327 (2011)]. It allows design of nanomaterials with suppressed Auger scattering which led to demonstration of a CW laser based on nanocrystals with O.Voznyy and T.Sargent at uToronto **[Nature 544**, 75(2017)].

Nanophotonics-theory of excitonic artificial atoms in self-assembled quantum dots:

When photon is absorbed by a semiconductor material it creates an exciton. We developed a theory of excitonic artificial atoms consisting of a specific number of electrons and holes confined by a parabolic potential, and new principles governing their electronic structure, "hidden symmetries", were established. The hidden symmetries are related to the degeneracies of the single particle FD spectrum and e-e interactions. The degeneracies can be manipulated using magnetic field, and a theory of excitonic artificial atoms in a magnetic was developed. The existence of FD spectrum in annealed self-assembled quantum dots was established experimentally. The theory has been supported by in-house experiments, in HMFL Grenoble, and by single dot spectroscopy in collaboration with Wuerzburg (Bayer and Forchel), Dortmund (Bayer), and Grenoble (Potemski). This theory played a role in the construction of NRC quantum dot lasers and was recognized with a CAP

Brockhouse Medal. [Phys. Rev. B60, 5597 (1999); Nature 405, 923 (2000), Phys.Rev.Lett.85, 389 (2000). Solid State Comm. (2003). Phys.Rev.B68,235330(2003). Phys.Rev.Lett.92, 187402 (2004)].
The effect of correlated electrons on SECS, FIR, PL and photo-current spectroscopies of self-assembled dots was investigated theoretically and verified experimentally. Phys.Rev.B51, 17708(1995); Phys.Rev.B51, 1769 (1995); Phys. Rev.B, 53,10841 (1996); "Quantum Dots", Springer-Verlag (1998). Phys.Rev.**B 61**, 13753 (2000). Physica E 13, 246 (2002).

Nanophotonics- Quantum dots for Quantum Information processing :
The application of self-assembled and gated quantum dots to quantum information processing, first proposed in Brum and Hawrylak, Superlatt. and Microstr. 22, 431 (1997), is being successfully developed through a combined theoretical and experimental effort. The **single dot spectroscopy** was used to demonstrate coupling and entangling of two particle (electron and hole) states in a single stack of two vertically coupled self-assembled quantum dots [Condensed Matter News 7, 16 (1999); **Science 291** , 451 (2001)] as well as determine **exciton** dephasing time [Phys.Rev.Lett.91,267401(2003)]. Recent work focused on theory of quantum dots in cavities and quantum dots as sources of single and entangled photon pairs for quantum cryptography [Nonlinear Optics 29,329(2002), Phys. Rev. **B 79**, 035309 (2009)], including theory of bright exciton splitting[Phys. Rev. **B 81**, 045311 (2010)] and lifetime of dark exciton [Phys.Rev.B.87, 115310(2013)].

Computational Nanophotonics -atomistic theory of excitons in self-assembled quantum dots
The progress has been made in the development of computational tools for the atomistic description of nanostructures, with application to self-assembled quantum dots. The current computational platform, QNANO, allows for the calculation of strain using VFF, electronic levels using tight binding approach, and **multi-exciton complexes** using Configuration Interaction (CI) method, for million atom nanostructures. When combined with rate equations, the results of theoretical calculations can be directly compared with **high excitation spectroscopy**. [Phys.Rev.B 71,035316 (2005)]. The method has been applied to NRC InAs qdots grown on InP nanotemplates [Phys. Rev. B **72**, 035326 (2005)]. It is implemented on a HPC cluster [J.Appl.Phys.2009, Phys.Rev.B2010; Phys.Rev.B.87, 115310(2013)].

Nanophotonics - negatively charged excitons in high magnetic fields - a new quasi-particle in electron hole plasmas:
It has been firmly believed that in strong magnetic field a system consisting of different numbers of electrons and holes separates into the electronic and excitonic components due to "hidden symmetries". Surprisingly, our numerical experiments showed that two electrons and a valence hole form a bound state with finite angular momentum. This state forms a quasi-particle of the charged electron-hole system. We have shown that these quasiparticles condense into incompressible liquids and play a significant role in the emission from 2DEG in FQHE. New experiments and calculations have led to the picture of fractionally charged excitons.[Phys. Rev.B 51, 10 880 (1995); Phys. Rev. 60,11661(1999), **Nature Physics 2**, 239 (2006), Phys.Rev.B 89, 115317 (2014)].

Nanophotonics - theory of magnetoluminescence from IQHE - observation of new many-body resonances:
Theory of photoluminescence from an interacting 2DEG in strong magnetic fields was developed and supported by numerical studies. It was found that at odd filling factors quasiparticles (holes) created in the 2DEG during the recombination process break into two spectral pieces. This nonperturbative result leads to the splitting of PL lines at odd filling factors. The splitting was shown to be an illustration of Anderson-Fano resonances in Fock space. This new theory opened up a possibility of coherent interpretation and understanding of the photoluminescence spectrum of 2DEG in the IQHE regime, and has been verified by experiments in Grenoble, Boston, and Tokyo. [Phys. Rev. B 56, 12386 (1997); Phys. Rev. Lett.80, 3344 (1998)].

Nanophotonics - Far Infrared Spectroscopy of correlated electrons in a strong magnetic field:
FIR spectroscopy can not probe electron-electron interactions in clean systems. To break "Kohn's theorem" one needs to introduce impurities. The theory of donor related Far Infrared Spectroscopy of correlated electrons in a strong magnetic field has been formulated. We have been able to explain a very puzzling experimentally observed "blue shift" of the transition energy in terms of impurity bound charge and spin density excitations. A new type of ground state and its FIR signature involving a spin texture has been predicted. This spin texture can be thought of as a positive charge binding two spin-reversed electrons and a hole in the spin polarized state. New calculations and experiments relate FIR spectroscopy to incompressible liquids in the fractional quantum Hall effect regime. [Phys. Rev. Lett.72 2943 (1994); Phys. Rev. Lett. 80, 3344 (1998)].

Nanophotonics - many-electron effects in optical properties of modulated semiconductor structures: from excitons to Fermi edge singularity:
The non-perturbative theory of the effect of free carriers on excitonic spectra of semiconductor nanostructures was developed. An exact solution to the problem of the evolution of the optical spectrum from excitonic to Fermi edge singularity has been formulated. The theory predicted that the FES is controlled by the negatively charged excitons. The theory is used to analyze a host of experiments in quantum wells, heterojunctions, and wires, explaining a number of puzzling experimental results. This work has stimulated new direct absorption measurements (Brown et al.) which searched for predicted two peaks in the absorption spectrum. These peaks have now been measured by Huard and co-workers in Grenoble and by Shields in Cambridge. The theory is now being extended to include electron-electron interactions. The FES in acceptor recombination has been predicted and subsequently measured experimentally.
[Phys. Rev. B42, 8986 (1990); Phys. Rev. B44, 3821 (1991); Phys. Rev. B44, 11236 (1991); Phys. Rev. B45, 42371 (1992); Phys. Rev. B46, 15593 (1993); Phys. Rev. B48, 4960 (1993); Phys. Rev. B R11082(1996); Comments Cond. Matt. Phys. 18, 135 (1997); Physica E9,716 (2001)].

Nanophotonics - photonic bandgaps, nonlinear dynamics, and classical and quantum chaos:

The theory of wave propagation in nonlinear periodically modulated absorptive and/or dispersive medium has been formulated in terms of equivalent dynamical maps. Exact, rigorous, and universal results were obtained. This addresses the problem of self induced photonic gaps, gap solitons, collective photon-polarization states, and chaotic phenomena in conservative systems. Phys. Rev. B44, 13082 (1992). The theory of nonlinear response of virtually excited semiconductor superlattices has been formulated in terms of effective semiconductor Bloch equations accounting for Fermion (electrons and holes) and Boson (Photons) exchange and direct interactions and relaxation processes. The theory of Coulomb impurity in quantum wires in a magnetic field was developed. The problem was shown to map into a class of chaotic systems such as the hydrogen atom in a magnetic field. [Phys. Rev. B49, 8174 (1994)].

Nanospintronics – controlling spin and magnetism at the nanoscale :
Theory of nano-spintronics at the single spin level was developed. This includes theory of magnetic, electronic and optical properties of quantum dots containing magnetic ions and electron spins. These systems may allow voltage control of magnetic properties on nanoscale with application as quantum and/or classical memories [Phys. Rev. **B 71**, 125321 (2005); Phys. Rev. Lett. **95**, 217206 (2005); Phys.Rev.Lett.**96**,157201 (2006); Phys. Rev. Lett. **97**, 017202 (2006); Phys. Rev. Lett. **98**, 207203 (2007); Eur.Phys.Lett.**81**, 37005 (2008); Phys. Rev. Lett. 108, 247203 (2012)]. One of key problems in nano-spintronics is related to the spin injection into nanoscale semiconductor structures. Working with G.Kioseoglou and A.Petrou (Buffalo) and B.Jonker (NRL) we (with M. Korkusinski) developed a theory of optical detection of spin polarization of carriers in self-assembled quantum dots[Phys. Rev.Lett.**101**, 027205 (2008)]. Working with A. Sachrajda we have developed a theory of spin blockade [Phys. Rev. **B 76**, 115332 (2007)], spin selective Aharonow-Bohm effect [Phys.Rev.Lett. (2008)], manipulation of total spin using voltage [Phys. Rev.**B78**, 165317 (2008)] and transport [Phys. Rev. B 85, 085309 (2012)].

Nanospintronics – quantum circuits based on electron spin
Quantum circuits with single electron spins as active elements are being developed. In lateral dots a single electron spin was successfully isolated and probed by current injection/detection with spin polarized electrons [Phys. Rev.B61,R16315(2000)]. The spin relaxation due to spin-orbit interaction and its manifestation in magnetic field induced spin transitions was demonstrated [Physica E 22, 414(2004)]. The spins in two individual dots were isolated and coupled in an attempt to build electron spin-based quantum computer [Phys. Rev. Lett. 91, 026803 (2003), Phys. Rev. B **72**, 125307 (2005)]. Voltage controlled coded qubit based on electron spin in a triple dot has been proposed [Solid State Commun.**136**, 508 (2005)] and a theory of a triple dot molecule implemented [Phys.Rev.B75,115301 (2007)] and compared with NRC built triple dot [Phys. Rev. Lett. **97**, 036807 (2006)]. HF-CI method for the computation of electronic properties and entanglement (wavefunctions) of quantum circuits based on electron spin has been developed [Phys. Rev. B 73, 075314 (2006); Phys. Rev. Lett. 97, 186802 (2006)]. Proposal for a **macroscopic quantum state in a semiconductor device** - using nanostructured gate of a transistor or InAs qdots in InP nwire to create artificial spin one chain, artificial Haldane gap material, was put forward.[Solid State Comm. 150, 2065(2010); Nature Scientific Reports 7, 5529 (2017)].

Nanospintronics - theory of artificial atoms in strong magnetic fields-quantum single spin transistor:

Theory of correlated electron states in quantum dots in a magnetic field has been formulated accounting for geometrical, dynamical, and statistical symmetries. This allowed for a number of exact results and analogies with incompressible states in the Fractional Quantum Hall Effect. This analytical work was supported by the implementation of exact diagonalization techniques, Hartree-Fock and Hartree codes. The theory was applied to gated, deep-etched, and self-assembled quantum dots. In self-assembled quantum dots exact diagonalization techniques helped to establish generalized Hund's rules. These rules were investigated theoretically by calculating FIR and PL spectra. For gated structures electronic correlations play an important role. This has been elucidated early on in our theory of single electron capacitance spectroscopy (SECS) of artificial atoms. This theory was verified and we have shown that transitions between incompressible "magic states" states were observed in SECS experiments by Ashoori, Stormer et al. We have also shown how electron-electron and final state interactions can be inferred from magneto-luminescence. This has stimulated experimental work (S.Patel et al. and K. Schmidt et al.) and has been largely confirmed by Karrai et al. Theory of Raman scattering from electronic excitations was developed and the predicted shell structure verified experimentally by Lockwood et al . The theoretical expertise was applied to the construction of the Quantum Single Electron/Spin Transistor developed at NRC. A series of new phenomena were predicted and observed. Good examples are recent observations of collapse of the Zeeman gap due to electronic correlations, pairing of spin excitations, and collapse of spin singlet phase. This theoretical and experimental work has led to the development of complete control over the electron numbers combined with achievement of spin polarized injection, and a demonstration of a single spin transistor. **This was recognized by the American Physical Society as one of ten most important breakthroughs in Condensed Matter Physics in 2002.** [Phys. Rev. Lett. 71, 3347 (1993); Phys. Rev. Lett.70, 485 (1993) Solid State Comm.93, 915(1995); Solid State Comm.93, 909(1995); Phys. Rev. Letters 77, 354 (1996); Phys. Rev. B56, 13227 (1997); Phys. Rev. B 59, 2801(1999); book "Quantum Dots", Springer-Verlag (1998). Phys. Rev. Lett. 88, 256804 (2002). Phys. Rev. B 67, 035325 (2003); Phys. Rev. Lett. 93, 206806 (2004). Solid State Comm.130, 115(2004)].

Many-body effects in 2D and layered electron gas:

The theory of many-body effects in 2D and layered electron gas was formulated to address single electron properties of a two-dimensional and layered electron gas both from the point of view of heterojunctions and superlattices, normal properties of high Tc layered superconductors and intercalated graphite. This was the first calculation of the self-energy for the layered electron gas. One of the prediction of the theory was the unusual dependence of the electron scattering time. This appears to have been observed in Four-Wave Mixing experiments by Kim et al at ATT Bell Laboratories. [Phys. Rev. Lett. 59, 485 (1987), Phys.Rev.B49,13624(1994).]

The theory of critical collective excitations in systems with infinite correlation length has been developed and applied to plasmons at a metal-insulator transition i.e. in Fibonacci structures. [Phys. Rev. Lett. 57, 380 (1986)].

Density functional theory of dense electron-hole plasma in superlattices:
The density functional theory of dense electron-hole systems in semiconductor superlattices predicted a stability of the electron-hole liquid vs exciton gas and negative bandgap renormalization in type II short period superlattices. The negative bandgap renormalization has been observed but no definite confirmation of the electron-hole liquid is available yet. [Phys. Rev. B39, 6264(1989)].

Plasmons in semiconductor superlattices:
The Dynamical RPA coupled with Local Density Approximation(LDA) calculations of bulk and surface plasmon excitations in semiconductor superlattices and their coupling to external probes formed a neccessary framework for the understanding and interpretation of a wide range of experiments: electronic Raman scattering, Electron Energy Loss Spectroscopy(EELS), Far Infrared Resonant Absorption (FIR), and amplification of surface plasmons. The theory of Raman scattering is used to extract from experiments carrier density, coupling of electron-hole plasma with optical phonons, and hot-electron scattering times. The work on amplification of acoustical surface plasmons has opened up a field of the applications of plasma wave instabilities in sub- millimiter wave detectors. For a review see: "Bulk and Surface Plasma Waves in Semiconducting Superlattices", in " Electromagnetic Waves: Recent Developments in Research", Vol.1, P. Halevi, Editor , North Holland, 1992; also Physica Scripta 35, 946 (1987).