The Shape of the Quantum Spacetime Discovered by Machines

For over a century, theoretical physics and mathematics have evolved in close partnership, united by one of the deepest scientific ambitions: the unification of the fundamental forces of nature. This enduring interplay has led to some of the most profound developments in modern science, culminating in the frameworks of quantum field theory and string theory. This colloquium will present a brief overview of that century-long partnership and of how it gave rise to one of the foremost frontiers of contemporary theoretical and mathematical physics: superstring theory. With the recent rise of machine learning and AI in scientific research, theoretical physics and mathematics are now entering a new era of transformative opportunity. I will survey the pioneering works that first introduced machine-learning methods into quantum field theory, string theory, and mathematical physics. In particular, I will describe how, in my own research, advanced generative AI methods are being used to explore configuration spaces in complex geometry, which in turn govern the phases and dynamics of quantum field theories realized in string theory.