

# OSKAR VAFEK

## *curriculum vitae*

Department of Physics

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### Education and Degrees

June 1998 - Aug 2003 Ph.D. Johns Hopkins University (physics)

Thesis advisor: Prof. Zlatko Teseanovic

Aug 1994 -May 1998 B.A. Goucher College (major: chemistry, minors: physics, mathematics)

### Positions held

Nov 2018 - present Director, Condensed Matter Theory  
National High Magnetic Field Laboratory

2017 - present Full Professor  
National High Magnetic Field Laboratory  
Department of Physics, Florida State University

2012 - 2017 Associate Professor  
National High Magnetic Field Laboratory  
Department of Physics, Florida State University

Sep - Dec 2015 Visiting Professor  
Department of Physics, Princeton University

2006 - 2012 Assistant Professor  
National High Magnetic Field Laboratory  
Department of Physics, Florida State University

2003 - 2006 Postdoctoral Scholar  
Stanford University Institute for Theoretical Physics  
Advisors: Profs. Robert B. Laughlin and Shoucheng Zhang

### Research interests

Theoretical condensed matter physics and statistical field theory, with an emphasis on the problems in superconductivity and strongly correlated systems

### Awards and honors

2012 Florida State University PAI Award for excellence in teaching and research

2010 NSF Career Award

2003 Stanford ITP Fellowship (Stanford University)

1998 Ellen E. Swomley Fellowship (Johns Hopkins University)

1998 Stimson-Duvall Scholarship (Goucher College)

Luise Kelly Prize in Chemistry (Goucher College)

Phi Beta Kappa Membership

1997 NSF Research Opportunity Award for summer research at Johns Hopkins U.

1997 Presidential Scholarship for the senior project (Goucher College)

## Journal publications and preprints

57. Bin-Bin Chen, Yuan Da Liao, Ziyu Chen, Oskar Vafek, Jian Kang, Wei Li, Zi Yang Meng, “*Realization of Topological Mott Insulator in a Twisted Bilayer Graphene Lattice Model*” arXiv:2011.07602.
56. Oskar Vafek and Jian Kang, “*Renormalization Group Study of Hidden Symmetry in Twisted Bilayer Graphene with Coulomb Interactions*” Phys. Rev. Lett. 125, 257602 (2020).
55. Jian Kang and Oskar Vafek “*Non-Abelian Dirac node braiding and near-degeneracy of correlated phases at odd integer filling in magic angle twisted bilayer graphene*” Phys. Rev. B 102, 035161 (2020).
54. Xiaoxue Liu, Zhi Wang, K. Watanabe, T. Taniguchi, Oskar Vafek, J. I. A. Li “*Tuning electron correlation in magic-angle twisted bilayer graphene using Coulomb screening*” arXiv:2003.11072 (accepted in Science).
53. Xiaoyu Wang and Oskar Vafek “*A diagnosis of explicit symmetry breaking in the tight-binding constructions for symmetry-protected topological systems*” Phys. Rev. B 102, 075142 (2020).
52. Jian Kang and Oskar Vafek “*Strong Coupling Phases of Partially Filled Twisted Bilayer Graphene Narrow Bands*” Phys. Rev. Lett. 122, 246401 (2019).
51. Jian Kang and Oskar Vafek “*Symmetry, Maximally Localized Wannier States, and a Low-Energy Model for Twisted Bilayer Graphene Narrow Bands*” Phys. Rev. X 8, 031088 (2018).
50. Shouvik Sur, Shou-Shu Gong, Kun Yang, and Oskar Vafek “*Quantum anomalous Hall insulator stabilized by competing interactions*” Phys. Rev. B 98, 125144 (2018).
49. P. Myles Eugenio and O. Vafek, “*Classification of symmetry derived pairing at the M point in FeSe*” Phys. Rev. B 98, 014503 (2018).
48. O. Vafek, A. V. Chubukov, “*Hund interaction, spin-orbit coupling and the mechanism of superconductivity in strongly hole-doped iron pnictides*” Phys. Rev. Lett. 118, 087003 (2017).
47. O. Vafek, N. Regnault, B. A. Bernevig, “*Entanglement of Exact Excited Eigenstates of the Hubbard Model in Arbitrary Dimension*” SciPost Phys. 3, 043 (2017).
46. A.V. Chubukov, O. Vafek, R.M. Fernandes, “*Displacement and annihilation of Dirac gap-nodes in d-wave iron-based superconductors*” Phys. Rev. B, 94, 174518 (2016)
45. J.B. Kemper, O. Vafek, J.B. Betts, F.F. Balakirev, W.N. Hardy, Ruixing Liang, D.A. Bonn, G.S. Boebinger, “*Thermodynamic signature of a magnetic-field-driven phase transition within the superconducting state of an underdoped high-temperature superconductor*”, Nature Physics 12, 47 (2016).
44. O. Vafek, “*Intrinsic thermal Hall conductivity in the mixed state of d-wave superconductors: from wavepacket dynamics to scaling*”, Phys. Rev. B 92, 174508 (2015).
43. James M. Murray and O. Vafek, “*Majorana bands, Berry curvature, and thermal Hall conductivity in the vortex state of a chiral p-wave superconductor*”, Phys. Rev. B 92, 134520 (2015).
42. V. Cvetkovic and O. Vafek, “*Berry phases and the intrinsic thermal Hall effect in high temperature cuprate superconductors*”, Nature Communications 6, 6518 (2015).
41. James M. Murray, O. Vafek, Leon Balents, “*Incommensurate spin density wave at a ferromagnetic quantum critical point in a three-dimensional parabolic semimetal*”, Phys. Rev. B 92, 035137 (2015) .
40. Kelly Ann Pawlak, J.M. Murray, and O. Vafek, “*Emergence of superconductivity in a doped single-valley quadratic band crossing system of spin-1/2 fermions*”, Phys. Rev. B 91, 134509 (2015).
39. R.M. Fernandes and O. Vafek “*Distinguishing spin-orbit coupling and nematic order in the electronic spectrum of iron-based superconductors*” Phys. Rev. B 90, 214514 (2014).
38. J.M. Murray and O. Vafek, “*Renormalization group study of interaction-driven quantum*

- anomalous Hall and quantum spin Hall phases in quadratic band crossing systems*”, Phys. Rev. B **89**, 201110(R) (2014).
37. J.M. Murray and O. Vafek, “*Excitonic and superconducting orders from repulsive interaction on the doped honeycomb bilayer*”, Phys. Rev. B **89**, 205119 (2014).
  36. J. Ludwig, Yu. B. Vasilyev, N. N. Mikhailov, J. M. Poumirol, Z. Jiang, O. Vafek, and D. Smirnov, “*Cyclotron resonance of single valley Dirac fermions in gapless HgTe quantum well*”, Phys. Rev. B **89**, 241406(R) (2014).
  35. Oskar Vafek, James M. Murray, and Vladimir Cvetkovic, “*Superconductivity on the brink of spin-charge order in doped honeycomb bilayer*”, Phys. Rev. Lett. **112**, 147002 (2014).
  34. Luyang Wang and Oskar Vafek, “*Unconventional superconductivity in a two-dimensional repulsive gas of fermions with spin-orbit coupling*”, Physica C **497**, 6 (2014).
  33. Oskar Vafek and Ashvin Vishwanath, “*Dirac Fermions in Solids - from High  $T_c$  cuprates and Graphene to Topological Insulators and Weyl Semimetals*”, Annual Reviews of Condensed Matter Physics Vol. 5: 83-112 (2014).
  32. Vladimir Cvetkovic and Oskar Vafek, “*Space group symmetry, spin-orbit coupling, and the low-energy effective Hamiltonian for iron-based superconductors*”, Phys. Rev. B **88**, 134510 (2013).
  31. Luyang Wang and Oskar Vafek, “*Quantum oscillations of the specific heat in d-wave superconductors with loop current order*”, Phys. Rev. B **88**, 024506 (2013).
  30. Vladimir Cvetkovic and Oskar Vafek, “*Topology and symmetry breaking in ABC trilayer graphene*”, arXiv:1210.4923.
  29. Robert E. Throckmorton and Oskar Vafek, “*Fermions on bilayer graphene: Symmetry breaking for  $B=0$  and  $\nu = 0$* ”, Phys. Rev. B **86**, 115447 (2012).
  28. Vladimir Cvetkovic, R.E. Throckmorton, and Oskar Vafek, “*Electronic multi-criticality in bilayer graphene*”, Phys. Rev. B **86**, 075467 (2012); Editor’s suggestion.
  27. Oskar Vafek, “*Graphene: Carbon’s superconducting footprint*”, Nature Physics **8**, 111 (2012).
  26. Z. Zhou, Oskar Vafek, and A. Seidel, “*Geometric phases of d-wave vortices in a model of lattice fermions*”, Phys. Rev. B **86**, 020505(R) (2012).
  25. H.J. Gardner, A. Kumar, L. Yu, P. Xiong, M.P. Warusawithana, L. Wang, Oskar Vafek, and D.G. Schlom, “*Enhancement of superconductivity by a parallel magnetic field in two-dimensional superconductors*”, Nature Physics **7**, 895 (2011).
  24. Scott C. Riggs, Oskar Vafek, J. B. Kemper, J. B. Betts, A. Migliori, F. F. Balakirev, W. N. Hardy, Ruixing Liang, D. A. Bonn and G. S. Boebinger, “*Heat capacity through the magnetic-field-induced resistive transition in an underdoped high-temperature superconductor*”, Nature Physics **7**, 332 (2011).
  23. Vladimir Juricic, Oskar Vafek, and Igor F. Herbut, “*Conductivity of interacting massless Dirac particles in graphene: Collisionless regime*”, Phys. Rev. B **82**, 235402 (2010); Editor’s suggestion.
  22. Oskar Vafek, “*Interacting fermions on the honeycomb bilayer: From weak to strong coupling*”, Phys. Rev. B **82**, 205106 (2010).
  21. Robert E. Throckmorton and Oskar Vafek, “*Relaxation of nuclear magnetic moments and site-selective NMR in d-wave superconductors*”, Phys. Rev. B **81**, 104515 (2010); Editor’s suggestion.
  20. Oskar Vafek and Kun Yang, “*Many-body instability of Coulomb interacting bilayer graphene: Renormalization group approach*”, Phys. Rev. B **81**, 041401(R) (2010); Editor’s suggestion and featured in Physics **3**, 1 (2010).
  19. Igor F. Herbut, Vladimir Juricic, and Oskar Vafek, “*Relativistic Mott criticality in graphene*”, Phys. Rev. B **80**, 075432 (2009).

18. Oskar Vafek and Matthew J. Case, “Renormalization group approach to two-dimensional Coulomb interacting Dirac fermions with random gauge potential”, Phys. Rev. B **77**, 033410 (2008).
17. Igor F. Herbut, Vladimir Juricic, and Oskar Vafek, “Coulomb Interaction, Ripples, and the Minimal Conductivity of Graphene”, Phys. Rev. Lett. **100**, 046403 (2008).
16. Ashot Melikyan and Oskar Vafek, “Quantum Oscillations in the mixed state of d-wave superconductor”, Phys. Rev. B **78**, 020502(R) (2008).
15. Oskar Vafek, “Anomalous Scaling and Gapless Fermions of d-Wave Superconductors in a Magnetic Field”, Phys. Rev. Lett. **99**, 047002 (2007).
14. Oskar Vafek, “Anomalous Thermodynamics of Coulomb-Interacting Massless Dirac Fermions in Two Spatial Dimensions”, Phys. Rev. Lett. **98**, 216401 (2007).
13. Oskar Vafek, “Thermo-Plasma Polariton within Scaling Theory of Single-Layer Graphene”, Phys. Rev. Lett. **97**, 266406 (2006).
12. Oskar Vafek and Ashot Melikyan, “Index Theoretic Characterization of d-Wave Superconductors in the Vortex State”, Phys. Rev. Lett., **96**, 167005 (2006).
11. Oskar Vafek, M.R. Beasley and S.A. Kivelson “Disorder induced non-Fermi liquid near a metal-superconductor quantum phase transition”, <http://arxiv.org/abs/cond-mat/0505688>.
10. B. Andrei Bernevig and Oskar Vafek, “Piezo-Magneto-Electric Effects in p-Doped Semiconductors”, Phys. Rev. B, **72**, 033203 (2005).
9. Han-Dong Chen, Oskar Vafek, Ali Yazdani, Shou-Cheng Zhang “Pair Density Wave in the Pseudogap State of High Temperature Superconductors”, Phys. Rev. Lett. **93**, 187002 (2004).
8. Oskar Vafek and Zlatko Tešanović, “Quantum criticality of d-wave quasiparticles and superconducting phase fluctuations”, Phys. Rev. Lett. **91**, 237001 (2003).
7. Oskar Vafek, Zlatko Tešanović and Marcel Franz, “Relativity Restored: Dirac Anisotropy in QED<sub>3</sub>”, Phys. Rev. Lett. **89**, 157003 (2002).
6. Marcel Franz, Zlatko Tešanović and Oskar Vafek, “QED<sub>3</sub> theory of pairing pseudogap in cuprates: From d-wave superconductor to antiferromagnet via an algebraic Fermi liquid”, Phys. Rev. B **66**, 054535 (2002).
5. Zlatko Tešanović, Oskar Vafek and Marcel Franz, “Chiral symmetry breaking and phase fluctuations: A QED<sub>3</sub> theory of the pseudogap state in cuprate superconductors”, Phys. Rev. B **65**, 180511 (2002).
4. O. Vafek, A. Melikyan, and Z. Tešanović, “Quasiparticle Hall Transport of d-wave Superconductors in Vortex State”, Phys. Rev. B **64**, 224508 (2001).
3. Marcel Franz and Oskar Vafek, “Universal thermal conductivity in the vortex state of cuprate superconductors”, Phys. Rev. B **64**, 220501 (2001).
2. O. Vafek, A. Melikyan, M. Franz and Z. Tešanović, “Quasiparticles and Vortices in Unconventional Superconductors”, Phys. Rev. B **63**, 134509 (2001).
1. Sasha Dukan and Oskar Vafek, “Anomalous Behavior of the Upper Critical Field in Extreme Type-II Superconductors at Low Temperatures”, Physica C, **309(3-4)**, 295 (1998).

#### **Interdisciplinary Work** (Rheology and Non-linear Molecular Spectroscopy)

2. Oskar Vafek and Mark O. Robbins, “Molecular dynamics study of the stress singularity at a corner”, Phys. Rev. B **60**, 12002 (1999).
1. P. Collings, E. Gibbs, T. Starr, O. Vafek, C. Yee, L. A. Pomerance, R. F. Pasternac, “Resonance light scattering and its application in determining the size, shape, and aggregation number for supramolecular assemblies of chromophores”, J. Phys. Chem. B **103** (40): 8474-8481 (1999).

## Recent conference organization

- 2021 Magnet Lab Theory Winter School on “Modern aspects of condensed matter physics” Tallahassee FL (Jan 11 - Jan 15, 2021) Scientific Co-organizer
- 2020 KITP program: Correlated Systems with Multi-component Local Hilbert Spaces Santa Barbara CA (Sep 28 - Dec 18, 2020) Scientific Co-organizer
- International institute for physics: “Electronic Correlations and Topology in narrow band systems” Natal Brazil (moved to 2021 due to Covid-19) Scientific Co-organizer
- International Center for Theoretical Physics: “Superconductivity: from Microscopic Mechanisms to Topology to Macroscopic Properties” Trieste, Italy (May 18- 22, 2020 cancelled due to Covid-19) Scientific Co-organizer

## Talks and presentations

### Invited talks

*Strong coupling phases of partially filled twisted bilayer graphene narrow bands*

- APS March meeting, Denver, CO, March 3, 2020 (cancelled due to Covid-19)
- U. Va CMP seminar, April 30, 2020 (postponed due to Covid-19)
- Discussion Leader on the topic of “Topological Materials” at the first meeting of Quantum Materials Canada, program of the Canadian Institute for Advanced Research, May 27-29, 2020 Jouvence, Quebec, Canada (postponed to 2021 due to Covid-19)
- Nordita, Stockholm Sweden, Superconductivity and Magnetism, July 29-24, 2020 (cancelled due to Covid-19)
- Dongguan, China Condensed matter Dirac/Yukawa systems: theory and experiments, Sep 7-25, 2020 (postponed due to Covid-19)
- Oxford University CM (virtual) seminar, November 25 (2020)
- Flatiron Institute Center for Computational Quantum Physics (virtual) seminar, December 3 (2020)
- ( • ) “Induced topological states and phases in quantum matter” Weizmann Institute of Science, Israel, Jan 31-Feb 4, 2021 (postponed due to Covid-19)
- “Quantum Matter Frontier Seminars” (virtual) Perimeter Institute, Canada, Feb 8, 2021
- “Correlated synthetic quantum matter: theory meets experiment” (virtual) Bremen, Germany Feb 9, 2021
- ( • ) MIT Chez Pierre seminar, Mar 8, 2021
- ( • ) DCMP Symposium Invited Speaker, APS March meeting, Nashville, TN Mar 15-19, 2021
- ( • ) “Topological Matter School 2021” Donostia-San Sebastian, Spain Aug 22-27, 2021.

*Topology and interactions in twisted bilayer graphene narrow bands*

- A pair of lectures at the Magnet Lab Theory Winter School Tallahassee, Florida, United States January 6 (2020)

*Correlated electron phases in graphene moire structures: reality born in imagination*

- Colloquium at the Aspen center for physics program Moire Materials: Strong Correlations in Synthetic Superlattices Aspen, Colorado, United States June 20 (2019)

*Strong coupling phases of partially filled twisted bilayer graphene narrow bands*

- KITP Rapid Response Workshop: Correlations in Moire Flat Bands Santa Barbara, California, United States January 17 (2019)
- Stanford University Palo Alto, California, United States January 24 (2019)
- Princeton University Condensed Matter Seminar Princeton, New Jersey, United States February 4 (2019)
- University of Toronto Toronto, Canada February 27 (2019)

- UC San Diego Condensed matter physics seminar San Diego, California, United States November 7 (2019)
- KITP Conference: Spintronics Meets Topology in Quantum Materials Santa Barbara, California, United States November 14 (2019)

*Symmetry, maximally localized Wannier states, and low energy model for the twisted bilayer graphene*

- APS March meeting Boston, Massachusetts, United States March 7 (2019)
- CIFAR Quantum Materials Summer School Vancouver, Canada April 9 (2019)
- Advances in strongly correlated electronic systems Minneapolis, Minnesota, United States June 11 (2019)
- Advanced School and Workshop on Correlations in Electron Systems - from Quantum Criticality to Topology Trieste, Italy August 6 (2018)
- Correlated electron systems - novel developments William I. Fine Theoretical Physics Institute, Minneapolis, Minnesota, United States May 17 (2018)
- Strong Electron Correlations in Quantum Materials: Inhomogeneities, Frustration, and Topology Sao Paulo, Brazil August 16 (2018)

*Hund Interaction, Spin-Orbit Coupling and the Mechanism of Superconductivity in Strongly Hole-Doped Iron Pnictides*

- Gordon Research Conference on Superconductivity Waterville Valley, NH June 6 (2017)
- Kavli Institute for Theoretical Physics Santa Barbara, CA July 18 (2017)
- Johns Hopkins University Physics Department Seminar Baltimore, MD June 13 (2017)
- University of Maryland, College Park College Park, MD October 17 (2017)
- Condensed Matter Seminar, University of Michigan Ann Arbor, MI March 9 (2017)
- University of British Columbia, Physics Colloquium Vancouver Canada January 12 (2017)
- Simon Fraser University Vancouver, Canada January 13 (2017)

*Berry phases and the intrinsic thermal Hall effect in high temperature cuprate superconductors*

- Relativistic Fermions and Nodal Semimetals from Topology Banff International Research Station, Banff Canada, February 14 (2018)
- Multi-Component and Strongly-Correlated Superconductors Nordita, Stockholm, Sweden July 6 (2016)
- ICTP Conference on Interactions and Topology in Dirac Systems Trieste, Italy August 5 (2016)
- Strong Correlations and the Normal State of the High Temperature Superconductors, International Workshop, Max Planck Institute for the Physics of Complex Systems, Dresden Germany, May 20 (2016)
- University of California Los Angeles Condensed Matter Physics Seminar, September 17 (2014)
- UC Berkeley condensed matter seminar, Berkeley, CA, June 24 (2014)
- NSF Boulder School for Condensed Matter and Materials Physics, Boulder Colorado, July 11 (2014)

*Superconductivity on the brink of spin-charge order in doped 2D quadratic band touching models*

- Massachusetts institute for technology Cambridge, Massachusetts, United States April 30 (2018)
- Intertwined Orders in Strongly Correlated Systems, Laguna Beach, CA, January 29, (2016)
- University of Kentucky physics department colloquium, Lexington KY, September 25, (2015)

- International Centre for Theoretical Physics: School and Workshop on Strongly Correlated Electronic Systems - Novel Materials and Novel Theories Trieste, Italy August 19 (2015)
- Michigan State University East Lansing, MI March 21 (2015)
- Quantum Criticality in Correlated Materials and Model Systems, Natal, Brazil, July 29 (2014)
- NSF Boulder School for Condensed Matter and Materials Physics, Boulder Colorado, July 21 (2014)

*Space-group symmetry, spin-orbit coupling, and effective Hamiltonian for iron superconductors*

- KITP Workshop: Magnetism, Bad Metals and Superconductivity: Iron Pnictides and Beyond, Kavli Institute for Theoretical Physics, Santa Barbara, CA, September 9 (2014)
- Superconductivity: the Second Century, Nordita, Stockholm, Sweden (August 12, 2013)
- Zlatko Tesanovic Memorial Symposium, Johns Hopkins University, Baltimore, MD (March 23, 2013)

*Electronic multi-criticality on the graphene bi- and tri-layers*

- UC San Diego, La Jolla, CA (October 31, 2012)
- California Institute of Technology, Pasadena CA (October 29, 2012)

*Electronic multi-criticality in bilayer graphene*

- Max-Planck Institute for Complex Systems, Dresden, Germany (July 15, 2013)
- International Center for Theoretical Physics Trieste, Italy (August 14, 2012)
- Lorentz Institute, Leiden, The Netherlands (August 7, 2012)
- Symposium: Frontiers of Quantum Matter, George Mason University, Center for Quantum Science, Fairfax, VA (May 25, 2012)
- Department of Physics and Astronomy, CM seminar, Johns Hopkins University, Baltimore, MD (May 9, 2012)
- MIT Chez Pierre Seminar, Massachusetts Institute of Technology, Boston, MA (May 7, 2012)
- University of California, Berkeley, CM seminar, Berkeley, CA (April 25, 2012)

*Theoretical Approach to Many-body Instabilities in Bilayer Graphene*

- Gordon Research Conference on Correlated Electron Systems, Mt. Holyoke, MA (June 24-29, 2012)
- American Physical Society March Meeting, Boston, MA (March 2, 2012)
- Purdue University, CM seminar, West Lafayette, IN (February 10, 2012)
- KITP Conference: Fundamental Aspects of Graphene and Other Carbon Allotropes, Santa Barbara, CA (January 2012)

*Quantum oscillations and pseudogap in high temperature superconductors*

- Aspen Center For Physics: Workshop on A New Century of Superconductivity: Iron Pnictides and Beyond, Aspen CO (July 15, 2011).

*d-wave quasiparticles in magnetic field: spectrum and scaling*

- Boulder School for Condensed Matter and Materials Physics, Boulder Colorado, July 9 (2014)
- Unconventional Superconductivity Workshop, William I. Fine Theoretical Physics Institute, Minneapolis, MN (April 22, 2011).

*Interacting fermions on the honeycomb bilayer: from weak to strong coupling*

- Herb Seminar, University of Wisconsin, Madison, WI (April 12, 2011)
- Tage Erlander's award conference "Frontiers of Condensed Matter Physics", Nordita, Stockholm, Sweden (January 3-8, 2011)
- Princeton University, Graphene Workshop at Princeton, NJ (October 8-9, 2010)

- European Center for Theoretical Studies in Nuclear Physics and Related Areas (ECT\*), Trento, Italy (April 12-14, 2010)

*Physics of Graphene*

- FSU Colloquium (October 21, 2010)
- FSU Nuclear physics seminar (April 6, 2010)

*Interaction and disorder effects in single and double layer graphene*

- University of Florida Gainesville, FL (Feb 15, 2010)

*Coulomb interaction, ripples, and the minimal conductivity of graphene,*

- Princeton University, Condensed Matter Physics seminar (April 13, 2009)
- Johns Hopkins University, CMP seminar (April 15, 2009)
- Kavli Institute for Theoretical Physics, Workshop on Low Dimensional Electron Systems (May 19, 2009)
- Stanford University, CMP seminar (May 22, 2009)
- International Conference "Graphene Canada", Banff, Alberta, Canada (September 14-19, 2008)

*Quantum oscillations in the mixed state of d-wave superconductors*

- Aspen Center For Physics: Workshop on Quantum Vortices and Fluctuations in Superconductors and Superfluids, Aspen CO (July 8-9, 2009)

*Graphene Flatland*

- Goucher College Colloquium, Baltimore MD (April 16, 2009)

*Interaction and disorder effects in single and double layer graphene*

- Graphene International Conference Benasque, Spain (July 29, 2009)

*Quasiparticles in the vortex state of d-wave superconductor*

- 17. conference of Slovak physicists, Bratislava, Slovakia (September 19, 2009)
- Max Planck Institute, CMP seminar, Stuttgart, Germany (September 22, 2009)

*Two dimensional massless Dirac fermions in condensed matter*

- Invited colloquium talk at the University of Maryland at College Park (October 25, 2007)

*Massless Dirac Fermions in Condensed Matter.*

- Invited seminar talk at National High Magnetic Field Laboratory (October 5, 2007)

*'Interacting Massless Dirac Fermions in 2D'*

- Invited conference talk, KITP Miniprogram: Electronic Properties of Graphene (January 8-19, 2007), ([http://online.kitp.ucsb.edu/online/graphene\\_m07/vafek/](http://online.kitp.ucsb.edu/online/graphene_m07/vafek/))

**Contributed talks and presentations**

*Berry phases and the intrinsic thermal Hall effect in high temperature cuprate superconductors*

- 11th International Conference on Materials and Mechanisms of Superconductivity, Geneva, Switzerland, August 25, (2015)

*Superconductivity on the brink of spin-charge order in doped honeycomb bilayer*

- APS March Meeting, Denver, CO, March 3 (2014)

*Many-body instability of Coulomb interacting (ungated) bilayer graphene: RG approach*

- APS March meeting 2010, Portland OR, Mar 17, (2010)

*Dynamical conductivity of graphene (at neutrality point)*

- APS March meeting 2009, Pittsburgh PA (2009)

*Scaling, oscillations and gapless fermions of d-wave superconductors in magnetic field.*

*Coulomb interaction, ripples, and the minimal conductivity of graphene.*

- Poster presentations at LT25, Amsterdam, Holland (August 6-13, 2008).

*Interplay of Coulomb interactions and rippling of monolayer graphene: RG approach*

- Contributed talk APS March meeting 2008, New Orleans LA (March 10, 2008)

*Quantum Oscillations in the mixed state of d-wave superconductors*



- Contributed talk APS March meeting 2008, New Orleans LA (March 10, 2008)  
*Thermo-Plasma Polariton within Scaling Theory of Single-Layer Graphene.*
- APS March Meeting, Denver CO (March 6, 2007)  
*Low-temperature specific heat and thermal Hall conductivity in a vortex state of d-wave superconductors.*
- APS March Meeting, Denver CO (March 5, 2007)  
*'Disorder induced non-Fermi liquid near a metal-superconductor quantum phase transition'*
- Seminar talk, Aspen Center for Physics, Aspen CO (July 2005)
- Short talk, APS March Meeting, Los Angeles CA (March 2005)
- 'Nodal Quasiparticles and Quantum Vortices in Cuprate Superconductors: QED<sub>3</sub>'*
- Invited seminar talk, UC Berkeley, CA (February 2005)
- 'Pair Density Wave in the Pseudogap State of High Temperature Superconductors'*
- Invited seminar talk, Johns Hopkins University, MD (October 2004)
- 'Quasiparticle Hall Transport of d-wave superconductors in the mixed state'*
- Gordon Research Conference on Correlated Electron Systems, Waterville, ME (July 2002)
- The Hebrew University of Jerusalem: the Institute for Advanced Studies Winter School in Theoretical Physics (January 2002)
- 'Quasiparticle Thermal Hall Conductivity of High Temperature Superconductors.'*
- APS March Meeting, Indianapolis (March 2002)
- 'QED<sub>3</sub> Unified theory of underdoped cuprates'*
- The Hebrew University of Jerusalem: the Institute for Advanced Studies Winter School in Theoretical Physics (January 2002)
- 'Quasiparticle Hall Transport of d-wave Superconductors in Vortex State'*
- APS March Meeting, Seattle (March 2001)
- 'Quasiparticles and Vortices in Unconventional Superconductors'*
- APS March Meeting, Minneapolis (March 2000)
- Workshop on Microscopic Structure and dynamics of Vortices in unconventional Superconductors and Superfluids, Dresden (February 2000)

### Grant proposals:

National Science Foundation

- Title: *Correlated electron physics in graphene and other novel quantum materials.*  
Start Date: July 15, 2019.  
End Date: June 30, 2022.  
Status: awarded (\$360,000)
- Title: *Interplay between symmetry breaking, quasiparticles and their topology in quantum condensed matter systems.*  
Start Date: September 15, 2015.  
End Date: March 31, 2019.  
Status: awarded (\$299,156)
- Title: *CAREER: Theoretical approach to Dirac and related critical materials*  
Start Date: July, 2010.  
End Date: July, 2015.  
Status: awarded (\$420,000)

FSU Council for Research and Creativity

- Title: *Dirac Critically away from equilibrium*  
First Year Asst Professor (FYAP) Grants 2006-2007  
Status: awarded (\$15,000)