Dark photons in a Higgs-Stueckelberg model for dark matter

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ABSTRACT

An extension of the Standard Model (SM) is studied, in which two new vector bosons areintroduced, a first boson (Z') coupled to the SM by the usual minimal coupling, producing an enlarged gauge sector in the SM and a second boson field, in the dark sector of the model, remains massless and originates a dark photon, in a hybrid mixing scenario based on a combined Higgs and Stueckelberg mechanisms. An astrophysical application is evaluated obtaining an estimate of the impact on stellar cooling of white dwarfs

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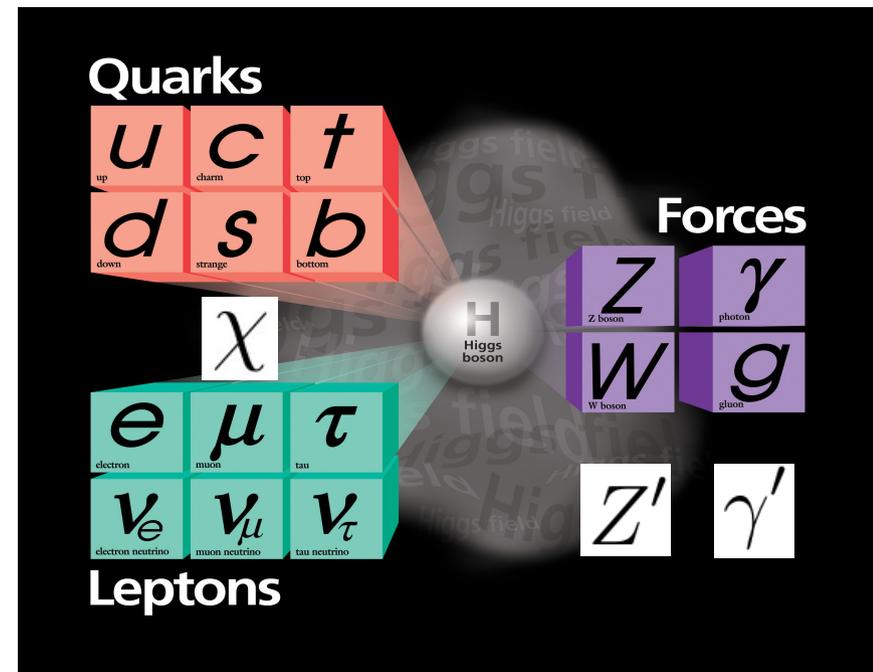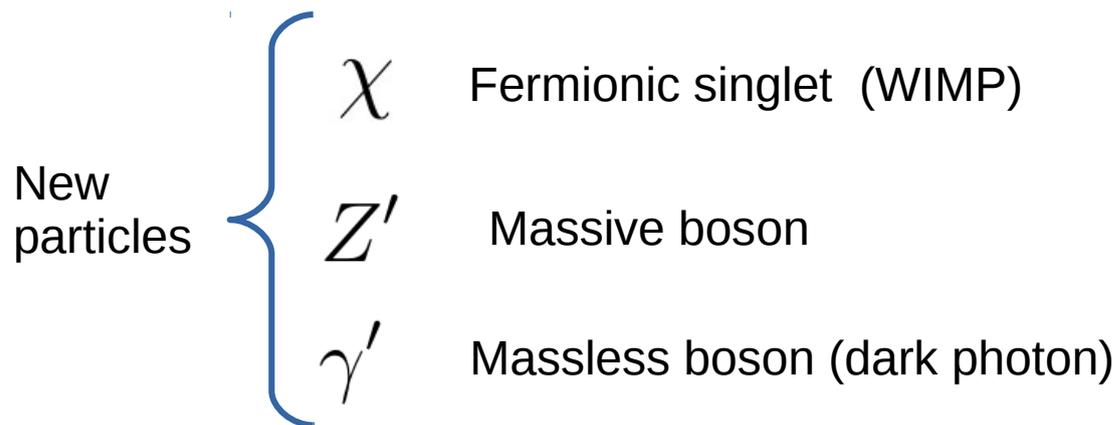UNIVERSIDADE FEDERAL
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CMPA

The XENON collab. presents a recent (low energy) result showing an excess that could be dark matter...
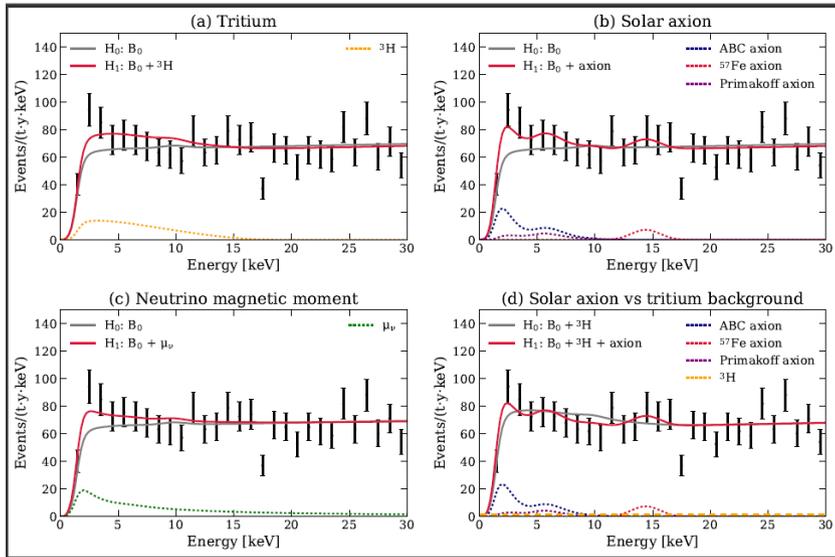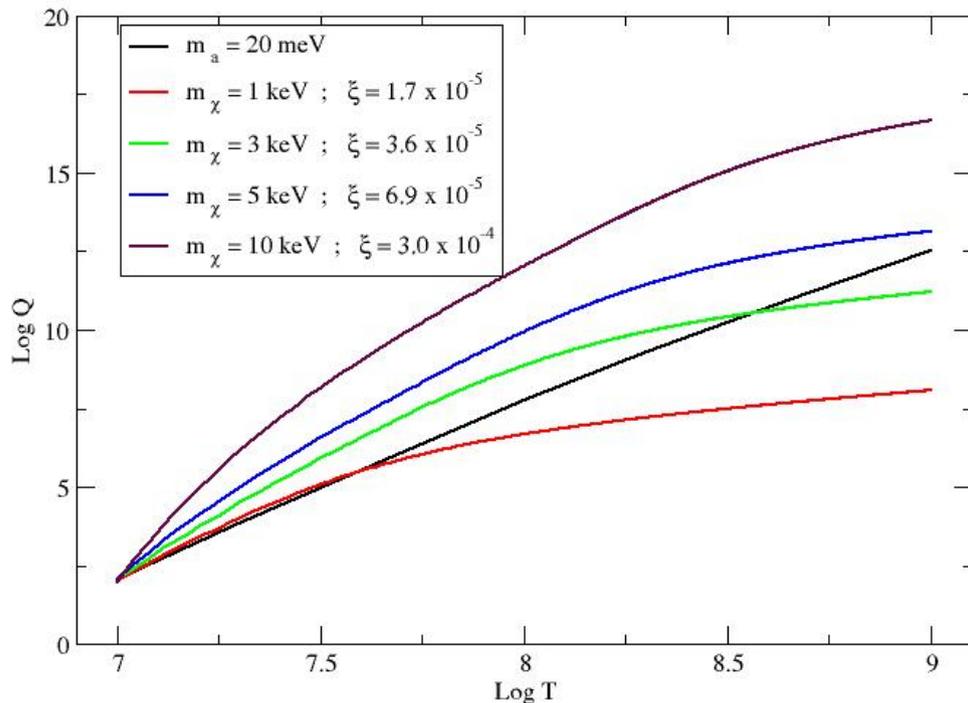

Possible explanations:

- Solar axion

- Large neutrino magnetic moment

- Contamination from tritium atoms

We review our model: (Higgs-Stueckelberg model for DM) and argue that the excess could be attributed to the fermionic WIMP:
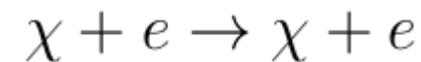
New particles
$$\begin{cases} \chi & \text{Fermionic singlet (WIMP)} \\ Z' & \text{Massive boson} \\ \gamma' & \text{Massless boson (dark photon)} \end{cases}$$

Energy loss in white dwarfs

Comparison between energy loss mechanisms by axion emission and dark photons

$$m_\chi = 1 \text{ keV to } 10 \text{ keV}$$

We argue that the excess observed in the XENON experiment could be understood in our model by a process:

$$\chi + e \rightarrow \chi + e$$

Legend (plot):
- $m_a = 20$ meV
- $m_\chi = 1$ keV ; $\xi = 1.7 \times 10^{-5}$
- $m_\chi = 3$ keV ; $\xi = 3.6 \times 10^{-5}$
- $m_\chi = 5$ keV ; $\xi = 6.9 \times 10^{-5}$
- $m_\chi = 10$ keV ; $\xi = 3.0 \times 10^{-4}$

Q in ergs/g.sec and T in K

$$\xi = \frac{e_\chi}{e}$$ ⟵ dark charge

A. H. Córsico, et al., Mon. Not. R. Astron. Soc. **424** 2792, (2012) [arXiv:1205.6180] :

they find $m_a \cos^2 \beta = 17.4^{+2.3}_{-2.7}$ meV,   Estimate of the axion mass from energy loss