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Thick Branes in Extra Dimensions and Suppressed Couplings

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Extra dimensions (ED) have been used as attempts to explain several phenomena in particle physics, such as the hierarchy and flavor problems. The interaction between new mediators in the bulk (vector, scalar of fermion fields) and the Standard Model (SM) particles can be naturally suppressed if one employs a single, flat ED. In this setup, the SM fields are localized in a finite width 'fat'brane, similar to models of Universal Extra Dimensions. A dark matter (DM) candidate is confined to a thin brane at the opposite end of the ED interval. Including brane localized kinetic terms on the fat brane for the mediator fields, the resulting coupling between the SM and these mediators can be several orders of magnitude smaller than the corresponding ones between the mediators and DM. The implications of this scenario is investigated for both vector (dark photon, DP) and scalar mediator fields in the 5-D bulk. The SM particles couple to the DP via their $B-L$ charges while the DP couples to the DM via a dark charge. Both the vector DP couplings and the corresponding Higgs portal couplings with the SM are shown to be naturally small in magnitude with a size dependent on ratio of the 5-D compactification radius and the SM brane thickness. This mechanism is also studied in 6-D. Finally, if a Dirac fermion is present in the bulk, it results (in 4-D) in two towers of Kaluza-Klein Majorana sterile neutrinos, whose mass mixing with the SM neutrinos is also suppressed. The seesaw mechanism is therefore obtained, and sterile neutrino masses of order $\mathcal{O}(1-10)$ TeV naturally explain the small SM neutrino mass.

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