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Scattering Amplitudes of Massive Spin-2 Kaluza-Klein States with Matter

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We perform a comprehensive analysis of the scattering of matter and gravitational Kaluza-Klein(KK) modes in five-dimensional gravity theories. We consider matter localized on a brane as well as in the bulk of the extra dimension for scalars, fermions and vectors respectively, and consider an arbitrary warped background. While naive power-counting suggests that there are amplitudes which grow as fast as O(sˆ3) [where s is the center-of-mass scattering energy-squared], we demonstrate
that cancellations between the various contributions result in a total amplitude which grows no faster than O(s). Extending previous work on the self-interactions of the gravitational KK modes, we show that these cancellations occur due to sum-rule relations between the couplings and the masses of the modes that can be proven from the properties of the mode equations describing the gravity and matter wavefunctions. We demonstrate that these properties are tied to the underlying diffeomorphism invariance of the five-dimensional theory. We discuss how our results generalize when the size of the extra dimension is stabilized via the Goldberger-Wise mechanism. Our conclusions
are of particular relevance for freeze-out and freeze-in relic abundance calculations for dark matter models including a spin-2 portal arising from an underlying five-dimensional theory.

Mini Symposia (Invited Talks Only)

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