

Duke University, 130 Hudson Hall, Box 90291, Durham, NC 27708 • (919) 660-8259 • yu6@duke.edu
<http://www.ee.duke.edu/fds/pratt/ECE/faculty/yaroslav.urzhumov>

1. Biographical information

- Born 1979
- U. S. Permanent Resident, 2009

2. Degrees, certificates and dates awarded

- **B.S.** in Applied Mathematics and Physics, *Moscow Institute of Physics and Technology* (Russia), 2000 (with distinction)
- **M.S.** in Applied Mathematics and Physics, *Moscow Institute of Physics and Technology* (Russia), 2002 (with distinction)
- **Certificate** of the Graduate Portfolio Certification Program in Nanoscience and Nanotechnology, *The University of Texas at Austin*, 2007
- **Ph.D.** in Physics, *The University of Texas at Austin*, 2007 (award-honored)

3. Professional and academic appointments

September, 2013- Present	Metamaterials Technologist	Metamaterials Commercialization Center, Invention Science Fund, Intellectual Ventures LLC, Bellevue, Wash.
September, 2013 - Present	Adjunct Assistant Professor	Electrical and Computer Engineering Dept., Duke University, Durham, N.C.
September, 2010 – September, 2013	Assistant Research Professor, Technical Coordinator	ECE Dept. and Center for Metamaterials and Integrated Plasmonics of Pratt School of Engineering, Duke University, Durham, N.C.
September, 2009 - August 2010	Research Scientist, Technical Coordinator	ECE/CMIP, Pratt School of Engineering, Duke University, Durham, N.C.
January, 2008 - August, 2009	Applications Engineer	COMSOL Inc., Los Angeles, California
January, 2004 - December, 2007	Graduate Research Assistant	Physics Dept., Univ. of Texas at Austin, Austin, Texas
January, 2003 - December, 2003	Graduate Research Assistant	Illinois Inst. of Technology, Chicago
August, 2002 - December, 2002	Teaching Assistant	Illinois Inst. of Technology, Chicago
January, 1999 - June, 2002	Undergraduate Research Assistant	Inst. for Theoretical and Experimental Physics, Moscow, Russia

4. Grants and awards

- Principal Investigator (PI), Grant “Wireless Power Transfer”, from Toyota Motor Engineering & Manufacturing North America, Inc., 06/01/2011-02/29/2012; amount: \$100k
- Co-PI, Grant “Protocol for Use of Random Composite Media for Cosmetic Applications,” from Procter & Gamble Co., 07/01/2012-09/30/2013; amount: \$80k
- Co-PI, Grant “Meta-ferrites for wireless charging applications”, from Toyota Technical Center USA, 09/01/2012-08/31/2013; amount: \$110k.
- Co-Investigator, MURI “Expanding the Limits of Acoustic Metamaterials”, from Office of Naval Research, 7/1/2013-6/30/2018; amount: \$700k (MURI total: \$7.5M)
- Key Personnel, ULI “Hydrodynamic Wake Control with Fluid-Permeable Metamaterials”, from Office of Naval Research, 6/15/2013-05/31/2016; amount: \$225k (ULI total: \$405k).

5. Expertise areas

- Technological applications:
 - Antennas and propagation theory; beamforming technology; radomes
 - Wireless communications and MIMO systems
 - Wireless power transfer: magneto-inductive and radiative
 - RF and microwave imaging
- Theoretical and applied physics:
 - Electromagnetism and wave phenomena, including optics, acoustics and elastodynamics
 - Plasmonics, surface resonance theory of metal-dielectric and phonon-polaritonic structures
 - Nanophotonics, optical photonic crystals, band structure calculations
 - Homogenization theory of sub-wavelength structures with application to electromagnetic metamaterials
 - Transformation media for manipulating electromagnetic fields, acoustic waves and fluid flow; wave and field cloaking theory
 - Metal-semiconductor metamaterials and hybrid photon-electronic systems
 - Optical magnetism, negative refraction and negative index, super-resolution
- Applied math and computing:
 - Numerical methods for differential equations (PDE, ODE) and their applications to continuum-level problems
 - Integrated modeling tools based on COMSOL Multiphysics software suite, MATLAB, and Mathematica

6. Research highlights

- Experimental demonstration of magneto-inductive relatively long range wireless power transfer with metamaterial “superlens” (Nature Scientific Reports, January 2014).
- Polymer-based metal-free cloaking devices for X-band microwaves (Optics Letters, May 2013).
- Plasmonic sensors: high-efficiency multiscale modeling (cover of Science magazine, August 31, 2012).
- Metamaterial design and FEM-based homogenization for microwave/RF applications, including next-generation stealth; highlighted in *IEEE Spectrum* magazine (June 2012).
- Fluid flow manipulation, turbulence suppression with transformation media; highlighted in the *Forbes* magazine, *Popular Science* magazine (U.S.), *De Ingenieur* (Netherlands), *Physical Review Letters*, *Science NOW* (online news of the Science magazine), *APS Physics*, *The Atlantic*, *Physics World*, *PhysOrg*, *New Scientist*, *Gizmag* and other scientific and engineering magazines (2011).
- Rigorous theory of metamaterial near-field focusing for wireless power transfer; reported on *MSNBC.com*, in *The Register* (UK), *Science Daily*, *Yahoo News*, *MIT Technology Review*, *Wireless Power Planet*, *The Technology Review*, *Next Big Future*, *Gizmag*, *TG Daily*, *PhysNews* and other scientific, engineering and tech news media (2011).
- Proposal for macroscopic optical invisibility devices based on anisotropic photonic crystals; highlighted on the cover of *Phys. Rev. Lett.* (2010).
- Theoretical demonstration of acoustic cloaking feasibility with attainable elastic material properties (2010).
- Invention of an optical Perfectly Impedance-Matched Negative-Index Metamaterial (see **Inventions**) (2008).
- Plasmonic Negative Index Metamaterials (NIM) for near-infrared light (2006-08).
- Finite Element implementation of the Surface Charge Integral Equation (SCIE) and Generalized Eigenvalue Differential Equation (GEDE) formalisms for surface plasmon resonances (2006-07).
- Design of a proof-of-principle optical experiment that demonstrated ground-breaking $\lambda/20$ resolution in mid-infrared using SiC superlens (2006).
- Efficient numerical procedures for band structure calculations of 3D and 2D photonic/plasmonic crystals with frequency-dispersive components (Bloch-Floquet modal solver) (2006-12).
- Quasistatic homogenization theory that encompasses electric, magnetic and magnetoelectric effective medium parameters; and methodology for fast characterization of metal-dielectric metamaterials based on quasistatic plasmon eigenmode expansion (2005-07).
- Prediction, observation and explanation of extraordinary optical transmission (EOT) via delocalized surface phonon-polaritons in perforated SiC membranes (2005-06).

- Theoretical discovery of extremely anisotropic waves with hyperbolic dispersion and a new kind of van Hove singularity in photonic crystals of the cubic class (2003).

7. Teaching experience and faculty service

- PhD Dissertation/Defense Committee of Ma Luo (Chair: Prof. Qing Liu), Duke/ECE, Spring 2013.
- PhD Dissertation/Defense Committee of Tianyao Yue (Chair: Prof. Qing Liu), Duke/ECE, Fall 2012.
- Regular poster presentation judge for the undergraduate independent study program, Duke/ECE, 2011-2013.
- Advising graduate (M.S.) student in an independent study course (Duke/ECE Course 399.07), Spring 2011.
- Lectures: Introduction to Electromagnetics Modeling with COMSOL Multiphysics, as part of the graduate course in Electrical and Computer Engineering (ECE 299), Duke University, Fall 2010.
- Developed COMSOL Training Class for electrical engineers; conducted for students and researchers at the Center for Metamaterials and Integrated Plasmonics, Department, Duke University, March 10, 2010; conducted for Northrop Grumman Corporation engineers at CMIP, Duke University, December 8, 2010.
- Provided expert level technical support related to Finite Element Analysis with COMSOL Multiphysics to hundreds of scientists, researchers and engineers in the US, Canada and overseas, with specialization in high and low frequency electromagnetism, optics and photonics (2008-2009)
- Conducted numerous COMSOL Multiphysics workshops for broad audiences in various cities across the U.S. (2008-2009)
- Taught Finite Element Method at multiple COMSOL training courses for academic and research audiences (2008-2009)
- Training course: “Nano-Photonics and Plasmonics in COMSOL Multiphysics”, COMSOL Users Conference 2008 (Boston, Mass.)
- Conducted supplementary course-related seminars for an undergraduate course in Electromagnetic Theory (Ill. Inst. Technol., Chicago, 2002)

8. Membership in professional societies

- Since 2012: Institute of Electrical and Electronics Engineers (**IEEE**)
- Since 2011: *Senior Member* of **SPIE**
- Since 2007: Optical Society of America (**OSA**)
- Since 2006: **SPIE** (formerly International Society for Optical Engineering)
- Since 2003: American Physical Society (**APS**)

9. Professional public service

I. Conference service (committee, chair)

- Technical Program Committee member, proceedings reviewer, session organizer: Metamaterials Congress 2013, Bordeaux, France, September 16-19, 2013.
- Program committee member, proceedings reviewer, session moderator: COMSOL Conference 2012 Boston, Newton (Mass.), Oct. 3-5, 2012.
- Session chair: MRS 2011 Spring Meeting, Symposium W, San Francisco (Calif.), April 25-29 (2011).

II. Journal service (reviewer, referee, adjudicator)

- Optical Society of America (OSA), since 2006: *Optics Express*, *Optics Letters*, *JOSA A*, *JOSA B*
- Institution of Engineering and Technology, UK (IET), since 2007: *Microwaves, Antennas and Propagation*
- Massachusetts Institute of Technology (MIT), since 2009: *Progress in Electromagnetics Research (PIER)*
- Institute of Physics, UK (IOP), since 2010: *Journal of Optics*
- American Institute of Physics (AIP), since 2010: *Journal of Applied Physics*, *Applied Physics Letters*
- American Physical Society (APS), since 2012: *Physical Review Letters*, *Physical Review X*
- Royal Society, UK, since 2010: *Proceedings A*
- John Wiley & Sons, since 2011: *International Journal of Numerical Modelling: Electronic Networks, Devices and Fields*
- Nature, since 2011: *Nature Materials*, *Nature Photonics*, *Nature Physics*, *Nature Scientific Reports*
- Taylor & Francis, 2012: book proposal
- COMSOL, 2012: *Proceedings of COMSOL Conference Boston*
- IEEE, 2012: *Ant. Wireless Prop. Lett.*, *Trans. Industr. Informatics*
- Hindawi Publishing, since 2012: *Advances in Optoelectronics*
- Cambridge University Press, 2013: book proposal

10. Other evidence of merit or recognition

1. 2011: Elected a Senior Member of SPIE
2. 2009: Selected for inclusion in the 2010 edition of Marquis *Who's Who In America*.
3. 2008: Outstanding Dissertation in Physics 2007-2008 award, Department of Physics, Univ. of Texas at Austin.
4. 2006: SPIE Scholarship award, The International Society of Optical Engineering.
5. 2005: David Bruton, Jr. Fellowship award, Univ. of Texas at Austin, Texas.

11. Patents and inventions

- 2008: Invention disclosure (U.S. Patent application filed): "Wide-angle wavelength-selective infrared absorber (WAWS-AIR) and Wide-angle

wavelength-selective emitter of thermal infrared radiation (WAWS-ETIR) based on a negative index impedance matched plasmonic metamaterial”. Filed with the Office of Technology Commercialization (OTC) of the University of Texas, reg. no. 5456.

12. Publications and Public Presentations: 113 (total)

a. Books and book chapters: 4

1. N. Landy, Y. Urzhumov and D. R. Smith, Chapter “Quasi-Conformal Approaches for Two and Three-Dimensional Transformation Optical Media”, in “Transformation Electromagnetics and Metamaterials: Fundamental Principles and Applications”, eds. Douglas H. Werner and Do-Hoon Kwon, *Springer*, London Heidelberg New York Dordrecht, 2014 (ISBN 978-1-4471-4995-8).
2. Y. Urzhumov and G. Shvets, Chapter “Optical Magnetism in Plasmonics Metamaterials”, in “Tutorials in Complex Photonic Media”; eds. Mikhail A. Noginov et al., *SPIE Press*, Bellingham, Wash., 2009 (ISBN 978-0-8194-7773-6).
3. Y. Urzhumov, "Sub-wavelength Electromagnetic Phenomena in Plasmonic and Polaritonic Nanostructures: from Optical Magnetism to Super-resolution", *Lambert Academic Publishing*, Germany, 2009 (ISBN 3838303903, 9783838303901) (252 pages).
4. Y. Urzhumov et al.: Russian translation of S. Weinberg, “The Quantum Theory of Fields”, editor V. Zhukovskiy, *Fizmatlit*, Moscow, Russia, 2003.

b. Refereed publications in scientific journals: 47

1. Dongheok Shin, Yaroslav Urzhumov, Donghwan Lim, Kyoungsik Kim & David R. Smith, “A versatile smart transformation optics device with auxetic elasto-electromagnetic metamaterials”, *Nature Sci. Rep.* **4**, p. 4084 | DOI: 10.1038/srep04084 (February 13, 2014).
2. Guy Lipworth, Joshua Ensworth, Kushal Seetharam, Da Huang, Jae Seung Lee, Paul Schmalenberg, Tsuyoshi Nomura, Matthew S. Reynolds, David R. Smith & Yaroslav Urzhumov, “Magnetic metamaterial superlens for increased range wireless power transfer”, *Nature Sci. Rep.* **4**, p. 3642 | DOI: 10.1038/srep03642 (January 10, 2014); highlighted in tech-news media (Phys.org, Campus Technology, Red Orbit, HNGN, Fierce Wireless Tech, Hexus, Bit-Tech, Architect Magazine, etc.)
3. Tom Driscoll, Yaroslav Urzhumov, Nathan Landy, Dimitri Basov and David R. Smith, “Dielectric Metamaterials and Composites in the Age of 3D Printing, and Directional Cloaking”, *Proc. of Metamaterials’2013: The 7th International Congress on Advanced Electromagnetic Materials in Microwaves and Optics* (2013).
4. Cristian Ciraci, Yaroslav Urzhumov and David R. Smith, “Effects of classical nonlocality on the optical response of three-dimensional plasmonic nanodimers”, *J. Opt. Soc. Am. B* **30** (10), p. 2731 (October 2013).

5. Yaroslav Urzhumov, Cristian Ciraci and David R. Smith, “Nanophotonics: Optical time reversal with graphene”, *Nature Physics* **9**, 393-394 (News & Views) (2013).
6. Yaroslav Urzhumov, Nathan Landy, Tom Driscoll, Dimitri Basov and David Smith, “Thin Low-Loss Dielectric Coatings for Free-Space Cloaking”, *Opt. Lett.* **38**, pp. 1606-1608 (2013); **most downloaded** Optics Letter in May 2013; highlighted in *Optics & Photonics News* (OPN) magazine, *Popular Science* magazine, *Laboratory Equipment* magazine, *NTV Russia* television, *Voice of Russia* radio, and various tech news media (*Yahoo News*, *PCMag*, *PhysOrg*, *DVICE*, *Business Standard*, *GizMag*, *Wired*, *inhabitat*, *GigaOm*, *Extreme Tech*, *Kurzweil AI*, *French Tribune*, *Design&Trend*, *Futurity*, and others).
7. Cristian Ciraci, Yaroslav Urzhumov and David R. Smith, “Far-Field Analysis of Axially Symmetric Three-Dimensional Directional Cloaks”, *Opt. Express* **21**, 9397 (2013).
8. Dongheok Shin, Yaroslav Urzhumov, Youngjean Jung, Gumin Kang, Seunghwa Baek, Minjung Choi, Haesung Park, Kyoungsik Kim and David R. Smith, “Broadband Electromagnetic Cloaking with Smart Metamaterials,” *Nature Comm.* **3**, 1213 (2012).
9. Y. Urzhumov and D. R. Smith, “Low-loss invisibility cloaks without superluminal velocity or magnetic response,” *Opt. Lett.* **37**, 4471 (2012); arXiv:1209.5627 [physics.optics]
10. Y. Urzhumov and D. R. Smith, “Flow stabilization with active hydrodynamic cloaks,” *Phys. Rev. E* **86**, 056313 (2012).
11. Y. Urzhumov, N. Landy and D. R. Smith, “Optically large three-dimensional directional cloaks: off-normal incidence performance study,” *Proc. of Metamaterials’2012: The 6th International Congress on Advanced Electromagnetic Materials in Microwaves and Optics*, p. 589 (2012).
12. C. Ciraci, R. T. Hill, J. J. Mock, Y. Urzhumov, A. I. Fernandez-Dominguez, S. A. Maier, J. B. Pendry, A. Chilkoti and D. R. Smith, “Probing the Ultimate Limits of Plasmonic Enhancement,” *Science* **337**, 1072 (2012); **selected for the cover** of August 31, 2012 issue.
13. Y. Urzhumov, T. Tyler, S. Dhar, V. Nguyen, N. M. Jokerst, D. R. Smith, P. Schmalenberg and J. S. Lee, “Electronically reconfigurable metal-on-silicon metamaterial,” *Phys. Rev. B* **86**, 075112 (2012); arXiv:1208.1250v1 [physics.optics].
14. M. A. Shapiro, S. Trendafilov, Y. Urzhumov, A. Alu, R. J. Temkin and G. Shvets, “Active Negative Index Metamaterial Powered by an Electron Beam,” *Phys. Rev. B* **86**, 005100 (2012).
15. O. Paul, Y. Urzhumov, C. Elsen, D. R. Smith and M. Rahm, “Construction of invisibility cloaks of arbitrary shape and size using planar layers of metamaterials,” *J. Appl. Phys.* **111**, 123106 (2012); arXiv:1110.5604v1.
16. D. Huang, Y. Urzhumov, D. R. Smith, K. H. Teo and J. Zhang, “Magnetic superlens-enhanced inductive coupling for wireless power transfer,” *J. Appl. Phys.* **111**, 064902 (2012); arXiv:1204.0231v1 [cond-mat.mtrl-sci]; highlighted by *American Institute of Physics* and reviewed in *ScienceDaily*, March 12, 2012.

17. Y. Urzhumov, N. Landy and D. R. Smith, “Isotropic-medium three-dimensional cloaks for acoustic and electromagnetic waves,” *J. Appl. Phys.* **111**, 053105 (2012); arXiv:1203.5831v1 [physics.optics].
18. Y. Urzhumov, Wenchen Chen, Chris Bingham, Willie Padilla and David R. Smith, “Magnetic levitation of metamaterial bodies enhanced with magnetostatic surface resonances,” *Phys. Rev. B* **85**, 054430 (2012); arXiv:1111.1695v2 [physics.optics]; highlighted in *Duke Engineering News*, reviewed in *MRS Materials 360 Global View Newsletter*, March 2012.
19. Y. Urzhumov and D. R. Smith, “Towards macroscopic optical invisibility devices: geometrical optics of complex materials,” *Proc. of the 5th International Congress on Advanced Electromagnetic Materials in Microwaves and Optics*, (“Metamaterials-2011”), Barcelona, Spain, October 10-15, 2011.
20. C. Fietz, Y. Urzhumov and G. Shvets, “Complex k band diagrams of 3D metamaterial/photonic crystals”, *Optics Express* **19**, 19027 (2011); arXiv:1106.0043 [cond-mat.mtrl-sci].
21. Y. Urzhumov and D. R. Smith, “Fluid flow control with transformation media,” *Phys. Rev. Lett.* **107**, 074501 (2011); Erratum: *Phys. Rev. Lett.* **107**, 189902 (2011); arXiv:1106.2282 [physics.flu-dyn]; marked *PRL Editors’ Suggestion*; selected for a *Synopsis in APS Physics*; reviewed by *The Forbes*, *The Atlantic*, *Physics World*, *Science NOW*, *PhysOrg*, *New Scientist*, *Gizmag* and other online mass media; one of the **Top 10 most downloaded** press releases in *EurekAlert*.
22. Y. Urzhumov and D. R. Smith, “Metamaterial-enhanced coupling between magnetic dipoles for efficient wireless power transfer”, *Phys. Rev. B* **83**, 205114 (2011); arXiv:1102.2281 [physics.class-ph]; reviewed by *MSNBC*, *The Register (UK)*, *Science Daily*, *Yahoo News*, *MIT Technology Review*, *Wireless Power Planet*, *The Technology Review*, *Next Big Future*, *Gizmag*, *TG Daily*, *PhysNews* and other online media.
23. E. Poutrina, D. Huang, Y. Urzhumov and D. R. Smith, “Nonlinear oscillator metamaterial model: numerical and experimental verification”, *Opt. Expr.* **19** (9), p. 8312 (2011).
24. Y. Urzhumov and D. R. Smith, “Transformation Optics with Photonic Band Gap Media”, *Phys. Rev. Lett.* **105**, p. 163901 (2010); **selected for the cover** of Oct. 15 issue; arXiv:1007.3227 [physics.optics]
25. D. R. Smith, Y. Urzhumov, N. B. Kundtz and N. Landy, “Enhancing Imaging Systems using Transformation Optics”, *Opt. Expr.* **18** (20), p. 21238 (2010).
26. R. Hill, J. Mock, Y. Urzhumov, D. Sebban, S. Oldenburg, S.-Y. Chen, A. Lazarides, A. Chilkoti and D. R. Smith, “Leveraging Nanoscale Plasmonic Modes to Achieve Reproducible Enhancement of Light”, *Nano Lett.* **10** (10), p. 4150-4154 (2010).
27. Y. Urzhumov, N. Kundtz, J. Pendry and D. R. Smith, **Invited Review Paper** “Cross-Section Comparisons of Cloaks Designed by Transformation Optical and Optical Conformal Mapping Approaches“, *J. Opt.* **13**, 024002, in *Special Issue on Transformation Optics* (2011); one of *J. Optics’ Top 25 papers of the year*; included in **2011 Highlights**.

28. Y. Urzhumov, F. Ghezzo, J. Hunt and D. R. Smith, "Acoustic cloaking transformations from attainable material properties", *New J. Phys.* **12**, p. 073014 (2010); selected for inclusion in **IOP Select** (Nov. 2010).
29. X. Zhang, M. Davanco, Y. Urzhumov, G. Shvets and S. Forrest, "A subwavelength near-infrared negative index material", *Appl. Phys. Lett.* **94**, p. 131107 (2009); one of APL's monthly **Top 20 most-downloaded** articles in 2010.
30. Y. Avitzour, Y. Urzhumov and G. Shvets, "Wide-angle infrared absorber based on a negative-index plasmonic metamaterial", *Phys. Rev. B* **79**, p. 045131 (2009); arXiv:0807.1312 [physics.optics].
31. X. Zhang, M. Davanco, Y. Urzhumov, G. Shvets and S. Forrest, "From scattering to Snell's law: A subwavelength near-infrared negative-index metamaterial," *Phys. Rev. Lett.* **101**, p. 267401 (2008).
32. F. Le, D. Brandl, Y. Urzhumov, H. Wang, J. Kundu, N. Halas, J. Aizpurua, and P. Nordlander, "Metallic nanoparticle arrays: a common substrate for both Surface-Enhanced Raman Scattering and Surface-Enhanced Infrared Absorption", *Amer. Chem. Soc. Nano* **2** (no. 4), p. 707-718 (2008).
33. Y. Urzhumov and G. Shvets, "Optical magnetism and negative refraction in plasmonic metamaterials", *Solid State Comm.* **146**, p. 208-220 (2008).
34. Y. A. Urzhumov, G. Shvets, J. A. Fan, F. Capasso, D. Brandl, and P. Nordlander, "Plasmonic nanoclusters: a path towards negative-index metafluids," *Opt. Express* **15**, p. 14129-14145 (2007).
35. D. Korobkin, Y. Urzhumov, B. Neuner III, C. Zorman, Z. Zhang, I. D. Mayergoyz, and G. Shvets, **Invited Paper** "Mid-infrared metamaterial based on perforated SiC membrane: Engineering optical response using surface phonon polaritons", *Appl. Phys. A: Mat. Sci. Process.* **88**, p. 605 (2007); arXiv:physics/0606207.
36. M. Davanco, Y. Urzhumov, and G. Shvets, "The Complex Bloch Bands of a 2D Plasmonic Crystal Displaying Isotropic Negative Refraction", *Optics Express* **15**(15), p. 9681-9691 (2007).
37. Y. Urzhumov, D. Korobkin, B. Neuner III, C. Zorman and G. Shvets, "Optical Properties of Sub-Wavelength Hole Arrays in SiC Membranes", *J. Opt. A: Pure Appl. Opt.* **9**, p. S1-S12 (2007).
38. V. Lomakin, Y. Fainman, Y. Urzhumov, and G. Shvets, "Doubly negative metamaterials in the near infrared and visible regimes based on thin film nanocomposites", *Optics Express* **14** (23), p. 11164 (2006).
39. T. Taubner, D. Korobkin, Y. Urzhumov, G. Shvets, and R. Hillenbrand, "Near-field microscopy through a SiC superlens", *Science* **313**, p. 1595 (in Brevia) (2006); also reported in *ScienceDaily* (Sep. 15, 2006) as an article "New 'superlens' reveals hidden nanostructures".
40. G. Shvets and Y. Urzhumov, "Negative index meta-materials based on two-dimensional metallic structures", *J. Opt. A: Pure Appl. Opt.* **8**, S122-S130 (2006).
41. D. Korobkin, Y. Urzhumov, and G. Shvets, "Enhanced near-field resolution in midinfrared using metamaterials", *J. Opt. Soc. Am. B* **23** (3), p. 468 (2006).

42. D. Korobkin, Y. Urzhumov, C. Zorman and G. Shvets, "Far-Field Detection of the Super-Lensing Effect in Mid-Infrared: Theory and Experiment", *J. Mod. Opt.* **52** (16), p. 2351 (2005).
43. G. Shvets and Y. Urzhumov, "Electric and Magnetic Properties of Sub-wavelength Plasmonic Crystals", *J. Opt. A: Pure Appl. Opt.* **7**, S23-S31 (2005).
44. Y. Urzhumov and G. Shvets, "Extreme Anisotropy of Wave Propagation in Two-Dimensional Photonic Crystals", *Phys. Rev. E* **72**, 026608 (2005).
45. G. Shvets and Y. Urzhumov, "Engineering the Electromagnetic Properties of Periodic Nanostructures Using Electrostatic Resonances", *Phys. Rev. Lett.* **93**, 243902 (2004); arXiv:cond-mat/0403400.
46. G. Shvets and Y. Urzhumov, "Polariton-enhanced Near-field Lithography and Imaging with Infrared Light", *Mat. Res. Soc. Symp. Proc.* **820** (2004).
47. Y. Urzhumov, "Special Relativistic Spherically Symmetric Lagrangian Hydrodynamics from General Relativity", *Grav. Cosmol.* **8**, 222-226 (2002); arXiv:astro-ph/0101098.

c. Other publications: 34

1. Dongheok Shin, Yaroslav Urzhumov, Kyoungsik Kim and David R. Smith, "Self-adjustable smart cloaking with an elastic and electromagnetic crystal," Proc. of Korea-Japan Forum, 2013.
2. Yaroslav Urzhumov, Nathan Landy, Tom Driscoll and David R. Smith, "All-dielectric cloaking structures: design and stereolithographic fabrication", Proc. of SPIE Optics + Photonics 2013, San Diego, August 25-29, 2013.
3. Dongheok Shin, Yaroslav Urzhumov, Youngjean Jung, Kyoungsik Kim and David R. Smith, "Smart metamaterial based on elastic crystals", Proc. of SPIE Optics + Photonics 2013, San Diego, August 25-29, 2013.
4. Yaroslav Urzhumov, Guy Lipworth, Joshua Ensworth, Kushal Seetharam, Jae Seung Lee, Paul Schmalenberg, Matt Reynolds and David R. Smith, "Negative-permeability Superlenses for Near-Field Magneto-inductive Wireless Power", Proc. of PIERS 2013, Stockholm, Sweden, August 10-15, 2013.
5. Yaroslav Urzhumov, Nathan Landy, Tom Driscoll and David R. Smith, "Realization of Multidirectional Microwave Cloaks Based on Thin Dielectric Coatings", Proc. of PIERS 2013, Stockholm, Sweden, August 10-15, 2013.
6. Yaroslav Urzhumov, Anthony F. Starr, and David R. Smith, "Structurally Rigid Elastic Composites for Acoustic Imaging Countermeasures", Proc. of Phononics 2013: 2nd International Conf. on Phononic Crystals/Metamaterials, Sharm El-Sheikh, Egypt; June 2-7, 2013.
7. D. R. Smith, Y. Urzhumov and N. Landy, "Considerations for Transformation Optics Based Electromagnetic Cloaking," Proc. of ETOPIM9, Marseille, France, September 2-7 (2012).
8. Y. Urzhumov, N. Landy, C. Ciraci and D. R. Smith, "Going beyond Axisymmetry: 2.5D Vector Electromagnetics," Proc. of COMSOL Conference 2012, Boston, 2012.

9. Shiu-an-Yeh Chen, Yaroslav Urzhumov, David R. Smith, Anne A. Lazarides, "Characterization of high order modes of plasmonic antenna formed by nanoparticle/thin film hybrid structures," Proc. of SPIE Vol. **8269**, 82691M
10. E. Poutrina, Da Huang, Y. Urzhumov and D.R. Smith, "Nonlinear Oscillator Model for a Metamaterial with a Magnetic Response: Experimental Verification", Proc. of the 3rd International Topical Meeting on Nanophotonics and Metamaterials (NanoMeta 2011), Seefeld, Austria, Jan. 3-6 (2011); abstract TUE4f.26.
11. X. Zhang, M. Davanco, Y. Urzhumov, G. Shvets and S. Forrest, "A subwavelength near-infrared negative-index metamaterial", FiO/LS/META/OF&T 2008 Conf. Proc., paper MMB6, Rochester, NY, Oct. 19-24 (2008).
12. T. Taubner, M. L. Brongersma, C. Fietz, Y. Urzhumov, D. Korobkin, G. Shvets, and R. Hillenbrand, "Imaging process in superlens-based mid-infrared near-field microscopy", Metamaterials'07 Conf. Proc. (First International Congress on Advanced Electromagnetic Materials in Microwaves and Optics), Rome, Italy, Oct. 22-26 (2007).
13. G. Shvets, D. Korobkin, Y. A. Urzhumov, "Extraordinary transmission and absorption in hole arrays mediated by surface phonon polaritons" (**Invited**), Metamaterials'07 Conf. Proc., Rome, Italy, Oct. 22-26 (2007).
14. G. Shvets, D. Korobkin, Y. Urzhumov, B. Neuner III, C. Fietz, C. Zorman, T. Taubner, and R. Hillenbrand, "Extraordinary optical properties of SiC membranes", Frontiers in Optics (FiO) Conf. Proc., paper FThR1, San Jose, Calif., Sept. 16 (2007).
15. V. Lomakin, Y. Fainman, Y. Urzhumov, and G. Shvets, "Negative index metamaterials in the near-IR and visible spectra based on thin metal films", Electromagnetic Theory Symposium (EMTS) Proc., paper O18-14 p. 047, Ottawa, Canada, July 26-28 (2007).
16. M. Davanco, X. Zhang, S. R. Forrest, Y. Urzhumov, and G. Shvets, "Nanofabrication and characterization of sub-wavelength metamaterials for left-handed propagation at near-infrared wavelengths", Proc. IEEE LEOS Annual Conf., Lake Buena Vista, Florida, Oct. 21-25 (2007).
17. V. Lomakin, Y. Fainman, Y. Urzhumov, and G. Shvets, "Doubly Negative Metamaterials with Subwavelength Unit Cells in Visible and Near Infrared," in *Conference on Lasers and Electro-Optics/Quantum Electronics and Laser Science Conference and Photonic Applications Systems Technologies*, Baltimore, Maryland, May 6-11 (2007); OSA Technical Digest (CD) (Optical Society of America, 2007), paper QMJ6 (p. 4431633).
18. Y. Urzhumov and G. Shvets, **Invited Paper** "Quasistatic effective medium theory of plasmonic nanostructures", Proc. SPIE **6642**, 66420X-1 (2007).
19. V. Lomakin, Y. Fainman, Y. Urzhumov, and G. Shvets, **Invited Paper** "Optical metamaterials based on thin metal films: From negative index of refraction, to enhanced transmission, and to surface wave guidance", Proc. SPIE **6638**, 663805-1 (2007).

20. G. Shvets, Y. Urzhumov, D. Korobkin, B. Neuner III, C. Zorman, **Invited Paper** “Optical properties of sub-wavelength hole arrays in SiC membranes”, Proc. SPIE **6638**, p. 6638-12 (2007).
21. G. Shvets, Y. Urzhumov, V. Lomakin, M. Davanco, S. Forrest, **Invited Paper** “Negative Index Materials based on plasmonic and polaritonic components”, Proc. SPIE **6642**, p.6642-35 (2007).
22. G. Shvets, D. Korobkin, Y. A. Urzhumov and C. Zorman, “Super-lensing and sub-wavelength antennas in mid-IR using silicon carbide”, Proc. of American Physical Society (APS), abstract #G16.004, March 13-17 (2006).
23. G. Shvets, D. Korobkin, Y. Urzhumov, and M. Shapiro, "Spatial Dispersion in Metallic Meta-materials," in *Photonic Metamaterials: From Random to Periodic*, Technical Digest (CD) (Optical Society of America, 2006), paper MA5.
24. G. Shvets, D. V. Korobkin, M. Shapiro, and Y. Urzhumov, **Invited Paper** “Spatial Dispersion in Metallic Metamaterials”, *SPIE Optics+Photonics '06*, Proc. SPIE **6323**, p.6323-32 (2006).
25. Y. Urzhumov and G. Shvets, “Spectroscopy of Nano-Holes in Polaritonic Films: Theory and Experiment”, *SPIE Optics+Photonics '06*, Proc. SPIE **6323**, p.6323-33 (2006).
26. T. Taubner, R. Hillenbrand, D. Korobkin, Y. Urzhumov, G. Shvets, “Direct near-field optical verification of mid-infrared superlensing”, *SPIE Optics+Photonics '06*, Proc. SPIE **6323**, p.6323-35 (2006).
27. G. Shvets, D. Korobkin, Y. Urzhumov, and B. Neuner III, "Giant Transmission and Dissipation in Perforated Films Mediated by Surface Phonon Polaritons," in *Frontiers in Optics*, OSA Technical Digest (CD) (Optical Society of America, 2006), paper FThF4; arXiv:physics/0606207 (2006).
28. Y. Urzhumov and G. Shvets, **Invited Paper** “Applications of nanoparticle arrays to coherent anti-Stokes Raman spectroscopy of chiral molecules,” Proc. SPIE Int. Soc. Opt. Eng. **5927**, 59271D (2005).
29. D. Korobkin, Y. A. Urzhumov and G. Shvets, “Phononic Nanophotonics: Superlensing in mid-IR,” *Frontiers in Optics (FiO) Conf. Proc.*, paper FMG2, Tucson, Ariz., Oct. 16 (2005).
30. G. Shvets and Y. A. Urzhumov, “How to make an optical super-lens: the plasmonic crystal approach,” *Frontiers in Optics (FiO) Conf. Proc.*, paper FMG3, Tucson, Ariz., Oct. 16 (2005).
31. G. Shvets and Y. Urzhumov, “Applications of extreme anisotropy of two-dimensional photonic structures,” in *Conference on Lasers and Electro-Optics/International Quantum Electronics Conference and Photonic Applications Systems Technologies*, Technical Digest (CD) (Optical Society of America, 2004), paper IThE2.
32. Y. A. Urzhumov and G. Shvets, “Extreme anisotropy of two-dimensional photonic crystals due to mode degeneracy and crystal symmetry,” Proc. SPIE Int. Soc. Opt. Eng. **5184**, p. 47 (2003).
33. Y. A. Urzhumov, “Nucleosynthesis in the Universe – a review of modern views and most prominent results,” Preprint ITEP N. **29**, Moscow (2000).
34. Y. A. Urzhumov, "Neutrino Oscillations, Cosmology and Mirror World hypothesis", at the *XII Petrov Lectures* (in Russian), Kazan State Univ., June 22 -

July 2, 2000, Tatarstan, Russia (Abstract published in Proceedings, ISBN 5-900004-64-3).

d. Talks and presentations: 31

1. Y. Urzhumov, **Invited Talk** “Metamaterial-Based Design: The Grand Unification Scheme for Electromagnetic, Acoustic and Hydrodynamic Applications,” ECE Seminar, Boise State Univ., Boise, ID, April 8 (2013).
2. Y. Urzhumov, **Invited Talk** “Metamaterial-enabled applications in electromagnetic imaging, acoustics and fluid dynamics,” Electrical Engineering Research Seminar, Univ. at Buffalo – SUNY, Buffalo, NY, February 11 (2013).
3. Y. Urzhumov, N. Landy and D. R. Smith, **Talk** “Microwave Invisibility and Beyond: Metamaterial-Based Transformations,” Army Research Office MURI Review Meeting, Chapel Hill, N.C., November 8 (2012).
4. Y. Urzhumov, N. Landy, C. Ciraci and D. R. Smith, **Talk** “Going beyond Axisymmetry: 2.5D Vector Electromagnetics,” COMSOL Conference Boston, Newton, Mass., October 3-5 (2012).
5. Y. Urzhumov, N. Landy and D. R. Smith, **Talk** “Optically large three-dimensional directional cloaks: off-normal incidence performance study,” Metamaterials’2012: The 6th International Congress on Advanced Electromagnetic Materials in Microwaves and Optics, September 19 (2012).
6. Y. Urzhumov, N. Landy, J. Hunt, S. Larouche, Y.-J. Tsai, T. Driscoll, G. Lipworth, N. Kundtz, T. Tyler, N. Jokerst and David R. Smith, Poster “Metamaterials and Transformation Optics: A Symbiotic Duo That Enabled Novel Devices Across The Spectrum”, DoD Tri-Services Metamaterials Review 2012, Virginia Beach, Virginia, May 22-25 (2012).
7. Y. Urzhumov and D. R. Smith, Poster “Fluid-permeable metamaterials for flow control,” IWEM-V: The 5th Int’l Workshop on Electromagnetic Metamaterials, Albuquerque, New Mexico, March 26-28 (2012).
8. Y. Urzhumov, **Invited Talk** “Electromagnetic metamaterials and transformation optics: the symbiotic duo that enabled novel applications,” Duke University, ECE Department, Durham, N. Carolina, March 2 (2012).
9. Y. Urzhumov, **Invited Talk** “Electromagnetic metamaterials, transformation wave dynamics, and their real-world applications”, University of Utah, Salt Lake City, February 27 (2012).
10. Y. Urzhumov and D. R. Smith, Poster “Cloaking beyond Wave Physics: Making Things Intangible to Fluids”, Transformation Optics MURI Review, Virginia Beach, November 9 (2011).
11. Y. Urzhumov and D. R. Smith, **Talk** “Towards macroscopic optical invisibility devices: the geometrical optics of complex materials”, Metamaterials’2011: The Fifth Int’l Congress on Advanced Electromagnetic Materials in Microwaves and Optics, Barcelona, Spain, October 10-13 (2011).
12. Y. Urzhumov and D. R. Smith, **Invited Talk** “Transformation Electromagnetics from RF to Optical: Applications of photonic meta-media”, Optics and Photonics Seminar Series, Duke University, August 30 (2011).

13. Y. Urzhumov, R. Liu, E. Poutrina, S. Larouche and D. R. Smith, Poster “Three-Dimensional metamaterials for negative-index and quasi-optical devices”, AFOSR Joint Electronics Program Review, Arlington, Virginia, May 23-26 (2011).
14. Y. Urzhumov and D. R. Smith, **Talk** “Transformation Optics Beyond Effective Medium Regime: A Case for Low-Loss Optical Cloaks”, MRS 2011 Spring Meeting, San Francisco (Calif.), April 25-29 (2011).
15. Y. Urzhumov and D. R. Smith, Poster “Optical Invisibility: Advances in Theory and Design”, 2010 Fitzpatrick Institute of Photonics (FIP) Annual Meeting, Duke University, Durham (N. Carolina), October 27-28 (2010).
16. Y. Urzhumov, N. Kundtz, J. Hunt and D. R. Smith, Poster “Optical Cloaking Devices Based on Coordinate Transformations: Advances in Theory and Design”, Transformation Optics MURI Review 2010, Duke University, Durham (N. Carolina), July 27 (2010).
17. Y. Urzhumov, **Invited Keynote Talk** “Computational Plasmonics: From Nanoparticles to Optical Metamaterials”, Gordon Research Seminar in Plasmonics, Colby College, Waterville (Maine), June 12 (2010).
18. Y. Urzhumov, **Workshop** “Introduction to COMSOL Multiphysics”, lectures with hands-on training at Pasadena (Calif.), Austin (Tex.), Dallas (Tex.), Houston (Tex.), San Antonio (Tex.), 2008-2009 (multiple sessions).
19. Y. Urzhumov, **Training Course** “COMSOL Multiphysics: Introduction and Advanced Features”, 2-day lectures with hands-on training, Houston (Tex.), 2008-2009 (multiple sessions).
20. Y. Urzhumov, **Tutorial Presentation** “Nano-photonics and Nano-Plasmonics Modeling with COMSOL Multiphysics”, *COMSOL Conference 2008*, Boston (Mass.), October 9-11 (2008).
21. Y. Urzhumov, **Invited Talk** "Optical Negative-Index Materials Based on Plasmonic Components" [6642-35], *SPIE Optics+Photonics'07*, Plasmonic Metamaterials II, San Diego (Calif.), August 30 (2007).
22. Y. Urzhumov, **Talk** “Engineering Optical Metamaterials and Metafluids”, *Nanotechnology Seminar Series*, Research Colloquium of the Graduate Portfolio Program in Nanotechnology, Univ. of Texas at Austin, April 18 (2007).
23. Y. Urzhumov, **Talk** "Homogenization of periodic plasmonic nanostructures: optical magnetism and spatial dispersion" [6323-33], *SPIE Optics+Photonics'06*, Periodic and Complex Nanoplasmonic Structures I, San Diego (Calif.), August 14 (2006).
24. Y. Urzhumov, G. Shvets, Poster "Homogenization theory and optical magnetism of plasmonic nanostructures", *Gordon Research Conference in Plasmonics*, Keene (N. Hamp.), July 23-28 (2006).
25. Y. Urzhumov, **Talk** “Extreme Anisotropy in Highly Symmetric Photonic Crystals”, *V.I.P. Seminar* of the Institute for Fusion Studies, Univ. of Texas at Austin, November 22 (2005).
26. Y. Urzhumov, D. Korobkin, G. Shvets, Poster "Negative Index Materials in Visible and Infrared", *Negative-Index Metamaterials Kick-Off Meeting* of the Defense Advanced Research Projects Agency (DARPA) of the U.S. Department of Defense, San Antonio, Texas, April 27-29 (2005).

27. Y. Urzhumov, D. Korobkin, G. Shvets, Poster "Sub-wavelength Imaging with Near-Field Super-Lens: Theory and Experiment", *NanoNight-2005* at the Univ. of Texas, Austin, April 22 (2005).
28. Y. Urzhumov, **Talk** "Superlensing with 2D subwavelength photonic crystals", at the Physics Department of the Univ. of Texas at Austin, March 29 (2005).
29. Y. Urzhumov, D. Korobkin, G. Shvets, Poster "Applications of Negative-permittivity Materials to Sub-wavelength Imaging and Nanotechnologies", *NanoNight-2004* at Univ. of Texas, Austin, April 23 (2004).
30. Y. Urzhumov, Poster "Collective Stopping of Relativistic Electron Beams in Dense Plasma by Weibel and Tearing Instabilities", *FIW2002 - 6th Workshop on Fast Ignition of Fusion Targets*, November 16-19, 2002, St. Pete's Beach, Florida; Lawrence Livermore National Laboratories Report No. UCRL-ID-152852 (2004).
31. Y. A. Urzhumov, **Invited Talk** "Mirror World, Neutrino Oscillations and their Implications in Astrophysics", at the *All-Moscow Seminar in Astrophysics* (in Russian), Sternberg Astronomical Inst. of MSU, Moscow, November 24 (2000).

e. Breakdown of Publications by Institution

- Publications generated while at Duke University
 - Refereed papers & book chapters: 29
 - Proceedings, preprints, reviews: 10
 - Talks and presentations: 17
- Publications generated while an Applications Engineer at COMSOL, Inc.
 - Refereed: 5
 - Proceedings, preprints, reviews: 1
 - Talks: 3 (presented multiple times)
- Publications generated while in Graduate School at the University of Texas
 - Refereed: 13
 - Proceedings, preprints, reviews: 20
 - Talks and presentations: 10
- Publications while in Graduate School at the Illinois Institute of Technology
 - Conference proceedings and preprints: 1
- Publications generated while in Masters School at the Moscow Institute of Physics and Technology
 - Refereed: 1
 - Proceedings, preprints, reviews: 2

f. Citation Information from ISI Web of Knowledge

- Articles included: 54
- Sum of the times cited: 1423; excluding self-citations: 1319
 - citations per item: 26.35; average citations per year: 142.30
- Citing articles: 1218; excluding self-citations: 1177
- h-index: 18