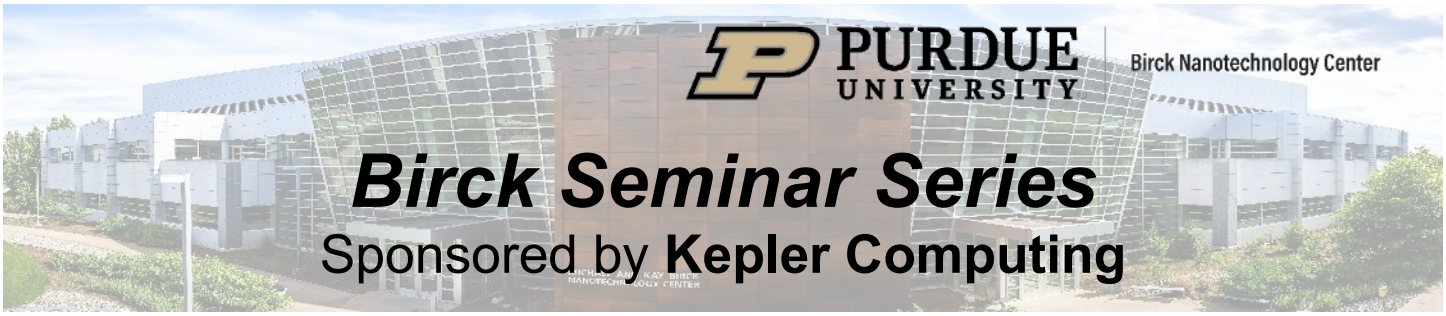

Somewhere over the quantum rainbow: the integrated future of frequency-bin quantum information processing

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Wednesday, April 1st @ 2:00 pm in BRK 1001

Coffee and snacks served before seminar

also on MS Teams

Abstract: Of the variety of photonic degrees of freedom for encoding quantum information, frequency bins offer unique synergies with integrated photonics, where ubiquitous microring resonators can be enlisted for producing, multiplexing, and manipulating "quantum rainbows"—states of light in which entangled photons carry information in superpositions of discrete colors. Yet despite such attractive overlap, frequency bins continue to trail more traditional on-chip formats like path encoding. In this talk, I will present a vision to close this gap via the quantum frequency processor (QFP), a paradigm leveraging pulse shapers and modulators for universal quantum information processing. After summarizing key tabletop QFP experiments, I will outline a roadmap for fully on-chip frequency-bin photonics, highlighting recent experimental results on polarization-frequency hyperentanglement and line-by-line pulse shaping. Throughout, I hope to show that—far from an illusory pot of gold—the end of the quantum rainbow leads to a future of scalable, broadband, and microring-centric on-chip quantum information processing.

Bio: Joseph M. Lukens received the BS degree in electrical engineering and physics in 2011 from the University of Alabama, Tuscaloosa, and the PhD degree in electrical engineering from Purdue University, West Lafayette, Indiana, in 2015. Employed as a Wigner Fellow and Research Scientist at Oak Ridge National Laboratory (ORNL) from 2015–2022 and then as Senior Director of Quantum Networking at Arizona State University (2022–2024), he joined Purdue University in January 2025 as an associator professor, where he maintains a joint faculty appointment at ORNL. His research interests encompass a variety of topics in photonic quantum information processing, optical networking, and Bayesian inference.

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