

Pavel A. Volkov

Department of Physics and Astronomy
University of Connecticut
Storrs, Connecticut 06269, USA

Website: pavolkov.com ; [Google Scholar](#)
Phone nr.: +1 (860) 4866748

RESEARCH INTERESTS:

Theoretical condensed matter physics: strongly correlated electronic systems, unconventional and topological superconductivity, ferroelectrics and polar metals, quantum phase transitions, strange metals, interactions in (topological) semimetals, frustrated magnetism and Kondo lattices, analytical methods and experiment-based phenomenology

EDUCATION:

- 07/2018 **PhD** in Physics, Ruhr-Universität Bochum (Germany),
Advisor: K. B. Efetov (now deceased) Co-advisor: I. Eremin
- 06/2013 **M.Sc.(cum laude)** in Physics,
Moscow Institute of Physics and Technology (Russia)
- 06/2011 **B.Sc. (cum laude)** in Physics,
Moscow Institute of Physics and Technology (Russia)

ACADEMIC POSITIONS:

- 08/2022 – Now **Assistant Professor**, University of Connecticut
(on leave 08/2022-08/2023)
- 08/2022 – 08/2023 **Postdoctoral fellow**, Harvard University (on leave from U. of Conn.)
- 09/2018 – 08/2022 **Postdoctoral fellow**, Center for Materials Theory, Rutgers University
- 11/2013 – 08/2018 **Graduate research assistant**, Ruhr-Universität Bochum

AWARDS AND FELLOWSHIPS:

- 2024 UConn Quantum CT industry challenge problems award (44,665 USD for my group)
2024 UConn Quantum Innovation Seed Grants (co-PI; 25,000 USD for my group)
2022 Martin and Beate Block Winter Award, Aspen Center for Physics

PUBLICATIONS:

[*-equal contribution] [† - corresponding author]

36 peer-reviewed publications, google scholar: [Pavel A. Volkov](#),

Preprints/Under Review:

43. "Quantum geometric photocurrents of quasiparticles in superconductors",
D. Kaplan, K. P. Lucht, **P. A. Volkov**, J. H. Pixley
[arXiv:2502.12265](#) .
42. "Tunable t-t'-U Hubbard models in twisted square homobilayers",
P. M. Eugenio, Z.-X. Luo, A. Vishwanath, **P. A. Volkov**,
[arXiv:2406.02448](#).
41. "Quasiparticle and superfluid dynamics in Magic-Angle Graphene",
E. Portolés†, M. Perego, **P. A. Volkov**†, ..., J. H. Pixley, T. Ihn, K. Ensslin,
[arXiv:2405.06793](#).
40. "Strong non-linear response of strange metals",
S. Kryhin, S. Sachdev, **P. A. Volkov**,
[arXiv:2403.00062](#).
39. "Incipient nematicity from electron flat bands in a kagome metal",
N. Drucker†, ... , **P. A. Volkov**†, M. Li†
[arXiv:2401.17141](#).
38. "Hyperbolic spin waves in magnetic polar metals",
A. Kumar, P. Chandra, **P. A. Volkov**
[arXiv:2312.14377](#).
37. "The Future of the Correlated Electron Problem",
A. Alexandradinata, ..., **P. A. Volkov** et al.,
[arXiv:2010.00584](#); Workshop: [The Future of the Correlated Electron Problem](#)

Peer-Reviewed Publications:

36. "Tunable Spatiotemporal Orders in Driven Insulators",
D. Kaplan†, **P. A. Volkov**†, Z. Zhuang, A. Chakraborty, P. Chandra†
Phys. Rev. Lett. 134 (Editor's Suggestion) (2025).
35. "Superfluid stiffness of twisted multilayer graphene superconductors",
A. Bannerjee, Z. Hao, ... , **P. A. Volkov**, A. Vishwanath, K.C. Fong, P. Kim
Nature 638, 93 (2025).
34. "Observation of an electronic microemulsion phase emerging from a quantum crystal-to-liquid transition",
J. Sung*, J. Wang*, I. Esterlis*, **P. A. Volkov*** , ..., P. Kim, E. Demler, H. Park
Nature Physics (2025).
33. "2.5-dimensional topological superconductivity in twisted superconducting flakes",
K. P. Lucht, J. H. Pixley, **P. A. Volkov**
[npj Quantum Materials 10, 10 \(2025\)](#).
32. "Josephson effects in twisted nodal superconductors",
P. A. Volkov, S. Y. F. Zhao, N. Poccia, X. Cui, P. Kim , J. H. Pixley
Phys. Rev. B 111, 014514 (2025).

31. "Quantum Bipolaron Superconductivity from Quadratic Electron-Phonon Coupling",
Z. Han, S. A. Kivelson, **P. A. Volkov**,
[Phys. Rev. Lett. 132, 226001 \(2024\)](#), **Editor's Suggestion**.
30. "Dielectric relaxation in the quantum multiferroics $\text{Rb}_2\text{Cu}_2\text{Mo}_3\text{O}_{12}$ and $\text{Cs}_2\text{Cu}_2\text{Mo}_3\text{O}_{12}$ ",
D. Flavian, **P. A. Volkov**, ... A. Zheludev
[Phys. Rev. B 110, 174433 \(2024\)](#).
29. "Inducing \mathbb{Z}_2 topology in twisted nodal superconductors",
K. P. Lucht, **P. A. Volkov**, J. H. Pixley
[Phys. Rev. B 109, 184507 \(2024\)](#).
28. "Pair-Kondo effect: a mechanism for time-reversal broken superconductivity and finite-momentum pairing in UTe_2 ",
T. Hazra, **P. A. Volkov**
[Phys. Rev. B 109, 184501 \(2024\)](#).
27. "Josephson diode effects in twisted nodal superconductors",
P. A. Volkov, É. Lantagne-Hurtubise, ... , J. H. Pixley, M. Franz
[Phys. Rev. B 109, 094518 \(2024\)](#).
26. "Time-reversal symmetry breaking superconductivity between twisted cuprate superconductors",
S. Y. F. Zhao, X. Cui, **P. A. Volkov**, H. Yoo, R. Engelke, Y. Ronen, R. Zhong, G. Gu, S. Plugge, T. Tummuru, M. Franz, J. H. Pixley, N. Poccia, P. Kim
[Science 382, 6677, 1422 \(2023\)](#).
25. "Phonon-induced collective modes in spin-orbit coupled polar metals",
A. Kumar, P. Chandra, **P. A. Volkov**
[Phys. Rev. B 108, 075162 \(2023\)](#), **Editor's Suggestion**.
24. "Dielectric relaxation by quantum critical magnons",
D. Flavián, **P. A. Volkov**, S. Hayashida, K. Yu. Povarov, S. Gvasaliya, P. Chandra, A. Zheludev
[Phys. Rev. Lett. 130, 216501 \(2023\)](#).
23. "Current- and Field-Induced Topology in Twisted Nodal Superconductors",
P. A. Volkov, J. H. Wilson, K. P. Lucht, J. H. Pixley ,
[Phys. Rev. Lett. 130, 186001 \(2023\)](#), **Editor's Suggestion**.
22. "Magic angles and correlations in twisted nodal superconductors",
P. A. Volkov, J. H. Wilson, K. P. Lucht, J. H. Pixley ,
[Phys. Rev. B 107, 174506 \(2023\)](#), **Editor's Suggestion**;
featured in Journal Club for Condensed matter Physics.
21. "Light-Driven Transitions in Quantum Paraelectrics ",
Z. Zhuang, A. Chakraborty, P. Chandra, P. Coleman, **P. A. Volkov**,
[Phys. Rev. B 107, 224307 \(2023\)](#).
20. "Rydberg dressed spin-1/2 Fermi gases in one dimension",
J. Lee, **P. A. Volkov**, B. J. DeSalvo, J. H. Pixley
[Phys. Rev. A 107, 053307 \(2023\)](#).
19. "Superconductivity from energy fluctuations in dilute quantum critical polar metals ",
P. A. Volkov, P. Chandra, P. Coleman
[Nature Communications, 13, 4599 \(2022\)](#).

18. "Spin-Phonon Resonances in Nearly Polar Metals with Spin-Orbit Coupling",
A. Kumar, P. Chandra, **P. A. Volkov**
[Phys. Rev. B 105, 125142 \(2022\)](#).
17. "Failed excitonic quantum phase transition in $\text{Ta}_2\text{Ni}(\text{Se}_{1-x}\text{S}_x)_5$ ",
P. A. Volkov*, M. Ye*, H. Lohani, I. Feldman, A. Kanigel, G. Blumberg,
[Phys. Rev. B 104, L241103 \(Letter\) \(2021\)](#).
16. "Lattice dynamics of the excitonic insulator $\text{Ta}_2\text{Ni}(\text{Se}_{1-x}\text{S}_x)_5$ ",
M. Ye*, **P. A. Volkov***, H. Lohani, I. Feldman, A. Kanigel, G. Blumberg,
[Physical Review B 104, 045102 \(Editor's Suggestion\) \(2021\)](#)
15. "Critical charge fluctuations and emergent coherence in a strongly correlated excitonic insulator",
P. A. Volkov*, M. Ye*, H. Lohani, I. Feldman, A. Kanigel, G. Blumberg,
[npj Quantum Materials volume 6, Article number: 52 \(2021\)](#)
14. "Interplay between nematicity and Bardasis-Schrieffer modes in the short-time dynamics of unconventional superconductors",
M. A. Müller, **P. A. Volkov**, I. Paul, I. M. Eremin,
[Phys. Rev. B 103, 024519 \(2021\)](#)
13. "Multiband Quantum Criticality of Polar Metals",
P. A. Volkov, P. Chandra,
[Phys. Rev. Lett. 124, 237601 \(2020\)](#)
12. "Magnon Bose-Einstein Condensation and Superconductivity in a Frustrated Kondo Lattice",
P. A. Volkov, Snir Gazit, J. H. Pixley,
[Proceedings of the National Academy of Sciences, 117 \(34\) 20462 \(2020\)](#).
11. "Emerging superconductivity with broken time reversal symmetry inside a superconducting s-wave state",
V. Grinenko, R. Sarkar, K. Kihou, C. H. Lee, I. Morozov, S. Aswartham, B. Buchner,
P. Chekhonin, W. Skrotzki, K. Nenkov, R. Huhne, K. Nielsch, D. V. Efremov,
S.-L. Drechsler, V. L. Vadimov, M. A. Silaev, **P. A. Volkov**, I. Eremin, H. Luetkens,
H. H. Klauss,
[Nature Physics 16, 789 \(2020\)](#)
10. "Random singlet state in $\text{Ba}_5\text{CuIr}_3\text{O}_{12}$ single crystals",
P. A. Volkov, C.-J. Won, D. I. Gorbunov, J. Kim, M. Ye, H.-S. Kim, J. H. Pixley,
S.-W. Cheong and G. Blumberg,
[Phys. Rev. B 101, 020406 \(Rapid communications\) \(2020\)](#)
9. "Collective modes in pumped unconventional superconductors with competing ground states",
M. A. Müller, **P. A. Volkov**, I. Paul, and I. M. Eremin,
[Phys. Rev. B 100, 140501 \(Rapid communications\) \(2019\)](#)
8. "Quasiparticle Interference and Symmetry of Superconducting Order Parameter in Strongly Electron-Doped Iron-based Superconductors",
J. Böker, **P. A. Volkov**, P. J. Hirschfeld and I. Eremin,
[New Journal of Physics 21, 083021 \(2019\)](#)
7. "Coulomb-induced instabilities of nodal surfaces",
P. A. Volkov and S. Moroz,
[Phys. Rev. B 98, 241107 \(Rapid communications\) \(2018\)](#)
6. "Charge and current orders in the spin-fermion model with overlapping hot spots",

- P. A. Volkov** and K. B. Efetov,
[Phys. Rev. B 97, 165125 \(Editor's Suggestion\) \(2018\)](#)
5. "s+is state with incipient bands: doping dependence and STM signatures" ,
 J. Böker*, **P. A. Volkov***, I. Eremin and K. B. Efetov,
[Phys. Rev. B 96, 014517 \(2017\)](#)
 4. "Anisotropic superfluidity of two-dimensional excitons in a periodic potential" ,
 Yu. E. Lozovik, I. L. Kurbakov and **P. A. Volkov**,
[Phys. Rev. B 95, 245430 \(2017\)](#)
 3. "Spin-fermion model with overlapping hot spots and charge modulation in cuprates" ,
P. A. Volkov and K. B. Efetov,
[Phys. Rev. B 93, 085131 \(2016\)](#)
 2. "Overlapping hot spots and charge modulation in cuprates",
P. A. Volkov and K. B. Efetov,
[J. Supercond. Nov. Magn. 29, 1069 \(2016\)](#)
 1. "Fast Dynamics of the Order Parameter in Superconductors with a Charge-Density Wave",
 A. Moor, **P. A. Volkov**, A. F. Volkov, and K. B. Efetov,
[Phys. Rev. B 90, 024511 \(2014\)](#)
 0. "Collective quantum coherent oscillations in a globally coupled array of qubits",
P. A. Volkov, M. V. Fistul,
[Phys. Rev. B 89, 054507 \(2014\)](#)

INVITED TALKS:

- December 2024 "Correlated Electrons in Polar Metals"
 ANS Special Seminar,
 Massachusetts Institute of Technology
- December 2024 "Topology and phase transitions in twisted nodal superconductors and beyond"
 R. G. Herb Condensed Matter Seminar,
 University of Wisconsin - Madison
- November 2024 "Superconductivity with a Twist: Realizing exotic superconductivity in 2D materials and interfaces"
 Physics and Astronomy Colloquium,
 Dartmouth University
- August 2024 "Twisted square lattices: appr. symm. and tunable t-t'-U Hubbard models"
 KITP program: "Tunable Two-Dimensional Materials: Moiré and Beyond",
 Kavli Institute for Theoretical Physics
- July 2024 "Non-linear transport of correlated metals"
 ACP program: "Probing Collective Excitations in Quantum Matter...",
 Aspen Center for Physics
- July 2024 "Superfluid and Quasiparticle Dynamics of Magic-Angle TBG"
 ACP program: "Quantum Matter Through the Lens of Moiré Materials",
 Aspen Center for Physics

- May 2024 “Non-linear transport of strange metals”
KITP conference: “Theories ... on Gapless Quantum Many-body Systems”,
Kavli Institute for Theoretical Physics
- March 2024 “Topology and phase transitions in twisted nodal superconductors ”
GLAM Special Seminar,
Stanford University
- March 2024 “Correlated Electrons in Polar Metals ”
APS March Meeting (Minneapolis)
- December 2023 “”Superconductivity from energy fluctuations: SrTiO₃ and beyond” ”
“Recent Advances in Superconductivity: Theory and Experiment” ,
The University of Florida, Gainesville
- December 2023 “Topology and phase transitions in twisted nodal superconductors ”
Condensed Matter Seminar,
Johns Hopkins University
- December 2023 “Twisting two-dimensional superconductors”
Physics Colloquium,
Drexel University
- April 2022 “Magic angles and topology in twisted nodal superconductors”
Center for Quantum Materials & Condensed Matter Seminar,
Stony Brook University
- January 2022 “Twisted Nodal Superconductors”
Tsung-Dao Lee Institute Youth Forum for Quantum Physics,
Tsung-Dao Lee Institute, Shanghai (online)
- December 2021 “Twisted Nodal Superconductors”
Harvard Quantum Initiative QuantumFest,
Harvard University
- November 2021 “Twisted Nodal Superconductors”
Condensed Matter Theory Seminar,
Yale University
- September 2021 “Magic Angles and Topology in Twisted Nodal Superconductors”
Seminar of the Condensed Matter section,
Max Planck Institute for Complex Systems, Dresden (online)
- July 2021 “Twisted Nodal Superconductors”
Workshop “New Trends in Quantum Condensed Matter Theory”,
ISSP-University of Tokyo (online)
- June 2021 “Magic Angles and Topology in Twisted Nodal Superconductors”
Seminar of Quantum Many-Body Theory section,
Max Planck Institute for Solid State Research, Stuttgart (online)
- March 2021 “Electronic phase diagram of the excitonic insulator candidates
Ta₂Ni(Se_{1-x}S_x)₅ probed by Raman scattering”
APS March Meeting (online)
- December 2020 “Critical charge fluctuations and emergent coherence in a strongly correlated
excitonic insulator”
APS Mid-Atlantic Section Fall Meeting (online)

- October 2020 “Quantum critical polar metals”
Condensed Matter Resnick seminar
Bar-Ilan University (online)
- July 2020 “Novel Metallicity near Polar Quantum Critical Points”
Program “Microscopics of Superconductivity in Perovskite Oxides: Challenges,
Hurdles and Enigmas” (online)
- May 2016 “Spin-fermion model with overlapping hot spots and charge modulation in
cuprates”
International Workshop and Seminar “Strong Correlations and the Normal State
of the High Temperature Superconductors”
Max Planck Institute for the Physics of Complex Systems (Dresden)

CONTRIBUTED TALKS AND POSTERS:

1. “Superfluid and Quasiparticle Dynamics of Magic-Angle Twisted Bilayer Graphene”, APS March Meeting (2024)
2. “Magnetic field-induced topological domains in twisted nodal superconductors”, APS March Meeting (2023)
3. “Magnetic field-induced topological domains in twisted nodal superconductors”, short talk at Aspen Center for Physics winter conference “New directions in strong correlation physics: From strange metals to topological superconductivity” (2022)
4. “Excitonic insulator and its failed quantum phase transition in $\text{Ta}_2\text{Ni}(\text{Se}_{1-x}\text{S}_x)_5$ ”, talk at International Conference on Strongly Correlated Electron Systems SCES (2021)
5. “Excitonic insulator and its failed quantum phase transition in $\text{Ta}_2\text{Ni}(\text{Se}_{1-x}\text{S}_x)_5$ ”, poster at virtual DPG Meeting of the Condensed Matter Section (2021)
6. “Magic angles and topology in twisted nodal superconductors”, talk at virtual DPG Meeting of the Condensed Matter Section (2021)
7. “Current-controlled topology in twisted bilayer superconductors” and “Polar quantum criticality in (topological) semimetals”, short talks during “Electronic Topology across the Correlation Spectrum” program at Aspen Center for Physics, (2021)
8. “Excitonic insulator and its failed quantum phase transition in $\text{Ta}_2\text{Ni}(\text{Se}_{1-x}\text{S}_x)_5$ ”, talk at Condensed Matter Physics in the Cities (2021)
9. “Electronic phase diagram of the excitonic insulator candidates $\text{Ta}_2\text{Ni}(\text{Se}_{1-x}\text{S}_x)_5$ probed by Raman scattering”, Low-energy electrodynamics in solids LEES (2021).
10. “Magic angles and topology in twisted nodal superconductors”, talk at APS March Meeting (2021)
11. “Quantum criticality of multiband polar metals”, poster and blackboard talk at QCTCES19 workshop/seminar (Dresden, Germany, 2019)
12. “Magnon Bose-Einstein condensation in a metal”, poster at CNLS 39th annual conference (Santa Fe, USA, 2019)
13. “Quantum critical polar metals”, talk at APS March Meeting (Boston, USA, 2019)
14. “Magnon Bose-Einstein condensation in a metal”, talk at APS March Meeting (Boston, USA, 2019)
15. “Pair density waves from coexistence: properties and experimental signatures”, talk at DPG Spring Meeting (Berlin, Germany, 2018).
16. “Charge and current orders in the cuprates: implications from spin-fermion model with overlapping hot spots”, talk at APS March Meeting (Los Angeles, USA, 2018)

17. “Charge and current orders in spin-fermion model with overlapping hot spots”, poster and contributed talk at School on Unconventional Superconductivity SUNSET-2017 (Cargese, France, 2017).
18. “Superconducting fluctuations with small Fermi energies: the case of FeSe”, talk at DPG Spring Meeting (Dresden, Germany, 2017).
19. “Charge and current orders in the cuprates: implications from spin-fermion model with overlapping hot spots”, talk at DPG Spring Meeting (Dresden, Germany, 2017).
20. “Spin-fermion model with overlapping hot spots and charge modulation in cuprates ”, talk at APS March Meeting (Baltimore, USA, 2016)

TEACHING EXPERINCE:

2023-now **Assistant Professor** at University of Connecticut:

Courses: Quantum Mechanics III (grad. course on many-body theory); Introduction to Solid State Physics (mixed grad/undergrad class)

2013-2018 **Teaching assistant** at Ruhr-Universitaet Bochum:

Courses: Classical Electrodynamics, (Advanced) Solid State Physics, Advanced Quantum Mechanics. *Organized:* Journal Club, course on field theory methods in condensed matter.

RESEARCH SUPERVISION:

2024-now **Graduate Advisor** E. Scheuermann, P. Pinney (University of Connecticut)

2023-2025 **Postdoc Advisor** P. Myles Eugenio (University of Connecticut)

Undergrad. Advisor J. Tang (University of Connecticut)

2020-2021 **Co-Mentor** of A. Kumar (postdoc fellow) at Rutgers University (with P. Chandra)

2013-2018 **Co-Mentor** of J. Boker, M. A. Muller (Master, then PhD students) at Ruhr-Universitaet Bochum (with Ilya Eremin)

SERVICE ACTIVITIES:

Refereeing: ERC Advanced Grant (2024), Nature (2024), Physical Review Letters (2019-now), Nature Communications (2021,2024), Science Advances (2022), SciPost Physics (2021) Physical Review B (2018-now), Physical Review Research (2020-now), Scientific Reports (2018), npj 2D materials (2019), Communications Physics (2018)

Sesion chair: APS March meeting (2019), (2021); APS Mid-Atlantic Section Fall Meeting (2020)