

Ultraheavy Accidental Composite Dark Matter

TPPC Retreat

by Stefano Palmisano (Sapienza → GGI)
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Accidental Composite Dark Matter

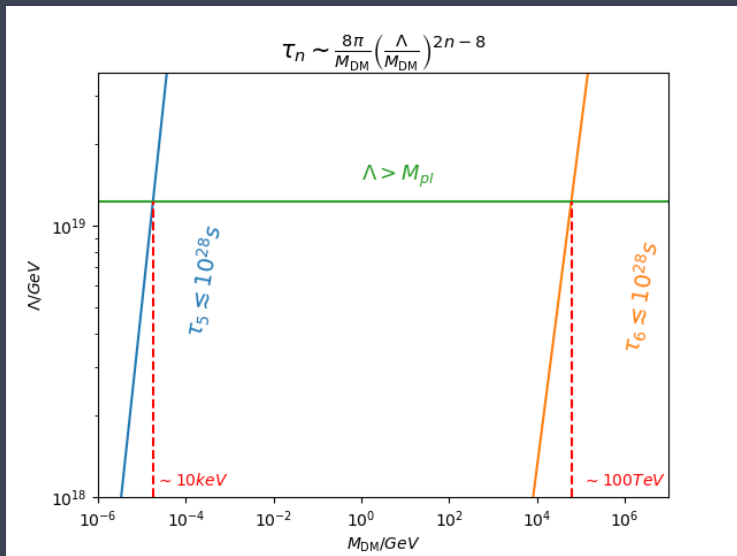
Ultraheavy DM in the context of GUT

Accident-zilla (?)

Cosmology (just a sketch)

Accidental Composite Dark Matter

» Accidentally Stable DM



» Régimes

Strongly Coupled Régime

- * QCD-like theories whose baryons comprise the DM
- * Geometrical cross-section $\rightarrow M_{\text{DM}} \sim 100\text{TeV}$

Weakly Coupled Régime

- * Perturbative freeze-out à la minimal DM
- * *Followed* by dark confinement
- * Can have lower mass
- * Important role played by glueballs

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Minimal GUT-zilla

$N_{\text{DC}} = 3$ copies of dark quark $Q \sim (\mathbf{3}, \mathbf{2})_{\frac{1}{6}}$ make up

$$\text{DM} \sim \text{"}QQQ\text{"} \sim (\mathbf{1}, \mathbf{2})_{\frac{1}{2}}$$

» Issues with Minimal GUTzilla

Not accidentally stable

- * Dim. 6 operator $QQQ\ell$ breaks baryon number
- * $M_{\text{DM}} \lesssim 10^5 \text{ GeV}$
- * Is there a way to make it accidentally stable?

Dark glubealls

- * Dark gluons may be produced together with dark quarks during thermalization
- * Can glueballs then overclose the universe?
- * Does dilution due to glueball decay play a role?

Accident-zilla (?)

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SM contributions

$$V = \dots + \left(\alpha_3 \frac{C_3^c}{4} + \alpha_2 \frac{C_2^t}{3} + \alpha_Y Y^2 \right) \sum_{i < j} \frac{1}{r_{ij}} + \dots$$

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Spin-Spin interactions

$$V = \dots + \alpha_{\text{DC}} \frac{C_{N_{\text{DC}}}}{N_{\text{DC}}-1} \sum_{i<j} \frac{1}{3M_Q^2} \mathbf{S}_i \cdot \mathbf{S}_j \delta^{(3)}(\mathbf{r}_{ij})$$

» Accidentality of GUTzilla DM

- * In Q , in order for DM to be a color singlet, $N_{\text{DC}} = 3 \pmod 3$
 - * $N_{\text{DC}} = 3$ is not accidental
 - * $N_{\text{DC}} = 6, 9, \dots$ have EM charged ground states baryons

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 - Spin 0 $\supset (\mathbf{1}, \mathbf{3})_{-1}$
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- * No subset of the $\mathbf{10}$ of $SU(5)_{\text{GUT}}$ can be the minimal Accident-zilla

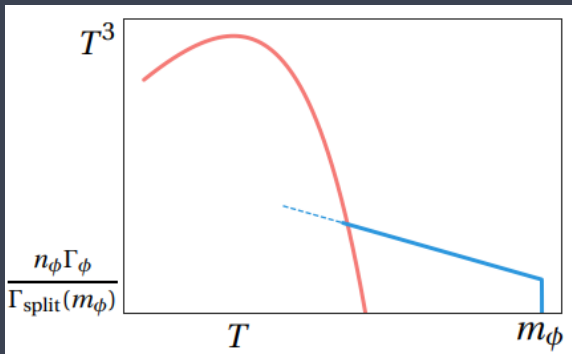
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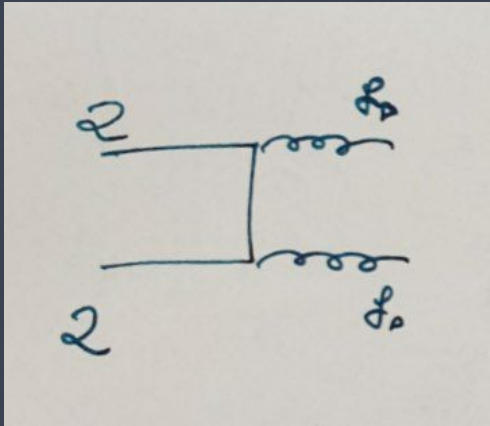
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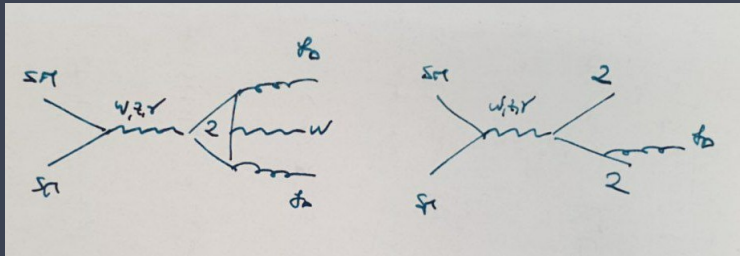
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» Production of dark gluons?



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» Thanks for listening

