Two important questions

- Mass scale of dark matter

$$m_{DM} \ll M_{\rm fundamental} (= M_{\rm pl}, M_{\rm GUT}, M_{\rm st})$$

$$m_{DM}/M_{\rm fundamental} \ll 1$$

"Hierarchy problem"

- Stability of dark matter

Why is it stable/long-lived?

Overview of model

- Assume chiral gauge symmetry
- Chiral gauge symmetry forbids any mass terms
- Strong dynamics generate mass gap
- One of the composite particle is accidentally stable due to the gauge symmetry

Model

Keisuke Harigaya, Yasunori Nomura (2016)

	Ψ_1	Ψ_2	$\overline{\Psi}_1$	$\overline{\Psi}_2$
$SU(N)$	N	N	$\overline{N}$	$\overline{N}$
$U(1)_D$	1	-1	-a	a
$U(1)_P$	1	-1	-1	1

gauge symmetry

accidental symmetry

$$SU(2)_L \times SU(2)_R$$

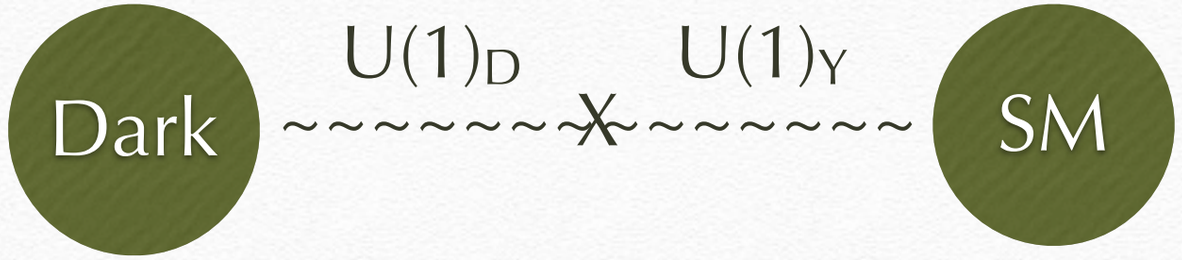
$$\downarrow$$

$$SU(2)_V$$

one would-be NGB π_D^0

+

two pseudo NGB $\pi_D^\pm$



Smoking-gun: Rich dark sector

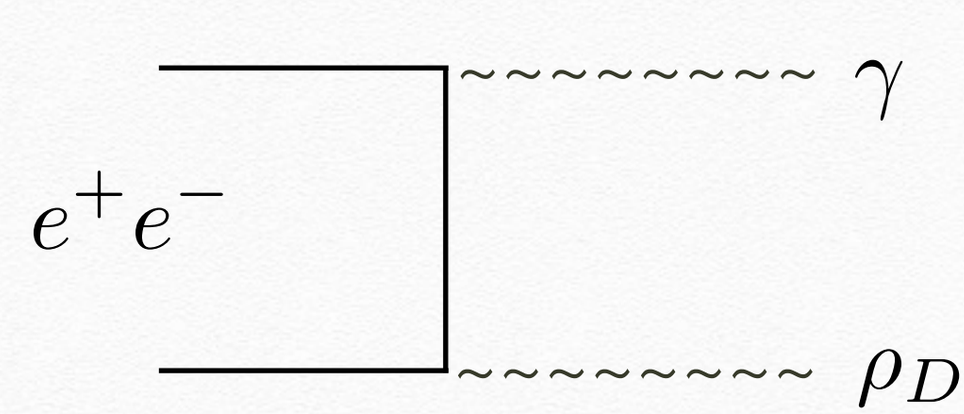
mass

Dark rho meson
Dark sigma meson
Dark eta′

$4\pi m_{\pi_D, A_D}$

Dark photon
dark pion

10-100 MeV



mono-photon

see Hochberg, Kuflik and Murayama (2015)
for more rigorous discussion