"Scalar fields within warped extra-dimension"

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Abstract

In this thesis, we explored three different implications of scalar fields in warped extra-dimension.

- First, scalar fields were employed to dynamically generate singular branes in Randall-Sundrum (RS)-like models by appropriate profiles — the smooth/thick-branes. In the context of thick-branes, we constructed four different setups: (*i*) a smooth generalization of RS2 where a scalar field dynamically generates a singular brane allowing symmetric or asymmetric warped geometries on either side of the brane; (*ii*) a double thick-brane scenario which mimics two positive tension branes and allows to address the hierarchy problem; (*iii*) a $\mathbb{Z}_2$ symmetric triple thick-brane; and (*iv*) a dilatonic thick-brane scenario. The stability of background solution is verified in all the above mentioned setups.
- Second, we considered a thick-brane cosmological model with warped fifth-dimension where the dynamics of the 4D universe is driven by the time-dependent 5D background. Different scenarios were found for which the cosmic scale factor $a(t, y)$ and the scalar field $\phi(t, y)$ depend non-trivially on the time t and the 5th-dimension y.
- Third, we discussed a symmetric 5D model with three D3-branes (IR–UV–IR) where the Higgs doublet and the other Standard Model (SM) fields are embedded in the bulk. The $\mathbb{Z}_2$ geometric symmetry led to the warped KK-parity for all the bulk fields. Within this setup we investigated the low-energy effective theory for the bulk SM bosonic sector. It turned out that the zero-mode scalar sector contains an even scalar which mimics the SM Higgs boson and a second, stable odd scalar particle which is a dark matter candidate. The model that resulted from the $\mathbb{Z}_2$-symmetric background geometry resembles the Inert Two Higgs Doublet Model. Implications for dark matter were discussed within this model.