

Ivan Lisenkov, PhD

Current Position

Postdoctoral Researcher
Department of Electrical and Computer Engineering
Northeastern University

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Research Interests

Theoretical condensed matter physics:

Magnetization dynamics; Linear, nonlinear and topological phenomena in ferromagnets and antiferromagnets; Spin transfer and spin-Hall related effects; Magneto-elastic interactions;

Experimental magnetism:

Spin-transfer torque devices, spin-wave signal processing devices;

Electromagnetism:

Artificial magnetic materials; Electrodynamics of magnetic materials;

Education

PhD in Physics and Mathematics **Russian Academy of Sciences** (The Higher Attestation Commission of Russian Federation)
Physics and Mathematics, 2010

Topic: **On the characteristics of acoustic waves in liquid and solid media with cylindrical inclusions**

Scientific Advisor: Prof. Sergey Nikitov

Area of examination: Radiophysics

Qualification work performed at Kotelnikov Institute of Radioengineering and Electronics

MSc and BSc **Moscow Institute of Physics and Technology (State University)**, Moscow, Russia
Department of Physical and Quantum Electronics
Applied Mathematics and Physics, 2007

Professional Experience

2018– **Department of Electrical and Computer Engineering, Northeastern University**,
Boston, Massachusetts, USA
Postdoctoral Researcher

- Development of anti-ferromagnetic spin-transfer torque THz-frequency sources
- Development of sub-GHz and GHz conformal antennas for portable electronics

2016–2018 **School of Electrical Engineering and Computer Science, Oregon State University**,
Corvallis, Oregon, USA
Postdoctoral Researcher

- Established a general theoretical formalism for the parametric generation and amplification of localized dipolar-exchange spin-waves by a magneto-elastic interaction.
- Applied the developed theory to design of a magneto-acoustic analog correlator.
- Developed an experimental technique for magneto-elastic parameters characterization based on a linear response theory.
- Design of table-top RF experiments for thin magnetic film devices performance evaluation and characterization

2013–2016

Department of Physics, Oakland University, Rochester, Michigan, USA
Research Associate

- Established a general theory of spin-wave excitations in confined arrays of magnetic nanodots with arbitrary dot shape and lattice symmetry. Formulated conditions of nonreciprocity of edge spin-wave modes in magnetic arrays. Developed an according computer code.
- Formulated a theory of electromagnetic field interactions with arrays of thin magnetic elements and designed according computer code.
- Explained experimental results of the nonlinear magnon interaction in the Bose-Einstein condensate of magnons
- Explained recent phenomena in pure spin current flow through antiferromagnets. Developed a theory of THz generation in antiferromagnetic materials

2010–

Kotelnikov Institute for Radio-engineering and Electronics of RAS, Moscow, Russia
Researcher (on leave since 2013)

- Established a multiple scattering theory for spin-waves spectra in magnonic crystals. Explained distinguishing features of the locally resonant and Bragg-type band gaps in magnonic crystals.
- Developed a variation of a multipole expansion method for acoustic waves and applied the method to acoustic waves in microstructured optical fibers.
- Formulated an effective medium theory for bulk and surface acoustic waves in microstructured metamaterials. Formulated conditions for a complex Doppler effect in acoustic metamaterials.

Visiting Research Positions

2010

Adam Mickiewicz University in Poznan, Poznan, Poland
Host Professor: Maciej Krawczyk

- Developed a theory of spin-wave non-reciprocity in magnonic crystals.

Teaching Experience

Oregon State University

2018 ECE 390 “Electric and Magnetic Fields” (hybrid on-line/classroom) (26 students, instructor)

2017 ECE 411 “Engineering Magnetics” (25 students, guest instructor)

Oakland University

2016 PHY 380 “Electricity and Magnetism” (3 students, guest instructor)

Moscow Institute for Physics and Technology (State University)

2013 Level 4 “Electrodynamics of Metamaterials” (15 students, instructor, new course)

Student Mentoring

2017–2018 A graduate student at Oregon State University
Project: Signal Processing using parametric non-linear interactions of spin-waves

2015–2016 A graduate student at Oakland University
Project: Signal processing with spin-waves in re-configurable magnetic arrays

- 2014–2015 An undergraduate student at the Oakland University
Project: Scattering of electromagnetic waves by magnetic metasurfaces
- 2010–2013 An undergraduate student at the Moscow Institute of Physics and Technology
Project: Acoustic waves in wedge-shaped metamaterials

Honors and Awards

- 2017 Professional Development award from the Oregon State University (\$1000)
- 2015 Medal from the Russian Academy of Sciences for young scientists in the category “General Physics and Astronomy” for excellence in research
- 2009 Prize for the excellence in research among young scientists at the Kotelnikov Institute of Radioelectronics and Engineering, Moscow, Russia
- 2007, 2005 Moscow Institute for Physics and Technology: graduated with honors in Applied Physics and Mathematics, Moscow

Service to Profession

- Outstanding reviewer for Journal of Magnetism and Magnetic Materials
- Ad-hoc reviewer for: IEEE Transactions on Magnetics, Scientific Reports, Applied Physics Letters, Journal of Applied Physics
- Invited panelist for the National Scientific Foundation, USA (Panel “Magnetic and Memory Devices”)
- Session chair for 2016 and 2017 International Conferences on Magnetism and Magnetic Materials
- Member of the NextGen Magneticians 2017 Advisory Board of the IEEE Magnetics Society

Research Grants & Contracts

- 2016–2018 **DARPA HR0011-17-2-2005**
Title: Signal Processing at RF (SPAR)
Objective: To develop and demonstrate an analog correlator and a spin-waves amplifier based on parametric magneto-elastic interaction
PI: Prof. Albrecht Jander (Oregon State University)
Award amount: \$1,000,000 per year
Role: Development of physical models of the magneto-acoustic correlator and parametric amplifier, spin-wave and acoustic waves transducer design, overall correlator design.
- 2016–2018 **NSF EFMA-1641989**
Title: Non-Reciprocal Magneto-Acoustic Waves in Chiral Magnetic Systems
Objective: Development of chiral materials and meta-materials supporting strongly non-reciprocal spin waves and magneto-acoustic waves and demonstration of acoustic signal circulators and reconfigurable microwave circulators, which are based on the non-reciprocal waves
PI: Prof. Ilya Krivorotov (University of California, Irvine)
co-PI: Prof. Andrei Slavin (Oakland University)
Award amount: \$2,000,000
Role: Developed of a new theoretical formalism for spin-waves and acoustic waves in topological and chiral materials. Contributed to the proposal and the first year interim report. Left Oakland University before the project completed.

- 2016 **US Army TARDEC**
Title: Design of conformal ground vehicle antenna based on a magnetic metamaterial
Objective: Development of a comprehensive theory of magnetic-metamaterial-based microwave antennas. Deliver a computer program for US Army TARDEC enabling time efficient electromagnetic simulations of magnetic metalaterials
PI: Prof. Andrei Slavin (Oakland University)
Award amount: \$77,000
Role: Proposed the idea of the metamaterial-based antennas for ground vehicles, developed a new theoretical formalism and efficient numerical scheme for magnetic metamaterial electromagnetic simulations. Wrote a computer program delivered to TARDEC for an internal use. Contributed to the research proposal and the final report. Project completed.
- 2010–2016 **NSF DMR-1015175**
Title: Dynamically Controlled Artificial Magnonic Materials Based on Arrays of Nano-Sized Magnetic Dots
Objective: Theoretical investigation of spin-wave properties of man-made materials based on dipolary interacting island of magnetic materials
PI: Prof. Andrei Slavin (Oakland University)
Award amount: \$440,000
Role: Formulated a new theoretical formalism for localized spin-wave modes in magnetic arrays, conceptualized spin-wave signal processing devices based on the magnetic arrays, established a theoretical formalism for electromagnetic waves interactions with magnetic arrays. Delivered an open-source computer program for spin-wave modeling in magnetic arrays. Contributed to the interim and final reports. Project completed.

Skills

- Fundamental methods of linear and nonlinear theoretical physics: Hamiltonian approach, Green functions theory, linear response theory, effective media homogenization techniques, Fourier methods.
- Programming Languages and Tools: Wolfram Mathematica, MuMax3 micromagnetic simulations package, C++ (including C++11), OpenMP for high performance parallel computing, Python with NumPy and cython, \LaTeX , git version control, bash for script wring.
- Operating Systems: Good knowledge of GNU/Linux in an application to scientific computing
- On-line and hybrid teaching using Canvas

Publications & Talks

19 refereed publications (2 reviews), 21 conference talks (3 invited), 3 invited colloquia
 288 citations, h-index $h = 9$

INVITED REVIEWS

- 2017 **2. Coherent Spin Currents in Antiferromagnetic Dielectrics**
 Vasyl Tyberkevych, Roman Khymyn, Ivan Lisenkov, Boris Ivanov, Andrei Slavin
Journal of Physics D: Applied Physics (requested by the editor, in preparation)
- 2015 **1. Magnonics: a new research area in spintronics and spin wave electronics**
 Sergej Nikitov, Dmitry Kalyabin, Ivan Lisenkov, Andrei Slavin, Yu N Barabanenkov, Sergey Osokin, Alexandr Sadovnikov, Evgeniy Beginin, Mariya Morozova, Yu A Filimonov, Yu V Khivintsev, Sergei Vysotsky, Valentin Sakharov, Evgeniy Pavlov
Physics Uspekhi 58, 1002 (2015)

PREPRINTS

- 2018 **Ultra-fast artificial neuron: generation of picosecond-duration spikes in a current-driven antiferromagnetic auto-oscillator**
Roman Khymyn, [Ivan Lisenkov](#), James Voorheis, Olga Sulymenko, Oleksandr Prokopenko, Vasil Tiberkevich, Johan Akerman, Andrei Slavin
arXiv:1802.10236

REFEREED PUBLICATIONS

- 2018 20. **Ultra-fast logic devices using artificial “neurons” based on antiferromagnetic pulse generators**
O. Sulymenko, O. Prokopenko, [I. Lisenkov](#), J. Åkerman, Vasil Tiberkevich, Andrei Slavin, and R. Khymyn
J. Appl. Phys. accepted, in press (Featured Article)
19. **Nonreciprocal surface acoustic waves in multilayers with magneto-elastic and interfacial Dzyaloshinskii-Moriya interactions**
Roman Verba, [Ivan Lisenkov](#), Ilya Krivorotov, Vasil Tiberkevich, and Andrei Slavin
Phys. Rev. Applied 9, 064014 (2018)
- 2017 18. **Magnon-magnon interactions in a room-temperature magnonic Bose-Einstein condensate**
Oleksandr Dzyapko, [Ivan Lisenkov](#), Patrik Nowik-Boltyk, Vladislav E. Demidov, Sergej O. Demokritov, Benny Koene, Andrei Kirilyuk, Theo Rasing, Vasyly Tiberkevich, Andrei Slavin
Phys. Rev. B 96, 064438 (2017)
17. **Antiferromagnetic THz-frequency Josephson-like Oscillator Driven by Spin Current**
Roman Khymyn, [Ivan Lisenkov](#), Vasyly Tiberkevich, Boris A. Ivanov, Andrei Slavin
Scientific Reports 7, 43705 (2017)
16. **Low Power Microwave Signal Detection With a Spin-Torque Nano-Oscillator in the Active Self-Oscillating Regime**
Steven Louis, Vasyly Tyberkevych, Jia Li, [Ivan Lisenkov](#), Roman Khymyn, Elena Bankowski, Thomas Meitzler, Ilya Krivorotov, Andrei Slavin
IEEE Transactions on Magnetics VOL. 53, NO. 11, NOVEMBER 2017 1400804
- 2016 15. **Interaction of microwave photons with nanostructured magnetic metasurfaces**
[Ivan Lisenkov](#), Vasyly Tyberkevych, Luke Levin-Pompetski, Elena Bankowski, Thomas Meitzler, Sergey Nikitov, Andrei Slavin
Phys. Rev. Applied 5, 064005 (2016)
14. **Theoretical formalism for collective spin-wave edge excitations in arrays of dipolarly interacting magnetic nanodots**
[Ivan Lisenkov](#), Vasyly Tyberkevych, Sergey Nikitov, Andrei Slavin
Phys. Rev. B 93, 214441 (2016)
13. **Transformation of spin current by antiferromagnetic insulators**
Roman Khymyn, [Ivan Lisenkov](#), Vasil S. Tiberkevich, Andrei N. Slavin, Boris Ivanov
Phys. Rev. B 93, 224421 (2016)
12. **Bias-free spin-wave phase shifter for magnonic logic**
Steven Louis, [Ivan Lisenkov](#), Sergey Nikitov, Vasyly Tyberkevych and Andrei Slavin
AIP Advances 6, 065103 (2016)
- 2015 11. **Electrodynamic boundary conditions for planar arrays of thin magnetic elements**
[Ivan V. Lisenkov](#), Vasyly Tyberkevych, Sergey Nikitov and Andrei Slavin
Appl. Phys. Lett. 107, 082405 (2015)

- 10. Nonreciprocity of edge modes in 1D magnonic crystal**
I. Lisenkov, D. Kalyabin, S. Osokin, J.W. Klos, M. Krawczyk, S. Nikitov
Journal of Magnetism and Magnetic Materials 378, 313–319 (2015)
- 2014
- 9. Spin-wave edge modes in finite arrays of dipolarly coupled magnetic nanopillars**
Ivan Lisenkov, Vasyl Tyberkevych, Andrei Slavin, Pavel Bondarenko, Boris A Ivanov, Elena Bankowski, Thomas Meitzler, Sergey Nikitov
Phys. Rev. B 90, 104417 (2014)
- 8. Frequency separation of surface acoustic waves in layered structures with acoustic metamaterials**
D. Kalyabin, I. Lisenkov, Y.P. Lee, S. Nikitov
Photonics and Nanostructures — Fundamentals and Applications 12, 239–251 (2014)
- 2013
- 7. Edge rotational magnons in magnonic crystals**
Ivan Lisenkov, Dmitriy Kalyabin and Sergey Nikitov
Appl Phys Lett. 103, 202402 (2013)
- 6. Nonreciprocity of spin waves in metallized magnonic crystal**
M Mruczkiewicz, M Krawczyk, G Gubbiotti, S Tacchi, Yu A Filimonov, D V Kalyabin, I V Lisenkov and S A Nikitov *New J. Phys.* 15 113023 (2013)
- 2011
- 5. The Complex Doppler Effect in Double Negative Media**
I. V. Lisenkov and S. A. Nikitov
Journal of Communications Technology and Electronics, 56, 687–689 (2011)
- 4. Acoustic wave propagation in fluid metamaterial with solid inclusions**
I.V. Lisenkov, R.S. Popov, S.A. Nikitov
Appl. Phys. A 103, 921–925 (2011)
- 2008
- 3. Elastic Wave Propagation in a Microstructured Acoustic Fiber**
Sergey A. Nikitov, Roman S. Popov, Ivan V. Lisenkov, and Chul Koo Kim
IEEE Proc. of Ultrason. Ferr. and Freq. Control, 55, 1831–1839 (2008)
- 2. Elastic waves in periodic and non-periodic sets of hollow cylinders**
S. A. Nikitov, Yu. V. Gulyaev, I. V. Lisenkov, R. S. Popov, A. V. Grigorievskii and V. I. Grigorievskii
AIP Conf. Proc., 1022, 287 (2008)
- 2007
- 1. Propagation of Elastic Waves in Phononic Crystals**
I. V. Lisenkov, S. A. Nikitov, R. S. Popov, and Chul Koo Kim
Journal of Communications Technology and Electronics, 52, 1122–1134. (2007)
- INVITED PRESENTATIONS
- 2017
- 4. Acoustically pumped magnonics**
Ivan Lisenkov, Mikkel Hansen, Albrecht Jander, and Pallavi Dhagat
2017 SPIE Optics + Photonics, San Diego, CA August, 6–10 2017
- 2016
- 3. Mechanism of spin current transfer through antiferromagnetic dielectrics**
Roman Khymyn, Boris Ivanov, Ivan Lisenkov, Vasyl Tyberkevych and Andrei Slavin
2016 Joint Intermag-MMM Conference, San Diego, CA January, 11–15 2016
- 2015
- 2. Transfer of a pure spin through an antiferromagnetic insulator**
R. Khymyn, B. Ivanov, I. Lisenkov, V. Tyberkevych and A. Slavin
The 13th RIEC International Workshop on Spintronics, Sendai, Japan, November 18–20 2015.

- 2007 **1. Review of Phononic Crystals, nonlinear processes, devices and prospects**
S. Nikitov, Y. Gulaev V. Grigorevsky, A. Grigorevsky, I. Lisenkov, R. Popov
2007 IEEE International Ultrasonics Symposium, Oct 28-31, New York
- INVITED COLLOQUIA
- 2018 **5. Acoustically driven magnonics**
Ivan Lisenkov
Department of Physics, Southern Georgia University, Stateboro, CA. October 01, 2018.
- 4. Ultrafast antiferromagnetic dynamics under spin-transfer torque. Current state and outlook**
Ivan Lisenkov
Department of Physics, UCLA, Los Angeles, CA. January 29, 2018.
- 2017 **3. Spin current and THz frequency range generation in antiferromagnets**
Ivan Lisenkov
Department of Physics, Oregon State University, Corvallis, OR. February 01, 2017.
- 2016 **2. Arrays of magnetic nanoelements as a new reconfigurable magnetic material for magnonic signal processing and digital logic applications**
Ivan Lisenkov
The Materials Sciences Division at the Lawrence Berkeley National Laboratory, Berkeley, CA. January 20, 2016.
- 2014 **1. Arrays of magnetic nanodots as a new reconfigurable magnetic material for magnonic applications**
Ivan Lisenkov
Northeastern University of Boston, Boston MA. September 2014
- CONTRIBUTED PRESENTATIONS
- 2018 **Dipole-exchange spin-wave spectrum in ferromagnetic films calculated using the method of geometrical optics**
Ivan Lisenkov, Vasyl Tyberkevych, and Andrei Slavin
ICM 2018, Jul 15–20, San Francisco, CA
- Parametric amplification of spin-waves by surface acoustic waves in nano-scale devices**
Ivan Lisenkov
TANMS 2018 Annual Research Strategy Meeting, Jan 30–31, Los Angeles, CA
- 2017 **Surface-acoustic-wave-pumped parametric amplification of forward volume spin waves**
Ivan Lisenkov, Joe Davies, Albrecht Jander, Pallavi Dhagat
2017 MMM Conference, Nov 06–10, Pittsburgh, PA
- Nonreciprocal magneto-elastic waves in magnetic/non-magnetic bilayers with interfacial Dzyaloshinskii-Moriya interaction**
Roman Verba, Ivan Lisenkov, Roman Khymyn, Vasyl Tyberkevych, Andrei Slavin
2017 MMM Conference, Nov 06–10, Pittsburgh, PA
- Control of the antiferromagnetic resonance frequency by spin-current**
Ivan Lisenkov, Vasyl Tyberkevych, Andrei Slavin
2017 MMM Conference, Nov 06–10, Pittsburgh, PA

Determination of magnetoelastic constants in ferrite films using strain-dependent FMR measurements and a linear perturbation theory

Khalid Masood, Ivan Lisenkov, Brandon Howe, Benjamin Gray, Hyung-Min Jeon, Albrecht Jander, Pallavi Dhagat

2017 MMM Conference, Nov 06–10, Pittsburgh, PA

Spintronic generator of ultrashort pulses based on an antiferromagnetic film

Ivan Lisenkov, Roman Khymyn, Vasyl Tyberkevych and Andrei Slavin

2017 Intermag, Apr 24th-28th 2017, Dublin, Ireland

Inhomogeneous parametric pumping of spin-waves by acoustic waves in an yttrium-iron-garnet film

Ivan Lisenkov, Albrecht Jander and Pallavi Dhagat

2017 Intermag, Apr 24th-28th 2017, Dublin, Ireland

2016

Self-sustained Oscillations of a Biaxial Antiferromagnet Under a Spin-transfer Torque

Ivan Lisenkov, Roman Khymyn, Vasyl Tyberkevych and Andrei Slavin

2016 MMM Conference, Oct 31- Nov 04, New Orleans, LA

Stabilization of a Bose-Einstein condensate of magnons through interaction of two condensates with opposite wave vectors

Oleksandr Dzyapko, Patrik Nowik-Boltyk, Vladislav E. Demidov, Sergej O. Demokritov, Benny Koene, Andrei Kirilyuk, Theo Rasing, Ivan Lisenkov, Vasyl Tyberkevych, Andrei N. Slavin

2016 MMM Conference, Oct 31- Nov 04, New Orleans, LA

Ultrafast Spectrum Analyzer Based on the Injection Locking of a Spin-Torque Nano-Oscillator

Steven Louis, Ivan Lisenkov, Vasyl Tyberkevych, Jia Li, Roman Khymyn, Elena Bankowski, Thomas Meitzler, Ilya Krivorotov and Andrei Slavin

2016 MMM Conference, Oct 31- Nov 04, New Orleans, LA

Giant frequency splitting of dipolar azimuthal modes caused by Berry phase in magnetic nanorings

Ivan Lisenkov, Vasyl Tyberkevych and Andrei Slavin

2016 The Joint European Magnetic Symposia, Aug 21- 26 Glasgow, UK

Manipulation of Electromagnetic Waves Using Arrays of Magnetic Nano-Elements

Ivan Lisenkov, Luke Levin-Pompetzki, Vasyl Tyberkevych, Sergey Nikitov and Andrei N. Slavin

2016 Joint Intermag-MMM Conference, Jan 11-15, San Diego, CA

Vector Hamiltonian Formalism in the Theory of Nonlinear Magnetization Dynamics

Vasyl Tyberkevych, Ivan Lisenkov, Anatoly D. Belanovsky and Andrei N. Slavin

2016 Joint Intermag-MMM Conference, Jan 11-15, San Diego, CA

2015

Reconfigurable microwave metamaterial based on arrays of magnetic nanowires

Ivan Lisenkov, Anatoly Belanovsky, Vasyl Tyberkevych, Sergey Nikitov, Andrei Slavin

META'15, the 6th International Conference on Metamaterials, Photonic Crystals and Plasmonics, New York; 07/2015

Dynamic reconfigurable magnonic circuits based on domain walls in arrays of dipolarly coupled magnetic nanodots

S. Louis, I. Lisenkov, M. Morozova, S. Nikitov, V. Tyberkevych and A. Slavin

International Symposium Spin Waves 2015, June 7 - 13, Saint Petersburg, Russia

Mechanism of a pure spin transfer through an antiferromagnetic insulator

R. Khymyn, B. Ivanov, I. Lisenkov, V. Tyberkevych and A. Slavin

INTERMAG 2015 May 11-15, 2015 Beijing, China

Reflection of electromagnetic waves from an array of thin magnetic nanoelements

Ivan Lisenkov, Vasyl Tyberkevych, Sergey Nikitov, Andrei Slavin
INTERMAG 2015 May 11-15, 2015 Beijing, China

Spin-wave Waveguides Formed by Domain Walls in Arrays of Dipolarly Coupled Magnetic Nanodots

Ivan Lisenkov, Steven Louis, Sergey Nikitov, Vasyl Tyberkevich and Andrei Slavin
INTERMAG 2015 May 11-15, 2015 Beijing, China

2014 **Unidirectional spin wave edge mode in an array of magnetic nanopillars with antiferromagnetic order**

Ivan Lisenkov, Vasyl Tyberkevych, Sergey Nikitov and Andrei Slavin

2014 Annual Conference on Magnetism and Magnetic Materials 03-07 Nov, Honolulu, HI

Magnonic metamaterial with reconfigurable anisotropy based on a magnetic nanodot array with triangular lattice

Roman Khymyn, Ivan Lisenkov, Elena Bankowski, Thomas Meitzler, Vasyl Tyberkevych, Andrei Slavin

2014 Annual Conference on Magnetism and Magnetic Materials 03-07 Nov, Honolulu, HI

2013 **Surface acoustic waves control with external magnetic field in TbCo₂/FeCo films**

Ivan V. Lisenkov, A. Klimov, V. Onoprienko, V. Preobrajenski, Philippe Pernod and S. A. Nikitov

2013 IEEE International Ultrasonics Symposium, 21-25 Jul, Prague, Czech Republic

2012 **Local resonance band gaps in ferromagnetic nanostructured composites**

Ivan Lisenkov and Sergey Nikitov

Days on Diffraction 2012 28 May - 01 June, Saint Petersburg, Russia

2011 **Complex Acoustic Doppler Effect in Double Negative Resonance Metamaterials**

I. V. Lisenkov and S. A. Nikitov

2011 IEEE International Ultrasonics Symposium, Oct 18-21 Orlando, FL