

Gravity-mediated Scalar Dark Matter in Warped Extra-Dimensions

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Based on:
Folgado, Donini and Rius
arXiv:1907.04340

BLV2019, IFT Madrid, 22/10/2019.

Gravity mediated DM in classical Minkowsky 4D

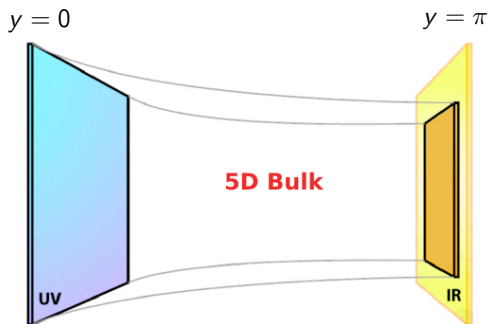
- Nowadays we have lots of evidences of the existence of DM, all of them are related with the gravitational interaction.
- Would it be possible that DM only interacts with the standard matter via gravity?

$$dS = g_{\mu\nu} dx^\mu dx^\nu \quad g_{\mu\nu} = \eta_{\mu\nu} + h_{\mu\nu}$$

- And the interaction lagrangian would be given by:

$$\mathcal{L} = \frac{1}{\bar{M}_{pl}} T^{\mu\nu} h_{\mu\nu} \quad \longrightarrow \quad \text{Too weak}$$

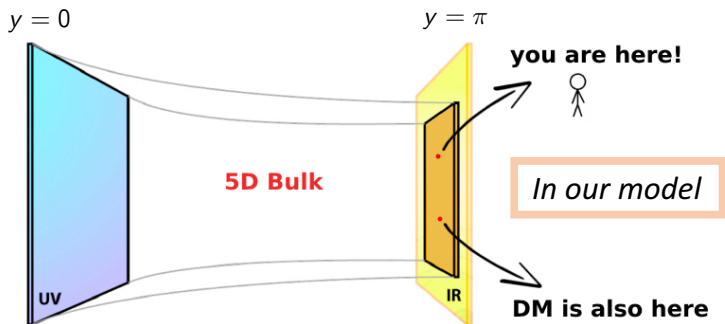
Randall-Sundrum model in 1 minute



- Two free parameters in the model: k and r_c .
 - Scale of interactions in UV brane: \bar{M}_{pl} .
 - Scale of interactions in IR brane: Λ .
- $$\Lambda = \bar{M}_{pl} e^{-2kr_c}$$

$$ds^2 = e^{-2kr_c} \eta_{\mu\nu} dx^\mu dx^\nu - r_c^2 dy^2$$

Randall-Sundrum model in 1 minute



$$ds^2 = e^{-2kr_c y} \eta_{\mu\nu} dx^\mu dx^\nu - r_c^2 dy^2$$

Interaction with gravity

- The interaction between the particles located in the IR brane and the gravitons is given by

$$\mathcal{L} = -\frac{1}{M_5^{3/2}} T^{\mu\nu} h_{\mu\nu} = -\frac{1}{\bar{M}_{pl}} T^{\mu\nu} h_{\mu\nu}^{(0)} - \frac{1}{\Lambda} \sum_n T^{\mu\nu} h_{\mu\nu}^{(n)},$$

Where Λ , $m_n = f(k, r_c)$. We can parametrise the RS model using Λ and $m_g \equiv m_1$.

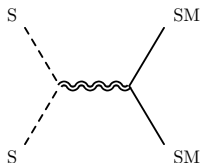
- Degrees of freedom of the RS + DM:

$$\boxed{\Lambda, m_g, m_S}$$

- The mechanism to stabilize the distance between the 4D branes typically introduces a new field that mixes with the scalar component of the RS metric (h_{55}) and it is called **radion**. Its mass is a new free parameter.

DM Annihilation

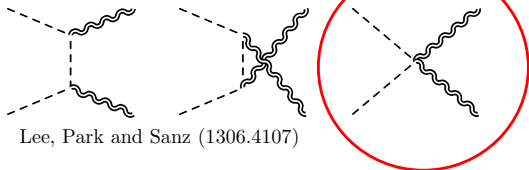
- DM Annihilation into SM particles (graviton virtual exchange).



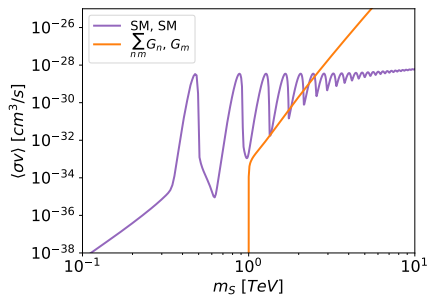
Not enough to achieve the relic abundance in the freeze out paradigm! (1706.07540)

- DM Annihilation directly into gravitons (only if $m_S > m_g$).

NEW!!

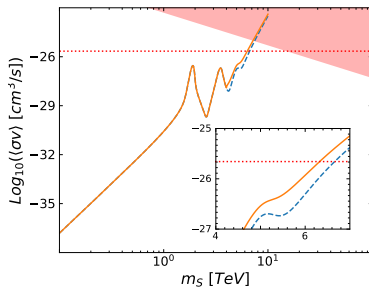


DM Annihilation



$$\Lambda = 100 \text{ TeV}$$

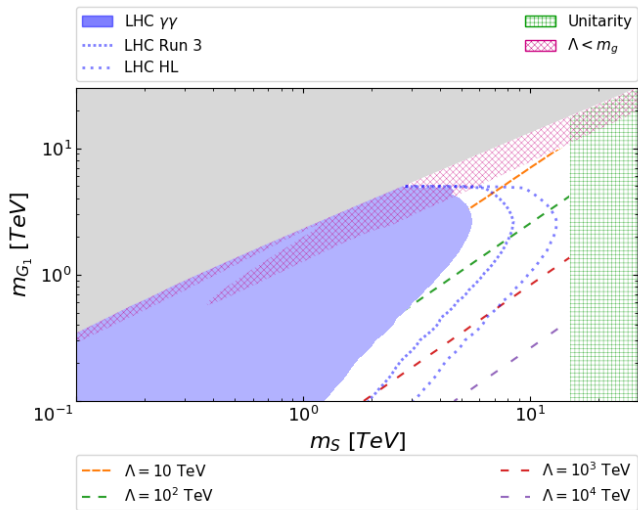
$$m_g = 1 \text{ TeV}$$



$$\Lambda = 10 \text{ TeV}$$

$$m_g = 4 \text{ TeV}$$

Final results



Summary

- In this work we have analysed the phenomenology of a 5-dimensional RS model in which the DM only interacts via gravitational interaction.
- It is possible to obtain the correct relic density in a large region of the parameter space.
- Strong constraints in the parameter region where is possible to reach the correct relic abundance. The most constrigent bounds come from searches of resonances in the LHC.
- We have also analysed the case in which the extra dimension is stabilized by a radion with the Goldberger-Wise mechanism and the effect

Backup

