Detecting Non-Standard Neutrino Interactions from Solar Neutrinos in Low Threshold Dark Matter detectors

THE SENSITIVITY OF SKIPPER CCD DARK MATTER DETECTORS TO ELECTRON AND NUCLEAR RECOILS FROM NEW PHYSICS IN THE NEUTRINO SECTOR

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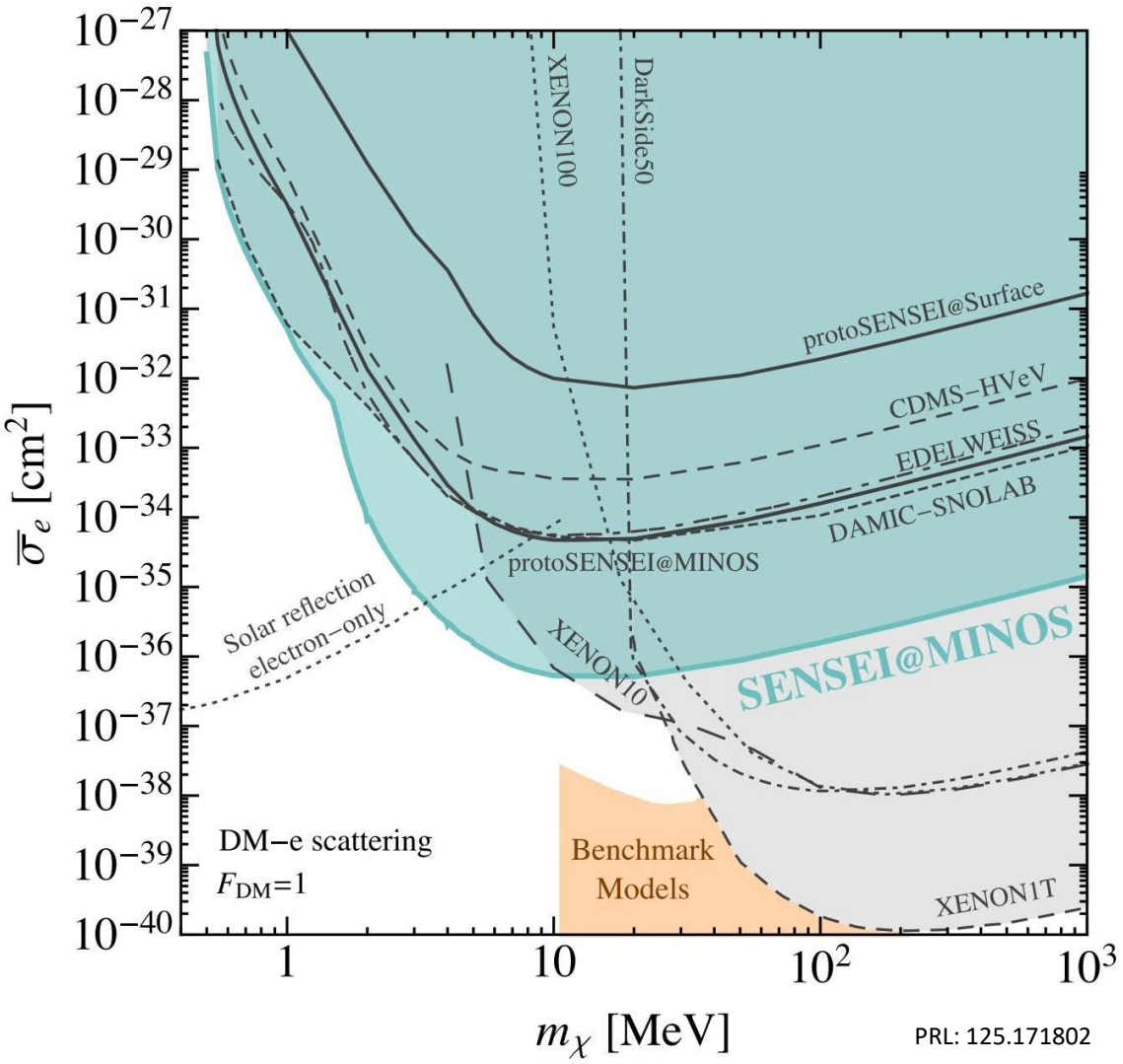
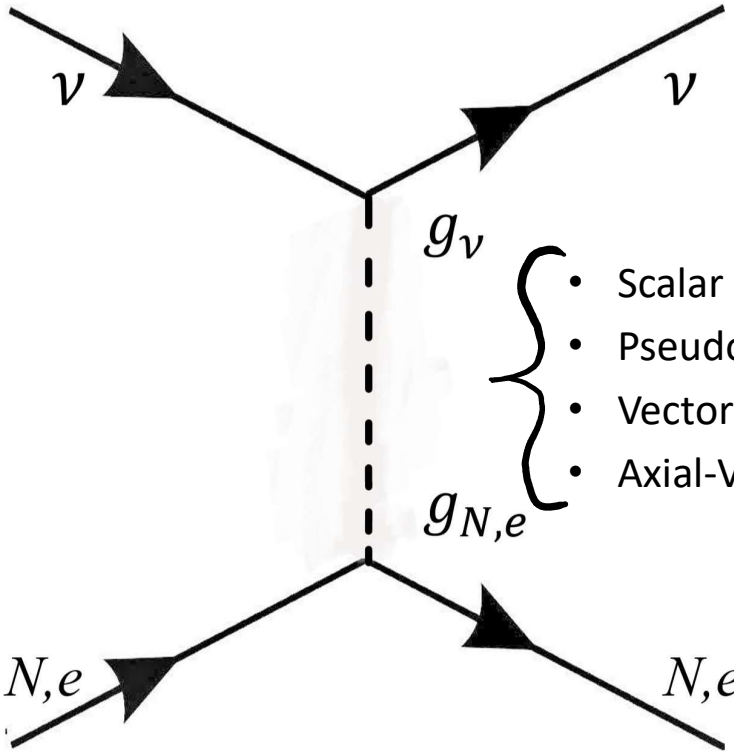
arXiv: 211x.xxxxx

A sample of the current state of the low-threshold DM experimental landscape



PRL: 125.171802

Non-Standard Interaction Models



- Scalar
- Pseudo-Scalar
- Vector
- Axial-Vector

$$\mathcal{L} \supset (g_{\nu,\phi}\phi\bar{\nu}_R\nu_L + h.c.)$$

$$+g_{\nu,Z'}\bar{\nu}_L\gamma^\mu\nu_L Z'_\mu$$

$$+g_{e,i}\bar{e}\mathcal{O}_i e + g_{q,i}\bar{q}\mathcal{O}_i q$$

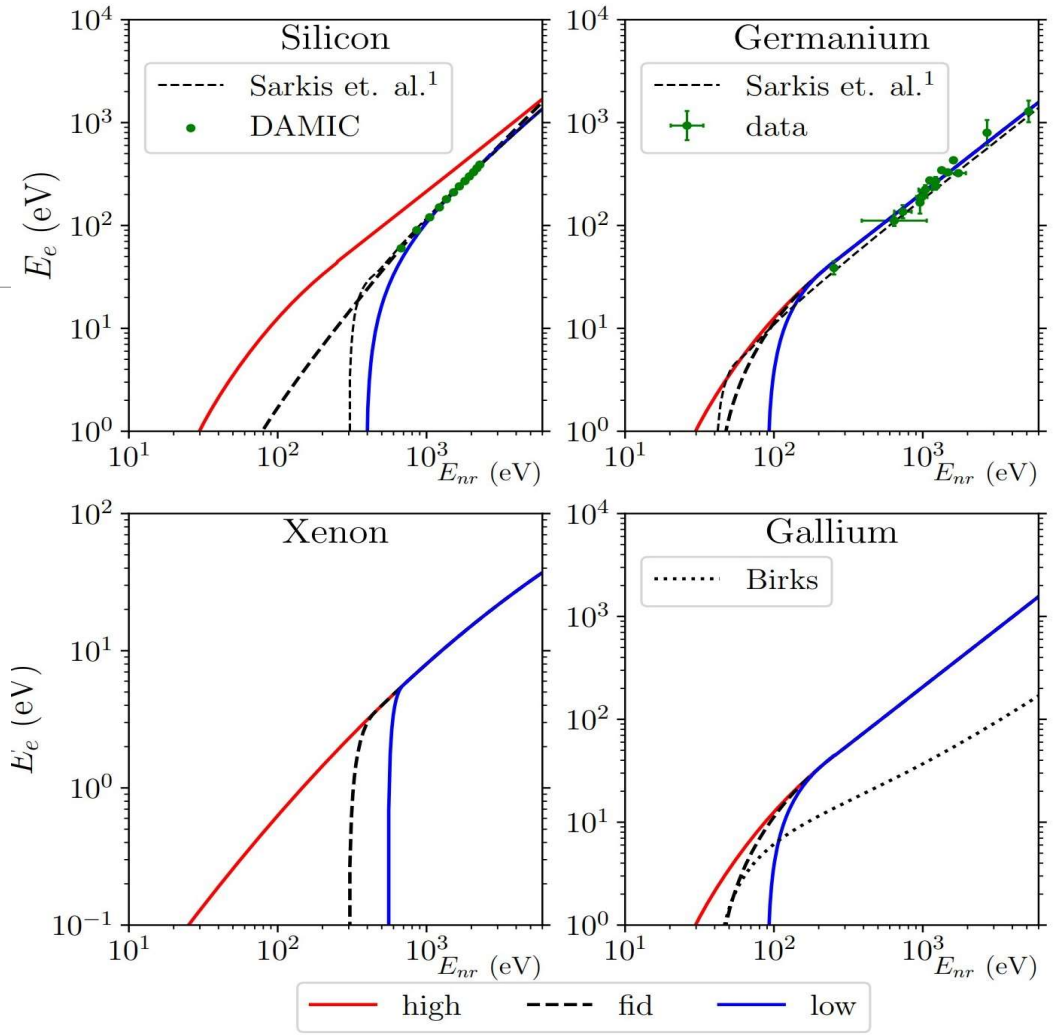
Yield Functions
(Quenching factor)

Lindhard model assumes high energy (not well measured below ~keV)

Consider a wide range of functions based on different cut-off energies

Requires a higher minimum energy to produce a signal

Signals suppressed by a material dependent factor



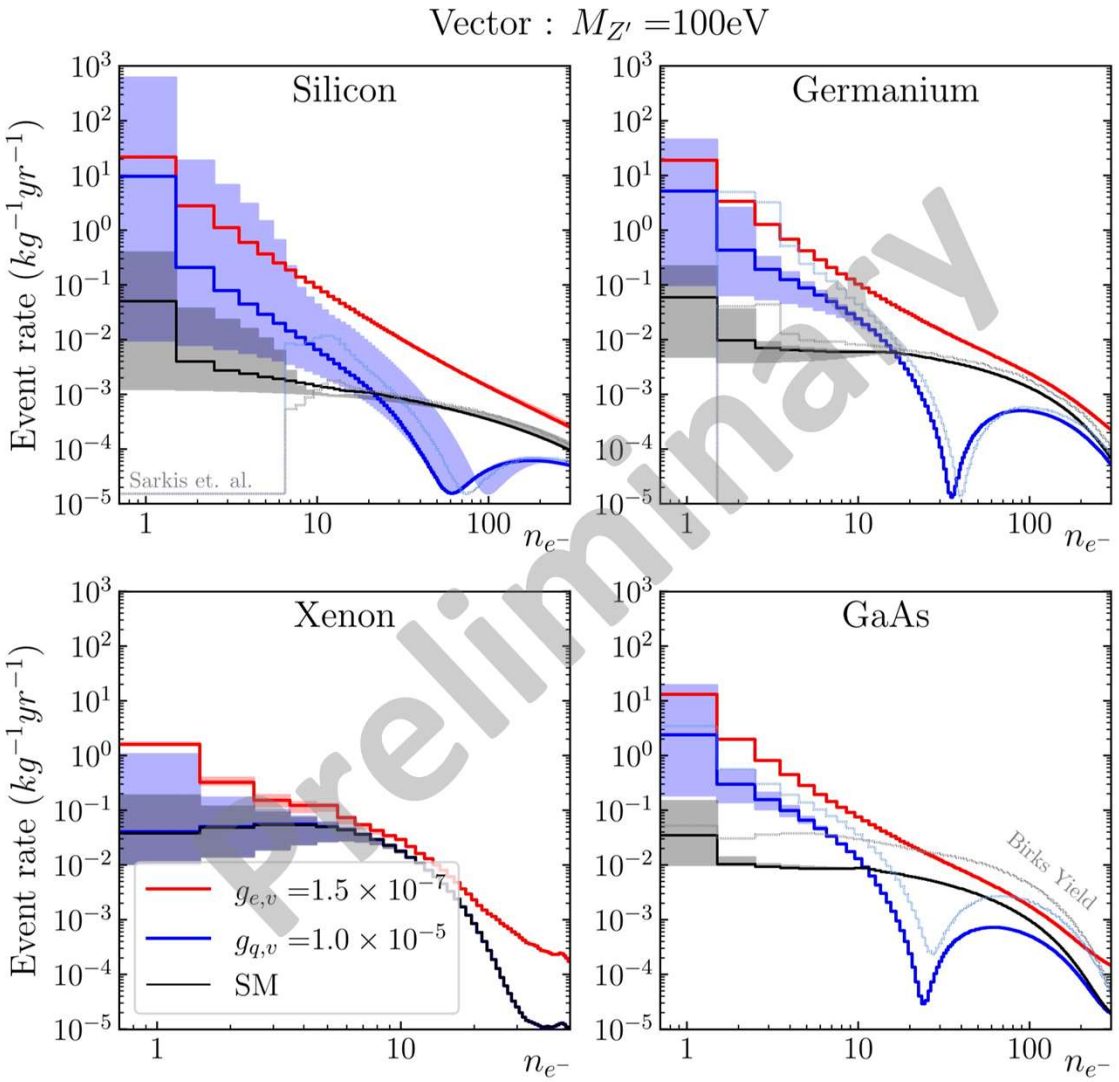
[1] Sarkis et. al. PRD.101.102001

Event Rates

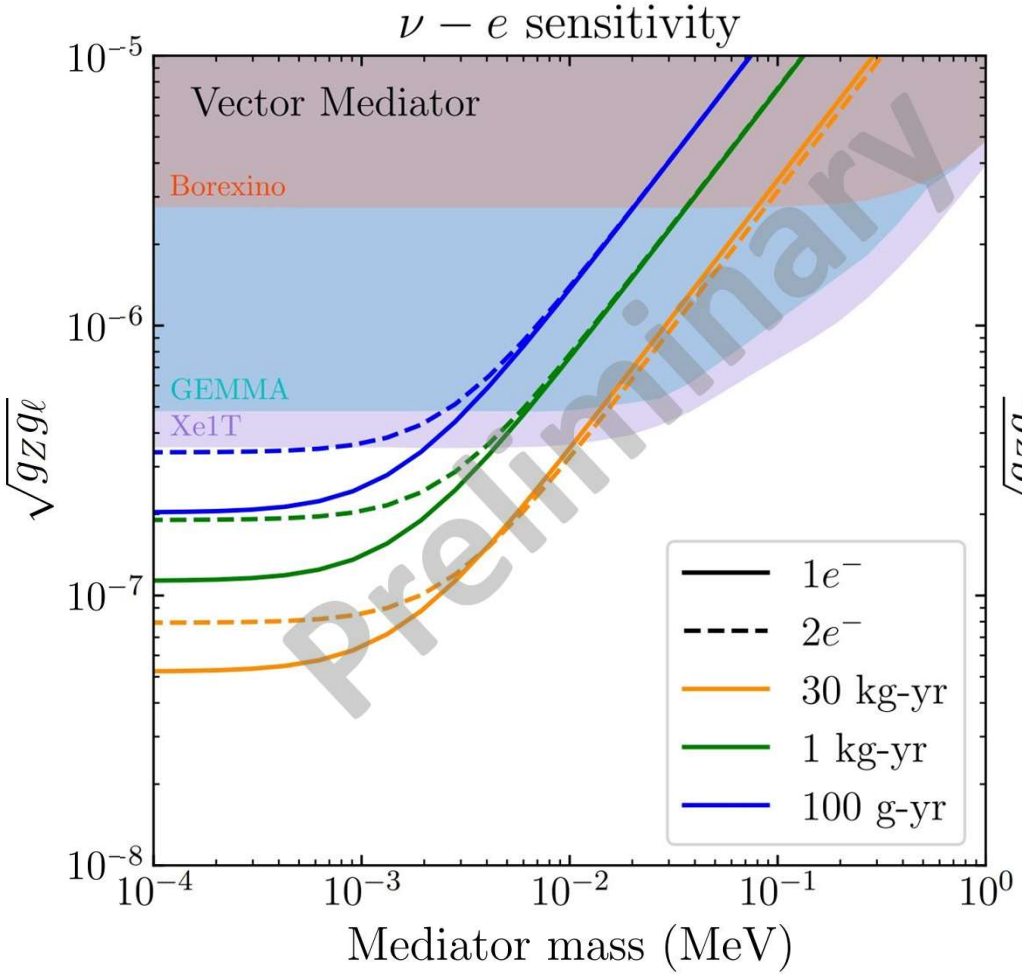
Amplified at low thresholds

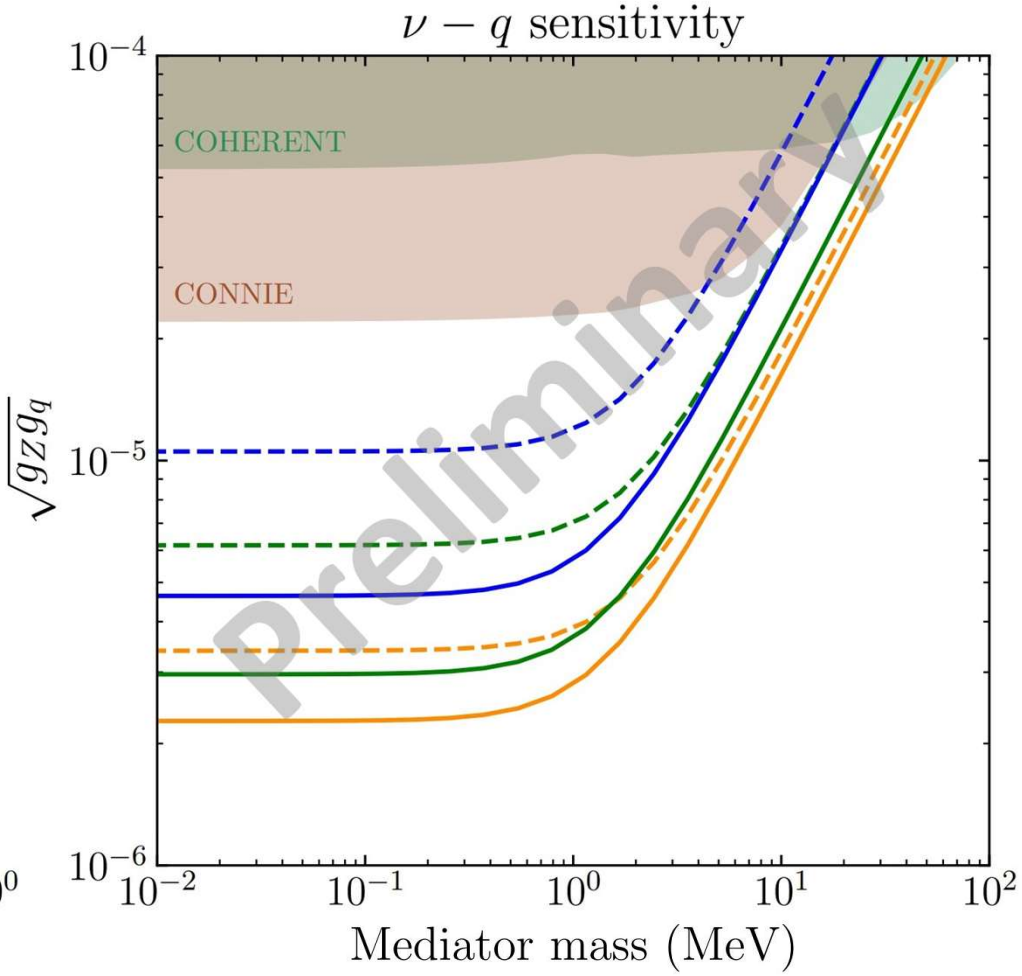
Well suited to DM direct detection

Nuclear recoil signals require a larger coupling

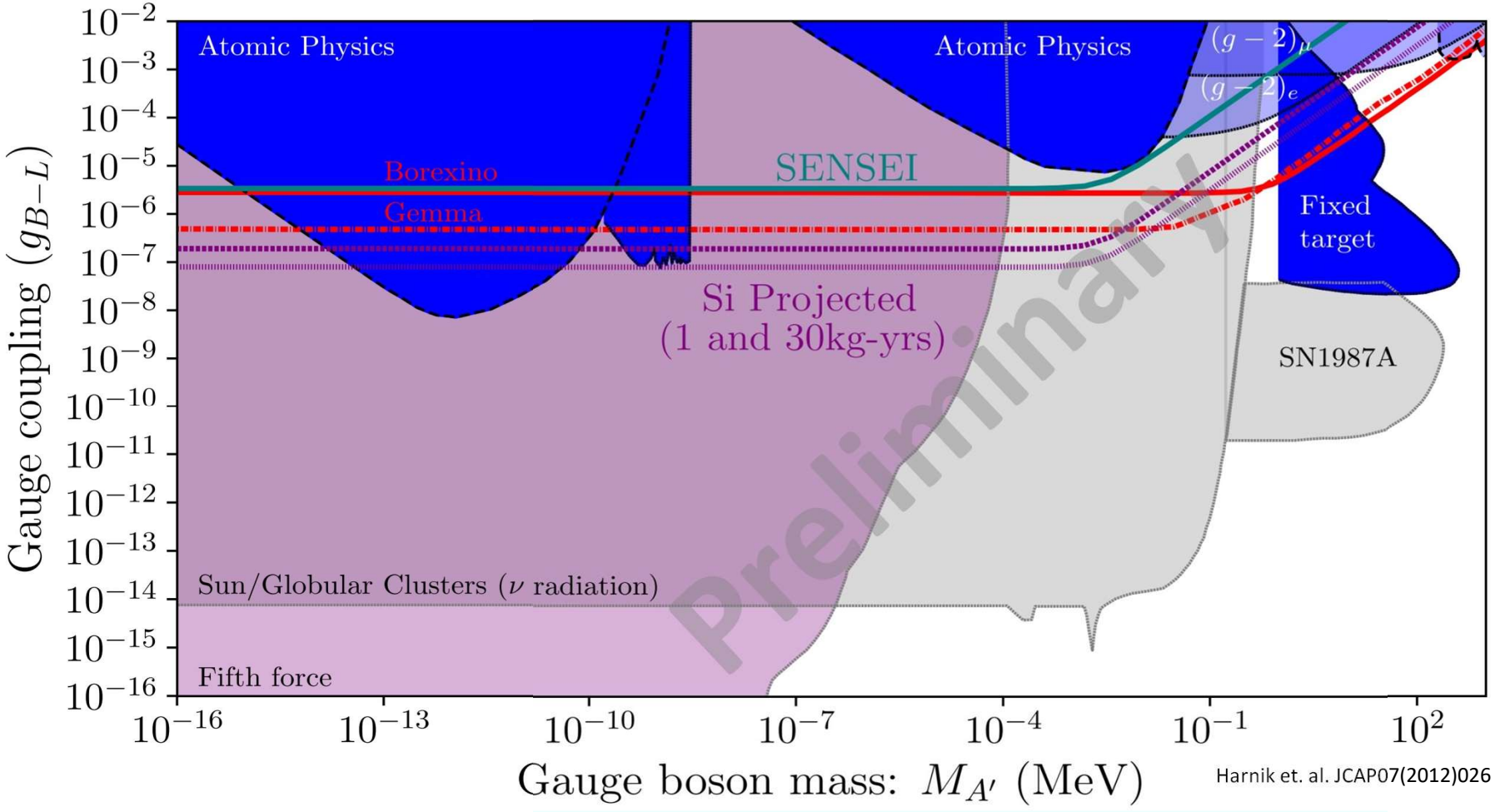


Detector Sensitivity





A specific UV model: Gauged B-L



Harnik et. al. JCAP07(2012)026

Summary

- Low threshold DM detectors are sensitive to NSI of solar neutrino scattering
- Sensitive to both electron and nuclear scattering
  - The latter is dependent on the yield function
- Near future experiments will be able to probe parameter space not constrained by existing direct detection experiments