

Joseph M. Lukens | CV

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Education

Purdue University

Doctor of Philosophy, GPA – 4.0/4.0

Electrical Engineering

Dissertation

Novel Applications of Photonic Signal Processing: Temporal Cloaking and Biphoton Pulse Shaping

Advisor: Andrew M. Weiner

West Lafayette, IN

Aug. 2015

The University of Alabama

Bachelor of Science, GPA – 4.0/4.0

Electrical Engineering and Physics

Tuscaloosa, AL

May 2011

Work Experience

Oak Ridge National Laboratory

Research Scientist and Wigner Fellow

Conduct experimental photonics research in quantum information science.

Oak Ridge, TN

Aug. 2015–present

Purdue University

Graduate Research Assistant

Conduct research in pulse shaping of entangled photons, optical communications, and temporal cloaking.

West Lafayette, IN

Aug. 2011–Aug. 2015

The University of Alabama

Undergraduate Research Assistant

Simulated electromagnetic wave phenomena, designing structures with COMSOL Multiphysics.

Tuscaloosa, AL

May 2010–May 2011

M. C. Dean, Inc.

Engineering Intern

Analyzed telecommunication infrastructure plans for forthcoming private and military constructions.

Dulles, VA

June–Aug. 2009

Professional Societies

2013–present: The Optical Society (OSA)

2009–present: Tau Beta Pi Engineering Honor Society

2009–present: Eta Kappa Nu Electrical and Computer Engineering Honor Society

Awards and Honors

- 2019: Technology Commercialization Award, UT-Battelle
- 2019: Research Featured in *Optics and Photonics News*, “Year in Optics”
- 2019: Early Career Award, U.S. Department of Energy
- 2017: Technology Commercialization Award, UT-Battelle
- 2017: Significant Event Award, UT-Battelle, for ORNL’s first quantum technology license
- 2015: Paul Baran Young Scholar Award from the Marconi Society
- 2015: College of Engineering Outstanding Graduate Student Research Award
- 2014: Finalist, Frontiers in Optics Emil Wolf Student Paper Competition (as co-author)
- 2014: First Place, Siegman International School on Lasers Poster Competition
- 2013: Temporal Cloaking Research Featured in CLEO Press Luncheon
- 2011: Outstanding Senior Physics Major
- 2011: Eta Kappa Nu Outstanding Senior Award
- 2011: First Place, IEEE Region 3 Southeastcon Student Paper Competition
- 2010: Fred R. Maxwell, Jr., Award for the Outstanding Junior Student in ECE
- 2007: National Merit Scholar

Fellowships and Scholarships

Wigner Fellowship	Oak Ridge National Laboratory <i>Aug. 2015–Aug. 2018</i>
NDSEG Fellowship	Department of Defense <i>Sept. 2012–Aug. 2015</i>
Meissner Fellowship	Purdue University <i>Aug. 2011–Aug. 2012</i>
National Merit Presidential Scholarship	University of Alabama <i>Aug. 2007–May 2011</i>

Journal Publications

- 26:** N. B. Lingaraju, H.-H. Lu, S. Seshadri, P. Imany, D. E. Leaird, J. M. Lukens, and A. M. Weiner, "Quantum frequency combs and Hong–Ou–Mandel interferometry: the role of spectral phase coherence," *Optics Express* (in press).
- 25:** H.-H. Lu, A. M. Weiner, P. Lougovski, and J. M. Lukens, "Quantum information processing with frequency-comb qudits," *IEEE Photonics Technology Letters* (in press).
- 24:** J. M. Lukens, H.-H. Lu, B. Qi, P. Lougovski, A. M. Weiner, and B. P. Williams, "All-optical frequency processor for networking applications," *Journal of Lightwave Technology* (in press).
- 23:** H.-H. Lu, P. Imany, N. B. Lingaraju, M. S. Alshaykh, O. D. Odele, A. J. Moore, D. E. Leaird, M. Qi, A. M. Weiner, J. M. Lukens, B. P. Williams, N. A. Peters, P. Lougovski, and J. A. Jaramillo-Villegas, "Quantum information processing in the frequency domain," *Optics and Photonics News* **30(11)**, 43 (2019). **Optics in 2019 Feature**
- 22:** H.-H. Lu, N. Klco, J. M. Lukens, T. D. Morris, A. Bansal, A. Ekström, G. Hagen, T. Papenbrock, A. M. Weiner, M. J. Savage, and P. Lougovski, "Simulations of subatomic many-body physics on a quantum frequency processor," *Physical Review A* **100**, 012320 (2019).
- 21:** P. Imany, J. A. Jaramillo-Villegas, M. S. Alshaykh, J. M. Lukens, O. D. Odele, A. J. Moore, D. E. Leaird, M. Qi, and A. M. Weiner, "High-dimensional optical quantum logic in large operational spaces," *npj Quantum Information* **5**, 59 (2019).
- 20:** B. P. Williams, J. M. Lukens, N. A. Peters, B. Qi, and W. P. Grice, "Quantum secret sharing with polarization-entangled photon pairs," *Physical Review A* **99**, 062311 (2019).
- 19:** H.-H. Lu, J. M. Lukens, B. P. Williams, P. Imany, N. A. Peters, A. M. Weiner, and P. Lougovski, "A controlled-NOT gate for frequency-bin qubits," *npj Quantum Information* **5**, 24 (2019).
- 18:** M. Kues, C. Reimer, J. M. Lukens, W. J. Munro, A. M. Weiner, D. J. Moss, and R. Morandotti, "Quantum optical microcombs," *Nature Photonics* **13**, 170–179 (2019).
- 17:** H.-H. Lu, J. M. Lukens, N. A. Peters, B. P. Williams, A. M. Weiner, and P. Lougovski, "Quantum interference and correlation control of frequency-bin qubits," *Optica* **5**, 1455–1460 (2018).
- 16:** J. M. Lukens, R. C. Pooser, and N. A. Peters, "A broadband fiber-optic nonlinear interferometer," *Applied Physics Letters* **113**, 091103 (2018). **Editor's Pick**
- 15:** M. McCall, J. B. Pendry, V. Galdi, Y. Lai, S. A. R. Horsley, J. Li, J. Zhu, R. C. Mitchell-Thomas, O. Quevedo-Teruel, P. Tassin, V. Ginis, E. Martini, G. Minatti, S. Maci, M. Ebrahimpouri, Y. Hao, P. Kinsler, J. Gratus, J. M. Lukens, A. M. Weiner, U. Leonhardt, I. I. Smolyaninov, V. N. Smolyaninova, R. T. Thompson, M. Wegener, M. Kadic, and S. A. Cummer, "Roadmap on transformation optics," *Journal of Optics* **20**, 063001 (2018).
- 14:** J. M. Lukens, N. T. Islam, C. C. W. Lim, and D. J. Gauthier, "Reconfigurable generation and measurement of mutually unbiased bases for time-bin qudits," *Applied Physics Letters* **112**, 111102 (2018). **Editor's Pick**
- 13:** P. Imany, J. A. Jaramillo-Villegas, O. D. Odele, K. Han, D. E. Leaird, J. M. Lukens, P. Lougovski, M. Qi, and A. M. Weiner, "50-GHz-spaced comb of high-dimensional frequency-bin entangled photons from an on-chip silicon nitride microresonator," *Optics Express* **26**, 1825–1840

(2018).

12: H.-H. Lu, J. M. Lukens, N. A. Peters, O. D. Odele, D. E. Leaird, A. M. Weiner, and P. Lougovski, "Electro-optic frequency beamsplitters and tritters for high-fidelity quantum information processing," *Physical Review Letters* **120**, 030502 (2018). **Altmetric Score: 89**

11: J. M. Lukens and P. Lougovski, "Frequency-encoded photonic qubits for scalable quantum information processing," *Optica* **4**, 8–16 (2017).

10: O. D. Odele, J. M. Lukens, J. A. Jaramillo-Villegas, P. Imany, C. Langrock, M. M. Fejer, D. E. Leaird, and A. M. Weiner, "High-speed switching of biphoton delays through electro-optic pump frequency modulation," *APL Photonics* **2**, 011301 (2017).

9: J. M. Lukens, N. A. Peters, and R. C. Pooser, "Naturally stable Sagnac–Michelson nonlinear interferometer," *Optics Letters* **41**, 5438–5441 (2016). **Editors' Pick**

8: J. M. Lukens, O. D. Odele, D. E. Leaird, and A. M. Weiner, "Electro-optic modulation for high-speed characterization of entangled photon pairs," *Optics Letters* **40**, 5331–5334 (2015). **Featured in Spotlight on Optics**

7: O. D. Odele, J. M. Lukens, J. A. Jaramillo-Villegas, C. Langrock, M. M. Fejer, D. E. Leaird, and A. M. Weiner, "Tunable delay control of entangled photons based on dispersion cancellation," *Optics Express* **23**, 21857–21866 (2015).

6: J. M. Lukens, A. J. Metcalf, D. E. Leaird, and A. M. Weiner, "Temporal cloaking for data suppression and retrieval," *Optica* **1**, 372–375 (2014). **Scientific Press Coverage**

5: J. M. Lukens, O. Odele, C. Langrock, M. M. Fejer, D. E. Leaird, and A. M. Weiner, "Generation of biphoton correlation trains through spectral filtering," *Optics Express* **22**, 9585–9596 (2014).

4: J. M. Lukens, A. Dezfooliyan, C. Langrock, M. M. Fejer, D. E. Leaird, and A. M. Weiner, "Orthogonal spectral coding of entangled photons," *Physical Review Letters* **112**, 133602 (2014).

3: J. M. Lukens, A. Dezfooliyan, C. Langrock, M. M. Fejer, D. E. Leaird, and A. M. Weiner, "Demonstration of high-order dispersion cancellation with an ultrahigh-efficiency sum-frequency correlator," *Physical Review Letters* **111**, 193603 (2013).

2: J. M. Lukens, A. Dezfooliyan, C. Langrock, M. M. Fejer, D. E. Leaird, and A. M. Weiner, "Biphoton manipulation with a fiber-based pulse shaper," *Optics Letters* **38**, 4652–4655 (2013).

1: J. M. Lukens, D. E. Leaird, and A. M. Weiner, "A temporal cloak at telecommunication data rate," *Nature* **498**, 205–208 (2013). **General Press Coverage**

Conference Papers

(30) Oct. 2019: H.-H. Lu [presenter], J. M. Lukens, B. Qi, P. Lougovski, A. M. Weiner, and B. P. Williams, "All-optical processing with dynamic frequency transformations," 8908514, IEEE Photonics Conference, San Antonio, TX.

(29) Aug. 2019: P. Imany [presenter], M. S. Alshaykh, J. M. Lukens, J. A. Jaramillo-Villegas, A. J. Moore, D. E. Leaird, and A. M. Weiner, "Generation of a non-separable two-qudit state using a time-frequency SUM operation," Th1A.4, Coherence and Quantum Optics, Rochester, NY.

(28) May 2019: H.-H. Lu [presenter], J. M. Lukens, B. P. Williams, P. Imany, N. A. Peters,

A. M. Weiner, and P. Lougovski, “Bayesian machine learning of frequency-bin CNOT,” FF1F.3, CLEO, San Jose, CA. **Upgraded to Invited**

(27) May 2019: P. Imany [presenter], M. S. Alshaykh, J. M. Lukens, A. J. Moore, D. E. Leaird, and A. M. Weiner, “Demonstration of four-party 32-dimensional Greenberger–Horne–Zeilinger entangled state,” JTh5C.5, CLEO, San Jose, CA. **Postdeadline Session**

(26) May 2019: H.-H. Lu, N. Klco, J. M. Lukens [presenter], T. D. Morris, A. Bansal, A. Ekström, G. Hagen, T. Papenbrock, A. M. Weiner, M. J. Savage, and P. Lougovski, “Subatomic many-body physics simulations on a quantum frequency processor,” FTh3A.6, CLEO, San Jose, CA.

(25) May 2019: J. M. Lukens [presenter], “Quantum information processing with frequency-bin qubits: progress, status, and challenges,” JTU4A.3, CLEO, San Jose, CA. **Invited**

(24) May 2019: N. Lingaraju [presenter], H.-H. Lu, S. Seshadri, P. Imany, D. E. Leaird, J. M. Lukens, and A. M. Weiner, “Spectral phase coherence in HOM interferometry,” JTU3A.5, CLEO, San Jose, CA.

(23) May 2019: P. Imany [presenter], M. S. Alshaykh, J. M. Lukens, J. A. Jaramillo-Villegas, D. E. Leaird, and A. M. Weiner, “A two-qudit operation on a 256-dimensional Hilbert space,” JTU3A.3, CLEO, San Jose, CA.

(22) Sep. 2018: J. M. Lukens [presenter], N. T. Islam, C. C. W. Lim, and D. J. Gauthier, “Mutually unbiased bases for time-bin qudits,” JW3A.66, Frontiers in Optics, Washington, DC.

(21) Sep. 2018: H.-H. Lu [presenter], J. M. Lukens, P. Imany, N. A. Peters, B. P. Williams, A. M. Weiner, and P. Lougovski, “Experimental demonstration of CNOT gate for frequency-encoded qubits,” JTU3A.55, Frontiers in Optics, Washington, DC.

(20) Sep. 2018: P. Imany [presenter], J. A. Jaramillo-Villegas, J. M. Lukens, O. D. Odele, D. E. Leaird, M. Qi, and A. M. Weiner, “Two-qudit deterministic optical quantum logic in a single photon,” JTU2A.53, Frontiers in Optics, Washington, DC.

(19) May 2018: H.-H. Lu, J. M. Lukens [presenter], N. A. Peters, B. P. Williams, A. M. Weiner, and P. Lougovski, “Two-photon interference and entanglement control via reconfigurable quantum frequency processor,” JTh5B.3, CLEO, San Jose, CA. **Postdeadline Session**

(18) May 2018: J. M. Lukens [presenter], R. C. Pooser, and N. A. Peters, “A broadband all-fiber SU(1,1) interferometer,” FTh4G.3, CLEO, San Jose, CA.

(17) May 2018: W. P. Grice, J. M. Lukens [presenter], N. A. Peters, and B. P. Williams, “Two-photon N -party quantum secret sharing,” FTU4A.5, CLEO, San Jose, CA.

(16) Sep. 2017: H.-H. Lu, J. M. Lukens [presenter], N. A. Peters, O. D. Odele, A. M. Weiner, and P. Lougovski, “Linear-optical frequency beamsplitter for fiber-optic quantum networks,” Th454, QCrypt, Cambridge, UK.

(15) Sep. 2017: H.-H. Lu [presenter], J. M. Lukens, N. A. Peters, O. D. Odele, A. M. Weiner, and P. Lougovski, “Electro-optic frequency beamsplitter for quantum networking applications,” JW4A.23, Frontiers in Optics, Washington, DC.

(14) June 2017: J. M. Lukens [presenter], N. A. Peters, and R. C. Pooser, “A nonlinear interferometer with intrinsic stability,” FTU3F.6, CLEO, San Jose, CA.

(13) Oct. 2016: J. M. Lukens [presenter] and P. Lougovski, “Optical quantum computing with

spectral qubits,” FTh5F.5, Frontiers in Optics, Rochester, NY.

(12) Oct. 2016: O. D. Odele [presenter], J. M. Lukens, J. A. Jaramillo-Villegas, P. Imany, C. Langrock, M. M. Fejer, D. E. Leaird, and A. M. Weiner, “Rapid delay modulation of biphotons,” JW4A.174, Frontiers in Optics, Rochester, NY.

(11) Oct. 2016: E. Layden, T. Coulter, J. Lukens [presenter], N. A. Peters, B. Lawrie, and R. Pooser, “Nonlinear interferometric plasmonic sensing,” LF2E.6, Laser Science, Rochester, NY.

(10) June 2016: O. D. Odele [presenter], J. M. Lukens, D. E. Leaird, and A. M. Weiner, “Modulation technique for improving temporal resolution in biphoton coincidence measurements,” FTu4C.5, CLEO, San Jose, CA.

(9) May 2016: E. Layden [presenter], T. Coulter, J. Lukens, B. Lawrie, and R. Pooser, “Locked SU(1,1) Nonlinear Interferometer for Phase Shift Measurements in Triangular Nanohole Arrays,” B7.00008, DAMOP: Annual Meeting of the APS Division of Atomic, Molecular and Optical Physics, Providence, RI.

(8) May 2015: O. D. Odele [presenter], J. M. Lukens, J. A. Jaramillo-Villegas, C. Langrock, M. M. Fejer, D. E. Leaird, and A. M. Weiner, “Temporal position modulation of biphoton correlations through pump frequency tuning,” FTh1A.8, CLEO, San Jose, CA.

(7) May 2015: J. M. Lukens [presenter], A. J. Metcalf, D. E. Leaird, and A. M. Weiner, “Temporal cloaking enhancements for optical communication,” FW4D.7, CLEO, San Jose, CA.

Upgraded to Invited

(6) Oct. 2014: O. D. Odele [presenter], J. M. Lukens, C. Langrock, M. M. Fejer, D. E. Leaird, and A. M. Weiner, “Observation of the temporal Talbot effect for entangled photons,” FW2C.2, Frontiers in Optics, Tucson, AZ. **Finalist, Emil Wof Student Paper Competition**

(5) Aug. 2014: J. M. Lukens [presenter], A. Dezfouliyan, C. Langrock, M. M. Fejer, D. E. Leaird, and A. M. Weiner, “Ultrafast biphoton spectral coding,” Poster T23, Siegman International School on Lasers, Stanford, CA.

(4) June 2014: J. M. Lukens [presenter], A. Dezfouliyan, C. Langrock, M. M. Fejer, D. E. Leaird, and A. M. Weiner, “Record-efficiency biphoton correlator and observation of high-order dispersion cancellation,” FTh4A.3, CLEO, San Jose, CA.

(3) June 2014: J. M. Lukens [presenter], A. Dezfouliyan, C. Langrock, M. M. Fejer, D. E. Leaird, and A. M. Weiner, “Encoding and decoding of biphoton wavepackets,” FW3A.8, CLEO, San Jose, CA.

(2) Oct. 2013: J. M. Lukens [presenter], A. Dezfouliyan, C. Langrock, M. M. Fejer, D. E. Leaird, and A. M. Weiner, “Manipulation of entangled photons with a fiber-based pulse shaper,” FW1C.3, Frontiers in Optics, Orlando, FL.

(1) June 2013: J. M. Lukens [presenter], D. E. Leaird, and A. M. Weiner, “A telecom-based temporal cloak,” QM4E.4, CLEO, San Jose, CA. **Selected for Press Luncheon**

Invited Talks and Seminars

(8) Jan. 2019: *Rochester Institute of Technology*: “Frequency bins for quantum information processing” (Photonics for Quantum Workshop).

- (7) **Jan. 2019:** *ORNL*: “Frequency bins for quantum information processing” (ORNL Quantum Networking Symposium).
- (6) **Nov. 2018:** *Tennessee Technological University*: “Quantum optics: what is and what should be.”
- (5) **Oct. 2018:** *University of Bologna, Italy*: “Emerging technology: quantum information” (Marconi Society Young Scholars Symposium).
- (4) **Feb. 2018:** *University of Bilbao, Spain*: “Photonic quantum information processing with spectral qubits” (Quantum Simulation and Computation).
- (3) **Oct. 2017:** *University of Waterloo, Canada*: “Classical telecom meets spectral qubits: frequency-bin encoding for photonic quantum information” (Quantum Innovators in Science and Engineering).
- (2) **Mar. 2016:** *University of Warsaw, Poland*: “Optical telecom technology for quantum signal processing” (Spectral and Spatial Engineering of Quantum Light).
- (1) **Oct. 2015:** *University of Oxford, UK*: “Taking photonic signal processing to new heights: classical and quantum.”

Book Chapter

J. M. Lukens and A. M. Weiner, “Biphoton Pulse Shaping,” in *All-Optical Signal Processing* (S. Wabnitz and B. J. Eggleton, eds.), Ch. 13 (Springer, 2015).

Intellectual Property

- 4: J. M. Lukens, N. A. Peters, and R. C. Pooser, “Gain balanced nonlinear optical interferometer,” *U. S. Patent Application* 16/408,945 (2019).
- 3: W. P. Grice, J. M. Lukens, and N. A. Peters, “Deterministic single-photon source based on spectral shift of a heralded photon,” *U. S. Patent* 10,175,554 (2019).
- 2: W. P. Grice, J. M. Lukens, and N. A. Peters, “Deterministic single-photon source based on spectral shift of a heralded photon,” Invention disclosure non-exclusively licensed by *Qubitekk, Inc.* (2017).
- 1: J. M. Lukens, N. A. Peters, and R. C. Pooser, “Nonlinear interferometer systems and methods,” *U. S. Patent Application* 15/582,178 (2017).

Selected Press Coverage

ARS Technica: “Careful phasing of a photonic qubit brings light under control,” Chris Lee (2/8/2018)

<https://arstechnica.com/science/2018/02/careful-phasing-of-a-photonic-qubit-brings-light-under-control/>

ABC News: “Researchers invent invisibility cloak,” Geetika Rudra (6/7/2013)

<http://abcnews.go.com/blogs/technology/2013/06/researchers-invent-invisibility-cloak/>

Australian Broadcasting Corporation: “Time cloak could secure telecommunications,” Anna

Salleh (6/6/2013)

<http://www.abc.net.au/science/articles/2013/06/06/3775012.htm#.UbCnovmR-So>

BBC: "Invisibility 'time cloak' developed," Melissa Hogenboom (6/5/2013)

<http://www.bbc.co.uk/news/science-environment-22780651>

Forbes: "Take that, NSA - scientists hide communications using a hole in time," Alex Knapp (6/6/2013)

<http://www.forbes.com/sites/alexknapp/2013/06/06/take-that-nsa-scientists-hide-communications-using-a-hole-in-time/>

New Scientist: "Time cloak used to hide messages in laser light," Aviva Rutkin (11/28/2014)

http://www.newscientist.com/article/dn26627-time-cloak-used-to-hide-messages-in-laser-light.html#.VICbbTHF_j2

Optics and Photonics News: "Temporal cloak could boost security over fiber," Patricia Daukantas (6/2013)

http://www.osa-opn.org/home/newsroom/2013/june/temporal_cloak_could_boost_security_over_fiber/#.UfkX5o2R-So

Photonics Spectra: "Via photonics, secure communications," Hank Hogan (8/2017)

<https://www.photonics.com/Article.aspx?AID=62140&PID=5&VID=141&IID=963>

Wall Street Journal: "Invisible ink for digirati," Daniel Akst (6/14/2013)

<http://online.wsj.com/article/SB10001424127887323734304578543530511954180.html>