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Small Kinetic Mixing in String Theory

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Kinetic mixing between gauge fields of different $U(1)$ factors is a well-studied phenomenon in 4d EFT. In string compactifications with $U(1)$ s from sequestered D-brane sectors, kinetic mixing becomes a key target for the UV prediction of a phenomenologically important EFT operator. Surprisingly, in many cases kinetic mixing is absent due to a non-trivial cancellation. In particular, D3-D3 kinetic mixing in type-IIB vanishes while D3-anti-D3 mixing does not. This follows both from exact CFT calculations on tori and as well as from a leading-order 10d supergravity analysis, where the key cancellation is between the C2 and B2 contribution. We take the latter approach, which is the only one available in realistic Calabi-Yau settings, to a higher level of precision by including sub-leading terms of the brane action and allowing for non-vanishing C0. The exact cancellation persists, which we argue to be the result of $SL(2, \mathbb{R})$ self-duality. We note that a B2-C2 term on the D3-brane, which is often forgotten in the recent literature, is essential to obtain the correct zero result. Finally, allowing for $SL(2, \mathbb{R})$ -breaking fluxes, kinetic mixing between D3-branes arises at a volume-suppressed level. We provide the basic explicit formulae, leaving the study of phenomenologically relevant, more complex situations for the future.

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