Contribution ID: **1311** Type: **Parallel Talk**

Accidental composite dark matter in SU(5)-GUT theories

Thursday, 7 July 2022 12:05 (15 minutes)

New ''dark" fermionic fields charged under a confining dark group (SU(N) or SO(N)) can come as embeddings in SU(5) multiplets to explain dark matter (DM). These fermions would form bound states due to the confining nature of the dark gauge group. Such dark baryons could prove to be a good neutral DM candidate stable due to a dark baryon number. DM relic abundance sets the dark confinement scale to be of $\mathcal{O}(100)$TeV. Previous works require the mass of these baryonic DM-forming light fields m, (where m is less than the dark confinement scale $\Lambda_{\rm DC}$) to be way smaller than the unification scale (GUT scale). This was done assuming that their GUT partners in SU(5) representations have GUT scale mass. In our work, focusing on the role of these heavy GUT states in these models, we find that the dark fermions cannot come in almost degenerate GUT multiplets.
We further find that cosmological constraints from Big Bang Nucleosynthesis in addition to unification requirements allow for only certain values of masses for these GUT fermions.
However, these mass values give a too large contribution to the DM relic abundance.
To evade this, the mass of the GUT states must be lower than the reheating temperature.
In general, we find that the heavy dark GUT states impact both the cosmological evolution and grand unification. Our study clarifies under which conditions both aspects of the theory are realistic.

In-person participation

Yes

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Session Classification: Dark Matter

Track Classification: Dark Matter