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Generative AI for Brane Configurations and Calabi-Yau Mirror Curves in String Theory

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In this talk, I will provide a brief overview of the pioneering work since 2017 that introduced machine learning techniques to the study of quantum field theory, string theory, and related areas of mathematics and theoretical physics. I will then explain how more advanced generative AI methods can be used to explore Calabi-Yau mirror curves and related brane configurations in string theory, which in turn give rise to various phases and dynamical phenomena in a family of 4-dimensional supersymmetric quiver gauge theories. Some of these dynamical phenomena are linked to Seiberg duality of the associated 4-dimensional quiver gauge theories, which in mathematical language correspond to cluster mutations in the framework of cluster algebras. The talk will conclude with a preview of the tools that advanced - and crucially explainable - AI can offer for the future study of quantum field theories and string theory, and more broadly for research at the interface of mathematics and theoretical physics.