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Physical Yukawa Couplings in Heterotic String Compactifications

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One of the challenges of heterotic compactification on a Calabi-Yau threefold is to determine the physical (27)3 Yukawa couplings of the resulting four-dimensional N=1 theory. In general, the calculation necessitates knowledge of the Ricci-flat metric. However, in the standard embedding, which references the tangent bundle, we can compute normalized Yukawa couplings from the Weil-Petersson metric on the moduli space of complex structure deformations of the Calabi-Yau manifold. In various examples (the Fermat quintic, the intersection of two cubics in $\mathbb{P}5$, and the Tian-Yau manifold), we calculate the normalized Yukawa couplings for (2,1)-forms using the Weil-Petersson metric obtained from the Kodaira-Spencer map. In cases where h1,1=1, this is compared to a complementary calculation based on performing period integrals. A third expression for the normalized Yukawa couplings is obtained from a machine learned approximate Ricci-flat metric making use of explicit harmonic representatives. The excellent agreement between the different approaches opens the door to precision string phenomenology.

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