Luminogenesis from Inflationary Dark Matter

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- Epilog

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- Some form of DM-Luminous matter unification is needed to accomplish this.

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- Dynamics of DQCD: Interesting implications on small-scale structure anomalies

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- Deep connection with the model of electroweak-scale right-handed neutrinos (PQH).

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- Requirement: $SU(3)_C \times SU(6) \times U(1)_Y$ needs to be *anomaly-free*.

Inflationary Dark Matter

$SU(6)$	$SU(4) \times SU(2) \times U(1)_{DM}$
6	$(\mathbf{1},\mathbf{2})_{\mathbf{2}} + (\mathbf{4},\mathbf{1})_{-\mathbf{1}}$
20	$(\mathbf{4},\mathbf{1})_{\mathbf{3}} + (\mathbf{4}^*,\mathbf{1})_{-\mathbf{3}} + (\mathbf{6},\mathbf{2})_{\mathbf{0}}$
35	$(\mathbf{1},\mathbf{1})_{\mathbf{0}} + (\mathbf{15},\mathbf{1})_{\mathbf{0}} + (\mathbf{1},\mathbf{3})_{\mathbf{0}} + (\mathbf{4},\mathbf{2})_{-\mathbf{3}}$ $+(\mathbf{4}^*,\mathbf{2})_{\mathbf{3}}$

Table: The $(\mathbf{1},\mathbf{2})_{\mathbf{2}}$'s represent luminous matter while $(\mathbf{4},\mathbf{1})_{\mathbf{3}} + (\mathbf{4}^*,\mathbf{1})_{-\mathbf{3}}$ represent dark matter

Inflationary Dark Matter

	$SU(3)_c \times SU(6) \times U(1)_Y$
R $\supset$ SM fermions	$(\mathbf{3},\mathbf{6},\mathbf{1/6})_{\mathbf{L}} + (\mathbf{1},\mathbf{6},\mathbf{-1/2})_{\mathbf{L}}$ $+(\mathbf{3},\mathbf{1},\mathbf{2/3})_{\mathbf{R}} + (\mathbf{3},\mathbf{1},\mathbf{-1/3})_{\mathbf{R}}$ $+(\mathbf{1},\mathbf{1},\mathbf{-1})_{\mathbf{R}}$
R $\supset$ Mirror fermions	$(\mathbf{3},\mathbf{6},\mathbf{1/6})_{\mathbf{R}} + (\mathbf{1},\mathbf{6},\mathbf{-1/2})_{\mathbf{R}}$ $+(\mathbf{3},\mathbf{1},\mathbf{2/3})_{\mathbf{L}} + (\mathbf{3},\mathbf{1},\mathbf{-1/3})_{\mathbf{L}}$ $+(\mathbf{1},\mathbf{1},\mathbf{-1})_{\mathbf{L}}$
R $\supset$ dark matter fermions	$(\mathbf{1},\mathbf{20},\mathbf{0})$

Table: R denotes representation. SM left-handed doublets and right-handed singlets are parts of the first entry, Mirror right-handed doublets and left-handed singlets are parts of the second entry, and dark matter left and right-handed fermions belong to the last entry.

Dark Matter genesis

- The inflaton field is contained in $(1, 35, 0) = 1, 1, 1, 0)_0 + (1, 15, 1, 0)_0 + (1, 1, 3, 0)_0 + (1, 4, 2, 0)_{-3} + (1, 4^*, 2, 0)_3$.
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- At the end of inflation, the inflaton decayed mainly into DM!
- DM is the mother of all matter!

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- The excess DM, as represented by χ_L and χ_R, can be converted into the excess LM using the above interactions if the aforementioned symmetry is broken, allowing $\Phi_{\bar{15}}^{(L)}$ and $\Phi_{\bar{15}}^{(R)}$ mass mixing. Then one can have $\chi_L + \chi_L^{c,T} \to l_L + l_L^{M,c}$. l_L and $l_L^{M,c}$ denote SM leptons and Mirror leptons.

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- In the EW-scale ν_R model (PQH), $l_R^M \to l_L + \phi_S \Rightarrow$ only SM leptons are left.

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- Broken global $U(1)_{SM} \times U(1)_{Mirror} \Rightarrow$ Conversion of a small amount of DM, 14 %, into LM $\Rightarrow$ Phenomenological consequences at the LHC.

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- Λ_4 depends on the unification scale M_{DUT}. (with K. J. Ludwick and P. H. Frampton)

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flow.pdf

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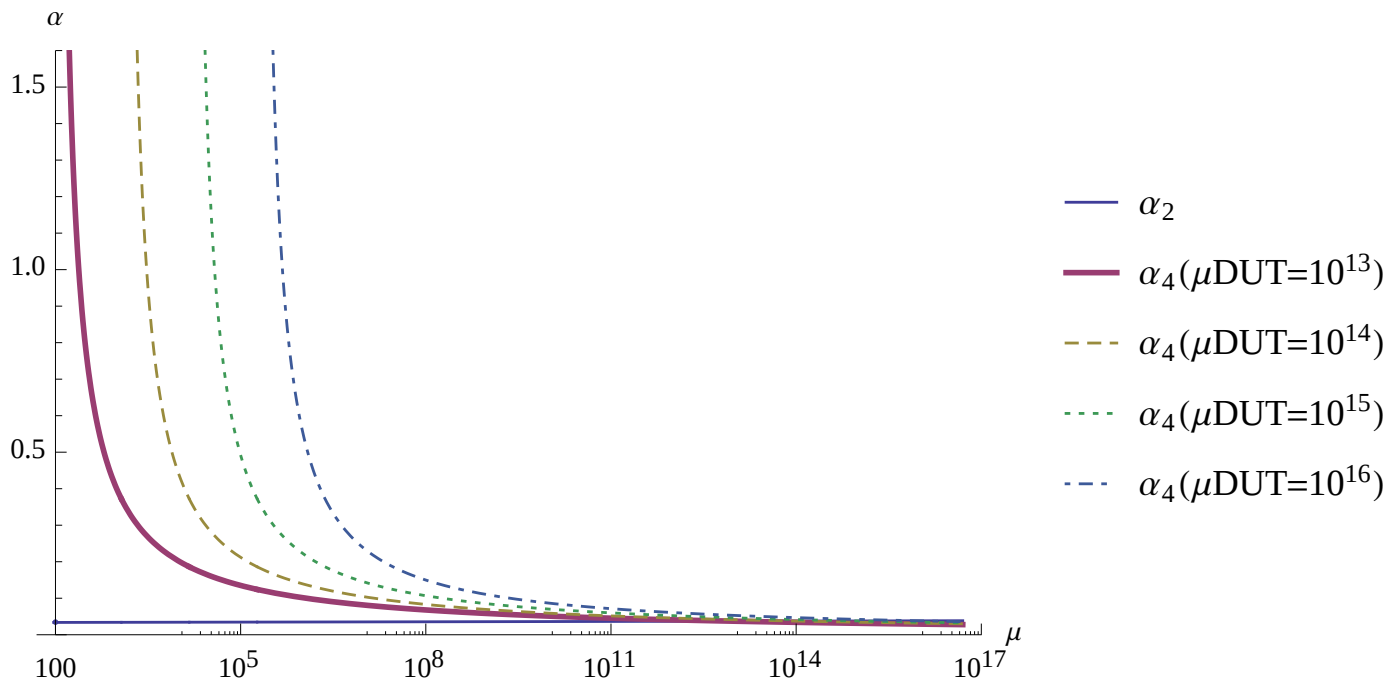

DQCD (SU(4))

flow 2.pdf

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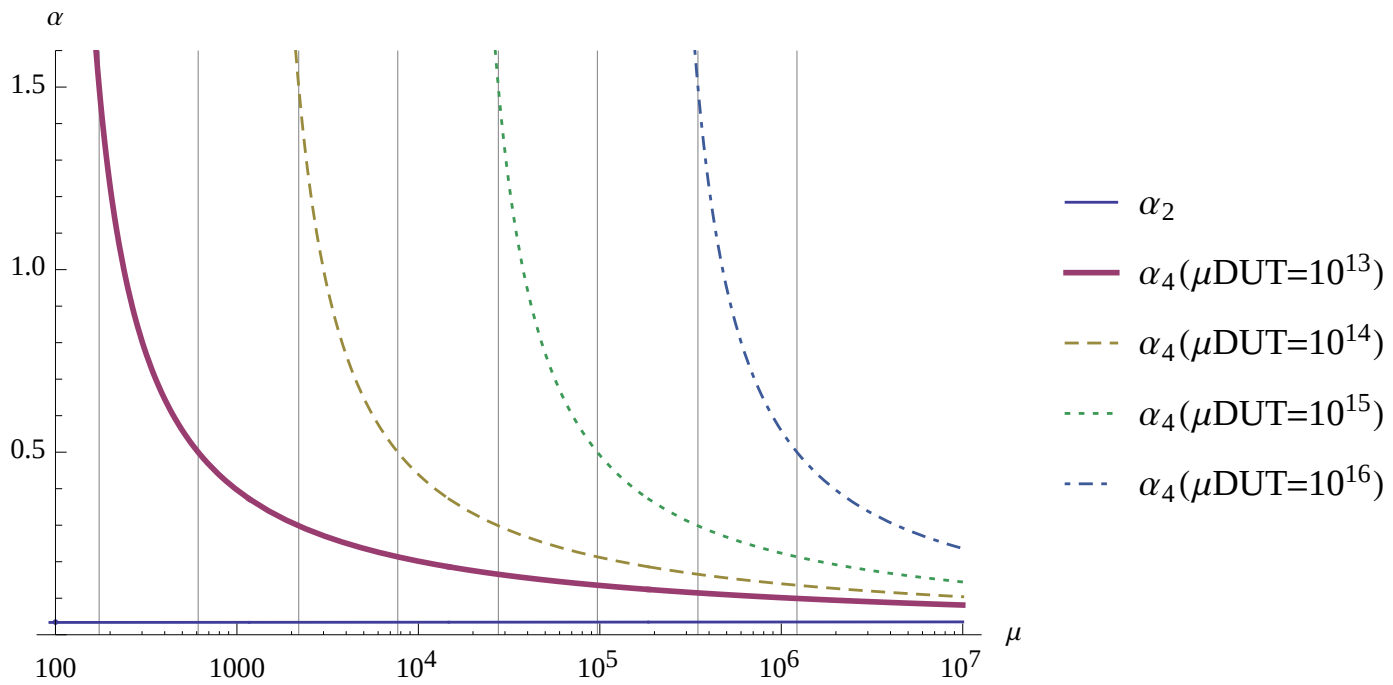

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- The Dark "pions" interact strongly with the DM CHIMPs $\Rightarrow$ Small scale structure anomalies resolved for $m_{\pi_{DM}} < 1 MeV$ and for masses of CHIMPs up to $\sim 100\, TeV$.

Direct detection of DM

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- Other related phenomena are under investigation.

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- Deep connection with the neutrino mass problem in the form of the electroweak-scale right-handed neutrino model.
- DM has its own strong interaction sector DQCD with interesting implications for the small scale structure anomalies.