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Obtaining Small Kinetic Mixing in String Theory

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Kinetic mixing between $U(1)$ gauge groups is a well-known possible interaction between our visible Standard Model sector and a hidden sector supposed to contain dark matter. Naturally, the mixing coupling must be very small for the hidden sector to remain "almost"completely hidden. We aim to follow up on the established literature and investigate how very small kinetic mixing can arise in string theory compactifications. In particular, we focus on the large volume scenario in type IIB. Small kinetic mixing can be attained by tuning the hidden gauge coupling to small values, embedding the $U(1)$s in non-abelain gauge groups or by sequestering the visible and hidden sector. We elaborate why tiny gauge couplings are unsatisfactory since they reduce the cutoff of the 4-dim. effective theory. Considering the large volume scenario, we show that the hidden gauge coupling is bounded from below, thus excluding kinetic mixing of 10^{-12}. Driven by phenomenology, we advocate a "minimal setup"for stringy kinetic mixing incorporating charged states and evading the issues related to tiny gauge couplings. In this minimal setup, small kinetic mixing is achieved: 1) by embedding the $U(1)$s in non-abelian gauge groups, 2) by sequestering the visible and hidden sector hosted on D-brane stacks. Surprisingly, it turns out that the naive approach by simply separating the visible and hidden D-branes over long distances in the Calabi-Yau manifold is not sufficient to achieve exponentially suppressed kinetic mixing. We also discuss how a charge conjugation symmetry, which forbids kinetic mixing, can be realized in type IIB.

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