Department of Physics
Arizona State University

COLLOQUIUM

Thursday, September 29th, 2022

Refreshments at 3:45pm in PSF 186
Colloquium from 4:00 PM – 5:00 PM in PSF 101

Quantum Fields, Quantum Gravity, and Black Holes

Professor Alex Maloney

McGill University

Abstract:

Black hole physics provides a powerful window onto some of the deepest and most perplexing questions in quantum field theory and quantum information theory. This can be made precise using the AdS/CFT correspondence, which relates theories of quantum gravity to conformal field theories (CFTs) in one less dimension. These CFTs are similar to the gauge theories which describe the fundamental forces of particle physics, as well as to those which describe important statistical and condensed matter systems at criticality. In studying this correspondence, we have made a surprising discovery: there is evidence that classical space-time geometry emerges from the entanglement of more fundamental quantum mechanical degrees of freedom, and that -- in a sense -- space-time *is* entanglement. In fact, it appears that the simplest theories of gravity are related to field theories where the coupling constants are essentially random variables, much like in a spin glass or other disordered system. This leads to a remarkable relationship between the microscopic physics of black holes and the study of quantum information theory, and opens up new perspectives on our understanding of quantum gravity, quantum field theory, and statistical mechanics.

Bio:

Alex Maloney is a theoretical physicist whose work focuses on fundamental questions in theoretical physics, particularly those related to black holes, quantum field theory, and emerging relationships with quantum chaos and quantum information theory. He received his PhD from Harvard in 2003, after which he held postdoctoral positions at the Stanford Linear Accelerator Center and the Institute for Advanced Study in Princeton. In 2007 he moved to McGill, where is a Professor and William Macdonald Chair in Physics.

Host: Prof. Cindy Keeler

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