The Hichhiker's Guide to the Black Hole

Black holes are among the most extreme objects in the universe—regions where even light cannot escape—and they provide one of the most dramatic arenas where quantum mechanics and gravity collide. Does information that falls into a black hole disappear forever, or is it somehow preserved?

In this colloquium, I will explore this longstanding question through the modern perspectives of string theory and holography. By translating complicated gravitational systems into equivalent quantum theories without gravity, holography offers a powerful new language for understanding some of the deepest problems in quantum gravity.

Along the way, I will discuss the surprising connection between quantum entanglement and the geometry of spacetime, as well as recent developments such as the island proposal and quantum simulation approaches to black hole physics. The goal of this talk is to offer a guided journey through the frontier of modern theoretical physics, with black holes serving as our window into the quantum structure of the universe.