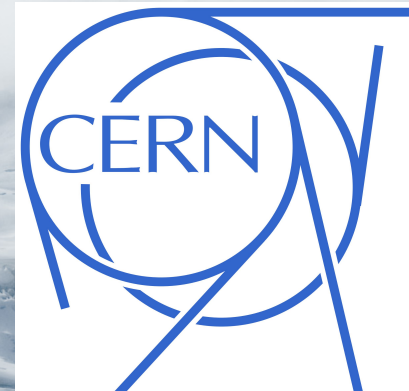


Current Research Interests

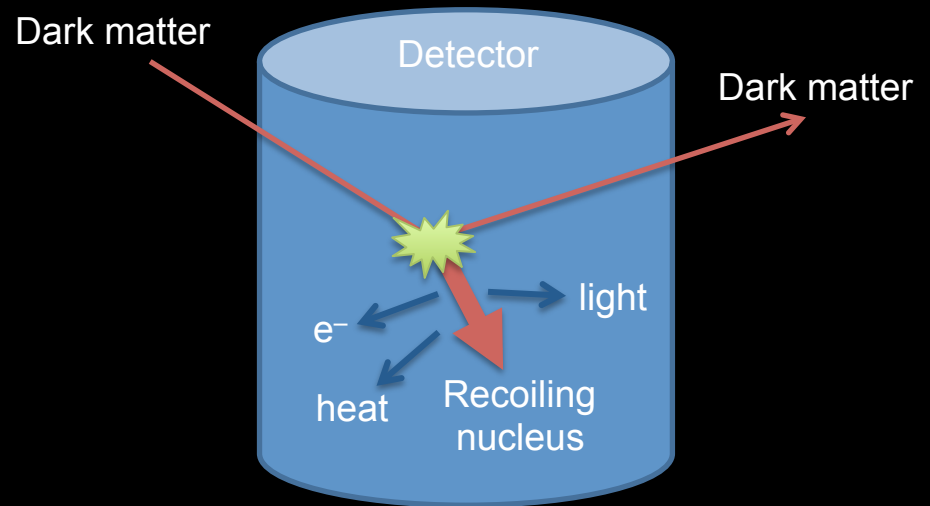
Kai Schmidt-Hoberg
November 8, 2013



Dark matter

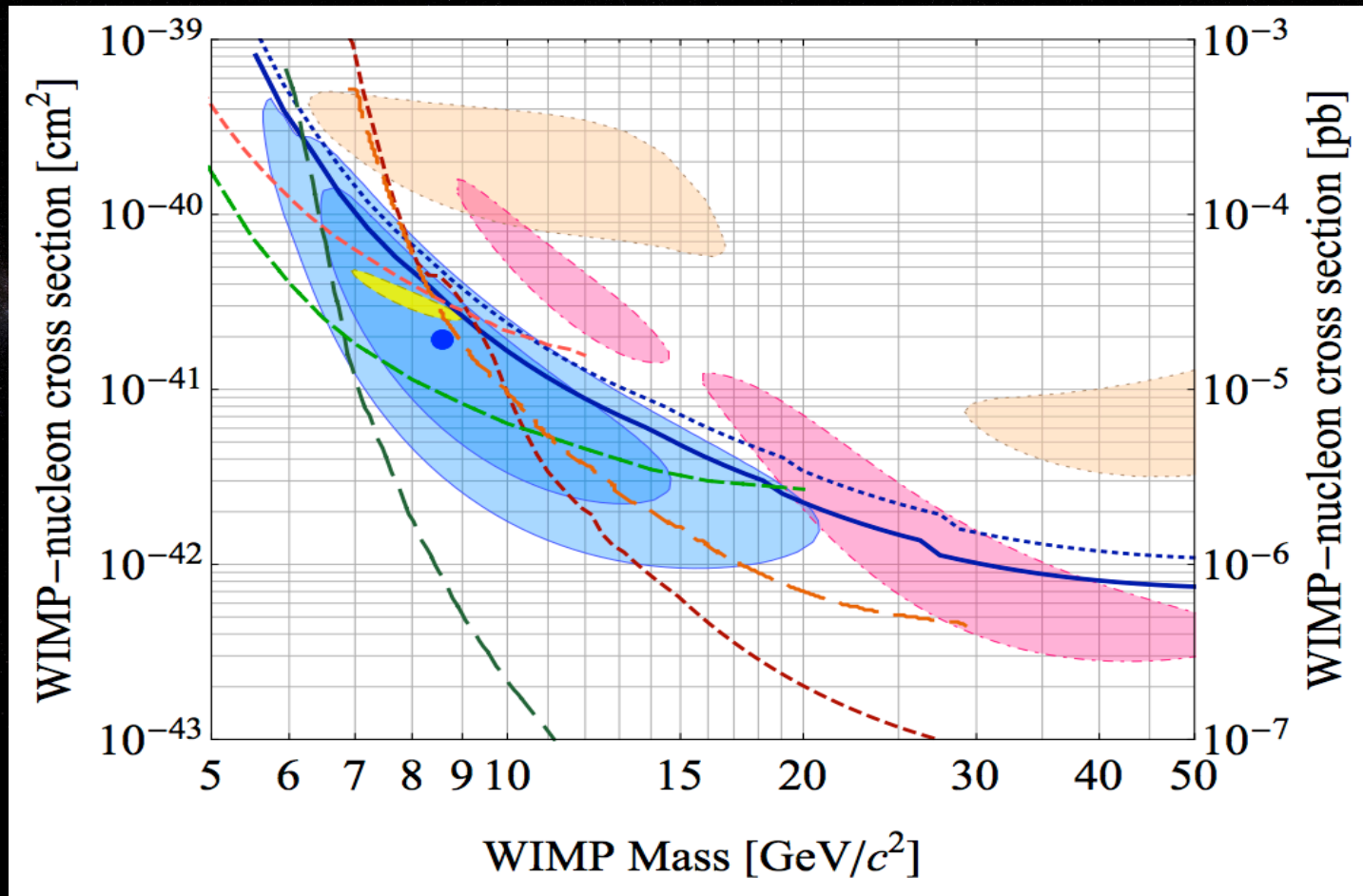
direct detection

Dark matter particles from the Galactic halo that pass through the Earth will occasionally **scatter off nuclei**. The resulting **recoil energy** of the nucleus can be measured in **dedicated low background detectors**.

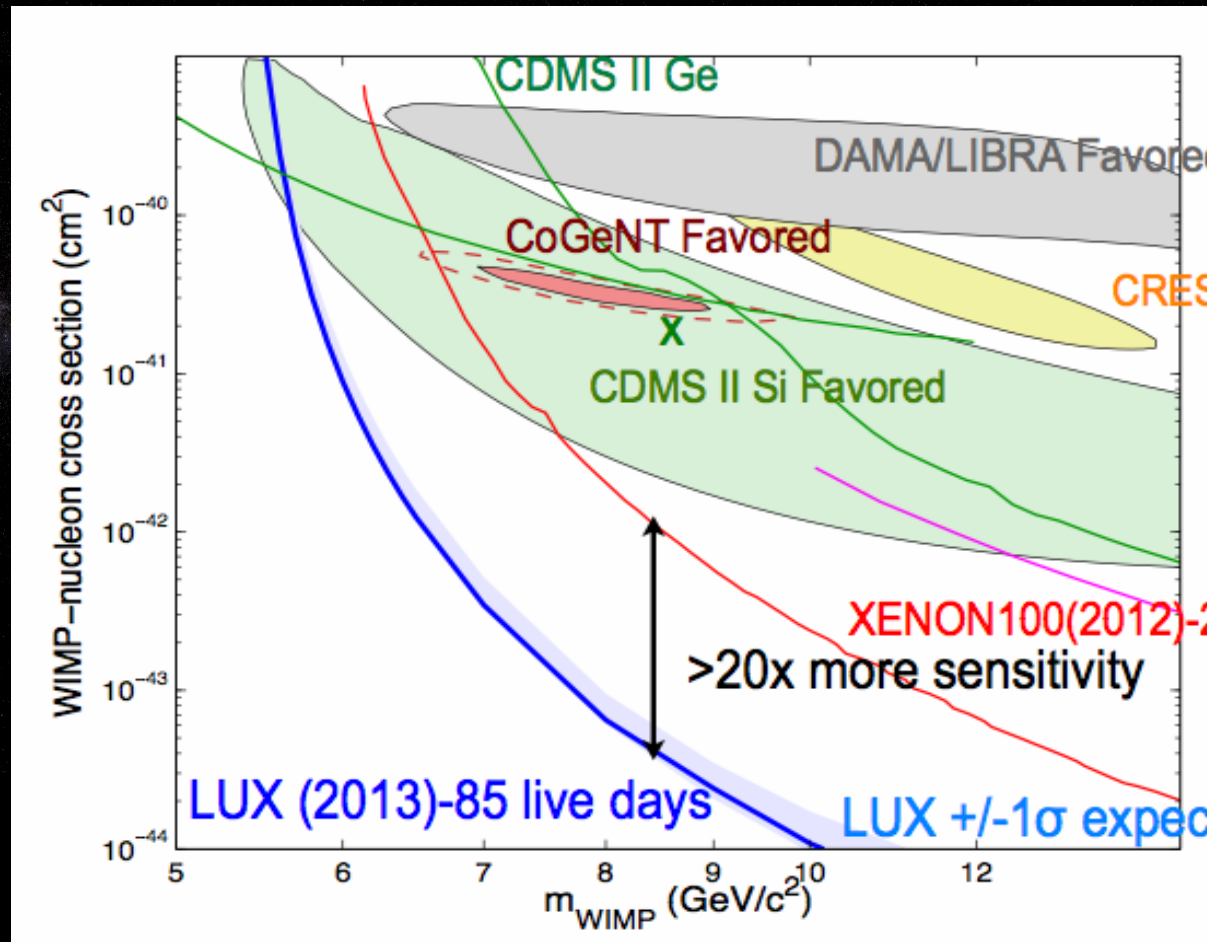


Overall consistency?

The standard picture...



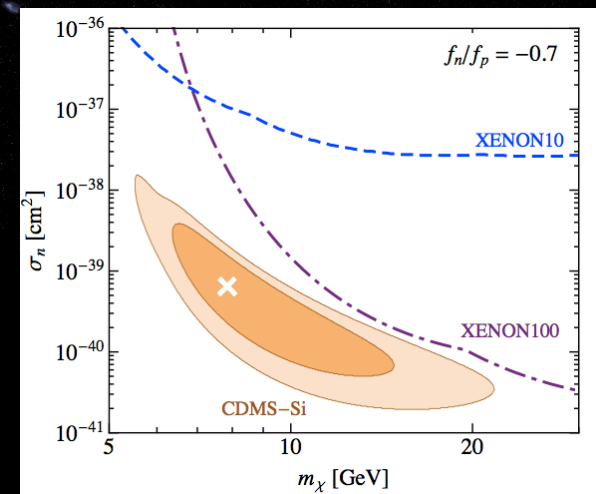
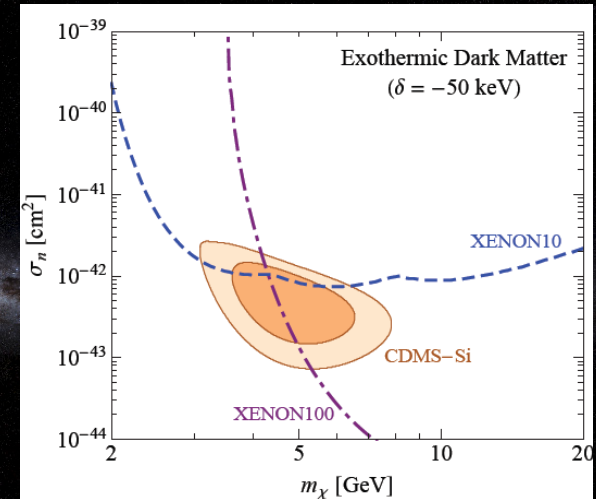
Bad news for LDM aficionados



Possible ways out?

- Astrophysics can't help - to reduce the tension between XENON based and CDMS-Si, we need to **modify particle physics** in order to suppress scattering for heavy targets.

- **Exothermic dark matter:** In collision, dark matter particles make a transition from a metastable heavier to a lighter state and release a small amount of energy (about 50 keV).
- **Isospin-dependent couplings:** Partial destructive interference between protons and neutrons suppresses targets with large ratio A/Z .
- **Something better?**



Singlet extensions of the MSSM

- ▶ MSSM plus extra singlet S

Nice feature:

Additional tree-level contribution to Higgs mass:

$$M_Z^2 \cos^2(2\beta) + \lambda^2 v^2 \sin^2(2\beta) + \text{radiative corrections}$$

- ▶ Standard symmetry for the NMSSM: global $\mathbb{Z}_3 + R$ parity

$$\mathcal{W}_{\text{NMSSM}} = \mathcal{W}_{\text{MSSM}}^{\mu=0} + \lambda S H_u H_d + \frac{1}{3} \kappa S^3$$

- ▶ Original motivation: Solve the μ problem: $\mu_{\text{eff}} = \lambda \langle S \rangle$

Singlet extensions of the MSSM

- ▶ MSSM plus extra singlet S

Nice feature:

Additional tree-level contribution to Higgs mass:

$$M_Z^2 \cos^2(2\beta) + \lambda^2 v^2 \sin^2(2\beta) + \text{radiative corrections}$$

- ▶ Standard symmetry for the NMSSM: global $\mathbb{Z}_3 + R$ parity

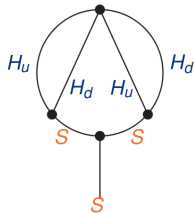
$$\mathcal{W}_{\text{NMSSM}} = \mathcal{W}_{\text{MSSM}}^{\mu=0} + \lambda S H_u H_d + \frac{1}{3} \kappa S^3$$

- ▶ Original motivation: Solve the μ problem: $\mu_{\text{eff}} = \lambda \langle S \rangle$

- ▶ domain wall problem Abel, Sarkar & White

- ▶ tadpole problem (e.g. from $(H_u H_d)^2$ operator) Abel

- ▶ need better symmetry!

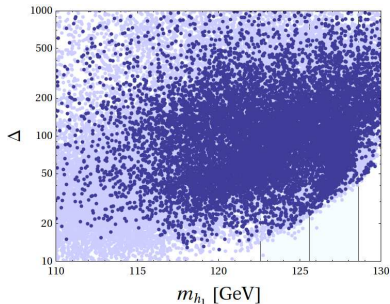


Fine-Tuning in the GNMSSM

Effective low-energy superpotential has additional terms

$$\mathcal{W}_{\text{GNMSSM}} = \mathcal{W}_{\text{NMSSM}} + \mu H_u H_d + \frac{1}{2} \mu_s S^2$$

- ▶ Implemented in 'state of the art' spectrum calculator
- ▶ Interesting from a fine tuning perspective



- ▶ SUSY not quite dead yet...