

Alexey Kovalev

Curriculum Vitae

Education and Training

Moscow Institute of Physics & Technology, Russia	M.S. (Equiv.), <i>Physics</i>	1999
Delft University of Technology, Netherlands	Ph.D., <i>Physics</i>	2006

Research and Professional Experience

Univ. of Nebraska-Lincoln	Associate Professor	2019–
Univ. of Nebraska-Lincoln	Assistant Professor	2013–2019
UC Riverside	Assistant Project Scientist	2010–2013
UCLA	Post Doc	2008–2010
Texas A&M University	Post Doc	2006–2008

Additional Research Experience

- 2002 Lyman Laboratory of Physics, Harvard University, USA (collaboration with Prof. Arne Brataas and Prof. Yaroslav Tserkovnyak)
- 2003 Norwegian University of Science and Technology, Trondheim, Norway (collaboration with Prof. Arne Brataas)
- 2003 Les Houches School Nanosciences, Les Houches, France
- 2006 Kavli Institute for Theoretical Physics UCSB, Santa Barbara, USA
- 2008 Institute of Physics of the Academy of Sciences of the Czech Republic, Prague, Czech Republic (collaboration with Dr. Karel Vyborny)
- 2008 Yukawa Institute for Theoretical Physics, Kyoto University
- 2010 Kavli Institute for Theoretical Physics China at the Chinese AS
- 2011 University of Konstanz, Germany
- 2013 Tohoku University, Japan
- 2013 Kavli Institute for Theoretical Physics UCSB, Santa Barbara, USA
- 2013 Institute for Quantum Information and Matter (IQIM), Caltech, USA
- 2015 Kavli Institute for Theoretical Physics UCSB, Santa Barbara, USA
- 2018 Kavli Institute for Theoretical Sciences at the University of Chinese Academy of Sciences

Research Interests

- Condensed Matter Physics
- Spintronics and Spincaloritronics
- Magnetoelectronics
- Quantum Information Theory

Research Highlights and Highly Cited Papers

- 2002 The work published in Phys. Rev. B 66, 224424, generalized the well-known Valet-Fert theory to non-collinear systems and described the spin transfer torque effect in metallic multilayered systems. This effect is important for applications in the spin-torque memory.
- 2005 The work published in Phys. Rev. Lett. 94, 167201, established the basis for future studies of the coupling between the elastic modes and the magnetic order parameter.
- 2006 The work published in Phys. Rev. B 75, 014430, established the theoretical basis for the spin-transfer-torque driven ferromagnetic resonance — an important effect used for characterizing ferromagnets and microwave generation.
- 2010 Series of works on the AHE — a fundamental effect in condensed matter physics — resulted in the publication, Phys. Rev. Lett. 105, 036601, which for the first time established an ab-initio scheme for the AHE calculations in disordered systems.
- 2012 The work published in EPL (Europhysics Letters) 97, 67002 proposed novel magnonic effects for realizations of logic and memory devices.
- 2013 The work published in Phys. Rev. A (Rapids) 87, 020304 showed that quantum information can be stored in a much more efficient and fault tolerant way by employing low density quantum codes.
- 2014 In Phys. Rev. B (Rapids) 89, 241101, my group developed a theory of skyrmion motion induced by temperature gradients.
- 2016 My group was the first to theoretically propose the magnon-mediated spin Nernst effect and the magnon analog of the quantum spin Hall effect in magnetic insulators. Results were published in Phys. Rev. Lett. 117, 217203.
- 2016 My group theoretically proposed a realization of antiskyrmions in thin magnetic films with interfacial Dzyaloshinskii-Moriya interaction. We showed stability of antiskyrmion lattices in quasi-two-dimensional magnets with low symmetry in Phys. Rev. B 93, 064428.
- 2018 My group demonstrated that stable skyrmion-antiskyrmion pairs can be generated in magnetic layers with magnetization twist. Results were published in Phys. Rev. Materials 2, 124401.
- 2020 My group theoretically proposed realizations of topological magnons in ferromagnets and antiferromagnets with gradients of Dzyaloshinskii-Moriya interaction. Results were published in Phys. Rev. Lett. 125, 257201.

Honors, Awards, and Recognitions

- 1992 Winner and runner-up of Kirov region Physics and Mathematics Olympics
- 1994 Stipendium of Landau Institute for Theoretical Physics
- 1999 Graduation with Highest Honors from Moscow Institute of Physics and Technology
- 2006 The work published in Phys. Rev. Lett. 94, 167201 (2005) was also chosen as highlight of the Jaarboek 2006 (Annual Research Book) of Foundation for Fundamental Research on Matter, the Netherlands
- 2010 Nominee for UCLA Chancellor's post-doctoral research award
- 2013 Research Development Fellow, University of Nebraska-Lincoln
- 2014 Nebraska EPSCoR First Award
- 2015 DOE Early Career Award

Teaching Experience

- PHYS-918 (Quantum Mechanics III)
- PHYS-211H (General Physics I Honors)
- PHYS-212H (General Physics II Honors)
- PHYS-212 (General Physics II)
- PHYS-211 (General Physics I)

Synergistic Activities

- **Group Leader** for 2015 KITP Follow-On Workshop on Spintronic Phenomena with Spin, Energy, and Charge and canted phases in Dzyaloshinskii-Moriya magnets
- **Reviewer** for Physical Review Letters, The European Physical Journal B, Physical Review B, D, Europhysics Letters, Journal of Physics D: Applied Physics, New Journal of Physics, Quantum Information Processing, Journal of Applied Physics, Nature Physics, Scientific Reports (Nature Publishing).
- **Membership in Scientific Organizations:** American Physical Society (APS).
- **Ad hoc reviewer** for NSF programs DMR-CMMT.
- **Ad hoc reviewer** for DOE MSE Division, Theoretical Condensed Matter Physics.
- **Event supervisor** for 2014-2018 Nebraska Science Olympiads.
- **Invited Presentations While at UNL:** **1.** Spin glass reflection of the decoding transition for space-time codes. International Workshop on Quantum LDPC Codes, Perimeter Institute for Theoretical Physics, Canada (7/2014); **2.** Skyrmionic spin Seebeck effect via dissipative thermomagnonic torques. ICC-IMR/20th REIMEI International Workshop Spin Mechanics, Tohoku University, Japan (6/2014); **3.** Magnetization pumping and dynamics in a Dzyaloshinskii-Moriya magnet. ISSP International workshop on New Perspectives in Spintronic and Mesoscopic Physics, University of Tokyo, Japan (6/2015); **4.** Stability of skyrmion lattices and symmetries of Dzyaloshinskii-Moriya magnets. ISSP International symposium on New Perspectives in Spintronic and Mesoscopic Physics, University of Tokyo, Japan (6/2015); **5.** Torque, spin and energy currents in chiral magnets. IUMRS International Conference on Electronic Materials 2016, SUNTEC Singapore (7/2016); **6.** Spin Nernst and torque effects in Dzyaloshinskii-Moriya ferromagnets. SPIE Nanoscience + Engineering symposium, Spintronics IX, San Diego, California, USA (8/2016); **7.** Magnon-mediated Dzyaloshinskii-Moriya torques, heat pumping, and spin Nernst effect. Spin Mechanics 4, Fairmont Chateau Lake Louise, Canada (2/2017); **8.** Magnon-mediated Dzyaloshinskii-Moriya torques, heat pumping, and spin Nernst effect. DPG Spring Meeting, Dresden, Germany (3/2017); **9.** Spin Nernst effect of magnons in antiferromagnets. 13th International Workshop on Magnetism and Superconductivity at the nanoscale, Coma Ruga, Spain (7/2017); **10.** Stabilization and control of Majorana bound states with elongated skyrmions. SPIE Nanoscience + Engineering symposium, Spintronics X, San Diego, California, USA (8/2017); **11.** Magnon-mediated spin Nernst effect and pumping of spin current in a collinear antiferromagnet. Workshop on antiferromagnetic spintronics, MINATEC, Grenoble, France (10/2017); **12.** From skyrmions to antiskyrmions: nucleation, control, and stability. The ninth workshop “Spin Caloritronics IX”, Columbus, Ohio, USA (6/2018); **13.** From skyrmions to antiskyrmions: nucleation, control, and stability. Collective Spin Dynamics in Nanostructures Workshop, Beijing, China

(10/2018); **14.** Numerical and analytical bounds on threshold error rates for hypergraph-product codes. 1st Summer Workshop on Quantum Algorithm and Software (QAS), Shenzhen, China (8/2019); **15.** Superfluid Spin Transistor. “Spin Caloritronics XI”, University of Illinois Urbana-Champaign, USA (5/2022) **16.** Towards control of spin currents in magnetic insulators. TopMax22, International Workshop at Max Planck Institute, Dresden, Germany (6/2022).

- ***Seminars and Colloquiums While at UNL:*** **1.** Spin supercurrents and torquing with majorana fermions. KITP UCSB, Santa Barbara (10/2013); **2.** Magnetization Switching and Energy Manipulation in Dzyaloshinskii-Moriya Magnets. Nebraska Center for Materials and Nanoscience, University of Nebraska-Lincoln (9/2014); **3.** Semiconductors, Diodes, and Transistors. Science by the Slice Lecture, University of Nebraska-Lincoln (6/2016); **4.** Torque, spin and energy currents in chiral magnets. RIKEN Center for Emergent Matter Science, Japan (7/2016); **5.** Magnon-mediated Dzyaloshinskii-Moriya torques, heat pumping, and spin Nernst effect. University of Missouri, Columbia (9/2016); **6.** Colloquium: Stabilization of (anti)skyrmions and magnon-mediated phenomena in Dzyaloshinskii-Moriya magnets. University of Konstanz, Konstanz, Germany (7/2017); **7.** Stabilization of (anti)skyrmions and magnon-mediated phenomena in Dzyaloshinskii-Moriya magnets. Martin Luther University of Halle-Wittenberg, Halle, Germany (7/2017); **8.** Stabilization of (anti)skyrmions and magnon-mediated phenomena in Dzyaloshinskii-Moriya magnets. MINATEC, Grenoble, France (7/2017); **9.** Antiskyrmions and magnon-mediated phenomena in Dzyaloshinskii-Moriya magnets. University of California, Riverside (2/2018); **10.** Boundary twists, instabilities, and (anti)skyrmion creation. Center for Nonlinear Studies, Los Alamos, USA (8/2018); **11.** Nonequilibrium spin currents and spin polarization in noncollinear antiferromagnetic insulators. Case Western Reserve University, Cleveland, USA (10/2019); **12.** Noncollinear Antiferromagnetic Insulators as a Promising Platform for Spintronics. Online Spintronics Seminar (2/2021); **13.** Antiferromagnetic insulators as a promising platform for spintronics. Online seminar, The Korea Advanced Institute of Science and Technology (KAIST) (10/2021); **14.** Colloquium: Towards control of spin currents in magnetic insulators. Wayne State University (2/2022)
- ***Contributed Presentations While at UNL:*** K. Hamilton[†], A. Kovalev, L. Pryadko. Qubits with always-on couplings and gates based on decoupling pulse sequences: fault tolerance with quantum LDPC codes. APS March Meeting 2014, Denver, USA (3/2014); K. Shtengel, A. Kovalev. Spin supercurrents and torquing with Majorana fermions. APS March Meeting 2014, Denver, USA (3/2014); D. Drummond[†], A. Kovalev, C.Y. Hou, L. Pryadko, K. Shtengel. Entanglement Inequalities for Majorana Fermions in Semiconductor Nanowires. APS March Meeting 2014, Denver, USA (3/2014); A. Kovalev, L. Pryadko. Spin glass reflection of quantum error correcting codes. APS March Meeting 2014, Denver, USA (3/2014); A. Kovalev. Parafermion stabilizer codes. QEC14 at ETH Zurich, Switzerland (12/2014); U. Gungordu[†], R. Nepal[†], A. Kovalev. Parafermion stabilizer codes. APS March Meeting 2015, San Antonio, USA (3/2015); A. Kovalev, U. Gungordu[†]. Magnetization pumping and dynamics in a uniform Dzyaloshinskii-Moriya magnet. APS March Meeting 2015, San Antonio, USA (3/2015); L. Pryadko, I. Dumer, A. Kovalev. Irreducible normalizer operators and thresholds for degenerate quantum codes with sublinear distances. APS March Meeting 2015, San Antonio, USA (3/2015); K. Belashchenko, A. Kovalev, M. van Schilfhaarde. Theory of spin relaxation at metallic interfaces. APS March Meeting 2016, Baltimore, USA (3/2016); Y. Jiang, A. Kovalev, L. Pryadko. Potts glass reflection of the decoding threshold for qudit quantum error correcting codes. APS March Meeting 2016, Baltimore, USA (3/2016); V.

Zyuzin[†], A. Kovalev. Torque, spin and energy Hall currents in magnets with Dzyaloshinskii-Moriya interactions. APS March Meeting 2016, Baltimore, USA (3/2016); U. Gungordu[†], R. Nepal[†], O. Tretiakov, K. Belashchenko, A. Kovalev. Stability of skyrmion lattices and symmetries of Dzyaloshinskii-Moriya magnets. APS March Meeting 2016, Baltimore, USA (3/2016); A. Kovalev, V. Zyuzin[†]. Spin Nernst and torque effects in Dzyaloshinskii-Moriya ferromagnets. APS March Meeting 2016, Baltimore, USA (3/2016); A. Kovalev, V. Zyuzin[†]. Magnon-mediated torque, spin and energy currents in chiral magnets. Theoretical Condensed Matter Physics PI DOE Meeting, Gaithersburg, Maryland, USA (8/2016); A. Kovalev, U. Gungordu[†], Theory of Magnon Motive Force in Chiral Ferromagnets, Annual Conference on Magnetism and Magnetic Materials, New Orleans (11/2016); A. Kovalev, Phase diagram of Ising models constructed from hypergraph-product codes, QEC 2017: 4th International Conference on Quantum Error Correction, University of Maryland in College Park (9/2017); A. Kovalev, S. Prabhakar[†], I. Dumer, L. Pryadko. Phase diagram of Ising models constructed from hypergraph-product codes. APS March Meeting, Los Angeles, USA (3/2018); B. Li[†], A. Mook, A. Kovalev. Magnon-mediated analog to the Edelstein effect in an antiferromagnet. APS March Meeting, Los Angeles, USA (3/2018); R. Nepal[†], U. Gungordu[†], A. Kovalev. Magnetic skyrmion bubble driven by surface acoustic waves. APS March Meeting, Los Angeles, USA (3/2018); A. Kovalev, A. Raeliarijaona[†]. Boundary twists, instabilities, and (anti)skyrmion creation. Theoretical Condensed Matter Physics PI DOE Meeting, Gaithersburg, Maryland, USA (8/2018); Boundary twists, instabilities, and (anti)skyrmion creation, Joint MMM Intermag Conference, Washington DC, USA (1/2019); Boundary twists, instabilities, and creation of skyrmions and antiskyrmions, APS March Meeting, Boston, USA (3/2019).

- ***Invited Presentations Prior to UNL Appointment:*** **1.** Spin Helicity and Chirality in Superconductor and Semiconductor Nanostructures - International Workshop, Karlsruhe, Germany (7/2008); **2.** 55th Conference on Magnetism and Magnetic Materials, Atlanta/Georgia, USA (2010); **3.** 7th International Workshop on Magnetism and Superconductivity at the Nanoscale, Coma-Ruga, Spain (2011); **4.** APS March Meeting 2012, Boston, USA; **5.** The 8th ASRC International Workshop on Spin Mechanics, Tokai, Japan (2013); **6.** The fifth workshop “Spin Caloritronics V”, Columbus, Ohio, USA (2013).
- ***Seminars and Colloquiums Prior to UNL Appointment:*** IBM Almaden Research Center, USA (11/2005); University of Utah, Salt Lake City, USA (3/2006); The Royal Institute of Technology (KTH), Stockholm, Sweden (6/2006); Interuniversity Microelectronics Centre (IMEC), Leuven, Belgium (8/2006); University of Groningen, Groningen, the Netherlands (9/2006); Texas A&M University, College Station, USA (12/2006, 10/2007 and 3/2008); University of Texas, Austin, USA (5/2008); University of California, Los Angeles (12/2008); California State University, Northridge, USA (4/2010); Argonne National Laboratory, USA (Colloquium, 7/2010); University of California, Riverside (11/2010 and 4/2011); The City University of New York (1/2011); University of Konstanz, Germany (9/2011); Stony Brook University (2/2012); University of Guelph, Canada (10/2012); Perimeter Institute for Theoretical Physics, Canada (10/2012); Institute for Quantum Computing, University of Waterloo, Canada (10/2012); University of Sherbrooke, Canada (11/2012); University of Nebraska (03/2013).
- ***Contributed Presentations Prior to UNL Appointment:*** ICTP Conference on the Science and Technology of Spin Transport in Nanostructures”, Trieste, Italy (2002); ICM

[†]Graduate and Postdoctoral Advisees

2003 - International Conference on Magnetism, Rome, Italy (2003); Annual NorFa network meeting 2003, Rost, Norway (2003); Annual Meeting of the RTN Network, Halle, Germany (2003); Les Houches School Nanosciences, France (2003); The 3rd International Conference on Physics and Applications of Spin-Related Phenomena in Semiconductors (PASPS III), Santa Barbara, USA (2004); FOM Wetenschappelijke Vergadering van de Werkge-meenschap voor de Gecondenseerde Materie, Veldhoven, the Netherlands (2004); 50th/52nd Conference on Magnetism and Magnetic Materials, San Jose, Tampa, USA (2005/2007); The Kavli Institute of Theoretical Physics at the University of California, Santa Barbara, USA (4/2006); APS March Meeting 2007/2008/2010, Denver/New Orleans/Portland, USA; Summer School Nanomagnetism and Spintronics, Prague, Czech Republic (9/2008); The 23rd Nishinomiya-Yukawa Memorial International Workshop on Spin Transport in Condensed Matter, Kyoto, Japan (11/2008); DARPA/MTO STT-RAM Quarterly Review Meeting, Wyoming, USA (7/2009) and Arizona, USA (2/2010); Workshop on Opportunities for Mag-netism in MEMS/NEMS, Argonne National Laboratory, USA (4/2010); Kavli Institute for Theoretical Physics China at the Chinese Academy of Sciences (5/2010); APS March Meet-ing 2011, Dallas, USA; 2011 and 2012 Quantum Computing (QC) and Quantum Algorithms (QA) Program Review, Denver, USA (8/2011 and 8/2012); Second International Conference on Quantum Error Correction, Los Angeles, USA (12/2011); IEEE International Symposium on Information Theory, ISIT 2012, Boston, USA (7/2012); The 6th Windsor Summer School, Low-Dimensional Materials, Strong Correlations, and Quantum Technologies (8/2012).

Research Funding

- *Title:* Statistical mechanics of non-local disordered models associated with quantum LDPC codes; *Amount and Period:* \$255,000, 07/01/2014 – 08/30/2018; *Agency:* NSF (Single PI)
- *Title:* Finite temperature effects in spin, energy and charge transport phenomena with textures; *Amount and Period:* \$20,000, 05/12/2014 – 05/13/2015; *Agency:* NSF-EPSCoR (Single PI)
- *Title:* Spin transport through interfaces with spin-orbit interactions; *Amount and Period:* \$98,000, 11/01/2014 – 10/30/2016; *Agency:* Seed project within Nebraska-MRSEC (Single PI)
- *Title:* Non-collinear magnetism and dynamic effects in Dzyaloshinskii-Moriya magnets; *Amount and Period:* \$750,000, 7/15/2015 – 7/14/2020; *Agency:* DOE (Single PI)
- *Title:* International Conference on Electronic Materials (IUMRS-ICEM 2016); *Amount and Period:* \$1,500, 7/4/2016 – 7/8/2016; *Agency:* College of Arts and Sciences International Travel for Scholarly Presentations
- *Title:* Spin Currents in Magnetic Systems and Heterostructures; *Amount and Period:* \$344,971, 8/15/2020 – 8/14/2023; *Agency:* DOE (Single PI)
- *Title:* RII Track-1: Emergent Quantum Materials and Technologies (EQUATE); *Amount and Period:* \$20,000,000, 6/2021 – 05/2026; *Agency:* NSF-EPSCoR (Senior Investigator)

Undergraduate, Graduate, and Postdoctoral Advisees

- Undergraduate student advisee during REU Program: Lorien X. Hayden (REU-UCLA, 2010)
- Graduate student advisee: Kathleen Hamilton (University of California, Riverside)
- Graduate student advisee: David Drummond (University of California, Riverside)
- Graduate student advisee: Rabindra Nepal (University of Nebraska-Lincoln)

- Graduate student advisee: Shane Sandhoefner (University of Nebraska-Lincoln)
- Graduate student advisee: Bo Li (University of Nebraska-Lincoln)
- Postdoctoral scholar advisee: Utkan Güngördü (University of Nebraska-Lincoln)
- Postdoctoral scholar advisee: Vladimir Zyuzin (University of Nebraska-Lincoln)
- Postdoctoral scholar advisee: Aldo Raeliarijaona (University of Nebraska-Lincoln)
- Postdoctoral scholar advisee: Sanjay Prabhakar (University of Nebraska-Lincoln)
- Undergraduate student advisee, 2018 UNL MRSEC SRP: Fatima Alba Pedroza
- Undergraduate student advisee, 2019 UNL MRSEC SRP: Dalton Snyder-Tinoco
- Graduate student advisee: Edward Schwartz (University of Nebraska-Lincoln)
- Postdoctoral scholar advisee: Hamed Vakilitaleghani (University of Nebraska-Lincoln)

Publications (79 articles)

1. A. F. Barabanov, O. V. Urazaev, A. A. Kovalev, L. A. Maksimov, “*On the splitting of the lower band of charged elementary excitations of a two-dimensional antiferromagnet,*” JETP LETTERS 68, No. 5, 412-416, (1998)
2. A. F. Barabanov, O. V. Urazaev, A. A. Kovalev, L. A. Maksimov, “*On the Structure of the Spin Polaron in a Two-Dimensional Antiferromagnet,*” Doklady Phys. 44, 5, 286-289, (1999)
3. A. F. Barabanov, A. A. Kovalev, O. V. Urazaev, A. M. Belemouk, “*Spin-polaron excitations in the two-dimensional Kondo lattice with spin frustration,*” Phys. Lett. A 265, 221, (2000)
4. S. V. Korepov, A. A. Kovalev, M. A. Liberman, “*Transport properties of double quantum wires with correlated disorder,*” Solid State Commun. 117, No. 5, 291-296 (2001)
5. A. F. Barabanov, A. A. Kovalev, O. V. Urazaev, *et al.*, “*Evolution of the Fermi Surface of Cuprates on the Basis of the Spin-Polaron Approach,*” JETP 92, 677 (2001)
6. A. A. Kovalev, A. Brataas, and G. E. W. Bauer, “*Spin transfer in diffusive ferromagnet-normal metal systems with spin-flip scattering,*” Phys. Rev. B 66, 224424 (2002)
7. A. A. Kovalev, G. E. W. Bauer and A. Brataas, “*Magnetovibrational coupling in small cantilevers,*” Appl. Phys. Lett. 83, 1584 (2003)
8. A. A. Kovalev, G. E. W. Bauer, A. Brataas, “*Magnetovibrational magnetization dynamics,*” JMMM 272-276, e1593-e1594 (2004)
9. A. A. Kovalev, G. E. W. Bauer, A. Brataas, “*Nano-mechanical magnetization reversal,*” Phys. Rev. Lett. 94, 167201 (2005)
10. A. A. Kovalev, G. E. W. Bauer, A. Brataas, “*Perpendicular spin valves with ultrathin ferromagnetic layers,*” Phys. Rev. B 73, 054407 (2006)
11. A. A. Kovalev, G. E. W. Bauer, A. Brataas, “*Magnetomechanical torques in small magnetic cantilevers,*” Special issue, Jpn. J. Appl. Phys., 45, 3878 (2006)
12. A. A. Kovalev, G. E. W. Bauer, A. Brataas, “*Current-driven ferromagnetic resonance, mechanical torques and rotary motion in magnetic nanostructures,*” Phys. Rev. B 75, 014430 (2007)
13. Y. Tserkovnyak, B. I. Halperin, A. A. Kovalev, A. Brataas, “*Boundary Spin Hall Effect in a two-dimensional semiconductor system with Rashba spin-orbit coupling,*” Phys. Rev. B 76, 085319 (2007)
14. A. A. Kovalev, M. F. Borunda, T. Jungwirth, *et al.*, “*Aharonov-Casher effect in a two dimensional hole ring with spin-orbit interaction,*” Phys. Rev. B 76, 125307 (2007)

15. T. S. Nunner, N. A. Sinitsyn, M. F. Borunda, V. K. Dugaev, A. A. Kovalev, Ar. Abanov, C. Timm, T. Jungwirth, J. I. Inoue, A. H. MacDonald, J. Sinova, “*Anomalous Hall effect in a two-dimensional electron gas,*” Phys. Rev. B 76, 235312 (2007)
16. A. W. Rushforth, K. Vyborny, C. S. King, K. W. Edmonds, R. P. Campion, C. T. Foxon, J. Wunderlich, A. C. Irvine, V. Novák, K. Olejnik, A. A. Kovalev, *et al.*, “*The Origin and Control of the Sources of AMR in (Ga,Mn)As Devices,*” JMMM 321, 1001 (2009)
17. A. A. Kovalev, L. P. Zarbo, Y. Tserkovnyak, G. E. W. Bauer, J. Sinova, “*Piezospin Polarization of Currents in Nanostructures,*” Phys. Rev. Lett. 101, 036401 (2008)
18. A. A. Kovalev, K. Vyborny, J. Sinova, “*Hybrid skew scattering regime of the anomalous Hall effect in Rashba systems: unifying Keldysh, Boltzmann, and Kubo formalisms,*” Phys. Rev. B (Rapids) 78, 041305 (2008)
19. M. F. Borunda, X. Liu, A. A. Kovalev, X-J. Liu, T. Jungwirth, J. Sinova, “*Aharonov-Casher and spin Hall effects in two-dimensional mesoscopic ring structures with strong spin-orbit interaction,*” Phys. Rev. B 78, 245315 (2008)
20. A. A. Kovalev, “*NANOMECHATRONICS: A new twist on a classic experiment,*” Nature Nanotechnology 3, 710 (2008)
21. K. Vyborny, A. A. Kovalev, J. Sinova, *et al.*, “*Semiclassical framework for the calculation of transport anisotropies,*” Phys. Rev. B 79, 045427 (2009), **PRB Editors’ Suggestion**
22. A. A. Kovalev, Y. Tserkovnyak, K. Vyborny, J. Sinova, “*Transport theory for disordered multiple-band systems: Anomalous Hall effect and anisotropic magnetoresistance,*” Phys. Rev. B 79, 195129 (2009)
23. A. A. Kovalev and Y. Tserkovnyak, “*Thermoelectric spin transfer in textured magnets,*” Phys. Rev. B (Rapids) 80, 100408 (2009)
24. M. Trushin, K. Vyborny, P. Moraczewski, A. A. Kovalev, J. Schliemann, and T. Jungwirth, “*Anisotropic magnetoresistance of spin-orbit coupled carriers scattered from polarized magnetic impurities,*” Phys. Rev. B 80, 134405 (2009)
25. A. A. Kovalev and Y. Tserkovnyak, “*Magnetocaloritronic nanomachines,*” Solid State Commun. (Special issue: Caloritronics) 150, 500 (2010)
26. A. A. Kovalev, J. Sinova and Y. Tserkovnyak, “*Anomalous Hall Effect in Disordered Multi-band Metals,*” Phys. Rev. Lett. 105, 036601 (2010)
27. A. A. Kovalev, L. X. Hayden[†], G. E. W. Bauer, Y. Tserkovnyak, “*Macrospin Tunneling and Magnetopolaritons with Nanomechanical Interference,*” Phys. Rev. Lett. 106, 147203 (2011), **Featured in Physics, PRL Editors’ Suggestion**
28. P. Upadhyaya, P. K. Amiri, A. A. Kovalev, *et al.*, “*Thermal Stability Characterization of Magnetic Tunnel Junctions Using Hard-Axis Magnetoresistance Measurements,*” J. Appl. Phys. 109, 07C708 (2011)
29. G. E. Rowlands, T. Rahman, J. A. Katine, J. Langer, A. Lyle, H. Zhao, J. G. Alzate, A. A. Kovalev, *et al.*, “*Deep sub-nanosecond spin torque switching in magnetic tunnel junctions with combined in-plane and perpendicular polarizers,*” Appl. Phys. Lett. 98, 102509 (2011)
30. A. A. Kovalev, I. Dumer, L. P. Pryadko, “*Design of additive quantum codes via the codeword-stabilized framework,*” Phys. Rev. A 84, 062319 (2011)
31. A. A. Kovalev and Y. Tserkovnyak, “*Thermomagnonic spin transfer and Peltier effects in textured magnets,*” EPL 97, 67002 (2012)

[†]Graduate and Postdoctoral Advisees

32. A. A. Kovalev and L. P. Pryadko, “Improved quantum hypergraph-product LDPC codes,” IEEE International Symposium on Information Theory Proceedings, p. 348 (2012)
33. A. A. Kovalev and L. P. Pryadko, “Fault tolerance of quantum low-density parity check codes with sublinear distance scaling,” Phys. Rev. A (Rapids) 87, 020304 (2013)
34. A. A. Kovalev and L. P. Pryadko, “Quantum hyperbicycle low-density parity check codes with finite rate,” Phys. Rev. A 88, 012311 (2013)
35. A. A. Kovalev, I. Dumer, L. P. Pryadko, “Linked-Cluster Technique for Finding the Distance of a Quantum LDPC Code,” ITA Workshop Proceedings, pp. 1-6 (2013)
36. A. De, A. A. Kovalev, “Control of Majorana Edge Modes by a g -factor Engineered Nanowire Spin Transistor,” Solid State Commun. (Special issue: Spin Mechanics) 198, 66 (2014)
37. A. A. Kovalev, A. De, K. Shtengel, “Spin Transfer of Quantum Information between Majorana Modes and a Resonator,” Phys. Rev. Lett. 112, 106402 (2014)
38. I. Dumer, A. A. Kovalev, L. P. Pryadko, “Numerical techniques for finding the distances of quantum codes,” IEEE International Symposium on Information Theory, p. 1086 (2014)
39. D. E. Drummond[†], A. A. Kovalev, C-Y. Hou, *et al.*, “Demonstrating Entanglement by Testing Bell’s Theorem in Majorana Wires,” Phys. Rev. B 90, 115404 (2014)
40. A. A. Kovalev, “Skyrmionic spin Seebeck effect via dissipative thermomagnonic torques,” Phys. Rev. B 89, 241101(Rapids) (2014)
41. U. Gungordu[†], R. Nepal[†], A. A. Kovalev, “Parafermion stabilizer codes,” Phys. Rev. A 90, 042326 (2014)
42. A. A. Kovalev, U. Gungordu[†], “Magnetization pumping and dynamics in a Dzyaloshinskii-Moriya magnet,” EPL 109, 67008 (2015)
43. A. A. Kovalev, L. P. Pryadko, “Spin glass reflection of the decoding transition for quantum error correcting codes,” Quantum Inform. Comput. Vol. 15, pp. 0825-0852 (2015)
44. K. E. Hamilton[†], A. A. Kovalev, A. De, L. P. Pryadko, “Continuous frequency multiplication in a strongly driven modulated nanowire,” J. Appl. Phys. 117, 213103 (2015)
45. I. Dumer, A. A. Kovalev, and L. P. Pryadko, “Thresholds for Correcting Errors, Erasures, and Faulty Syndrome Measurements in Degenerate Quantum Codes,” Phys. Rev. Lett. 115, 050502 (2015)
46. U. Gungordu[†], R. Nepal[†], O. A. Tretiakov, K. Belashchenko, A. A. Kovalev, “Stability of skyrmion lattices and symmetries of quasi-2D chiral magnets,” Phys. Rev. B 93, 064428 (2016)
47. A. A. Kovalev, V. Zyuzin[†], “Spin torque and Nernst effects in Dzyaloshinskii-Moriya ferromagnets,” Phys. Rev. B 93, 161106(Rapids) (2016)
48. K. D. Belashchenko, O. Tchernyshyov, A. A. Kovalev, O. A. Tretiakov, “Magnetoelectric domain wall dynamics and its implications for magnetoelectric memory,” Appl. Phys. Lett. 108, 132403 (2016)
49. U. Gungordu[†], A. A. Kovalev, “Theory of magnon motive force in chiral ferromagnets,” Phys. Rev. B 94, 020405(Rapids) (2016)
50. I. Dumer, A. A. Kovalev, L. P. Pryadko, “Distance verification for LDPC codes,” IEEE International Symposium on Information Theory, (2016)
51. K. D. Belashchenko, A. A. Kovalev, M. van Schilfgaarde, “Theory of spin loss at metallic interfaces,” Phys. Rev. Lett. 117, 207204 (2016)
52. V. Zyuzin[†], A. A. Kovalev, “Magnon spin Nernst effect in antiferromagnets,” Phys. Rev. Lett. 117, 217203 (2016)

53. A. A. Kovalev, V. Zyuzin[†], Bo Li[†], “*Pumping of magnons in a Dzyaloshinskii-Moriya ferromagnet,*” Phys. Rev. B 95, 165106 (2017)
54. L. Tao, T. Paudel, A. A. Kovalev, E. Tsymbal, “*Reversible spin texture in ferroelectric HfO₂,*” Phys. Rev. B 95, 245141 (2017)
55. I. Dumer, A. A. Kovalev, L. P. Pryadko, “*Distance verification for classical and quantum LDPC codes,*” IEEE Transactions on Information Theory, 63(7), 4675–4686 (2017)
56. U. Gungordu[†], S. Sandhoefner[†], A. A. Kovalev, “*Stabilization and control of Majorana bound states with elongated skyrmions,*” Phys. Rev. B 97, 115136 (2018)
57. V. Zyuzin[†], A. A. Kovalev, “*Spin Hall and Nernst effects of Weyl magnons,*” Phys. Rev. B 97, 174407 (2018)
58. A. A. Kovalev, S. Prabhakar[†], I. Dumer, L. P. Pryadko, “*Numerical and analytical bounds on threshold error rates for hypergraph-product codes,*” Phys. Rev. A 97, 062320 (2018)
59. R. Nepal[†], U. Gungordu[†], A. A. Kovalev, “*Magnetic skyrmion bubble motion driven by surface acoustic waves,*” Appl. Phys. Lett. 112, 112404 (2018)
60. B. Li[†], A. A. Kovalev, “*Chiral topological insulator of magnons,*” Phys. Rev. B 97, 174413 (2018)
61. A. A. Kovalev, S. Sandhoefner[†], “*Skyrmions and antiskyrmions in quasi-two-dimensional magnets,*” Front. Phys. 6, 98 (2018)
62. A. Raeliarijaona[†], R. Nepal[†], A. A. Kovalev, “*Boundary twists, instabilities, and creation of skyrmions and antiskyrmions,*” Phys. Rev. Materials 2, 124401 (2018)
63. K. D. Belashchenko, O. Tchernyshyov, A. A. Kovalev, and D. E. Nikonov, “*Magnetoelectric memory cells with domain-wall-mediated switching,*” United States Patent 10,090,034 (2018)
64. S. Prabhakar[†], R. Nepal[†], R. Melnik, A. A. Kovalev, “*Aharonov-Bohm phase and valley splitting in strained graphene p-n junction,*” Phys. Rev. B 99, 094111 (2019)
65. Y. Jiang, I. Dumer, A. A. Kovalev, L. P. Pryadko, “*Duality and free energy analyticity bounds for few-body Ising models with extensive homology rank,*” Journal of Mathematical Physics 60, 083302 (2019)
66. H. Takenaka, S. Sandhoefner[†], A. A. Kovalev, E. Y Tsymbal, “*Magnetoelectric control of topological phases in graphene,*” Phys. Rev. B 100, 125156 (2019), **PRB Editors’ Suggestion**
67. K. D. Belashchenko, A. A. Kovalev, M. van Schilfgaarde, “*First-principles calculation of spin-orbit torque in a Co/Pt bilayer,*” Phys. Rev. Materials 3, 011401(R) (2019)
68. B. Li[†], A. Mook, A. Raeliarijaona[†], A. A. Kovalev, “*Magnonic analog of the Edelstein effect in antiferromagnetic insulators,*” Phys. Rev. B 101, 024427 (2020)
69. B. Li[†], S. Sandhoefner[†], A. A. Kovalev, “*Intrinsic spin Nernst effect of magnons in a non-collinear antiferromagnet,*” Phys. Rev. Research 2, 013079 (2020)
70. K. D. Belashchenko, A. A. Kovalev, and M. van Schilfgaarde, “*Interfacial contributions to spin-orbit torque and magnetoresistance in ferromagnet/heavy-metal bilayers,*” Phys. Rev. B 101, 020407(R) (2020)
71. G. G. Baez Flores, A. A. Kovalev, M. van Schilfgaarde, and K. D. Belashchenko, “*Generalized magnetoelectronic circuit theory and spin relaxation at interfaces in magnetic multilayers,*” Phys. Rev. B 101, 224405 (2020)

[†]Graduate and Postdoctoral Advisees

72. B. Li[†], A. A. Kovalev, “*Magnon Landau Levels and Spin Responses in Antiferromagnets,*” Phys. Rev. Lett. 125, 257201 (2020)
73. B. Li[†], A. A. Kovalev, “*Spin superfluidity in noncollinear antiferromagnets,*” Phys. Rev. B 103, L060406 (2021)
74. Wuzhang Fang, Aldo Raeliarijaona[†], Po-Hao Chang, Alexey A. Kovalev, and Kirill D. Belashchenko, “*Spirals and skyrmions in antiferromagnetic triangular lattices,*” Phys. Rev. Materials 5, 054401 (2021)
75. Shane Sandhoefner[†], Aldo Raeliarijaona[†], Rabindra Nepal, Dalton Snyder-Tinoco[†], and Alexey A. Kovalev, “*Regular and in-plane skyrmions and antiskyrmions from boundary instabilities,*” Phys. Rev. B 104, 064417 (2021)
76. Edward Schwartz[†], Bo Li, and Alexey A. Kovalev, “*Superfluid spin transistor,*” Phys. Rev. Research 4, 023236 (2022)
77. A. A. Kovalev and U. Gungordu, “*Majorana bound states with chiral magnetic textures,*” Journal of Applied Physics 132, 041101 (2022)
78. A. A. Kovalev, “*Magnetic skyrmions unwrapped,*” Nature Physics 18, pages 853–854 (2022)
79. E. Schwartz[†], H. Vakili[†], M. Ali, and A. A. Kovalev, “*Spin Hall effect of vorticity,*” arXiv preprint arXiv:2209.04420 (2022)