Coherent Elastic Neutrino-Nucleus Scattering: Theoretical and experimental impact

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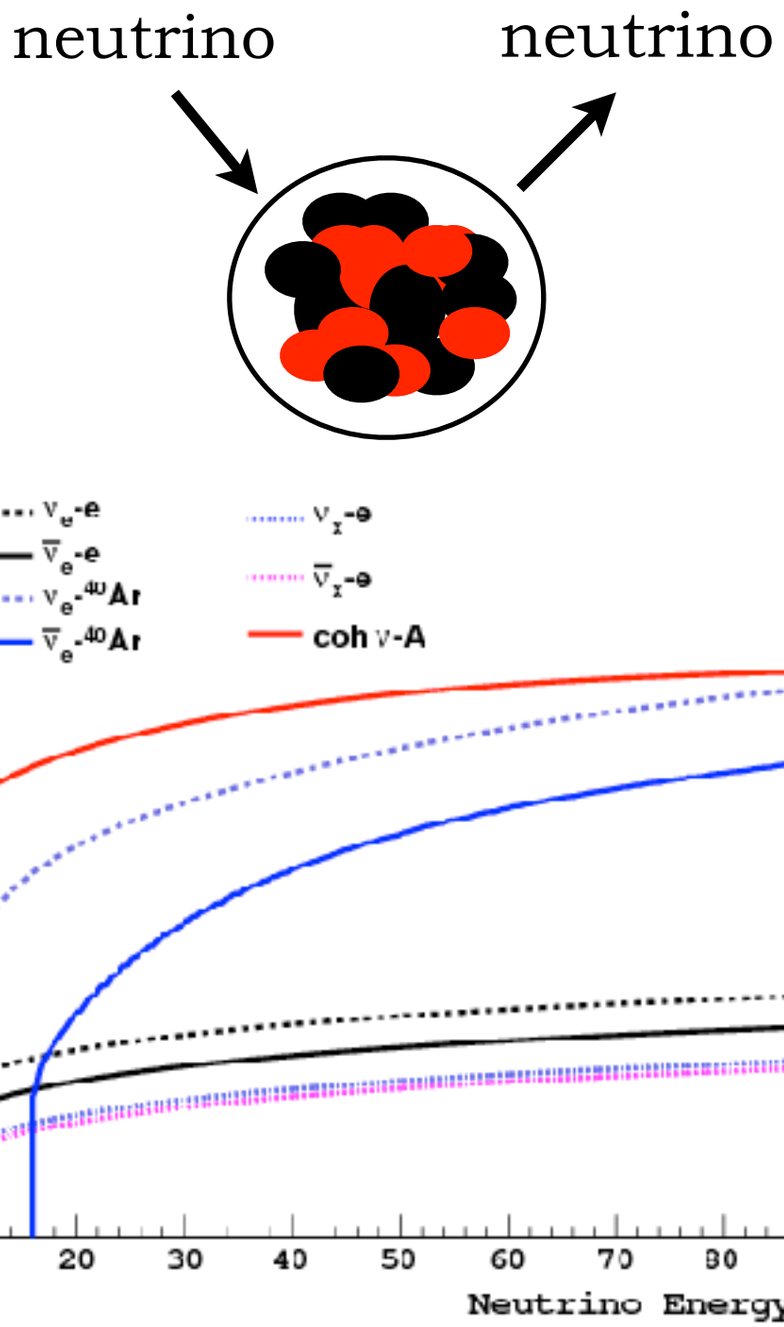
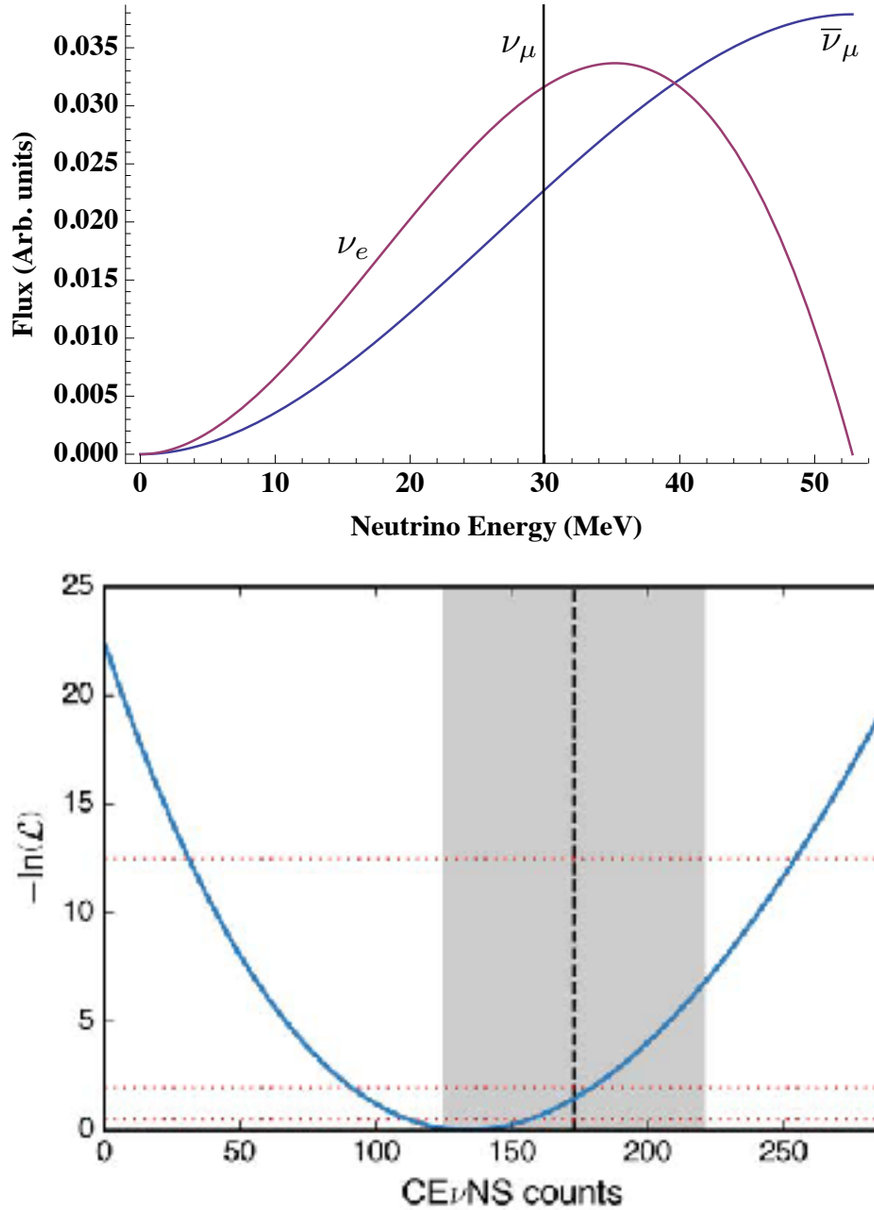
NF03 Workshop
September 17, 2020

Coherent elastic neutrino-nucleus scattering (CEvNS)



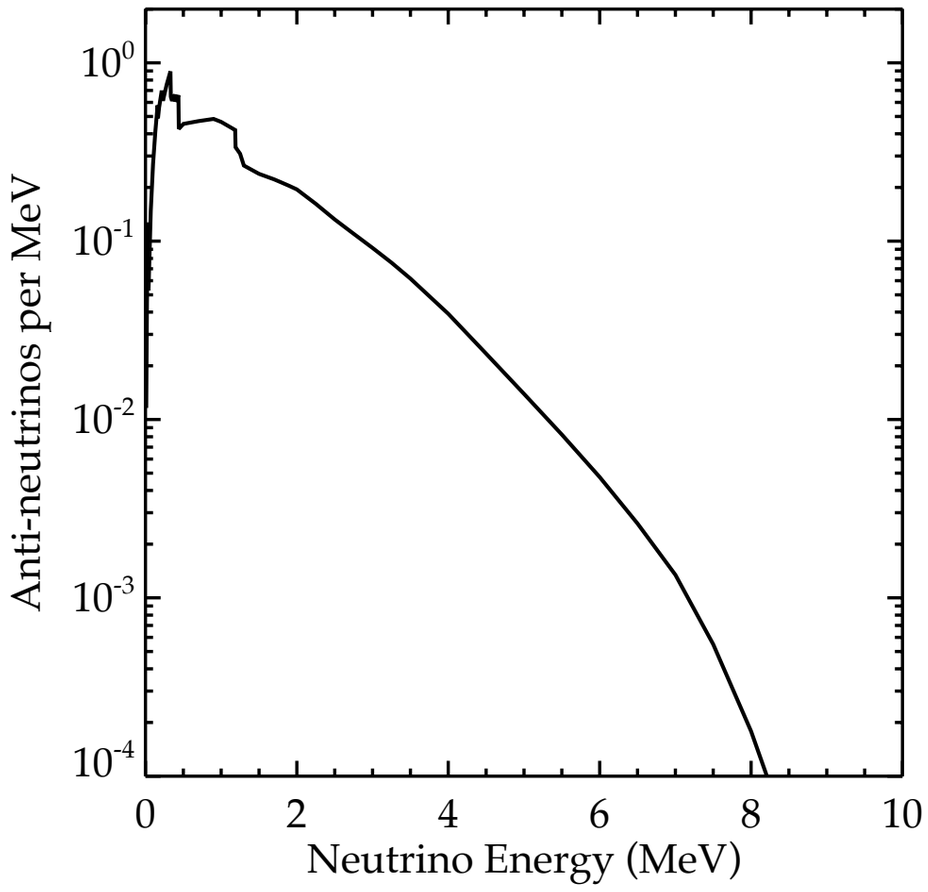
Brice et al, 1311.5958

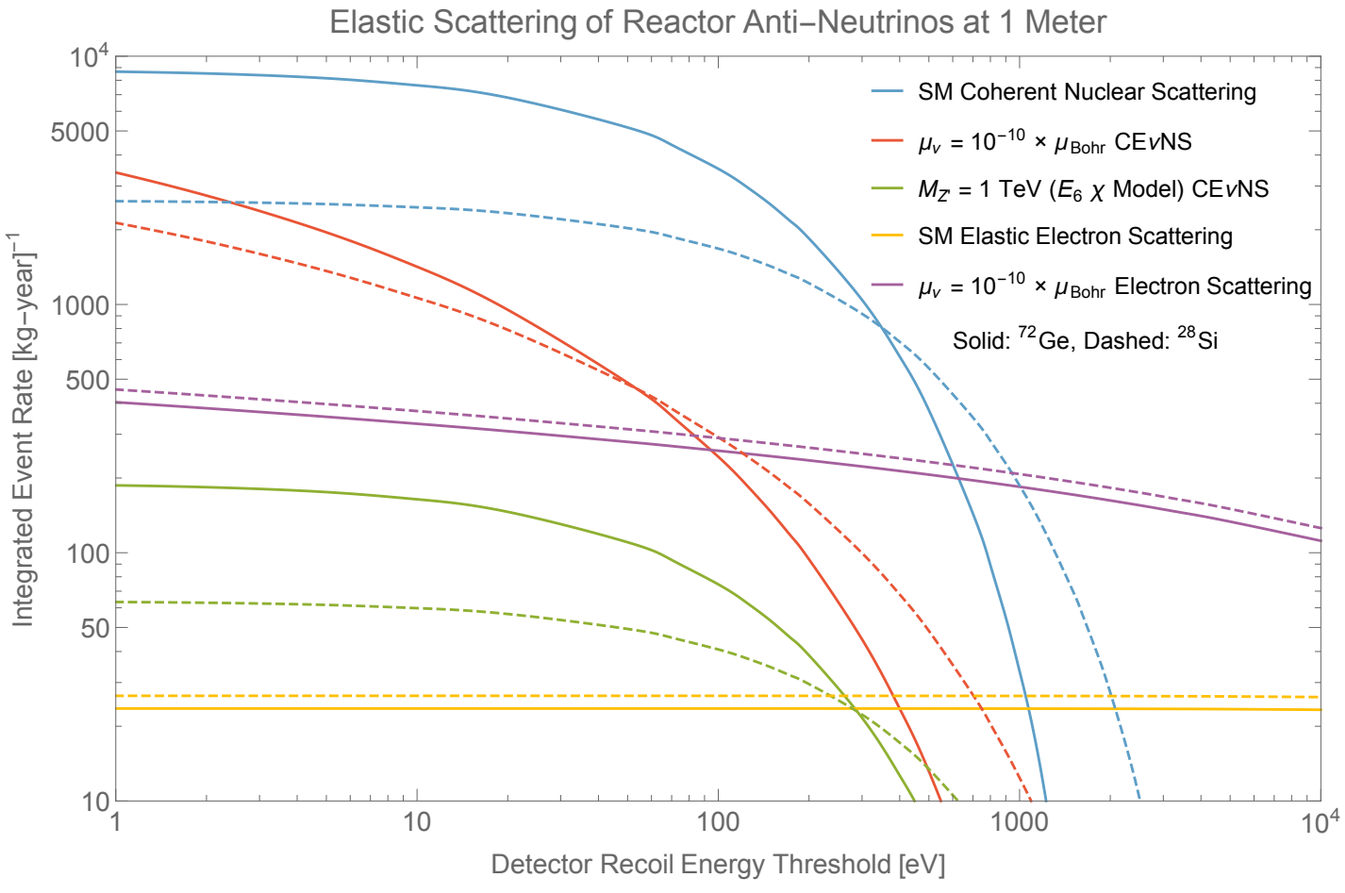


COHERENT detection papers:
CsI: 1801.05546
Argon: 2003.10630

CEvNS at nuclear reactors

CEvNS at reactors requires low backgrounds, and low threshold detectors



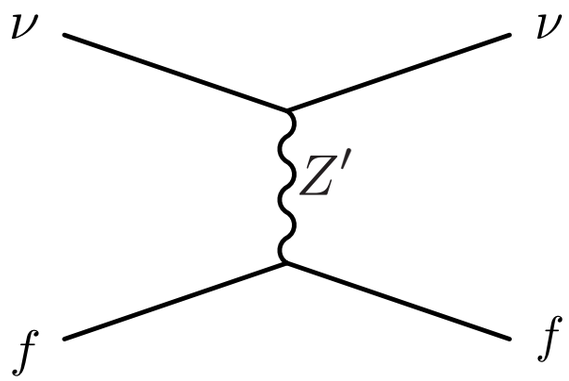


Dutta, Mahapatra, Strigari, Walker, 2015

Searches for new physics with CEvNS

Non-standard/generalized interactions

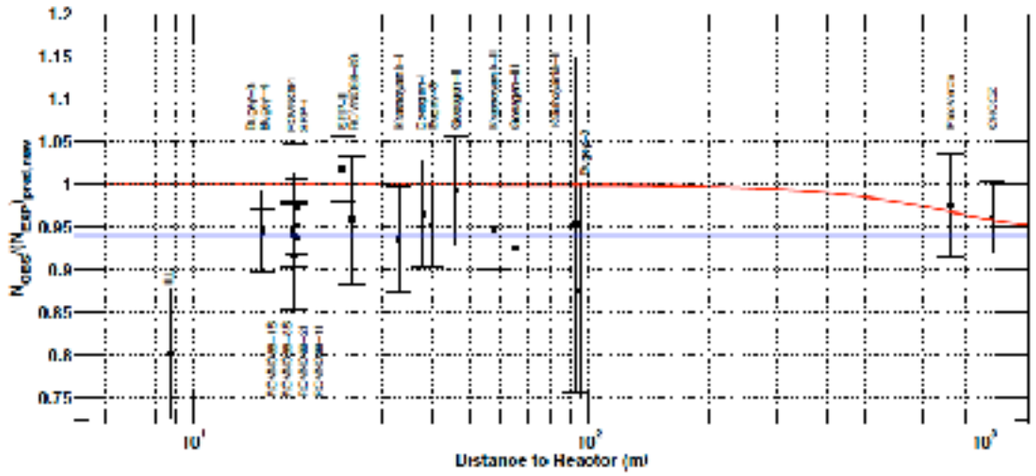
Scholberg 2005; Barranco 2005; Coloma et al. 2018; Liao & Marfatia 2017; Aristizabal-Sierra et al. 2018



Sterile neutrinos

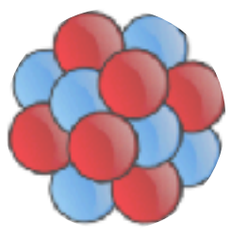
Anderson et al. 2010; Dutta et al. 2015; Kosmas et al. 2017, Blanco et al. 2019

Reactor, Gallium anomalies



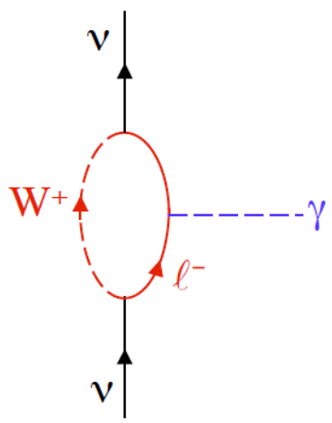
Nuclear form factors/charge radius

Patton et al. 2013; Cadeddu et al. 2018; Ciuffoli et al. 2018



Magnetic moment

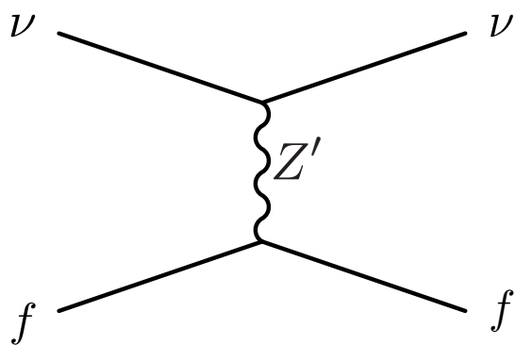
Vogel & Engel 1989



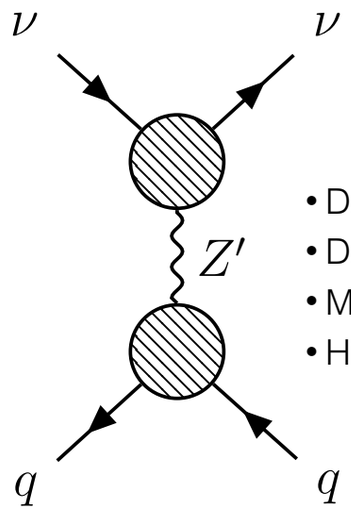
Non-standard neutrino interactions (NSI)

New physics searches facilities by both energy and timing distributions in COHERENT

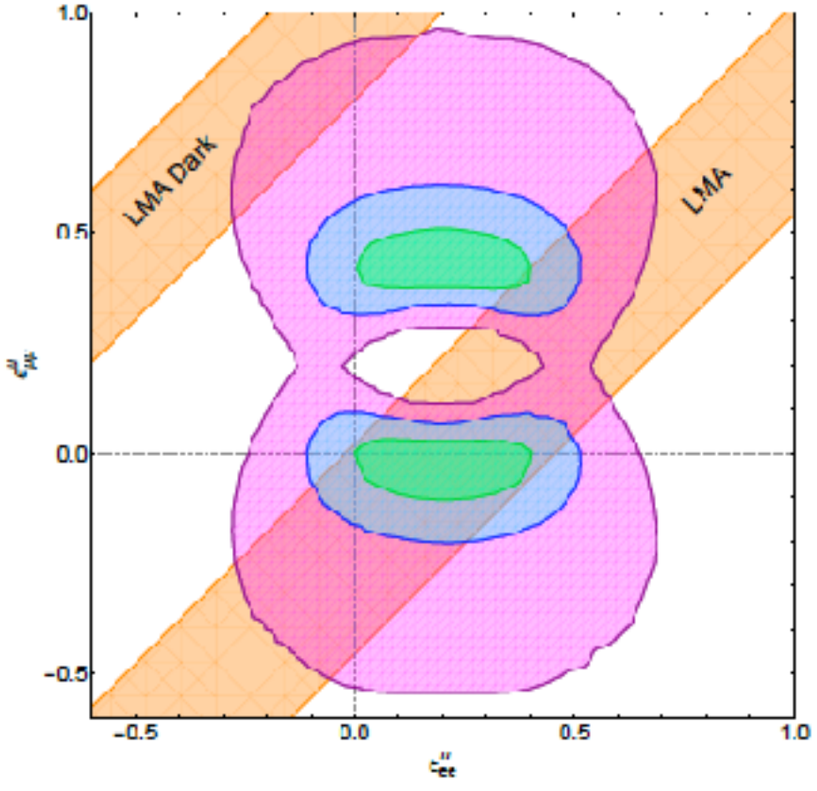
Dutta, Liao, Sinha, Strigari PRL 2019; Giunti PRD 2020



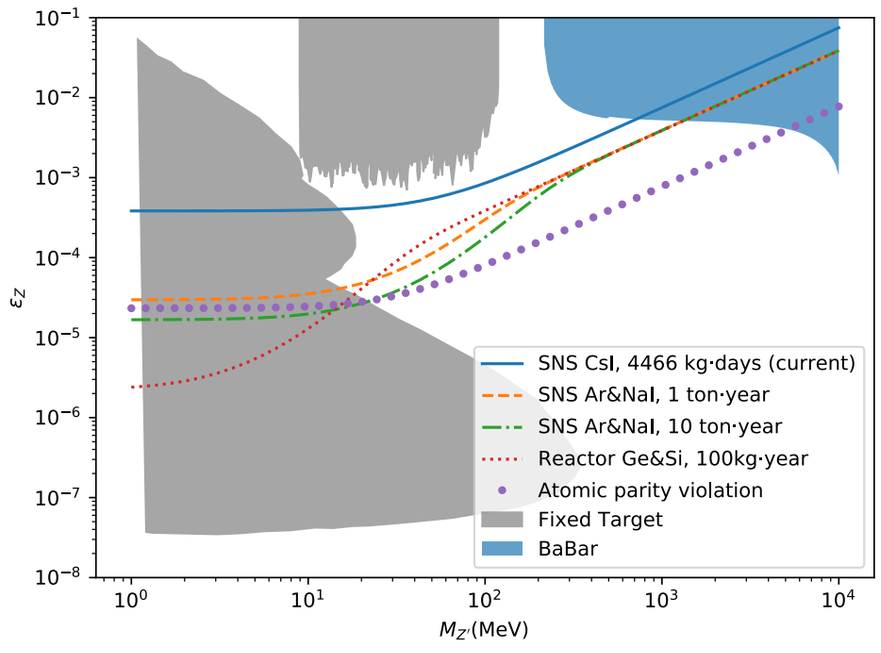
- Heavy mediators parameterized with EFT
- UV complete models can give large NSI
- Independent constraints from oscillation experiments



- Dark hypercharge gauge boson
- Dark Z boson
- Model with mu-tau flavor symmetry
- Hidden Sector Fermions

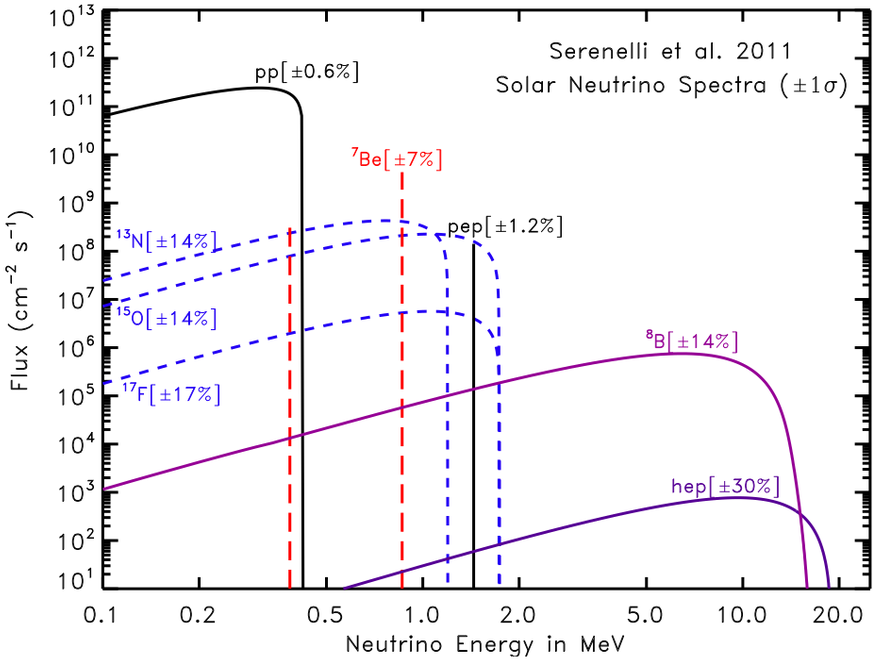


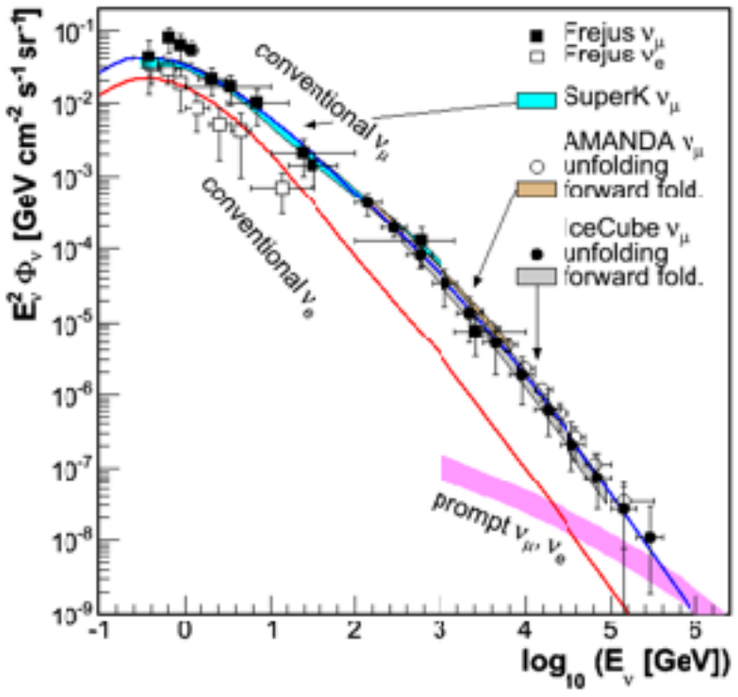
Coloma, Denton, Gonzalez-Garcia, Maltoni 2017; Denton, Farzan, Shoemaker 2018; Denton & Gehrlein 2020

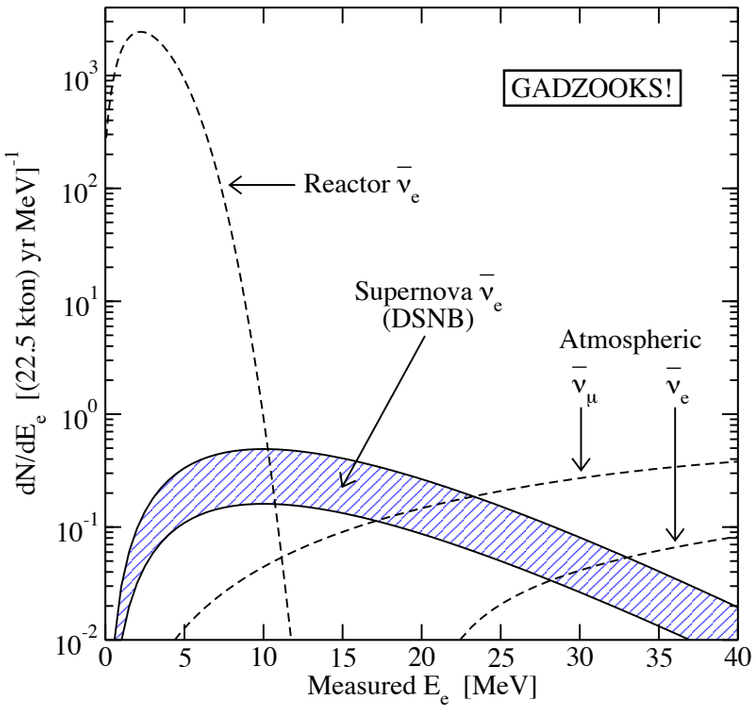


Lindner et al. 2017; Farzan et al. 2018; Abdullah et al. 2018, Brdar et al. 2018

CEvNS from astrophysical sources







Sun

Neutral current 8B energy spectrum

CEvNS + electron scattering evenets (Recent Xenon nT)

Atmosphere

Low energy (< 50 MeV) atmospheric neutrinos

Flux uncertainties, dependence on detector location

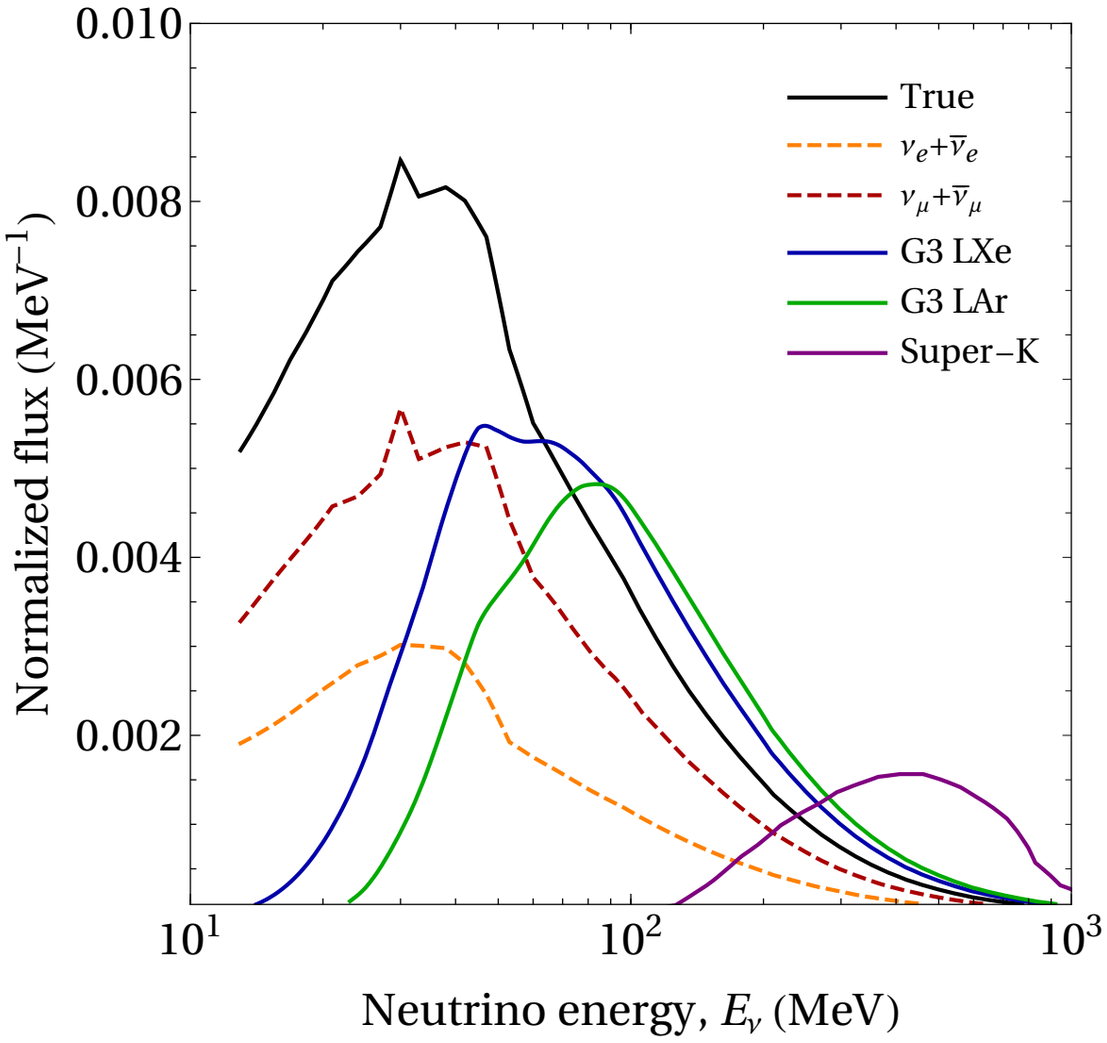
Neutral current interaction; nuclear cross section uncertainties

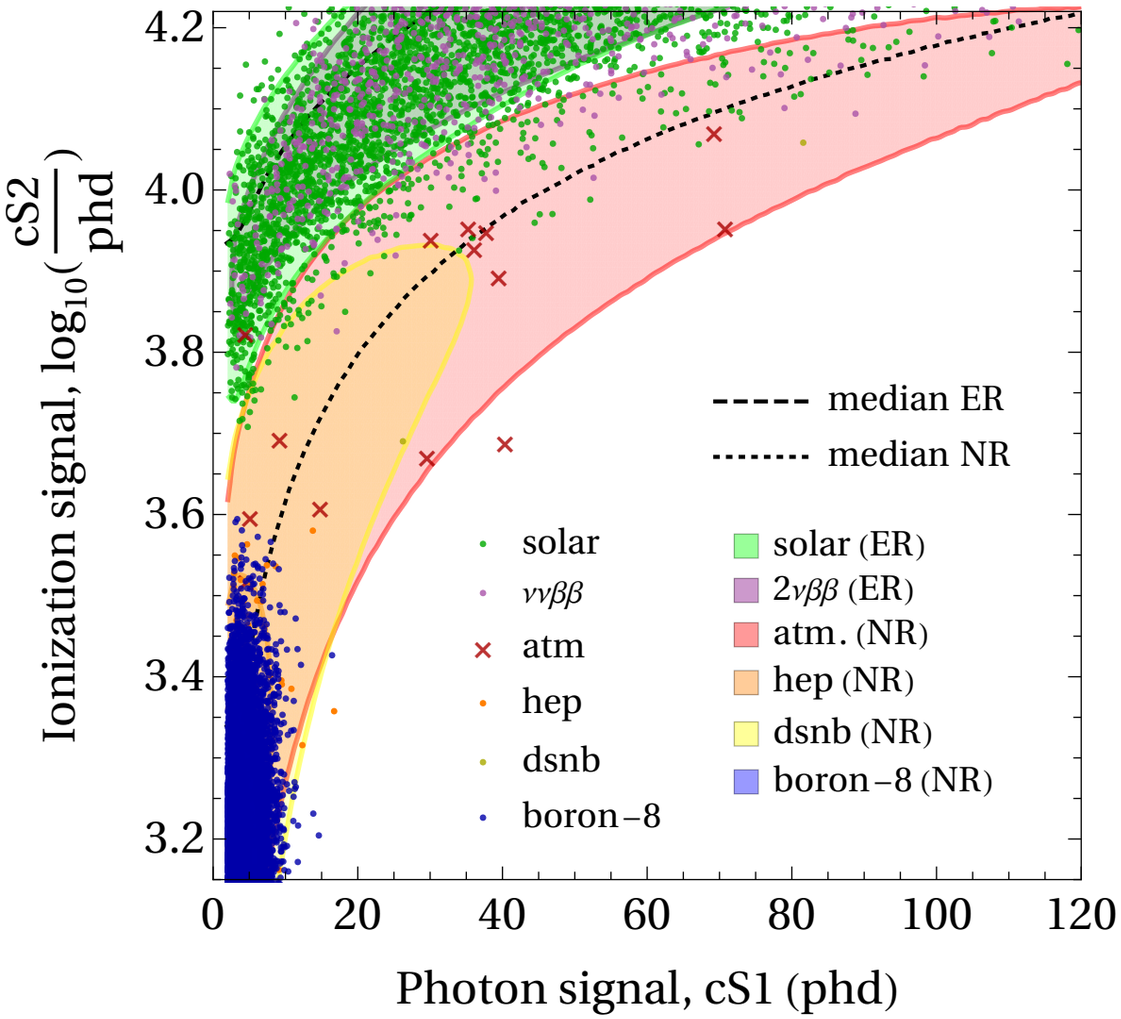
Supernovae

Neutral current sensitivity to all neutrino flavor components

Sensitivity to both Galactic supernova burst (Horiwitz et al. 2003; Lang et al. 2016) and diffuse supernova neutrino background (DSNB)

CEvNS with atmospheric neutrinos





Newstead, Lang, Strigari 2020

CEvNS community white-paper

Contributions/signatures welcome from all members of community

https://www.overleaf.com/2859619433mgdvwgrxqddt

CEνNS whitepaper

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