Contribution ID: **286** Type: **not specified**

AI for the String Landscape: Targeted Discovery in Type IIB Flux Vacua

Tuesday 8 July 2025 10:00 (30 minutes)

Understanding the vast landscape of string theory vacua is a central challenge in connecting fundamental theory to low-energy phenomenology. In this talk, I present recent advances in using machine learning —specifically conditional generative models —as tools for automated discovery in the string landscape. Focusing on the inverse problem in Type IIB flux compactifications, I demonstrate how Conditional Variational Autoencoders (CVAEs) can efficiently generate flux vacua with targeted properties, such as specified values of the superpotential or satisfying strict tadpole constraints. These models enable controllable sampling in regions of moduli space that are computationally inaccessible via traditional methods like MCMC, achieving speedups of several orders of magnitude while discovering physically novel vacua beyond the training data.

Complementing this, I will also present a framework for systematic enumeration of flux vacua in compact regions of moduli space using a tailored algorithm, applied to a two-modulus Calabi-Yau orientifold. This analysis reveals detailed structure in the vacuum distribution, including hierarchical mass scales and rare vacua with very small superpotentials, offering a complementary, data-driven view of the landscape.

Together, these results illustrate how AI methods can augment theoretical tools to enable both exploratory and targeted investigation of the string landscape —with potential implications for bottom-up model building and upcoming agent-based scientific discovery.

Presenter: KRIPPENDORF, Sven