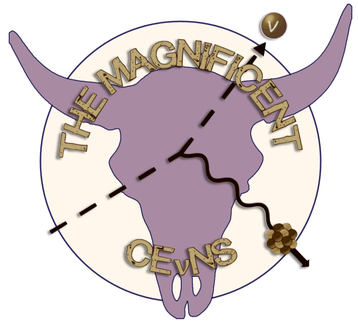


Bounds on new physics with data of the Dresden-II reactor experiment and COHERENT

– JHEP05(2022)037 –

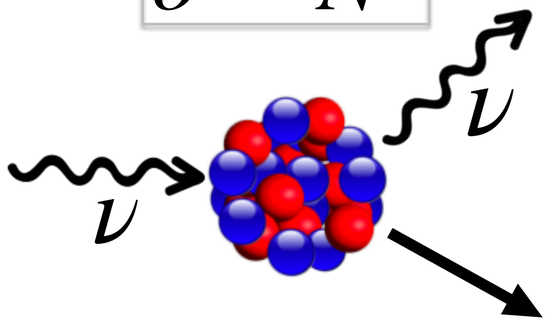
Leire Larizgoitia on behalf of
Pilar Coloma, Ivan Esteban, M.C. Gonzalez-Garcia, Francesc Monrabal, Sergio Palomares-Ruiz

Magnificent CEνNS, 12 June 2024

Coherent Elastic Neutrino-Nucleus Scattering

First Observation

$$\sigma \sim N^2$$



CEνNS

Need of a good combination of neutrino source & detector technology.

COHERENT experiment demonstrated CEνNS
- Science 357, 1123–1126 (2017) -

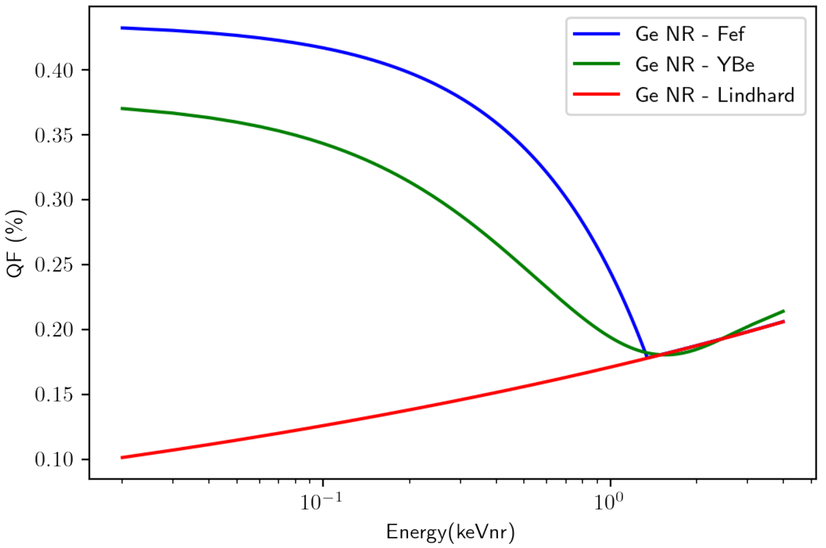
Source: The Spallation Neutron Source (SNS), at the Oak Ridge National Laboratory, USA.

Detector: A low-background 14.6 kg CsI[Na] scintillator.

The Dresden-II reactor experiment
- Phys. Rev. D 104 (2021) 072003 [2108.02880] -

Source: Boiling water reactor (BRW) at Grundy County, near Morris, Illinois, USA.

Detector: 2.924 kg ultra-low noise p-type point contact (PPC) Germanium detector.

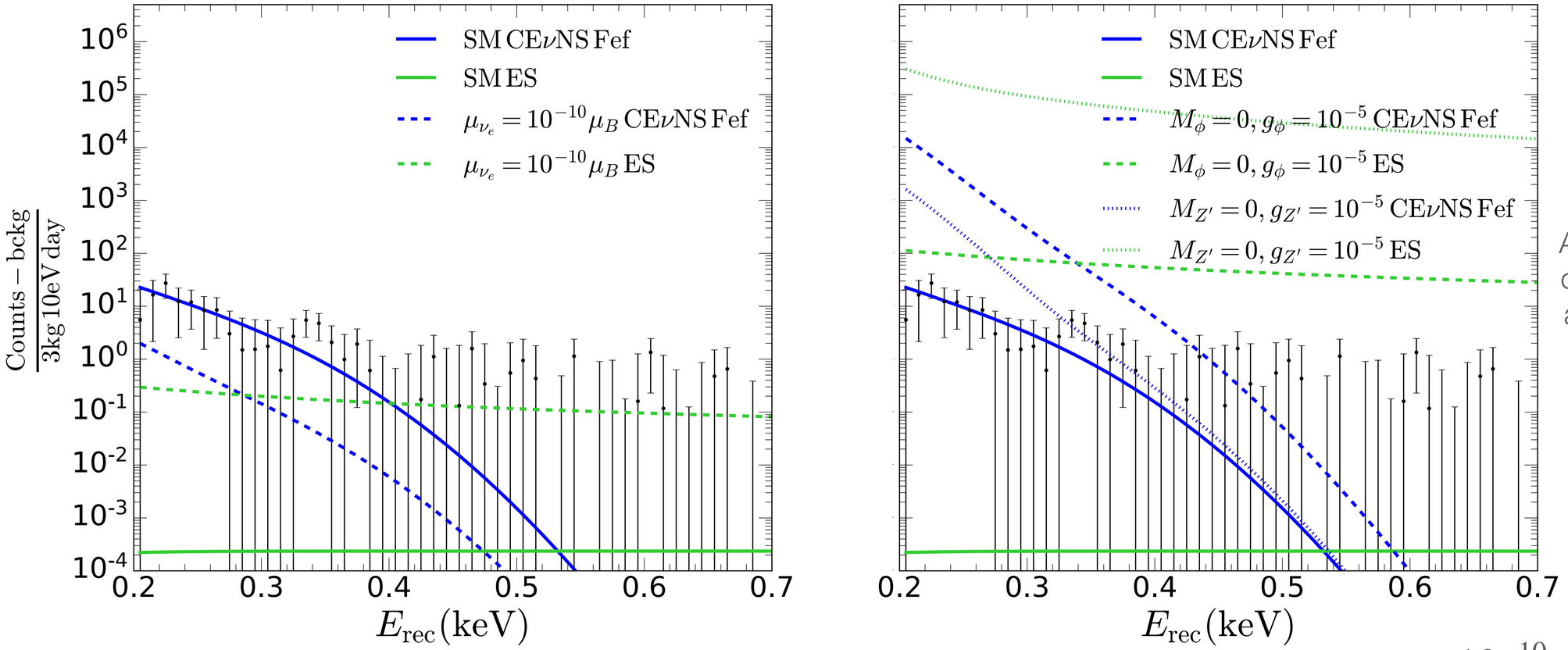


Two different quenching factors (QF) are considered: Fef, YBe
- Phys. Rev. D **103** (2021) 122003 -

The Dresden-II reactor experiment

Comparison of the spectral rate of signal events from CEνNS and $\nu_e e^-$ scattering to data

Fef Quenching factor was considered, measured by using iron-filtered monochromatic neutrons.



Assuming mediators couple universally to all relevant fermions

Left: the SM and the electromagnetic scattering induced by a neutrino magnetic moment $\mu_{\nu_e} = 10^{-10}\mu_\beta$.

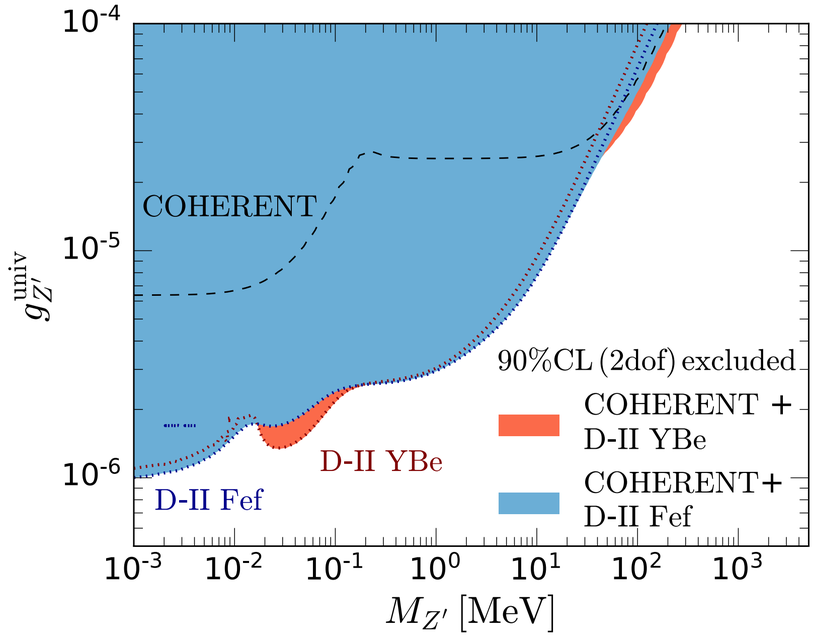
Right: the SM and the contribution induced by an interaction mediated by both a massless scalar and vector boson.

Detecting CEνNS

The combination of different neutrino sources and target nuclei will break degeneracies.

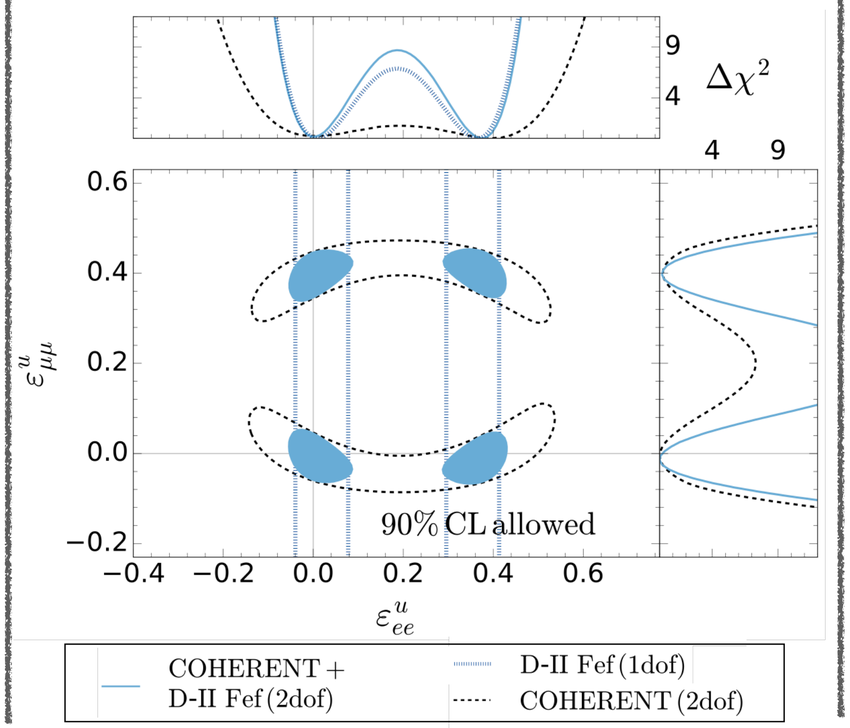
Combining sources and detectors

Light vector mediator models



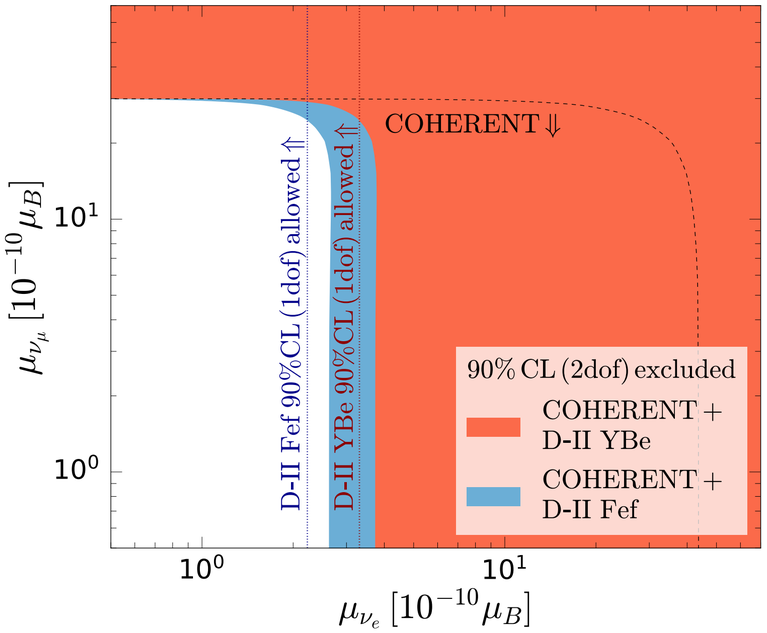
90% CL excluded regions for models with light vector mediators coupled universally to all relevant fermions.

Non-standard neutrino interactions (NSI)



90% CL allowed regions on flavor diagonal NSI with up-quarks (for zero values of all other NSI coefficients).

Neutrino magnetic moments

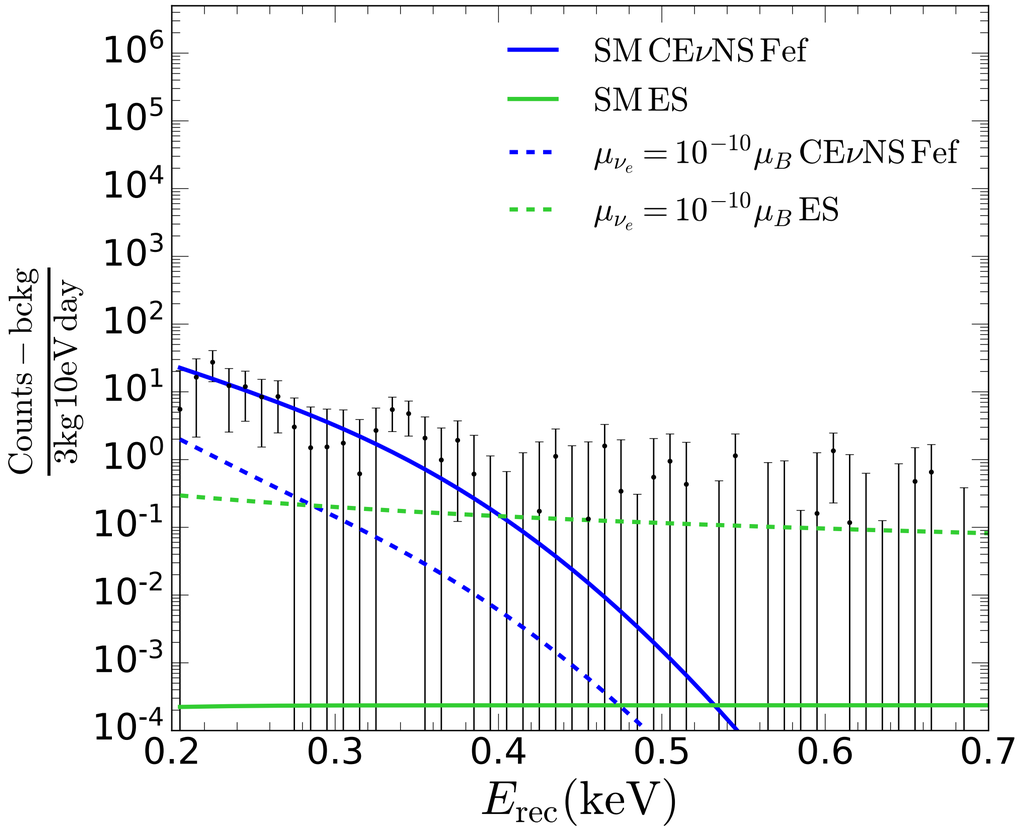


90% CL excluded regions (color) from Dresden-II + COHERENT analysis.
90% CL allowed regions (arrows) from Dresden-II and COHERENT (CsI + Ar) data.

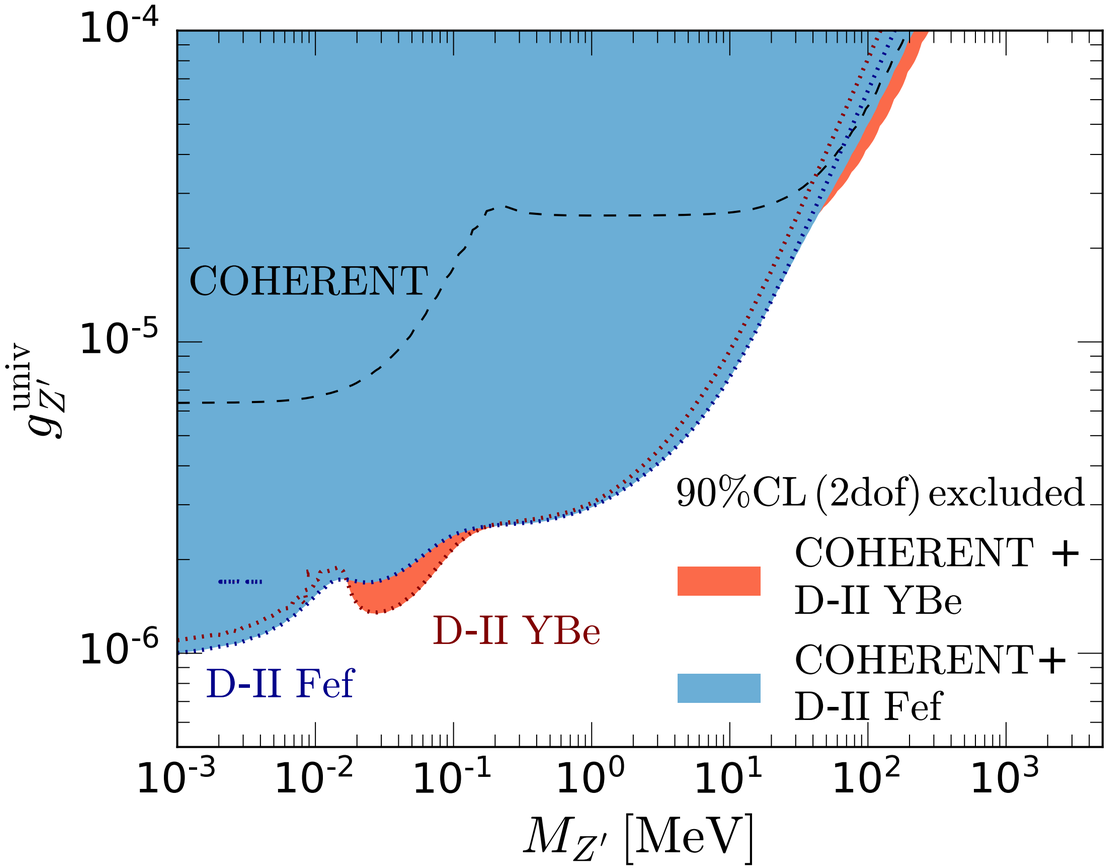
The role of $\nu_e e^-$ scattering inclusion

Could pass the signal selection cuts for the Dresden-II experiment and the COHERENT CsI detector

May lead to stronger constraints than using only CEνNS



At higher recoil energies, **ES dominates.**



Small-mass limit: COHERENT CsI improves bounds on the coupling with light vector mediators in B–L and universal models.

Thank you