Michele Cotrufo, Ph.D.

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https://scholar.google.com/citations?user=oEu1DyQAAAAJ

Employment

2023 – ... **Assistant Professor** (tenure track), The Institute of Optics, University of Rochester.

2018 – 2023 **Postdoctoral research fellow** in the group of **Prof. Andrea Alù** at the *Advanced Science Research Center (Research Foundation of CUNY), New York, NY, U.S.A.*

2017 – 2018 **Postdoctoral research fellow** in the group of **Prof. Andrea Alù** at *University of Texas at Austin, Austin, TX, U.S.A.*

Education

2012 – 2017 Ph.D. Physics, **Eindhoven University of Technology (The Netherlands)**, Advisor: Prof. Andrea Fiore. Co-advisors: Prof. Femius Koenderink and Prof. Ewold Verhagen.

2010 – 2012 M.Sc. Physics, **University of Padova (Italy)**, graduated summa cum laude. Thesis Advisor: Prof. Filippo Romanato.

2007 – 2010 B.Sc. Physics, **University of Bari (Italy)**, graduated summa cum laude. Thesis Advisor: Prof. Gaetano Scamarcio.

Grants, Fellowships, Honors and Awards

2023 **Photonics 2023** Young Investigator Award (MDPI), web.

2018 - 2020 **Rubicon fellowship**, a grant sponsored by the Dutch Research Council to allow young scientists to gain experience at a foreign top institute ($134k for 2 years), web.

Selected Press Releases

- S. Thorn, *New metasurface-based edge detecting filter for remote sensing could transform crop monitoring*, Phys.org, May 28, 2024, web.

- S. R.-K. Rodriguez and S. A. Mann, *Heat-assisted nonreciprocity*, Nature Photonics News & Views, January 2, 2024, web.

- S. Rhea, *Bartering light for light: Scientists discover new system to control the chaotic behavior of light*, Eurekalert, November 2, 2023, web.

- C. Lee, *Single-Chip Lidar Routing is in Our Tiny Future*, Ars Technica, April 29, 2020, web.

- T. Abate, *Could Shrinking a Key Component Make Autonomous Cars Affordable?*, Stanford Engineering, April 16, 2020, web.

- S. Rhea, *A New Theory for Trapping Light Particles Aims to Advance Development of Quantum Computers*, Phys.org - Science Daily, June 24, 2019, web.

Patents (citation number indicates corresponding published paper, when available)

- US Patent App. 18/078,301 (2023).[24]

- US Patent App. 18/063,756 (2023).[22]

Books and Book Chapters

[2] **M. Cotrufo** and A. Alù, "Metamaterials for analog all-optical computation," in *Progress in Optics*, Elsevier, 2024. web.

[1] J. Quan, **M. Cotrufo**, X. Li, and A. Alù, "Two-dimensional hybrid plasmonic materials," in *Plasmonic Materials and Metastructures*, Elsevier, 2024. web.

Peer-reviewed publications (* denotes equal contributors)

Manuscripts in preparation or under review (draft available upon request):

[38] **M. Cotrufo***, S. Esfahani*, D. Korobkin*, and A. Alù, "Temporal signal processing with nonlocal optical metasurfaces," under review. web.

[37] S. Esfahani*, **M. Cotrufo***, and A. Alù, "Space-time nonlocal metasurfaces for event-based image processing," under review. web.

[36] J. R. Nolen*, A. C. Overvig*, **M. Cotrufo**, and A. Alù, "Arbitrarily polarized and unidirectional emission from thermal metasurfaces," under review. web.

2024

[35] M. Deng*, **M. Cotrufo***, J. Wang, *et al.*, "Broadband angular spectrum differentiation using dielectric metasurfaces," *Nature Communications*, vol. 15, no. 1, p. 2237, 2024. web.

[34] **M. Cotrufo**, A. Cordaro, D. L. Sounas, A. Polman, and A. Alù, "Passive bias-free non-reciprocal metasurfaces based on thermally nonlinear quasi-bound states in the continuum," *Nature Photonics*, vol. 18, no. 1, pp. 81–90, 2024. web.

[33] **M. Cotrufo**, S. B. Sulejman, L. Wesemann, *et al.*, "Reconfigurable image processing metasurfaces with phase-change materials," *Nature Communications*, vol. 15, no. 1, p. 4483, 2024. web.

[32] **M. Cotrufo***, J. Krakofsky*, S. A. Mann*, *et al.*, "Intersubband polaritonic metasurfaces for high-contrast ultra-fast power limiting and optical switching," *npj Nanophotonics*, 2024, in press. web.

[31] T. J. Cui, S. Zhang, A. Alu, *et al.*, "Roadmap on electromagnetic metamaterials and metasurfaces," *Journal of Physics: Photonics*, 2024. web.

[30] X. Jiang, S. Yin, H. Li, *et al.*, "Coherent control of chaotic optical microcavity with reflectionless scattering modes," *Nature Physics*, vol. 20, no. 1, pp. 109–115, 2024. web.

2023

[29] **M. Cotrufo***, S. Singh*, A. Arora, A. Majewski, and A. Alù, "Polarization imaging and edge detection with image-processing metasurfaces," *Optica*, vol. 10, no. 10, pp. 1331–1338, 2023. web.

[28] **M. Cotrufo***, A. Arora*, S. Singh, and A. Alù, "Dispersion engineered metasurfaces for broadband, high-na, high-efficiency, dual-polarization analog image processing," *Nature Communications*, vol. 14, no. 1, p. 7078, 2023. web.

[27] A. Li, H. Wei, **M. Cotrufo**, *et al.*, "Exceptional points and non-hermitian photonics at the nanoscale," *Nature Nanotechnology*, vol. 18, no. 7, pp. 706–720, 2023. web.

[26] H. Moussa, **M. Cotrufo**, and A. Alù, "Controllable transmission switch based on asymmetric coupled nonlinear resonances," *Physical Review Applied*, vol. 19, no. 6, p. 064 002, 2023. web.

[25] N. Nefedkin, **M. Cotrufo**, and A. Alù, "Nonreciprocal total cross section of quantum metasurfaces," *Nanophotonics*, vol. 12, no. 3, pp. 589–606, 2023. web.

[24] A. C. Overvig, **M. Cotrufo**, M. Markowitz, *et al.*, "Zone-folded quasi-bound state metasurfaces with customized, symmetry-protected energy-momentum relations," *ACS Photonics*, vol. 10, no. 6, pp. 1832–1840, 2023. web.

2022

[23] M. Wang, G. Hu, S. Chand, *et al.*, "Spin-orbit-locked hyperbolic polariton vortices carrying reconfigurable topological charge," *eLight*, vol. 2, no. 1, pp. 1–11, 2022. web.

[22] M. Markowitz, **M. Cotrufo**, Y. Zhou, *et al.*, "Tailored Resonant Waveguide Gratings for Augmented Reality," *Optics Express*, vol. 30, 12 2022. web.

[21] N. Nefedkin, **M. Cotrufo**, A. Krasnok, and A. Alù, "Dark-state induced quantum nonreciprocity," *Advanced Quantum Technologies*, vol. 5, no. 3, p. 2 100 112, 2022. web, (***Invited paper***).

2021

[20] A. Hofstrand, **M. Cotrufo**, and A. Alù, "Nonreciprocal Pulse Shaping and Chaotic Modulation with Asymmetric Noninstantaneous Nonlinear Resonators," *Physical Review A*, vol. 104, no. 5, 2021. web.

[19] **M. Cotrufo**, S. A. Mann, H. Moussa, and A. Alù, "Nonlinearity-Induced Nonreciprocity - Part I," *IEEE Transactions on Microwave Theory and Techniques*, vol. 69, no. 8, pp. 3569–3583, 2021. web.

[18] **M. Cotrufo**, S. A. Mann, H. Moussa, and A. Alù, "Nonlinearity-Induced Nonreciprocity - Part II," *IEEE Transactions on Microwave Theory and Techniques*, vol. 69, no. 8, pp. 3584–3597, 2021. web.

[17] S. A. Mann, N. Nookala, S. C. Johnson, *et al.*, "Ultrafast Optical Switching and Power Limiting in Intersubband Polaritonic Metasurfaces," *Optica*, vol. 8, no. 5, pp. 606–613, 2021. web.

[16] Y. Mazor, **M. Cotrufo**, and A. Alù, "Unitary Excitation Transfer between Coupled Cavities Using Temporal Switching," *Physical Review Letters*, vol. 127, no. 1, p. 013 902, 2021. web.

2020

[15] A. Prakash, T. Wang, A. Bucsek, *et al.*, "Self-Assembled Periodic Nanostructures Using Martensitic Phase Transformations," *Nano Letters*, 2020. web.

[14] K. Y. Yang, J. Skarda, A. Dutt, *et al.*, "Nonreciprocal Devices in Silicon Photonics," *Optics and Photonics News*, vol. 31, no. 12, pp. 38–38, 2020. web.

[13] K. Y. Yang*, J. Skarda*, **M. Cotrufo***, *et al.*, "Inverse-designed non-reciprocal pulse router for chip-based LiDAR," *Nature Photonics*, pp. 1–6, 2020. web.

2019

[12] **M. Cotrufo** and A. Alù, "Excitation of Single-Photon Embedded Eigenstates in Coupled Cavity–Atom Systems," *Optica*, vol. 6, no. 6, pp. 799–804, 2019. web.

[11] **M. Cotrufo**, L. Sun, J. Choi, A. Alù, and X. Li, "Enhancing Functionalities of Atomically Thin Semiconductors with Plasmonic Nanostructures," *Nanophotonics*, vol. 8, no. 4, pp. 577–598, 2019. web.

[10] M.-A. Miri, **M. Cotrufo**, and A. Alù, "Anomalous Optical Forces in PT-Symmetric Waveguides," *Optics Letters*, vol. 44, no. 14, pp. 3558–3561, 2019. web.

Before 2019

[9] **M. Cotrufo**, L. Midolo, Ž. Zobenica, *et al.*, "Nanomechanical Control of Optical Field and Quality Factor in Photonic Crystal Structures," *Physical Review B*, vol. 97, no. 11, p. 115 304, 2018. web, (***Editor suggestion***).

[8] M.-A. Miri, **M. Cotrufo**, and A. Alu, "Optical Gradient Forces between Evanescently Coupled Eaveguides," *Optics Letters*, vol. 43, no. 17, pp. 4104–4107, 2018. web.

[7] M. Petruzzella, Ž. Zobenica, **M. Cotrufo**, *et al.*, "Anti-Stiction Coating for Mechanically Tunable Photonic Crystal Devices," *Optics Express*, vol. 26, no. 4, pp. 3882–3891, 2018. web.

[6] **M. Cotrufo**, A. Fiore, and E. Verhagen, "Coherent Atom-Phonon Interaction through Mode Field Coupling in Hybrid Optomechanical Systems," *Physical Review Letters*, vol. 118, no. 13, p. 133 603, 2017. web.

[5] M. Petruzzella, F. Pagliano, Ž. Zobenica, *et al.*, "Electrically Driven Quantum Light Emission in Electromechanically Tuneable Photonic Crystal Cavities," *Applied Physics Letters*, vol. 111, no. 25, p. 251 101, 2017. web.

[4] Ž. Zobenica, R. W. van der Heijden, M. Petruzzella, *et al.*, "Integrated Nano-Opto-Electro-Mechanical Sensor for Spectrometry and Nanometrology," *Nature Communications*, vol. 8, no. 1, pp. 1–8, 2017. web.

[3] **M. Cotrufo**, C. I. Osorio, and A. F. Koenderink, "Spin-Dependent Emission from Arrays of Planar Chiral Nanoantennas Due to Lattice and Localized Plasmon Resonances," *ACS Nano*, vol. 10, no. 3, pp. 3389–3397, 2016. web.

[2] **M. Cotrufo** and A. Fiore, "Spontaneous Emission from Dipole-Forbidden Transitions in Semiconductor Quantum Dots," *Physical Review B*, vol. 92, no. 12, p. 125 302, 2015. web.

[1] T. Xia, Y. Cho, **M. Cotrufo**, *et al.*, "In-Assisted Deoxidation of GaAs Substrates for the Growth of Single InAs/GaAs Quantum Dot Emitters," *Semiconductor Science and Technology*, vol. 30, no. 5, p. 055 009, 2015. web.

Select conference proceedings and presentations (*presenting author)

[25] S. Esfahani*, **M. Cotrufo**, and A. Alù, "Space-time nonlocal metasurfaces for event-based image processing," in *2024 United States National Committee of URSI National Radio Science Meeting (USNC-URSI NRSM)*, 2024, pp. 404–405, (***Student Paper Competition Winner, 3rd place***).

[24] **M. Cotrufo*** and A. Alù, "Analog optical image processing and computing with metastructures," in *EL06 Adaptive Nanophotonics—Tunable, Reprogrammable and Integrated*, MRS Spring Meeting, 2023, (***invited talk***).

[23] **M. Cotrufo***, "Optical metasurfaces for advanced linear and nonlinear functionalities," in *Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XVI*, SPIE, 2023, (***invited talk***).

[22] A. Arora*, **M. Cotrufo**, and A. Alù, "Metasurfaces for broadband analog image processing," in *2023 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting (USNC-URSI)*, IEEE, 2023, pp. 571–572, (***Selected for a Honorable Mention in the Student Paper Competition***).

[21] **M. Cotrufo** and A. Alù, "Nonlinear metasurfaces for exotic control of light," in *Photonic and Phononic Properties of Engineered Nanostructures XIII*, SPIE, 2023, PC1243101, (***invited talk***).

[20] J. H. Krakofsky*, **M. Cotrufo**, S. Mann, *et al.*, "Mid-infrared power limiters and saturable-absorber mirrors based on $\chi^{(3)}$ gaassb/ingaas intersubband polaritonic metasurfaces," in *2023 Conference on Lasers and Electro-Optics Europe & European Quantum Electronics Conference (CLEO/Europe-EQEC)*, IEEE, 2023, pp. 1–1.

[19] **M. Cotrufo***, A. Cordaro, A. Polman, and A. Alù, "Nonlinearity-induced nonreciprocity in passive silicon gratings supporting quasi-bound states in the continuum," in *CLEO: QELS_Fundamental Science*, Optica Publishing Group, 2022, FF4N–6.

[18] J. Quan, **M. Cotrufo**, S. Chand, *et al.*, "Exciton dynamics in plasmonic cavities coupled to monolayer wse2," in *APS March Meeting Abstracts*, vol. 2022, 2022, pp. M55–004.

[17] K. Van Gasse*, **M. Cotrufo**, K. Yang, A. Alù, and J. Vuckovic, "All optical switching in a silicon nonlinear fano resonator," in *CLEO: Science and Innovations*, Optica Publishing Group, 2022, SM4O–2.

[16] **M. Cotrufo**, S. Guo, A. Overvig*, and A. Alù, "Nanostructured metasurfaces for optical wavefront manipulation," in *Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XIV*, SPIE, vol. 11696, 2021, p. 1 169 609, (***invited talk***).

[15] M.-A. Miri*, **M. Cotrufo**, and A. Alù, "Controlling optical forces between evanescently coupled pt-symmetric waveguides," in *CLEO: QELS_Fundamental Science*, Optical Society of America, 2019, FTu4B–6.

[14] K. Y. Yang*, J. Skarda, **M. Cotrufo**, *et al.*, "Inverse designed fano resonance in silicon microresonators," in *Conference on Lasers and Electro-Optics (CLEO)*, IEEE, 2019, pp. 1–2.

[13] K. Y. Yang*, J. Skarda, **M. Cotrufo**, *et al.*, "Inverse-designed silicon photonic circuit for nonreciprocal transmission," in *Frontiers in Optics*, Optical Society of America, 2019, FTh3C–1.

[12] A. Fiore*, D. Pellegrino, **M. Cotrufo**, *et al.*, "Tailoring radiative emission in integrated quantum light sources," in *CLEO: QELS_Fundamental Science*, Optical Society of America, 2018, JTh3C–4.

[11] **M. Cotrufo***, E. Verhagen, and A. Fiore, "Control of the electromagnetic field in a cavity by an external perturbation," in *Proc. of SPIE*, vol. 10111, 2017, pp. 1 011 128–1.

[10] M. Petruzzella*, S. Birindelli, F. M. Pagliano, *et al.*, "Single photons from electrically driven reconfigurable photonic crystal cavities (conference presentation)," in *Quantum Photonic Devices*, SPIE, vol. 10358, 2017, 103580Q.

[9] M. Petruzzella*, F. Pagliano, Ž. Zobenica, *et al.*, "Tuneable quantum light from a photonic crystal led," in *European Quantum Electronics Conference*, Optical Society of America, 2017, EA_6_5.

[8] Z. Zobenica*, R. Van Der Heijden, M. Petruzzella, *et al.*, "Integrated spectrometer and displacement sensor based on mechanically tunable photonic crystals," in *2017 International Conference on Optical MEMS and Nanophotonics (OMN)*, IEEE, 2017, pp. 1–2.

[7] **M. Cotrufo***, A. Fiore, and E. Verhagen, "Engineering raman transitions in an optomechanical system strongly coupled with a two-level emitter," in *CLEO: QELS_Fundamental Science*, Optical Society of America, 2016, FM1C–3.

[6] **M. Cotrufo***, A. Fiore, and E. Verhagen, "Optically-controlled coherent atom-phonon interaction in optomechanical systems," in *40th Annual Meeting NNV AMO, Lunteren, The Netherlands*, 2016.

[5] **M. Cotrufo***, L. Midolo, Ž. Zobenica, *et al.*, "Active control of the vacuum field in nanomechanical photonic crystal structures," in *Frontier in Optics, Rochester*, 2016.

[4] **M. Cotrufo***, L. Midolo, Ž. Zobenica, *et al.*, "Active control of the vacuum field in nanomechanical photonic crystal structures," in *META '16, Malaga, Spain*, 2016.

[3] Ž. Zobenica*, R. van der Heijden, M. Petruzzella, *et al.*, "Fully integrated nano-opto-electro-mechanical wavelength and displacement sensor," in *Optical Sensors*, Optical Society of America, 2016, SeW2E–4.

[2] **M. Cotrufo***, C. Osorio, and A. Koenderink, "K-space polarimetry measurements of the spin-dependent emission from arrays of chiral plasmonic nanoantennas," in *39th Annual Meeting NNV AMO, Lunteren, The Netherlands*, 2015.

[1] R. van der Heijden*, M. Petruzzella, F. Pagliano, *et al.*, "Fully integrated nano-opto-electro-mechanical wavelength and displacement sensor," in *Optical Sensors, Sensors 2016*, OSA-The Optical Society, 2014.

Teaching experience

2023 – ... Undergraduate and Graduate classes at the **University of Rochester**
OPT 201, Geometrical Optics Lab
OPT 412, Quantum Mechanics - Optics

2014 – 2016 Teaching Assistant at **Eindhoven University of Technology (The Netherlands)** for 3 semesters (20-30 students per class):
– Lab instructor for Modern Physics lab for undergraduate students (Laser Doppler Anemometry, Gamma ray detection).
– MATLAB course for finite-element-method simulations.

2011 – 2012 Teaching Assistant at **University of Padova (Italy)** for 2 semesters (20-30 students per class).
– Recitation classes for undergraduate students (2/weeks) for mathematics (calculus, differential equations, geometry) and physics (mechanics, thermodynamics and electromagnetism)
– Lab instructor (General Physics, Mechanics, Statistics).

Professional service

2016 - Present Reviewer for Nature Communications, Science Advances, Physical Review Letters, PRX Quantum, Physical Review A, Physical Review B, Physical Review E, Physical Review Applied, Physical Review Research, Physical Review Materials, Light: Science & Applications, ACS Photonics, Optics Express, Optics Letters, Optics Material Express, Journal of the Optical Society of America B, New Journal of Physics, Journal of Applied Physics, European Journal of Physics, Applied Physics Letters, Photonics Research, Communications in Physics, Scientific Reports, IEEE Photonics, IEEE TAP.

Professional service (continued)

Reviewer Certificates and Recognitions

- Selected as "*Outstanding Reviewer for Light: Science & Applications in Year 2022*" from Springer Nature.
- "Certificate of Recognition" from Optical Society of America for "*dedication to quality scientific peer review*".
- "IOP trusted reviewer" from the Institute of Physics for "*high level of peer review competence, with the ability to critique scientific literature to an excellent standard*".

2023 Session chair for the sessions *'Advanced Fabrication Technologies for Micro/Nano Optics and Photonics XVI '* and *'Volumetric Printing and Maskless Lithography'* at **Photonics West 2023 (SPIE)**, San Francisco, CA.

2021 Session chair for the sessions *'Super-resolution and near-field imaging: effects and devices'*, *'Vortex beams'* and *'Photonic computing'* at **Metamaterials 2021**, The 15th International Congress on Artificial Materials for Novel Wave Phenomena, New York, NY.

2020 Session chair for the sessions *'Metamaterials with extreme parameters I'*, *'Active and non-linear II'* and *'Active and non-linear III'* at **Metamaterials 2020**, The 14th International Congress on Artificial Materials for Novel Wave Phenomena, New York, NY.

2019 Session chair, *'Optical Computing Microdevices'* at the **2019 IEEE Photonics Conference**, San Antonio, TX.