SPECIAL SEMINAR

Date: Tuesday, August 9, 2022
Time: 2:00 P.M.
Location: PHYS 242

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Non-Abelian geometric phases in integrated photonic waveguide structures

Abstract: A promising paradigm for the design of intrinsically stable quantum computers is holonomic quantum computation [1], i.e. the notion of implementing quantum gates as non-Abelian holonomies, a class of topologically protected unitary operators. The geometric phase accumulated by a quantum system propagating through Hilbert space depends exclusively on its path. As a result, in contrast to dynamical phases, which record the passage of time, geometric phases cannot be made to disappear by a gauge transformation. The purely geometrical nature of these entities is ensured by restricting the propagation to an N-fold degenerate subspace, thereby generating a geometric phase that belongs to the U(N) group. Quantum optics constitutes a particularly versatile platform for the implementation of holonomic quantum computing. In this talk, I will present an all-optical setup allowing for the generation of non-Abelian geometric phases in large degenerate dark subspaces [2], implemented in integrated photonic waveguide structures. I will discuss the experimental implementation of U(2)-valued [3] and U(3)-valued non-Abelian geometric phases using indistinguishable photons [4] injected into a tripod arrangement of photonic waveguides.

Host: Hadiseh Alaeian

[1] P. Zanardi, M. Rasetti, Phys. Lett. A 264, 94–99 (1999).
[2] J. Pinske, L. Teuber, and S. Scheel, Phys. Rev. A 101, 062314 (2020).
[3] M. Kremer, L. Teuber, A. Szameit, and S. Scheel, Phys. Rev. Research 1, 033117 (2019).
[4] V. Neef et al., Three-dimensional non-Abelian Quantum Holonomy, in preparation.