



Broadband quantum and nonlinear photonics at long wavelengths

David Burghoff

Notre Dame

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Abstract: While the longwave infrared and terahertz ranges have potential to revolutionize disease detection and environmental monitoring, there is currently a lack of compact broadband sources and integrated photonics platforms. I will discuss some of the work of my group that seeks to address this grand challenge. First, I will discuss our development of quantum cascade laser-based frequency combs, light sources that fill the gap between broadband incoherent sources and lasers. I will showcase how we created the first combs in the terahertz range and how our experimental investigations of these combs led to our discovery of a new fundamental comb state that manifests in any laser at any wavelength. Next, I will delve into our development of ultra-low-loss platforms for long wavelengths based on hybrid photonic integration, which allowed us to create optical resonators in the longwave infrared with quality factors two orders of magnitude better than the state-of-the-art. Finally, I will discuss our creation of ptychoscopy, a new sensing modality that allows for ultra-precise measurements of optical spectra. This measurement enables the measurement of remote signals with quantum-limited frequency resolution over the entire bandwidth of a comb, for the first time allowing incoherent spectra to be characterized with the precision techniques of combs.



Biography: David Burghoff is an Assistant Professor at Notre Dame, where his lab blends photonics with quantum devices to develop novel sensing and computing modalities. Prior to this, he was a postdoctoral fellow and research scientist at the Massachusetts Institute of Technology, where he led a team working in DARPA's SCOUT program. He also received his Ph.D. from MIT, where he won the J.A. Kong Award for MIT's Outstanding Electrical Engineering Thesis. He co-chaired the 2022 and 2020 International Quantum Cascade Laser School and Workshop, and he was one of only five faculty nationally named as a 2022 Moore Inventor's Fellow. His other awards include the ONR Young Investigator Program Award, the NSF CAREER Award, the AFOSR Young Investigator Program Award, and the Intelligence Community Postdoctoral Fellowship.