

# Eric C. Blow

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## Education

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### **Princeton University, Princeton, N.J.**

***Master's Degree, Electrical Engineering, Photonics and Electronic Devices, GPA 3.54, 2017***

Thesis Topic: Microwave Photonic Cancellers

Relevant Coursework: Photonic Systems, Silicon Photonics, Nanophotonics, Microelectronics, and Solar Cells

Teaching Assistant and Guest Lecturer: Photonic Systems, Silicon Photonics, Photonics and Light Wave Communication, and Intro to Engineering

***Doctor of Philosophy, Ph. D, Electrical Engineering, Integrated Photonics, 2023***

Thesis Title: Microwave Photonic Cancellation: RF Analysis, III-V and Silicon Integration, Development of Balanced and Hybrid Architectures

Relevant Online Material: [https://github.com/ericcbow/MWP\\_RF\\_Sims](https://github.com/ericcbow/MWP_RF_Sims)

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### **The College Of New Jersey, Ewing, N.J.**

***Bachelor of Science, B.S., Electrical and Computer Engineering, GPA 3.80, 2015***

Concentration: Wireless communications, RF electronics, and Nonlinear photonics.

Awards: Merit Scholarship

- Armstrong Scholar Award – Awarded to engineering student with highest GPA in the previous academic year for their respective major and academic year
- Conrad Johnson Award – Senior Thesis Award
- 1<sup>st</sup> Place in 2014 Mayo Business Plan Competition – A cross-discipline startup competition where teams develop a product and business plan to pitch to a panel of business and engineering experts for \$16.5K
- Senior Thesis: Advanced Capability of Underwater Locator Beacon (ULB) for Accident Data Recorder (ADR)
  - Designed, simulated, and constructed underwater acoustic phased array

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## Engineering Research and Industry Experience

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### **NEC Laboratories America: Princeton, NJ**

***Researcher within Optical Networking and Sensing Group: 07/2023-Present***

### **Princeton University: Lightwave Laboratory, Princeton, NJ**

***Undergraduate Researcher: 2014-2015***

***Graduate Researcher: 2015-2023***

***Research Advisor: Dr. Paul R. Prucnal***

***Focus: Microwave Photonics, Neuromorphic Photonics, Cancellation Systems***

- Photonic Processing Research: Microwave Photonics, Neuromorphic Photonics, Integrated Photonics
- Developed Novel Architecture for RF Optimization: Balanced Photonic Canceller and Hybrid Photonic Canceller
- Integrated Cancellers on Indium Phosphide, active and passive Silicon, and Silicon Nitride
- Designed, simulated, fabricated, and characterization of Integrated microwave photonic systems
- Lead commercial integrated photonic foundry MPW tapeouts: Indium Phosphide (JePPIX), Passive Silicon (ANT), Silicon Nitride (LioniX), and Active Silicon (AMF)
- Trained in Lithography and numerous cleanroom microelectronic/photonic fabrication processes
- Gained valuable experiences in software development, machining, lab automation

- Designed and Simulated Micro Ring Resonators, Electroabsorption Modulators, Semiconductor Optical Amplifiers, Mach-Zender Modulators, Michelson-Morley Modulators, DFB Lasers, Balanced Photodetectors, Multimode Interferers and other integrated RF photonic devices
- Wrote 6+ successful government and private research grants which resulted over a million USD in funding
- Authored 2 book chapters and 20+ academic papers within the field of photonics
- Reviewer for IEEE, Journal of Lightwave Technology, Photonic Technology Letters

## **Bascom Hunter Technologies, Baton Rouge, LA**

### ***Defense Contractor***

***Senior Photonics Engineer: Full Time 2019 – 2021 / Part Time: 2021 - 2023***

***Focus: Neuromorphic Photonics, High Dynamic Range Photonic Links, and Microwave Photonic Cancellers***

- Authored 7 successful research government research proposals resulting in 10 million USD of R&D funding
  - Awarded multiple SBIR Phase I and Phase II programs and one Phase III program
- **Principle Investigator** for Navy program N203-149: High Dynamic Range Microwave Photonic Link for LightRIDR System
- **Principle Investigator** for Navair program N202-099: NOHP-Neuromorphic Optoelectronic Hybrid Processor
- **Lead Engineer** for Army program A20B-T004-0271: Massively Parallel Photonic Artificial Neural Network Accelerator
- **Photonic Engineer** for SOCOM program S211-003: Wideband and Analog Radio Frequency Fingerprinting At a Distance
- **Photonic Engineer** for Navy Phase III SBIR N112-170: Future Advanced Satellite Communication (SATCOM) Technologies (FAST) SATCOM Pre-Planned Product Improvement (P3I) for Navy Multiband Terminal (NMT) (SPIN)
- **Photonic Engineer** for NASA program Z2.02-5311: HPSC-compatible Neuromorphic Photonic Coprocessor
- **Photonic Engineer** for Strategic Capabilities Office SCO 213-003: Photonic AI Processor (PHASOR)
- Designed and constructed integrated photonic testing facilities

## **The College of New Jersey: Photonics Laboratory, Ewing, NJ**

### ***Nonlinear Photonics Research Laboratory***

***Student Researcher 2012-2015***

***Research Advisor: Dr. David J. McGee***

- Research focused on linear and nonlinear optical techniques to probe and characterize novel optoelectrical materials
- Studied optical and electrical properties of Chromophore-Functionalized Carbon Nanotubes
- Responsible for conducting numerous experiments including optical switching, birefringence, and surface relief grating
- Conducted second harmonic generation experiments to determine orientational order of organic dimolecule
- Responsible for development of automated control and data acquisition for experiments using LabVIEW software

## **Naval Surface Warfare Center Carderock Division, Philadelphia, PA**

***Science Engineering Apprenticeship Program (SEAP): Engineering Intern , 2011***

***Summer Temporary Employed Position (STEP): Electrical Engineering Technician (05/2012-08/12; 05/2013-08/2013)***

- Responsible for development, testing, and troubleshooting various crucial components and control software
- Software and hardware design and testing for Automated Floating Dry Dock, ARDM4
- Onsite support and maintenance of I/O enclosures, control software, and valve actuators in Groton, CT
- Onsite support and software update of PLC, Valves, and Radar Tank Level Indicator on LHD 5 USS Batan in Norfolk, VA

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## **Skills**

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### ***Technical:***

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| • Circuit Design Software (PSPICE)     | • Automation Software (Python, LabVIEW)                 |
| • 3D Modeling Software (Solidworks)    | • Mathematical Modeling (MATLAB, Mathematica)           |
| • Software Languages (C++, VB, Python) | • Microwave/Communication Design (AWR Microwave Office) |
| • Photonic Simulation (PICWave)        | • Photonic Integrated Circuit Design (Optodesigner)     |
| • PCB Design (Altium, Eagle)           | • Photonic Layout Tools (ZeroPDK, GDS Factory)          |

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## Conferences

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- 1) Mid Infrared Technology for Health and the Environment (MIRTHE) Summer Symposium - 2016
- 2) IEEE Microwave Photonic Conference – 2016
- 3) IEEE Photonics Conference – 2018
- 4) Conference on Laser and Electro-Optics (CLEO) - 2020
- 5) SPIE Photonic West – 2021 [invited]
- 6) International Conference on Physical Computing – 2022 [invited]
- 7) IEEE Photonic Conference – 2023 [invited]

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## Publications

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Thesis:

- 8) A. Tait, M. Nahmias, B. Shastri, M. Chang, A. Wu, E. Zhou, **E. C. Blow**, T. Ferreira de Lima, B. Wu, and P. R. Prucnal. "Balanced WDM weight banks for analog optical processing and networking in silicon." In *Summer Topicals, IEEE/OSA*, number MC2.3 (Invited), July 2015.
- 9) M. P. Chang, J. Sun, **E. C. Blow**, and P. R. Prucnal, "A Microwave Photonic Canceller for Improved Interference Rejection in Full Duplex Radio", IEEE Photonic Conference, 2016
- 10) M. P. Chang, J. Sun, **E. C. Blow**, M. Lu, and P. R. Prucnal, "Sensors for Everyday Life, Chapter 10: Optical-Based Interference Cancellation in Wireless Sensor Networks" Volume 23 of the series Smart Sensors, Measurement and Instrumentation pp 273-301, Nov 2016
- 11) **E. C. Blow**, M. P. Chang, P. R. Prucnal, "Microwave Photonic Interference Canceller: Noise Figure Reduction via Balanced Architecture", MPC, Oct. 2016
- 12) P. Y. Ma, Y. Huang, M. P. Chang, **E. C. Blow**, S. Zhang, P. R. Prucnal, "Microwave Photonic Chaos Based Device Fingerprinting", OFC, 2016
- 13) M. P. Chang, **E. C. Blow**, J. Sun, M. Lu, P. R. Prucnal, "Integrated Microwave Photonic Circuit for Self-interference Cancellation", IEEE Transaction Theory and Techniques, 2017
- 14) M. P. Chang, **E. C. Blow**, J. Sun, M. Lu, P. R. Prucnal, "RF Characterization of an Integrated Microwave Photonic Circuit for Self-Interference Cancellation", IEEE Transaction Theory and Techniques, 2017
- 15) **E. C. Blow**, M. P. Chang, and P. R. Prucnal, "**Microwave Photonic Canceller: Noise Reduction Via Balanced Architecture**", IEEE Transactions on Microwave Theory and Techniques 2022
- 16) **Blow, Eric C.**, Prannay Kaul, and Paul R. Prucnal. "Integrated Balanced Microwave Photonic Canceller." 2018 IEEE Photonics Conference (IPC). IEEE, 2018.
- 17) Tait, Alexander N., **E. C. Blow**, et al. "Demonstration of multivariate photonics: blind dimensionality reduction with integrated photonics." *Journal of Lightwave Technology* (2019).
- 18) Huang, Chaoran, **E. C. Blow**, et al. "Accelerated secure key distribution based on localized and asymmetric fiber interferometers." *Optics express* 27.22 (2019): 32096-32110.
- 19) Huang, Chaoran, **E. C. Blow**, et al., "Demonstration of Multi-Channel Feedback Control for On-Chip Microring Weight Banks" OFC Post-deadline Paper
- 20) Huang, Chaoran, **E. C. Blow**, et al., "Demonstration of scalable microring weight bank control for large-scale photonic integrated circuits." *APL Photonics* 5.4 (2020): 040803.**E. C. Blow**, et al. "Silicon Photonic Weights for Microwave Photonic Canceller", CLEO 2020
- 21) T. F. de Lima, **E. C. Blow**, B. J. Shastri, and P. Prucnal, "Real-time Operation of Silicon Photonic Neurons," in Optical Fiber Communication Conference (OFC) 2020, OSA Technical Digest (Optical Society of America, 2020), paper M2K.4.
- 22) C. Huang, **E. C. Blow**, et al "Demonstration of photonic neural network for fiber nonlinearity compensation in long-haul transmission systems," in Optical Fiber Communication Conference. Optical Society of America, 2020, pp. Th4C–6 (Postdeadline)
- 23) **E. C. Blow**, et al, "Silicon Photonic Weights for Microwave Photonic Canceller", CLEO 2020
- 24) **E. C. Blow**, Paul R. Prucnal, "In-Band Full-Duplex Technologies and Applications, Chapter: IBFD Optical Systems" Artech House 2021

- 25) PATENT "Light-emitting diode neuron", S Bilodeau, P Prucnal, M Hack, TF de Lima, HT Peng, E Blow, US Patent App. 17/125,287
- 26) Huang, Chaoran, Shinsuke Fujisawa, Thomas Ferreira de Lima, Alexander N. Tait, **Eric C. Blow**, Yue Tian, Simon Bilodeau et al. "A silicon photonic–electronic neural network for fibre nonlinearity compensation." *Nature Electronics* 4, no. 11 (2021): 837-844.
- 27) Zhang, Weipeng, Chaoran Huang, Simon Bilodeau, Aashu Jha, Eric Blow, Thomas Ferreira De Lima, Bhavin J. Shastri, and Paul Prucnal. "Microring Weight Banks Control beyond 8.5-bits Accuracy." *arXiv preprint arXiv:2104.01164* (2021).
- 28) De Lima, Thomas Ferreira, Chaoran Huang, Simon Bilodeau, Alexander N. Tait, Hsuan-Tung Peng, Philip Y. Ma, **Eric C. Blow**, Bhavin J. Shastri, and Paul Prucnal. "Real-time Operation of Silicon Photonic Neurons." In *Optical Fiber Communication Conference*, pp. M2K-4. Optical Society of America, 2020.
- 29) **E. C. Blow**, T. Ferreira de Lima, H-T Peng, W. Zhang, C. Huang, B. J. Shastri, and Paul R. Prucnal "Broadband Radio-Frequency Signal Processing with Neuromorphic Photonics", SPIE Photonic West (invited) 2022.
- 30) Hsuan-Tung Peng, Thomas Ferreira de Lima, **E. C. Blow**, S Bilodeau, Aashu Jha, Chaoran Huang, Bhavin Shastri, and P. R. Prucnal "Time Series Prediction and Classification using Silicon Photonic Neuron with a Self-Connection"
- 31) Thomas Ferreira de Lima, **Eric C. Blow**, Eli A. Doris, Simon Bilodeau, Weipeng Zhang, Aashu Jha, Hsuan-Tung Peng, Chaoran Huang, Alexander N. Tait, Bhavin J. Shastri, and Paul R. Prucnal "Design Automation of Photonic Resonator Weights", De Gruyter Journal 2022
- 32) Peng, Hsuan-Tung, et al. "Time Series Prediction and Classification using Silicon Photonic Neuron with a Self-Connection." CLEO: Science and Innovations. Optica Publishing Group, 2022.
- 33) Zhang, W., Tait, A., Huang, C., Ferreira de Lima, T., Bilodeau, S., Blow, E.C., Jha, A., Shastri, B.J. and Prucnal, P., 2023. Broadband physical layer cognitive radio with an integrated photonic processor for blind source separation. *Nature Communications*, 14(1), p.1107
- 34) **Eric C. Blow**, Yusuf Jha, Lei Xu, Weipeng Zhang, Gary Xu, and Paul R. Prucnal "Hybrid Microwave Photonic Canceller for self-interference cancellation", IEEE Microwave Theory and Technique 2023
- 35) **Eric C Blow**, Simon Bilodeau, Weipeng Zhang, Thomas Ferreira de Lima, Josh Lederman, Paul R Prucnal "Radio-Frequency Linear Analysis And Optimization Of Silicon Photonic Neural Networks", ARP 2024 (Invited)
- 36) Joshua C. Lederman, Weipeng Zhang, Thomas Ferreira de Lima, **Eric C. Blow**, Simon Bilodeau, Bhavin J. Shastri, Paul R. Prucnal "Real-Time Blind Photonic Interference Cancellation for mmWave MIMO", *Nature Communication*, 2023
- 37) Joshua C. Lederman, Yusuf Jimoh, Weipeng Zhang, Thomas Ferreira de Lima, **Eric C. Blow**, Simon Bilodeau, Bhavin J. Shastri, Paul R. Prucnal , A Multi-Layer Topologically Reconfigurable Broadcast-and-Weight Photonic Neural Network, IPC 2023
- 38) T. F. de Lima, J. C. Lederman, W. Zhang, J. Hu, E. C. Blow, K. Asahi, Y. Aono, T. Wang, and P. R. Prucnal, "Real-Time Blind Source Separation with Integrated Photonics for Wireless Signals," in CLEO 2023
- 39) E.C. Blow et. Al. "Link Loss Analysis of Integrated Linear Weight Bank within Silicon Photonic Neural Network, SPIE Europe 2024
- 40) Lederman, Joshua C., et al. "Low-latency passive thermal desensitization of a silicon micro-ring resonator with self-heating." *APL Photonics* 9.7 (2024).

References are available upon request