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Simplified dark matter models: DMsimp

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Abstract. This is the note to describe the lagrangian for simplified dark matter models.

1 Simplified DM model

We introduce different types of DMs:

- real scalar DM (X_R)
- complex scalar DM (X_C)
- Dirac spinor DM (X_D)
- Majorana spinor DM (X_M)
- ...

and mediators:

- spin-0 (Y_0)
- spin-1 (Y_1)
- spin-2 (Y_2)
- ...

1.1 Spin-0 mediator

$$\mathcal{L}_{X_D}^{Y_0} = \frac{1}{2} M_{X_R}\, g^S_{X_R} X_R X_R Y_0 \tag{1}$$
$$+ M_{X_C}\, g^S_{X_C} X_C^* X_C Y_0 \tag{2}$$
$$+ \overline{X}_D (g^S_{X_D} + i g^P_{X_D} \gamma_5) X_D\, Y_0 \tag{3}$$

$$\mathcal{L}_{SM}^{Y_0} = \sum_{i,j} \big[\bar{d}_i \frac{y^d_{ij}}{\sqrt{2}} (g^S_{d_{ij}} + i g^P_{d_{ij}} \gamma_5) d_j \tag{4}$$
$$+ \bar{u}_i \frac{y^u_{ij}}{\sqrt{2}} (g^S_{u_{ij}} + i g^P_{u_{ij}} \gamma_5) u_j \big] Y_0 \tag{5}$$

$$\mathcal{L}_{SM\,EW}^{Y_0} = \frac{1}{\Lambda} \Big[g^S_{h1} \, (D^\mu \phi)^\dagger \, (D_\mu \phi) \; Y_0$$
$$+ g^S_{h2} m_H^2 \left(|\phi|^2 - v^2/2 \right) \; Y_0 \Big] \tag{6}$$
$$+ \frac{1}{\Lambda}\, B_{\mu\nu} (g^S_B \, B^{\mu\nu} + g^P_B \, \tilde{B}^{\mu\nu})\, Y_0 \tag{7}$$
$$+ \frac{1}{\Lambda}\, W^i_{\mu\nu} (g^S_W \, W^{i,\mu\nu} + g^P_W \, \tilde{W}^{i,\mu\nu})\, Y_0 \tag{8}$$

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1.2 Spin-1 mediator

$$\mathcal{L}_{X_D}^{Y_1} = \frac{i}{2}\, g^V_{X_C} (X_C^* (\partial_\mu X_C) - (\partial_\mu X_C^*) X_C)\, Y_1^\mu \tag{9}$$
$$+ \overline{X}_D \gamma_\mu (g^V_{X_D} + g^A_{X_D} \gamma_5) X_D \, Y_1^\mu \tag{10}$$

$$\mathcal{L}_{SM}^{Y_1} = \sum_{i,j} \big[\bar{d}_i \gamma_\mu (g^V_{d_{ij}} + g^A_{d_{ij}} \gamma_5) d_j \tag{11}$$
$$+ \bar{u}_i \gamma_\mu (g^V_{u_{ij}} + g^A_{u_{ij}} \gamma_5) u_j \big] Y_1^\mu \tag{12}$$

$$\mathcal{L}_{SM\,EW}^{Y_1} = g^V_h \, \frac{i}{2} \left(\phi^\dagger D_\mu \phi - D_\mu \phi^\dagger \phi \right) Y_1^\mu \tag{13}$$