Calabi-Yau Metrics with Kähler Moduli Dependence and Applications to String Phenomenology

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Abstract

A key goal of string phenomenology is to compute physical observables in Calabi-Yau compactifications as functions of the moduli. Quantities such as Yukawa couplings depend non-trivially on both complex structure and Kähler moduli, requiring detailed knowledge of geometric quantities, such as the Ricci-flat metric, across moduli space. While machine-learning methods provide efficient numerical approximations, analytic approaches remain limited in scope. In this talk, I will present a hybrid numerical-analytical method to construct approximate Ricci-flat Calabi-Yau metrics with explicit Kähler moduli dependence, combining machine learning with analytic ansätze and symbolic regression. I will then emphasise the relevance of this approach in the context of a complementary study of heterotic line bundle models, where we identified two compactifications that can reproduce the observed values of Standard Model quark and lepton masses and mixings.

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