CURRICULUM VITAE

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HIGHER EDUCATION

Aug. 1996	Ph.D.	Cornell University, Physics Thesis Advisor: Prof. V. Ambegaokar
Jun. 1991	Univ. Dipl.	Eötvös University, Budapest, Hungary Physics (*summa cum laude*) Thesis Advisor: Prof. A. Zawadowski
1990 – 1991	Fellow Year	Bristol University, Bristol, U.K. Thesis Advisor: Prof. B.L. Gyorffy
1989 – 1990	Senior Year	Eötvös University, Budapest, Hungary
1986 – 1989	Freshman – Junior Years	Bolyai University, Cluj, Romania

PREVIOUS POSITIONS, ACADEMIC, ADMININSTRATIVE, PROFESSIONAL AND OTHER

July – August 2014	Visiting Fellow	Materials Theory Institute, Argonne Nat'l Lab
August 2008 – Present	Professor	University of Notre Dame
August 2004 – 2008	Associate Professor	University of Notre Dame
August 2003 – Present	Director	Institute for Theoretical Sciences
Summers 2001– Present	Visiting Scientist	Argonne National Laboratory
January 2003 – June 2003	Visiting Professor	Institute of Physics, Budapest University of Technology and Economics, Budapest, Hungary
June 2001 – Present	Principal Investigator	Nanoscale: Interdisciplinary Research Team
Aug. 2000 – Aug. 2004	Assistant Professor	University of Notre Dame
Sep. 1998 – Aug. 2000	Postdoctoral Research Fellow	Argonne National Laboratory Research Advisors: Prof. A.A. Abrikosov & Dr. Michael R. Norman
Sep. 1996 – Aug. 1998	Postdoctoral Research Fellow	The University of Chicago Research Advisor: Prof. K. Levin

SCHOLARSHIPS AND FELLOWSHIPS

2003 Alfred P. Sloan Fellow

Hungarian Academy of Science – Soros Foundation Fellow, 1990-1991

Bristol Eötvös Exchange Fellowship, 1990-1991

CÉL Foundation Fellow, 1989-1990. (Awarded to outstanding students of the Hungarian minority in Romania.)

DISTINCTIONS, HONORS, AWARDS

2003 Alfred P. Sloan Fellow

Cornell, GPA 4.3 (A+)

The Best Thesis in Theoretical Physics, Bristol University, 1991

Diploma with Distinction (*summa cum laude*), Eötvös University, 1991 (the only one awarded in physics, total of seven in the Faculty of Natural Sciences, for the Class of 1991).

"Outstanding Student of the Faculty of Natural Sciences," Eötvös University, Budapest, 1990

First Prize, TDK Symposium (Scientific Associations of Students) Eötvös University, Dec. 1989

First Prize at the Scientific Symposium of Bolyai University, March 1989

Special Merit Bursary for the maximum GPA (100%) and "Head of Class" title, 1986-1990

PROFESSIONAL MEMBERSHIPS

Member – American Physical Society

PROFESSIONAL ACTIVITIES

Writer – Theory Panel

Basic Research Needs for Superconductivity
Report based on a BES Workshop on Superconductivity, May 8–10, 2006, to examine the prospects for superconducting grid technology and its potential for significantly increasing grid capacity, reliability, and efficiency to meet the growing demand for electricity over the next century.

Conference Organizer

- Half-a-century of Magnetic Semiconductors: An International Conference in Honor of Jacek K. Furdyna, September 3-4 2021
- Member of the Scientific Advisory Committee, International Conference on Vortex Matter: Vortex 2021, Mumbai, India; Vortex 2019, Antwerp, Belgium; Vortex 2017, Natal, Brazil; Vortex 2015, El Escorial, Spain

– Festschrift for George W. Crabtree's 70th Birthday celebration, 2014
–14th International Workshop on Vortex Matter Nanjing, China, 2013
– Coherent Hybrids on the Nanoscale, ND-ANL Workshop, 2012
– 13th International Workshop on Vortex Matter, Chicago, 2011
– Catalytic Materials by Design, Notre Dame, January 2010
– Fluorescence Intermittency in Molecules, Quantum Dots and Quantum Wires, Notre Dame, April 2007
– Mesoscopic Superconductivity and Magnetism, Chicago, Sept. 2006
– Room Temperature Superconductivity, Notre Dame, July 2005
– High Tc Superconductivity Theory Workshop, Argonne National Lab, July 2001

Panel Reviewer/Reviewer –	Fonds Wetenschappelijk Onderzoek (Belgian Science Foundation) National Science Foundation, Directorates of Materials Research, Computer Science and Engineering Small Business Research Initiative Petroleum Research Fund/American Chemical Society
Guest-Editor – Physica C,	Review Issue on Current Topics in Ultrahigh Temperature Superconductivity
Guest-Editor – Physica C,	Conference on the Third US-Polish Conference on Superconductivity and Magnetism
Editorial Advisory Board	Physica C (2012-present)
Referee –	Nature, Nature Physics, Applied Physics Letters, Nano Letters, Physica C, Journal of Physical Chemistry, Journal of Magnetism and Magnetic Materials, Journal of the Physics and Chemistry of Solids, The Physical Review B, The Physical Review Letters (including "super-refereeing" duties at the request of the Editor for evaluating manuscripts in multiple rounds of the refereeing process), etc.
Session Chair	– Office of Naval Research Workshop, October 2002, Pucon, Chile: Multifunctional Materials, Session on Magnetic Semiconductors – APS March Meeting 2006, Baltimore MD – APS March Meeting 2001, Seattle WA – APS March Meeting 2000, Atlanta, GA

UNIVERSITY ACTIVITIES

1. **Institute for Theoretical Sciences:** Founder and Director of ITS, a Joint Institute of Argonne National Laboratory and the University of Notre Dame.

2. **Argonne National Lab – Notre Dame Collaborative Research Scheme:** proposed and designed the program, co-wrote Request for Proposals document.

3. **Biophysics at Notre Dame:** invited Prof. Gabor Forgacs, George H. Vineyard Professor of Theoretical and Biological Physics Department of Physics and Biology, University of Missouri, to for consulting on how to establish a group of biological physics at Notre Dame.

4. **Dean's Committee on Biological Physics Initiative** 2016-2020

5. **Advisor to the Dean, Stavropoulos Center for Quantum Materials** 2020-2021

DEPARTMENTAL COMMITTEES

1. Computer/Network Security Committee (Fall 2000)
2. Course Offering Committee (Spring 2001, Fall 2001, Spring 2006)
3. Seminar Organizer: Condensed Matter Seminar Series (Spring & Fall 2002); Physics Theory (Spring 2006)
4. Departmental Strategic Planning (Fall 2002, Fall 2009)
5. Graduate Curriculum (Fall 2003, Spring 2006, Fall 2006)
6. Graduate Recruitment (Fall 2002, Fall 2003) – Representative for Physics and College of Science at the Xavier University Graduate Recruitment Fair
7. Colloquium Committee (Spring 2006)
8. Graduate Curriculum (Spring 2007)
9. Publications (Fall 2007)
10. Awards Committee (Spring 2010)
11. Teaching Committee (Fall 2009, Spring 2010)
12. Graduate Admission Committee (2009,2010)
13. **2-3 various departmental committees/semester**

BOOKS AND MONOGRAPHS

"Twisted: A journey from superfluid tornadoes to spiral galaxies" (in preparation)

REFEREED PUBLICATIONS

NOTE: As of January 25, 2023: 4168 citations, h-index 33, i-10 index 58
(Google Scholar: https://scholar.google.com/citations?user=-3-J4foAAAAJ)

Published articles

1. "Electromagnetic response of a static vortex line in a type-II superconductor: a microscopic study," B. Jankó and J.D. Shore, *Physical Review B: Rapid Communications* **46**, RC9720-9723 (1992).

2. "High order perturbation expansion for the two dimensional Hubbard model using the Gutzwiller wave function," Zs. Gulácsi, M. Gulácsi and B. Jankó, *Physical Review B* **47**, 4168-4173 (1993).

3. "On the coexistence of superconductivity and charge density waves," P. Miller, B. Jankó, and B.L. Gyorffy, *Physica C* **210**, 343-349 (1993).

4. "BCS superconductivity with fixed number parity," B. Jankó, A. Smith, V. Ambegaokar, *Physical Review B* **50**, 1152-1161 (1993).

5. "Parity fluctuations between Coulomb blockaded superconducting islands," B. Jankó and V. Ambegaokar, *Physical Review Letters* **75**, 1154-1157 (1995).

6. "Pseudogap effects induced by resonant pair scattering," B. Jankó, J. Maly, and K. Levin, *Physical Review B: Rapid Communications* **56**, R11 407-R11 410 (1997).

7. "Relationship between the pseudo- and superconducting gaps: Effect of residual pairing correlations below Tc," I. Kosztin, Q. Chen, B. Jankó, and K. Levin, *Physical Review B, Rapid Communications*, **58**, R5936-R5939 (1998).

8. "The cuprate pseudogap: Precursor superconductivity without preformed pairs," J. Maly, B. Jankó, and K. Levin, Proceedings of the 1997 Conference on Spectroscopies in Novel Superconductors, September 14-18, 1997, Cape Cod, MA, *Journal of Physics and Chemistry of Solids*, **59**, 1733-1736 (1998).

9. "Pairing fluctuation theory of superconducting properties in underdoped to overdoped cuprates," Q. Chen, I. Kosztin, B. Jankó, and K. Levin, *Physical Review Letters*, **81**, 4708-4711 (1998).

10. "Pseudogap regime in a BCS Bose-Einstein crossover scenario: Experimental consequences and tests," B. Jankó, I. Kosztin, and K. Levin, *International Journal of Modern Physics B*, **12**, 3009-3015 (1998).

11. "Superconductivity from a pseudogapped normal state: a mode coupling approach to precursor superconductivity," J. Maly, B. Jankó, and K. Levin, *Physical Review B*, **59**, 1354-1357 (1999).

12. "Pairing correlations and the pseudogap state: Application of the 'Pairing Approximation' theory," J. Maly, B. Jankó, and K. Levin, *Physica C*, **321**, 113-133 (1999).

13. "Superconducting transitions from the pseudogap state: d-wave symmetry, lattice, and low dimensionality effects," Q. Chen, I. Kosztin, B. Jankó, and K. Levin, *Physical Review B*, **59**, 7083-7093 (1999).

14. "Incoherent pair tunneling as a probe of the cuprate pseudogap regime," B. Jankó, I. Kosztin, K. Levin, M.R. Norman, and D.J. Scalapino, *Physical Review Letters*, **82**, 4304-4307 (1999).

15. "Ratchet effect in vortex dynamics: Reducing vortex densities in superconductors," C.S. Lee, B. Jankó, I. Derényi, and A.-L. Barabási, *Nature*, **400**, 337-340 (1999).

16. "Theory of Scanning Tunneling Spectroscopy of Magnetic-Field-Induced Discrete Nodal States in a D-Wave Superconductor," B. Jankó, *Physical Review Letters*, **82**, 4703-4706 (1999).

17. "Condensation energy and spectral functions in high-temperature superconductors," M.R. Norman, M. Randeria, B. Jankó, and J.C. Campuzano, *Physical Review B*, **61**, 14742-14750 (2000).

18. "Photoemission and the Origin of High Temperature Superconductivity," M.R. Norman, M. Randeria, B. Jankó, and J.C. Campuzano, Physica C, **341** 2063-2066 (2000).

19. "Dispersion of the neutron resonance in cuprate superconductors," A.V. Chubukov, B. Janko, O. Tchernyshyov, *Phys. Rev. B* **63**, art. no. 180507 1-4 (2001).

20. "Influence of vortices on the magnetic resonance in cuprate superconductors," M. Eschrig, M.R. Norman, B. Janko, *Phys. Rev. B* **64,** art. no. 134509 1-4 (2001).

21. "Collective interaction-driven ratchet for transporting flux quanta," C.J. Olson, C. Reichhardt, B. Janko and F. Nori, *Phys. Rev. Lett.* **87** art. no. 177002 1-4 (2001).

22. “Electronic specific heat in the pairing pseudogap regime,” C.P. Moca and B. Janko, *Phys. Rev. B* **65** art. no. 052503 1-4 (2002).

23. “Electronic structure of multiquantum giant vortex states in mesoscopic superconducting disks,” K. Tanaka, I. Robel and B. Janko, P NATL ACAD SCI USA **99**, 5233-5236 (2002).

24. “Ga1-xMnxAs: A frustrated ferromagnet,” G. Zarand and B. Janko, *Phys. Rev. Lett.* **89** art. no. 047201 1-4 (2002).

25. “Novel Josephson effects between multi-gap and single-gap superconductors,” D.F. Agterberg, E. D. Demler, B. Janko, *Phys. Rev. B* **66** (21): Art. No. 214507 1-4 DEC 1 2002.

26. “The origin of the pseudogap phase: precursor superconductivity versus a competing energy gap scenario,” K. Levin, Q. J. Chen, I. Kosztin, B. Janko, Y.J. Kao, A. Iyengar *J. Phys. Chem. Sol.*, **63** (12): 2233-2236 DEC 2002

27. “Zeeman-splitting induced bound states in diluted magnetic semicondutors,” M. Berciu and B. Janko, *Phys. Rev. Lett.* **90** (24): Art. No. 246804 1-4 JUN 20 2003.

28. “Theory of strong electron-phonon superconductivity for MgB2 in the framework of a two-band model,” C.P. Moca and B. Janko, *Physics C* **387** (1-2): 122-130 MAY 1 2003.

29. “Structure and Melting of Two-Species Charged Clusters in a Parabolic Trap,” J.A. Drocco, C. Olson-Reichhardt, C. Reichhardt, B. Janko Phys. Rev. Lett. E **68** (6): Art. No. 060401 1-4 December 2003

30. “Anomalous behavior of spin-wave resonances in $Ga_{1-x}Mn_xAs$ thin films,” T.G. Rappoport, P. Redlinski, X Liu, G. Zarand, B. Janko, and J.K. Furdyna, *Phys. Rev. B* **69**, 125213 1-9 (2004).

31. “Ratchet superconducting vortex cellular automata,” C.J.O. Reichhardt, C. Reichhardt, M.B. Hastings, et al., *Physics C-Superconductivity and its Applications* **404** (1-4) 266-271 (2004).

32. “Control of magnetic vortex chirality in square ring micromagnets,” A. Libal, M. Grimsditch, V. Metlushko,P. Vavassori, B. Janko, *Journal Of Applied Physics* **98** (8): Art. No. 083904 1-6 (2005).

33. “Zero- and one-dimensional magnetic traps for quasiparticles in diluted magnetic semiconductors,” P. Redlinski, T. Wojtowicz,T.G. Rappoport, A. Libal, J.K. Furdyna, B. Janko, *Phys. Rev. B* **72** (8): Art. No. 085209 1-9 (2005).

34. “Scaling theory of magnetoresistance in disordered local moment ferromagnets,” G. Zarand, C.P. Moca, B. Janko, *Phys. Rev. Lett.* **94** (24): Art. No. 247202 1-4 (2005).

35. “Pressure-induced ferromagnetism in (In,Mn)Sb dilute magnetic semiconductor,” M. Csontos,G. Mihaly, B. Janko, T. Wojtowicz, X. Liu, J.K. Furdyna, *Nature Materials* **4** (6): 447-449 (2005).

36. “Binding energy of shallow donors in a quantum well in the presence of a tilted magnetic field,” P. Redlinski, B. Janko, *Phys. Rev. B* **71** (11): Art. No. 113309 1-6 (2005).

37. “Positional disorder, spin-orbit coupling, and frustration in Ga1-xMnxAs,” G.A. Fiete, G. Zarand, B. Janko, P. Redlinski, C.P Moca, *Phys. Rev. B* **71** (11): Art. No. 115202 1-16 (2005).

38. “Manipulating spin and charge in magnetic semiconductors using superconducting vortices,” M. Berciu, T.G. Rappoport, B. Janko, *Nature* **435** (7038): 71-75 (2005).

39. “Optical response of a ferromagnetic-diluted magnetic semiconductor hybrid structure,” P. Redlinski, T.G. Rappoport, A. Libal, J.K. Furdyna, B. Janko, T. Wojtowicz, *Applied Physics Letters* **86** (11): Art. No. 113103 1-3 (2005).

40. “Magnetic scattering of spin polarized carriers in (In,Mn)Sb dilute magnetic semiconductor”, M. Csontos, T. Wojtowicz, X. Liu, M. Dobrowolska, B. Janko, J. K. Furdyna, *Phys.Rev.Lett.*, **95** 227203 1-4 (2005).

41. “Dynamics, rectification, and fractionation for colloids on flashing substrates”, A. Libal, C. Reichhardt, B. Janko, C.J.O. Reichhardt, *Physical Review Letters*, 96 Art. No. 188301 1-4 (2006).

42. “The effect of the Abrikosov vortex phase on spin and charge states in magnetic semiconductor-superconductor hybrids”, T.G. Rappoport, M. Berciu, B. Janko, Phys. Rev. B 1-12 Art. No. 094502, p. 1-12 (2006).

43. “Room temperature superconductivity – Preface”, B. Janko, G.W. Crabtree, W.K. Kwok, *Physica C-Superconductivity and its Applications* **468** (2): IX-IX (2008).

44. “Anomalous Hall effect in (In,Mn)Sb dilute magnetic semiconductors”, G. Mihaly, M. Csontos, S. Bordacs, I. Kezsmarki, T. Wojtowicz, Z. Liu, B. Janko, J.K. Furdyna *Phys. Rev. Lett.* **100** (10): Art. No. 107201 (2008).

45. “Spin-resolved spectra of Shiba multiples from Mn impurities in MbB2”, C.P. Moca, E. Demler, B. Janko, G. Zarand, *Phys. Rev. B* **77** (17): Art. No. 174516 (2008).

46. “Universal emission intermittency in quantum dots, nanorods and nanowires”, P. Frantsuzov, M. Kuno, B. Janko, R.A. Marcus, Nature Physics, **4** (7): 519-522 (2008).

47. “Nanoscale spin polarization in the dilute magnetic semiconductor (In, Mn)Sb”, A. Geresdi, A. Halbritter, M. Csontos, G. Mihaly, T. Wojtowicz, X. Liu, B. Janko, J.K. Furdyna, *Phys. Rev. B* **77** (23): Art. No. 233304 (2008).

48. Scaling analysis of the magnetoresistance in Ga_{1-x}Mn_xAs, C. P. Moca, B. L. Sheu, N. Samarth, P. Schiffer, B. Jankó, G. Zarand, *Phys. Rev. Lett,* **102**, Art. No. 137203, (2009).

49. “Model of fluorescence intermittency of single colloidal semiconductor quantum dots using multiple recombination centers” P. Frantsuzov, S. Volkán-Kacsó, B. Jankó, *Phys. Rev. Lett.* **103** Art. No. 207402 (2009).

50. “The effect of impurities on spin polarized Zeeman bound states in dilute magnetic semiconductor-superconductor hybrids” S.H. Lin, T.G. Rappoport, M.I Berciu, B. Jankó, *J. App.Phys.* **107,** Art. No: 034307 (2010).

51. “Correlations between subsequent blinking events in single quantum dots”, S. Volkán-Kacsó, P. Frantsuzov, B. Jankó, *Nano Letters, **10:*** 2761–2765 (2010).

52. “Vortex manipulation in superconducting films with tunable magnetic topology” M. V. Milosevic, F. M. Peeters, B. Janko, *Superconductor Science and Technology, **52,*** Art. No. 024001 (2011).

53. "Understanding fluorescence blinking is the first path to an imaging solution", F. Vietmeyer, S. Volkan-Kacso, P. Frantsuzov, M.K. Kuno, B. Janko, *Laser Focus World,* **47,** 45 (2011).

54. "Carrier recombination dynamics in individual CdSe nanowires". F. Vietmeyer, P. Franstuzov, B. Janko, M. K. Kuno, *Phys. Rev. B* **83** Art. No. 115319 (2011).

55. "Formation of Multiple-Flux-Quantum Vortices in Mesoscopic Superconductors from Simulations of Calorimetric, Magnetic, and Transport Properties" B. Xu, M. V. Milosevic, S.-H. Lin, F. M. Peeters, B. Janko, *Phys. Rev. Lett.* **107** Art. No. 057002 (2011).

56. "Electric Field-Induced Emission Enhancement and Modulation in Individual CdSe Nanowires" F. Vietmeyer,T. Tchelidze, V. Tsou, B. Janko, M. Kuno, *ACS Nano,* **6,** 9133-9140 (2012).

57. Universality of the Fluorescence Intermittency in Nanoscale Systems: Experiment and Theory" P. A. Frantsuzov, S. Volkan-Kacso, B. Janko, Boldizsar, *Nano Lett.* **13**, Pages: 402-408 (2013)

58. "Strongly Enhanced Pinning of Magnetic Vortices in Type-II Superconductors by Conformal Crystal Arrays", D. Ray, C.J.O. Reichhardt, B. Janko, C. Reichhardt, *Phys,. Rev. Lett* **110,** Article Number: UNSP 267001 (2013).

59. "Quantum rotor in nanostructured superconductors", S. H. Lin, M. V. Milosevic, L. Covaci, B. Janko, F.M. Peeters, *Nature: SCIENTIFIC REPORTS*, **4** Article Number: 4542 (2014).

60. "Vortex transport and pinning in conformal pinning arrays" D. Ray, C. Reichhardt, C.J.O. Reichhardt, B. Jankó *Physica C* **503** 123 (2014).

61. "Heterogeneous Fluorescence Intermittency in Single Layer Reduced Graphene Oxide" J.X. Si,S. Volkán-Kacsó, A. Eltom, Y. Morozov, M. P. McDonald, M. Kuno, B. Jankó *Nano Lett.* **15** 4317 (2015).

62. "Dimensional crossover in semiconductor nanostructures" M.P. McDonald, R. Chatterjee, J.X. Si, B. Jankó, M. Kuno *Nature Comm.* **7** 12726 (2016).

63. "Fluorescence intermittency originates from reclustering in two-dimensional organic semiconductors", A. Ruth, M. Hayashi, P. Zapol, J.X. Si, M.P. McDonald, Y.V Morozov, M. Kuno, B. Jankó *Nature Comm.* **8** 14521 (2017).

64. "Pinning, flux diodes and ratchets for vortices interacting with conformal pinning arrays" C.J.O. Reichhardt, Y.L. Wang, Z.L. Xiao, W.K. Kwok, D. Ray, C. Reichhardt, B. Jankó, *Physica C* **533** 148 (2017).

65. "Molybdenum Carbamate Nanosheets as a New Class of Potential Phase Change Materials", M. Zhukovskyi, V. Plashnitsa, N. Petchsang, A. Ruth, A. Bajpai, F. Vietmeyer, Y.X. Wang, M. Brennan, Y.S. Pang, K. Werellapatha, B. Bunker, S. Chattopadhyay, T.F. Luo, B. Jankó, P. Fay, M. Kuno, *Nano Lett.* **17** 3902 (2017).

66. "Defect-Mediated CdS Nanobelt Photoluminescence Up-Conversion", Y.V, Morozov, S. Draguta, S.B. Zhang, A. Cadranel, Y. X. Wang, B. Jankó, M. Kuno, *J. Phys. Chem. C* **121** 16607 (2017).

67. "Photoluminescence Up-Conversion in CsPbBr3 Nanocrystals", Y.V. Morozov, S.B. Zhang, M.C. Brennan, B. Jankó, M. Kuno, *ACS Energy Letters* **2** 2515 (2017).

68. "Switchable geometric frustration in an artificial-spin-ice-superconductor heterosystem" Y.L. Wang, X.Y. Ma, J. Xu, Z.L. Xiao, A. Snezhko, R. Divan, L.E. Ocola, J. E. Pearson, B. Jankó, W.K. Kwok, *Nature Nanotechnology* **13** 560 (2018).

69. "Vacancy-Mediated Anion Photosegregation Kinetics in Mixed Halide Hybrid Perovskites: Coupled Kinetic Monte Carlo and Optical Measurements" A. Ruth, M.C. Brennan, S. Draguta, Y.V. Morozov, M. Zhukovskyi, B. Jankó, P. Zapol, M. Kuno, *ACS Energy Letters* **3** 2321 (2018).

70. "Evaluation of CsPbBr3 nanocrystals for laser cooling", S.B. Zhang, M. Zhukovskyii, B. Jankó, M. Kuno, *Photonic Heat Engines: Science & Applications,* **10936** (2019).

71. "Can lasers really refrigerate CdS nanobelts?", Y.V. Morozov, S.B. Zhang, A. Pant, B. Jankó, S.D. Melgaard D.A. Bender, P. Paulzauskie, M. Kuno, *Nature,* **570** E60 (2019).

72. "Progress in laser cooling semiconductor nanocrystals and nanostructures", *Nature: Asia Materials* **11** 54 (2019).

73. "Up-conversion emission thermometry for semiconductor laser cooling", *J. Luminescence,* **222** 117088 (2020).

74. "Thermal Decoherence of Superradiance in Lead Halide Perovskite Nanocrystal Superlattices" F. Mattiotti, M. Kuno, F. Borgonovi, B. Jankó, L. Celardo, *Nano Lett.* **20** 7382 (2020).

75. "Reconfigurable Pinwheel Artificial-Spin-Ice and Superconductor Hybrid Device" Y.Y. Liu, X.Y. Ma, J. Xu, Y.L. Wang, Z.L. Xiao, S. N. Dong, B. Jankó, H.B. Wang, R. Divan, J. E. Pearson, P.H. Wang, W.K. Kwok, *Nano Lett*. **20** 8933 (2021).

76. "Vortex ordering and dynamics on Santa Fe artificial ice pinning arrays" *Appl. Phys. Lett*. **118** 162601 (2021).

77. "Vortex dynamics, pinning and angle-dependent motion on moire patters" W.Z. Li, C.J.O. Reichhardt, B. Jankó, C. Reichhardt, *Phys. Rev. B* **104** 024504 (2021).

78. "Number parity effects in the normal state of SrTiO3" Phys. Rev. B **105** 214509 (2022).

Peer Reviewed Publications in Conference Proceedings

79. "Pseudogap phenomena in the superconducting phase of the cuprates," I. Kosztin, Q.J. Chen, B. Jankó, and K. Levin, in *High Temperature Superconductivity*, edited by S.E. Barnes *et al*., AIP Conference Proceedings, **483**, p. 57-62 (American Institute of Physics, Woodbury, New York, 1999).

80. "A BCS-Bose-Einstein crossover theory and its application to the cuprates," Q.J. Chen, I. Kosztin, B. Jankó, and K. Levin, in *High Temperature Superconductivity*, edited by S.E. Barnes *et al*., AIP Conference Proceedings, **483**, p. 22-25 (American Institute of Physics, Woodbury, New York, 1999).

UNREFEREED PUBLICATIONS

None

OTHER PUBLICATIONS

None

INVITED LECTURES AND ADDRESSES

1. Jan 1991 *"Correlations in the repulsive Hubbard model: a Gutzwiller wave function study,"* University of Warwick, Coventry, UK, (Condensed Matter Seminar)

2. Apr 1991 *"Gutzwiller wave function method for the attractive Hubbard model,"* ETH Zurich, Switzerland, (Condensed Matter Seminar)

3. May 1991 *"Broken symmetry states in the attractive Hubbard Model: Hartree-Fock versus Gutzwiller variational method,"* Daresbury Laboratory, Daresbury, UK (Theory Group Seminar)

4. Jan 1996 *"Even-Odd Number Effects in Mesoscopic Superconductors,"* University of Illinois at Urbana-Champaign, USA, (Mesoscopic Physics Group Meeting)

5. Jan 1996 *"Coulomb Blockaded Mesoscopic Superconductors,"* University of Notre Dame, Notre Dame (Condensed Matter Seminar)

6. Feb 1996 *"Number Parity Effects in Superconductors,"* McMaster University, Hamilton, Canada (Condensed Matter Seminar)

7. Feb 1996 *"Number Parity Effects in Superconductors,"* University of Toronto, Toronto (Condensed Matter Seminar)

8. Mar 1996 *"Mesoscopic Superconductors with a Fixed Particle Number,"* University of Maryland, College Park, MD (Condensed Matter Seminar)

9. Jul 1997 *"Pseudogap Effect Via Resonant Pair Scattering,"* Argonne National Laboratory (Theory Seminar, Material Science Division)

10. Sep 1997 *"The Cuprate Pseudogap and Resonant Pair Scattering,"* University of Virginia, Charlottesville, VA, USA (Condensed Matter Seminar)

11. Sep 1997 *"ARPES and the cuprate pseudogap: Precursor superconductivity without preformed pairs,"* SNS97 Conference, Cape Cod, MA (Invited Talk)

12. Oct 1997 *"Experimental Tests of Resonant Pair Scattering,"* University of Notre Dame (Condensed Matter Seminar)

13. Nov 1997 *"The Pseudogap Phase in Cuprate Superconductors,"* University of Chicago (Computations in Science Seminar)

14. Feb 1998 *"Pseudogap Regime in a BCS BEC Crossover Scenario: Experimental Consequences and Tests,"* New3SC-1 Conference, Baton Rouge, LA (Invited Talk)

15. Mar 1998 *"Pseudogap Effect Via Resonant Pair Scattering,"* 1998 March Meeting, Los Angeles (Invited Talk)

16. Mar 1998 *"Pseudogap Effects Induced by Resonant Pair Scattering,"* Clarkson University (Colloquium)

17. Jul 1998 *"Pseudogap due to pairing correlations,"* Aspen Center for Physics (Seminar)

18. Sep 1998 *"Incoherent Pair Tunneling as a Probe of the Cuprate Pseudogap,"* Argonne National Laboratory (Theory Seminar, Material Science Division)

19. Sep 1998 *"Incoherent Pair Tunneling as a Probe of the Cuprate Pseudogap,"* University of Illinois at Urbana-Champaign (STCS Special Seminar)

20. Sep 1998 *"Incoherent Pair Tunneling as a Probe of the Cuprate Pseudogap,"* llinois Institute of Technology (Physics Department Colloquium)

21. Jan 1999 *"Incoherent Pair Tunneling as a Probe of the Cuprate Pseudogap,"* University of Chicago (Computations in Science Seminar)

22. Feb 1999 *"Incoherent Pair Tunneling as a Probe of the Cuprate Pseudogap,"* University of Wisconsin, Madison (Solid State Seminar)

23. Feb 1999 *"Incoherent Pair Tunneling as a Probe of the Cuprate Pseudogap,"* University of California, Los Angeles (Special Condensed Matter Theory Seminar)

24. Feb 1999 *"Magnetic-field-induced nodal states in a d-wave superconductor,"* University of California, Riverside (Condensed Matter Theory Seminar)

25. Feb 1999 *"Incoherent Pair Tunneling as a Probe of the Cuprate Pseudogap,"* Stanford University, Stanford (Interdisciplinary Research Group Seminar)

26. Feb 1999 *"Magnetic-field-induced nodal states in a d-wave superconductor,"* Argonne National Laboratory (Theory Group Seminar)

27. Apr 1999 *"Magnetic-field-induced nodal states in a d-wave superconductor,"* University of Alberta (Physics Department)

28. Apr 1999 *"Incoherent Pair Tunneling as a Probe of the Cuprate Pseudogap,"* University of Alberta (Theoretical Physics Institute)

29. May 1999 *"Ratchet Effect in Vortex Dynamics,"* Argonne National Laboratory (Theory Group Seminar)

30. May 1999 *"Magnetic-field-induced nodal states in a d-wave superconductor,"* New3SC-2 Conference, Las Vegas, Nevada (Invited Talk)

31. Sep 1999 *"Pair Correlations in the Cuprate Pseudogap,"*
Institute of Physics, Budapest (Theoretical Physics Seminar)

32. Oct 1999 *"Ratchet Effect in Vortex Dynamics,"*
University of Notre Dame (Condensed Matter Seminar)

33. Oct 1999 *"Incoherent Pair Tunneling as a Probe of the Cuprate Pseudogap,"*
SUNY Buffalo (Condensed Matter Seminar)

34. Feb 2000 *"Antiferromagnetism and Superconductivity in Cuprates,"*
University of Notre Dame (Departmental Colloquium)

35. Feb 2000 *"Antiferromagnetism and Superconductivity in Cuprates,"*
University of California, Riverside (Condensed Matter Seminar)

36. Feb 2000 *"Antiferromagnetism and Superconductivity in Cuprates,"*
University of Missouri-Rolla (Departmental Colloquium)

37. Apr 2000 *"Condensation energy and the neutron resonance in cuprates"*
University of Cluj, Romania (Departmental Seminar)

38. May 2000 "*Pseudogap Effects in Cuprate"*
Ohio State University (Condensed Matter Seminar)

39. Jan 2001 *"Condensation energy in cuprate superconductors"*
New3SC-3 Conference, Honolulu, Hawaii (Invited talk)

40. Mar 2002 "Copenhagen: A play by Michael Frayn" (Invited public lecture)
The Morris Performing Arts Center, in South Bend, IN

41. Jul 2002 "*Interband Scattering effects in MgB2"*
Third International US-Polish Conference, Ladek Zdroj, Poland (Invited Talk)

42. Oct 2002 "*Diluted Magnetic Semiconductors and Zeeman localization*"
Pucon, Chile (Invited talk) ONR Workshop on Multifunctional Materials

43. Nov 2002 "*Magnetic field induced Zeeman localization*"
University of Cincinnati, Ohio (Invited Talk, Seminar)

44. Nov 2002 "*Zeeman localization in magnetic semiconductor hybrids*"
University of Chicago, Illinois (Invited Talk, Seminar)

45. May 2003 "*Strong correlation effects in diluted magnetic semiconductors"*
Institute of Physics, Budapest University of Technology and Economics (Invited talk, Theoretical Physics Seminar)

46. Jun 2003 "*Permalloy-Magnetic Semiconductor Hybrids"*
Argonne LDRD Symposium

47. Nov 2003 University of Notre Dame
(colloquium)

48.	Nov 2003	Argonne National Laboratory, "Conference on Nanoscale Magnetism and Superconductivity" (invited talk)
49.	Dec 2003	National Science Foundation, NSF-NIRT Grantees meeting (invited talk)
50.	Jan 2004	University of Missouri, Columbia – departmental colloquium
51.	Feb 2004	Boston University – invited talk
52.	Feb 2004	IEEE Conference, Florida – invited talk
53.	Mar 2004	University of Missouri, Columbia – departmental colloquium
54.	Jun 2004	Conference on Superconducting Materials, Spain – invited talk
55.	Sep 2004	Autumn School on Strongly Correlated Systems, Hungary – invited for a series of lectures: short course on magnetic semiconductors
56.	Dec 2004	LDSD Conference – invited talk
57.	Aug 2005	University of Wisconsin, Milwaukee – colloquium
58.	Sep 2005	Joint JSPS and ESF Conference on Vortex Matter in Nanostructured Superconductors, Vortex VI, Crete, Greece – invited talk
59.	Sep 2005	US-Spain Workshop on Nanoscale Materials, Segovia, Spain – invited talk
60.	Mar 2006	APS March Meeting, Baltimore MD – invited talk
61.	Mar 2006	Rutgers University – colloquium
62.	Mar 2006	Boston University – seminar
63.	Jul 2006	Wolfgang Pauli Institute, Vienna – seminar
64.	Jul 2006	M2S-SC IV Dresden – largest tri-annual conference of the field – invited lecture
65.	Sep 2006	MesoSuperMag Chicago – Invited talk
66.	Apr 2007	Fluorescence Intermittency in molecules, quantum dots and quantum wires, Notre Dame, IN – workshop
67.	May 2007	Spintronics Conference, Antwerp, Belgium – Invited Talk
68.	Sep 2007	Vortex-5: Joint ESF & JSPS Conference on Vortex Matter in Nanostructured Superconductors, Rhodes, Greece – Invited Talk
69.	Nov 2008	Vortices at Fifty Years, Argonne, IL – 80th birthday of Nobel Laureate Alexei Abrikosov, symposium
70.	Mar 2009	Nanoscience and Engineering in Superconductivity, Tsukuba, Japan - Conference

71.	Sept 2009	IEEE conference, Torino, Italy
72.	Sept 2009	Vortex VI conference, Rhodes, Greece
73.	Oct 2009	Northwestern University - colloquium
74.	Oct 2009	Northwestern University - condensed matter seminar
75.	April 2010	Northern Illinois University, condensed matter seminar
76.	April 2010	Argonne National Laboratory - Materials Science Division, Condensed matter seminar
77.	July 2010	IAP – Quantum Effects in Clusters and Nanowires, University of Antwerpen, Antwerpen, Belgium – invited talk
78.	Sept 2010	"Nano-Magnetism and Magnetic Materials", International Conference on Electromagnetics in Advanced Applications (ICEAA 10), Australia, Sept. 20-24, 2010. – invited talk
79.	Nov 2010	"Universal fluorescence fluctuations at nanoscale", Notre Dame Institute for Advanced Study – invited talk
80.	Sept 2011	"Novel Andreev bound states in nanostructured superconductors", Vortex VII conference, Rhodes, Greece –invited talk
81.	Sept 2011	"Novel Andreev bound states in nanostructured superconductors", International Conference on Electromagnetics in Advanced Applications (ICEAA 11), Torino, Sept. 2012. – invited talk
82.	May 2013	"*Strongly Enhanced Vortex Pinning by Conformal Crystal Arrays*", 14th International Workshop on Vortex Matter in Superconductors, May 21-28, Nanjing, China – invited talk
83.	Sept 2013	"*Strongly Enhanced Vortex Pinning by Conformal Crystal Arrays*", Vortex Matter In Nanostructures Superconductors, 21-26 September, 2013, Rhodes, Greece. - invited talk
84.	Oct 2014	*"Quantum Rotors in Superconducting Nanostructures"*, University of Kentucky, Lexington, October 14, 2014, Condensed Matter Seminar
85.	May 2014	"*Vortex Ratchet Effect by Conformal Crystal Arrays*", 3rd International Conference On Superconductivity and Magnetism, Antalya, Turkey, April 27-May 2, 2014
86.	Sept 2015	"*Vortex ratchet effect in random and conformal pinning landscape*" – Invited talk, Ninth International Conference in School format: VORTEX MATTER IN NANOSTRUCTURED SUPERONDUCTORS, VORTEX IX, Rhodes, Greece, 12-17 September, 2015.
871.	May 2017	"*Reconfigurable ordering, frustration and stability of vortex matter via network Science"*, Invited talk, Vortex 2017, International Institute of Physics, UFRN, Natal Brazil (May 28-June 3, 2017) http://vortex2017.org/

88. May 2019 "*Network science approach to confined vortex matter"*, Invited talk, Vortex 2019, Antwerp, Belgium.

89. May 2019 "Universal properties of fluorescence intermittency in nanoscale emitters" Departmental Colloquium, Drexel University

90. May 2021 "*Superconducting Vortex Matter Under Extreme Confinement: The Effect of Anisotropic Interaction"*, Invited Talk, Vortex 2019, May 27- June 3, 2021.

91. Sept 2021 "*The interplay between spin and and off-diagonal order in ferromagnet/superconductor hybrid structures"*, Half-a-century of Magnetic Semiconductors: A Conference in Honor of Jacek K. Furdyna

Contributed Talks

1. Sep 1990 *"Analytical study of the d-dimensional Hubbard model with the Gutzwiller wave function,"* SERC Course in Condensed Matter Theory, Chester, UK (Talk)

2. Mar 1992 *"Electromagnetic response of vortex core states in a type-II superconductor,"* March Meeting of the American Physical Society (Work presented by J. Shore)

3. Aug 1993 *"Electromagnetic response of vortex core states in a type-II superconductor,"* LT-20 Satellite Conference on Vortices, Oregon, USA (Poster)

4. Mar 1995 *"Parity fluctuations between Coulomb blockaded superconducting islands,"* March Meeting of the American Physical Society, San Jose, California (Talk)

5. Mar 1996 *"Quaisparticle Motion in Coulomb Blockaded Superconducting Nanostructures,"* March Meeting of the American Physical Society, St. Louis, Missouri (Talk)

6. Mar 1997 *"Photoemission and Tunneling in the Cuprate Pseudogap Regime: Effects of Precursor Superconductivity,"* March Meeting of the American Physical Society, Kansas City, Missouri (Talk)

7. Sep 1997 *"Pseudogap Effects Induced by Resonant Pair Scattering,"* Spectroscopies in Novel Superconductors 1997, Cape Cod, Massachusetts (Poster)

8. Mar 1998 *"Pseudogap Phenomena in d-wave Superconductors via Resonant Pair Scattering,"* March Meeting of the American Physical Society, Los Angeles, California (Work presented by Q. Chen)

9. Mar 1998 *"Pseudogap Effects Above and Below Tc: A Resonant Pair Scattering Approach,"* March Meeting of the American Physical Society, Los Angeles, California (Work presented by I. Kosztin)

10. Mar 1999 *"Theory of Small Pair Superconductors: Application to the Cuprates,"* Centennial Meeting of the American Physical Society, Atlanta, Georgia (Presented by Q. Chen)

11. Mar 1999 *"Theory of Small Pair Superconductors: Between BCS Theory and BEC,"* Centennial Meeting of the American Physical Society, Atlanta, Georgia (Presented by I. Kosztin)

12. Mar 1999 *"Incoherent Pair Tunneling as a Probe of the Cuprate Pseudogap,"* Centennial Meeting of the American Physical Society, Atlanta, Georgia (Talk)

13. Mar 1999 *"Core line photoemission spectroscopy of cuprates: a test for spin-charge separation,"* Centennial Meeting of the American Physical Society, Atlanta, Georgia (Presented by N. Shannon)

14. Mar 1999 *"Ratchet effect in vortex dynamics: Reducing vortex densities in superconductors,"* Centennial Meeting of the American Physical Society, Atlanta, Georgia (Presented by A.-L. Barabási)

15. *"Electronic Specific Heat in the Pairing Pseudogap Regime,"* M2SC Houston (Poster)

16. Mar 2000 *"Thermodynamic Constraints on Cuprate Magnetic Excitations,"* March Meeting of the American Physical Society, Minneapolis, MN (Talk)

17. Mar 2001 "*Influence of the magnetic field on the cuprate neutron resonance,"* March Meeting of the American Physical Society, Seattle, WA (talk)

18. Mar 2001 "*Dispersion of the neutron resonance in cuprate superconductors"* March Meeting of the American Physical Society, Seattle, WA (talk presented by O. Thernyshyov)

19. Mar 2001 *"Disordered Ratchet for Transporting Superconducting Vortices,"* March Meeting of the American Physical Society, Seattle, WA (talk presented by C. J. Olson)

20. Mar 2001 *"Signatures of the Neutron Resonance in Two-Particle Tunneling,"* March Meeting of the American Physical Society, Seattle, WA (talk presented by E. Kim)

21. Mar 2002 *"Multiple Shiba states in MgB_2 due to two-band superconductivity,"* March Meeting of the American Physical Society, Seattle, WA (talk presented by C.P. Moca)

22. Mar 2002 *"Electronic structure of multiquantum giant vortex states in mesoscopic superconducting disks,"* March Meeting of the American Physical Society, Seattle, WA (talk presented by I. Robel)

23. Mar 2002 "*Linear magnetic field dependence of the spin wave resonances in Ga_1-xMn_xAs thin films"*, March Meeting of the American Physical Society, Austin, TX (talk presented by Tatiana Rappoport)

Since 2003 On average 4-5/year contributed talks presented by students, collaborators at various conferences.

GRANTS AND SPONSORED PROGRAMS

CURRENT SUPPORT

1. **Source:** The National Science Foundation
Project Title: Realizing robust superfluorescence from nanocrystal superlattices
Principal Investigator: M. Kuno,
Co-PI: B. Jankó
Total Amount: $500,877
FY 2020-2024

PAST SUPPORT

1. **Source:** NASA
Project Title: "NSTRF: Hybrid Van Der Waals Materials In Next-Generation Electronics"
Principal Investigator: B. Jankó
Graduate Student Fellow: A. Ruth
Total Amount: $57,000
FY 2015-2019

2. **Source:** Argonne National Laboratory
Project Title: "Investigate The Effects Of Creating Multiple Defect Types On Unconventional Superconductors Including Cuprates, Iron-Based And Topological Superconducting Materials"
Principal Investigator: B. Jankó
Total Amount: $18,828.00
FY June 1, 2018 - August 31, 2018

3. **Source:** Department of Energy/Argonne National Laboratory
Project Title: Superconducting and Magnetic Nanostructures
Principal Investigator: B. Jankó
Research Faculty: Y.L. Wang
Total Amount: $167,208
FY 2016-2018

4. **Source:** ND Energy
Project Title: Postdoctoral Support for Matt Smylie
Principal Investigator: B. Jankó
Postdoctoral Fellow: M. Smylie
Total Amount: $40,000
FY 2015-2016

5. **Source:** DOE/Argonne National Laboratory
Project Title: Collaborative work in partnership with Dr. Wai-Kwong Kwok, Argonne National Laboratory
Principal Investigator: B. Jankó
Total Amount: $36,000
FY 2016

6. **Source:** The National Science Foundation-National Nanoscale Initiative
Project Title: "NIRT: Spatial and Intensity Modulation of Light Emission in Fluorescent Molecules, Quantum Dots, and Nanowires"
Principal Investigator: B. Jankó
University Co-Investigators: M. Kuno, J. Merz, G. Snider
Total Amount: $1,200,000
FY 2007-2011

7. **Source:** Alfred P. Sloan Foundation
Total amount: $40, 000
Principal Investigator: B. Jankó
FY 2004

8. **Source:** Notre-Dame-Argonne Collaborative Research Fund
Project title: Ferromagnetic Semiconductor Nanostructures
Principal Investigator: B. Jankó
University collaborator: J.K Furdyna
National Laboratory Collaborators: U. Welp, W.K. Kwok
Total Amount: $200,000 for
FY 2003-2004

9. **Source:** Individual Investigator Program of **"Director's Competitive Grants"**, Argonne National Laboratory, Department of Energy, Basic Energy Sciences.
Project Title: *"Vortex Cellular Automata"*
PI: M. Iavarone
Co- Principal Investigator: B. Janko, C. Olson, C. Reichhardt
Total amount: $190,000
FY 2003-2004, renewable for another $85,000 for FY 2005

10. **Source:** Argonne National Laboratory, Department of Energy, Basic Energy Sciences.
Project Title: *"Photosynthetic reaction center as a novel quantum electronic circuit element"*
PI: G. Karapetrov
Co- Principal Investigator: B. Janko, I. Kosztin, M. Firestone
Total amount: $300,000 for
FY 2004-2006

11. **Source:** The National Science Foundation-National Nanoscale Initiative
Project Title: "NIRT*: Formation and properties of spin-polarized quantum dots in magnetic semiconductors by controlled variation of magnetic fields on the nanoscale*"
Principal Investigator: B. Jankó
University Co-Investigators: J.K. Furdyna, M. Dobrowolska, A. Chang, V. Metlushko
National Laboratory Collaborators: G.W. Crabtree, W.K. Kwok
Total Amount: $1,800,000 for
FY 2002-2006 + 30,000 International Collaboration Supplement

12. **Source:** Individual Investigator Program of **"Director's Competitive Grants"**, Argonne National Laboratory, Department of Energy, Basic Energy Sciences.
Project Title: *"Spin Polarized Nanostructures at Interfaces of Superconductors and Diluted Magnetic Semiconductors: New Prospects for Tunable Quantum Arrays"*
Principal Investigator: B. Jankó
Collaborating Investigators: G.W. Crabtree, W.K. Kwok, U. Welp
Total Amount: $150,000 for
FY 2002-2003, renewable for another $85,000 for FY2004

13. **Source:** Individual Investigator Program of **"Director's Competitive Grants"**, Argonne National Laboratory, Department of Energy, Basic Energy Sciences.
Project Title: *"Ratchet effect for manipulating trapped flux"*
Principal Investigator: B. Jankó
Collaborating Investigators: G.W. Crabtree, W.K. Kwok, U. Welp
Total Amount: $130,000

14. **Source:** Individual Investigator Program of **"Director's Competitive Grants"**, Argonne National Laboratory, Department of Energy, Basic Energy Sciences.
Project Title: *"Nanoscale Information Storage Using Superconducting Vortices"*
Principal Investigator: G.W. Crabtree,
Co-Principal Investigator: B. Jankó, G. Karapetrov
Total Amount: $130,000

PATENTS

1. A.-L. Barabási, **B. Jankó**, C.S. Lee, I. Dérenyi,
"Reducing vortex densities and transporting vortices in superconductors"
United States Patent No. 6,469,880

2. D. Ray, C. Reichhardt, B. Janko, Ch. Reichhardt,
"Strongly Enhanced Vortex Pinning with Conformal Pinning Arrays"
United States Patent No. 6,469,880
European App 14 760 635.5

RESEARCH ACCOMPLISHMENTS

Universal intensity fluctuation in nanoscale and singe molecule emitters
In 2005 I assembled an interdisciplinary team of engineers, chemists and physicists and in 2006 we secured an NSF-NIRT grant to investigate the fluorescence intermittency in colloidal quantum dots and nanowires. I co-organized an ITS workshop on fluorescence intermittency in colloidal quantum dots and quantum wires (http://www.theoryinstitute.org/blink/) , after which I co-authored with Nobel Laureate Rudy Marcus one of the most cited reviews in the field. This paper was published by **Nature Physics**. Together with my postdoc and student, we published a **Physical Review Letters** in which we presented a new theoretical model that reproduces for the first time *all* key experimental features of fluorescence intermittency. Within our theoretical model we succeeded to explain the so-called memory effects observed recently by Franco Stefani's group. No other available theory, including the celebrated Efros-Rosen model succeeded in showing correlations between subsequent on- and off-events.

Ratchet effect in colloids
In this latest (2006) **Physical Review Letters** we show that a rich variety of dynamic phases can be realized for mono- and bidisperse mixtures of interacting colloids under the influence of a symmetric flashing periodic substrate. With the addition of dc or ac drives, phase locking, jamming, and new types of ratchet effects occur. In some regimes we find that the addition of a nonratcheting species increases the velocity of the ratcheting particles. We show that these effects occur due to the collective interactions of the colloids.

Diluted Magnetic semiconductors
My latest major publication in this topic has been published by **Nature** in 2005 and a detailed, extensive report is in print at the Physical Review B (2006). A News and Views article was published by Nature Materials, and by several other news outlets such as LiveScience, OeMagazine, Physorg, Science Blog, Science Daily, Slashdot, IPfrontline, and Eouroresidentes. A news article about the work landed on the front page of the US National Science Foundation website webpage, and was featured in the National Nanotechnology Initiative as well as the MRS Materials Science Connections. The reception by the community was also very positive: We gave many (at least a dozen) invited talks at major international conferences and colloquia on this subject during the last year or so. In earlier papers, several published by **The Physical Review Letters**, we argue that in contrast to the presently accepted view in the field, the ferromagnetic state of diluted magnetic semiconductors is highly unusual, with a high degree of orientational frustration and memory effects reminiscent of spin glasses. Several experimental features

can be explained rather naturally within this framework. Our recent **Physical Review Letters** on permalloy-magnetic semiconductor hybrids has been selected for the June 30, 2003 issue of the **Virtual Journal of Nanoscale Science & Technology**. The Virtual Journal is an edited compilation of links to articles from participating publishers, covering a focused area of frontier research

Novel superconductor: MgB_2 Thermodynamic and some spectroscopic measurements seem to indicate that the recently discovered superconducting phase of MgB_2 might be the first genuine *two-band* superconductor, while other experiments do not support this possibility. In order to settle this issue, we propose scanning tunneling spectroscopy of a magnetic impurity embedded in MgB_2 We find that the number of Shiba bound states around the impurity is *exactly* equal to the number of electronic bands involved in the superconducting phase.

Vortex states in mesoscopic disks and magic numbers in confined magnetic colloids
Recent magnetization measurements indicate that mesoscopic superconductors exhibit a new, so-called giant vortex phase. We have obtained for the first time the microscopic electronic structure of giant vortices under a large variety of conditions. Our results have several unusual features directly observable by scanning tunneling spectroscopy: multiple bound states in the core, and Tomasch-like interference effects. The Magnetism and Superconductivity Group at Argonne National Lab is currently performing experiments to look for these features.

Condensation Energy in High Tc Superconductors
Identifying the source of condensation energy is the most fundamental problem in the field of high T_c superconductivity that can be solved without a microscopic model. My collaborators and I have recently pointed out that spectroscopic probes, such as angle-resolved photoemission, tunneling, etc., can be used not only to extract the condensation energy, but also to identify whether the transition is kinetic or potential energy driven. This last observation could be crucial for revealing the mechanism of condensation.

Thermodynamic Constraints on the Cuprate Magnetic Excitations[19,20,22,30]
Paper No. [18] is testing in detail the recently proposed link between the neutron resonance and the specific heat anomaly observed in cuprate superconductors. Using specific heat data and theoretical calculations, I have shown, that thermodynamic measurements strongly constrain the magnitude, temperature and especially the magnetic field dependence of the neutron resonance. My prediction of strong field dependence prompted both leading neutron scattering groups (led by H.A. Mook and Ph. Bourges, respectively) to look for this effect experimentally. ***The confirmation of this prediction by Mook et al. has recently been published by NATURE (LONDON)***. In collaboration with M. Eschrig and M. Norman [20], we gave a detailed numerical study of the magnetic field dependence of the resonance. [Invited talks No. 33-38]

Discrete nodal states in a layered superconductor with gap nodes[16]
In this work, *published in The Physical Review Letters, I proposed* an experiment that would probe the *existence*, the *number* and the *position* of gap nodes on the Fermi surface of a layered superconductor. *Predicted* that the low temperature *local* tunneling conductance on the Wigner-Seitz cell boundaries of the vortex lattice would show peaks spaced as $\pm \sqrt{n}$, $n = \{0, 1, 2, ...\}$. Away from the cell boundaries each peak is expected to split, in general, into a number of peaks, corresponding to the number of nodes in the order parameter. The experimental search for this effect is performed by S. Pan and J.C. Davis [UC Berkeley] [Talks No. 24, 26, 28, 30, including an **Invited Talk at the New3SC-2 Conference (Las Vegas, May 1999).**]

Ratchet effect in vortex dynamics[15,21]
Co-invented and designed specially patterned superconducting devices which show, under specific conditions, practically zero trapped flux density. These results **were reported in Nature**. The

Technology Transfer Office of Notre Dame University has recently *decided to pursue the patent* registration and maintenance process of this invention. Experimental efforts to detect the vortex ratchet effect are in progress at four institutions (S. Ruggiero [U Notre Dame], J. McElfresh [Purdue], C. Lobb [U Maryland] and G.W. Crabtree & W.-K. Kwok [ANL]). Work featured in several research and technology news publications: *"Inside R & D Alert", "Microelectronics Technology Alert", and "High Tech Ceramics News"*. (Invited talk No. 28).

Pair spectroscopy of the cuprate pseudogap [13-14]
In this Physical Review Letter, the incoherent pair tunneling experiment is predicted to detect the presence of pair correlations in the cuprate pseudogap state. I *organized* the collaborative work between researchers at The University of Chicago, Argonne National Laboratory, and University of California, Santa Barbara. The proposal already *triggered experimental projects* led by Eckstein, van Harlingen and Goldman, as well as theoretical collaboration with Goldbart and collaborators. Invited to present this work at eight institutions (Invited talks No. 18-22,24,27,32), including an **Invited Talk at the New3SC-2 Conference (Baton Rouge, February 1998)**.

Pseudogap effects induced by resonant pair scattering [6-13,26]
Developed a diagrammatic, self-consistent and conserving crossover theory that correctly reproduces the BCS and BEC limits and provides a detailed spectroscopic description of the intermediate state [6-9]. *This framework produced one of the most detailed description of the underdoped cuprate regime, including a semiquantitative agreement with the cuprate phase diagram, published recently in The Physical Review Letters [10]*. Extension to the superconducting phase [11] allowed for a direct comparison between theoretical spectral properties, and the experimental results from angle-resolved photoemission, tunneling [12] and diamagnetic susceptibility [13]. Work presented in nine invited lectures (Invited talks No. 9-17), including an **Invited Talk at the APS March Meeting 1998 (Los Angeles), and SNS'97 (Boston)**.

Parity Fluctuation Between Superconductors [5]
Predicted a novel quantum many-body effect, called number parity fluctuation that occurs when two superconductors of different number parity are connected by a tunnel junction. In this *Physical Review Letter* an explanation is suggested for the unusually large quasiparticle tunneling rate observed in Cooper pair pumps (fabricated and operated by Mooji and collaborators), and other nanoscale devices containing ultrasmall Josephson junctions. This process could also provide a mechanism for the damping of Coulomb blockade oscillations observed experimentally by Delsing *et al*. in one dimensional junction arrays. Work presented at five departments (Invited talk No. 8-4).

BCS Theory with Parity Constraint [4]
Developed the first detailed theory of quantum statistics of fermions with constrained number parity, interacting via the superconducting interaction. This theory triggered a substantial amount of follow-up work and was cited so far by 17 subsequent papers. Besides providing the *first rigorous explanation* of the even/odd free energy difference observed experimentally before this paper was published by Tinkham and coworkers, this work *predicted the parity dependence of the super-conducting energy gap, observed two years later* by Ralph and collaborators. Work presented in five invited talks (Talk No. 8-4).

Strongly Correlated Lattice Fermions with Arbitrary On-Site Interaction [2,3]
Generalized the one dimensional variational method of Vollhardt and coworkers to *arbitrary* dimension d, band filling n, on-site interaction strength U, and variational parameter g. In Ref. 3 we investigate the attractive ("negative-U") Hubbard model and find at half-filling a degenerate superconductor (S) charge-density-wave (CDW) state. Work presented in three invited talks (Talk No. 3-1).

Electromagnetic Response of Vortex Core States [1]
Derived the selection rules that govern the absorption and scattering of electromagnetic radiation by quasiparticles in a vortex core. The vortex core absorbs only light with circular polarization opposite to that of the quaisparticle core states. This work, *cited in five theoretical and five experimental papers*,

became especially useful to the experimental group of Drew and collaborators, who found evidence for this dipole transition. They also detected different chiralities in various frequency intervals, which need further investigation.

MASTER'S THESES DIRECTED

Joseph Kavanaugh, ESTEEM Program 2015

DOCTORAL DISSERTATIONS DIRECTED

1. Andras Libal "Ratchet Effect in colloidal systems", 2007
2. Sandor Volkan-Kacso "Fluorescence Intermittency at Nanoscale" 2010
3. Albert Lin 2015
4. Dipanjan Ray 2013
5. Shubin Zhang 2018
6. Xiaoyu Ma 2019
7. Jixin Si 2019
8. Francesco Mattiotti 2020

UNDERGRADUATE STUDENTS SUPERVISED

Jeffrey Drocco, ***Recipient of Goldwater Scholarship*** for our research, endorsed by Notre Dame for Rhodes and Marshall scholarships, PhD @ Princeton University, staff member CNLS-LANL

Yihao Yan, currently PhD student @Yale University

OUTREACH-HIGH SCHOOL STUDENT MENTOR

Emily Bell, Siemens Fellow

GRADUATE STUDENTS SUPERVISED

1. Andras Libal
2. Pascu Moca
3. Tatiana Rappoport
4. Istvan Robel
5. Sandor Volkan-Kacso
6. Albert Shi-Shin Lin
7. Andrew Dreyfuss
8. Dipanjan Ray
9. Shubin Zhang
10. Xiaoyu Ma
11. Francesco Mattiotti
12. Sushrut Ghonge
13. Ylli Imeri

POSTDOCTORAL RESEARCH ASSOCIATES & RESEARCH FACULTY ADVISED

Dr. Peter Gurin
Dr. Pawel Redlinski
Dr. Pavel Frantsuzov
Dr. Yonglei Wang
Dr. Matt Smylie

OTHER NOTABLE CONTRIBUTIONS

1. Designed and co-organized a series of international conferences on a wide ranging topics

   I. **Ultra high Temperature Superconductivity**, June 10-11, 2004, Notre Dame, IN. http://www.theoryinstitute.org/~its/rts/index.html
   II. **Mesosupermag 2006,** Aug. 28 – Sept. 1, 2006, Chicago, IL. http://spidey.msd.anl.gov/groups/sm/workshops/meso/index.htm
   III. **Fluorescence Intermittency in nanoscale systems,** April 1-3, 2007, Notre Dame, IN http://www.theoryinstitute.org/blink/
   IV. **Catalytic Materials by Design,** January 27-30, 2010 Notre Dame, IN http://theoryinstitute.org/catalysis/

2. Initiated and coordinated several visitor programs within the Institute
   - Theoretical computationonal biology (Summer 2004 at ANL, Prof. I. Kosztin, leader)
   - Econophysics (Summer 2005 at ND, (group leader: Prof. I. Kondor)
   - Bose Einstein Condensates and Fractional Quantum Hall Physics (Summer 2005, group leader: Prof. Janeindra K. Jain)
   - Teraherz spectroscopy (Summers 2005-2007, group leader; M. Tachiki)
   - Vortex Matter (Summer 2006, group leader: Prof. F. Peeters)

3. Invited to the Institute and hosted several Nobel Laureates: Alexei A. Abrikosov, Sir Anthony J. Leggett, Rudolph C. Marcus, James Mather

4. Organized several symposia on a variety of topics

   - Neutron Scattering on high Tc Superconductors (ANL, summer 1998)
   - Biological Imaging (ANL, summer 2004) More information on the bioimaging workshop at Argonne can be found at http://www.theoryinstitute.org/~its/bioimaging.htm
   - Notre Dame-ANL Workshop, January 2001

5. Organized since 1999 the Theory Visitors Program at the Materials Sciences Division of Argonne National Lab: applied and secured funding, arranged the appointment and coordinated the visit of 8-12 condensed matter theorists each summer, several of them women and minority. Participants (selection): G. Zarand (Harvard), E. Demler (Harvard), O. Tchernyshyov (Princeton), M. Berciu (Princeton), E. Carlson (UCLA), C. Olson (Los Alamos Nat'l Lab), C. Reichhardt (Los Alamos), I. Kosztin (Univ. Illinois, Urbana Champaign), Tanaka (U. Alberta), A. H. MacDonald (IU-Bloomington).

6. Organized multidisciplinary research teams to perform research on
   - the use of quantum dots in imaging dynamic biological processes at molecular level,
   - using photosynthetic reaction centers as active circuit elements,
   - vortex ratchet devices, nanoscale memory storage devices, hybrid materials, vortex cellular automata and vortex computing

7. Lectured and provided the audience historical background before the opening show of Michael Frayn's play "*Copenhagen"* at The Morris Performing Arts Center, in South Bend, IN.