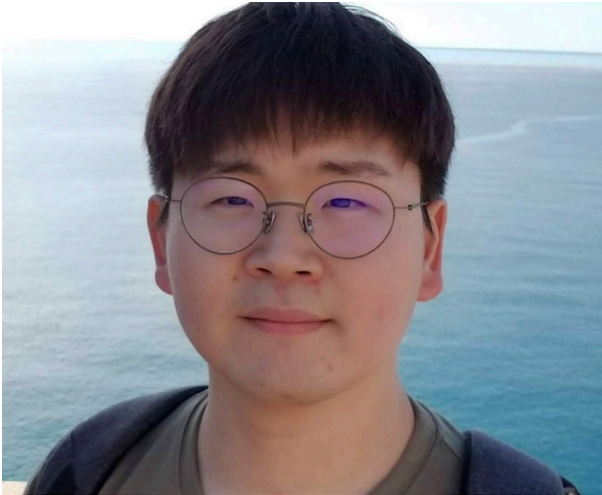


Scalable Quantum Information Processing with Spin-Photon Interfaces



Hyeonrak "Chuck" Choi
Postdoctoral Scholar
Massachusetts Institute of Technology

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Abstract

A central challenge of quantum information science (QIS) is to construct a scalable architecture that efficiently supports quantum computation, simulation, networking, and sensing. The scalability of such an architecture should not only accommodate qubit characteristics and device fabrication but also ensure noise resilience for protocols, error correction compatibility, and gate synthesis within algorithms. Diamond color centers have emerged as a promising solid-state qubit platform, demonstrating deterministic remote entanglement, minute-long coherence times with more than ten auxiliary qubits, and large-scale integration into photonic integrated circuits.

In this talk, I will present our advancements in crafting scalable QIS architectures based on color centers in diamond coupled with photonic integrated circuits. These electronic spin qubits are interacting through spin-photon interfaces and can be efficiently reconfigured with photonics. We address the noise and losses in spin-photon interaction through photonic cavity designs and statistical percolation. The architecture allows for cluster-state-based quantum error correction to suppress the error to the level of large-scale computation. We estimated the quantum resource for 2000-bit Shor's algorithm, noting substantial reductions achievable with a new magic state preparation technique.

Bio

Hyeonrak Choi (Chuck) is a postdoctoral researcher at MIT RLE, Quantum Photonics Group led by Prof. Dirk Englund. Chuck obtained his PhD in electrical engineering and computer science from MIT in 2021 under the supervision of Prof. Dirk Englund. He was awarded Claude E Shannon Research Fellowship in 2019 and supported by a non-committing Samsung Scholarship during 2014-2019. His interest is in quantum computing, quantum networks, and quantum photonics.

Host Professor Alexandra Boltasseva, aeb@purdue.edu, 765-494-0301