

MIKHAIL A. BELKIN**Professor**

Chair of Semiconductor Technology

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E-Mail: mikhail.belkin@wsi.tum.deChair webpage: <https://www.wsi.tum.de/views/groups.php?group=belkin>**Education**

Ph.D. in Physics, University of California at Berkeley May 2004*Dissertation title:* "Nonlinear Spectroscopic Studies of Chiral Media"*Research advisor:* Yuen-Ron Shen**B.S. in Physics and Mathematics, Moscow Institute of Physics and Technology** June 1998**Professional appointments**

Technical University of Munich, Munich, Germany

Walter Schottky Institute and Department of Electrical Engineering

Professor, Chair of Semiconductor Technology

2019 –

University of Texas at Austin, Austin, TX

Department of Electrical and Computer Engineering

Adjunct Professor

2019 –

Professor

2018 – 2019

Associate Professor

2014 – 2018

Assistant Professor

2008 – 2014

Harvard University, Cambridge, MA

Harvard School of Engineering and Applied Sciences

Research Associate (Prof. Federico Capasso group)

2006 – 2008

Postdoctoral Scholar (Prof. Federico Capasso group)

2004 – 2006

University of California at Berkeley, Berkeley, CA

Department of Physics

Graduate Research Assistant (Prof. Yuen-Ron Shen group)

1999 – 2004

Honors/Awards

2018 – Fellow of the SPIE, class of 2018

2017 – Myron L. Begeman Faculty Fellowship in Engineering, UT Austin

2016 – University of Texas at Austin Jack Kilby/Texas Instruments Award

2016 – General Motors Foundation Centennial Teaching Faculty Fellowship, UT Austin

2016 – Honorary Hans Fischer Senior Fellow, Institute for Advanced Study, TU Munich

2016 – Fellow of the OSA, class of 2016

2015 – Alexander von Humboldt Foundation Wilhelm Bessel Research Award

2015 – Jack Kilby/Texas Instruments Endowed Faculty Fellowship, UT Austin
2014 – Tour Speaker for the Society for Applied Spectroscopy
2012 – DARPA Young Faculty Award
2012 – National Science Foundation CAREER Award
2012 – Norman Hackerman Advanced Research Program Award for Early Career Investigators
2009 – AFOSR Young Investigator Award

Professional Society Membership

The Optical Society, OSA (Fellow)
International Society for Optics and Photonics, SPIE (Fellow)
Institute of Electrical and Electronics Engineers, IEEE (Senior Member)

Synergistic activities

Conference organizing

- Chair of the CLEO-Europe Semiconductor Lasers subcommittee (2022-present)
- Chair of the CLEO S&I 3 Semiconductor Lasers subcommittee (2017-2019)
- Co-chair for the 14th International Conference on Intersubband Transitions in Quantum Wells (Singapore, September 2017)
- Co-chair for the 2016 International Quantum Cascade Laser School and Workshop (Cambridge, UK, September 2016)
- Co-chair for the 12th International Conference on Intersubband Transitions in Quantum Wells (Bolton Landing, NY, September 2013)
- Member of the technical program committee for
 - 45th Freiburg Infrared Colloquium (Freiburg, Germany, May 16-17, 2023)
 - TeraTech 2023 International Symposium (Aizu-Wakamatsu, Japan, 2023)
 - 2023 International Conference on Nonlinear Optics and Excitation Kinetics in Semiconductors (Frauenwoerth, Germany 2023)
 - SPIE Photonics West (Novel In-Plane Semiconductor Lasers XV, 2015-present)
 - IEEE Photonics Conference (Semiconductor Lasers, 2019-present)
 - CLEO-Europe (Semiconductor Lasers, 2016-2021)
 - Mid-Infrared Coherent Sources (MICS) Conference (2021)
 - 45th Freiburg Infrared Colloquium (2021)
 - CLEO (S&I 3 Semiconductor Lasers, 2013-2017)
 - 35th International Conference on Infrared, Millimeter, and Terahertz Waves (October 2011)
 - 11th International Conference on Intersubband Transitions in Quantum Wells (September 2011)
 - IEEE Photonics Society topical meeting Advances in Terahertz Devices and Applications (January 2010)

Books and Book Chapters

- D. Botez and M.A. Belkin, Eds., “Mid-Infrared and Terahertz Quantum Cascade Lasers,” Cambridge University Press, 2023 (upcoming).
- M. Tymchenko, J.S. Gomez-Diaz, A. Krasnok, M.A. Belkin, and A. Alù, “Semiconductor-loaded nonlinear metasurfaces,” in Nonlinear Meta-Optics, C. De Angelis, G. Leo, and D.N. Neshev, Eds., CRC Press, Boca Raton, FL, 2020.

Peer-reviewed Journal Publications

Google Scholar link: <http://scholar.google.com/citations?user=ciL9ZFcAAAAJ>

1. R. Sarma, J. Xu, D. De Ceglia, L. Carletti, J. Klem, M.A. Belkin, and I. Brener, “Control of second-harmonic generation in all-dielectric intersubband metasurfaces by controlling the polarity of $\chi^{(2)}$,” *Opt. Expr.* **30**, 34533-34544 (2022).
2. J.H. Kim, W. Oberhausen, S. Jung, J. Xu, J. Mei, J.D. Kirch, L.J. Mawst, D. Botez, and M.A. Belkin, “Terahertz difference-frequency-generation quantum cascade lasers on silicon with wire grid current injectors,” *Opt. Expr.* **30**, 25410-25417 (2022)
3. R. Sarma, J. Xu, D. De Ceglia, L. Carletti, S. Campione, J. Klem, M.B. Sinclair, M.A. Belkin, and I. Brener, “An all-dielectric polaritonic metasurface with a giant nonlinear optical response,” *Nano Lett.* **22**, 896-903 (2022).
4. K. Zhang, G. Böhm, M.A. Belkin, “Mid-infrared microring resonators and optical waveguides on an InP platform,” *Appl. Phys. Lett.* **120**, 061106 (2022).
5. J. Yu, S. Park, I. Hwang, D. Kim, F. Demmerle, G. Boehm, M.-C. Amann, M.A. Belkin, and J. Lee, “Electrically tunable nonlinear polaritonic metasurface,” *Nat. Photon.* **16**, 72-78 (2022).
6. M. Monavarian, J. Xu, M. Khoury, F. Wu, P. De Mierry, P. Vennegues, M.A. Belkin, and J.S. Speck, “Defect tolerance of intersubband transitions in nonpolar GaN/(Al,Ga)N heterostructures: a path toward low-cost and scalable mid- to far-infrared optoelectronics,” *Phys. Rev. Applied* **16**, 054040 (2021).
7. N. Nefedkin, A. Mekawy, J. Krakofsky, Y. Wang, A. Belyanin, M. Belkin, A. Alù “Overcoming intensity saturation in nonlinear multiple-quantum-well metasurfaces for high-efficiency frequency upconversion,” *Adv. Mat.* 2106902 (2021).
8. S. Mann, N. Nookala, S.C. Johnson, M. Cotrufo, A. Mekawy, J.F. Klam, I. Brener, M.B. Raschke, A. Alù, and M.A. Belkin, “Ultrafast optical switching and power limiting in intersubband polaritonic metasurfaces,” *Optica* **8**, 606-613 (2021).
9. R.Sarma, N. Nookala, K.J. Reilly, S. Liu, D. de Ceglia, L. Carletti, M.D. Goldflam, S. Campione, K. Sapkota, H. Green, G.T. Wang, J. Klem, M.B. Sinclair, M.A. Belkin, and I. Brener, “Strong Coupling in All-Dielectric Intersubband Polaritonic Metasurfaces,” *Nano Lett.* **21**, 367-374 (2021).
10. D. Kim, J. Yu, I. Hwang, S. Park, F. Demmerle, G. Boehm, M.-C. Amann, M.A. Belkin, and J. Lee, “Giant nonlinear circular dichroism from intersubband polaritonic metasurfaces,” *Nano Lett.* **20**, 8032-8039 (2020).
11. M. Monavarian, J. Xu, M.N. Fireman, N. Nookala, F. Wu, B. Bonef, K.S. Qwah, E.C. Young, M.A. Belkin, and J.S. Speck, “Structural and optical properties of nonpolar m- and a-plane GaN/AlGaIn heterostructures for narrow-linewidth mid-infrared intersubband transitions,” *Appl. Phys. Lett.* **116**, 201103 (2020).

12. D. Kim, H. Chung, J. Yu, I. Hwang, S. Park, F. Demmerle, G. Boehm, M.-C Amann, M.A. Belkin, J.-Y. Jung, J. Lee "Spin-controlled nonlinear harmonic generations from plasmonic metasurfaces coupled to intersubband transitions," *Adv. Opt. Mat.* **8**, 2000004 (2020).
13. M. Jin and M.A. Belkin, "Infrared vibrational spectroscopy of functionalized atomic force microscope probes using resonantly-enhanced infrared photoexpansion nanospectroscopy," *Small Methods* **3**, 1900018 (2019).
14. S. Jung, D. Palaferri, K. Zhang, F. Xie, Y. Okuno, C. Pinzone, K. Lascola, and M.A. Belkin, "Homogeneous photonic integration of mid-infrared quantum cascade lasers with low-loss passive waveguides on InP platform," *Optica* **6**, 1023-1030 (2019).
15. R. Sarma, D. de Ceglia, N. Nookala, M. Vincenti, S. Campione, O. Wolf, M. Scalora, M. Sinclair, M. Belkin and I. Brener, "Broadband and efficient second-harmonic generation from a hybrid dielectric metasurface/semiconductor quantum-well structure," *ACS Photon.* **6**, 1458 (2019).
16. M. Tokman, Z. Long, S. Al Mutairi, Y. Wang, V. Vdovin, M. Belkin, and A. Belyanin, "Purcell enhancement of the parametric down-conversion in two-dimensional nonlinear materials," *APL Photonics* **4**, 034403 (2019).
17. K. Fujita, S. Jung, Y. Jiang, J.H. Kim, A. Nakanishi, A. Ito, M. Hitaka, T. Edamura, and M.A. Belkin, "Recent progress in terahertz difference-frequency quantum cascade laser sources," *Nanophoton.* **7**, 1795-1817 (2018).
18. Y. Liu, J. Lee, S. March, N. Nookala, D. Palaferri, J. F. Klem, S. R. Bank, I. Brener, and M. A. Belkin, "Difference-frequency generation in polaritonic intersubband nonlinear metasurfaces," *Adv. Opt. Mat.* **6**, 1800681 (2018).
19. J.H. Kim, S. Jung, Y. Jiang, K. Fujita, M. Hitaka, A. Ito, T. Edamura, and M.A. Belkin "Double-metal waveguide terahertz difference-frequency generation quantum cascade lasers with surface grating outcouplers," *Appl. Phys. Lett.* **113**, 161102 (2018).
20. A. Jiang, S. Jung, Y. Jiang, K. Vijayraghavan, J. H. Kim, and M. A. Belkin, "Mid-infrared quantum cascade laser arrays with electrical switching of emission frequencies," *AIP Adv.* **8**, 085021 (2018).
21. J. E. Ortmann, N. Nookala, Q. He, L. Gao, C. Lin, A. B. Posadas, A. Y. Borisevich, M. A. Belkin, and A. A. Demkov, "Quantum confinement in oxide heterostructures: room-temperature Intersubband absorption in SrTiP₃/LaAlO₃ multiple quantum wells," *ACS Nano* **12**, 7682-7689 (2018).
22. N. Nookala, J. Xu, O. Wolf, S. March, R. Sarma, S. Bank, J. Klem, I. Brener, and M. A. Belkin, "Mid-infrared second-harmonic generation in ultra-thin plasmonic metasurfaces without a full-metal backplane," *Appl. Phys. B.* **124**, 132 (2018).
23. M. Tokman, Z. Long, S. Al Mutairi, Y. Wang, M. Belkin, and A. Belyanin, "Enhancement of the spontaneous emission in subwavelength quasi-two-dimensional waveguides and resonators," *Phys. Rev. A.* **97**, 043801 (2018).
24. S. Jung, J. H. Kim, Y. Jiang, K. Vijayraghavan, and M. A. Belkin, "Broadly tunable terahertz difference-frequency generation in quantum cascade lasers on silicon," *SPIE Opt. Eng.* **57**, 011020 (2018).
25. S. Jung, J. Kirch, J.H. Kim, L.J. Mawst, D. Botez, and M.A. Belkin, "Quantum cascade lasers transfer-printed on silicon-on-sapphire," *Appl. Phys. Lett.* **111**, 211102 (2017).
26. L. Consolino, S. Jung, A. Campa, M. De Regis, S. Pal, K. Fujita, A. Ito, M. Hitaka, S. Bartalini, P. De Natale, M.A. Belkin, and M.S. Vitiello, "Spectral purity and tunability of terahertz quantum cascade laser sources based on intra-cavity difference frequency generation," *Sci. Adv.* **3**, e160331 (2017).

27. M. Tymchenko, J. S. Gomez-Diaz, J. Lee, M.A. Belkin, and A. Alù, "Highly-efficient THz generation using nonlinear plasmonic metasurfaces," *J. Opt.* **19**, 104001 (2017).
28. M.N. Fireman, B. Bonaf, E.C. Young, N. Nookala, M.A. Belkin, and J.S. Speck, "Strain compensated superlattices on m-plane gallium nitride by ammonia molecular beam epitaxy," *J. Appl. Phys.* **122**, 075105 (2017).
29. M. Jin, F. Lu, and M.A. Belkin, "High-sensitivity infrared vibrational nanospectroscopy in water," *Light Sci. Appl.* **6**, e17096 (2017).
30. L.N. Alyabyeva, E.S. Zhukova, M.A. Belkin, and B.P. Gorshunov, "Dielectric properties of semi-insulating Fe-doped InP in the terahertz spectral region," *Sci. Rep.* **7**, 7360 (2017).
31. S. Dutta-Gupta, N. Dabidian, I. Kholmanov, M.A. Belkin, G. Shvets, "Electrical tuning of the polarization state of light using graphene-integrated anisotropic metasurfaces," *Phil. Trans. R. Soc. A* **375**, 20160061 (2017).
32. S. Jung, J. Kim, Y. Jiang, K. Vijayraghavan, and M. A. Belkin, "Terahertz difference-frequency quantum cascade laser sources on silicon," *Optica* **4**, 38-43 (2017).
33. Z. Wu, W. Li, M.N. Yogeesh, S. Jung, A.L. Lee, M. Belkin, D. Akinwande, and Y. Zheng, "Tunable graphene metasurfaces with gradient features by self-assembly-based moiré nanosphere lithography," *Adv. Opt. Mat.* **4**, 2035-2043 (2016).
34. M. Tymchenko, J. S. Gomez-Diaz, J. Lee, N. Nookala, M. A. Belkin, and A. Alu, "Advanced control of nonlinear beams with Pancharatnam-Berry metasurfaces," *Phys. Rev. B.* **94**, 214303 (2016).
35. F. Lu, J. Lee, S. Jung, and M.A. Belkin, "Thermopile detector of light ellipticity," *Nature Commun.* **7**, 12994 (2016).
36. A. B. Khanikaev, N. Arju, Z. Fan, D. Purtseladze, F. Lu, J. Lee, P. Sarriugarte, M. Schnell, R. Hillenbrand, M.A. Belkin, and G. Shvets, "Experimental demonstration of the microscopic origin of circular dichroism in two-dimensional metamaterials," *Nature Commun.* **7**, 12045 (2016).
37. N. Dabidian, S. Dutta-Gupta, I. Kholmanov, K. Lai, F. Lu, J. Lee, M. Jin, S. Trendafilov, A. Khanikaev, B. Fallahazad, E. Tutuc, M.A. Belkin, and Gennady Shvets, "Experimental demonstration of phase modulation and motion sensing using graphene-integrated metasurfaces," *Nano Lett.* **16**, 3607-3615 (2016).
38. J. Lee, N. Nookala, J. S. Gomez-Diaz, M. Tymchenko, F. Demmerle, G. Boehm, M.-C. Amann, A. Alù, and M.A. Belkin "Ultrathin second-harmonic metasurfaces with record-high nonlinear optical response," *Adv. Opt. Mat.* **4**, 664-670 (2016).
39. N. Nookala, J. Lee, J.S. Gomez-Diaz, M. Tymchenko, F. Demmerle, G. Boehm, K. Lai, G. Shvets, M.-C. Amann, A. Alù, and M.A. Belkin, "Ultrathin gradient nonlinear metasurface with a giant nonlinear response," *Optica* **3**, 283-288 (2016).
40. Y. Jiang, K. Vijayraghavan, S. Jung, A. Jiang, J.H. Kim, F. Demmerle, G. Boehm, M.C. Amann, and M.A. Belkin, "Spectroscopic study of terahertz generation in mid-infrared quantum cascade lasers," *Sci. Rep.* **6**, 21169 (2016).
41. M. Tymchenko, J.S. Gomez-Diaz, J. Lee, N. Nookala, M.A. Belkin, and A. Alu, " Gradient nonlinear Pancharatnum-Berry metasurfaces," *Phys. Rev. Lett.* **115**, 207403 (2015).
42. J.S. Gomez-Diaz, M. Tymchenko, J. Lee, M.A. Belkin, and A. Alu, "Nonlinear processes in multi-quantum-well plasmonic metasurfaces: Electromagnetic response, saturation effects, limits, and potentials," *Phys. Rev. B.* **92**, 125429 (2015).
43. M.A. Belkin and F. Capasso, "New frontiers in quantum cascade lasers: high performance room temperature terahertz sources," *Phys. Scr.* **90**, 118002 (2015). (*Invited paper*)

44. A. Jiang, S. Jung, Y. Jiang, K. Vijayraghavan, J. Kim, and M.A. Belkin, "Widely tunable terahertz source based on intra-cavity frequency mixing in quantum cascade laser arrays," *Appl. Phys. Lett.* **106**, 261107 (2015).
45. K. Fujita, M. Hitaka, A. Ito, T. Edamura, M. Yamanishi, S. Jung, and M.A. Belkin, "Terahertz generation in mid-infrared quantum cascade lasers with a dual-upper-state active region," *Appl. Phys. Lett.* **106**, 251104 (2015).
46. S. Jung, Y. Jiang, K. Vijayraghavan, A. Jiang, F. Demmerle, G. Boehm, X. Wang, M. Troccoli, M.C. Amann, and M.A. Belkin, "Recent progress in widely tunable single-mode room temperature terahertz quantum cascade laser sources," *IEEE J. Sel. Top. Quantum Electron.* **21**, 1200710 (2015). (**Invited paper**)
47. S. Suchalkin, G. Belenky, and M.A. Belkin, "Rapidly tunable quantum cascade lasers," *IEEE J. Sel. Top. Quantum Electron.* **21**, 1200509 (2015). (**Invited paper**)
48. J. Lee, S. Jung, P.-Y. Chen, F. Lu, F. Demmerle, G. Boehm, M.-C. Amann, A. Alù, and M.A. Belkin, "Ultrafast electrically-tunable polaritonic metasurfaces," *Adv. Opt. Mat.* **2**, 1057–1063 (2014).
 - *Paper selected for the Best of Advanced Optical Materials - 2014 edition*
49. Y. Jiang, K. Vijayraghavan, S. Jung, F. Demmerle, G. Boehm, M.-C. Amann, and M.A. Belkin "External cavity terahertz quantum cascade laser sources based on intra-cavity frequency mixing with 1.2-5.9 THz tuning range," *J. Opt.* **16**, 094002 (2014). (**Invited paper**)
 - *Paper selected for the Journal of Optics "Highlights of 2014" collection*
50. J. Lee, M. Tymchenko, C. Argyropoulos, P.-Y. Chen, F. Lu, F. Demmerle, G. Boehm, M.-C. Amann, A. Alu, and M.A. Belkin, "Giant nonlinear response from plasmonic metasurfaces coupled to intersubband transitions," *Nature* **511**, 65–69 (2014).
51. S. Jung, A. Jiang, Y. Jiang, K. Vijayraghavan, X. Wang, M. Troccoli, and M. A. Belkin, "Broadly tunable monolithic room-temperature terahertz quantum cascade laser sources," *Nature Commun.* **5**, 4267 (2014).
52. A. Jiang, A. Matyas, K. Vijayraghavan, C. Jirauschek, Z.R. Wasilewski, M.A. Belkin, "Experimental investigation of terahertz quantum cascade laser with variable barrier heights," *J. Appl. Phys.* **115**, 163103 (2014).
53. F. Lu, M. Jin, and M.A. Belkin, "Tip-enhanced infrared nanospectroscopy via molecular expansion force detection," *Nature Photon.* **8**, 307–312 (2014).
54. K. Vijayraghavan, M. Jang, A. Jiang, X. Wang, M. Troccoli, and M.A. Belkin, "THz difference-frequency generation in MOVPE-grown quantum cascade lasers," *IEEE Photon. Technol. Lett.* **26**, 391 (2014).
55. J. Lee and M.A. Belkin, "Widely tunable thermo-optic plasmonic bandpass filter," *Appl. Phys. Lett.* **103**, 181115 (2013).
56. S. Suchalkin, G. Belenky, T. Hosoda, S. Jung, and M.A. Belkin, "Distributed feedback quantum cascade laser with optically tunable emission frequency," *Appl. Phys. Lett.* **103**, 041120 (2013).
57. K. Vijayraghavan, Y. Jiang, M. Jang, A. Jiang, K. Choutagunta, A. Vizbaras, F. Demmerle, G. Boehm, M. C. Amann, and M. A. Belkin, "Broadly tunable terahertz generation in mid-infrared quantum cascade lasers," *Nature Commun.* **4**, 2021 (2013).
58. S. Suchalkin, S. Jung, R. Tober, M.A. Belkin, and G. Belenky, "Optically tunable long wavelength infrared quantum cascade laser operated at room temperature," *Appl. Phys. Lett.* **102**, 011125 (2013).
59. M. Jang, S. Suchalkin, and M.A. Belkin, "Mid-infrared quantum cascade lasers with electrical control of the emission frequency," *IEEE J. of Quantum Electron.* **49**, 60-64 (2013).

60. K. Vijayraghavan, R.W. Adams, A. Vizbaras, M. Jang, C. Grasse, G. Boehm, M.C. Amann, and M.A. Belkin, "Terahertz sources based on Čerenkov difference-frequency generation in quantum cascade lasers," *Appl. Phys. Lett.* **100**, 251104 (2012).
61. Y. Zhao, M.A. Belkin, and A. Alu, "Twisted optical metamaterials for planarized, ultrathin, broadband circular polarizers," *Nature Commun.* **3**, 870 (2012).
62. A. Matyas, R. Chashmahcharagh, I. Kovacs, P. Lugli, K. Vijayraghavan, M.A. Belkin, and C. Jirauschek, "Improved terahertz quantum cascade laser with variable height barriers," *J. Appl. Phys.* **111**, 103106 (2012).
63. A. Vizbaras, M. Anders, C. Grasse, S. Katz, G. Boehm, R. Meyer, M.A. Belkin, and M.-C. Amann, "Short-wavelength InP quantum cascade laser sources by quasi-phase-matched intracavity second-harmonic generation," *Phys. Status Solidi C* **9**, 298-301 (2012).
64. Y. Chassagneux, Q.J. Wang, S.P. Khanna, E. Strupiechonski, J. Coudeville, E.H. Linfield, A.G. Davies, F. Capasso, M.A. Belkin, and R. Colombelli, "Limiting factors to the temperature performance of THz quantum cascade lasers based on the resonant-phonon depopulation scheme," *IEEE Trans. Terahertz Sci. Technol.* **2**, 83-92 (2012). (**Invited paper**)
65. F. Lu and M.A. Belkin, "Infrared absorption nano-spectroscopy using sample photoexpansion induced by tunable quantum cascade lasers," *Optics Express* **19**, 19942-19947 (2011).
66. J. Lee, F. Lu, and M.A. Belkin, "Broadly wavelength tunable bandpass filters based on long-range surface plasmon polaritons," *Opt. Lett.* **36**, 3744-3746 (2011).
67. M. Jang, X. Wang, R.W. Adams, M. Troccoli, and M.A. Belkin, "Room-temperature 2.95 μm quantum cascade laser sources based on intra-cavity frequency doubling," *Electron. Lett.* **47**, 667-668 (2011).
68. A. Vizbaras, M. Anders, S. Katz, C. Grasse, G. Boehm, R. Meyer, M.A. Belkin, and M.-C. Amann, "Room-temperature short-wavelength $\lambda=2.6\mu\text{m}$ quantum cascade laser sources by based on intracavity second-harmonic generation," *IEEE J. Quantum Electron.* **47**, 691-697 (2011).
69. R.W. Adams, A. Vizbaras, M. Jang, C. Grasse, S. Katz, G. Boehm, M.C. Amann, and M.A. Belkin, "Terahertz sources based on intracavity frequency mixing in mid-infrared quantum cascade lasers with passive nonlinear sections," *Appl. Phys. Lett.* **98**, 151114 (2011).
70. M. Jang, R.W. Adams, J.X. Chen, W.O. Charles, C. Gmachl, L.W. Cheng, F.-S. Choa, and M.A. Belkin, "Room-temperature operation of 3.6 μm $\text{In}_{0.53}\text{Ga}_{0.47}\text{As}/\text{Al}_{0.48}\text{In}_{0.52}\text{As}$ quantum cascade laser sources based on intracavity second harmonic generation," *Appl. Phys. Lett.* **97**, 141103 (2010).
71. R.W. Adams, K. Vijayraghavan, Q.J. Wang, J. Fan, F. Capasso, S.P. Khanna, A.G. Davies, E.H. Linfield, and M.A. Belkin, "GaAs/ $\text{Al}_{0.15}\text{Ga}_{0.85}\text{As}$ terahertz quantum cascade lasers with double-phonon resonant depopulation operating up to 172 K," *Appl. Phys. Lett.* **97**, 131111 (2010).
72. V.-M. Gkortsas, C. Wang, L. Kuznetsova, L. Diehl, A. Gordon, C. Jirauschek, M.A. Belkin, A. Belyanin, F. Capasso, and F.X. Kartner, "Dynamics of actively mode-locked quantum cascade lasers," *Optics Express*, **18**, 13616-13630 (2010).
73. A. Matyas, M.A. Belkin, P. Lugli, and C. Jirauschek, "Temperature performance analysis of terahertz quantum cascade lasers: vertical versus diagonal designs," *Appl. Phys. Lett.* **96**, 201110 (2010).

74. Q.J. Wang, C. Yan, L. Diehl, M. Hentschel, J. Wiersig, N. Yu, C. Pflugl, M.A. Belkin, T. Edamura, M. Yamanishi, H. Kan, and F. Capasso, "Deformed microcavity quantum cascade lasers with directional emission," *New J. Phys.* **11**, 125018 (2009).
75. N. Yu, M.A. Kats, C. Pflugl, M. Geiser, Q.J. Wang, M.A. Belkin, F. Capasso, M. Fischer, A. Wittmann, J. Faist, T. Edamura, S. Furuta, M. Yamanishi, and H. Kan, "Multi-beam multi-wavelength semiconductor lasers," *Appl. Phys. Lett.* **95**, 161108 (2009).
76. B.G. Lee, J. Kinsky, A.K. Goyal, C. Pflugl, L. Diehl, M.A. Belkin, A. Sanchez, and F. Capasso, "Beam combining of quantum cascade laser arrays," *Optics Express* **17**, 16216-16224 (2009).
77. C.Y. Wang, L. Kuznetsova, V.M. Gkortsas, L. Diehl, F.X. Kärtner, M.A. Belkin, A. Belyanin, X. Li, D. Ham, H. Schneider, P. Grant, C.Y. Song, S. Haffouz, Z.R. Wasilewski, H.C. Liu, and F. Capasso, "Mode-locked pulses from mid-infrared quantum cascade lasers," *Optics Express* **17**, 12929-12943 (2009).
78. B.G. Lee, H.A. Zhang, C. Pflügl, L. Diehl, M.A. Belkin, M. Fischer, A. Wittmann, J. Faist, and F. Capasso, "Broadband distributed-feedback quantum cascade laser array operating from 8.0 to 9.8 μm ," *IEEE Photon. Technol. Lett.* **21**, 914-916 (2009).
79. C. Yan, Q.J. Wang, L. Diehl, M. Hentschel, J. Wiersig, N. Yu, C. Pflügl, F. Capasso, M.A. Belkin, T. Edamura, M. Yamanishi, and H. Kan, "Directional emission and universal far-field behavior from semiconductor lasers with limaçon-shaped microcavity," *Appl. Phys. Lett.* **94**, 251101 (2009).
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Plenary, Tutorial, and Invited Conference Talks and Seminars

1. M.A. Belkin, "Mid-infrared photonic integration on InP," SPIE Photonics West, San Francisco, CA, February 2023. **(Invited talk)**
2. M.A. Belkin, "QCL-based mid-infrared photonic integration on InP," 9th Workshop on Physics and Technology of Semiconductor Lasers 2022, Krakow, Poland, October 3, 2022. **(Invited talk)**
3. M.A. Belkin, "Quantum cascade laser sources based on intra-cavity difference-frequency mixing: the challenge of outcoupling efficiency," International Symposium on Future Trends of Terahertz Semiconductor Technologies (TST2022), Kyoto, Japan, March 6, 2022. **(Invited talk)**
4. M.A. Belkin "Terahertz quantum cascade laser sources based on difference frequency mixing," International School on Terahertz Photonics and Electronics, Pisa, Italy, May 9, 2022. **(Invited talk)**
5. K. Zang, D. Burghart, A. Gardanow, R. Mayer, R. Meyer, G. Boehm, and M.A. Belkin, "Mid-infrared integrated photonics on the InP platform," SPIE Photonics Europe 2022, Strasburg, France, April 6, 2022. **(Invited talk)**
6. W. Oberhausen, J.H. Kim, G. Boehm, and M.A. Belkin, "Terahertz quantum cascade laser sources based on difference-frequency mixing with improved outcoupling efficiency," SPIE Europe 2022, Strasbourg, France, April 4, 2022. **(Invited talk)**
7. M.A. Belkin, "Overview the state of QCL technology and new directions in devices development," International School on Quantum Electronics, 64th Course: Progress in Photoacoustic & Photothermal Phenomena, Erice, Sicily, Oct. 16-23 (2021). **(Keynote talk)**
8. M.A. Belkin, "Mid-infrared photonic integration on InP," European Semiconductor Laser Workshop 2021: ESLW2021, Sept. 17-18, Paris, France/online. **(Invited talk)**
9. K. Zhang, D. Burghart, A. Gardanow, G. Boehm, R. Mayer, and M.A. Belkin, Mid-infrared integrated photonics on InP," 15th International Conference on Mid-Infrared Optoelectronic Materials and Devices (MIOMD), Surrey, U.K./online Sept. 1-3 (2021). **(Invited talk)**

10. M.A. Belkin, "Nonlinear metasurfaces based on intersubband polaritons," Laboratory of Physics, Ecole Normale Supérieure, April 12, 2021. **(Seminar)**
11. M.A. Belkin, "Infrared nanospectroscopy by detecting transient thermal expansion," Symposium on Modern Optics and Materials, Berkeley, CA March 2020. **(Invited talk)**
12. S. Jung, K. Zhang, F. Xie, Y. Okuno, C. Pinzone, K. Lascola, and M.A. Belkin, "III-V mid infrared quantum cascade laser photonic integrated circuits," SPIE Photonics West, San Francisco, CA, February 2020. **(Invited talk)**
13. M.A. Belkin, "Room-temperature terahertz quantum cascade laser sources based on intra-cavity difference frequency generation," Ferdinand Braun Institute, Berlin, January 2020 **(Seminar)**
14. M.A. Belkin, "Room-temperature terahertz quantum cascade laser sources based on intra-cavity difference frequency generation," Annual Workshop of International Research Project (IRP) – TERAMIR, Warsaw, Poland, October 2020. **(Plenary talk)**
15. M.A. Belkin, "Photonic devices based on quantum-engineered nonlinear metamaterials," Ioffe Institute, St. Petersburg, Russia, October 1, 2019. **(Seminar)**
16. M.A. Belkin, "Photonic devices based on quantum-engineered nonlinear metamaterials," The International Research Centre for Nanophotonics and Metamaterials, University of Information Technologies, Mechanics and Optics (ITMO), St. Petersburg, Russia, September 30, 2019. **(Seminar)**
17. M.A. Belkin, "Infrared nanospectroscopy by molecular expansion force detection," Harnessing Light with Structured Materials Symposium, Florence, Italy, July 11, 2019. **(Invited talk)**
18. M.A. Belkin, "Infrared nanospectroscopy by molecular expansion force detection," Chair in Hybrid Nanosystems seminar, Physics Department, Ludwig Maximilian University of Munich, May 22, 2019 **(Seminar)**
19. N. Nookala, S.A. Mann, A. Mekawy, J.F. Klem, I. Brener, A. Alu, and M.A. Belkin, "Optical power limiters based on intersubband polaritonic metasurfaces," CLEO-QELS, San Jose, CA, May 2019. **(Invited talk)**
20. M.A. Belkin, M. Jin and F. Lu, "High-Sensitivity Infrared Vibrational Photoexpansion Nanospectroscopy in Ambient and Aqueous Environments," PITTCON Conference, Philadelphia, PA, March 2019. **(Invited talk)**
21. S. Jung, J.H. Kim, D. Palaferri, J. Kirch, L.J. Mawst, D. Botez, F. Xie, Y. Okuno, C. Pinzone, K. Lascola, and M.A. Belkin, "Photonic integration with quantum cascade lasers," IEEE Photonics Conference, Reston, VA, Oct. 2018.
22. M.A. Belkin, "Terahertz quantum cascade laser sources based on intra-cavity difference frequency generation," 2018 International Quantum Cascade Laser School and Workshop, Cassis, France, Sept. 2018. **(Tutorial talk)**
23. M.A. Belkin, "Room-temperature THz quantum cascade laser sources based on intra-cavity difference-frequency mixing with improved outcoupling efficiency," IEEE Research and Applications of Photonics in Defense Conference (RAPID) conference, Miramar Beach, FL, Aug. 2018. **(Invited talk)**
24. N. Nookala, Y. Liu, J. Lee, D. Palaferri, M. Tymchenko, J.S. Gomez-Diaz, G. Boehm, J.F. Klem, M.-C. Amann, I. Brener, A. Belyanin, A. Alu, and M.A. Belkin, " Nonlinear intersubband polaritonic metasurfaces," Frontiers of photonics, plasmonics and electronics with 2D nanosystems, Erice, Sicily, Italy, July 2018. **(Invited talk)**
25. M.A. Belkin, "THz difference-frequency generation in quantum cascade lasers on silicon," Compound Semiconductor Week 2018, Boston, MA, May-June 2018. **(Invited talk)**

26. N. Nookala, J. Lee, Y. Liu, D. Palaferri, M. Tymchenko, G. Boehm, M.-C. Amann, O. Wolf, J.F. Klem, I. Brener, A. Alu, and M.A. Belkin "Intersubband polaritonic metasurfaces for frequency mixing and optical power limiting." the 48th Winter Colloquium on the Physics of Quantum Electronics, Snowbird, UT, Jan. 2018. **(Invited talk)**
27. M.A. Belkin, "Room-temperature THz quantum cascade lasers sources based on intra-cavity difference-frequency mixing," 3rd Nanolithography Workshop and Terahertz Conference 2017, San Luis Potosí, Mexico, Nov. 2017. **(Invited talk)**
28. M.A. Belkin, "Solid-state mid-infrared-THz revolution," AECOM, Austin, TX, Oct. 2017. **(Seminar)**
29. M.A. Belkin, "Nonlinear metamaterials and metasurfaces based on intersubband transitions," IEEE Photonics Conference, Orlando, FL, Oct. 2017. **(Invited talk)**
30. M.A. Belkin, "Nonlinear optics with intersubband polaritonic metasurfaces," Australian National University, Canberra, Australia, Sept. 2017. **(OSA travelling lecturer seminar)**
31. M.A. Belkin, "Nonlinear optics with intersubband polaritonic metasurfaces," Nanyang Technological University, Singapore, Sept. 2017. **(OSA travelling lecturer seminar)**
32. N. Nookala, J. Lee, Y. Liu, M. Tymchenko, G. Boehm, M.C. Amann, O. Wolf, J. Reno, I. Brener, A. Alu, and M.A. Belkin, "Intersubband polaritonic metasurfaces for frequency mixing and optical power limiting," 32nd International Union of Radio Science General Assembly and Scientific Symposium, Montreal, Canada, Aug. 2017. **(Invited talk)**
33. M.A. Belkin, "High-performance broadly-tunable THz quantum cascade laser sources based on intracavity difference-frequency mixing on silicon substrates," SPIE Optics+Photonics, San Diego, CA, Aug. 2017. **(Invited talk)**
34. N. Nookala, J Lee, Y. Liu, M. Tymchenko, J. S. Gomez-Diaz, F. Demmerle, G. Boehm, M.-C. Amann, O. Wolf, I. Brener, A. Alu, and M.A. Belkin, "Flat nonlinear optics: metasurfaces for efficient frequency mixing," SPIE Photonics West, San Francisco, CA, February 2017. **(Invited talk)**
35. S. Jung, Y. Jiang, J. H. Kim, L. Consolino, S. Bartalini, P. De Natale, M. Vitiello, K. Fujita, M. Hitaka, A. Ito, J. Kirch, D. Botez, F. Demmerle, G. Boehm, M.-C. Amann, and M.A. Belkin, "Narrow-linewidth ultra-broadband terahertz sources based on difference-frequency generation in mid-infrared quantum cascade lasers," SPIE Photonics West, San Francisco, CA, February 2017. **(Invited talk)**
36. M.A. Belkin, "Flat nonlinear optics: efficient frequency conversion in gradient nonlinear metasurfaces," Leipzig School of Natural Sciences – Building with Molecules and Nano-objects (BuildMoNa), September 30, 2016. **(Seminar)**
37. M.A. Belkin, "Room-temperature THz quantum cascade laser sources," 41st International Conference on Infrared, Millimeter and Terahertz Wave (IRMMW-THz), Copenhagen, Denmark, September 25-30, 2016. **(Keynote talk)**
38. N. Nookala, J. Lee, J.S. Gomez-Diaz, M. Tymchenko, F. Demmerle, G. Boehm, M.-C. Amann, A. Alu, and M.A. Belkin "Ultrathin gradient nonlinear metasurfaces with giant nonlinear response," SPIE Optics+Photonics, San Diego, CA, August 28-Sept. 1, 2016. **(Invited talk).**
39. M.A. Belkin, "Room-temperature THz quantum cascade laser sources," International Nano-Optoelectronics Workshop (iNOW), Munich, Germany, July 27-31, 2016. **(Invited talk)**
40. M.A. Belkin, "Flat nonlinear optics: efficient frequency conversion in gradient nonlinear metasurfaces," Gordon Research Conference on Plasmonics and Nanophotonics, Newry, ME, July 10-15, 2016. **(Invited talk)**

41. M.A. Belkin, "Mid- and far-IR photonic devices based on quantum-engineered optical nonlinearities," Walter Schottky Institute, Technical University of Munich, Garching, Germany, June 20, 2016. **(Seminar)**
42. M.A. Belkin, "Practical photonic devices based on quantum-engineered nonlinear metamaterials," Moscow Institute of Physics and Technology, March 21, 2016. **(Seminar)**.
43. M.A. Belkin, "Infrared vibrational nanospectroscopy via molecular expansion force detection," Walter Schottky Institute, Technical University of Munich, Garching, Germany, March 16, 2016. **(Seminar)**
44. J. Lee, N. Nookala, M. Tymchenko, J. S. Gomez-Diaz, F. Demmerle, G. Boehm, M.-C. Amann, A. Alu, and M.A. Belkin, "Flat Nonlinear Optics," 46th Winter Colloquium on The Physics of Quantum Electronics, Snowbird, UT, January 2016. **(Invited talk)**
45. J. Lee, N. Nookala, M. Tymchenko, J. S. Gomez-Diaz, F. Demmerle, G. Boehm, M.-C. Amann, A. Alu, and M.A. Belkin, "Flat nonlinear optics: efficient frequency conversion in ultrathin nonlinear metasurfaces," Frontiers in Optics/Laser Science San Jose, CA, October 2015. **(Invited talk)**
46. F. Lu, M. Jin, and M.A. Belkin, "Recent progress in tip-enhanced mid-infrared photoexpansion nanospectroscopy," American Vacuum Society 62nd International Symposium and Exhibition, San Jose, CA, October 2015. **(Invited talk)**
47. M.A. Belkin, "Nonlinear metasurfaces for efficient frequency conversion of semiconductor laser outputs," 2015 IEEE International Photonics Conference, Reston, VA, October 2015. **(Invited talk)**
48. M.A. Belkin, "Flat nonlinear optics: efficient nonlinear mixing in ultra-thin nonlinear metasurfaces with continuous phase control," OSA Nonlinear Metamaterials Incubator, Washington, DC, October 2015. **(Invited talk)**
49. M.A. Belkin, "Broadly-tunable monolithic THz quantum cascade laser sources," SCIX 2015 Conference, Providence, RI, September-October 2015. **(Invited talk)**
50. M.A. Belkin, M. Jin, and F. Lu, "Tip-enhanced infrared photoexpansion nanospectroscopy in air and aqueous solutions," SCIX 2015 Conference, Providence, RI, September-October 2015. **(Invited talk)**
51. M.A. Belkin, "Highly-nonlinear quantum-engineered polaritonic metasurfaces," SPIE Optics + Photonics, San Diego, CA, August 2015. **(Invited talk)**
52. M.A. Belkin, "Infrared vibrational nanospectroscopy via molecular expansion force detection," 8th International Conference on Advanced Vibrational Spectroscopy, Vienna, Austria, July 2015 **(Plenary talk)**
53. S. Jung, A. Jiang, Y. Jiang, K. Vijayraghavan, X. Wang, M. Troccoli, F. Demmerle, G. Boehm, M.-C. Amann, and M.A. Belkin, "Widely tunable room temperature THz quantum cascade laser sources," CLEO-Europe, Munich, Germany, June 2015. **(Invited talk)**
54. F. Lu, M. Jin, and M.A. Belkin, "Tip-enhanced infrared nanospectroscopy via molecular expansion force detection," Pittcon 2015, New Orleans, LA, March 2015. **(Invited talk)**
55. M.A. Belkin, "Practical photonic devices based on quantum-engineered nonlinear metamaterials," College of Optics Sciences Colloquium, University of Arizona, Tucson, AZ, February 2015. **(Seminar)**
56. J. Lee, S. Jung, M. Tymchenko, C. Argyropoulos, P.-Y. Chen, F. Lu, F. Demmerle, G. Boehm, M.-C. Amann, A. Alu, and M.A. Belkin, "Nonlinear optics with quantum-engineered intersubband metamaterials," SPIE Photonics West, San Francisco, CA, February 2015. **(Invited talk)**

57. F. Lu, M. Jin, and M.A. Belkin, "Tip-enhanced infrared nanospectroscopy via molecular expansion force detection," Eastern Analytical Symposium and Exhibition, Somerset, NJ, November 2014. **(Invited talk)**
58. M. Jin, F. Lu, and M.A. Belkin, "Recent progress in mid-infrared photoexpansion nanospectroscopy," SCIX 2014 Conference, Reno, NV, September-October 2014. **(Invited talk)**
59. M.A. Belkin, "Giant nonlinear response from plasmonic metasurfaces coupled to intersubband transitions," 6th International Workshop on Electromagnetic Metamaterials, Santa Fe, NM, September 23, 2014. **(Invited talk)**
60. J. Lee, Y. Jiang, K. Vijayraghavan, A. Jiang, M. Tymchenko, C. Argyropoulos, P.-Y. Chen, F. Lu, F. Demmerle, G. Boehm, M.-C. Amann, A. Alu, and M. A. Belkin, "Nonlinear optics with quantum-engineered intersubband metamaterials," International Quantum Cascade Lasers School and Workshop, Policoro, Italy, September 10, 2014. **(Invited talk)**
61. J. Lee, M. Tymchenko, C. Argyropoulos, P. Chen, F. Lu, F. Demmerle, G. Böhm, M.-C. Amann, A. Alu, M.A. Belkin, "Giant nonlinear response from plasmonic metasurfaces coupled to intersubband transitions," SPIE Optics + Photonics, San Diego, CA, August 17, 2014. **(Invited talk)**
62. Y. Jiang, S. Jung, K. Vijayraghavan, A. Jiang, M.A. Belkin "Broadly-tunable THz sources based on intra-cavity difference-frequency generation in mid-infrared quantum cascade lasers" SPIE Optics + Photonics, San Diego, CA, August 17, 2014. **(Invited talk)**
63. S. Jung, A. Jiang, Y. Jiang, K. Vijayraghavan, X. Wang, M. Troccoli, F. Demmerle, G. Boehm, M.-C. Amann, and M.A. Belkin, "Broadly Tunable Room Temperature Monolithic Terahertz Quantum Cascade Laser Sources," OSA Advanced Photonics (SENSORS), Barcelona, Spain, July 31, 2014. **(Invited talk)**
64. M.A. Belkin, "Nonlinear optics with quantum-engineered intersubband metamaterials," Walter Schottky Institute, Technical University of Munich, Garching, Germany, July 17, 2014. **(Seminar)**
65. J. Lee, S. Jung, M. Tymchenko, C. Argyropoulos, P.-Y. Chen, F. Lu, F. Demmerle, G.Boehm, M.-C. Amann, A. Alu, and M. A. Belkin, "Giant nonlinear response from plasmonic metasurfaces coupled to intersubband transitions," The 23rd Annual International Laser Physics Workshop, Sofia, Bulgaria, July 15, 2014. **(Invited talk)**
66. M.A. Belkin, F. Lu, M. Jin, "Mid-infrared nanospectroscopy by detecting molecular expansion forces," The 23rd Annual International Laser Physics Workshop, Sofia, Bulgaria, July 14, 2014. **(Invited talk)**
67. M.A. Belkin, "Ultrasensitive infrared vibrational nanospectroscopy via molecular expansion force detection," Chemistry and Biochemistry seminar, Worcester Polytechnic Institute, Worcester, MA, May 28, 2014. **(Seminar)**
68. M.A. Belkin, "Ultrasensitive infrared vibrational nanospectroscopy via molecular expansion force detection," Chicago section of the Society for Applied Spectroscopy seminar, Chicago, IL, May 14, 2014. **(Seminar)**
69. M.A. Belkin, "Nonlinear optics with quantum-engineered intersubband metamaterials," Physics Department seminar, Queens College of the City University of New York, NY, May 5, 2014. **(Seminar)**
70. M.A. Belkin, "Infrared vibrational nanospectroscopy via molecular force detection," Electrical and Computer Engineering seminar, University of Maryland, College Park, MD, March 7, 2014. **(Seminar)**

71. M.A. Belkin, “Broadly-tunable room-temperature THz quantum cascade laser sources,” Thorlabs Quantum Electronics, Jessup, MD, March 5, 2014. **(Seminar)**
72. M.A. Belkin, “Infrared vibrational nanospectroscopy via molecular force detection,” Thorlabs Quantum Electronics, Jessup, MD, March 5, 2014. **(Seminar)**
73. M. A. Belkin, Y. Jiang, K. Vijayraghavan, S. Jung, F. Demmerle, G. Boehm, and M.-C. Amann, “Broadly-tunable room-temperature THz quantum cascade laser sources,” SPIE Photonics West, San Francisco, CA, February 4, 2014. **(Invited talk)**
74. M.A. Belkin, “Infrared vibrational nanospectroscopy via molecular force detection,” Institute of Bioengineering seminar, École Polytechnique Fédérale de Lausanne, January 15, 2014. **(Seminar)**
75. M.A. Belkin, “Broadly-tunable room-temperature THz quantum cascade laser sources,” mm-Wave, THz, and Infrared Seminar Series, Rice University, Houston, TX, October 18, 2013. **(Seminar)**
76. F. Lu, M. Jin, and M.A. Belkin “Mid-infrared vibrational nanospectroscopy via direct molecular force detection,” SCIX 2013 Conference, Milwaukee, WI, September-October 2013. **(Invited talk given by a student from my group)**
77. M. A. Belkin, Y. Jiang, K. Vijayraghavan, F. Demmerle, G. Boehm, and M. Amann, “Broadly-tunable room temperature terahertz quantum cascade laser sources: devices and applications,” SCIX 2013 Conference, Milwaukee, WI, September-October 2013. **(Invited talk)**
78. J. Lee, P.Y. Chen, C. Argyropoulos, A. Alu, and M.A. Belkin, “Metamaterials based on intersubband polaritons,” The 7th International Congress on Advanced Electromagnetic Materials in Microwaves and Optics, Bordeaux, France, September 2013. **(Invited talk)**
79. Y. Jiang, K. Vijayraghavan, A. Jiang, F. Demmerle, G. Boehm, M.C. Amann, and M.A. Belkin, “Broadly tunable room temperature THz source,” 12th International Conference on Intersubband Transitions in Quantum Wells (ITQW), Bolton Landing, NY, Sept. 2013 **(Invited talk given by a student from my group)**
80. K. Vijayraghavan, Y. Jiang, A. Jiang, F. Demmerle, G. Boehm, X. Wang , M. Troccoli, M.C. Amann, and M.A. Belkin, “High performance room-temperature intracavity terahertz difference-frequency generation in quantum cascade lasers” International Conference on Infrared, Millimeter, and Terahertz Waves (IRMMW-THz), Mainz, Germany, Sept. 2013. **(Invited talk given by a student from my group – first place student paper award)**
81. M.A. Belkin, “Widely tunable terahertz quantum cascade lasers,” Photonics Institute, Technical University of Vienna, Vienna, Austria, July 16, 2013. **(Seminar)**
82. M.A. Belkin, “Widely tunable terahertz quantum cascade lasers,” Walter Schottky Institute, Technical University of Munich, Garching, Germany, July 15, 2013. **(Seminar)**
83. M.A. Belkin, “High performance broadly-tunable terahertz quantum cascade laser sources based on intra-cavity frequency mixing,” The 21st International Symposium “Nanostructures: physics and technology,” Saint Petersburg, Russia, June 2013. **(Invited talk)**
84. M. A. Belkin, K. Vijayraghavan, Y. Jiang, A. Jiang, F. Demmerle, G. Boehm, and M. Amann, “Room-temperature quantum cascade laser sources of terahertz radiation,” CLEO-QELS, San Jose, CA, June 2013. **(Invited talk)**
85. M.A. Belkin, “Nanoscale mid-infrared vibrational spectroscopy with monolayer sensitivity,” 96th Canadian Chemistry Conference, Quebec City, Canada, May 30, 2013. **(Invited talk)**

86. M.A. Belkin, “Broadly-tunable room-temperature THz quantum cascade laser sources,” Electrical Engineering Seminar, University of Texas at Dallas, Richardson, TX, May 16, 2013. (**Seminar**)
87. M.A. Belkin, “Broadly-tunable room-temperature THz quantum cascade laser sources,” Atomic, Molecular, and Optical Physics Seminar, Texas A&M University, College Station, TX, April 26, 2013. (**Seminar**)
88. M.A. Belkin, “Nanoscale infrared spectroscopy by detecting molecular forces,” Electrical and Computer Engineering Seminar, University of Houston, Houston, TX, April 19, 2013. (**Seminar**)
89. M.A. Belkin, “Room-temperature electrically-pumped THz semiconductor sources,” US-UK Workshop in Mid-IR to THz Technology and Applications, Edinburgh, UK, February 19, 2013. (**Invited talk**)
90. M.A. Belkin, K. Vijayraghavan, A. Vizbaras, A. Jiang, F. Demmerle, G. Boehm, R. Meyer, M.-C. Amann, A. Matyas, R. Chashmahcharagh, P. Lugli, C. Jirauschek, and Z.R. Wasilewski, “THz quantum cascade lasers for operation above cryogenic temperatures,” SPIE Photonics West, San Francisco, CA, February 6, 2013. (**Invited talk**).
91. M.A. Belkin, F. Lu, M. Jin, M. Salih, P. Dean, S.P. Khanna, L.H. Li, G. Davies, and E.H. Linfield, “Terahertz and mid-infrared photoexpansion nanospectroscopy,” SPIE Photonics West, San Francisco, CA, February 6, 2013. (**Invited talk**)
92. M. Belkin, “Infrared vibrational nanospectroscopy by detecting molecular forces,” Texas A&M University Institute for Quantum Science and Engineering Workshop, College Station, TX, January 16, 2013. (**Invited talk**)
93. M. Belkin, K. Vijayraghavan, F. Demmerle, M. Jang, A. Jiang, C. Grasse, and M.-C. Amann, “Room-temperature THz quantum cascade laser sources,” Photonics Global Conference, Singapore, December 15, 2012. (**Invited talk**)
94. M.A. Belkin, “Nanoscale spectroscopy and plasmonics in infrared,” Electrical Engineering Seminar, Nanyang Technological University, Singapore, December 12, 2012. (**Seminar**)
95. M.A. Belkin, “Room temperature terahertz quantum cascade laser sources,” Physics Department Seminar, Fudan University, Shanghai, China, December 10, 2012. (**Seminar**)
96. M.A. Belkin, “Room-temperature THz quantum cascade laser sources,” Electrical Engineering Department Seminar, University of Wisconsin at Madison, Madison, WI, November 19, 2012. (**Seminar**)
97. M.A. Belkin, “THz generation and nanoscale chemical imaging with quantum cascade lasers,” Optical, Electronic, and Quantum Systems Seminar, University of Colorado at Boulder, Boulder, CO, October 12, 2012. (**Seminar**)
98. M. Belkin and F. Lu, “Tip-enhanced mid-infrared and terahertz photoexpansion nanospectroscopy,” SciX conference, Kansas City, MO, October 1, 2012. (**Invited talk**)
99. M.A. Belkin, “THz generation and nanoscale chemical imaging with quantum cascade lasers,” Institute of Fundamental Electronics, University of Paris – South, Orsay, France, September 12, 2012. (**Seminar**)
100. M.A. Belkin, “Nanoscale chemical imaging with quantum cascade lasers,” Walter Schottky Institute, Technical University of Munich, Garching, Germany, September 6, 2012. (**Seminar**)
101. M.A. Belkin, “THz generation and nanoscale chemical imaging with quantum cascade lasers,” Department of Electrical Engineering, University of California – Los Angeles, Los Angeles, CA, August 14, 2012. (**Seminar**)

102. M.A. Belkin, "THz generation and nanoscale chemical imaging with quantum cascade lasers," The International Laser Center, Moscow State University, Moscow, Russia, June 8, 2012. **(Seminar)**
103. M.A. Belkin, "Terahertz quantum cascade lasers: Progress towards room-temperature operation," Defense Science Research Council (DSRC) workshop on "Solid state devices with vacuum tube-like electron dynamics for high-power terahertz generation," Arlington, VA, February 2, 2012. **(Invited talk)**
104. M.A. Belkin, "Nanoscale spectroscopy and plasmonics in infrared," Condensed Matter Seminar, Physics Department, Purdue University, West Lafayette, IN, January 13, 2012. **(Seminar)**
105. M.A. Belkin, "Nanoscale spectroscopy and plasmonics in infrared," Nanoelectronics and Nanophotonics Seminar, Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, January 12, 2012. **(Seminar)**
106. M.A. Belkin, "Nanoscale chemical imaging and THz generation using quantum cascade lasers," Air Force Research Laboratory, Brooks City-Base, TX, October 2011. **(Seminar)**
107. M.A. Belkin, "Nanoscale imaging and plasmonic devices in infrared," Princeton Institute for the Science and Technology of Materials, Princeton University, Princeton, NJ, October 2011. **(Seminar)**
108. M.A. Belkin and F. Lu, "Infrared absorption nano-spectroscopy with quantum cascade lasers," Federation of Analytical Chemistry and Spectroscopy Societies (FACSS) Conference, Reno, NV, October 2011. **(Invited talk)**
109. M.A. Belkin, "Nanoscale imaging, optoelectronics, and plasmonics in mid-infrared," Schottky Seminar, Walter Schottky Institute, Technical University of Munich, Garching, Germany, July 2011. **(Seminar)**
110. M.A. Belkin, "Nanoscale imaging, optoelectronics, and plasmonics in mid-infrared," Photonics Seminar, Technical University of Vienna, Vienna, Austria, July 2011. **(Seminar)**
111. M.A. Belkin, "Nanoscale imaging, optoelectronics, and plasmonics in mid-infrared," Laser Seminar, ETH Zurich, Switzerland, July 2011. **(Seminar)**
112. M.A. Belkin, M. Jang, R.W. Adams, J. X. Chen, W. O. Charles, C. Gmachl, X. Wang, M. Troccoli, A. Vizbaras, M. Anders, S. Katz, C. Grasse, G. Boehm, R. Meyer, M.C. Amann, L. W. Cheng, and F.-S. Choa, "2.6-3.6 micron InGaAs/AlInAs quantum cascade laser sources based on intra-cavity second harmonic generation," 20th International Laser Physics Workshop, Sarajevo, Bosnia and Herzegovina, July 2011. **(Invited talk)**
113. M.A. Belkin, M. Jang, R.W. Adams, J.X. Chen, W.O. Charles, C. Gmachl, L.W. Cheng, F.-S. Choa, X. Wang, M. Troccoli, A. Vizbaras, M. Anders, C. Grasse, and M.-C. Amann, "InGaAs/AlInAs quantum cascade laser sources based on intra-cavity second harmonic generation emitting in 2.6-3.6 micron range," SPIE Photonics West, San Francisco, CA, January 2011. **(Invited talk)**
114. M.A. Belkin, M. Jang, R.W. Adams, K. Vijayraghavan, J. X. Chen, W.O. Charles, C. Gmachl, L.W. Cheng, F.-S. Choa, A. Vizbaras, M. Anders, S. Katz, C. Grasse, G. Boehm, R. Meyer, M.C. Amann, X. Wang, and M. Troccoli, "2.6-3.6 μ m InGaAs/AlInAs quantum cascade laser sources based on intra-cavity second harmonic generation," 41st Winter Colloquium on The Physics of Quantum Electronics, Snowbird, UT, January 2011. **(Invited talk)**
115. M.A. Belkin and F. Lu, "Photoacoustic microscopy with quantum cascade lasers," International Quantum Cascade Lasers School and Workshop, Florence, Italy, September 2010. **(Invited talk)**

116. M.A. Belkin, “Towards room-temperature quantum cascade lasers in Terahertz,” Condensed Matter Seminar, Physics Department, The University of Texas at Austin, Austin, TX, April 2010. **(Seminar)**
117. M.A. Belkin, R. W. Adams, A. Vizbaras, M. Jang, C. Grasse, S. Katz, G. Boehm, and M.C. Amann, “THz quantum cascade laser sources for room-temperature operation,” 40th Winter Colloquium on The Physics of Quantum Electronics, Snowbird, UT, January 2010. **(Invited talk)**
118. M.A. Belkin, “Towards room-temperature terahertz quantum cascade laser sources,” Physics Department Seminar, State University of New York at Stony Brook, Stony Brook, NY, November 2009. **(Seminar)**
119. M.A. Belkin, “Terahertz quantum cascade laser sources for high temperature operation,” CLEO-Europe, Munich, Germany, June 2009. **(Invited talk)**
120. M.A. Belkin, A. Belyanin, S. Khanna, G. Davies, E. Linfield, and J. Faist, “High temperature operation of quantum cascade laser sources,” IEEE Photonics Society International Conference on Indium Phosphate and Related Materials, Newport Beach, CA, May 2009. **(Invited talk)**
121. M.A. Belkin, F. Capasso, and A. Belyanin, “High temperature operation of terahertz quantum cascade laser sources,” Materials Research Society Spring Meeting, San Francisco, CA, April 2009. **(Invited talk)**
122. M.A. Belkin, “Quantum cascade lasers: from systems for chemical sensing to nonlinear optics in terahertz,” The Center for Nanotechnology Seminar, University of Washington, Seattle, WA, October 2008. **(Seminar)**
123. M.A. Belkin, “Designing THz QCL sources for operation above cryogenic temperatures,” International Quantum Cascade Lasers School and Workshop, Monte Verita, Switzerland, September 2008. **(Invited talk)**
124. M.A. Belkin, “Towards room-temperature terahertz quantum cascade laser sources,” NSF Research Center Mid-Infrared Technologies for Health and the Environment (MIRTHE) workshop, Baltimore, MD, August 2008. **(Tutorial)**
125. M.A. Belkin, F. Capasso, A. Belyanin, F. Xie, M. Fischer, A. Wittmann, and J. Faist, “Room-temperature terahertz sources based on intra-cavity difference-frequency generation in mid-infrared quantum cascade lasers,” 17th International Laser Physics Workshop, Trondheim, Norway, June-July 2008. **(Invited talk)**
126. M.A. Belkin, “Quantum cascade lasers – bridging the terahertz gap with semiconductor lasers,” Photonics Center Seminar, University of Massachusetts at Lowell, Lowell, MA, June 2008. **(Seminar)**
127. M.A. Belkin, “Quantum cascade lasers – bridging the terahertz gap with semiconductor lasers,” Department of Physics Seminar, Texas A&M University, College Station, TX, May 2008. **(Seminar)**
128. M.A. Belkin, “Quantum cascade lasers – bridging the terahertz gap with semiconductor lasers,” Department of Electrical and Systems Engineering Seminar, University of Pennsylvania, Philadelphia, PA, April 2008. **(Seminar)**
129. M.A. Belkin, “Quantum cascade lasers – bridging the terahertz gap with semiconductor lasers,” Department of Electrical and Computer Engineering Seminar, University of Texas, Austin, Austin, TX, April 2008. **(Seminar)**

130. M.A. Belkin, “Quantum cascade lasers – bridging the terahertz gap with semiconductor lasers,” Department of Physics Seminar, Georgia Institute of Technology, Atlanta, GA, April 2008. **(Seminar)**
131. M.A. Belkin, “Quantum cascade lasers – bridging the terahertz gap with semiconductor lasers,” College of Optics Seminar, University of Central Florida, Orlando, FL, March 2008. **(Seminar)**
132. M.A. Belkin, “Quantum cascade lasers – bridging the terahertz gap with semiconductor lasers,” Department of Physics Seminar, Tufts University, Medford, MA, March 2008. **(Seminar)**
133. M.A. Belkin, “Quantum cascade lasers – bridging the terahertz gap with semiconductor lasers,” Department of Physics Seminar, University of California at Davis, Davis, CA, February 2008. **(Seminar)**
134. M.A. Belkin, “Quantum cascade lasers – bridging the terahertz gap with semiconductor lasers,” Department of Physics Seminar, Arizona State University, Tempe, AZ, February 2008. **(Seminar)**
135. M.A. Belkin, “THz quantum cascade laser sources for operation above cryogenic temperatures,” Department Seminar, Department of Electrical and Computer Engineering, University of California, San Diego, CA, January 2008. **(Seminar)**
136. M.A. Belkin, A.A. Belyanin, and F. Capasso, “Terahertz source based on intracavity difference-frequency generation in quantum cascade lasers,” SPIE Photonics West, San Jose, CA, January 2008. **(Invited talk)**
137. M.A. Belkin, “Novel intersubband THz sources for operation above cryogenic temperatures,” 38th Winter Colloquium on The Physics of Quantum Electronics, Snowbird, UT, January 2008. **(Invited talk)**
138. M.A. Belkin, “Terahertz quantum cascade lasers sources for operation above cryogenic temperatures,” School of Electronic and Electrical Engineering seminar, University of Leeds, U.K., September 2007. **(Seminar)**
139. M.A. Belkin, F. Capasso, A. Belyanin, and D.L. Sivco, “Terahertz quantum cascade laser source based on intra-cavity difference-frequency generation,” CLEO-Europe, Munich, Germany, June 2007. **(Invited talk)**
140. M.A. Belkin, F. Capasso, A. Belyanin, and D.L. Sivco, “Terahertz difference-frequency generation in quantum cascade lasers,” CLEO/QELS, Baltimore, MD, May 2007. **(Invited talk)**
141. M.A. Belkin, “New directions in quantum cascade lasers research: from nonlinear optics to mid-IR sensors for lab-on-a-chip,” GE Global Research seminar, Niskayuna, NY, October 2006. **(Seminar)**
142. M.A. Belkin, “New directions in quantum cascade laser applications: from optofluidic lasers to plasmonic laser antennas,” 2nd International Workshop on Quantum Cascade Lasers, Brindisi, Italy, September 2006. **(Invited talk)**
143. M.A. Belkin, “Sum-frequency spectroscopy as a novel probe of molecular chirality,” Special Seminar, Los Alamos National Laboratory, Los Alamos, NM, June 2004. **(Seminar)**
144. M.A. Belkin, “Sum-frequency spectroscopy as a novel probe of molecular chirality,” Atomic, Molecular and Optical Science Seminar, Physics Department, University of California at Berkeley, Berkeley, CA, April 2004. **(Seminar)**

145. M.A. Belkin, "The application of sum-frequency generation spectroscopy to study chirality," LEOS Moscow Chapter Seminar, International Laser Center of Moscow State University, Moscow, Russia, September 2003. **(Seminar)**
146. M.A. Belkin and Y.R. Shen, "Sum-frequency spectroscopy as a novel probe of molecular chirality," CLEO/QELS, Baltimore, MD, June 2003. **(Invited talk)**