

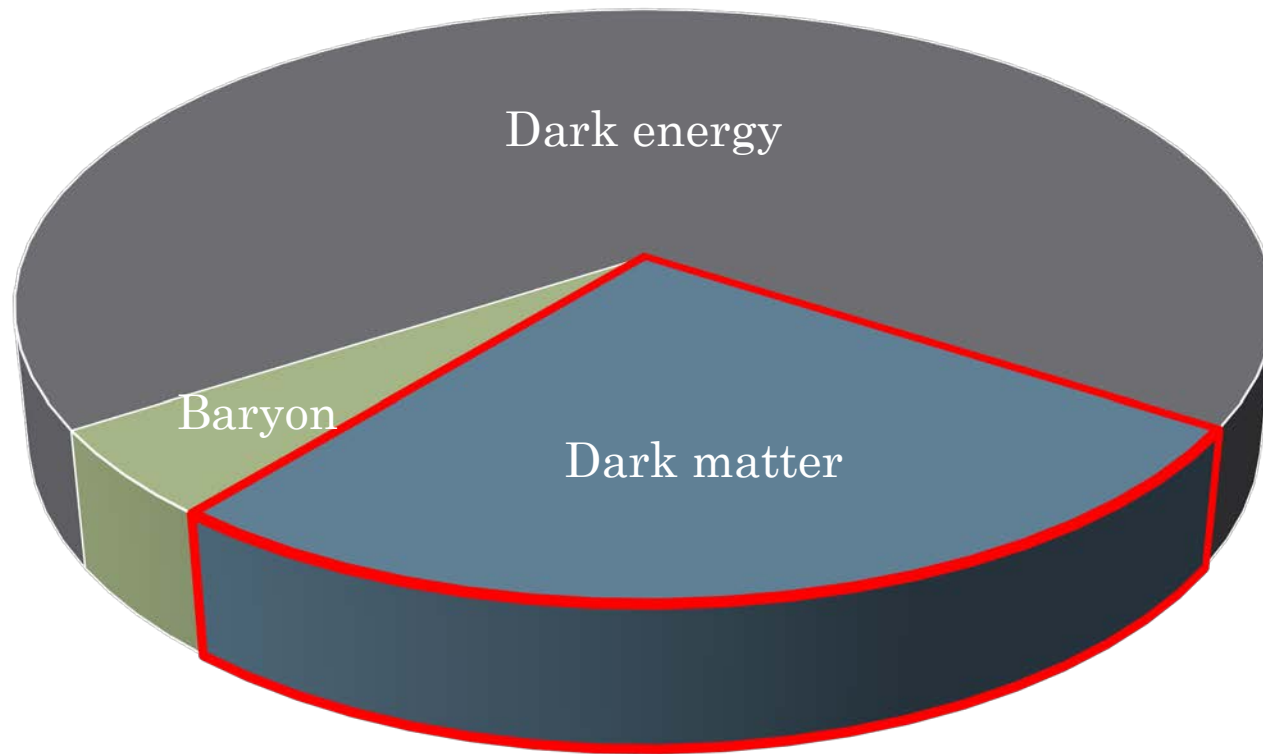
Asymmetric Dark Matter and an Anti- ν signal

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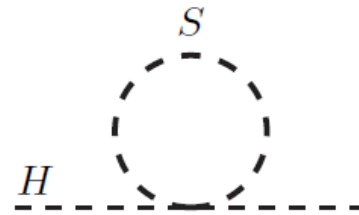
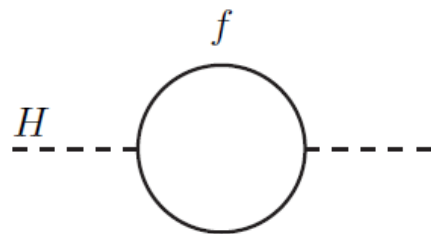
arXiv:1411.4014, Phys. Rev. D **92**, 013008



A Rigid “New Physics”

Is WIMP sufficient?

- New physics must be at $\mathcal{O}(v)$!



- Can we sincerely believe it?

Asymmetric DM (ADM)

$$\rho_{\text{DM}} \sim 5\rho_{\text{baryon}}$$

Can we use any symmetry?

 DM with $B - L$

Basic properties of ADM

- Mass around GeV
- B-L sharing with the SM

$$\Delta\mathcal{L}_{\text{ADM}} \sim \frac{\mathcal{O}_{\text{ADM}}^n \mathcal{O}_{\text{SM}}^m}{\Lambda_{\text{ADM}}^{n+m-4}}$$

- Conserving the total B-L
 - SM singlet
- ...Not constraining at all

	WIMP	ADM
Mass	EWSB	(1-10) GeV
Relic abundance	WIMP miracle	B-L asymmetry
Interaction	$SU(2)_L$, etc.	B-L share Annihilation
Detection	Collider DD ID	model dependent

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Really?

Assumption

- Use chem. equilibrium to share B-L
 - $n_B \sim n_{DM}$ w/o tuning

What can be signal ?

- Let's try!

B-L
sharing
interaction

$$\Delta\mathcal{L}_{\text{ADM}} \sim \frac{\mathcal{O}_{\text{ADM}}^n \mathcal{O}_{\text{SM}}^m}{\Lambda_{\text{ADM}}^{n+m-4}}$$

Y neutral
B-L charged

$$\mathcal{O}_{\text{SM}}^m = LH \Rightarrow \mathcal{O}_{\text{SM}}^m \sim \nu$$

$$\mathcal{O}_{\text{SM}}^m = UDD \Rightarrow \mathcal{O}_{\text{SM}}^m \sim n \rightarrow \bar{\nu}ep$$

- ν signal at indirect detection

neutrino and ADM

- Decay or scattering **always** lead **(anti)neutrino signal!**

$$\Delta\mathcal{L}_{\text{ADM}} \sim \frac{\mathcal{O}_{\text{ADM}}^n \mathcal{O}_{\text{SM}}^m}{\Lambda_{\text{ADM}}^{n+m-4}}$$

	e	p	ν
B-L	-1	1	-1
Q_{EM}	-1	1	0

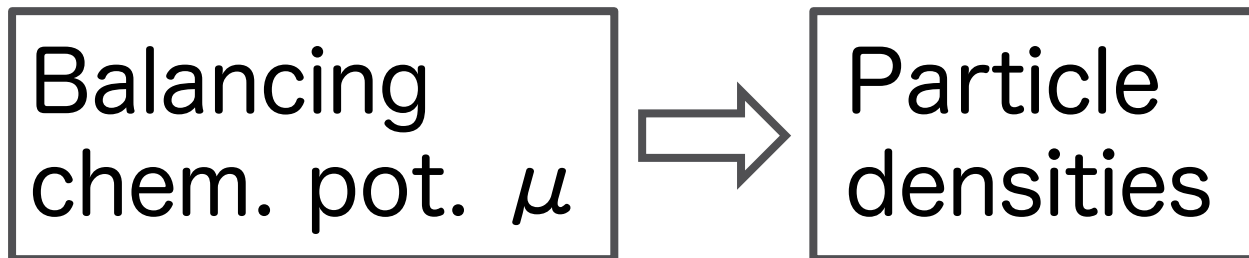
$Q_{\text{EM}}=0$ and $B-L \neq 0$
 \Rightarrow only ν

Particle or Antiparticle?

- Is signal ν or anti- ν ?

||

- Is $(B-L)_{ADM}$ positive or negative?
- This seems to depend on $\Delta\mathcal{L}_{ADM}$



Earlier study

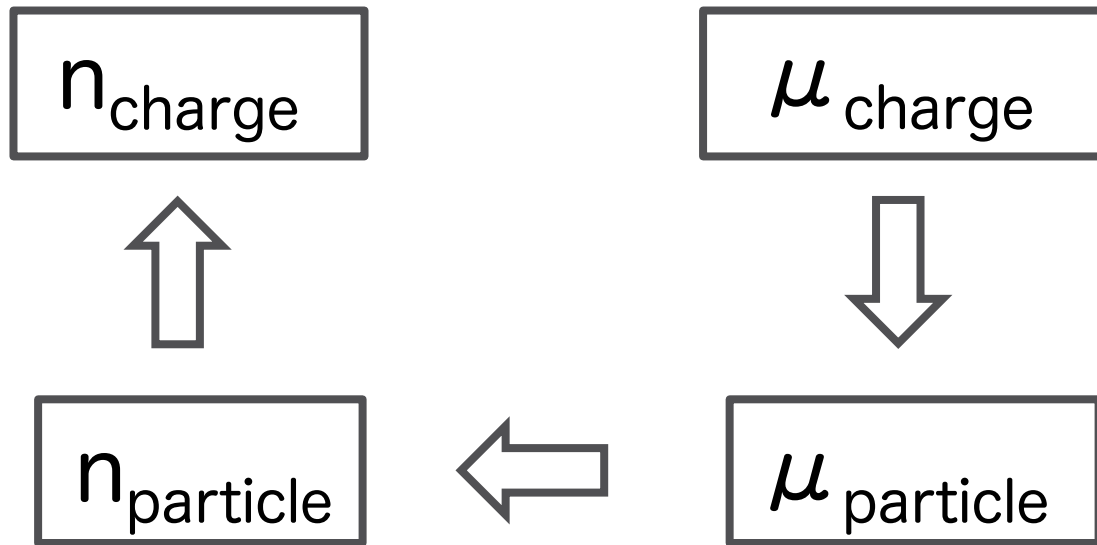
- DM mass is independent of $\Delta\mathcal{L}_{\text{ADM}}$
 - with a DM-only hidden sector

Ibe, Matsumoto and Yanagida 2012

$$m \sim 5.1/Q_{\text{DM}} \text{ GeV}$$

- $(B-L)_{\text{ADM}}$ is positive
- Complicated hidden sectors?

Symmetry and charge



- No relation depends on $\Delta\mathcal{L}_{\text{ADM}}$
- n_{particle} can be written in n_{charge}

Then...?

- $(B-L)_{ADM}$ is always positive
- **Always anti- ν signal!**
 - Indirect detection is possible

Summary

- ADM is a hopeful DM model
- We predict a generic signal
 - **Anti- ν signal** is important
 - Hyper-K, INO, ...etc.