

Zubin Jacob

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Professional Experience

Sept 2015 – Present	Assistant Professor, Birck Nanotechnology Center, School of Electrical and Computer Engineering, Purdue University, Indiana, U.S.A.
July 2014 – Aug 2015	Associate Professor, Department of Electrical and Computer Engineering, University of Alberta, Alberta, Canada
Sept 2010 – July 2014	Assistant Professor, Department of Electrical and Computer Engineering, University of Alberta, Alberta, Canada

Education:

Ph.D. Aug 2010	Electrical & Computer Engineering	Purdue University, U.S.A. Advisor: Prof. Evgenii Narimanov
M.S.E.E. Aug 2007	Electrical Engineering	Princeton University, U.S.A.
M.A.E.E. Aug 2006	Electrical Engineering	Princeton University, U.S.A.
B.Tech. E.E. Aug 2004	Electrical Engineering	Indian Institute of Technology – Bombay, India

Honors and Awards:

[1] Visiting Faculty (Feb 2015-present), International Center for Theoretical Sciences, Tata Institute of Fundamental Research, Bangalore, India

[2] Nominated by the office of the Vice President of Research, University of Alberta for the Simons Foundation Investigator award 2014 and nominated by the associate dean of engineering and chair of the department for the Alfred P. Sloan Foundation award 2014

[3] **Multiple awards in Doctoral school including Dmitri N. Chorafas Best Dissertation Prize 2010** (Awarded only to 31 students in 2010 around the world among top universities such as MIT, UCLA, Purdue, EPFL etc), **IEEE-Photonics society fellowship award** for 2009-2010 and **SPIE graduate scholarship award 2008** for potential long range contributions to optical science and engineering

Editorial Positions

1. Editorial Board of Scientific Reports , a journal by the Nature Publishing Group
2. Editorial Board of UK IOP Journal of Optics, Impact Factor: 2.010
3. Guest editor for special issue on Quantum Plasmonics 2015 , IOP Journal of Optics

Professional Society Activities

- Co-chair of metamaterials track, Meta, New York 2015
- Technical committee member, Metamaterials session, OSA CLEO/QELS 2015 2016 2017
- Technical committee member, Surface Plasmon Polaritons 7, Jerusalem, Israel 2015
- Optical Metamaterials session organizer, Progress in Electromagnetics Research Symposium (PIERS) Guangzhou, China, Aug 2014
- International advisory committee, Asia-Pacific Near-field-optics (APNFO) 2015, 2016
- Panelist, Panel discussion on metamaterials, IEEE Photonics, Montreal, Canada 2014
- Panelist and Host, Panel discussion on metamaterials, IEEE Summer topicals, USA, 2014
- Organizing committee member, Green Photonics Session, Photonics North, Ottawa 2013

Research Grants and Contracts Received

[1] Funding Organization: NSERC (equivalent to NSF)

Program: Discovery

Title: Nanostructured metamaterials: Physics and Devices

Period held: 2010-2015

Level of support: 33,000\$ per year

Principal Investigator (PI): Self

Total support: 160,000\$

[2] Funding organization: NSERC

Program: Engage for industrial collaborations with Lambdaguard, an aviation security start-up

Title: Nanowire metamaterials for aviation security applications

Period held: Fall 2013

PI: Self

Level of support: 25,000\$

[3] Funding organization: Helmholtz Alberta Initiative

Program: Seed funding

Title: Metamaterial thermophotovoltaics

Period held: Aug 2013 – March 2015

PI: Self

Co-PI: S. Pramanik, Y. Tsui, R. Fedosejevs, M. Malac

German collaborators from Helmholtz research centers: M. Eich, M. Stromer

Level of support: 104,500\$

[4] Funding organization: ICIMFACTS

Program: Indo-Canada joint center grant

Title: Plasmon enhanced light addressable potentiometric sensors

Period held: Sept 2013 – Sept 2016

PI: T. Thundat (Chemical and Materials Engineering)

Co-PI: Self

Level of support: 67,000\$ per year (30 % is Zubin's share)

Total support: 201,000\$ (30 % is Zubin's share)

[5] Funding organization: Institute for Oil Sands Innovation

Title: Optical nanoscopy to investigate the role of residual bitumen in colloidal interactions

Period held: Sept 2014 – Sept 2016

PI: Self

Level of support: 180,000 \$

[6] Funding organization: Purdue Research Foundation

Title: International travel grant

PI: Self

Level of support: 2000 USD

[7] Funding organization: CSEE

Program: Proof of principle

Title: Metamaterial emitters for thermal energy conversion

PI: Self

Period held: 2011-2012

Level of support: 18,500\$

[8] Funding organization: Nanobridge

Program: Stage 1, proof of concept

Title: Plasmonic nanoantenna arrays for organic photovoltaics

Period held: 2012-2013

PI: Self

Co-PI: S. Pramanik and R. Fedosejevs

Level of support: 73,400\$

[9] Funding organization: CSEE

Program: Proof of principle

Title: Slow light enhanced light trapping in solar cells

PI: Self

Period held: 2012-2013

Level of support: 23,500\$

[10] Funding organization: CSEE

Program: Mobility fund

Title: Metamaterials for thermal energy applications

PI: Self

Period held: Winter 2013

Level of support: 2000\$

Student Fellowships

Level of support (2010-2015) > 700,000 CDN\$

(In Canada, the student fellowships form a major source of funding and relies on competitively attracting the topmost Canadian students to your group)

NSERC (federal)Fellowship : W. Newman, S. Molesky, P. Shekhar, C. Cortes, R. Starko-Bowes

AITF (provincial) Fellowship: R. Starko Bowes, P. Shekhar, Y. Guo, F. Khosravi

Queen Elizabeth II fellowship: P. Shekhar, S. Molesky

University of Alberta recruitment scholarship: Y. Guo

Master's Thesis Supervision Completed (Total=4)

1. P. Shekhar, Sept. 2013 (Next position: PhD student, University of Alberta)

Thesis title: "Strong coupling and superradiance in hyperbolic metamaterials"

2. Y. Guo, Aug 2014 (Next position: PhD student, Stanford University)

Thesis title: "Singular fluctuational electrodynamic effects in hyperbolic metamaterials and moving media"

3. H. Huan, Sept 2014 (Next position: PhD student, UCSD)

Thesis title: "Nanostructured metamaterials for thermal applications"

4. J. Atkinson, Dec 2015 (Next position: PhD student, Waterloo Univ.)

Thesis title: "Ellipsometric characterization of anisotropy in nanowire metamaterials"

Master's and PhD Thesis Students Currently Being Supervised (Total=10)

1. W. Newman, Aug 2011-present (at Purdue)

Thesis title: Enhanced spontaneous emission in hyperbolic metamaterials, theory and experiment

2. S. Molesky, Aug 2011 – present (at U. Alberta)

Thesis title: Thermal metamaterials

3. C. Cortes, Aug 2012 – present (at Purdue)

Thesis title: Open quantum system theory for plasmonics and metamaterials

4. P. Shekhar, Sept 2013 – present (at U. Alberta)

Thesis title: Nonlocal plasmonics mapped using electron energy loss spectroscopy

5. S. Jahani, Jan 2012 – present (at U. Alberta)

Thesis title: Transparent sub-diffraction optics for nanoscale light confinement without metal

6. R. Starko Bowes, Sept 2013 – present (at U. Alberta)
Thesis title: Fabrication of polaritonic structures with embedded quantum emitters

7. Farid Kalhor, May 2014 – present (at U. Alberta)
Thesis title: Chiral sculpting of light using metamaterials for biosensing

8. Farhad Khosravi, Sept 2015 – present (at U. Alberta)
Thesis title: Nanoscale quantum optics and dipole-dipole interactions

9. Todd Van Mechelen Jan 2016-present (at Purdue)
Thesis title: Universal spin-momentum locking of evanescent waves

10. Zohreh Poursoti Sept 2015-present (at U. Alberta)
Thesis title: Fabrication of metasurfaces for imaging and thermal applications

Visiting faculty (Total = 1):

2011-2012 Prof. Bin Guo, Associate Professor, Wuhan University of Science and Technology, China

Post-Doctoral Scholars (Total =1)

Dr. Sarang Pendharker (at U. Alberta)

Undergraduate Capstone Projects supervised Univ. Alberta (Total = 7, 3 prizes):

1. W. Newman, Title: "Infrared non-invasive sub-wavelength microscopy with metamaterials" (2011) **Best UG Thesis 2nd prize**
2. S. Molesky, Title: "Metamaterial enhanced fluorescence detection" (2011)
3. C. L. Cortes, Title: "Single photon sources using metamaterials" (2012) **Best UG Thesis, 2nd prize**
4. C. Dewalt, Title: "Metamaterial emitters for thermophotovoltaics" (2012)
5. J. Atkinson, J. Garrett, D. Brossart Title: "Fabrication of nanowire metamaterials for biosensing" (2012), (co-advised), **Best UG Design Project, 3rd prize**
6. C. Potts, "Imaging below the diffraction limit with hyperbolic metamaterials" (2013)
7. T. V. Mechelen, "Fluorescence lifetime imaging microscopy using metamaterials" (2013)

Summer interns Univ. Alberta (Total = 15):

2011 Y. Guo, C. Cortes, V. Divekar

2012 C. Dewalt, J. Atkinson, X. Chen, H. Zhao, F. Zhang, Y. He, L. Zhi

2013 T. V. Mechelen, Giacomo Torai, Paco Guidice, Chensheng Gong, Jingyi Tian

2014 T. V. Mechelen

Research Book Contributions and Books Published

1. *Optical Hyperspace: Negative refractive index and subwavelength imaging*, L. Alekseyev, **Z. Jacob** and E. Narimanov, in *Tutorials on Complex Photonic Media*, M. A. Noginov, M. W. McCall, G. Dewar and N.I. Zheludev, Eds., SPIE Press, Bellingham, WA, 33-55 (2009)

Serial Journal Articles

h-index: 21, 12 papers with over 40 citations
 Total No. of citations > 3300 (Google Scholar)
 Summary: 42 published journal papers, 2 under review

-Super-Coulombic atom-atom interactions in hyperbolic media
C. Cortes and **Z. Jacob**, under review in Nature Communications
 -Fundamental limits of engineering Forster Resonance Energy Transfer
Cortes and **Z. Jacob**, under review in Nature Communications

1. Roadmap on Optical Metamaterials
 A. Urbas, **Z. Jacob** et.al. J. Opt. (2016)
2. Total internal reflection fluorescence microscopy to investigate the distribution of residual bitumen in oil sands tailings
 S.S. Shende, S. Pendharker, **Z. Jacob**, N. Nazemifard ACS Energy & Fuels (2016)
3. Controlling thermal emission with refractory epsilon-near-zero metamaterials via topological transitions
 P. N. Dyachenko*, S. Molesky*, A. Yu Petrov, M. Störmer, T. Krekeler, S. Lang, M. Ritter, **Z. Jacob** M. Eich, Nature Communications 7, 11809, (2016) (* equal author contribution)
4. Universal spin-momentum locking of evanescent waves
T. V. Mechelen and **Z. Jacob**, Optica 3 (2), 118-126 (2016)
 ➤ Highlighted by phys.org, nanowerk and many other news agencies " Spinning light waves might be locked for photonics technologies"
5. Preferential emission into epsilon-near-zero metamaterial
 T. Galfsky, Z. Sun, **Z. Jacob**, and V. M. Menon,
 Opt. Mat. Exp. Vol. 5, Issue 12, pp. 2878-2883 (2015)
6. Universal spin-momentum locked optical forces
F. Kalhor, T. Thundat and **Z. Jacob** Appl. Phys. Lett. 108 (6), 061102 (2016)

7. All-dielectric metamaterials
S. Jahani and **Z. Jacob**, Nature Nanotechnology 11(1), 23-26, (2016)
 - Highlighted by phys.org and multiple news agencies
8. Ferrel-Berremen modes in epsilon-near-zero media
W. Newman, C. Cortes, J. Atkinson, S. Pramanik, R. Decorby and **Z. Jacob**, ACS Photonics 2(1), 2-7 (2014)
9. Relaxed Total Internal Reflection
S. Jahani and **Z. Jacob**, IEEE Photonics Journal Vol. 7, Issue 3 (2015)
 - Invited article for IEEE Breakthroughs in Photonics 2014,
10. Ideal near-field thermophotovoltaic cells
S. Molesky and **Z. Jacob**, Phys. Rev. B 91 (20), 205435 (2015)
11. Optical characterization of nanowire metamaterials with epsilon-near-zero, epsilon-near-pole and hyperbolic response,
R. Starke-Bowes, J. Atkinson, W. Newman, T. Kallos, G. Palikaras, R. Fedosejevs, S. Pramanik, **Z. Jacob**, J. Opt. Soc. Am B 32 (10), 2074-2080 (2015)
12. Photonic skin-depth engineering
S. Jahani, Z. Jacob, J. Op. Soc. Am. B 32 (7), 1346-1353 (2015)
13. Active hyperbolic metamaterials: enhanced spontaneous emission and light extraction
T. Galfsky, H. Krishnamoorthy, W. Newman, E. Narimanov, **Z. Jacob**, V. M. Menon, Optica 2 (1), 62-65 (2015)
 - Out of the top downloads for the year for Optica, two papers are from Z. Jacob's group
14. Hyperbolic Phonon-Polaritons
Z. Jacob Nat. Mat. (news and views), 13, 1081-1083 (2014)
15. Angular distribution emission from hyperbolic metamaterials
L. Gu, J. Livenere, G. Zhu, T. Tumkur, H. Hu, C. Cortes, **Z. Jacob**, S. Prokes, M. Noginov, Scientific Reports 4, 7327 (2014)
16. Giant non-equilibrium vacuum friction: role of singular evanescent wave resonances in moving media
Y. Guo, **Z. Jacob** J. Opt. 16 114023 (2014)
 - **Invited** article for special issue on nanoscale light-matter interaction and selected for the **cover**
 - Highlighted in the labtalk section "Lighting a fire with vacuum friction"
17. Singular evanescent wave resonances in moving media
Y. Guo, **Z. Jacob**, Opt. Ex., Vol. 22, Issue 21, pp. 26193-26202 (2014)
 - Highlighted in the Laser Focus World Jan 2015 issue
 - Highlighted by SPIE newsroom

18. Transparent subdiffraction optics: Nanoscale light confinement without metal
S. Jahani, **Z. Jacob** *Optica*, Vol. 1, Issue 2, pp. 96-100 (2014)
 - Highlighted in OSA Optics and Photonics News
 - Press coverage in phys.org, novuslight and interview featured on multiple websites
19. Thermal excitation of plasmons for near-field thermophotovoltaics
Y. Guo, S. Molesky, H. Hu, C. L Cortes, **Z. Jacob** *Appl. Phys. Lett.* 105, 073903 (2014)
20. Fluctuational electrodynamics of hyperbolic metamaterials
Y. Guo , **Z. Jacob**, *J. Appl. Phys.* 115, 234306 (2014)
21. Strong coupling in hyperbolic metamaterials
P. Shekhar, **Z. Jacob**, *Phys. Rev. B* 90, 045313 (2014)
22. Hyperbolic metamaterials: Fundamentals and applications
P. Shekhar, J. Atkinson , **Z. Jacob** *Nano Convergence* 1:14, (2014) (Invited Review)
23. Photonic analog of a van Hove singularity in metamaterials
C. Cortes , **Z. Jacob**, *Phys. Rev. B* 88. 045407, (2013)
24. Thermal Hyperbolic Metamaterials
Y. Guo and **Z. Jacob**, *Opt. Exp.* Vol. 21, Issue 12, pp. 15014-15019 (2013)
 - **Invited** article for the special issue on hyperbolic metamaterials
25. *Enhanced and directional single photon emission in hyperbolic metamaterials*
W. Newman, C. Cortes, **Z. Jacob**, *J.O.S.A. B* Vol. 30, Iss. 4, pp. 766–775 (2013)
 - Among the top downloads of J.O.S.A. B for March – June 2013
26. *High temperature epsilon-near-zero and epsilon-near-pole metamaterial emitters for thermophotovoltaics*
S. Molesky, C. Dewalt , **Z. Jacob**, *Opt. Exp.*, V.21, Issue S1 pp. A96-A110 (2013)
 - Featured as an OSA **spotlight on Optics**
 - Featured as a research highlight by **Nature Photonics** and **Laser Focus World**
27. *Applications of hyperbolic metamaterial substrates*
Y. Guo, W. Newman, C. L. Cortes, **Z. Jacob**, *Advances in Optoelectronics*, 452502, 1 (2012)
 - **Invited article** for the special issue on metamaterials
28. *Broadband super-Planckian thermal emission from hyperbolic metamaterials*
Y. Guo, C. L. Cortes, S. Molesky, **Z. Jacob**, *Appl. Phys. Lett.* 101, 131106 (2012)
 - Featured as a **research highlight** of the issue by the Editor
 - Selected as a research highlight among all papers published in APL in 2012

29. *Quantum Plasmonics*
Z. Jacob, M.R.S. Bulletin, 37, pp 761-767 (2012)
 ➤ **Invited article** for the special issue on plasmonics
30. *Quantum nanophotonics using hyperbolic metamaterials*
 C. L. Cortes, W. Newman, S. Molesky, **Z. Jacob**, J. Opt. 14, 063001 (2012)
 ➤ Review article featured on the **cover**
 ➤ 2nd most downloaded paper of the journal in 2012
 ➤ Selected as a research highlight among all papers published in J. Opt. in 2012
31. *Topological transitions in metamaterials*
 H. N. S. Krishnamurthy*, **Z. Jacob***, E. E. Narimanov, I. Kretzschmar, V. M. Menon
 *equal author contribution, Science 336, 205 (2012)
32. *Broadband Purcell Effect: Radiative decay engineering with metamaterials*
Z. Jacob, I.I. Smolyaninov & E. E. Narimanov, Appl. Phys. Lett. 100, 181105 (2012)
 ➤ Among top highlights of 5 years in Applied Physics Letters in the photonics sub-division
33. *Improving the radiative decay rate for dye molecules with hyperbolic metamaterials*
 J. Kim, V. P. Drachev, **Z. Jacob**, G. V. Naik, A. Boltasseva, E. E. Narimanov & V. M. Shalaev
 Opt. Exp., 20, 8100-8116 (2012)
34. *Plasmonics goes quantum*
Z. Jacob & V.M. Shalaev, Science 334, 463 (2011)

Prior to independent career (during graduate school)

35. *Controlling spontaneous emission with metamaterials*,
 M. A. Noginov, H. Li, D. Dryden, G. Nataraj, Yu. A. Barnakov, G. Zhu, M. Mayy, **Z. Jacob** and
 E. E. Narimanov, Opt. Lett. 35, 1863-1865 (2010)
36. *Engineering the photonic density of states with metamaterials*
Z. Jacob, J. Kim, G. Naik, E. Narimanov, A. Boltasseva and V. M. Shalaev, Appl. Phys. B., 100 pp. 215-218
 (2010)
37. *Materializing a binary hyperlens design*
 A. V. Kildishev, U. K. Chettiar, **Z. Jacob**, V. M. Shalaev, and E. Narimanov, , Appl. Phys. Lett, **94**, 071102
 (2009)
38. *Solutions in folded geometries, and associated cloaking due to anomalous resonance*
 G. W. Milton, N.P. Nicorovici, R.C. McPhedran, K. Cherednichenko and **Z. Jacob**, New. J. Phys. **10**,
 115021 (2008)

39. *Optical Hyperspace for plasmons: Dyakonov states in metamaterials*
Z. Jacob and E. Narimanov, Appl. Phys. Lett. **93**, 221109 (2008)
40. *Semiclassical description of non-magnetic cloaking*
Z. Jacob and E. Narimanov, Opt. Exp. **16**, 4597-4604 (2008)
➤ **OpticsInfobase image of the week**
41. *Semiclassical theory of the hyperlens*
Z. Jacob, L. V. Alekseyev and E. Narimanov, J. Opt. Soc. Am. A**24**, A52-A59, (2007)
42. *Optical Hyperlens: Far-field imaging beyond the diffraction limit*
Z. Jacob, L. V. Alekseyev and E. Narimanov, Opt. Exp. **14**, 8247-8256 (2006)
 - **Cover of optics express and over 1000 citations on Google Scholar**

Conference Proceedings and Presentations (Total > 70)

1. Super-coulombic energy transfer in hyperbolic media, W. Newman and Z. Jacob, CLEO 2015 #FM3C.1, San Jose, CA, USA
2. S. Jahani and **Z. Jacob**, Transparent subdiffraction optics: nanoscale light confinement without metal, CLEO 2015. # FM3C.3, San Jose, CA, USA.
3. Quantum dissipative dynamics of two-level atoms in hyperbolic metamaterials, Cortes, C.L., Torlai, G., Jacob, Z. APS meeting for Division of Atomic, Molecular, and Optical Physics June 2015
4. Anisotropic metamaterials for thermal photonics, Materials Science and Engineering, Lang, S.; Dyachenko, P.N.; Petrov, A.Y.; Eich, M.; Störmer, M.; Biehs, S.-A.; Tschikin, M.; and **Jacob, Z.**; Darmstadt, Germany, September 2014
5. P.N. Dyachenko, S. Lang, A.Yu. Petrov, M. Störmer, M. Eich, Huan Hu, S. Molesky and **Z. Jacob**, New frontier for plasmonics and metamaterials: Thermophotovoltaics, 11th World Conference on Thermophotovoltaic Generation of Electricity, Amsterdam, Netherlands, 2014.
6. P.N. Dyachenko, S. Molesky, A.Yu. Petrov, M. Störmer, T. Krekeler, S. Lang, M. Ritter, **Z. Jacob** and M. Eich, Radiative engineering with refractory epsilon-near-zero metamaterials, SPIE Photonics Europe 2016, Brussels, Belgium, 2016.
7. *Fluctuational forces in metamaterials*, C. Cortes *and **Z. Jacob**, SPIE Optics + Photonics, San Diego 2014
8. *Settling the controversy of FRET*, C. Cortes* and **Z. Jacob** SPIE Optics+Photonics San Diego 2014
9. *High temperature plasmonics and metamaterials for thermophotovoltaics*, S. Molesky and **Z. Jacob*** Meta Congress Denmark 2014
10. *Engineering vacuum and thermal fluctuations with metamaterials*, Y. Guo and **Z. Jacob***, Meta Congress Denmark, 2014
11. *Transparent sub-diffraction optics: nanoscale light confinement without metal*, S. Jahani *and **Z. Jacob**, Gordon plasmonics poster (2014)

12. *Ferrel-Berremann modes in epsilon-near-zero media*, W. Newman*, C. Cortes, J. Atkinson, S. Pramanik, R. DeCorby, **Z. Jacob**, Gordon plasmonics poster (2014)
13. *High temperature plasmonics*, S. Molesky* and **Z. Jacob**, Gordon Research Seminar talk and Gordon Plasmonics poster (2014)
14. *Momentum-resolved electron energy loss spectroscopy (q-EELS) for quantum plasmonics and metamaterials*, P. Shekhar*, V. Gaiind, M. Malac, R. Egerton, **Z. Jacob**, Gordon Plasmonics Poster (2014)
15. *Angle-resolved valence EELS of a single crystal gold sample*, M. Malac, K. Kimoto, R. Egerton, P. Shekhar*, **Z. Jacob**, Y. Taniguchi, V. Gaiind, Microscopy and microanalysis, poster (2014)
16. *Strong coupling and collective spontaneous emission in semiconductor hyperbolic metamaterials*, P. Shekhar*, **Z. Jacob**, IEEE Photonics Oral Presentation WE4.3 (2013)
17. *Momentum-resolved electron energy loss spectroscopy (q-EELS) for quantum plasmonics and metamaterials*, P. Shekhar*, V. Gaiind, M. Malac, R. Egerton and **Z. Jacob**, CLEO Oral Presentation, FM2C.7 (2014)
18. *Metamaterial van Hove Singularity*, C. Cortes* and **Z. Jacob**, OSA FIO 2013
19. *Long range intermolecular forster energy transfer mediated by metamaterials*, C. Cortes* and **Z. Jacob**, OSA FIO 2013
20. *Collective spontaneous emission effects in semiconductor hyperbolic metamaterials* P. Shekhar* and **Z. Jacob**, IEEE Photonics 2013
21. *Angular distribution of emission from hyperbolic metamaterials*, L. Gu, J. E. Livenere, G. Zhu, T.U. Tumkur, S. M. Prokes, B. Wells, V. A. Podolskiy, C. L. Cortes, **Z. Jacob**, M. A. Noginov, SPIE Optics + Photonics 2013
22. *Characterization of the optical topological transition in 1D (multilayer) and 2D (nanowire) hyperbolic metamaterials*, W. D. Newman*, S. Bodepudi, M. Zhang, R. Starko-Bowes, H. Hu, J. Atkinson, I. A. Utkin, R. Fedosejevs, R. G. DeCorby, S. Pramanik, **Z. Jacob**, SPIE Optics + Photonics 2013
23. *Transformed cladding waveguides: confining light with all-dielectric metamaterials*, S. Jahani*, **Z. Jacob**, SPIE Optics + Photonics 2013
24. *Collective spontaneous emission effects in semiconductor hyperbolic metamaterials* P. Shekhar*, **Z. Jacob**, SPIE Optics + Photonics 2013
25. *Broadband thermal emission beyond the black body limit*, Y. Guo and **Z. Jacob**, OSA CLEO/QELS, 2013
26. *Transformed Cladding Waveguides*, S. Jahani and **Z. Jacob**, OSA CLEO/QELS, 2013
27. *High temperature epsilon-near-zero and epsilon-near-pole emitters for thermophotovoltaics*, S. Molesky and **Z. Jacob**, OSA CLEO/QELS 2013
28. *High temperature plasmonics*, Y. Guo, C. Cortes and **Z. Jacob**, OSA CLEO/QELS 2013
29. *Broadband super-planckian thermal emission*, Y. Guo* and **Z. Jacob**, Photonics North 2013
30. *Metamaterials for thermophotovoltaics*, S. Molesky* and **Z. Jacob**, Photonics North 2013
31. *Transformed Cladding waveguides*, S. Jahani and **Z. Jacob***, Photonics North, Ottawa 2013
32. *High Temperature Plasmonics*, Y. Guo, S. Molesky and **Z. Jacob**, SPP 6, Ottawa 2013

33. *Broadband super-planckian thermal emission from hyperbolic metamaterials*, Y. Guo and **Z. Jacob**, SPP 6, Ottawa 2013
34. *Confining light with all-dielectric metamaterials*, S. Jahani and **Z. Jacob** SPP 6, Ottawa, 2013
35. *Thermal Metamaterials*, Y. Guo, S. Molesky, **Z. Jacob**, Nanoscale Radiative Heat Transfer, Les Houches, France 2013 (only 50 invited attendees)
36. *Epsilon-Near-Zero Metamaterial Emitters for High Efficiency Thermophotovoltaics*, S. Molesky*, C. Dewalt and **Z. Jacob**, FTh3D, OSA Frontiers in Optics, 2012
37. *Quantum Nanophotonics using hyperbolic metamaterials*, **Z. Jacob***, Poster, Gordon Plasmonics, 2012
38. *Single photon resonance cone in metamaterials*, W. Newman and **Z. Jacob***, SPIE Optics and Photonics, 8455-07, 2012
39. *Metamaterial thermal antenna*, S. Molesky, C. Dewalt and **Z. Jacob***, SPIE Optics and Photonics, 8455-29, 2012
40. *Giant photonic lamb shift in hyperbolic metamaterials*, C. Cortes* and **Z. Jacob**, SPIE Optics and Photonics, 8455-24, 2012
41. *Coupling NV centers in diamond to hyperbolic metamaterials*, S. Jahani* and **Z. Jacob**, SPIE Optics and Photonics, 8455-23, 2012
42. *Metamaterial thermal antenna using the wolf effect*, S. Molesky* and **Z. Jacob**, JTh2A, CLEO/QELS, 2012
43. *Quantum resonance cones in metamaterials*, W. Newman* and **Z. Jacob**, JTh2A, OSA CLEO/QELS 2012
44. *Topological transitions in metamaterials*, H. Krishnamurthy**, **Z. Jacob****, I. Kretchmar, E. Narimanov, V. Menon, (**equal author contribution), QM2E, OSA CLEO/QELS 2012
45. *Broadband Engineering of Quantum Dot Spontaneous Emission Using Flat Dispersion Metamaterial*, H. Krishnamoorthy, V. Menon, **Z. Jacob**, E. Narimanov, and I. Kretzschmar, QThP3, OSA CLEO/QELS, 2011
46. *Spontaneous emission near hyperbolic metamaterials*, **Z. Jacob***, I. Smolyaninov, and E. Narimanov, paper QThP5, OSA CLEO/QELS 2011
47. *Spontaneous emission near hyperbolic metamaterials*, **Z. Jacob***, Photonics North, Ottawa, 2011, UPNO-18-3-4,
48. *Controlling Spontaneous Emission with Metamaterials*, Mikhail Noginov, T. U. Tumkur, H. Li, Yu. A. Barnakov, G. Zhu, C. E. Bonner, M. Mayy, P. Black, **Z. Jacob**, L. Alekseyev, E. E. Narimanov, FMM1, International conference on Luminescence, Michigan Ann Arbor, July 2011,
49. *Controlling emission and reflectance with metamaterials*, M. Noginov, T. Tumkur, H. Li, Yu. Barnakov, G. Zhu. C. Bonner, M. May, P. Black, **Z. Jacob**, L. Alekseyev, E. Narimanov, OSA Frontiers in Optics, 2011
50. *Spontaneous emission enhancement using metamaterials*, H. Krishnamurthy, **Z. Jacob**, I. Kretchmar, E. Narimanov, V. Menon, IEEE Winter Topicals , 2011
51. *Transforming light with optical metamaterials*, Vladimir M. Shalaev, A. V. Kildishev, **Z. Jacob**, A. Boltasseva, S. Xiao, V. P. Drachev, X. Ni, G. V. Naik, J. Y. Kim, E. E. Narimanov, Metamaterials, Barcelona, 2011

52. *Transforming Light with Tunable and Active Metamaterials*, Vladimir M. Shalaev, A. V. Kildishev, S. Xiao, V. P. Drachev, X. Ni, G. Naik, **Z. Jacob**, J.-Y. Kim, A. Boltasseva, E. E. Narimanov, SPIE Photonics West 2011
53. *Control of emission and reflectance with metamaterials*, M. Noginov, T. Tumkur, H. Li, Yu. Barnakov, G. Zhu, C. Bonner, M. Mayy, P. Black, **Z. Jacob**, L. Alekseyev, E. Narimanov, Metamaterials, Barcelona, 2011
54. *Towards meta-devices*, A. Boltasseva, G. Naik, P. West, N. Emani, **Z. Jacob**, R. B. Nielsen, M. D. Thoreson, V. Shalaev, 7754-53, SPIE Optics and Photonics, 2010
55. *Hyperbolic metamaterial route to engineer the photonic density of states*, **Z. Jacob**, J.-Y. Kim, G. Naik, E. Narimanov, A. Boltasseva, V. M. Shalaev, MTuA3, Photonic Metamaterials and Plasmonics (META), 2010
56. *Hyperbolic Metamaterials*, **Z. Jacob*** and E. Narimanov, IPAM mathematics workshop in metamaterials, UCLA, Jan 2010
57. *Experimental probing of the photonic density of states in hyperbolic metamaterials* M. A. Noginov, H. Li. D. M. Dryden, G. Nataraj, Yu. A. Barnakov, G. Zhu, M. Mayy, **Z. Jacob** and E. E. Narimanov, QTuD3, OSA CLEO/ QELS 2010.
58. *Metamaterial based broadband engineering of quantum dot spontaneous emission*, H. Krishnamoorthy, **Z. Jacob**, E. Narimanov, I. Kretzschmar and V. Menon, JWA23, OSA CLEO/QELS 2010
59. *Radiative decay engineering with hyperbolic metamaterials*, **Z. Jacob***, J. Kim, G. Naik, E. Narimanov, A. Boltasseva and V. Shalaev, QTuD2, OSA CLEO/QELS 2010
60. *Infinite at any frequency: density of states in (meta)materials with hyperbolic dispersion*, E. Narimanov and **Z. Jacob**, 40th Winter colloquium on the Physics of Quantum Electronics, 2010
61. *Broadband Purcell effect in metamaterials*, **Z. Jacob**, I. Smolyaninov and E. Narimanov, PDPB6, **(post-deadline)**, OSA Frontiers in Optics, 2009
62. *Single photon gun: Radiative decay engineering using metamaterials* **Z. Jacob***, I. Smolyaninov and E. Narimanov, IPDB 2 **(post-deadline)**, OSA **CLEO/IQEC 2009**
63. *NanoHUB web-based nanophotonics simulation tools*, X. Ni, M.D. Swanson, S. Ishii, Z. Liu, **Z. Jacob**, U. K. Chettiar, A. V. Kildishev, V. M. Shalaev, SPIE Optics+Photonics, 2009
64. *A tool for designing realizable hyperlenses* X. Ni, **Z. Jacob**, A. V. Kildishev, V. Shalaev and E. Narimanov, JWA 110, OSA CLEO/IQEC 2009 Hosted on NanoHUB, simulation tools for nanotechnology (<http://nanohub.org/resources/4770>)
65. *Optical hyperspace for plasmons: Dyakonov states in metamaterials*, **Z. Jacob** and E. Narimanov, IThG3, OSA CLEO/ IQEC 2009 **Theodor Maiman best student paper award finalist**
66. *Dyakonov plasmons*, **Z. Jacob*** and E. Narimanov, 7029-24, SPIE Optics + Photonics, 2008
67. *Impedance matched hyperlens*, **Z. Jacob***, A. Kildishev and E. Narimanov, QFL 4, OSA CLEO/QELS 2008
68. *Semiclassical description of hyperlensing and cloaking*, **Z. Jacob***, L. Alekseyev and E. Narimanov, International Union of Radio Science (URSI) , Ottawa, Canada, 2007

69. *Resonant enhancement of absorption in the superlens*, Z. Jacob, L. Alekseyev and E. Narimanov, X38, APS March meeting 2007
70. *Semiclassical theory of the hyperlens*, **Z. Jacob***, L. Alekseyev and E. Narimanov, JWA2, OSA CLEO/QELS 2007
71. *Optical hyperlens: far-field imaging beyond the diffraction limit*, **Z. Jacob**, L. Alekseyev and E. Narimanov, QTuD3, OSA CLEO/QELS 2007
72. *Optical hyperlens*, **Z. Jacob**, L. Alekseyev and E. Narimanov, Conference on Electronic transport and optical properties of inhomogeneous materials 7, Sydney, Australia 2006
Best student paper/poster presentation award
73. *Asymmetric microdisk resonators: using geometry to control evanescent field*, **Z. Jacob*** and E. Narimanov, JWB 89, OSA CLEO/QELS 2006

Invited Lectures (Total > 50)

1. SFB Center on Multiscale Materials, Hamburg, Germany, Oct 2015
2. Metamaterials Congress, Oxford, UK, Sept 2015
3. SPIE San Diego, Optics+Photonics, Aug 2015
4. Session on near-field radiation heat transfer, Meta, City College of New York, Aug 2015
5. Session on quantum plasmonics, Meta, City College of New York, Aug 2015
6. Session on orbital angular momentum, Meta, City College of New York, Aug 2015
7. Session on 2D materials, PIERS Prague, Czech Republic July 2015
8. Session on nanoscale heat transfer and Casimir Physics, PIERS Prague, Czech Republic July 2015
9. Quantum Photonics Seminar, Purdue University, Feb 2015
10. Center for Nano Science and Engineering, Indian Institute of Science, Bangalore, India Dec 2014
11. International Center for Theoretical Sciences, TIFR Bangalore, India Dec 2014
12. IEEE Talk, Indian Institute of Technology – Bombay, Mumbai, India Dec 2014
13. SPIE Visiting Lecturer Seminar, Australian National University, Canberra, Alberta Dec 2014
14. Workshop on hyperbolic metamaterials, Australian National University, Canberra, Australia Dec 2014
15. Physics department seminar, Brown University, Nov 2014
16. Optics Seminar, Columbia University, Nov 2014
17. Institute for Quantum Information Science, University of Calgary, Canada Nov 2014
18. Schlumberger Research Seminar, Edmonton, Alberta, Nov 2014
19. IWEM 4th Sandia workshop on metamaterials, Santa Fe, Sept 2014
20. IEEE Photonics, San Diego, Oct 2014
21. CASTL Center seminar, University of California – Irvine, Oct 2014
22. Technical University Hamburg, Department of Electrical Engineering, Germany, Aug 2014
23. Denmark Technical University, Fotonik Center, Denmark Aug 2014
24. Metamaterials Congress, Lyngby, Denmark, Aug 2014
25. SPIE Optics + Photonics, Metamaterials symposium, San Diego, Aug 2014
26. IEEE summer topicals, Metamaterials session, Montreal, Canada July 2014

27. Association of Professional Engineers and Geoscientists and of Alberta (APEGA) summit, Edmonton, Canada, April 2014
28. Meta, Singapore, Session on super-resolution imaging, May 2014
29. Meta, Singapore, Special session on hyperbolic metamaterials, May 2014
30. Meta, Singapore, Symposium on all-dielectric metamaterials, May 2014
31. Quantum Photonics Seminar, University of Ottawa, April, 2014
32. University of Minnesota, March 2014
33. APS March Meeting, 2014
34. Quantum photonics workshop, Leiden, Denmark, July, 2014
35. Physics colloquium, Norfolk State University, USA, Oct 2013
36. Quantum Electronics session, OSA Frontiers in Optics, Oct. 2013
37. PIERS, Stockholm, Sweden, Aug. 2013
38. SPIE Optics+Photonics, San Diego, Aug 2013
39. CMOS Emerging Technologies, Canada July 2013
40. Center for Photonics and Multiscale Nanomaterials, University of Michigan, Feb 2013
41. Nanometa, Austria, Jan. 2013
42. Applied Physics Department, Caltech, USA, Aug. 2012 [Prof. Harry Atwater's group]
43. Seminars in the Physics and Chemistry Departments, University of Alberta, Canada Nov. 2011
44. EE Seminar, Princeton University, New Jersey, USA, Aug 2011
45. Northwestern University, Chicago, USA, May 2011
46. ECE Photonics and Electromagnetism seminar, University of Toronto, Canada, May 2011
47. IEEE talk, EE department, Indian Institute of Technology – Bombay, India, Sept 2010
48. Optics colloquium, International school of Photonics, Cochin University of Science and Technology, Kerala, India, Sept. 2010
49. ECE colloquium, Indian Institute of Science, Bangalore, India, Sept. 2010
50. JNCASR-Purdue Nano Energy Meet, Bangalore, India, Sept. 2010
51. **Z. Jacob**, I. I. Smolyaninov and E. Narimanov, *Quantum Nanophotonics with hyperbolic metamaterials*, SPIE Optics and Photonics, Aug 2011
52. **Z. Jacob**, A.V. Kildishev and E. Narimanov, *Impedance matched Hyperlens*, SPIE Symposium on Nanoscience and Engineering, August 2008
53. OSA lecture series, University of Toronto, Canada, July 2007
54. **Z. Jacob**, L. Alekseyev and E. Narimanov, *Optical Hyperlens*, SPIE Optics and Photonics, Sept 2007

Patents Approved and Patent Applications (1 granted, 2 provisional)

1. S. Jahani and **Z. Jacob**, "Light confinement using all-dielectric metamaterials", US 61/762,146
2. S. Molesky and **Z. Jacob**, "Metamaterial emitters for thermophotovoltaics", US 61/901,284
3. **Z. Jacob**, R. Starko Bowes, S. Pramanik, "Hybrid nanowire antennas for organic photovoltaics", US 61/901,861

Activities as a Referee

- Grant reviewer for US, Canadian and European Agencies: US Department of Energy, Army Research Office, NSERC (equivalent to NSF in Canada), MITACS, European Research Council, Stanford Energy Research Grants, NWO Netherlands etc.

Courses Developed

Nonlinear Optics (graduate course)
 Fall 2011/2012/2013/2014
 Enrollment: 16/ 13/6/10
 Students Teaching rating (max 5.0): 4.8,4.8

Courses "In Charge Of"

Continuous-time signals and systems (2nd year UG course, Univ. Alberta)
 Winter 2012/2013/2014
 Enrollment: 68/68/76
 Teaching rating (max 5.0): 4.3,4.5,4.6

Photonics I (4th year undergraduate course, Univ. Alberta),
 Managed associated Lab with 2 Lab instructors, 1 TA
 Fall 2012/2013/2014
 Enrollment: 73/44/51
 Teaching rating (max 5.0): 3.9,4.5

Signals and Systems (3rd year UG course)
 Fall 2015/Spring 2016
 ECE, Purdue University
 Overall instructor teaching rating (max 5.0): 4.4

School Committee Activities

- Exam Committees Univ. Alberta (Total = 16)
 1. External examiner, 2. Chair of examining committee, 3. Departmental examiner, 4. Thesis supervising committee (Total = 16) P. Rahimzadeh² (ECE), J. Laforge^{2,3} (ECE), J. Haagsma¹ (Chem. Engg.), Z. Dezhahang¹ (Chemistry), B. Nejad³ (ECE), H. Moghaddas^{2,3} (ECE), A. Kandakkathara^{3,4} (ECE), S. Sawderberg³ (ECE), S. Sun¹ (Chemistry), S. Movahedian³ (ECE), T. Allen³ (ECE), R. Starko Bowes³ (ECE), C. Horvath³ (ECE), J. Pollock³ (ECE), T. Abraham (CME), A. Singh (ECE)
- International PhD committees (Total=4) 1. Thejaswi Tumkur 2. John Kitur (Norfolk State University, USA) 3. Tal Galfsky (CUNY, Queens) 4. Harish Krishnamurthy (CUNY, Queens)
- Organizer of ECE, Univ. of Alberta Distinguished Speaker Series

Professional and Honorary Society Memberships:

Member: Institute of Electrical and Electronics Engineering (IEEE), Optical Society of America (OSA), American Physical Society (APS), SPIE

Other Activities:

- ECE open house talk, *Staring at the invisible*, University of Alberta, Sept 2011 (audience consisted of total 200 members: prospective undergraduates and their families)
- IEEE student mixer talk, Winter 2011, *Why choose graduate school?*
- IEEE Antenna Society Student Chapter, Inaugural Function Talk, Summer 2012
- SPIE student mixer talk, Winter 2011, *What is nanophotonics?*
- Faculty advisor for University of Alberta's OSA student chapter founded by my research group students
- EE Majors Recruitment talk, Jan 2015, *Why I became an Electrical Engineer*
- Canadian Associate of Physicists 2015 Congress talk and lab tour for High School Teachers on future of photonic technologies
- Faculty teaching appreciation dinner nominated by ECE undergraduate students at Purdue 2015