ALP-EFTs for additionally gauged U(1) symmetries

based on work with Alexey Kivel and Felix Yu (2208.XXXXX)
and with Saereh Najjari and Felix Yu (22XX.XXXXX)
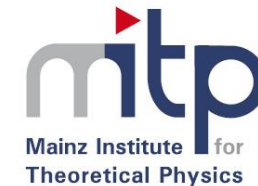
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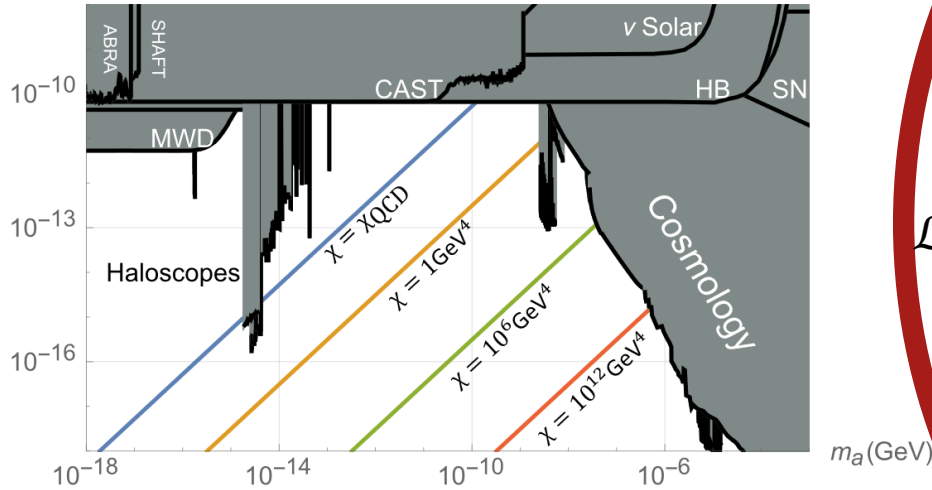
17th Patras Workshop

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Axion

(Pseudo-)scalar boson with mass m_a and decay constant f_a, can couple to photons via

$$\mathcal{L} \supset -\frac{G_{a\gamma\gamma}}{4} a F_{\mu\nu}\tilde{F}^{\mu\nu}$$

Axion-diphoton coupling

$$G_{a\gamma\gamma} = \frac{e^2}{8\pi^2}\frac{1}{f_a}\left(\frac{8}{3} - 1.92\right)$$

Dark Photon

Vector boson with mass $m_{Z'}$ and gauge coupling g', can couple to Standard Model via kinetic mixing

$$\mathcal{L} \supset \frac{\epsilon_{\text{eff}}}{2} B_{\mu\nu}B'^{\mu\nu}$$

Kinetic mixing parameter

$$\epsilon_{\text{eff}} = -\frac{eg'}{16\pi^2 c_W}\frac{4}{3}\left(\frac{5}{3} - \ln(36g'^2)\right)$$
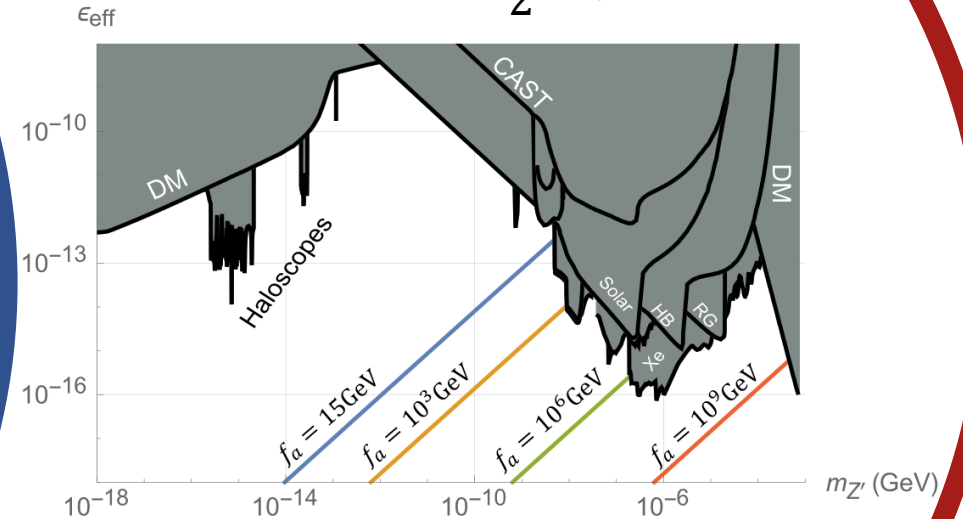
Can get common scale and new operators from UV completion

$$\mathcal{L} \supset C_{Z'\gamma}\frac{g'e}{(4\pi)^2}\frac{a}{f_a}Z'_{\mu\nu}\tilde{F}^{\mu\nu}$$

$$m_{Z'} \sim g'f_a$$