

Speaker: Jeremy Young

Time: 11:00am-12:00pm

Location: Whitaker Biomedical Engineering 1103

Title: Accelerating quantum dynamics with long-range interactions

Abstract: One of the major goals in the field of quantum science is to utilize the properties of quantum mechanics for applications in quantum computation, quantum simulation, and quantum sensing. In order to address this goal, a variety of different many-body quantum platforms have been developed. Many of these quantum platforms exhibit long-range interactions, particularly power-law interactions, including Rydberg atoms, polar molecules, trapped ions, and vacancy centers in diamond, among others. This gives rise to a natural question: how does the long-range nature of these interactions affect the resulting quantum evolution?

In this colloquium, I will discuss some of the ways that these long-range interactions have been utilized both for studying new many-body physics and for applications in quantum science. I will focus in particular on how long-range interactions can be used to accelerate entanglement generation in two contexts. First, I will illustrate how long-range interactions can be used to provide exponential speedups over short-range interactions in entanglement spreading and state transfer and discuss how this can be achieved with Rydberg atoms and polar molecules. Second, I will present an approach for engineering multi-qubit gates in Rydberg atoms.

Bio: Jeremy Young received his PhD at the University of Maryland in 2019 working with Alexey Gorshkov. He is currently working with Ana Maria Rey as a postdoctoral associate at JILA in the University of Colorado Boulder, where he was previously a National Research Council postdoctoral fellow. His research interests center on the interfaces of atomic, molecular, and optical physics with quantum information and condensed matter physics. He is particularly interested in exploring the ways that long-range interactions and the external environment can give rise to interesting many-body physics or be utilized as resources for quantum computation, simulation, and sensing.