

Physics Opportunities of Coherent Elastic neutrino-Nucleus Scattering Phenomenology

Diego Aristizabal

USM
Chile

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

- Neutrino processes at different energy scales
- Intermediate regime
- A few comments on theoretical uncertainties
- Low-energy regime

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

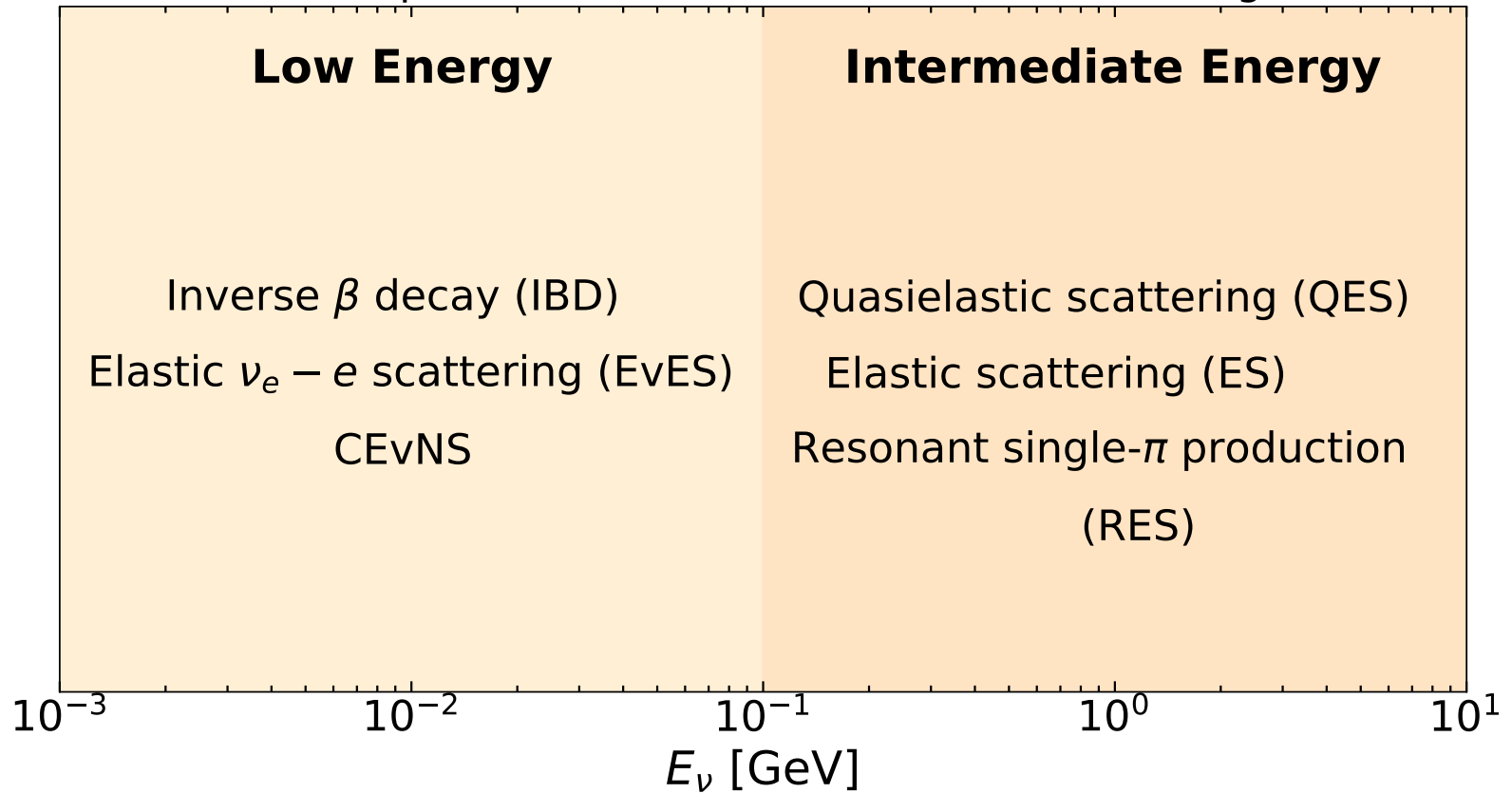
The case of DM detectors: PandaX-4T & XENONnT

Final remarks

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

Neutrino processes at different energy scales

Neutrino processes at low and intermediate energies



Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

- Neutrino processes at different energy scales
- Intermediate regime
- A few comments on theoretical uncertainties
- Low-energy regime

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

Final remarks

Intermediate regime

QES (CC)

$$\nu_\mu + n \rightarrow \mu^- + p$$

$$\bar{\nu}_\mu + p \rightarrow \mu^+ + n$$

ES (NC)

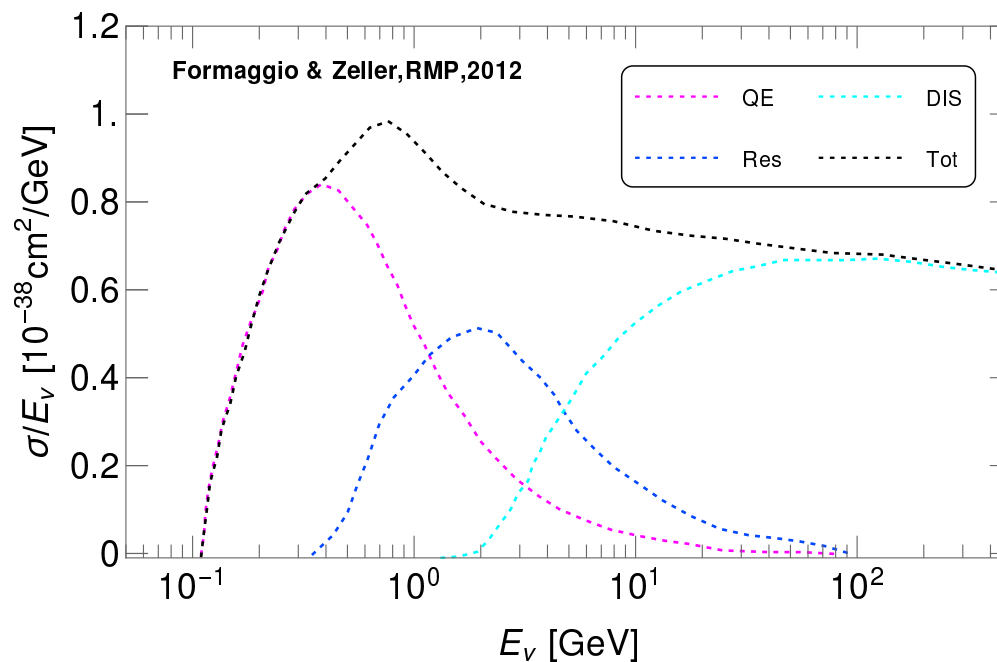
$$\nu + p \rightarrow \nu + p \quad \bar{\nu} + p \rightarrow \bar{\nu} + p$$

$$\nu + n \rightarrow \nu + n \quad \bar{\nu} + n \rightarrow \bar{\nu} + n$$

RES (NC & CC)

$$\nu_\mu N \rightarrow \mu^- N^* \rightarrow \mu^- \pi N'$$

$$\nu_\mu N \rightarrow \nu_\mu N^* \rightarrow \nu_\mu \pi N'$$



QES: MINERvA, 2013 (FNAL)

MINERvA, 2020

ES: MiniBooNE, 2010 (FNAL)

RES: K2K, 2008 (JPARC)

T2K, 2017

MINERvA, 2017

Theoretically calculations are challenging
Theoretical uncertainties are large!

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

- Neutrino processes at different energy scales
- Intermediate regime
- A few comments on theoretical uncertainties
- Low-energy regime

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

Final remarks

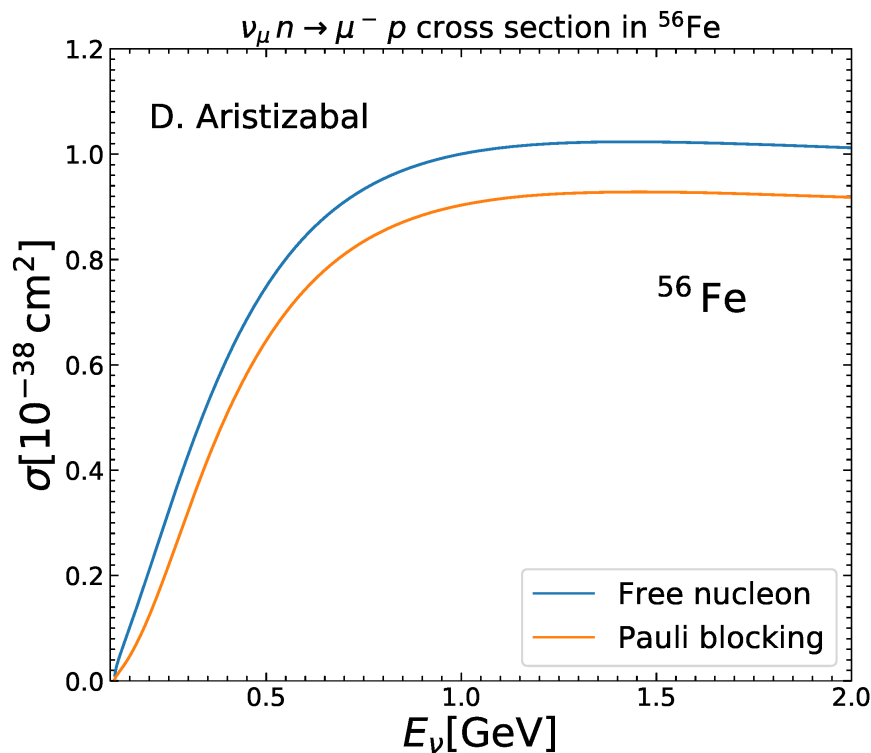
A few comments on theoretical uncertainties

Dominant effects

Pauli blocking: Final-state fermion states must be assured an unoccupied quantum state.

Fermi motion: Nucleons in the nuclear environment are not at rest.

Reinteractions: The recoiling nucleon can reinteract in the nuclear medium



Environmental effects are $\sim 20\% - 30\%$

Nuclear effects are relevant

Effects in MC generators:

GENNIE & NuWro Differences $\sim 10\%$

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

- Neutrino processes at different energy scales
- Intermediate regime
- A few comments on theoretical uncertainties
- Low-energy regime

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

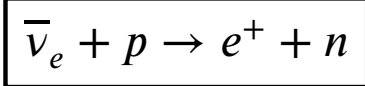
CEvNS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

Final remarks

Low-energy regime

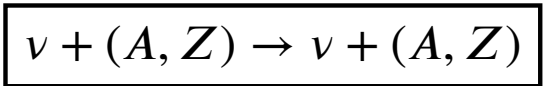
Inverse beta decay (IBD)



Used in reactor neutrino detection. Daya Bay, 2015

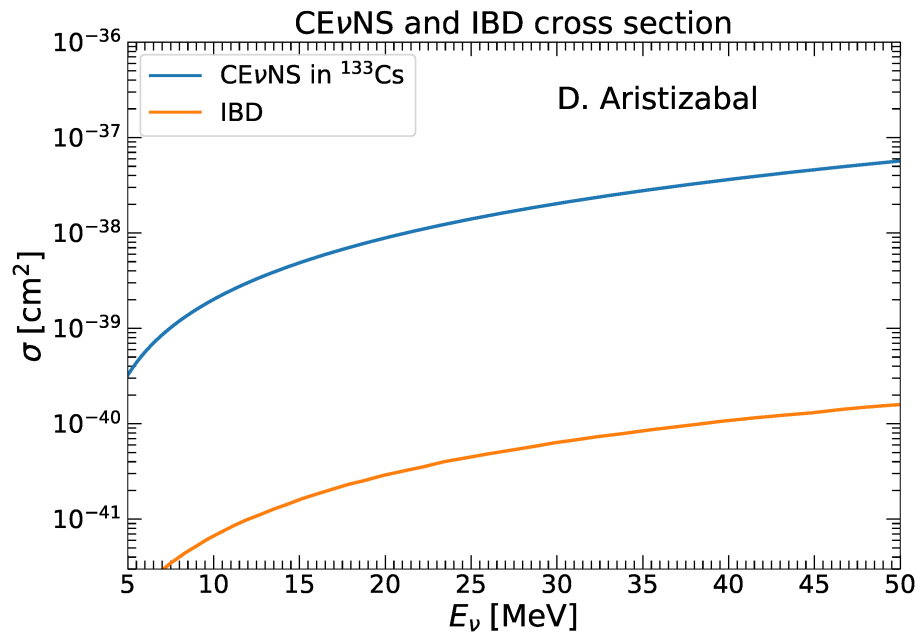
Uncertainties of $\sim 0.1\%$ (τ_n), PDG, 2023

CEvNS



Measured at the SNS, 2017 (first ever)

Uncertainties of $\sim 1 - 5\%$ (rms of n^0 distribution)



Environmental effects are absent

Nuclear effects are subdominant

Clean processes!

In neutrino standards

CEvNS cross section is “huge”

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

- Neutrino processes at different energy scales
- Intermediate regime
- A few comments on theoretical uncertainties
- Low-energy regime

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

Final remarks

Why Coherent Elastic ν -nucleus
Scattering (CEvNS)?

CEvNS: Cross section,
environments and
measurements

- CEvNS cross section
- CEvNS environments
- Neutrino sources and CEvNS
“regimes”
- Physics program
(opportunities)
- Possible BSM scenarios
- Ongoing projects worldwide

Measurements: COHERENT

CEvNS physics with the
 ν BDX-DRIFT detector

The case of DM detectors:
PandaX-4T & XENONnT

Final remarks

CEvNS: Cross section, environments and measurements

CE ν NS cross section

CE ν NS occurs when the neutrino energy E_ν is such that nucleon amplitudes sum up coherently \Rightarrow cross section enhancement

$$\lambda \gtrsim R_N \Rightarrow q \lesssim 200 \text{ MeV}$$

$$E_R = q^2/2m_N \Rightarrow E_\nu \simeq \sqrt{E_R^{\max} m_N/2}$$

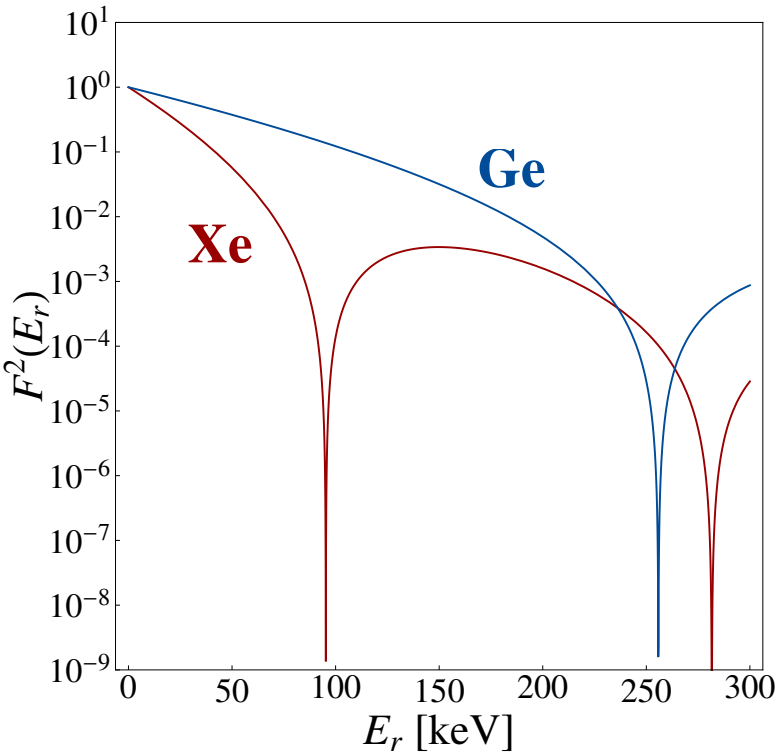
$$E_\nu \lesssim 200 \text{ MeV}$$

Freedman, 1974; Drukier & Stodolsky, 1984

$$\frac{d\sigma_\nu}{dE_R} = \frac{G_F^2}{4\pi} Q_W^2 m_N \left(1 - \frac{E_r m_N}{2E_\nu^2}\right) \underbrace{F_W^2(E_r)}_{\text{Form factor}}$$

$$Q_W^2 = [N - (1 - 4s_W^2)Z]^2 \simeq N^2$$

Helm, 1956



Why Coherent Elastic ν -nucleus Scattering (CE ν NS)?

CE ν NS: Cross section, environments and measurements

- CE ν NS cross section
- CE ν NS environments
- Neutrino sources and CE ν NS "regimes"
- Physics program (opportunities)
- Possible BSM scenarios
- Ongoing projects worldwide

Measurements: COHERENT

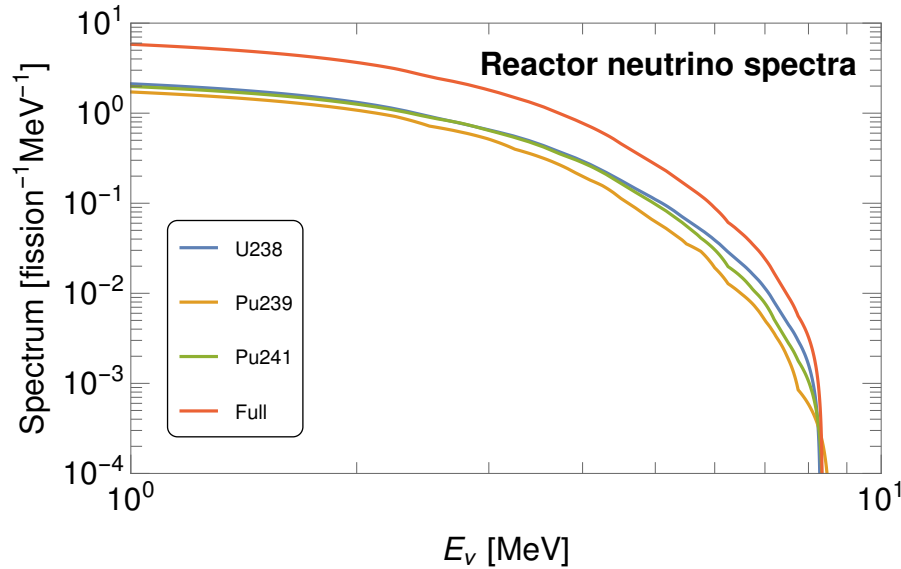
CE ν NS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

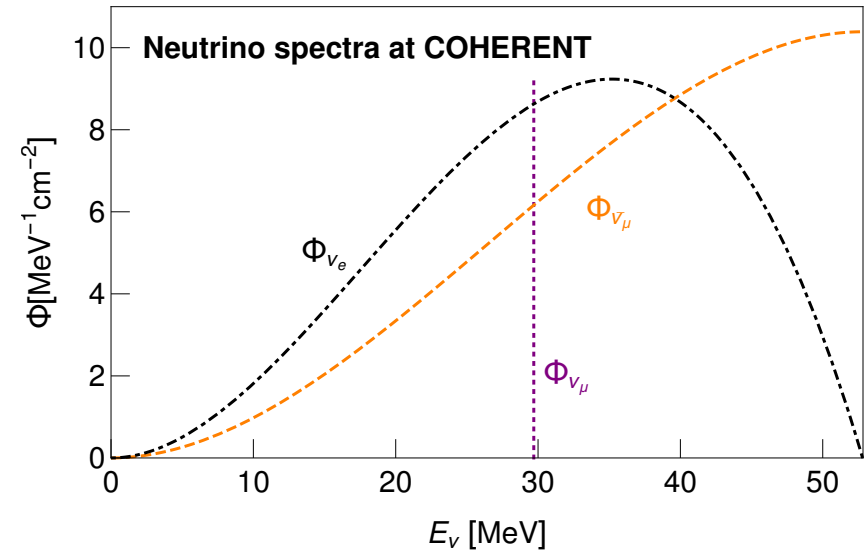
Final remarks

CEvNS environments

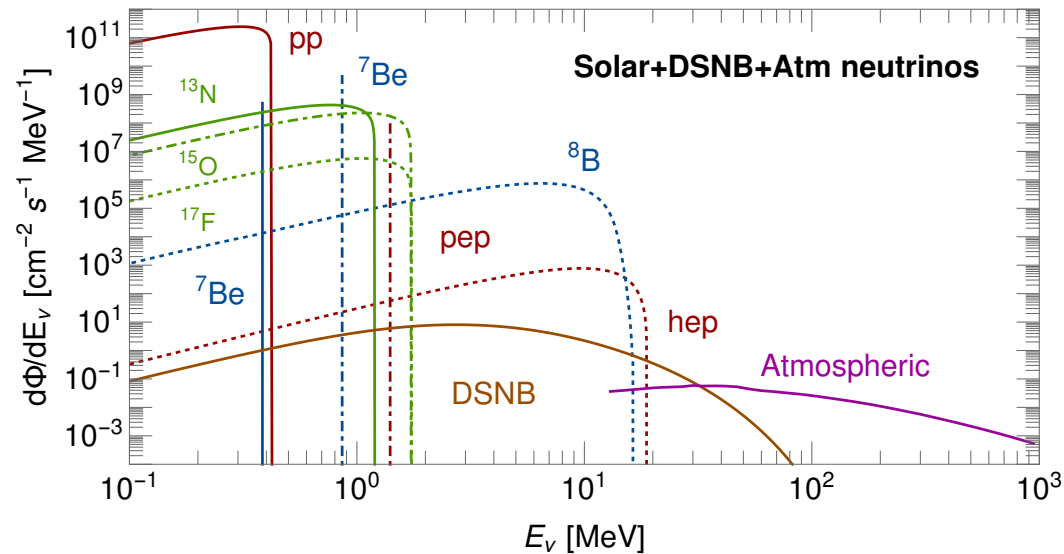
Reactor (CONUS, NUCLEUS, RICOCHET...)



Fixed target neutrinos (COHERENT)



Solar+DSNB+Atm (DM detectors)



Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

- CEvNS cross section
- CEvNS environments
- Neutrino sources and CEvNS "regimes"
- Physics program (opportunities)
- Possible BSM scenarios
- Ongoing projects worldwide

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

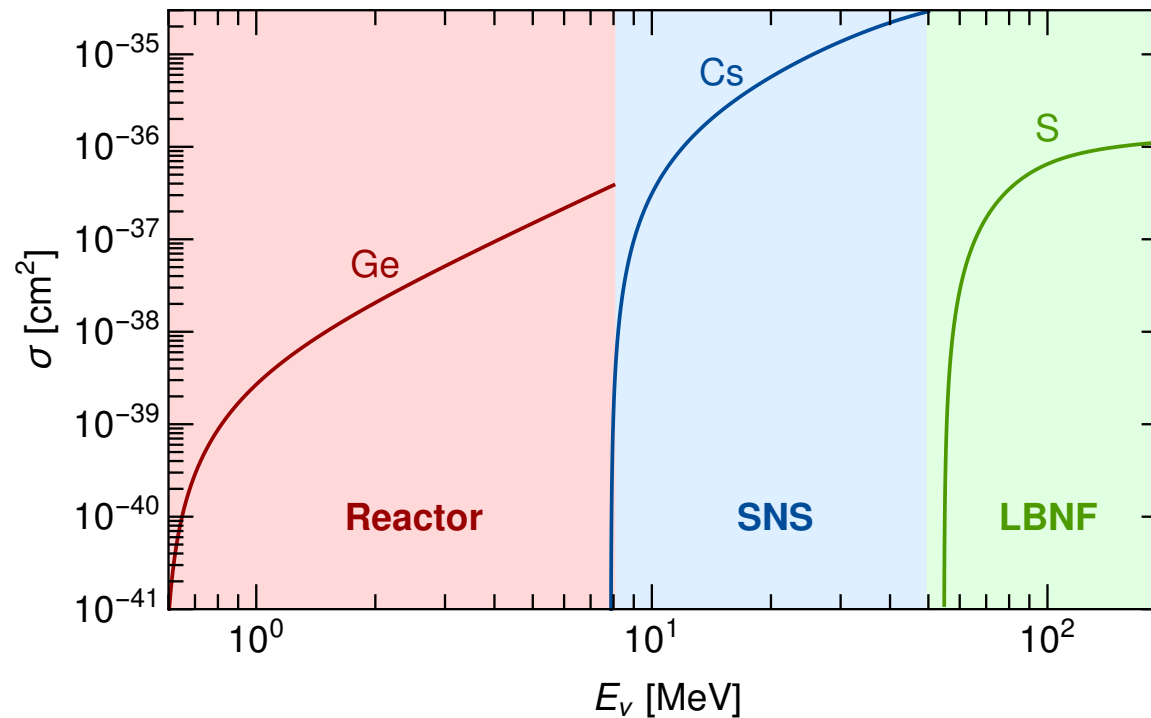
Final remarks

Neutrino sources and CEvNS “regimes”

Decay-in-flight neutrinos sources can as well be used

NuMI and LBNF

D.A.S. et al. arXiv:2103.10857



Entering the “high-energy” window requires a substantial amount of ν 's in the low-energy tail

LBNF provides that!

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

- CEvNS cross section
- CEvNS environments
- Neutrino sources and CEvNS “regimes”
- Physics program (opportunities)
- Possible BSM scenarios
- Ongoing projects worldwide

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

Final remarks

The combination of measurements from different sources and different detectors define a rather rich physics program

CEvNS measurements

CONUS (Ge), CONNIE (Si), COHERENT (Ar, CsI, NaI)

ν BDX-DRIFT (CS₂, CF₄, C₈H₂₀Pb), XLZD (LXe), Captain-Mills (LAr)

SM measurements

Measurements of $\sin^2 \theta_W$ at a new energy scale

... Complementary to DUNE measurements in electron channel

Measurements of neutron distributions in e.g. Ge, C, S, F, Pb...

BSM searches

Neutrino NSI, NGI, Dark-neutrino interactions, dark sectors

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

- CEvNS cross section
- CEvNS environments
- Neutrino sources and CEvNS "regimes"
- Physics program (opportunities)
- Possible BSM scenarios
- Ongoing projects worldwide

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

Final remarks

Possible BSM scenarios

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

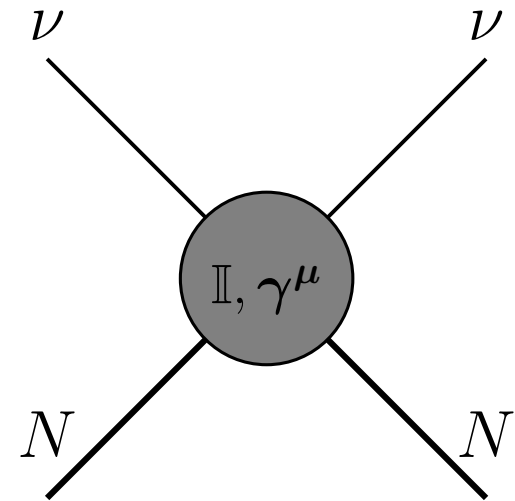
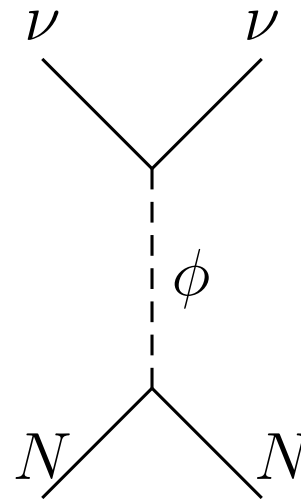
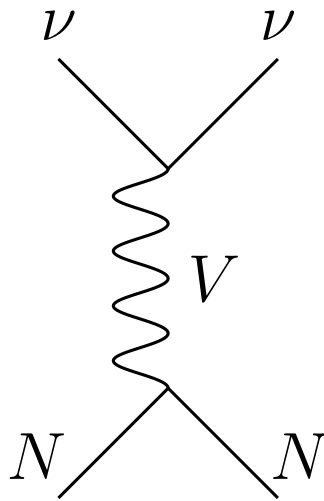
- CEvNS cross section
- CEvNS environments
- Neutrino sources and CEvNS "regimes"
- Physics program (opportunities)
- Possible BSM scenarios
- Ongoing projects worldwide

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

Final remarks



Measurements: COHERENT

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

- Measurements with CsI (2017)
- Updated CsI data (2021)

CEvNS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

Final remarks

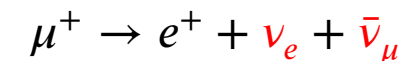
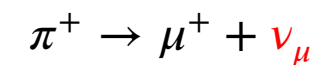
Measurements with CsI (2017)

CE ν NS observed by COHERENT more than 40 years after its prediction

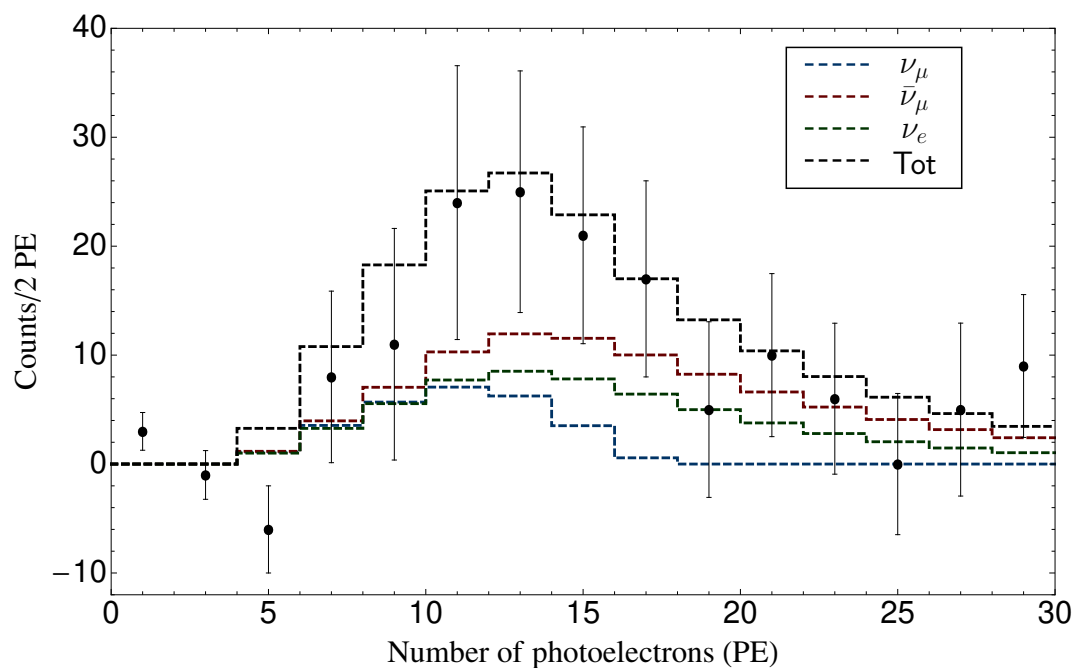
Akimov et. al. 2017

COHERENT uses neutrinos produced at the SNS

@ Oak Ridge National Laboratory in the collision $p - \text{Hg}$



Presence of CE ν NS favored @ the 6.7σ level. Data consistent with SM @ the 1σ



$$n_{\text{PE}} = 1.17 (E_R/\text{keV})$$

**Measured in LAr
CENNS-10 2003.10630
Ge expected in 2024**

Why Coherent Elastic ν -nucleus Scattering (CE ν NS)?

CE ν NS: Cross section, environments and measurements

Measurements: COHERENT

● Measurements with CsI (2017)

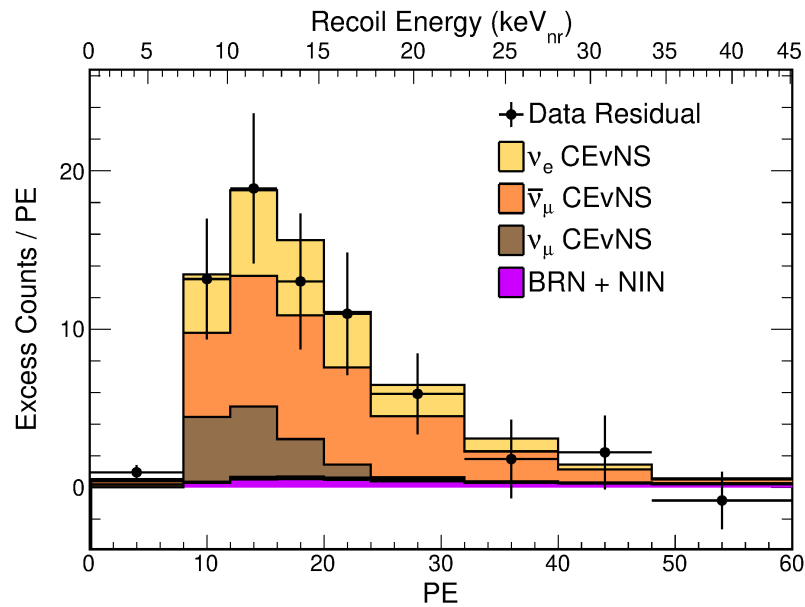
● Updated CsI data (2021)

CE ν NS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

Final remarks

Updated CsI data (2021)

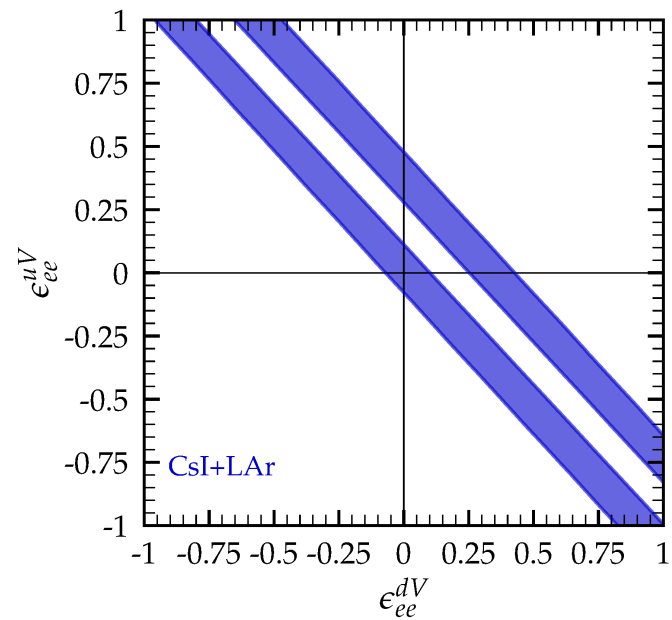
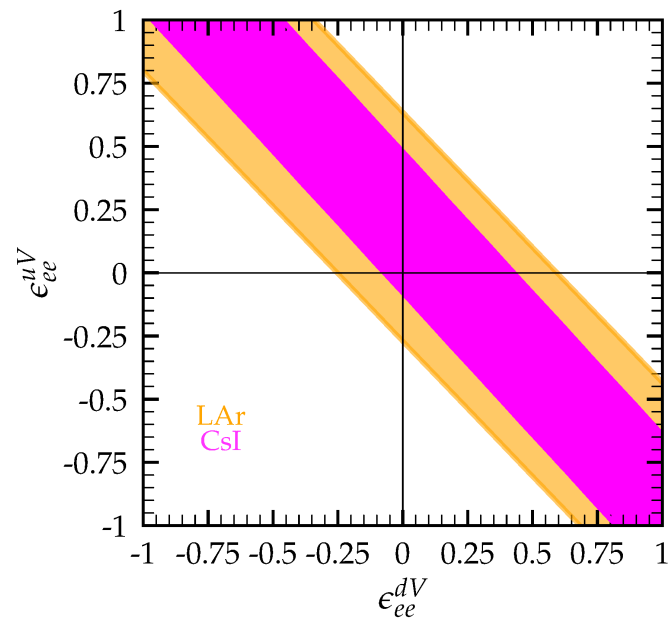


Larger data set (twice that of 2017)

$N_{\text{exp}} = 306 \pm 20$ ($N_{\text{th}} = 341 \pm 11$)

Smaller statistical uncertainties (Q_F)

De Romeri et al, 2211.11905



Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

● Measurements with CsI (2017)

● Updated CsI data (2021)

CEvNS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

Final remarks

Why Coherent Elastic ν -nucleus
Scattering (CEvNS)?

CEvNS: Cross section,
environments and
measurements

Measurements: COHERENT

CEvNS physics with the
 ν BDX-DRIFT detector

- Project
- ν BDX-DRIFT: Basics
- Signals in CS_2 and CF_4
- Measurements of R_n via
CEvNS
- Neutron density distributions:
Results
- Neutrino Nonstandard
Interactions (NSI)

The case of DM detectors:
PandaX-4T & XENONnT

Final remarks

CEvNS physics with the ν BDX-DRIFT detector

➡ **Collaboration** started back in 2021: D.A.S. (USM), Bhaskar Dutta (TAMU)
Joshua Barrow (Minnesota), Doojin Kim (South Dakota)
Daniel Snowden-Ifft (Oxy College), Louis Strigari (TAMU)

➡ **Goal:** CEvNS Physics and LDM searches with directional detectors

➡ **Strategy:** Use Fermilab neutrino beamlines (pion decay-in-flight)
Leverage the low-energy tail & abundant flux

Directional LDM signals & sensitivities: Work in progress
Neutron backgrounds at the MINOS hall: 2210.08612 [hep-ex] (PRD)
CEvNS measurements: 2103.10857 [hep-ph] (PRD)

Why Coherent Elastic ν -nucleus
Scattering (CEvNS)?

CEvNS: Cross section,
environments and
measurements

Measurements: COHERENT

CEvNS physics with the
 ν BDX-DRIFT detector

● Project

● ν BDX-DRIFT: Basics

● Signals in CS_2 and CF_4

● Measurements of R_n via
CEvNS

● Neutron density distributions:
Results

● Neutrino Nonstandard
Interactions (NSI)

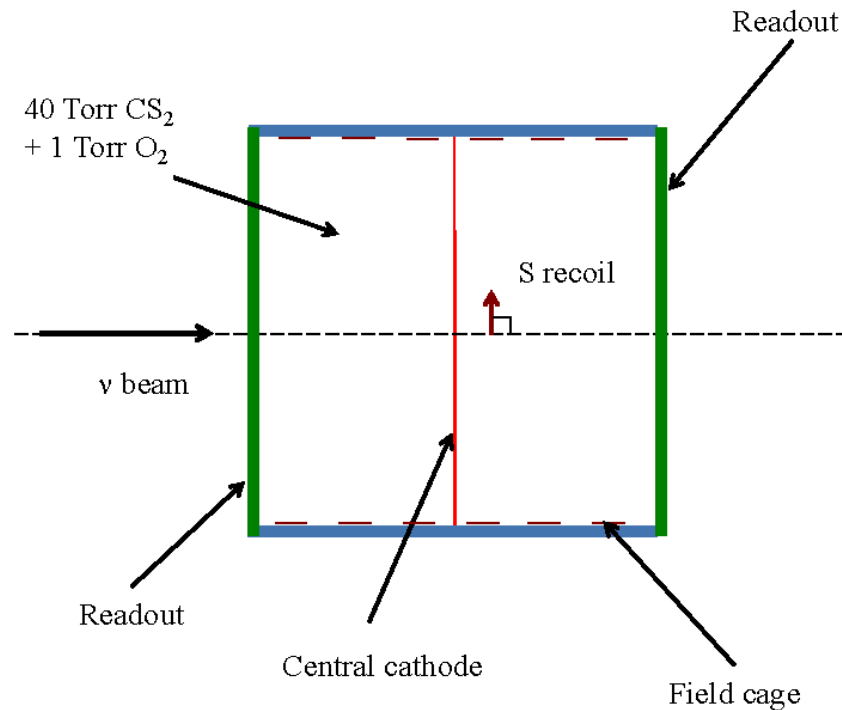
The case of DM detectors:
PandaX-4T & XENONnT

Final remarks

ν BDX-DRIFT: Basics

⇨ Directional low pressure TPC detector

⇨ Operates with CS_2 (other gases possible CF_4 , $\text{C}_8\text{H}_{20}\text{Pb}\dots$)



⇨ NRs mainly in sulfur induce ionization

⇨ CS_2^- ions used to transport the ionization to the readout planes

(MWPCs)

Multi-wire proportional chambers

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

● Project

● ν BDX-DRIFT: Basics

● Signals in CS_2 and CF_4

● Measurements of R_n via CEvNS

● Neutron density distributions: Results

● Neutrino Nonstandard Interactions (NSI)

The case of DM detectors: PandaX-4T & XENONnT

Final remarks

Signals in CS₂ and CF₄

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

- Project
- ν BDX-DRIFT: Basics
- Signals in CS₂ and CF₄

● Measurements of R_n via CEvNS

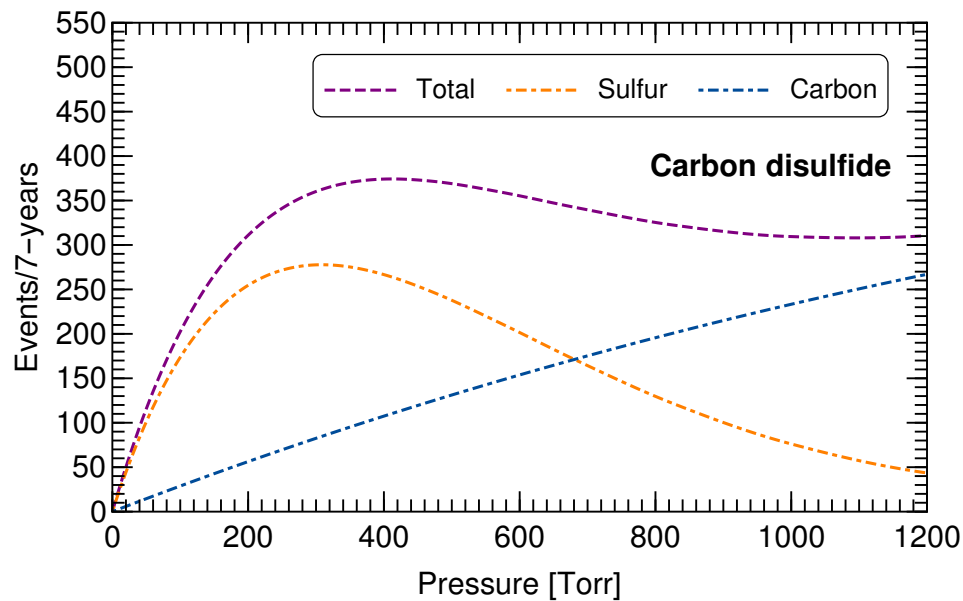
● Neutron density distributions: Results

● Neutrino Nonstandard Interactions (NSI)

The case of DM detectors: PandaX-4T & XENONnT

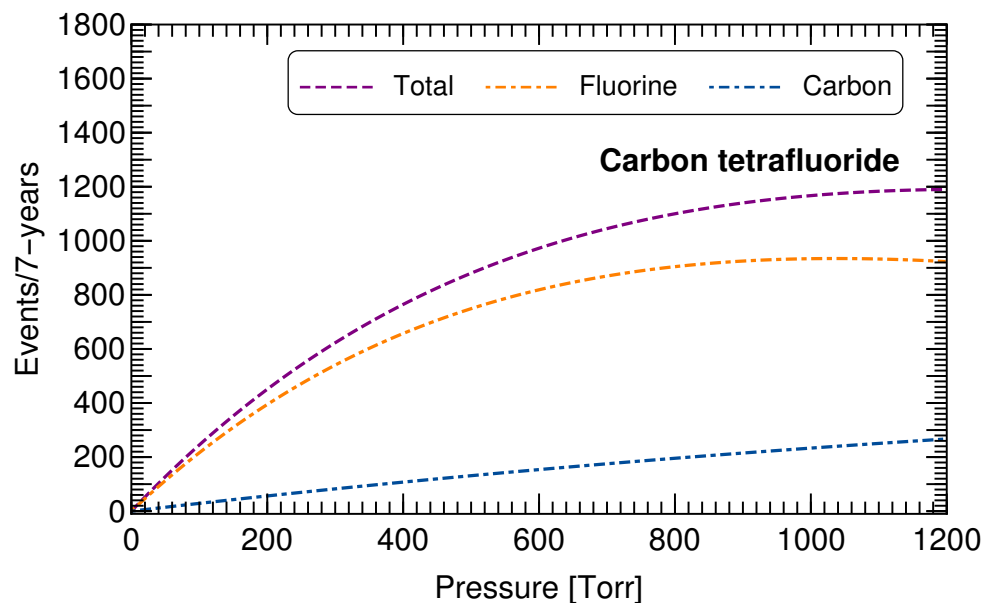
Final remarks

D.A.S. et al. arXiv:2103.10857



Signal peaks at 400 Torr
Expected signal: 370 events

D.A.S. et al. arXiv:2103.10857



100% filled with CF₄
Expected signal: 880 events

Measurements of R_n via CEvNS

$$F_W(q^2) = \frac{1}{Q_W} [Z g_V^p F_V^p(q^2) + (A - Z) g_V^n F_V^n(q^2)]$$

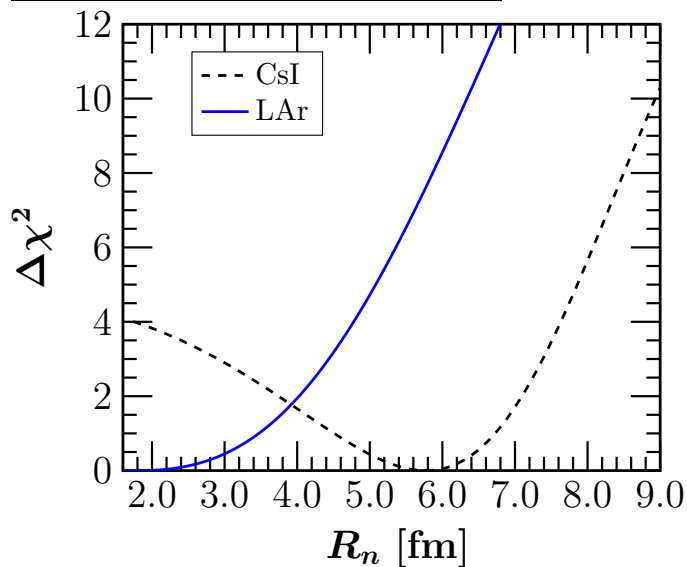
⇒ F_V^p : Depends on R_p ⇒ known at 0.1% level ($e^- - N$ scattering)

⇒ F_V^n : Depends on R_n ⇒ poorly known (hadron experiments)

$$N_{\text{CEvNS}} = N_{\text{CEvNS}}(R_n)$$

$$N_{\text{CEvNS}}^{\text{Exp}} \Rightarrow R_n$$

Miranda et al, JHEP 05 (2020)



COHERENT 90% CL limits

CsI: $R_n^{\text{Cs}} = R_n^l : R_n \in [3.4, 7.2] \text{ fm}$

Ar: $R_n < 4.33 \text{ fm}$

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

- Project
- ν BDX-DRIFT: Basics
- Signals in CS_2 and CF_4

● Measurements of R_n via CEvNS

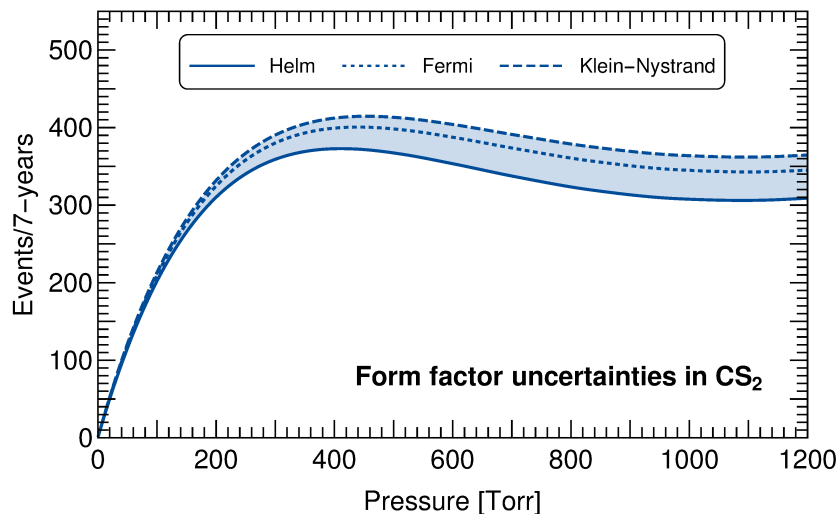
- Neutron density distributions: Results
- Neutrino Nonstandard Interactions (NSI)

The case of DM detectors: PandaX-4T & XENONnT

Final remarks

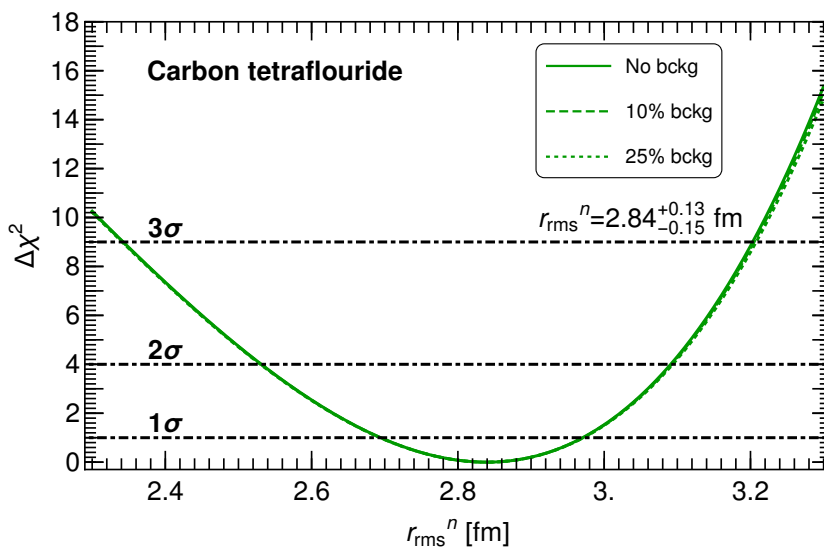
Neutron density distributions: Results

D.A.S. et al. PRD, 104 (2021)



High-energy nature of the flux
 ⇒ Moderate dependence on the FF
 ⇒ Accounted for in signal uncertainty ~ 10%

D.A.S. et al. PRD, 104 (2021)



Approximation: $r_{\text{rms}}^n|_C = r_{\text{rms}}^n|_F$
 C and F determined with a 3% accuracy

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

- Project
- ν BDX-DRIFT: Basics
- Signals in CS₂ and CF₄
- Measurements of R_n via CEvNS

● Neutron density distributions: Results

- Neutrino Nonstandard Interactions (NSI)

The case of DM detectors: PandaX-4T & XENONnT

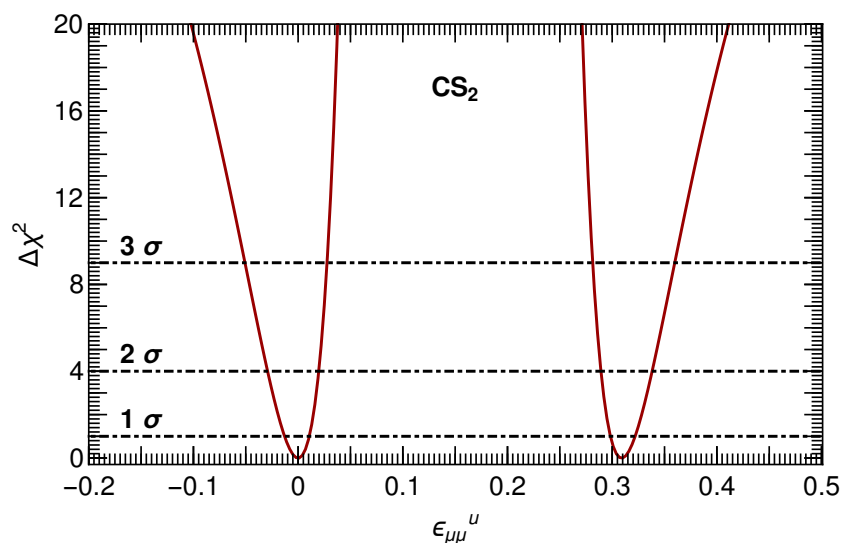
Final remarks

Neutrino Nonstandard Interactions (NSI)

$$\mathcal{L}_{\text{NSI}} \sim G_F \bar{\nu}_a \gamma_\mu (1 - \gamma_5) \nu_b q \gamma^\mu \epsilon_{ab}^q q$$

Initial state flavor, ν_μ : Only $\epsilon_{\mu b}$ parameters are testable

D.A.S. et al, PRD 104 (2021)



Region I: Deviations are small, $\epsilon_{\mu\mu}^u \rightarrow 0$

Region II: NSI exceeds SM by ~ 2

⇒ Destructive interference

νBDX-DRIFT CS₂ (7-years)		COHERENT CsI (1-year)	
$\epsilon_{\mu\mu}^u$	$[-0.013, 0.011] \oplus [0.30, 0.32]$	$\epsilon_{\mu\mu}^u$	$[-0.06, 0.03] \oplus [0.37, 0.44]$
$\epsilon_{e\mu}^u$	$[-0.064, 0.064]$	$\epsilon_{e\mu}^u$	$[-0.13, 0.13]$

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

- Project
- ν BDX-DRIFT: Basics
- Signals in CS₂ and CF₄
- Measurements of R_n via CEvNS
- Neutron density distributions: Results
- **Neutrino Nonstandard Interactions (NSI)**

The case of DM detectors: PandaX-4T & XENONnT

Final remarks

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

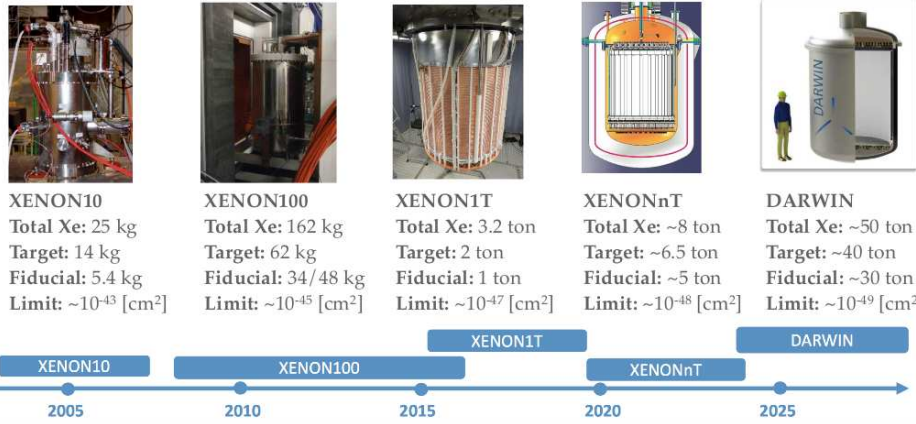
The case of DM detectors: PandaX-4T & XENONnT

- Multi-ton DM detectors
- Impact of reactor neutrinos
- Actual measurements
- What can you learn from these data?
- Survival probability and event rate
- Sensitivities

Final remarks

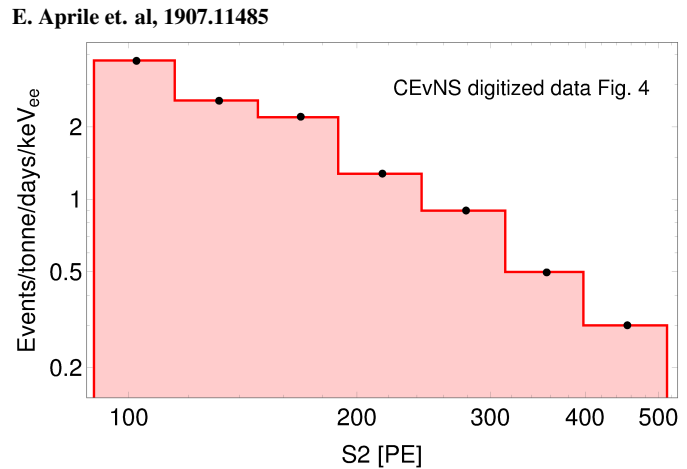
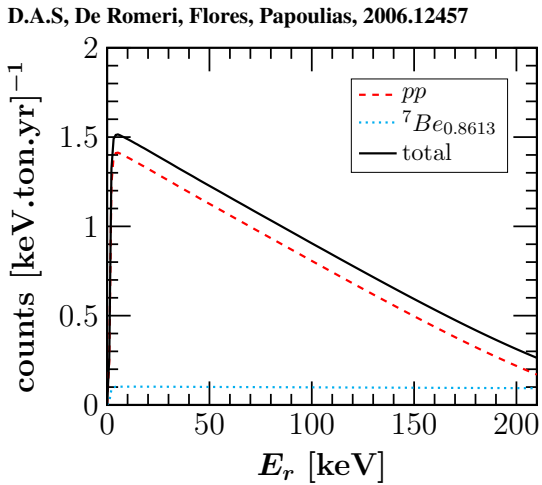
The case of DM detectors: PandaX-4T & XENONnT

Multi-ton DM detectors



Lux-Zeplin (LZ) [G2 detector]
 SURF, South Dakota, USA
 Total: 10 ton of LXe
 Fiducial: 5.6 ton of LXe
 DM sensitivity: 10^{-48} cm²
XLZD Consortium: 40-100 ton

Neutrino-induced NR and ER will be abundant
 in thrid generation DM detectors (XLZD)



Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

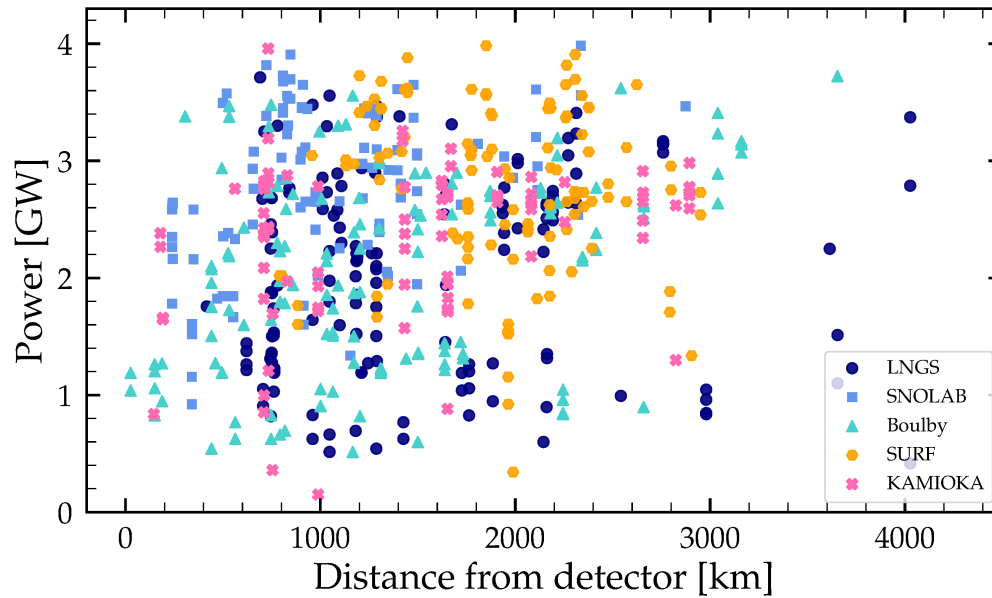
The case of DM detectors: PandaX-4T & XENONnT

- Multi-ton DM detectors
- Impact of reactor neutrinos
- Actual measurements
- What can you learn from these data?
- Survival probability and event rate
- Sensitivities

Final remarks

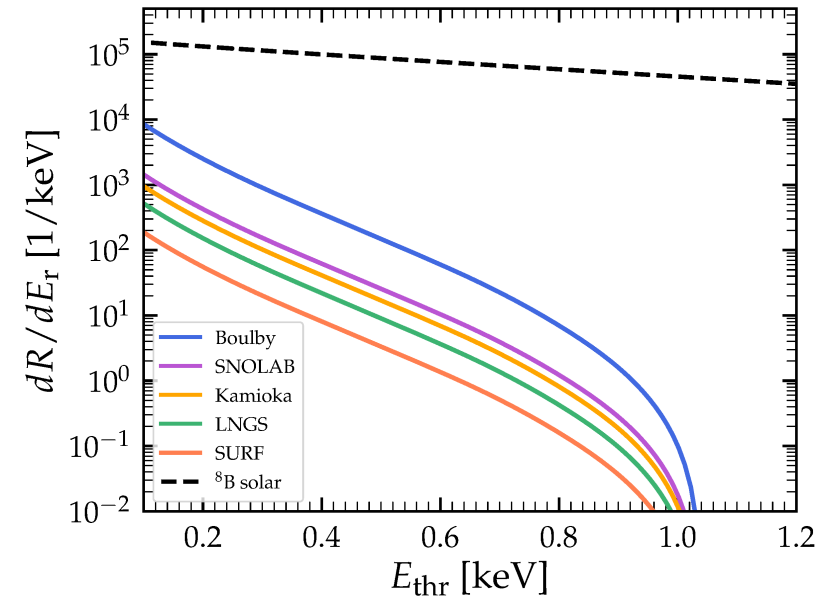
Impact of reactor neutrinos

D.A.S. et al, 2402.06416



Reactor clusters $L \leq 1000$ km
Boulby: Power+short baselines

Event rates sizable in all cases
Best location: SURF & LNGS



Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

● Multi-ton DM detectors

● Impact of reactor neutrinos

● Actual measurements

● What can you learn from these data?

● Survival probability and event rate

● Sensitivities

Final remarks

Actual measurements

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

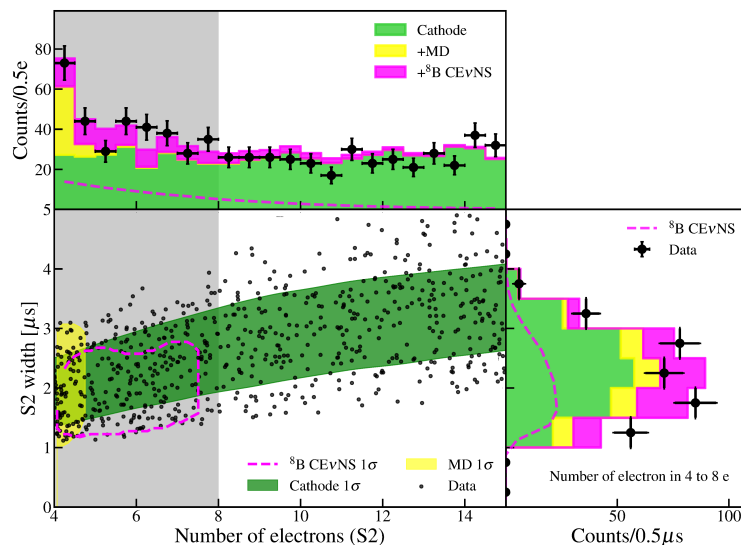
Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

- Multi-ton DM detectors
- Impact of reactor neutrinos
- Actual measurements
- What can you learn from these data?
- Survival probability and event rate
- Sensitivities

Final remarks



PandaX-4T, arXiv:2407.10892

Paired scintillation+ionization signals (P)

Ionization-only signals (US2)

P signals: 3.5 ± 1.3 events

US2 signals: 75 ± 28 events

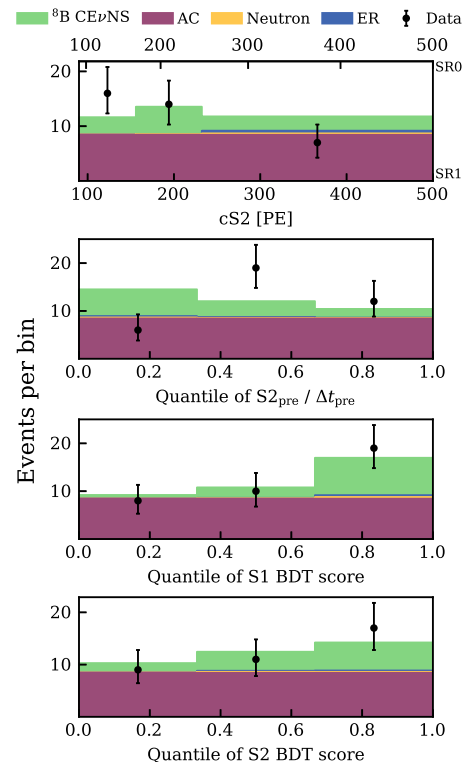
XENONnT, arXiv:2408.02877

Exposure: 3.5 tonne-year

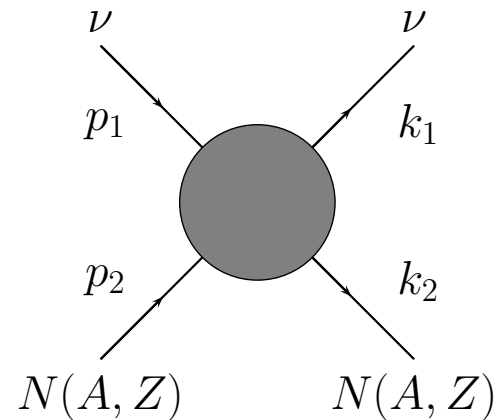
NR threshold at 0.5 keV

Signal: $11.9^{+4.5}_{-4.2}$ events

Background-only signal rejected at 2.73σ



What can you learn from these data?



Implications

⇒ Induce new matter potentials ⇒ Affects neutrino propagation in the SUN

Affects neutrino flavor conversion

⇒ Modifies $\nu - q$ interactions ⇒ Affects the CEvNS cross section

Affects the detection process

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

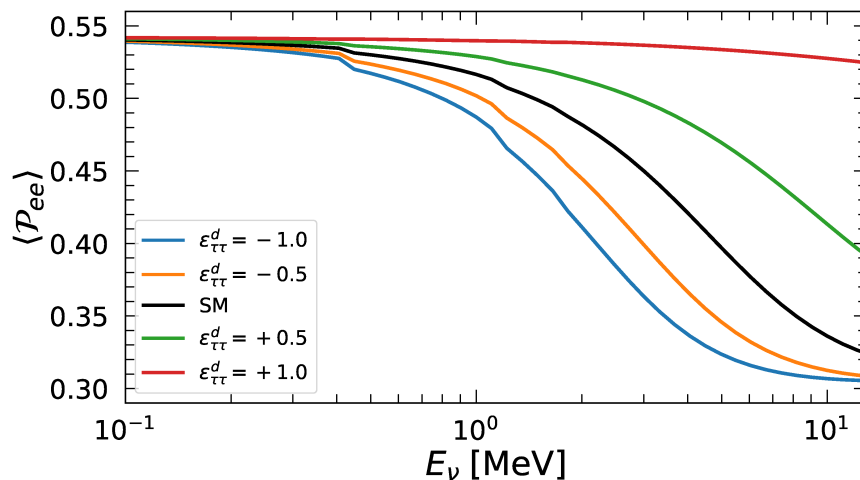
The case of DM detectors: PandaX-4T & XENONnT

- Multi-ton DM detectors
- Impact of reactor neutrinos
- Actual measurements
- What can you learn from these data?
- Survival probability and event rate
- Sensitivities

Final remarks

Survival probability and event rate

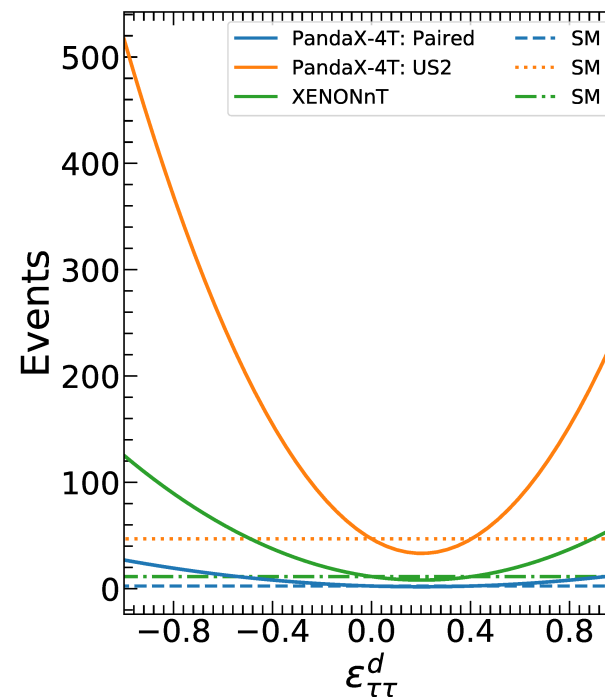
Case $\epsilon_{\tau\tau}^d \neq 0$



Resonant conversion of matter states

Positive effective couplings \Rightarrow
farther from resonant region

Effects of the new couplings
enhance/depletes the detection cross section
Event rate increases/decreases



Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

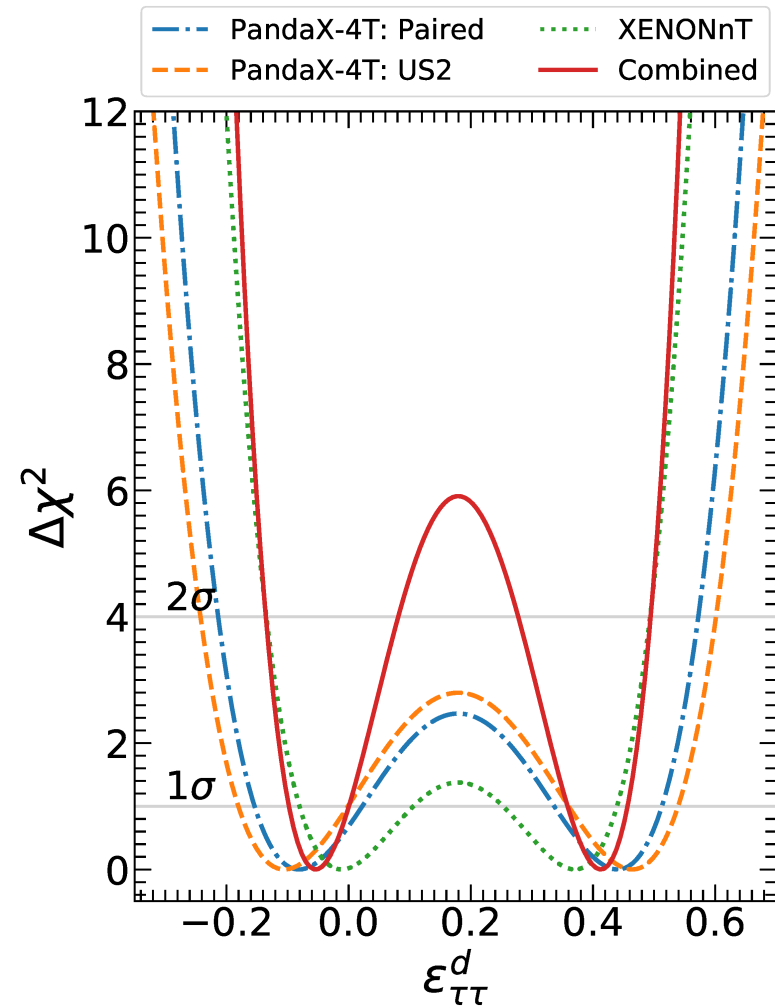
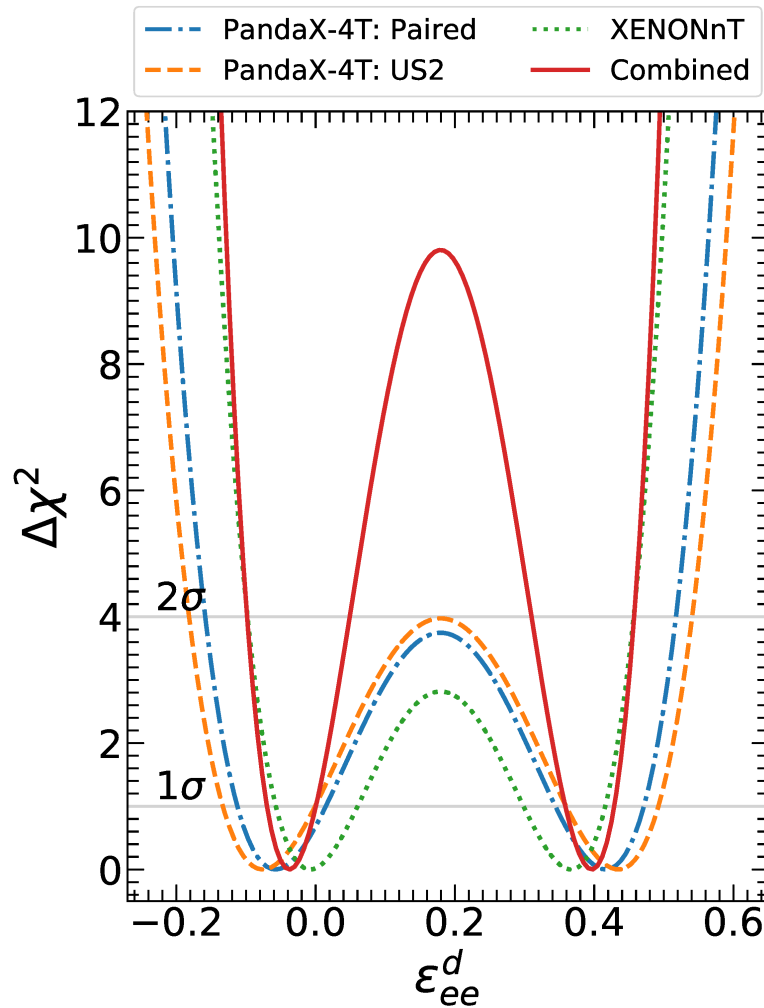
The case of DM detectors: PandaX-4T & XENONnT

- Multi-ton DM detectors
- Impact of reactor neutrinos
- Actual measurements
- What can you learn from these data?
- Survival probability and event rate
- Sensitivities

Final remarks

Sensitivities

D.A.S. et al, 2409.02003



Sensitivities (exclusion limits) are competitive with COHERENT combined measurements!

Why Coherent Elastic ν -nucleus Scattering (CEvNS)?

CEvNS: Cross section, environments and measurements

Measurements: COHERENT

CEvNS physics with the ν BDX-DRIFT detector

The case of DM detectors: PandaX-4T & XENONnT

- Multi-ton DM detectors
- Impact of reactor neutrinos
- Actual measurements
- What can you learn from these data?
- Survival probability and event rate
- Sensitivities

Final remarks

Why Coherent Elastic ν -nucleus
Scattering (CEvNS)?

CEvNS: Cross section,
environments and
measurements

Measurements: COHERENT

CEvNS physics with the
 ν BDX-DRIFT detector


The case of DM detectors:
PandaX-4T & XENONnT


Final remarks


- Takeaways


Final remarks


Takeaways

 CEvNS measurements (facilities) offer a rich neutrino program
agendas: ν -cleus, CONUS, CONNIE, COHERENT (SNS), NuMI & LBNF

 Directional detectors (ν BDX-DRIFT) combined with a high-energy neutrino beam (e.g. LBNF)
is suitable for CEvNS measurements in CS_2 , CF_4 , $\text{C}_8\text{H}_{20}\text{Pb}$...

 Directional detection improves background rejection
Other aspects of directionality yet to be explored: Identification of DM spin [?]

 Multi-ton DM detectors already observing neutrino-induced NRs
Still small statistics and sizable uncertainties... Improvements expected

 Into the future: Multi-ton DM detectors along with multi-ton detectors (LAr) at the STS
Measurements at the European Spallation Source... Delivering $\gtrsim 10^3$ events/year

Why Coherent Elastic ν -nucleus
Scattering (CEvNS)?

CEvNS: Cross section,
environments and
measurements

Measurements: COHERENT

CEvNS physics with the
 ν BDX-DRIFT detector

The case of DM detectors:
PandaX-4T & XENONnT

Final remarks

● Takeaways