Search for CEvNS & BSM Physics in NEON experiment

Gyunho Yu

Institute for Basic Science (Center for Underground Physics)

On behalf of NEON Collaboration

K-neutrino 2026

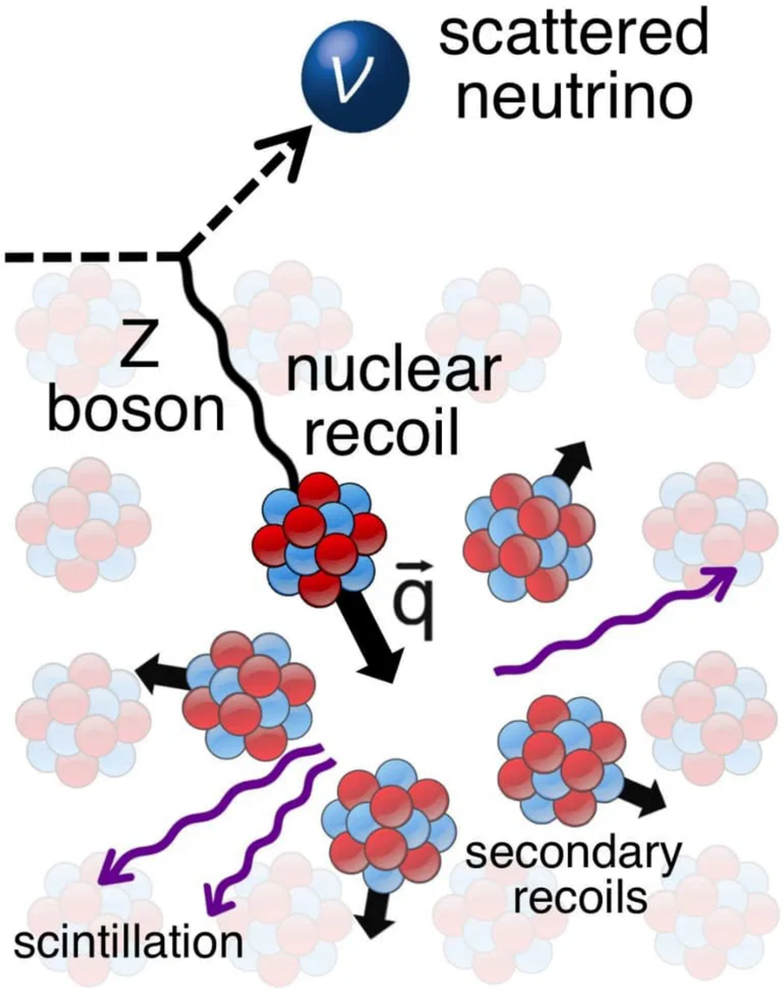
What is CEvNS ?

- **C**oherent **E**lastic ν – **N**ucleus **S**cattering **(CEvNS)**
- Neutrino scatters off the nucleus as whole
- Predicted in 1974 by D.Z.Freedman [Phys. Rev. D 9, 1383]

PHYSICAL REVIEW D VOLUME 9, NUMBER 5 1 MARCH 1974

Coherent effects of a weak neutral current

Daniel Z. Freedman†
National Accelerator Laboratory, Batavia, Illinois 60510
and Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11790



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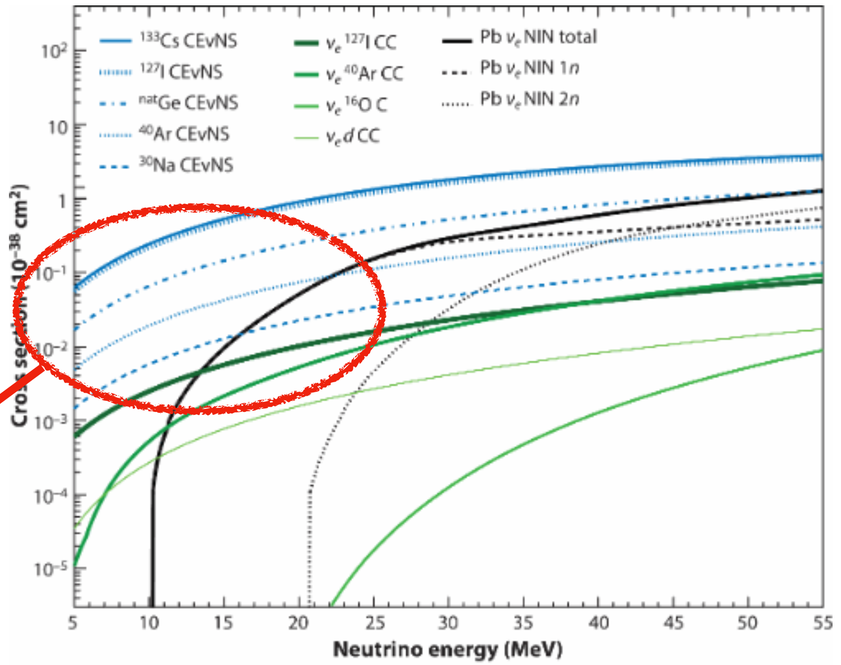
Fermi constant **Weinberg angle** **Form factor**

$$\frac{d\sigma(E_\nu, T)}{dT} \simeq \frac{G_F^2}{4\pi}\left[N - \left(1 - 4\sin^2(\theta_W)\right) Z\right]^2 F^2(q^2) M \left(1 - \frac{MT}{2E_\nu^2}\right)$$

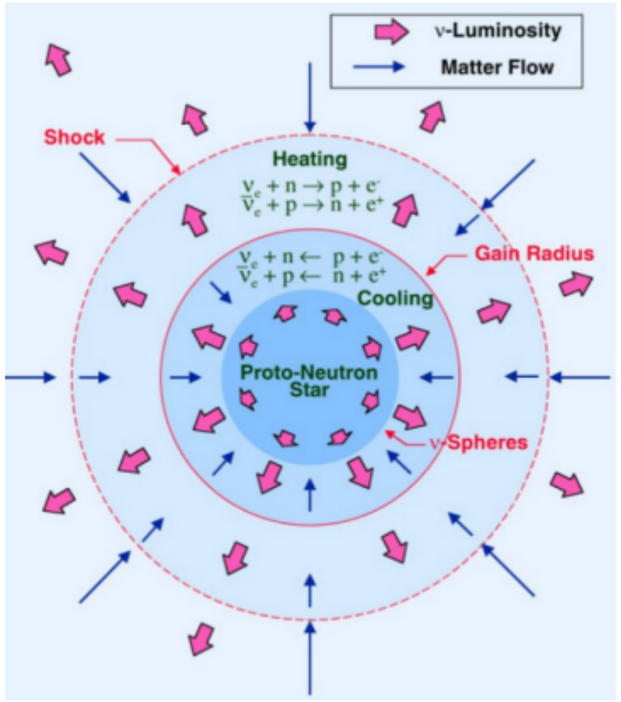
- Total cross-section is **proportional to target** N^2
- **Dominant interaction at low energy** ν (MeV scale)

Ann. Rev. Nucl. Part. Sci. 73 (2023) 41

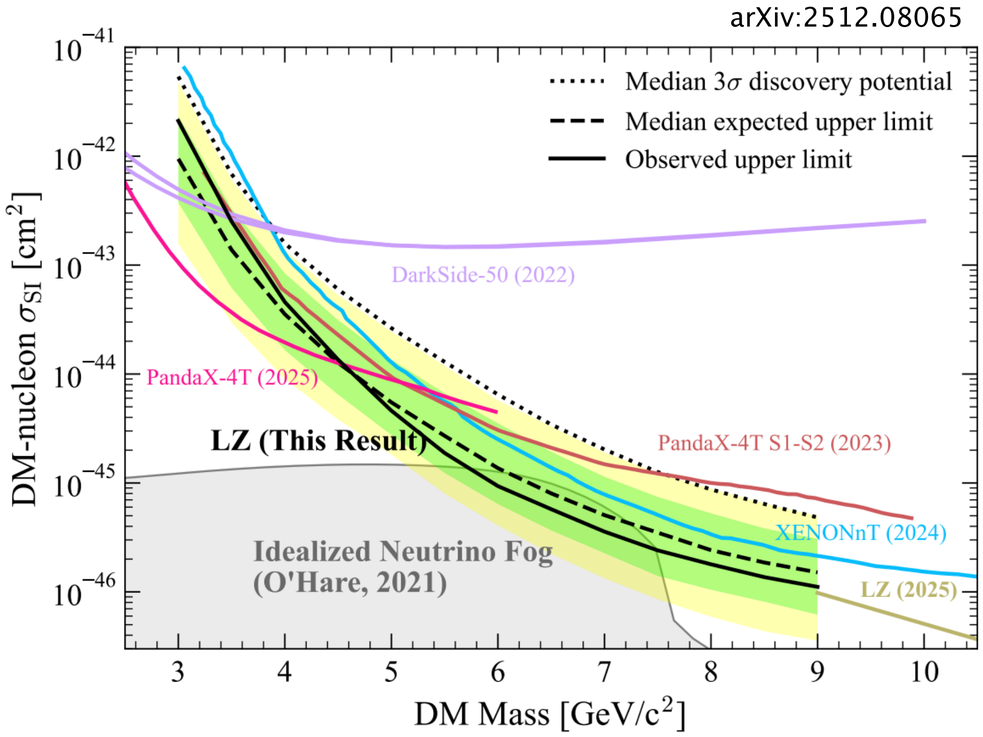
Cross-section according to ν energy in COHERENT



Physical Potential of CEvNS

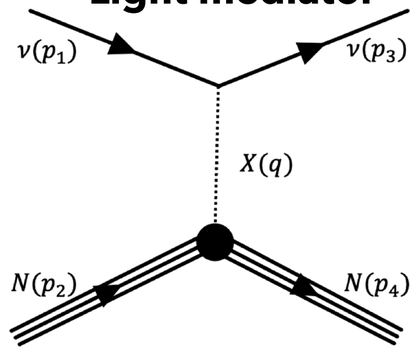


Supernova modeling & detection

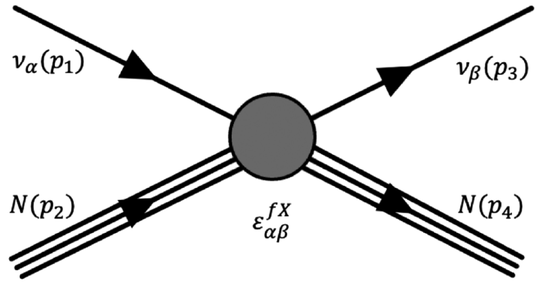


Neutrino fog understanding for direct DM search

Light mediator



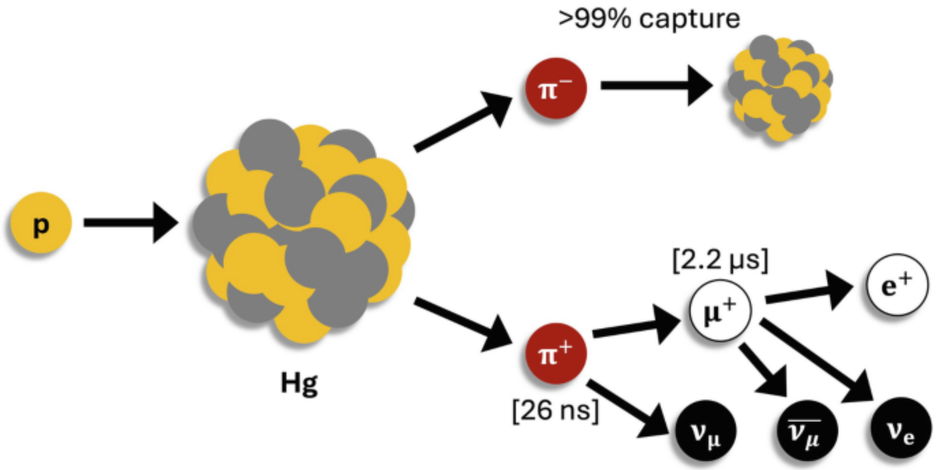
Non standard interaction

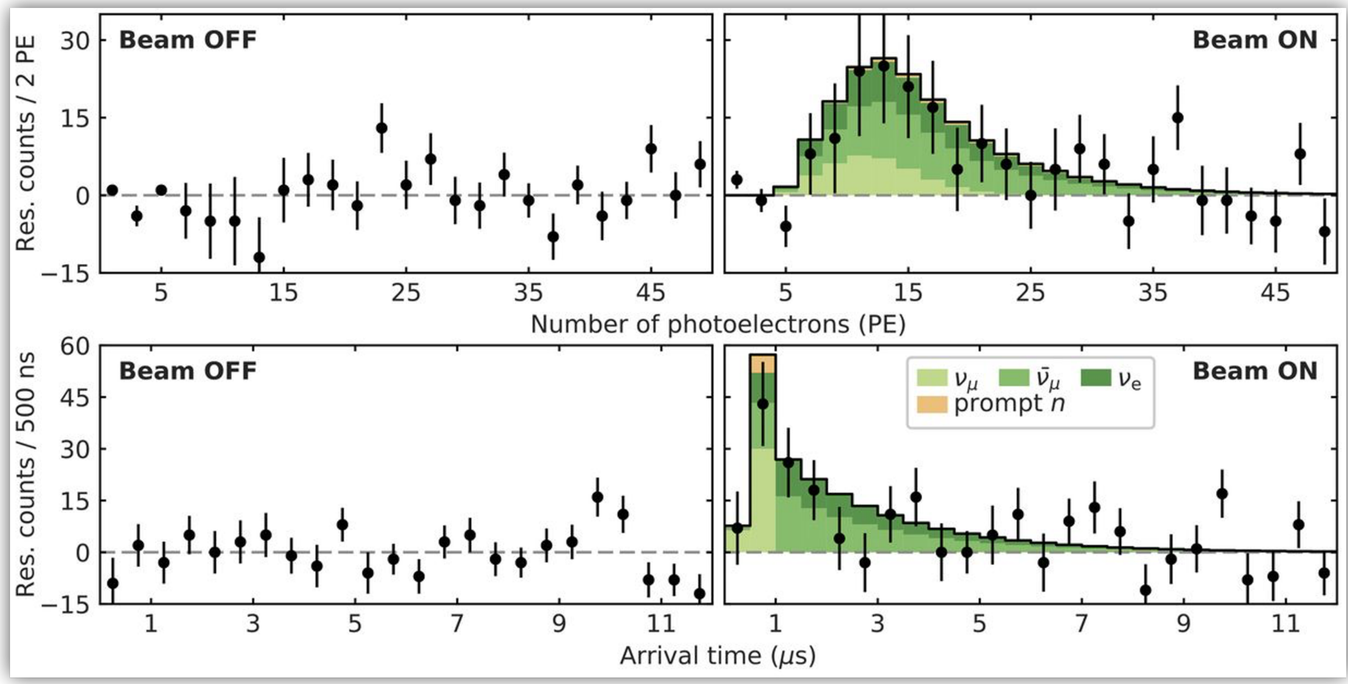


BSM interaction interpretation

Observation History of CEvNS

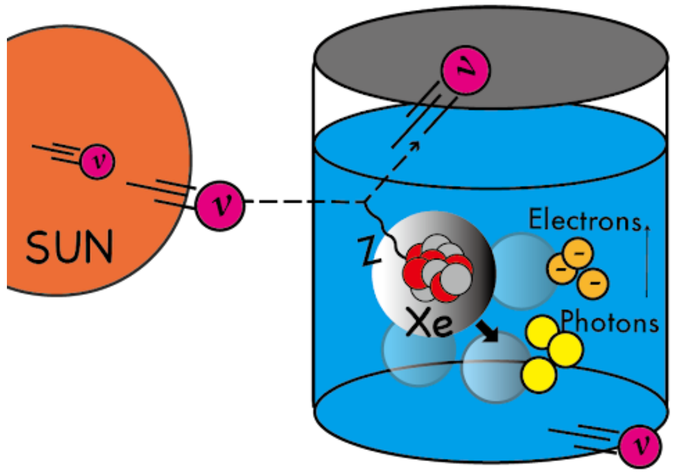
- First observation in 2017 by COHERENT (Sapallation Neutron Source (SNS) $\rightarrow \pi$ DAR).
  - **CsI[Na]** [Science 357, 1123-1126] **LAr** [Phys. Rev. Lett. 126, 012002] **Ge** [Phys. Rev. Lett. 134, 231801]

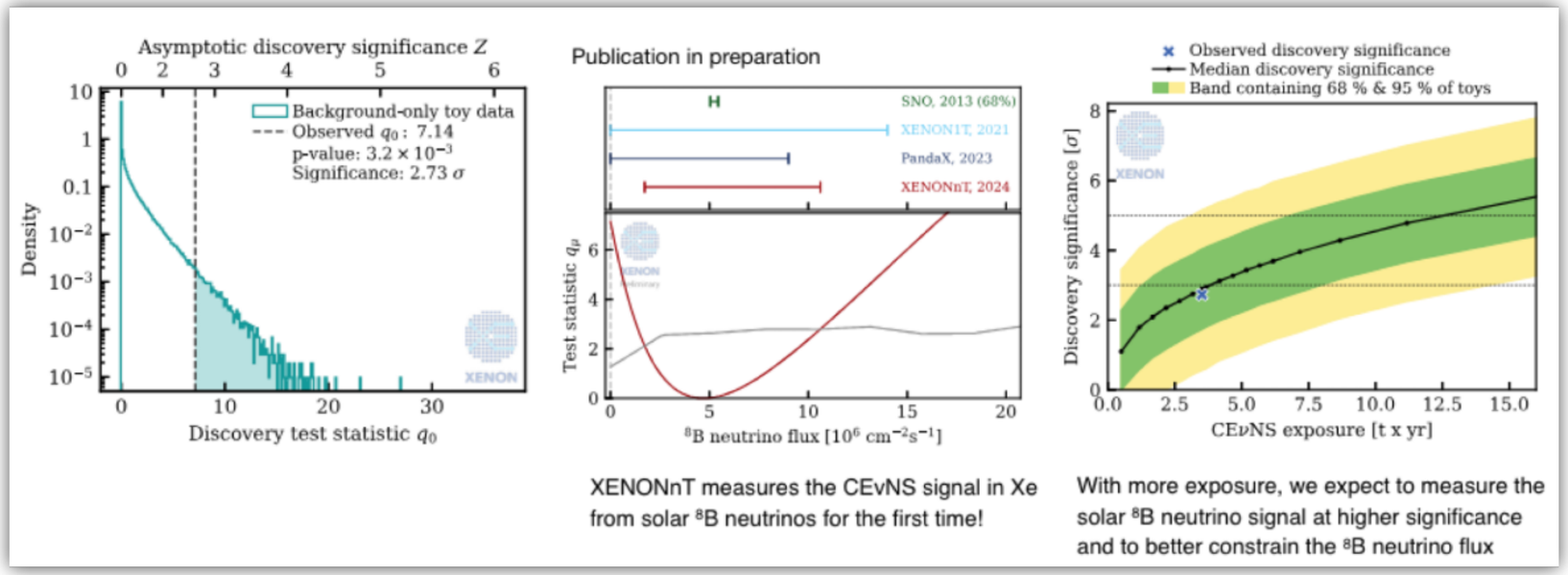




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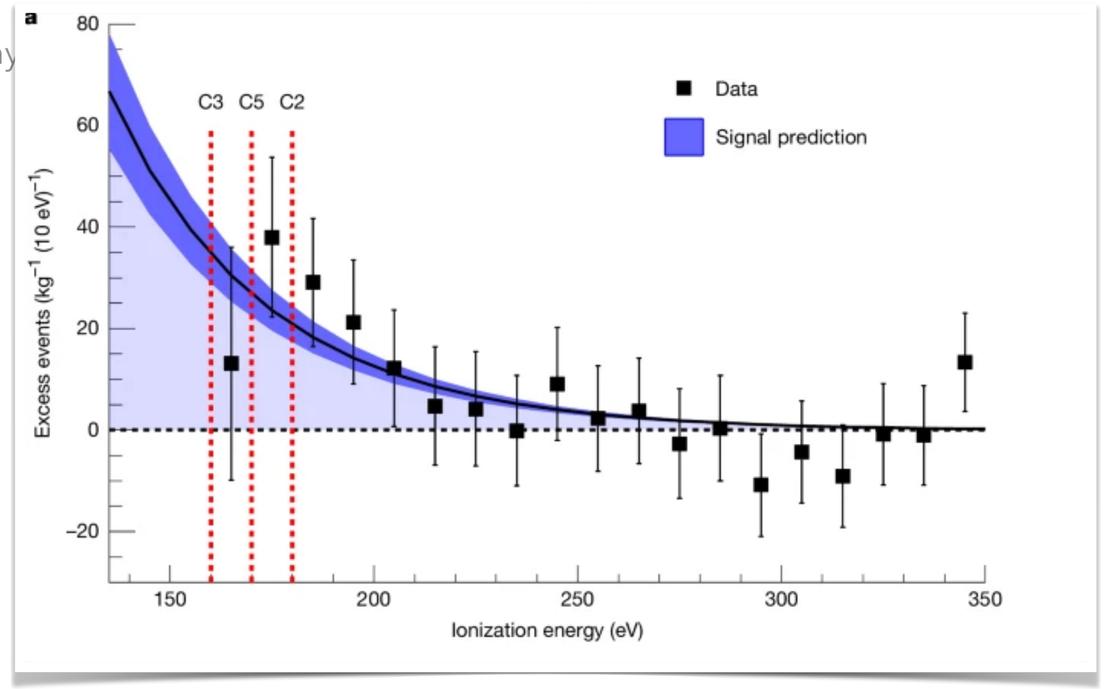
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- Solar ^{8}B ν CEvNS indication by XENONnT & PandaX-4T
  - **(LXe) target at 2.78σ & 2.64σ** [Phys. Rev. Lett. 133, 191002] & [Phys. Rev. Lett. 133, 191001]





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- **Reactor** ν CEvNS observed by the CONUS+ in 2025.
  - **(HPGe) target at 3.7σ** [Nature 643, 1229–1233 (2025)



NEON experiment



- NEON : **N**eutrinos **E**lastic scattering **O**bservation with **N**aI(Tl)
  - Reactor ν detection, using NaI(Tl) targets
  - Primal goal : **CEvNS detection**
- ~20 collaboration members
  - Active members from COSINE-100 & NEOS

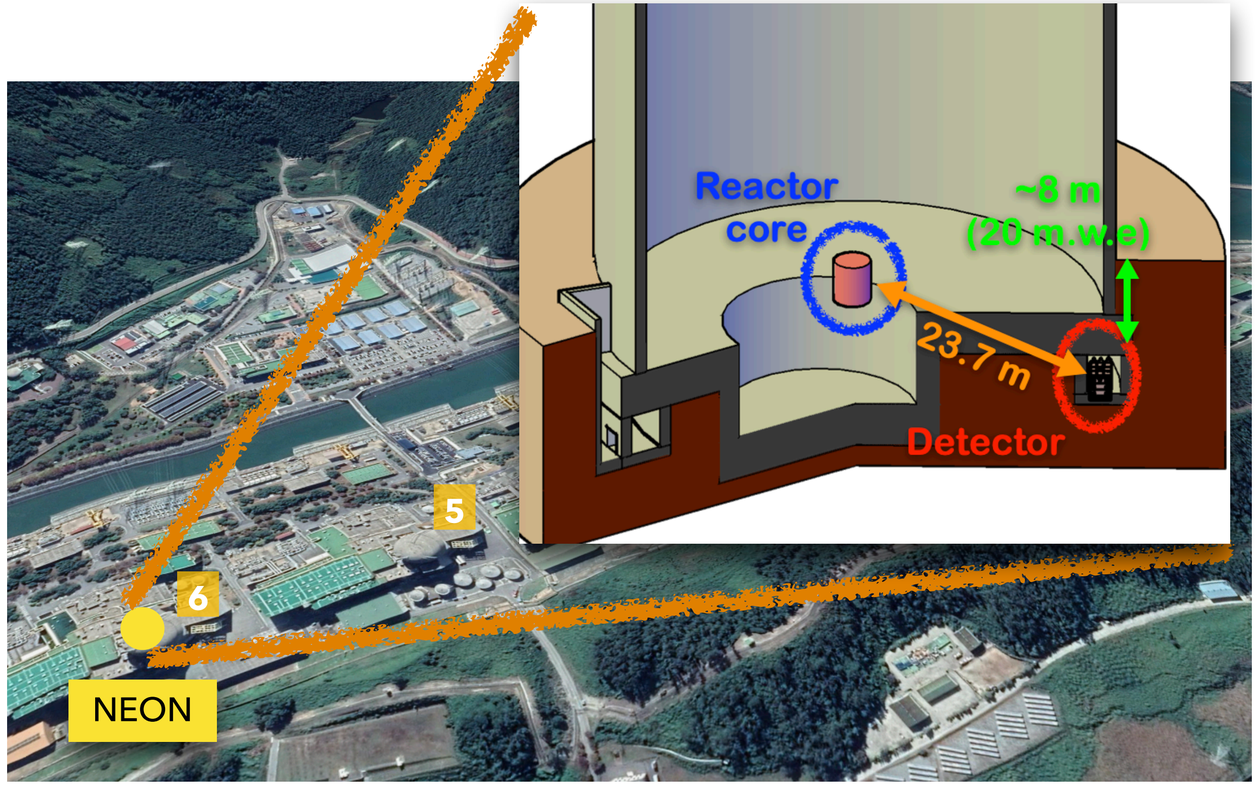
NEON Strategy : Reactor

Source : Reactor Neutrino

- Site : Hanbit Nuclear Power Plant, Yeonggwang
- Single flavor ($\bar{\nu}_e$) from β decay
- Rich ν flux : ~ 8.09 × 10^{12}/cm^2/sec at **24 m**
- Low energy ν (< 10 MeV)

  → **CEvNS dominant region**

  → **Low recoil energy**



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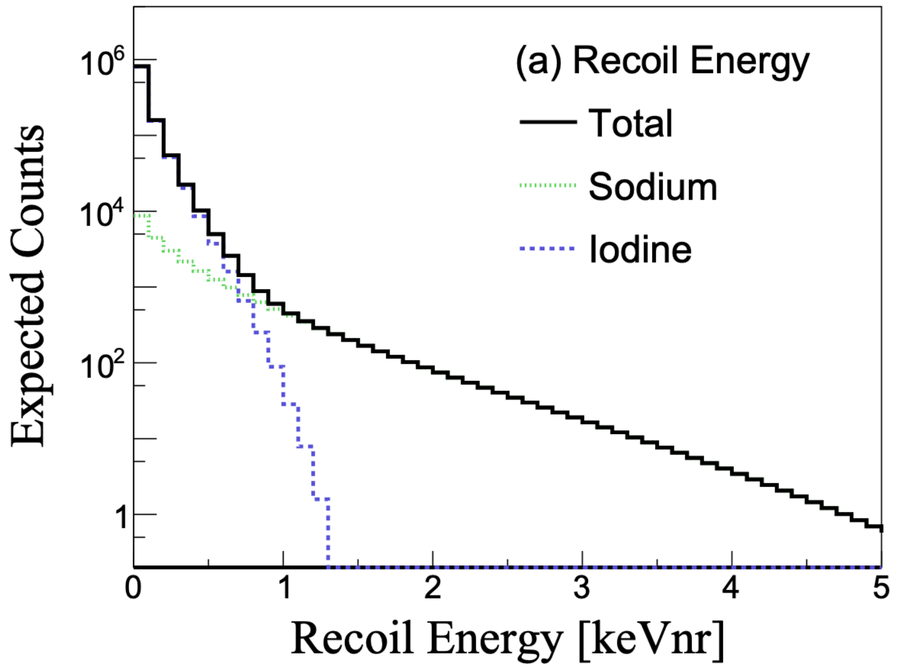
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Target : NaI(Tl) crystals

- Enables large recoil energy for Na from low-E ν

CEvNS Recoil energy comparison between Na & I



NEON Strategy : Reactor & NaI

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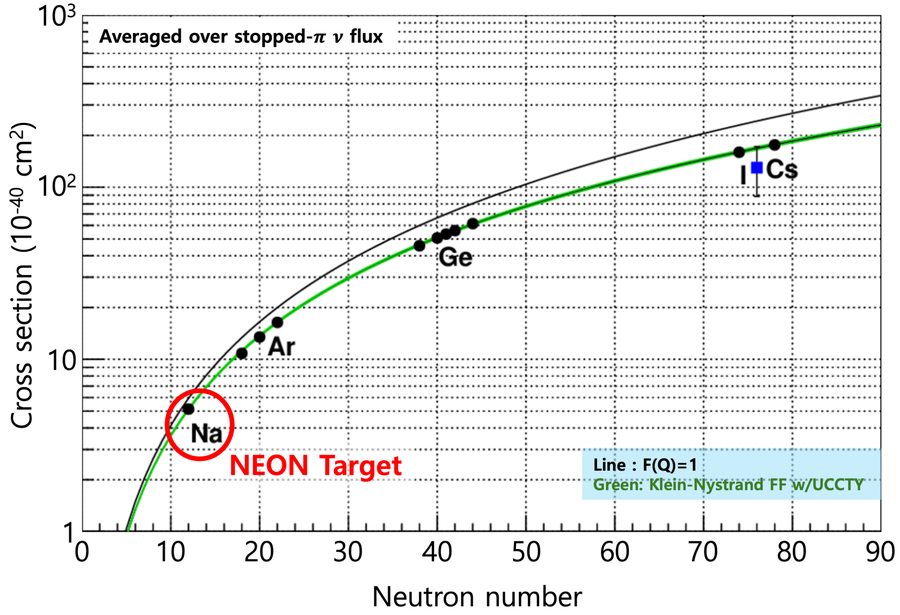
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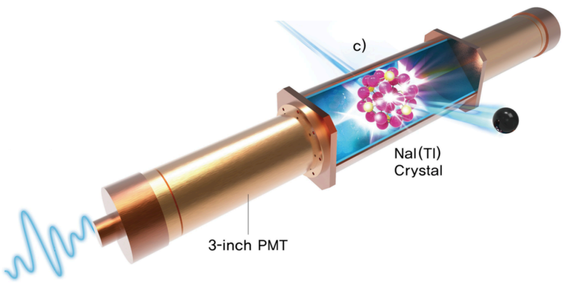
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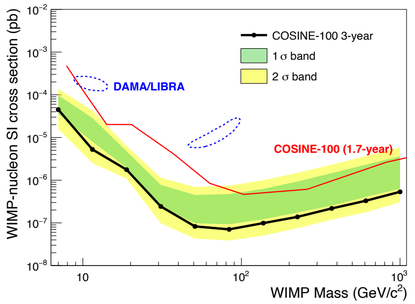
  → **Low recoil energy**

Target : NaI(Tl) crystals

- Enables large recoil energy for Na from low-E ν
- Unexplored target : F(q) & axial-vector term understanding
- **Experiences from COSINE-100**
  - High light yield & controlled background.

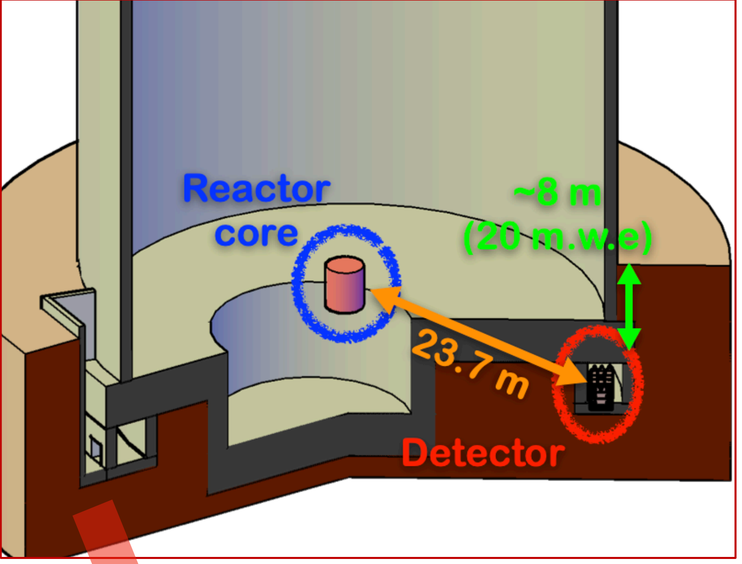
WIMP search using NaI(Tl) @ COSINE-100



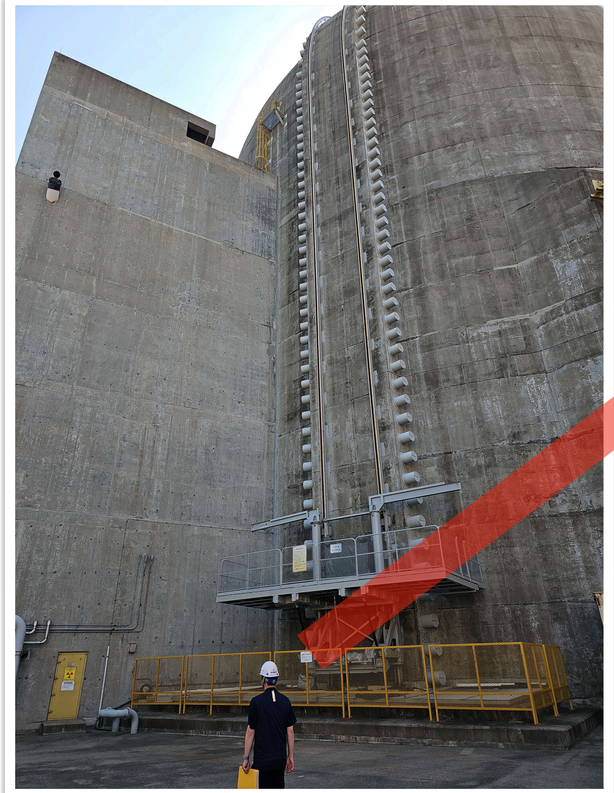


Similar detector & analysis strategy!

NEON Detector Site



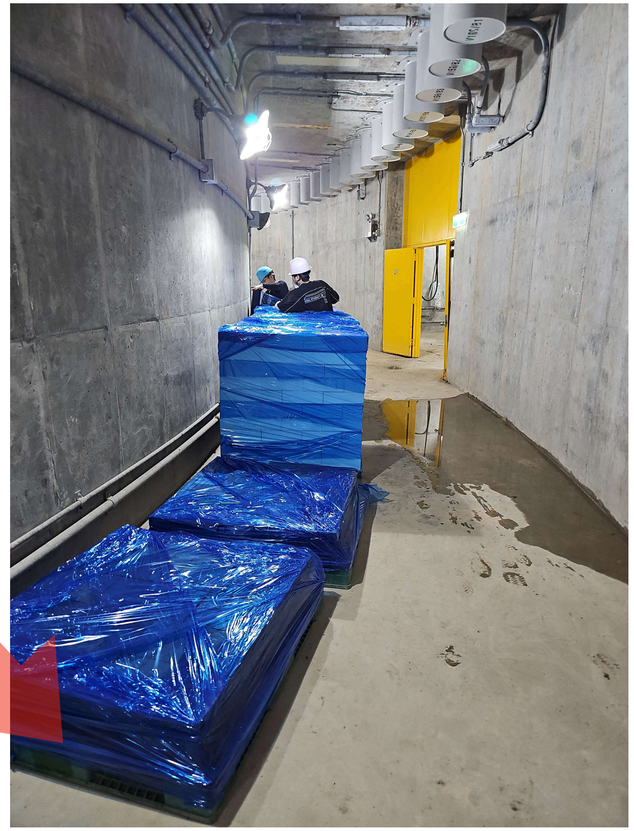
Hanbit nuclear power plant unit 6



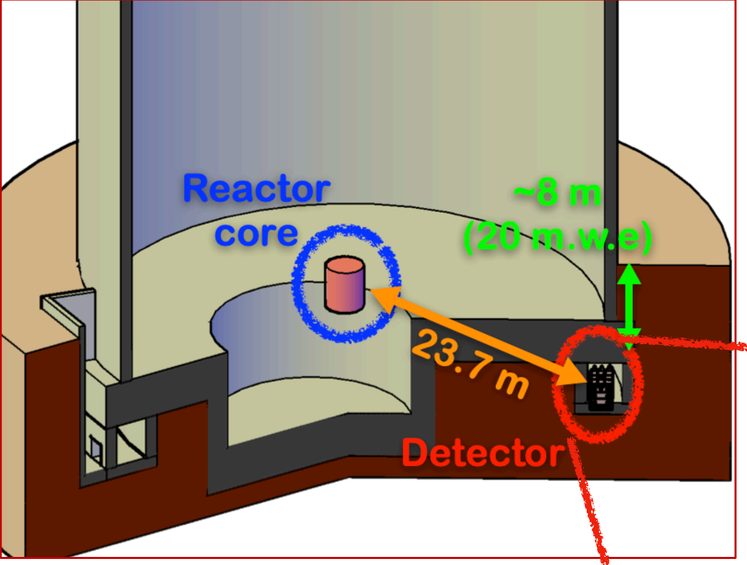
Entrance to
Tendon gallery



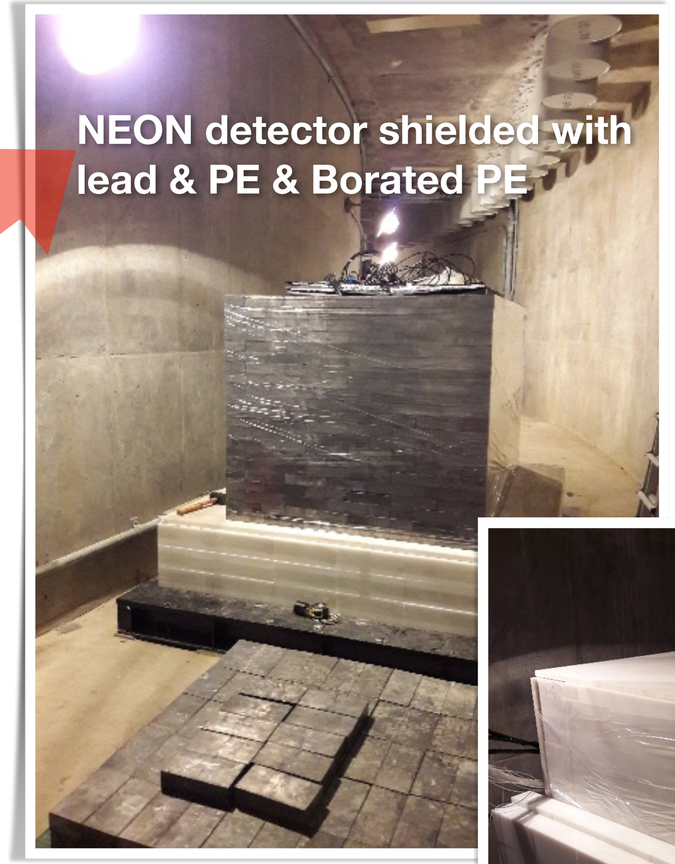
Tendon gallery



NEON Detector Site

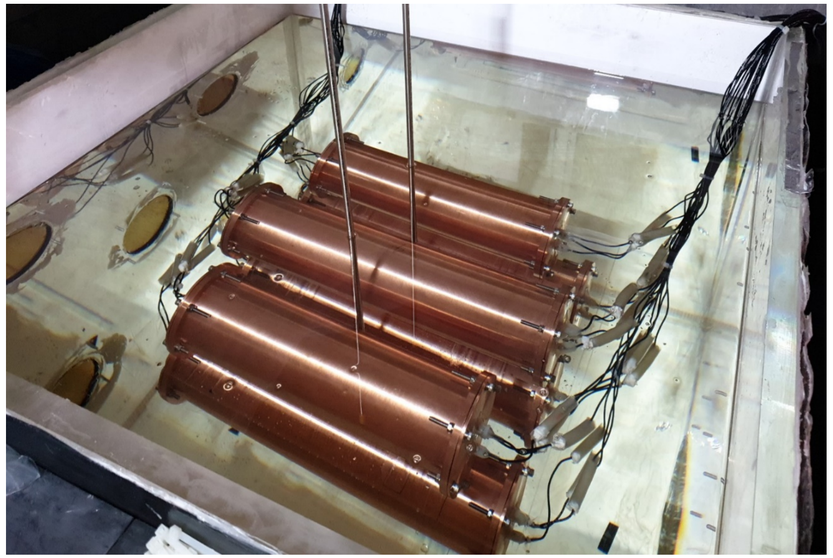








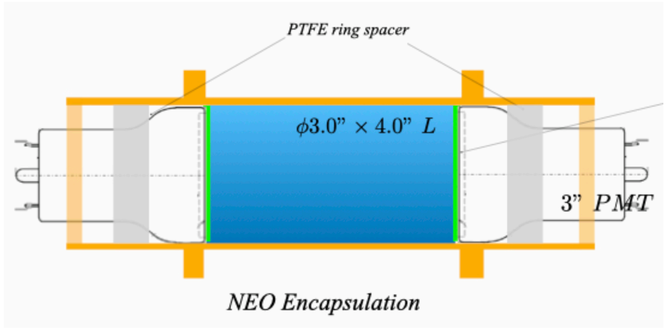
NEON Detector Design



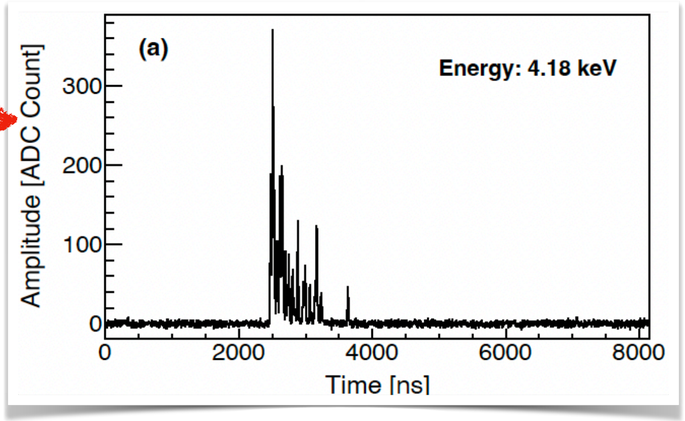
Detector	Mass (kg)	size (inch, D×L)	Light yield w/o LG (PEs/keV)	Light yield w/ LG (PEs/keV)
DET-1	1.67	3 × 4	22.0±0.4	25.3±0.6
DET-2	3.34	3 × 8	25.6±1.1	27.8±1.4
DET-3	1.65	3 × 4	21.8±0.5	23.3±0.9
DET-4	3.34	3 × 8	23.7±0.4	25.4±0.7
DET-5	3.35	3 × 8	22.4±0.5	23.6±0.8
DET-6	3.35	3 × 8	25.0±0.5	27.9±0.7

NaI(Tl) targets w/ 2 PMTs each

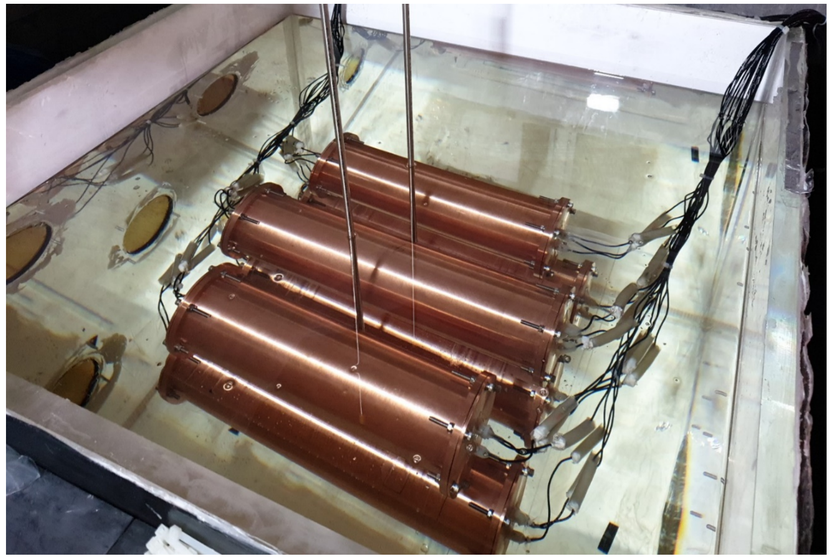
- 6 NaI(Tl) detectors (16.7 kg total)



Scintillation waveform example



NEON Detector Design

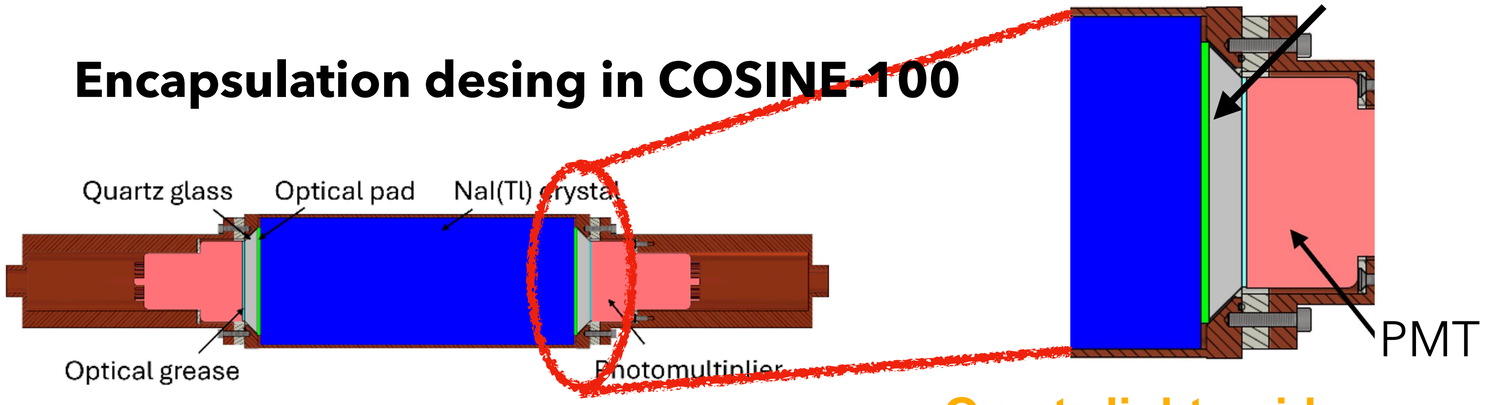


NaI(Tl) targets w/ 2 PMTs each

- 6 NaI(Tl) detectors (16.7 kg total)
- **New encapsulation technique** :

~15 PE/keV → **~24 PE /keV in NEON** (~ 5 PE for 200 eV threshold)

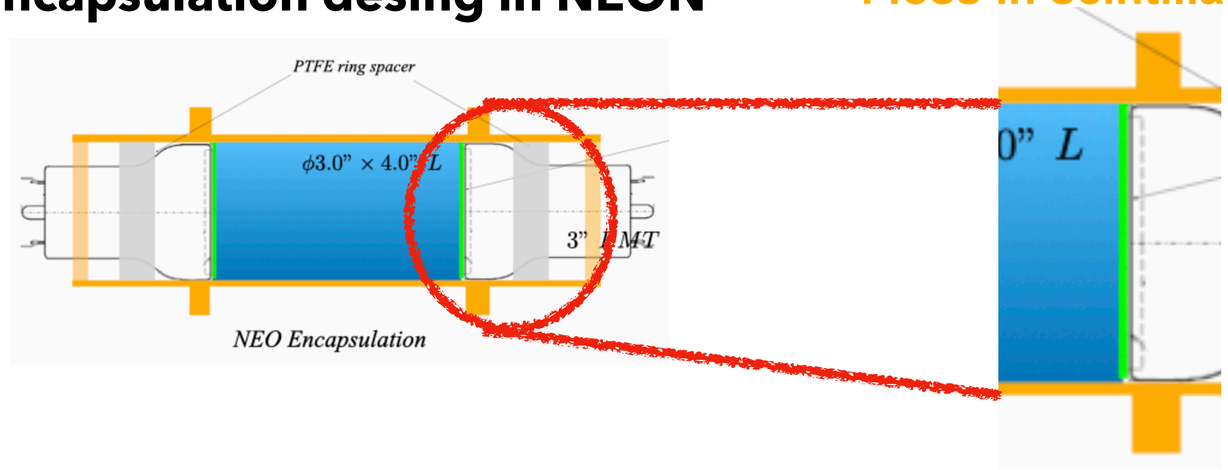
Encapsulation desing in COSINE-100



Quartz light guide

: loss in scintillation light

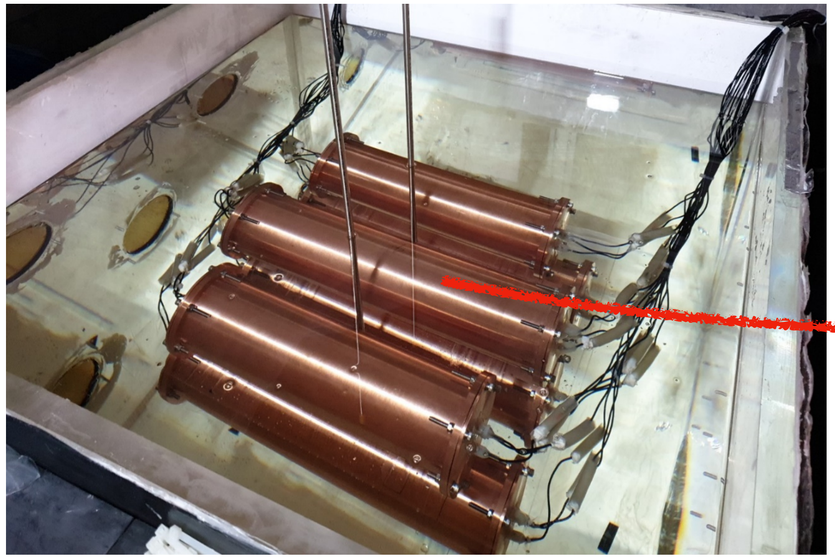
Encapsulation desing in NEON

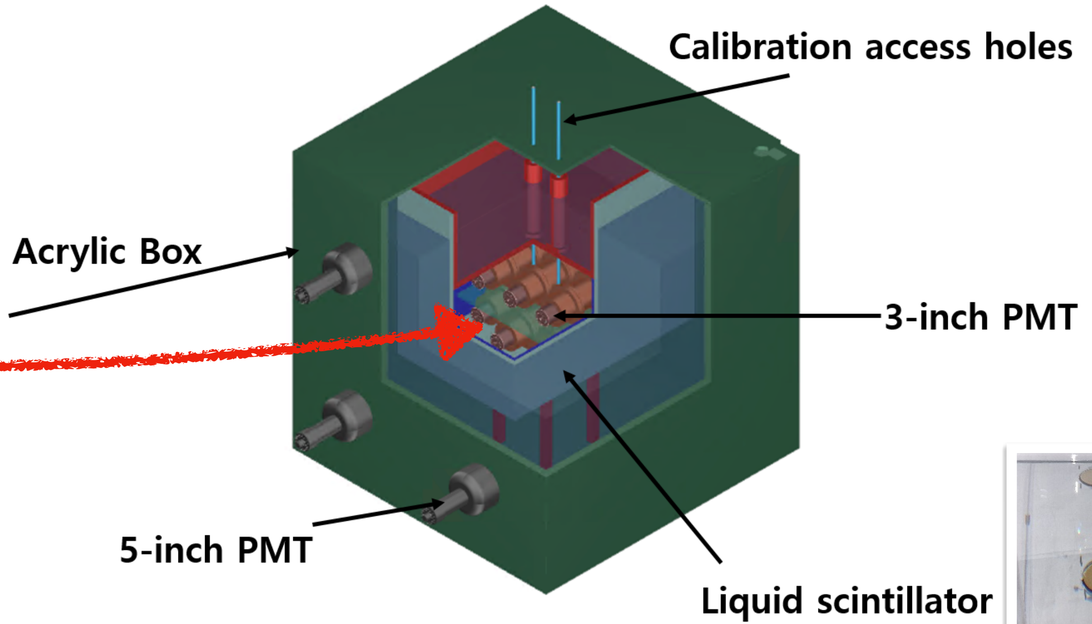


No quartz light guide

: efficient light collection

NEON Detector Design



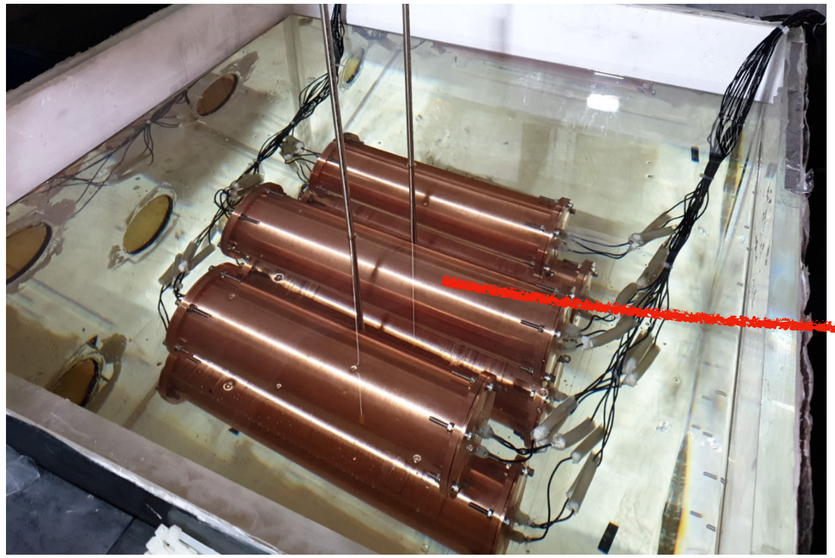


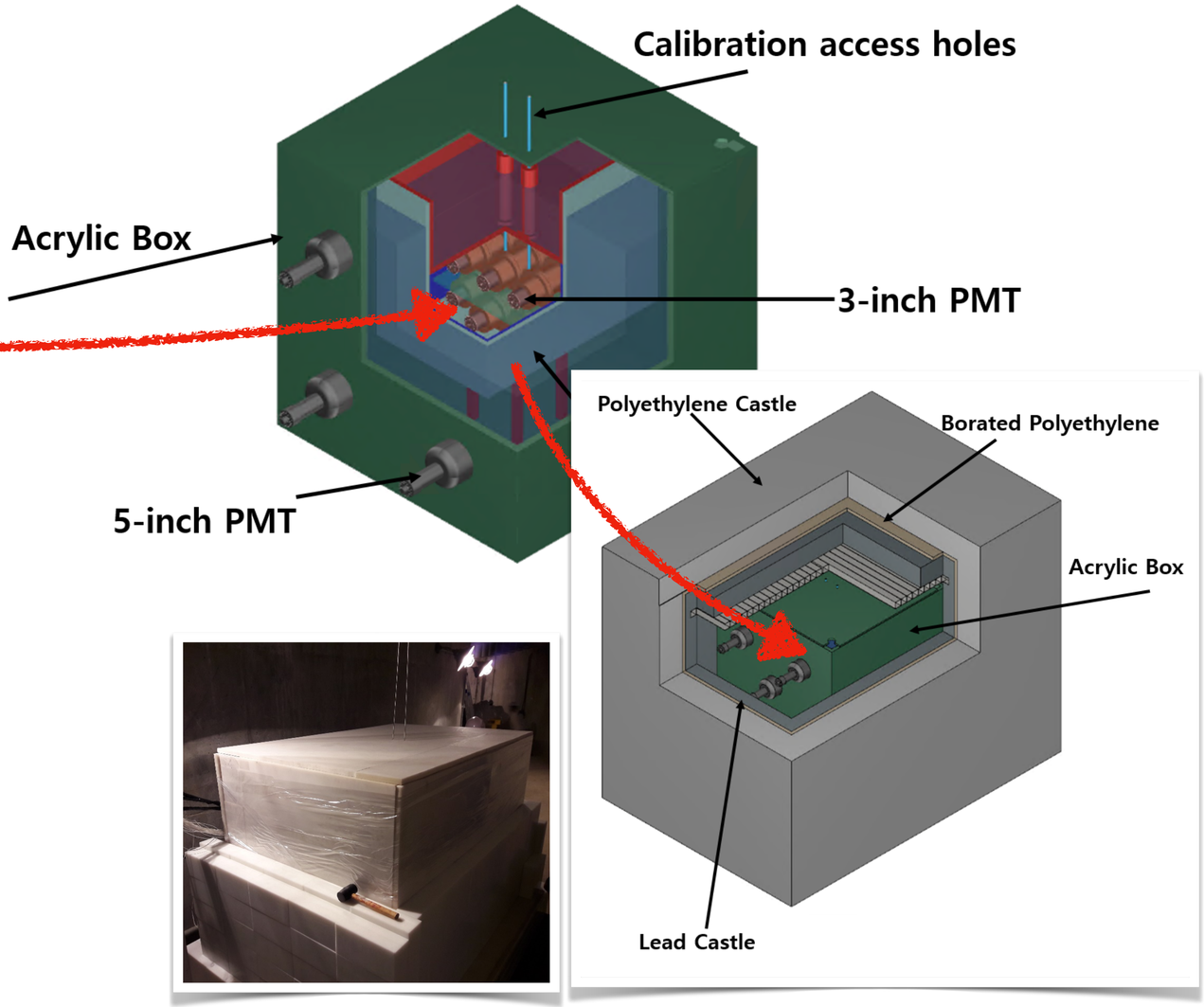


Active Shield

- Crystals immersed into 800L Liquid scintillator (LS).
- LS signal collected with 10 PMTs.
- Gives an efficient method for background rejection, with time-coincidence between crystal and LS.

NEON Detector Design





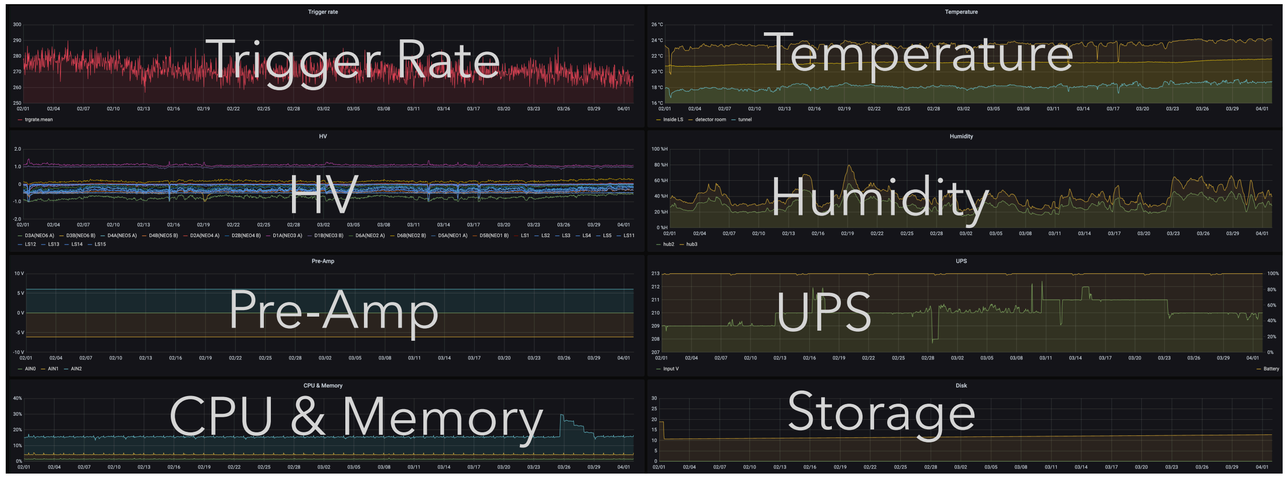
Passsive Shield

- 10/15 cm lead shield
- 2.5 cm Borated Polyethylene (PE)
- 20/30 cm PE blocks.

NEON Data taking

Monitoring

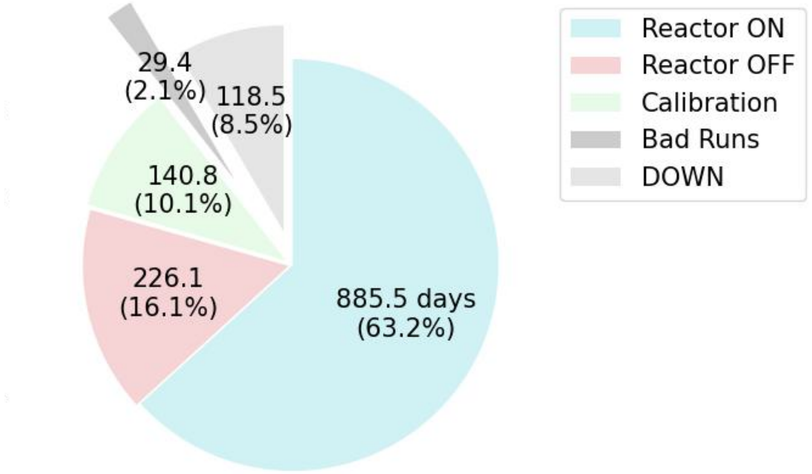
- Trigger rate
- Electronics status
- Environmental parameters



NEON Data taking

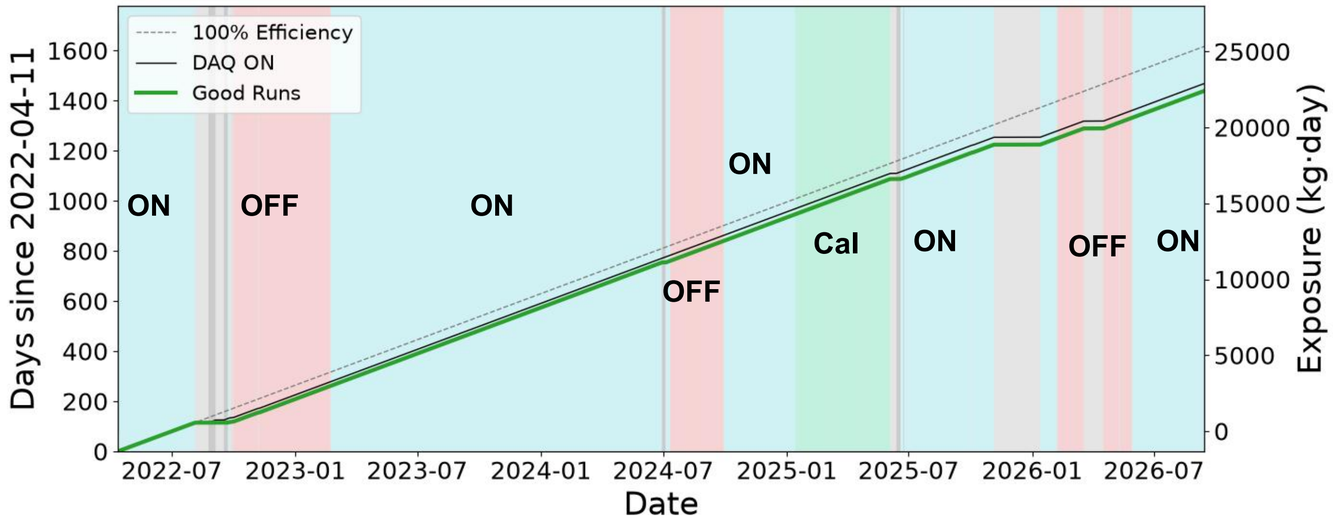
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Exposure

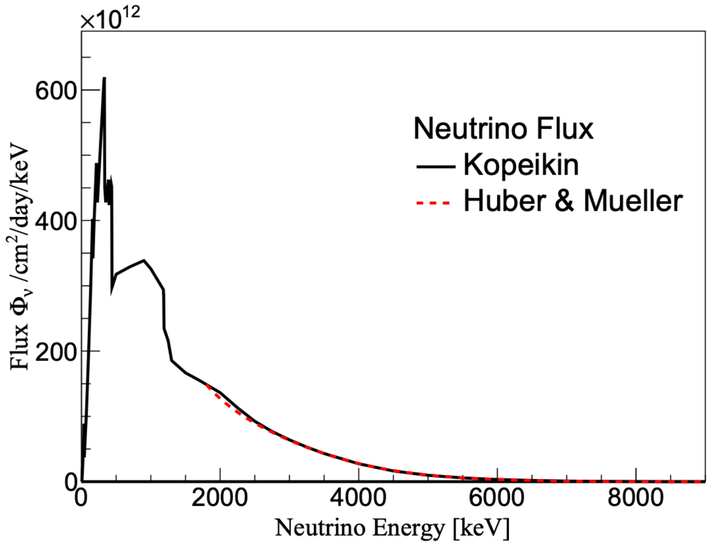
- Apr. 11, 2022 ~ Sep.14, 2026
- ~21681.61 kg · day exposure
- ON/OFF ratio : 994.7/303.6 days



CEvNS search in NEON

CEvNS spectrum simulation

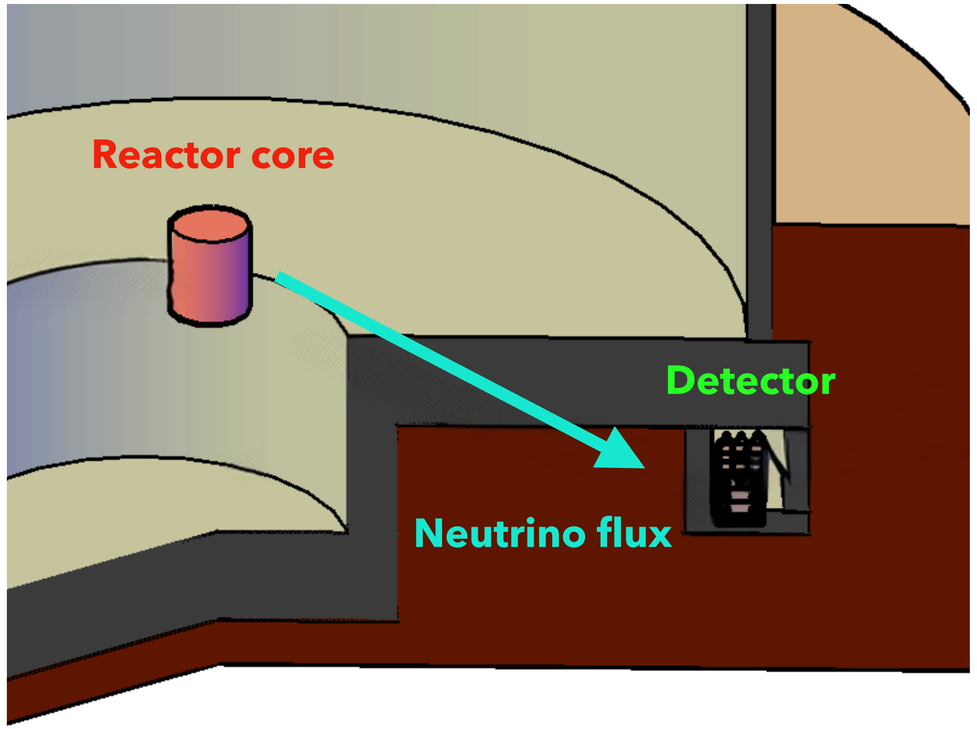
Neutrino flux @ 24m from core



$$\Phi(E_\nu) = \frac{1}{4\pi L^2} \sum_i f_i \phi_i(E_\nu) \frac{P_{\text{th}}}{\langle E_r \rangle}$$

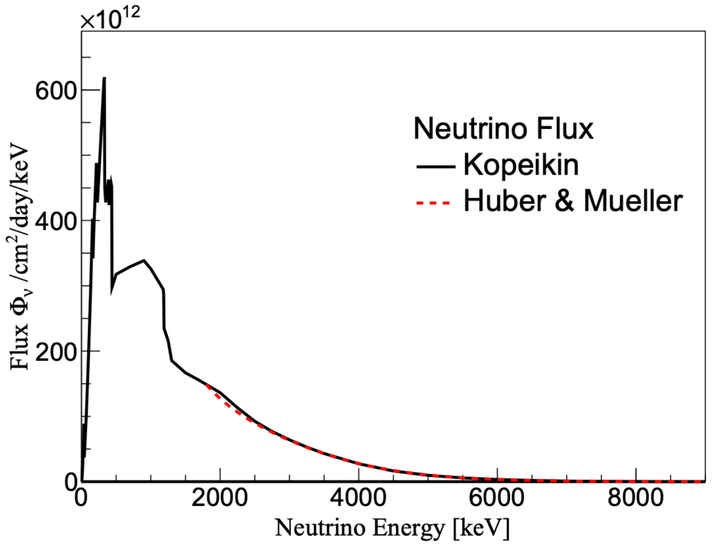
P_{th} : 2.815 GWth

$f_i\phi_i$: neutrino flux for each isotope fission (used Kopeikin model)



CEvNS spectrum simulation

Neutrino flux @ 24m from core

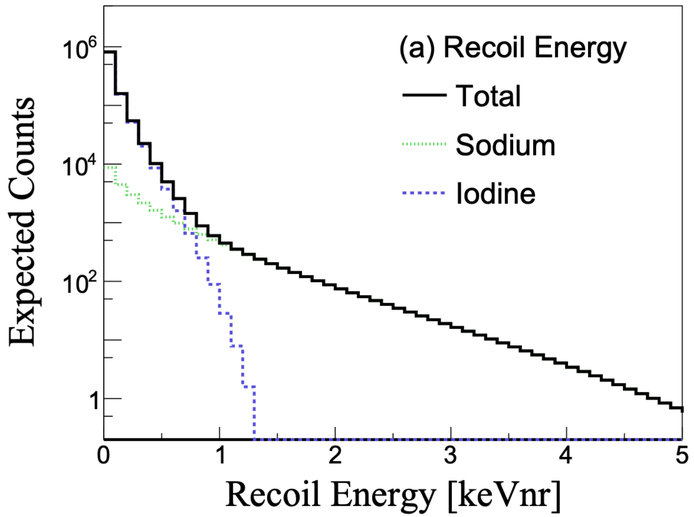


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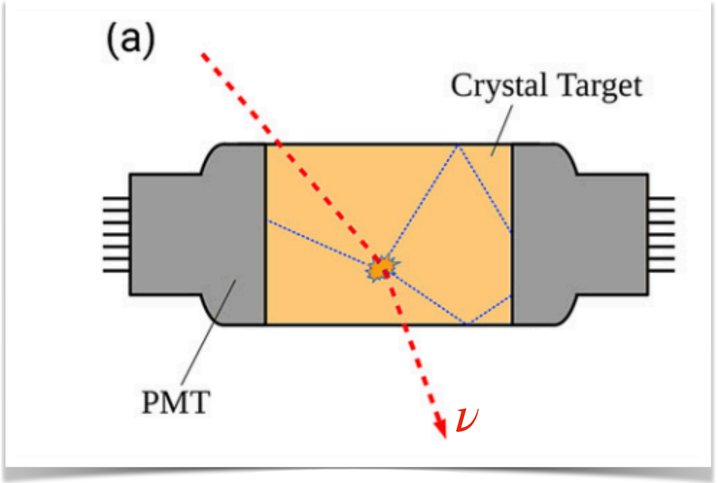
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CEvNS recoil spectrum w/ NaI



$$\frac{dR}{dE_{\text{rec}}} = n_t \int_{E_{\text{thr}}}^{\infty} dE_\nu \Phi(E_\nu) \frac{d\sigma}{dE_{\text{rec}}}(E_\nu)$$

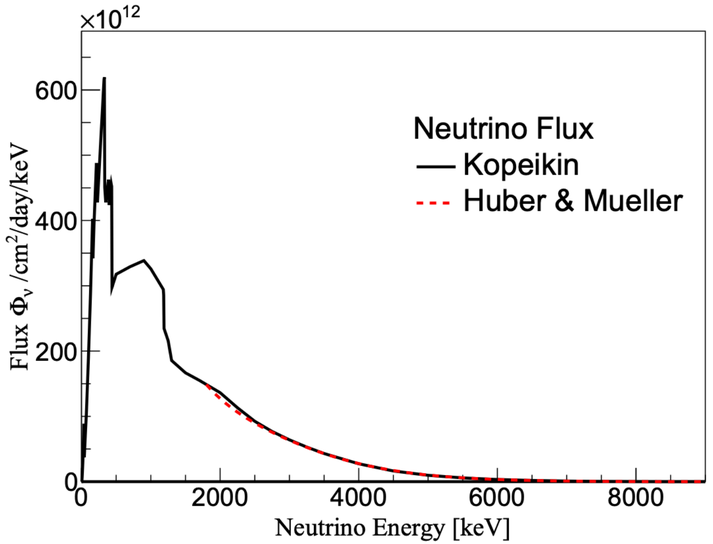
Sodium signal is dominant over detector threshold !



$$\frac{d\sigma}{dE_{\text{rec}}} = \frac{G_F^2 m_A}{4\pi} \left(1 - \frac{m_A E_{\text{rec}}}{2E_\nu^2}\right) Q_{\text{w}}^2$$

CEvNS spectrum simulation

Neutrino flux @ 24m from core

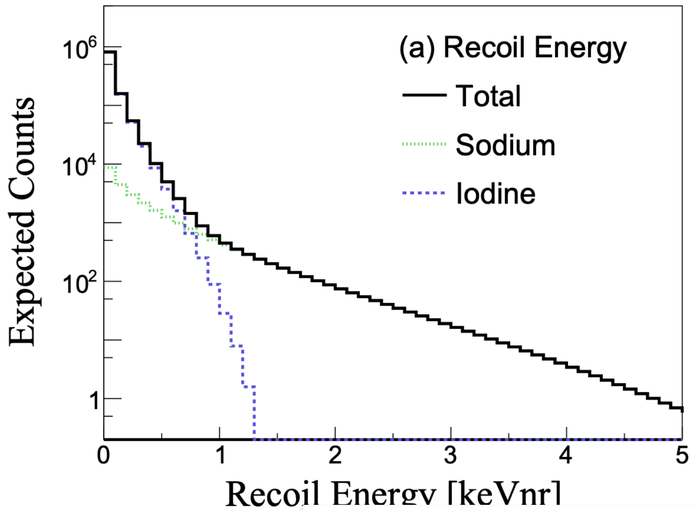


$$\Phi(E_\nu) = \frac{1}{4\pi L^2} \sum_i f_i \phi_i(E_\nu) \frac{P_{\rm th}}{\langle E_r \rangle}$$

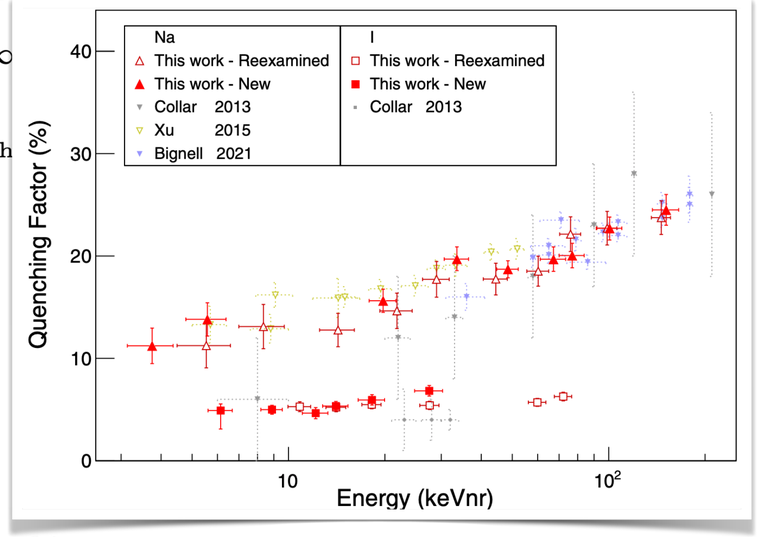
P_{th} : 2.815 GWth

$f_i\phi_i$: neutrino flux for each isotope fission (used Kopeikin model)

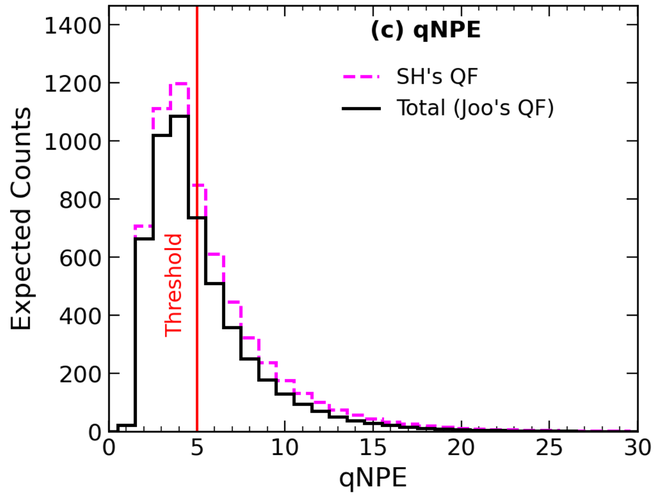
CEvNS recoil spectrum w/ NaI



$$\frac{dR}{dE_{\rm rec}} = n_t \int_{E_{\rm th}}^{\infty}$$



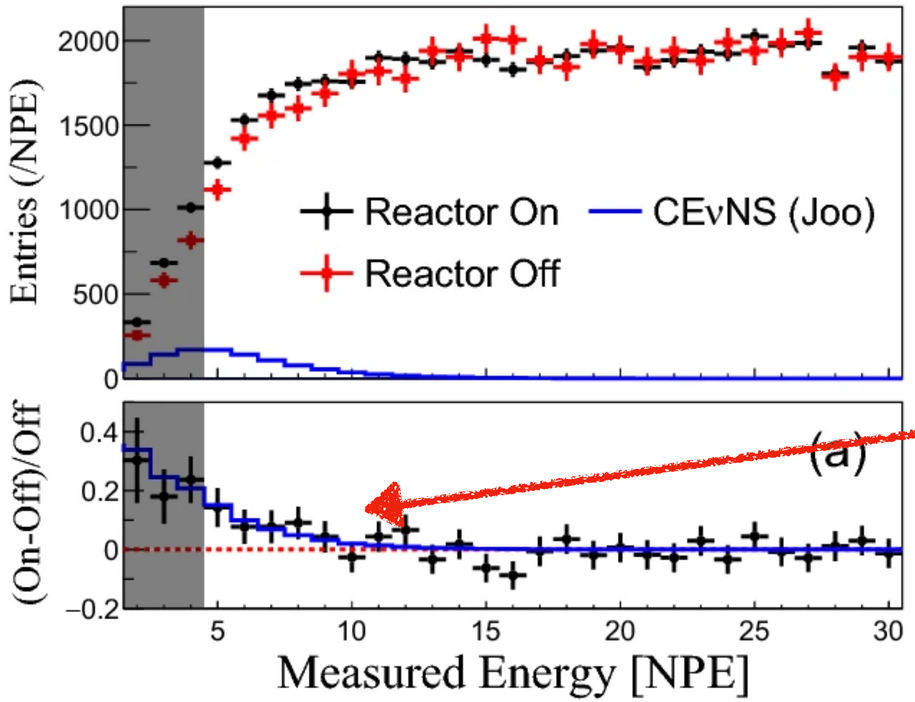
Expected CEvNS spectrum in NEON



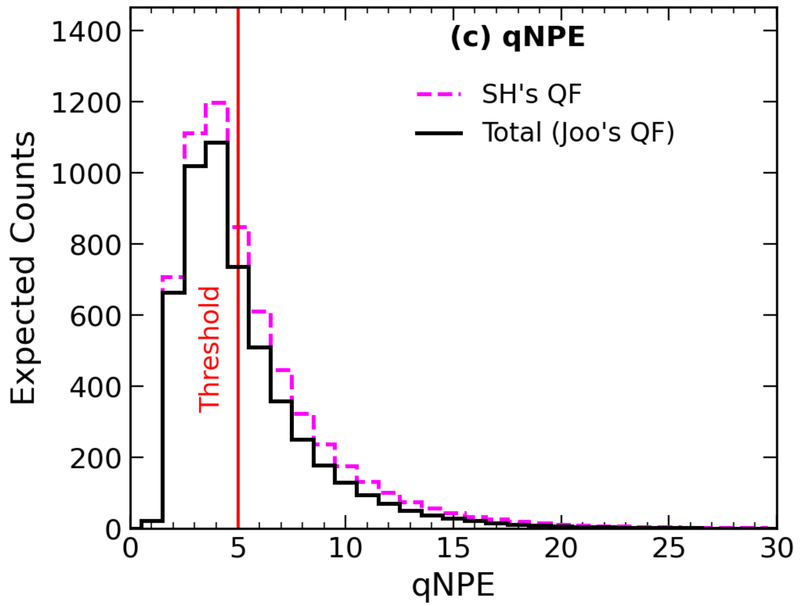
Quenching & Detector Resolution

CEvNS detection strategy

CEvNS analysis with simulation data



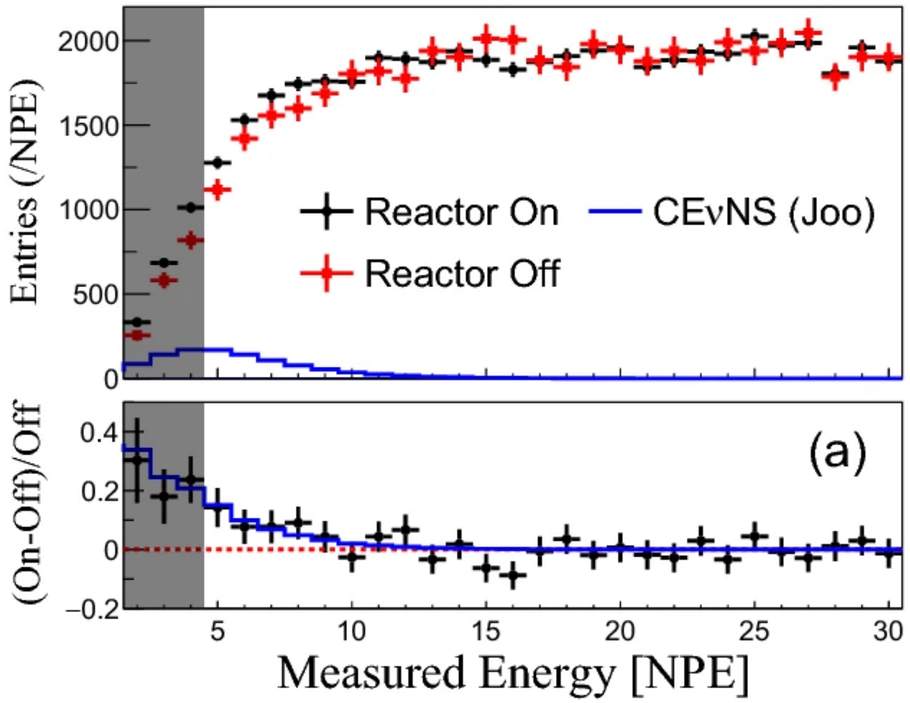
Expected CEvNS spectrum in NEON

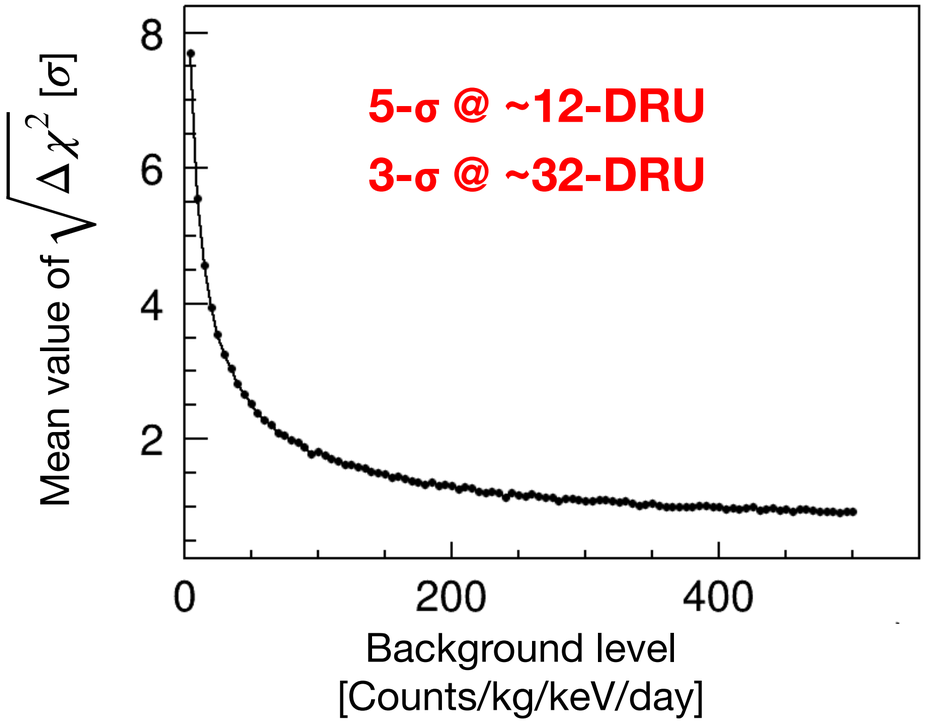


- **'Reactor On - Reactor Off' remains only neutrino-induced events.**
- 700 days Reactor On & 200 eV threshold & 10% QF → **~1290 CEvNS expected**

CEvNS detection strategy

CEvNS analysis with simulation data

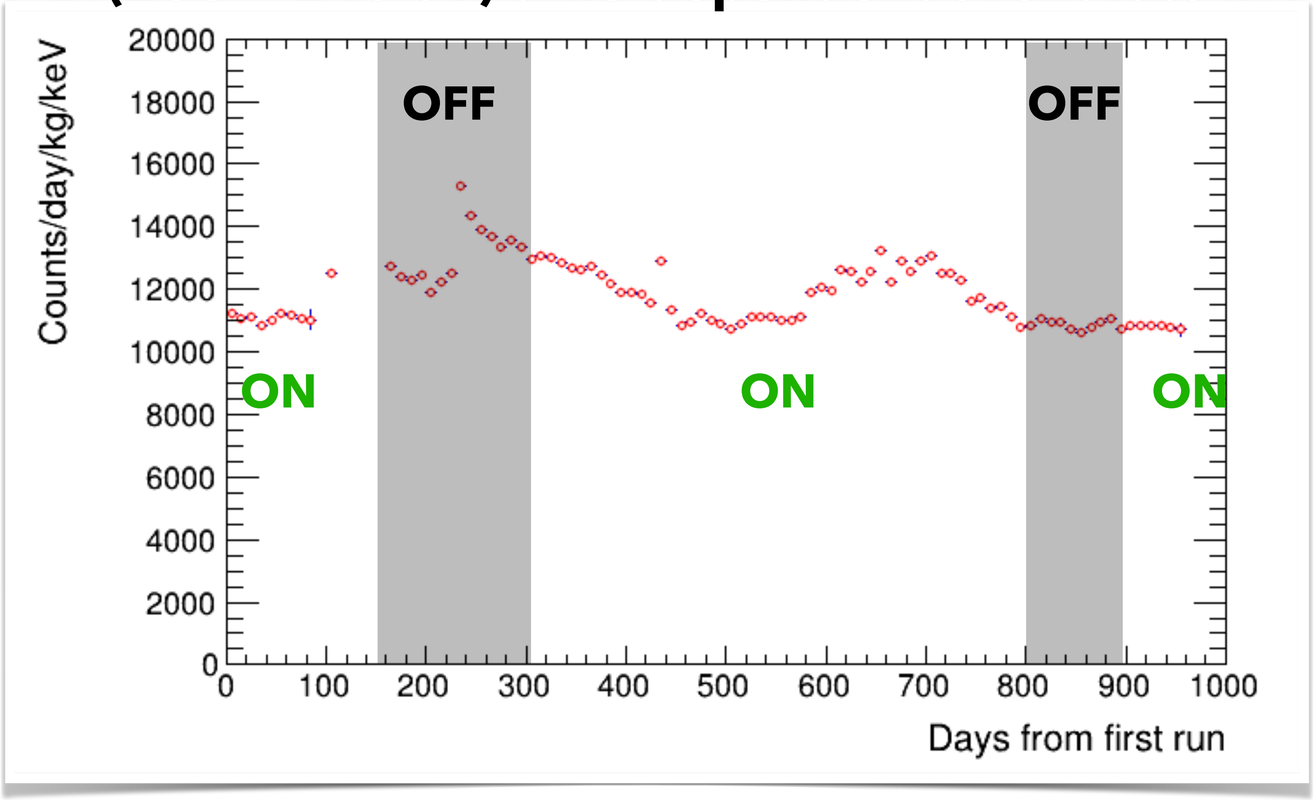




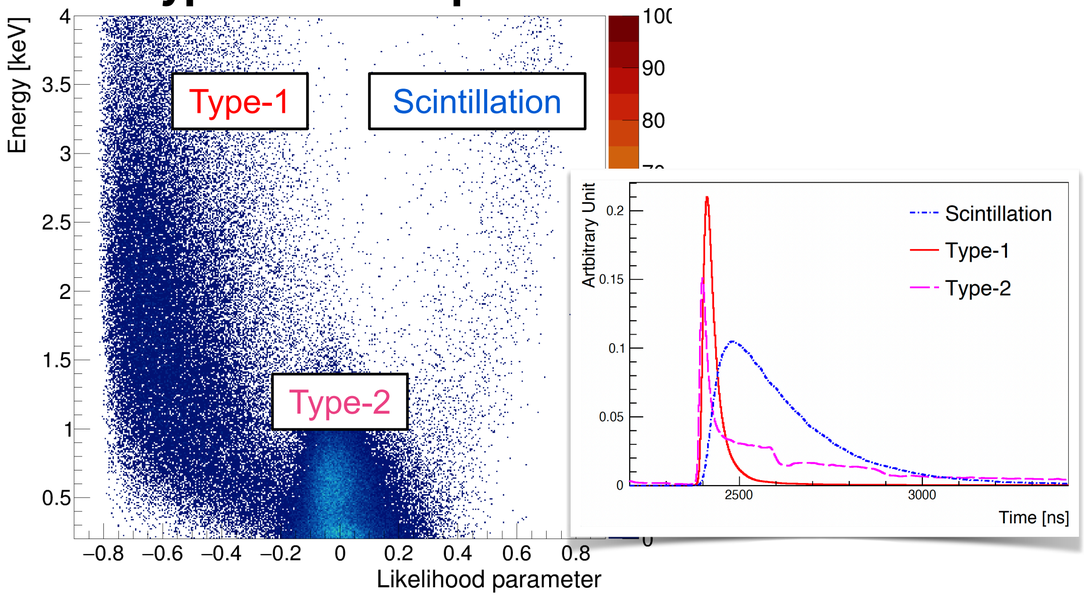
- **'Reactor On - Reactor Off' remains only neutrino-induced events.**
- 700 days Reactor On & 200 eV threshold & 10% QF → **~1290 CEvNS expected**
- **200eV threshold & Background rate < 32 counts/kg/keV/day** is required for 3σ

Too noisy NEON data

5 P.E. (200 ~ 240 eV) time-dependent event rate in NEON Detector 4



Event types with PSD parameter



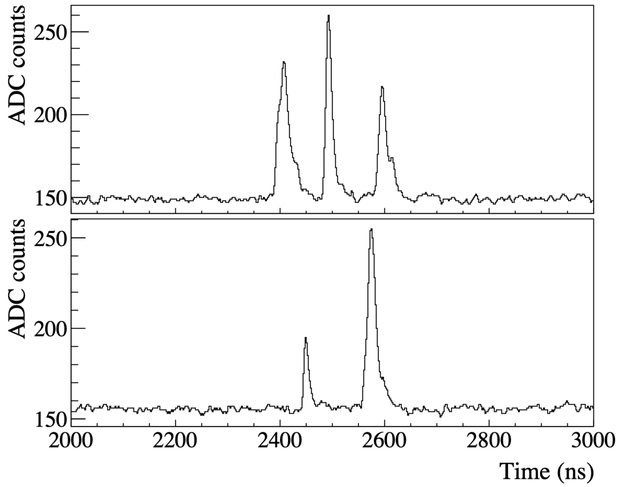
Large noise contamination in NEON data

- PMT induced noise contaminates the data
- Fluctuation → ON-OFF is impossible

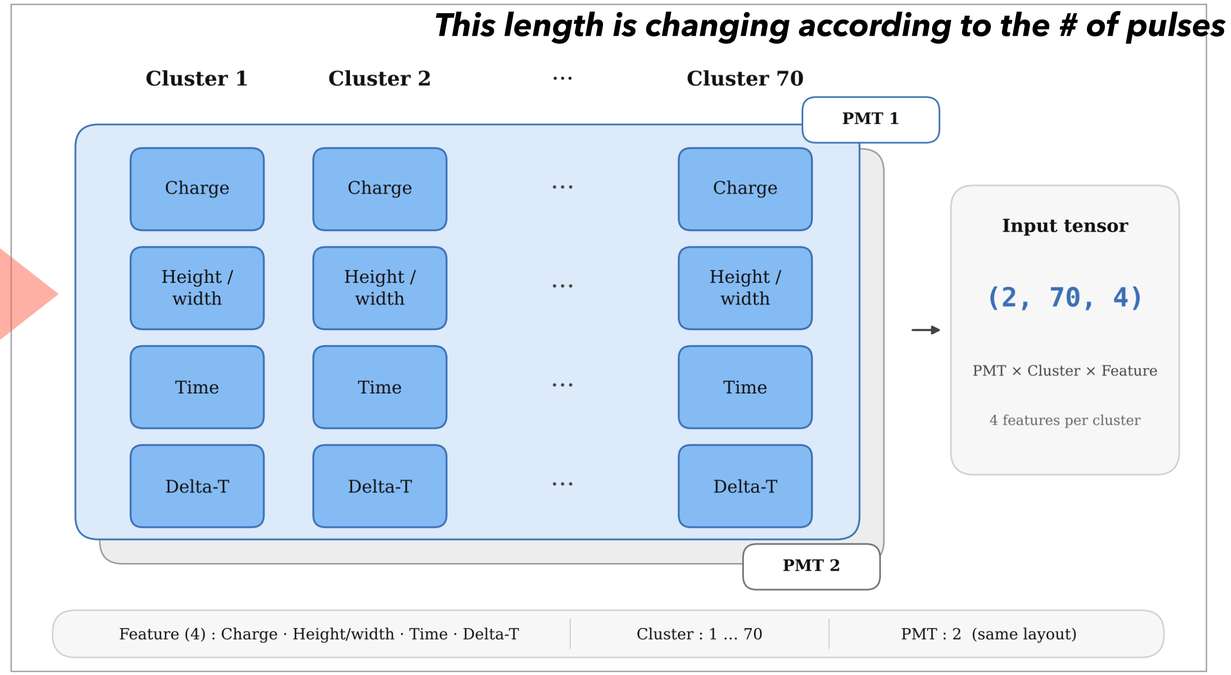
Precise noise selection is required !

Event selection

Deep Learning training



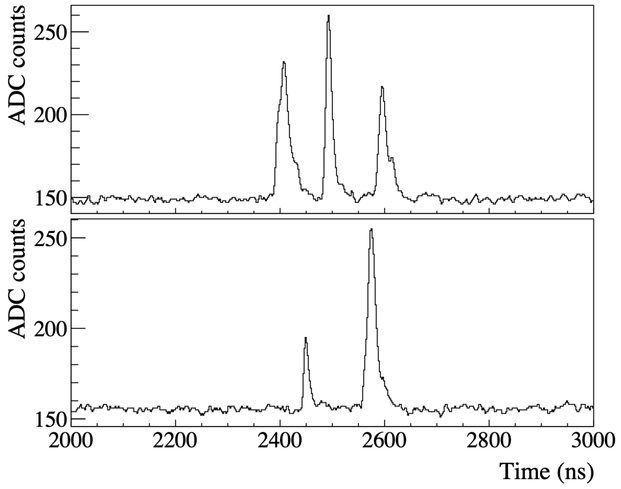
Extract

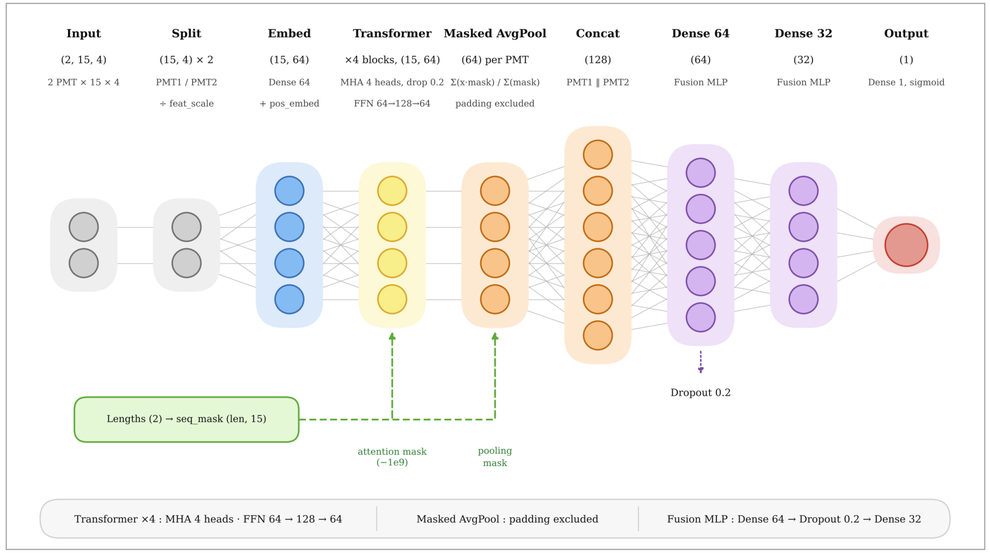


- **Transformer training** after extracting waveforms' feature : Charge, Height/width, Time, delta-T

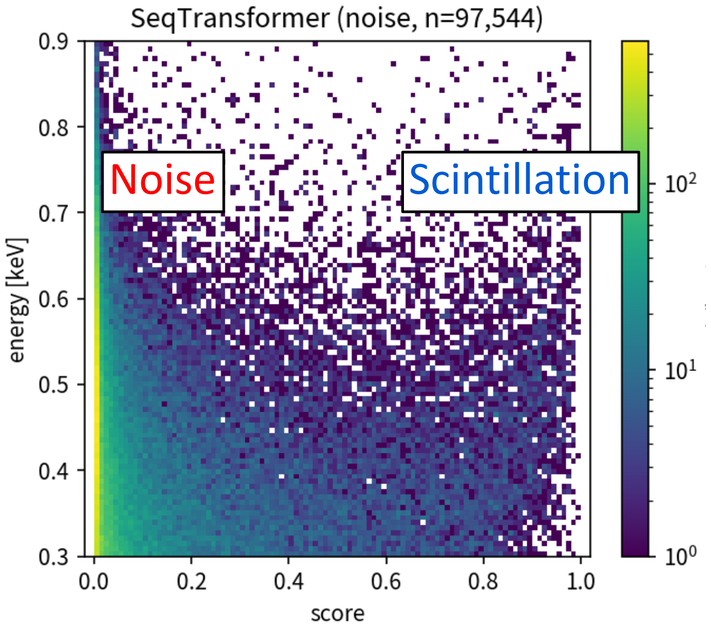
Event selection

Deep Learning training





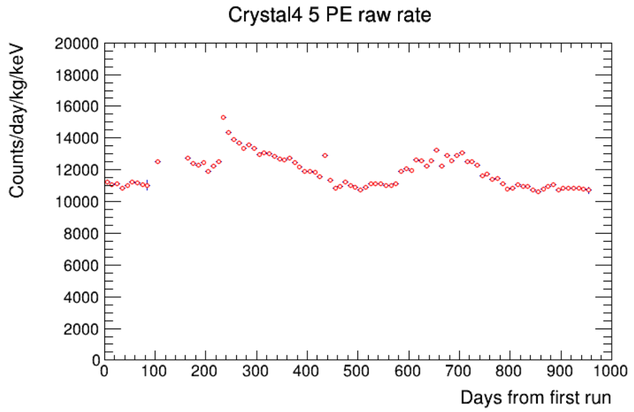
Concept of Transformer training



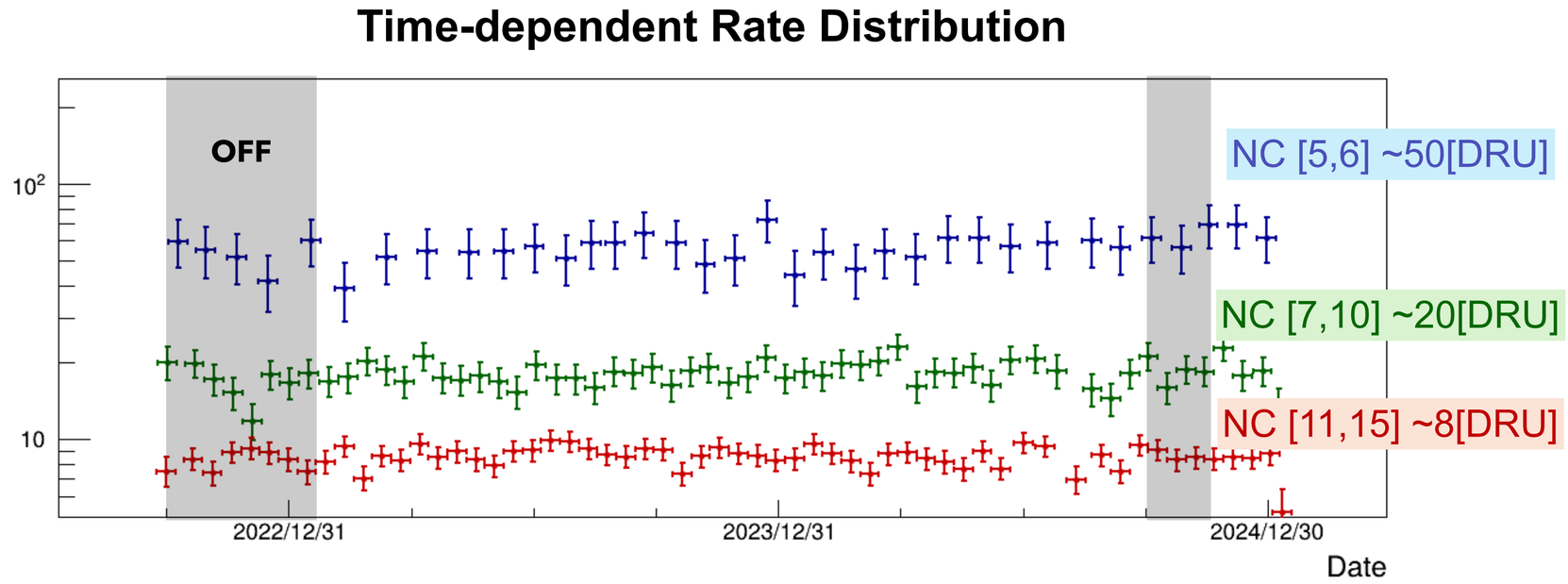
- **Transformer training** after extracting waveforms' feature : Charge, Height/width, Time, delta-T
- **Signal : WF simulation** | **Noise : Physics data**
- Clear noise separation power can be found in 2D spectrum.

Event selection

Deep Learning training



Noise Rejection



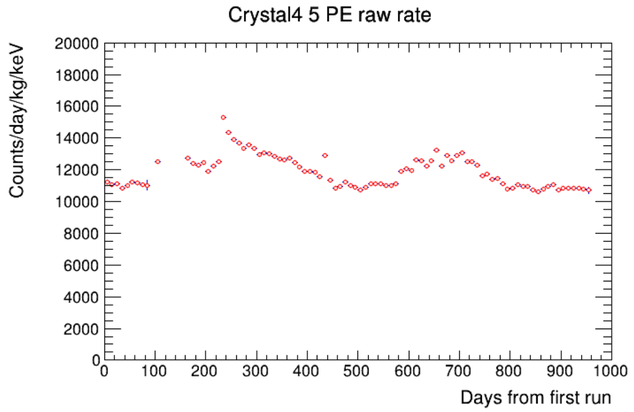
NC : number of clusters (pulses)

NC 5 ~ 0.4 keV

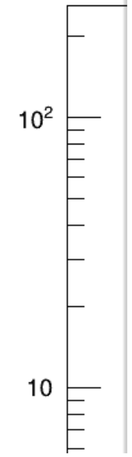
- Relatively **stable event rate over time** achieved after DL selection
- **Fine tuning still required** for 3σ level requirement (36 DRU)

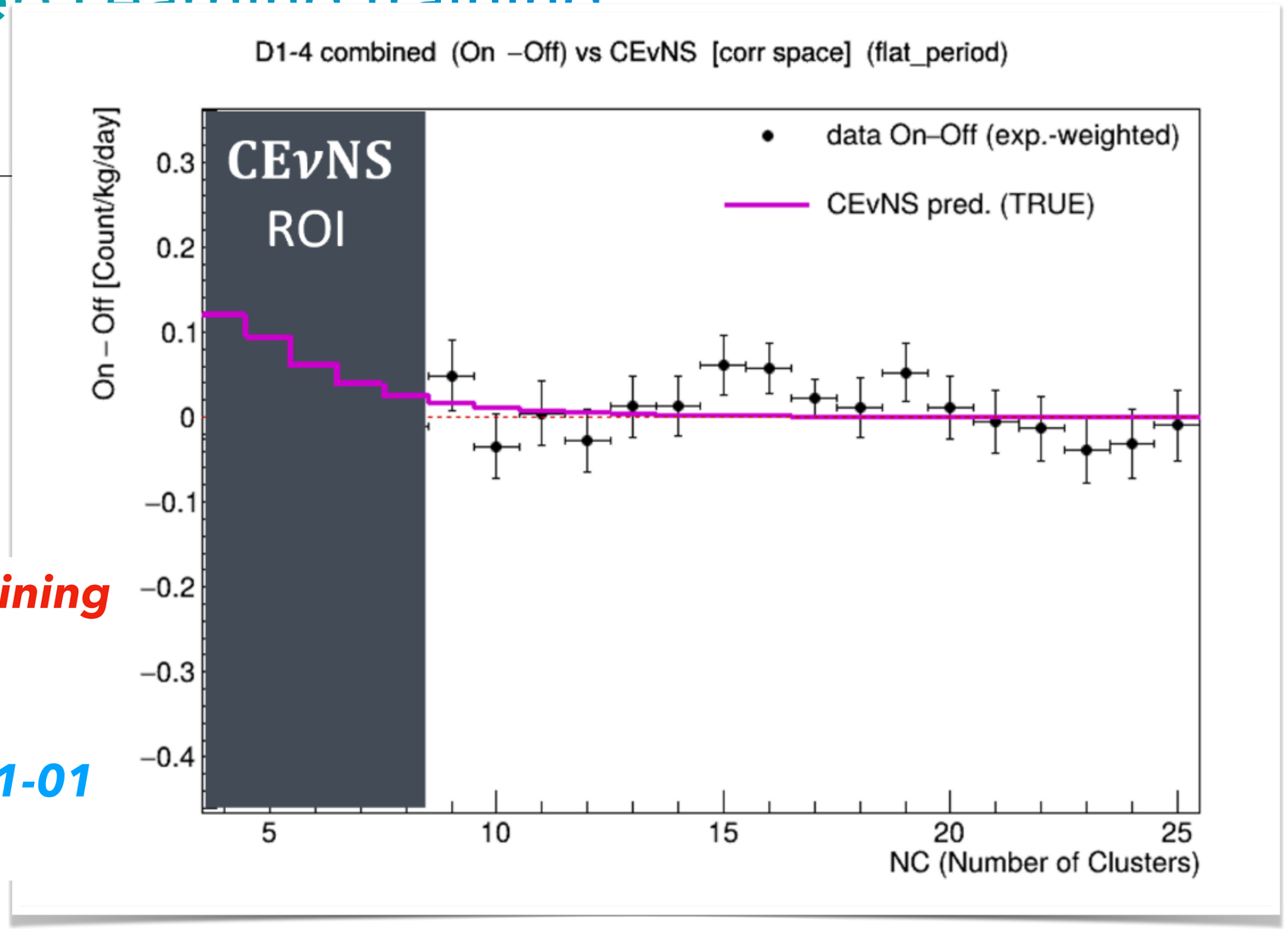
Event selection

Deep Learning training



Noise Rejection



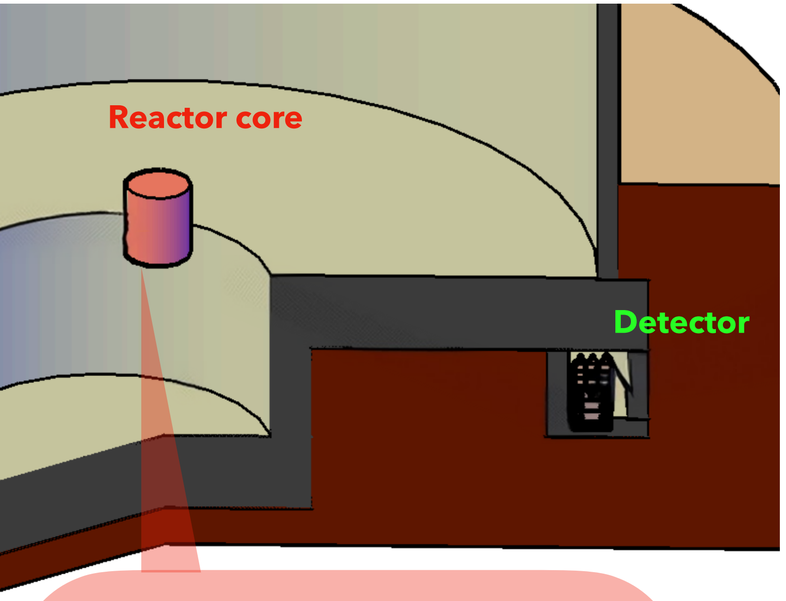


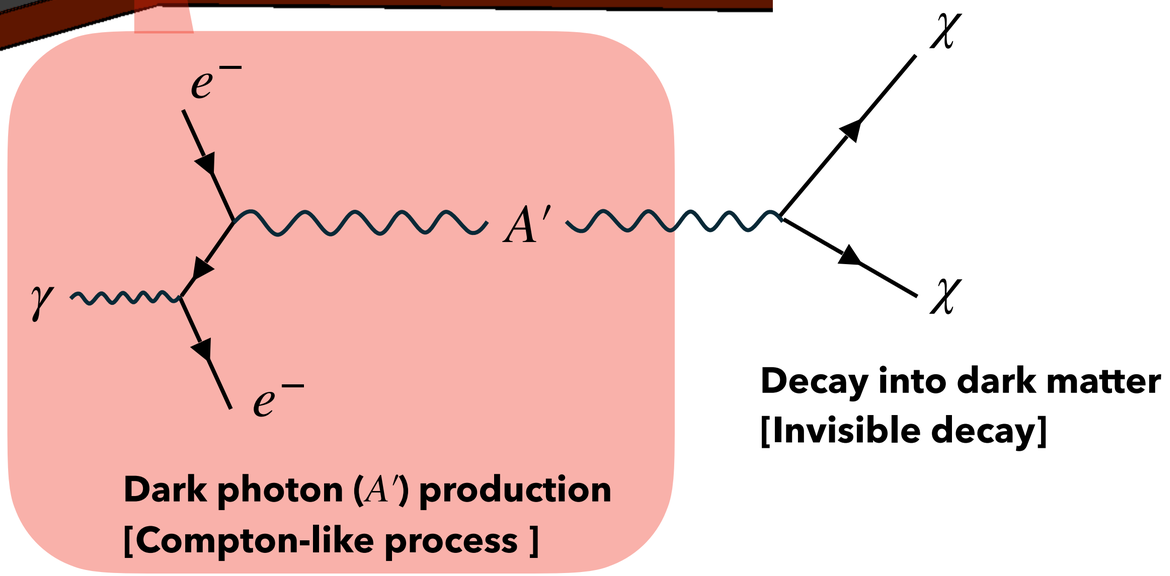
CEvNS existence check after DL training fine tuning !

Can be discussed in NNN Poster T1-01 (Byungcheol Koh)

Another BSM searches in NEON

1. Dark photon to LDM



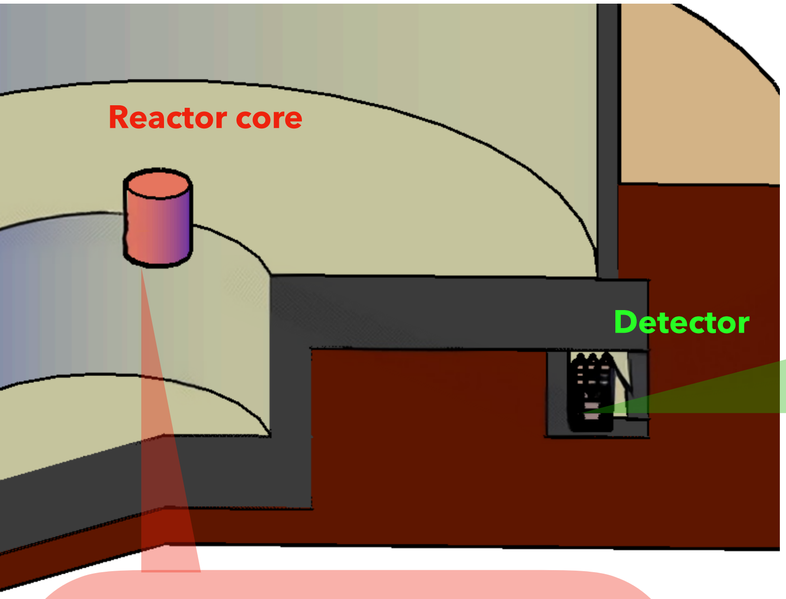


Dark photon (A') production
[Compton-like process]

Decay into dark matter
[Invisible decay]

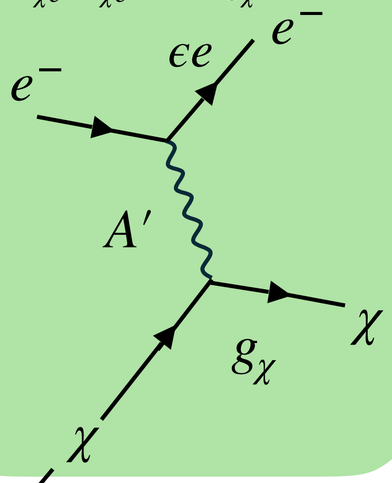
- **Dark photon production** from high-flux photon from reactor
- Invisible decay into Light Dark Matter (LDM)

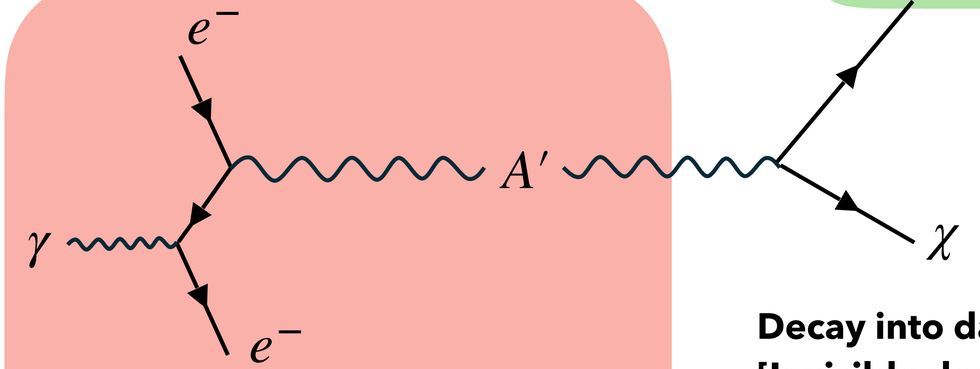
1. Dark photon to LDM



DM - e- scattering

$[\sigma_{\chi e^- \to \chi e^-} \propto \epsilon^2 g_\chi^2]$



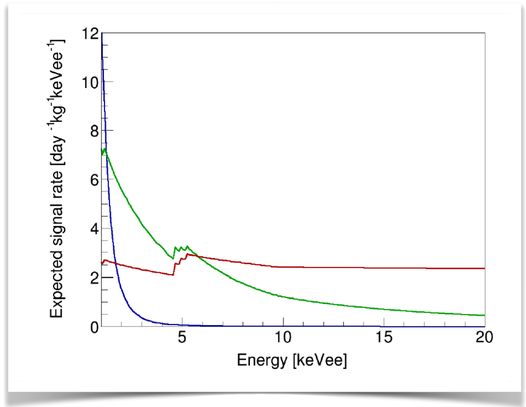


Dark photon (A') production [Compton-like process]

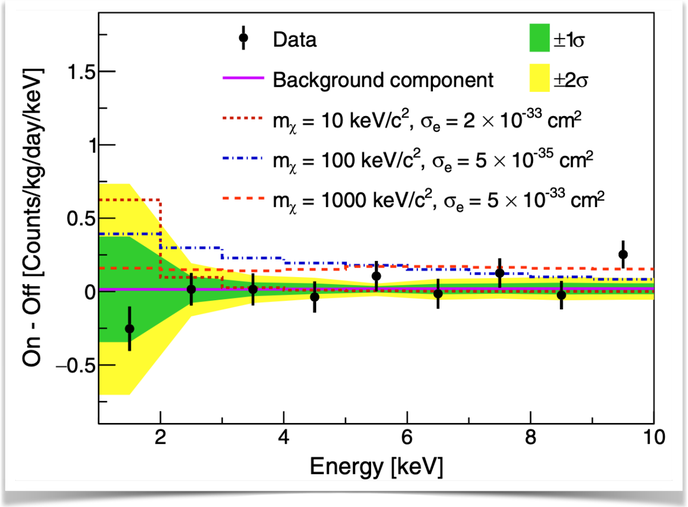
Decay into dark matter [Invisible decay]

- **Dark photon production** from high-flux photon from reactor
- Invisible decay into Light Dark Matter (LDM)
- DM - electron scattering detection, in **1~10 keV of Reactor On - Off data**

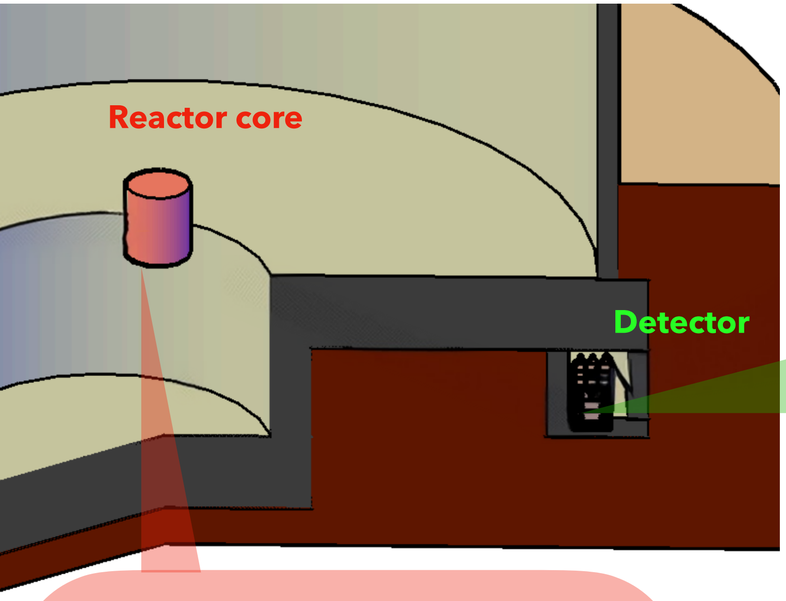
Expected signal



Data fit example

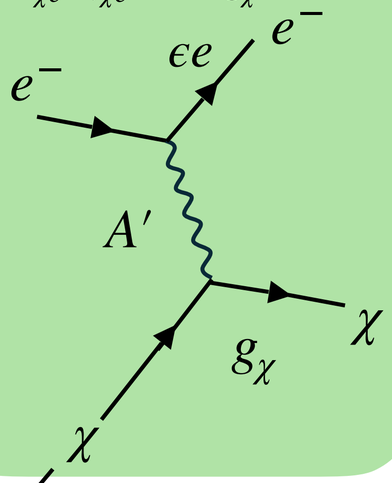


1. Dark photon to LDM

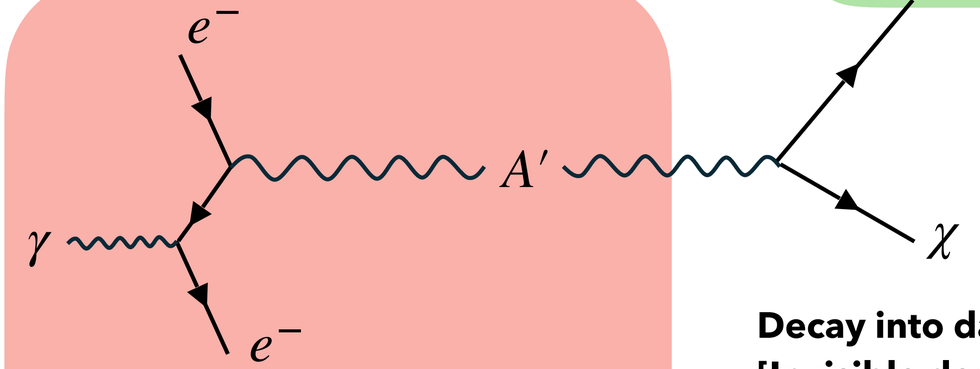


DM - e- scattering

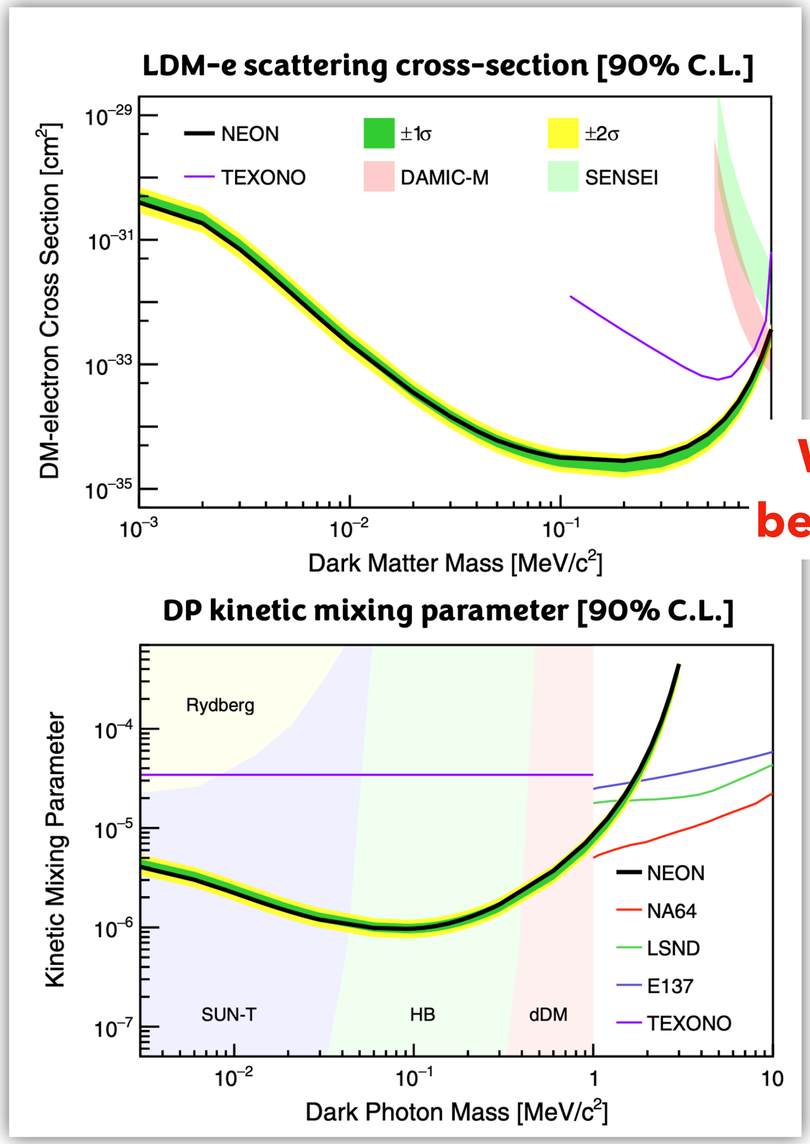
$[\sigma_{\chi e^- \to \chi e^-} \propto \epsilon^2 g_\chi^2]$



Decay into dark matter
[Invisible decay]



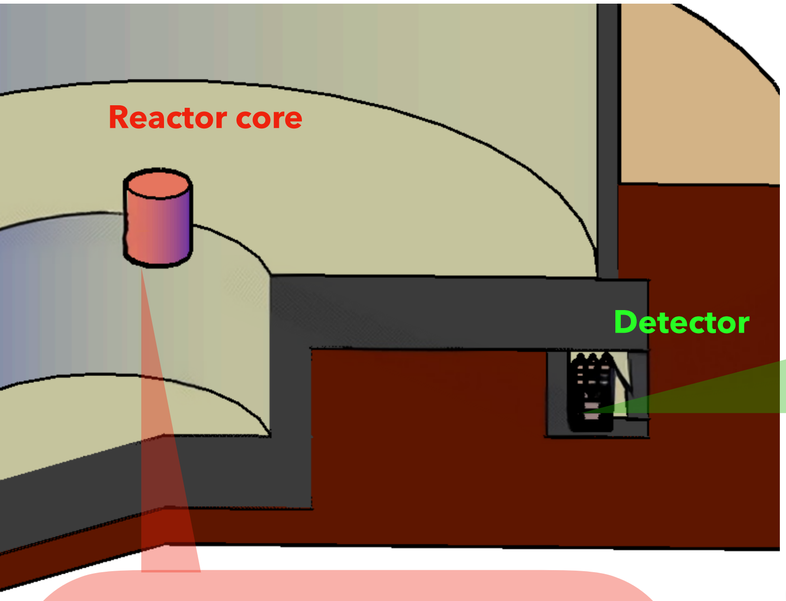
Dark photon (A') production
[Compton-like process]



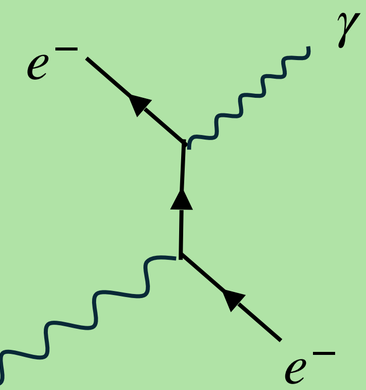
World best limit

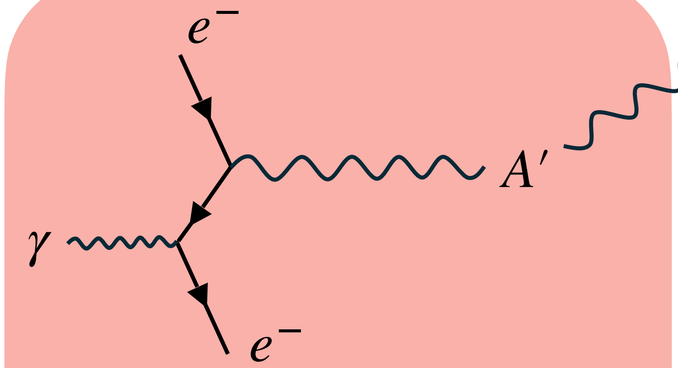
Phys. Rev. Lett **134**,0210802

2. Dark photon absorption (ongoing)



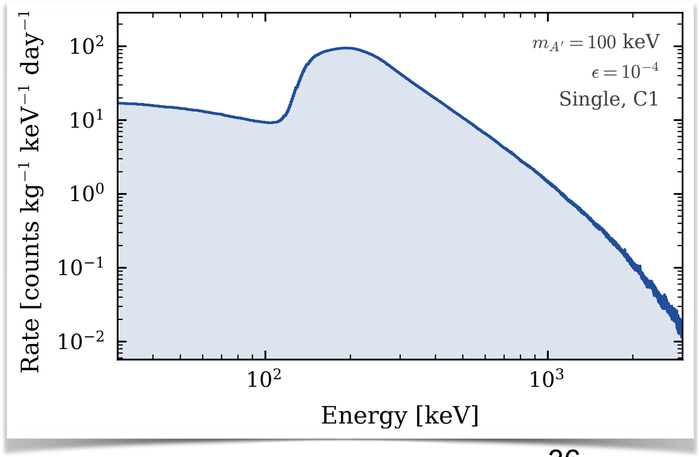
Dark photon absorption
$[\sigma_{A'\to\gamma} \propto \epsilon^4]$





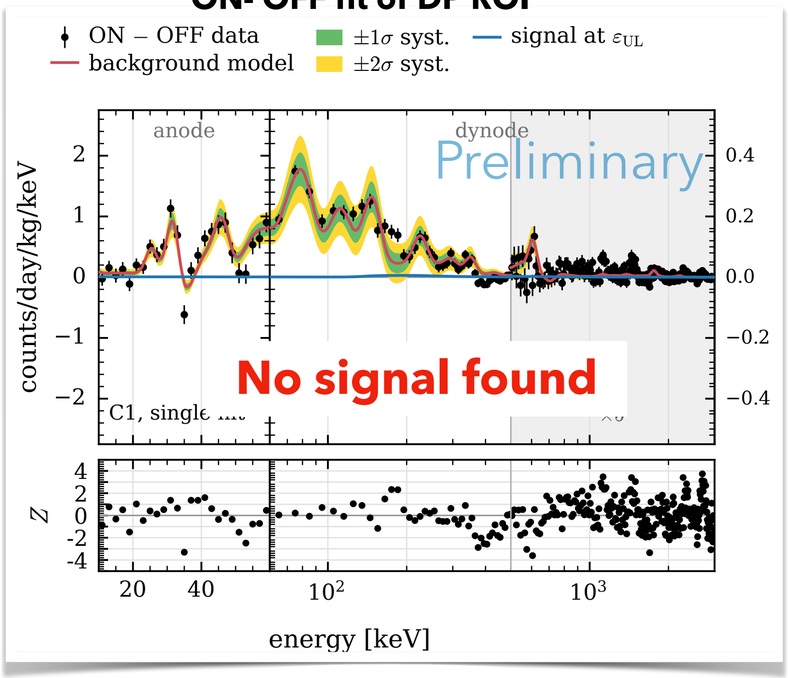
Dark photon (A') production [Compton-like process]

Expected signal

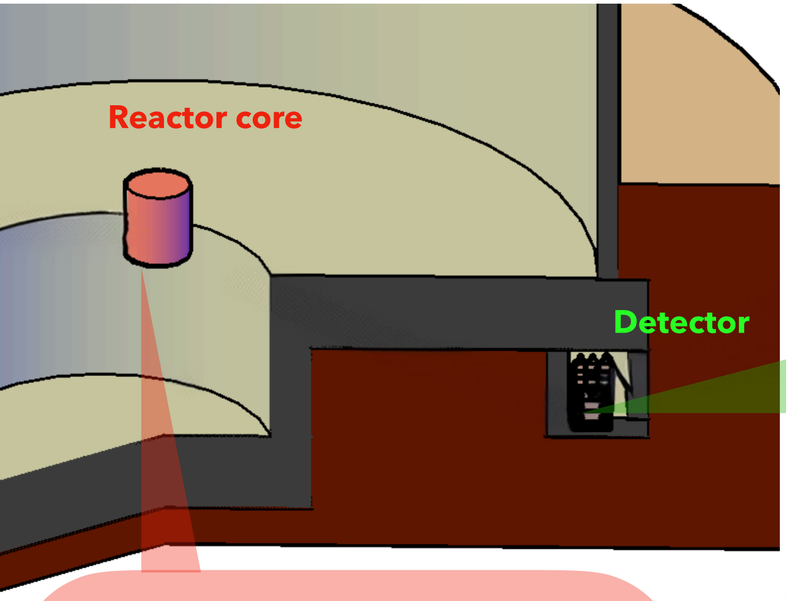


- Dark photon might reach the detector and absorbed via decay channel e^+e^- (when $m_{A'} > 2m_e$)
- Region of Interest : **10 ~ 3000 keV, Reactor On - Off data**

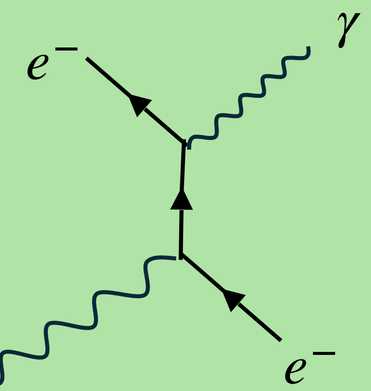
ON- OFF fit of DP ROI

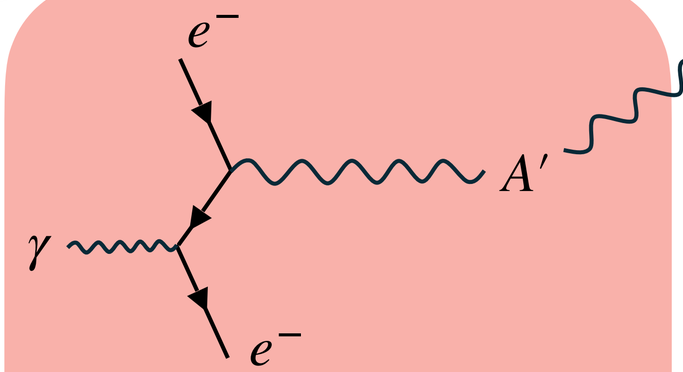


2. Dark photon absorption (ongoing)



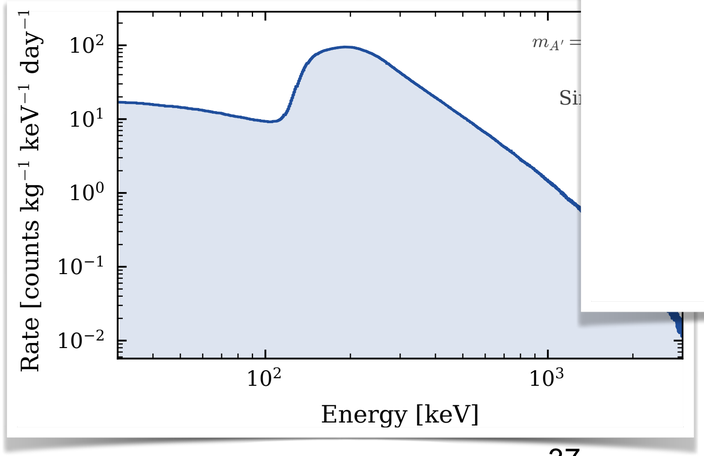
Dark photon absorption
$[\sigma_{A' \to \gamma} \propto \epsilon^4]$

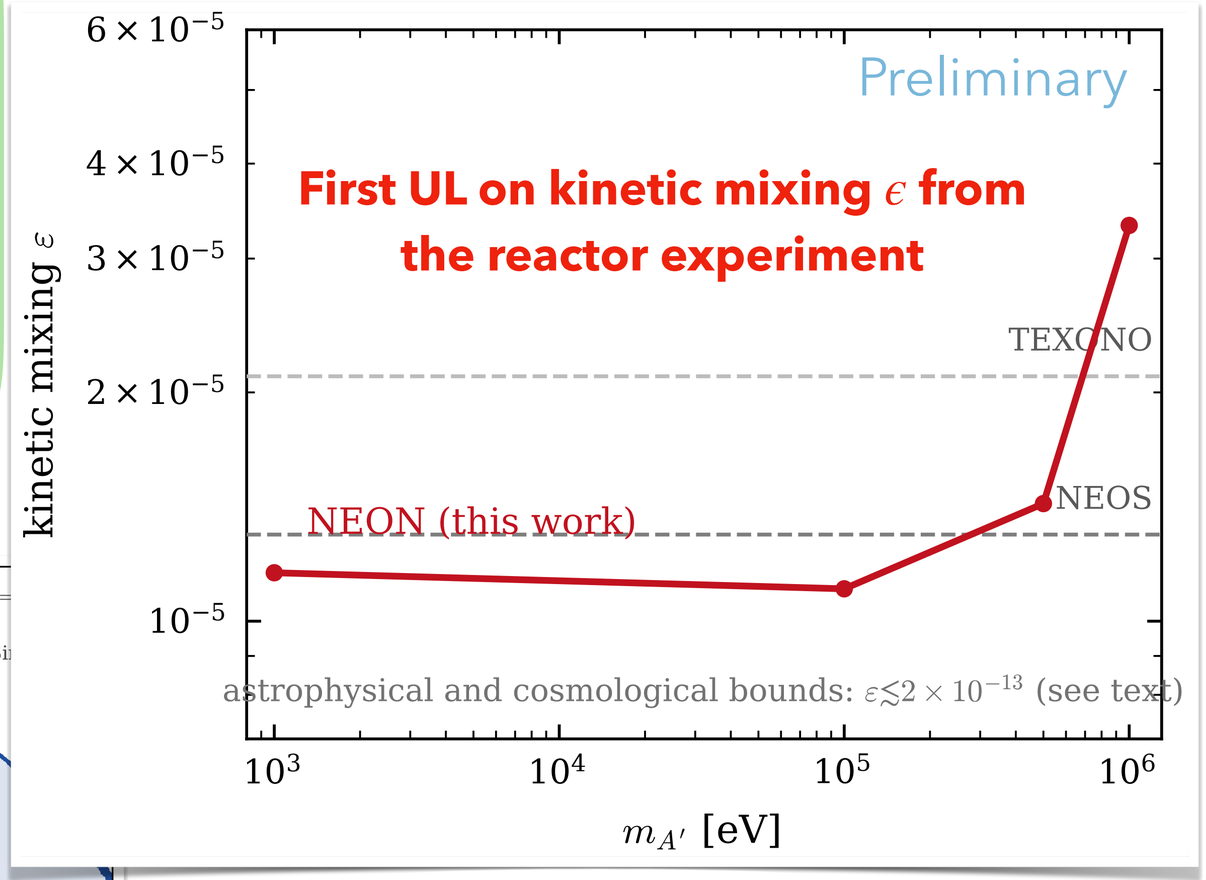




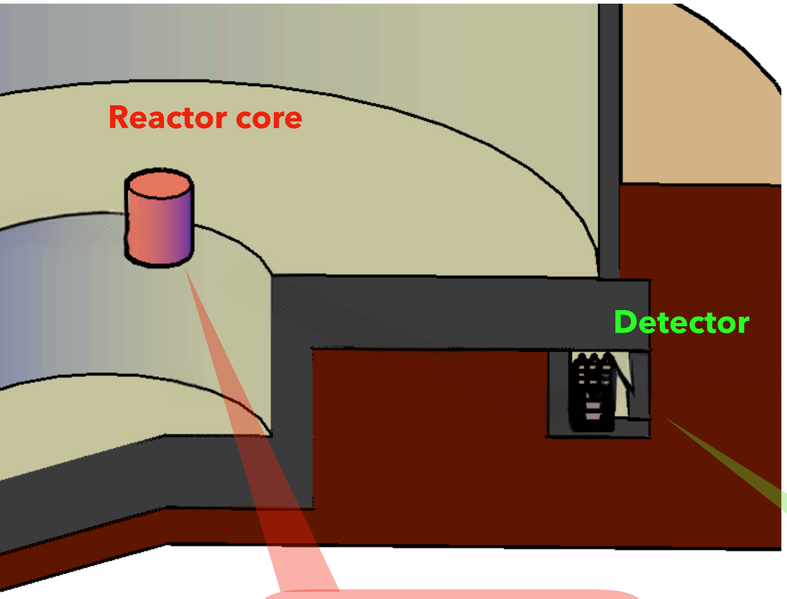
Dark photon (A') production
[Compton-like process]

Expected signal



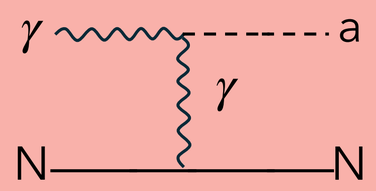


3. Axion Like Particles from Reactor

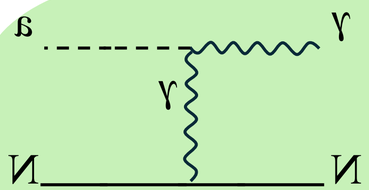


- ALP coupling with photon ($g_{a\gamma}$) and electron (g_{ae})
- Region of Interest : **1 ~ 3000 keV, Reactor On - Off data**

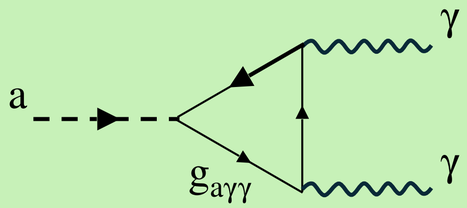
$g_{a\gamma}$



[Primakoff]

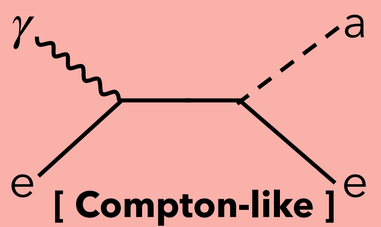


[Inverse Primakoff]

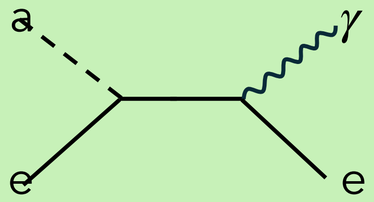


[γ-pair]

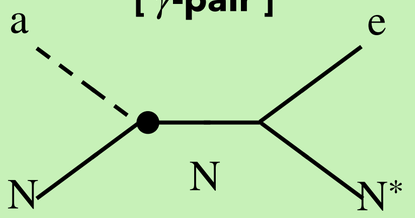
g_{ae}



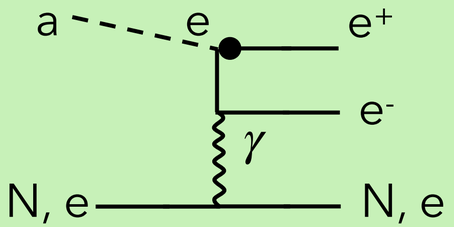
[Compton-like]



[Inverse Compton-like]

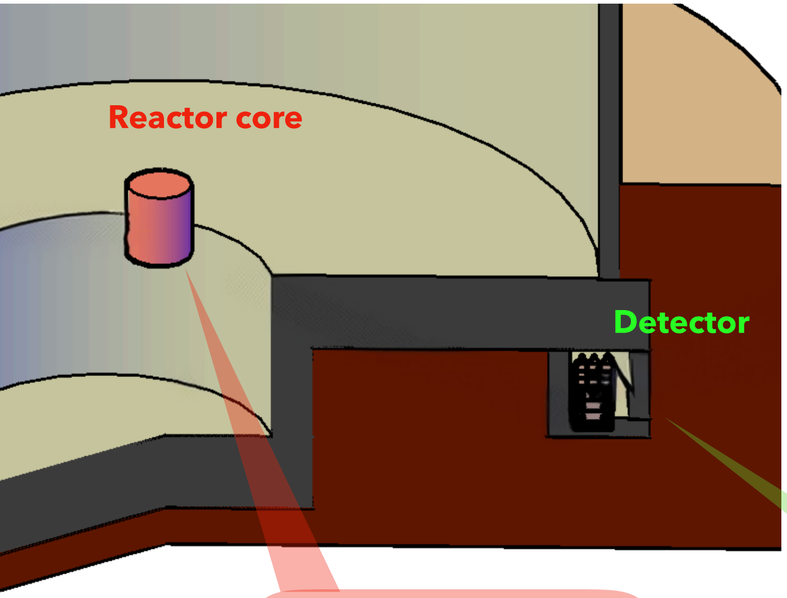


[Axio-electric]

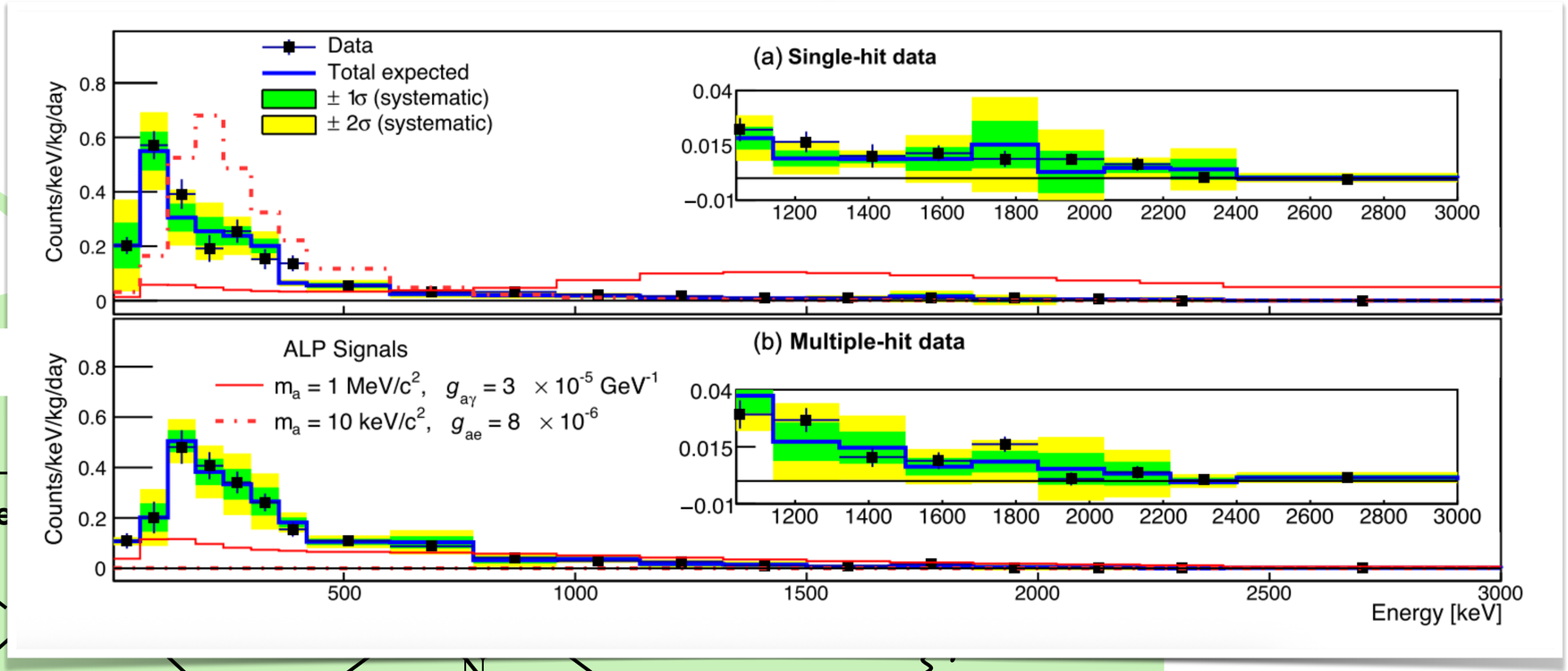


[e-pair]

3. Axion Like Particles from Reactor

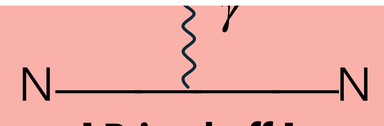


- ALP coupling with photon ($g_{a\gamma}$) and electron (g_{ae})
- Region of Interest : **1 ~ 3000 keV, Reactor On - Off data**



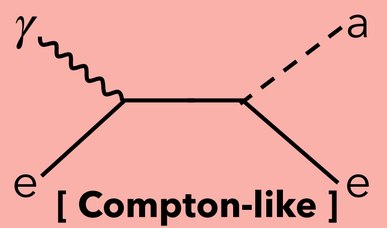
No excess found

$g_{a\gamma}$



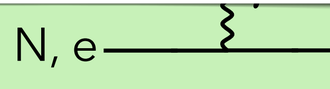
[Primakoff]

g_{ae}



[Compton-like]

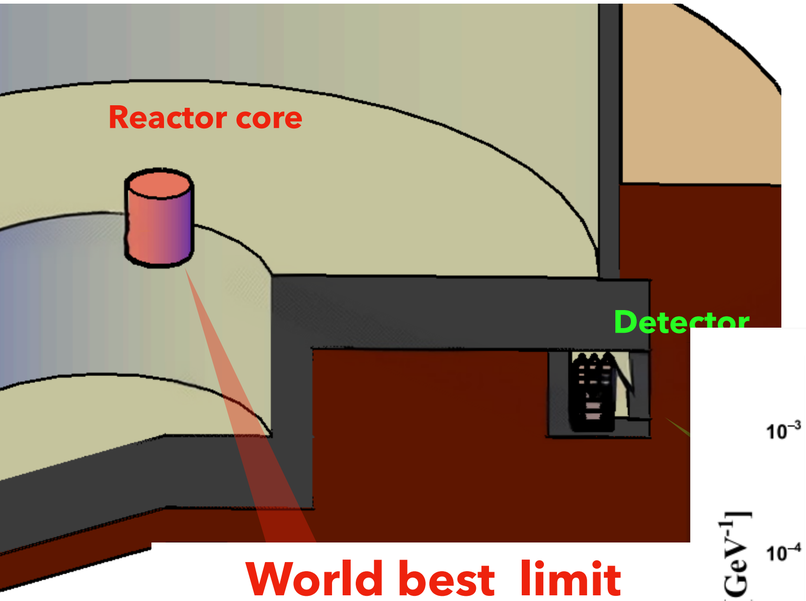
[Inverse Compton-like] **[Axio-electric]**



[e-pair]

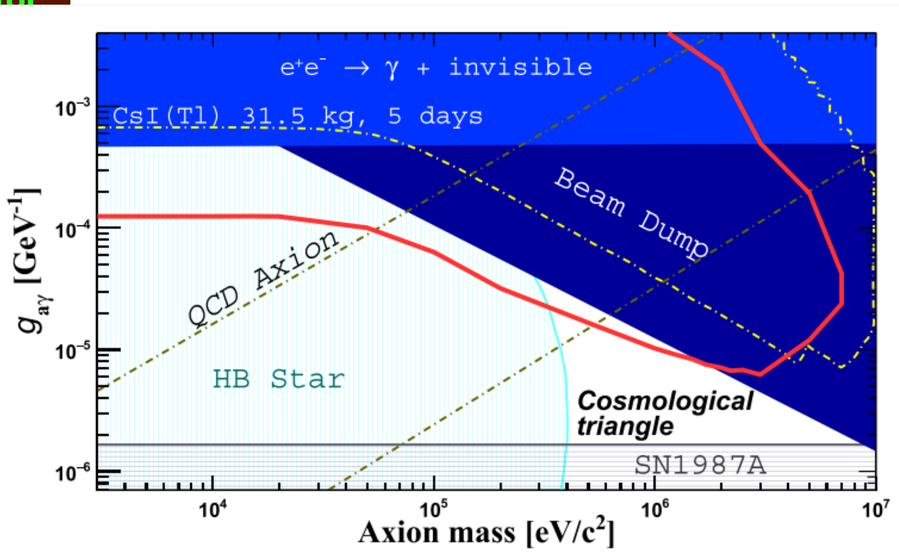
Phys. Rev. Lett **134**,201002

3. Axion Like Particles from Reactor

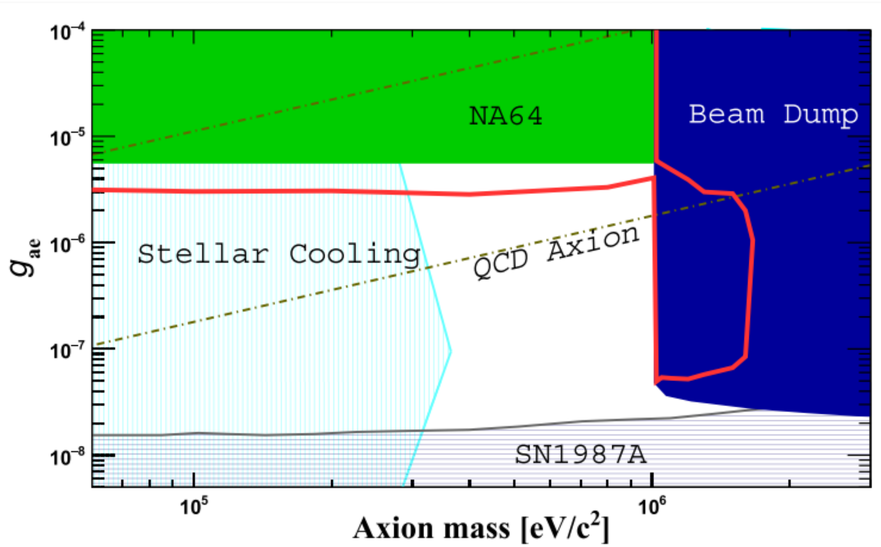


- ALP coupling with photon ($g_{a\gamma}$) and electron (g_{ae})
- Region of Interest : **1 ~ 3000 keV, Reactor On - Off data**

World best limit
&
First sensitivity in cosmological triangle



(a) Axion-photon coupling

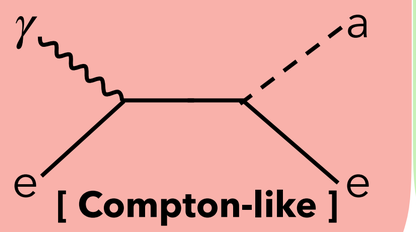


(b) Axion-electron coupling

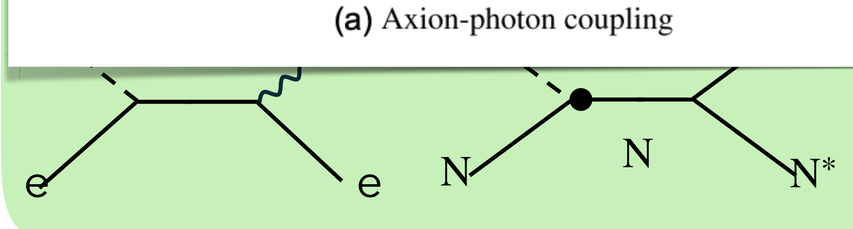
$g_{a\gamma}$

[Primakoff]

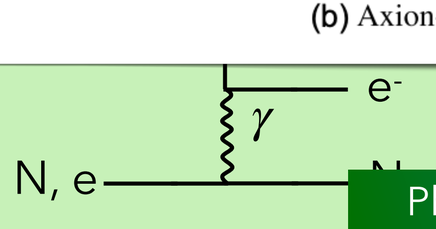
g_{ae}



[Compton-like]



[Inverse Compton-like] [Axio-electric]

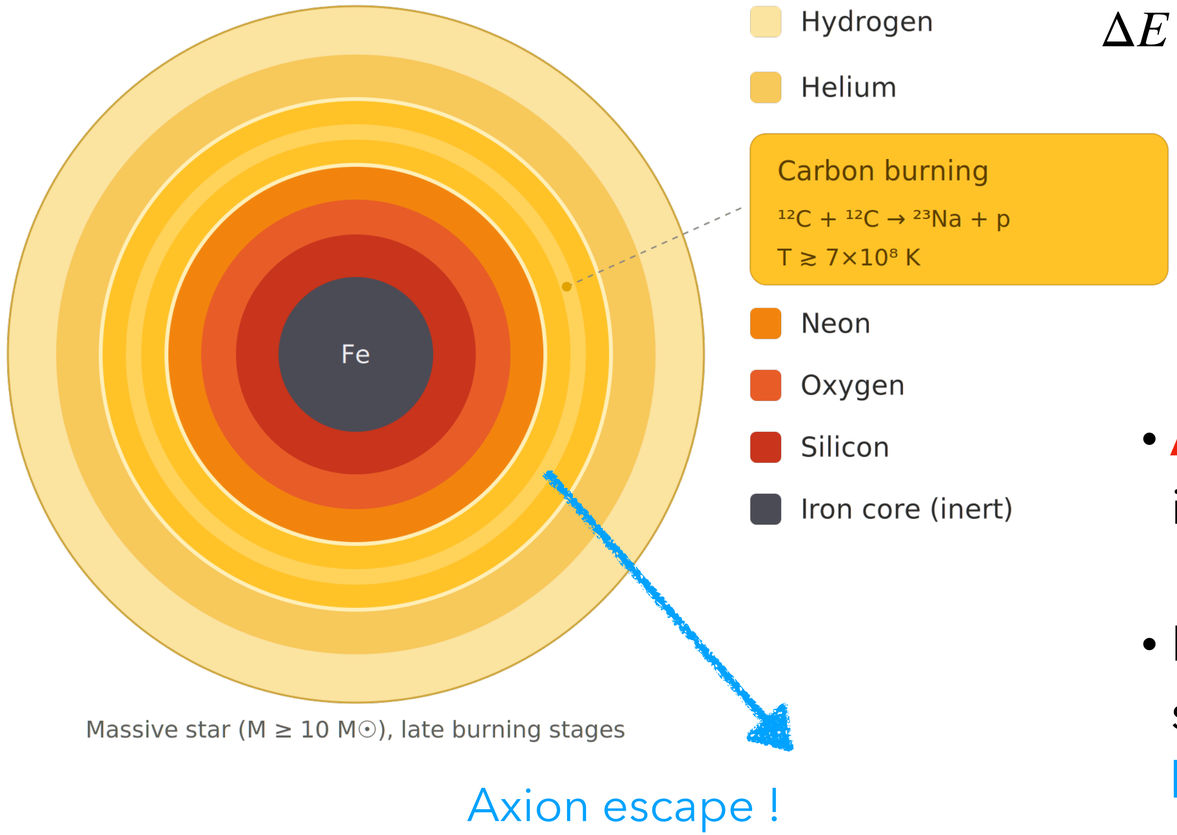


[e-pair]

Phys. Rev. Lett **134**,201002

4. Galactic Axion Search (ongoing)

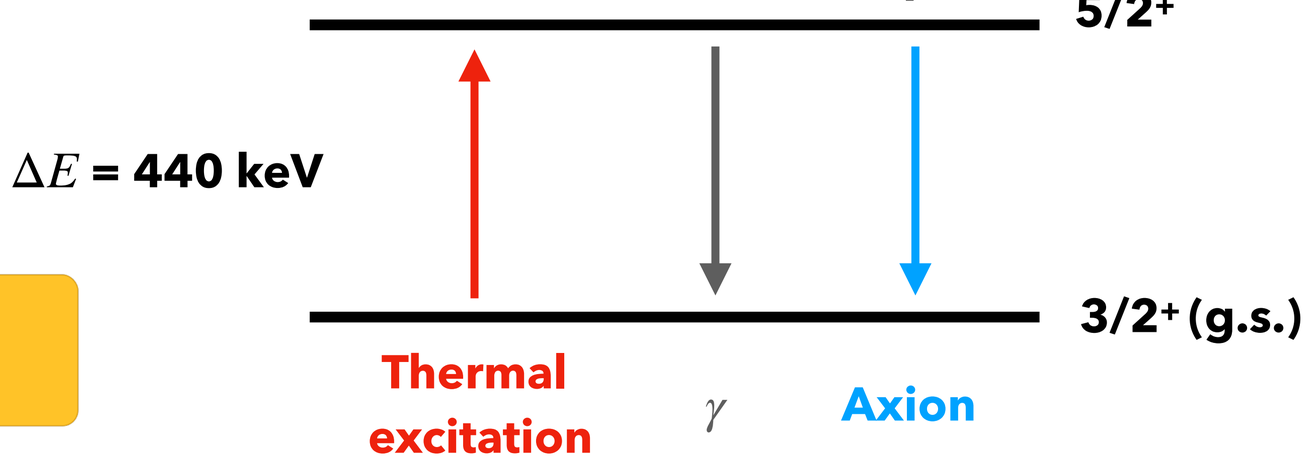
Shell-burning structure of a star



Axion escape !

"Axion Pump"

$^{12}C + {}^{12}C \rightarrow {}^{23}Na + p$

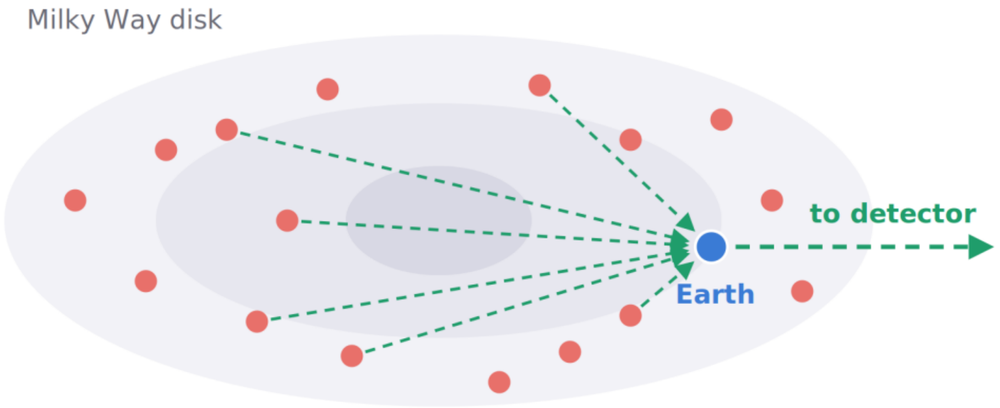


- **Axion generation from Carborn burning** inside a star is suggested in 1991 [Phys. Rev. Lett. **66**, 2557]

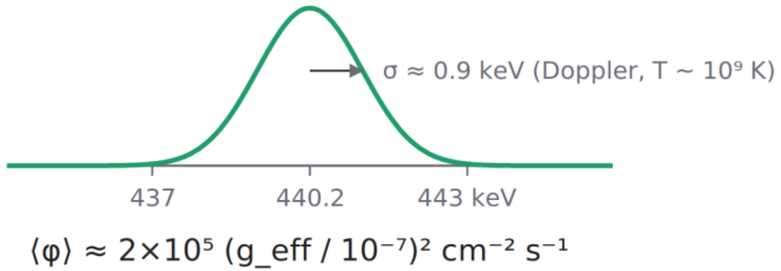
- Hot&dense star core repeats ^{23}Na's photo-excitation and sometimes make **axio-dexcitation, with 440 keV level.**

4. Galactic Axion Search (ongoing)

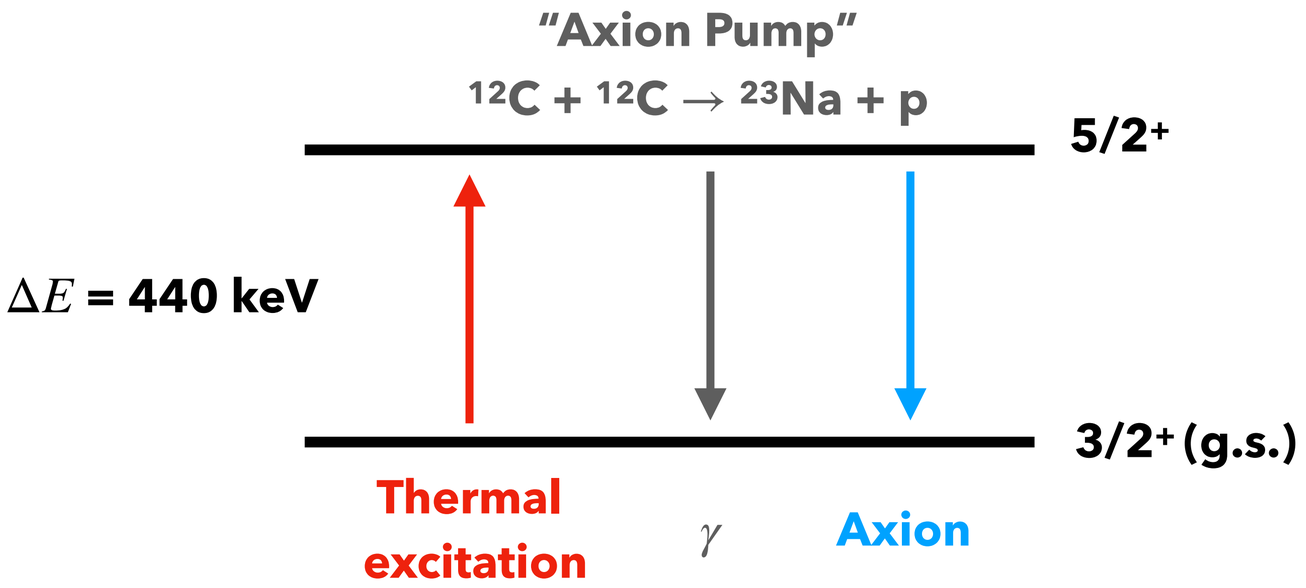
Galactic Na axion reaching to the Earth



Thermally broadened 440 keV axion line

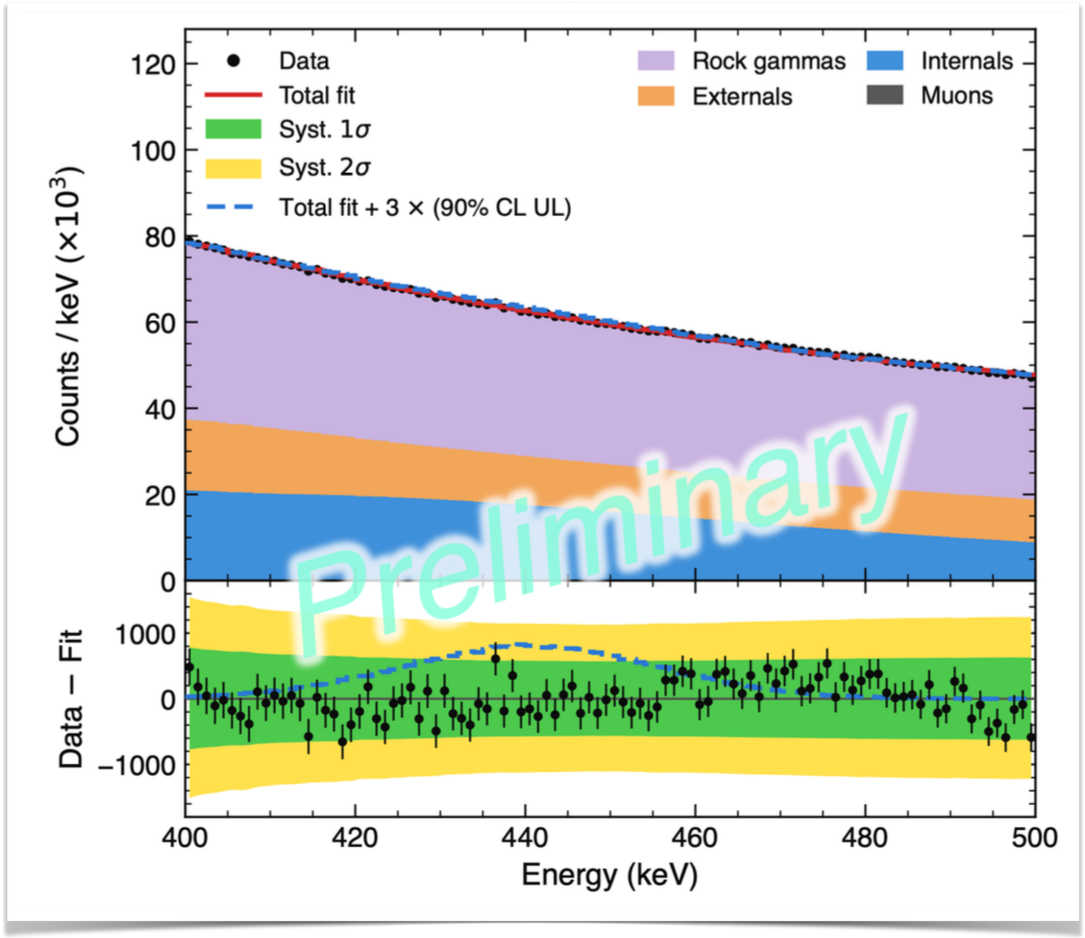


⟨φ⟩ ≈ 2×10⁵ (g_eff / 10⁻⁷)² cm⁻² s⁻¹



- Those axion-emitting stars are **all around within our galaxy**. [Phys. Rev. Lett. **135**, 222701]
- Axions travels from the galaxy to Earth, resonantly **absorbed to NaI detector** and emitting **440 keV.** *[arXiv:2603.16998]*

4. Galactic Axion Search (ongoing)



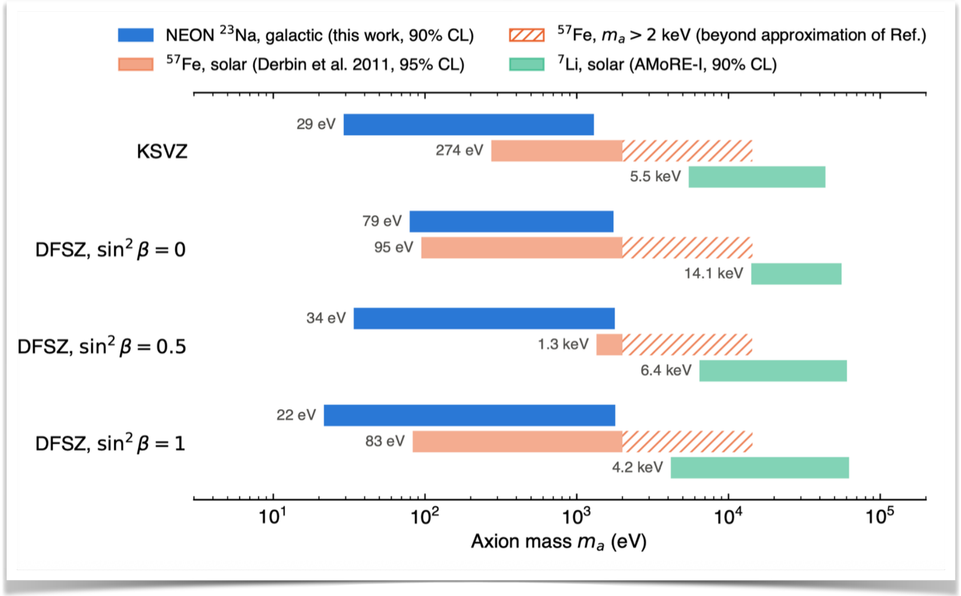
No signal found.

3 times of C.L. Upper limit is still inside the 2σ band

Can be discussed in NNN Poster

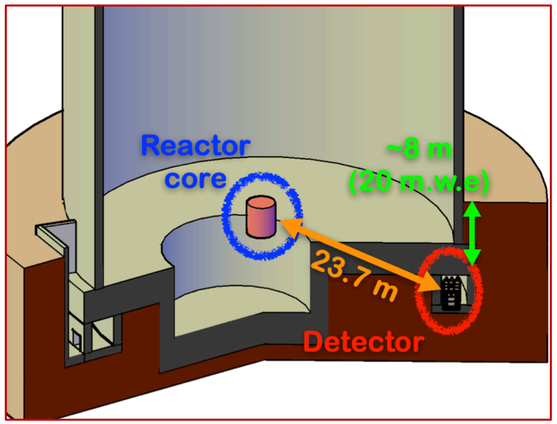
T1-03(Seohyun Lee)

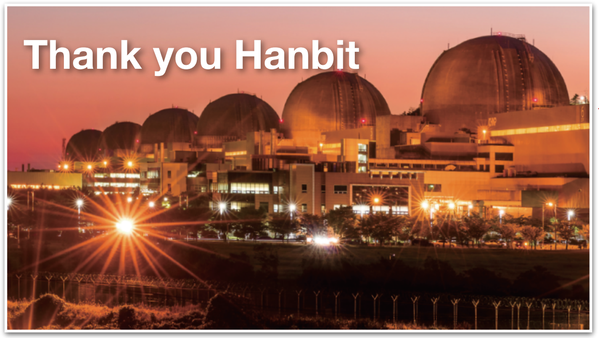
$$2.25\times10^{-6} < \left| g_{\mathrm{eff}}^{^{23}\mathrm{Na},aNN} \right| < 1.27\times10^{-2} \text{ (90 \% C.L.)}$$



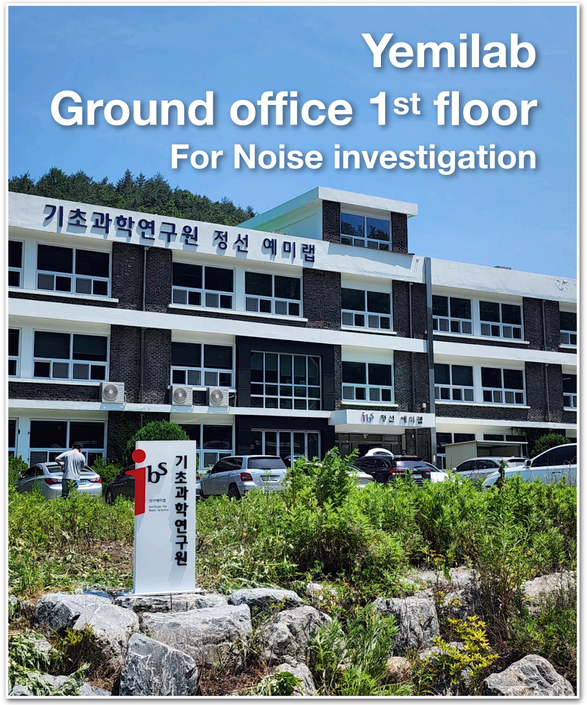
It pushes the lower mass bound of laboratory searches for nucleon-coupled stellar axions down to 22–79 eV

Detector decomission : Hanbit to Yemilab











Summary

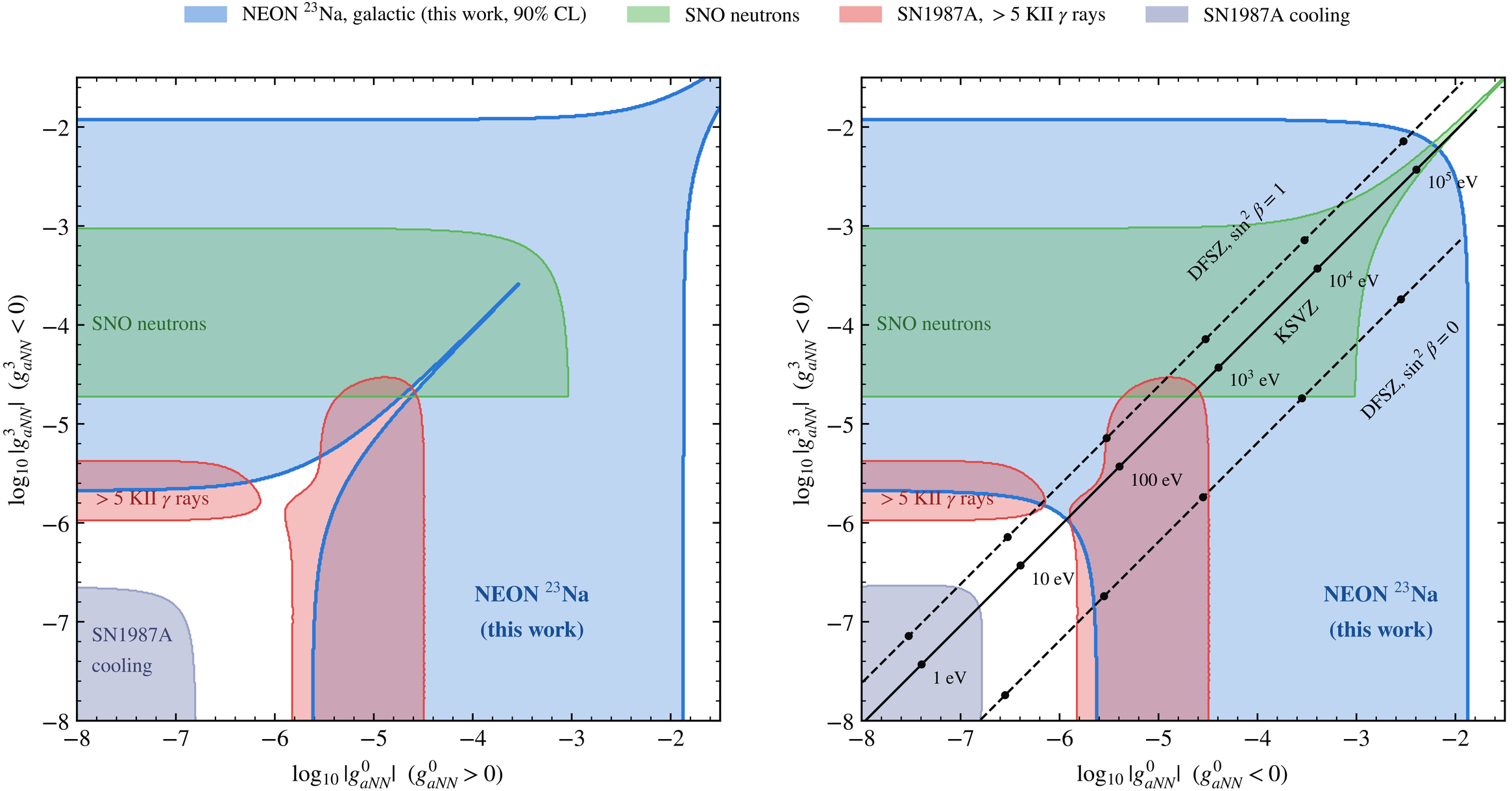
- NEON searches for CEvNS using Na(Tl) target & reactor neutrino source in Korea, and decommissioned recently.
- Event selection using DL is ongoing for precise CEvNS signal search.
- Many BSM studies has been conducted and ongoing.

NEON posters also can be found in NNN

October 29, Thursday

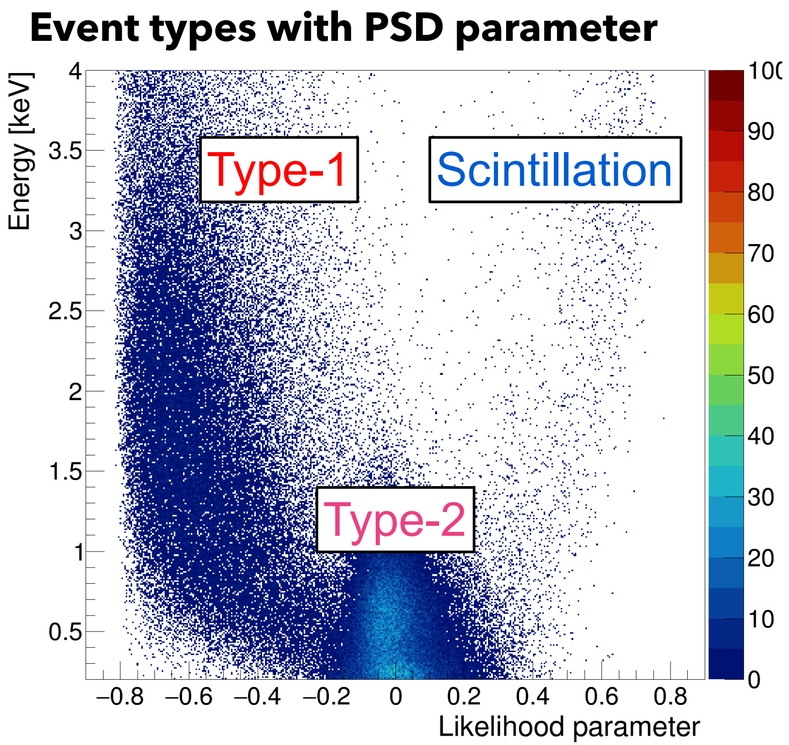
T1-01	Event selection and data analysis techniques for CEvNS analysis in NEON
T1-02	Current status of the NEON experiment
T1-03	Searches for Dark Sector Particles with the NEON experiment

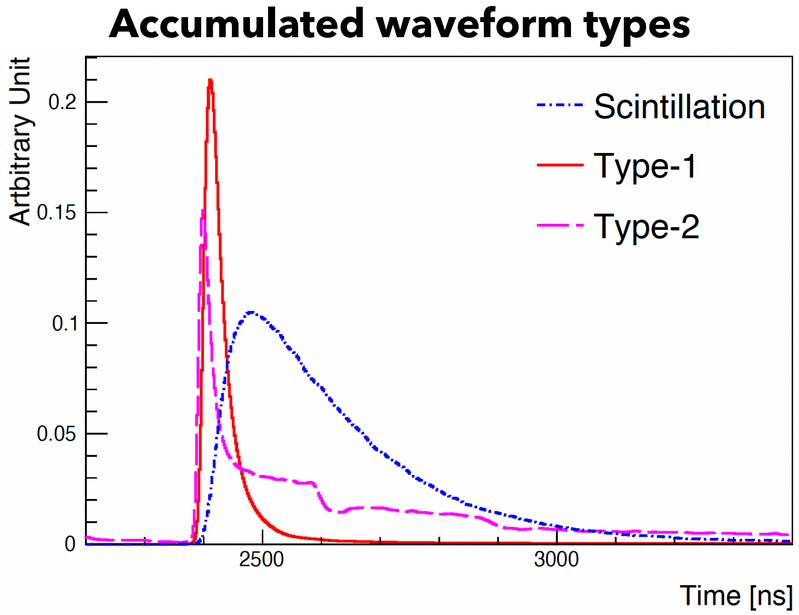
Backup


NEON ^{23}Na, galactic (this work, 90% CL)
SNO neutrons
SN1987A, >5 KII γ rays
SN1987A cooling
SNO neutrons
>5 KII γ rays
SN1987A
cooling
NEON ^{23}Na
(this work)
$\log_{10}|g^0_{aNN}|$ $(g^0_{aNN}>0)$
$\log_{10}|g^3_{aNN}|$ $(g^3_{aNN}<0)$
SNO neutrons
>5 KII γ rays
DFSZ, $\sin^2\beta=1$
10^5 eV
10^4 eV
KSVZ
10^3 eV
100 eV
10 eV
1 eV
DFSZ, $\sin^2\beta=0$
NEON ^{23}Na
(this work)
$\log_{10}|g^0_{aNN}|$ $(g^0_{aNN}<0)$
$\log_{10}|g^3_{aNN}|$ $(g^3_{aNN}<0)$

Event selection

Noise events types





- **Type 1 (PMT-induced noise)**

  : Short pulses (< 50 ns), fast decaying distribution → easy to be separated.

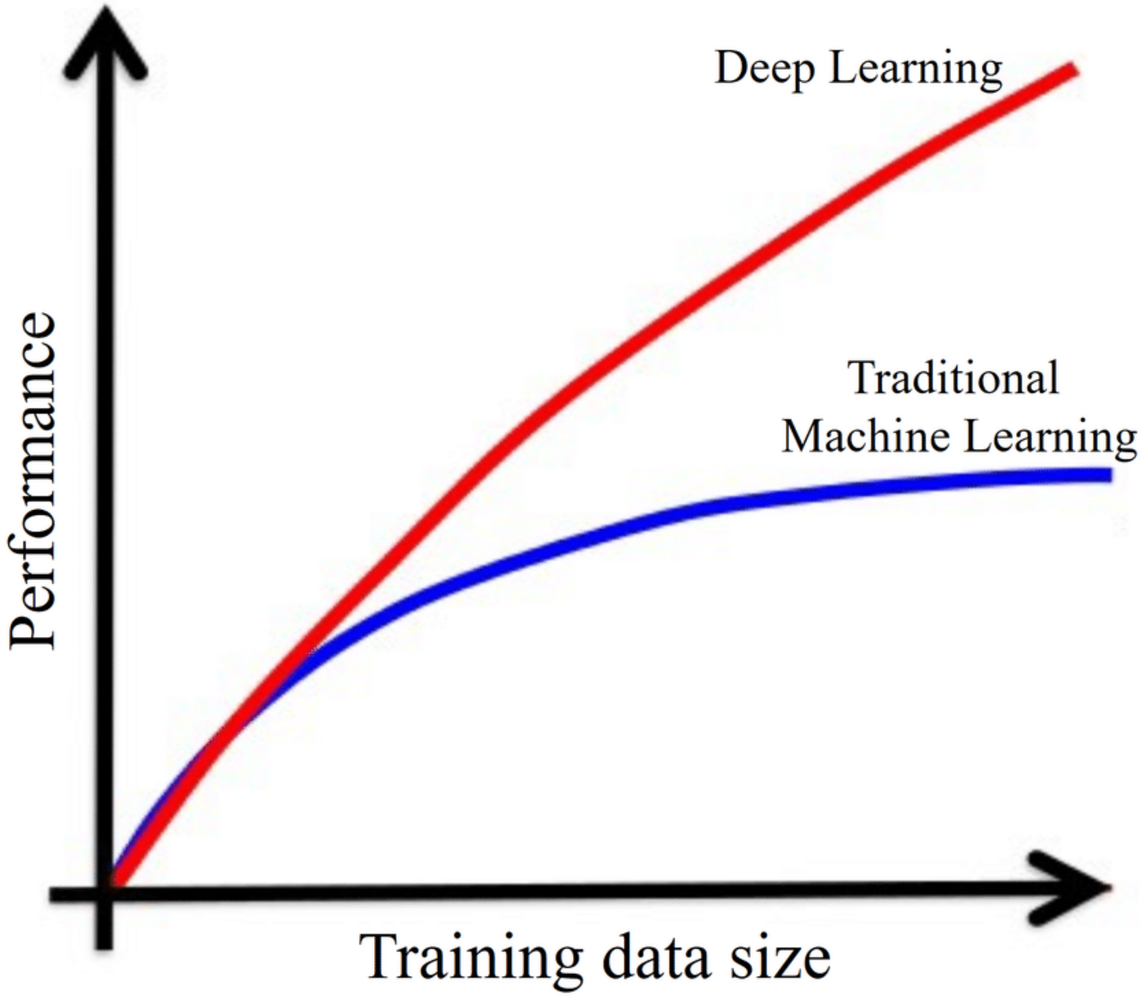
- **Type 2 (Phosphorous events)**

  : Slowly decaying distribution → hard to be separated from scintillation.

Event selection

Waveform simulation

NIM A 1065, 169489 (2024)



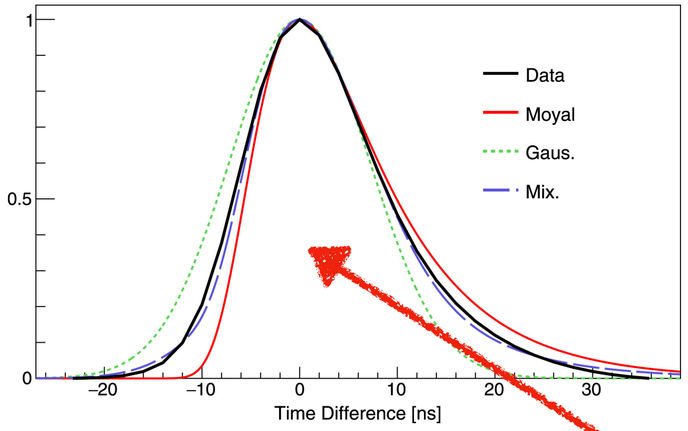
- **Pure & lots of scintillation sample** required for DL training.

Event selection

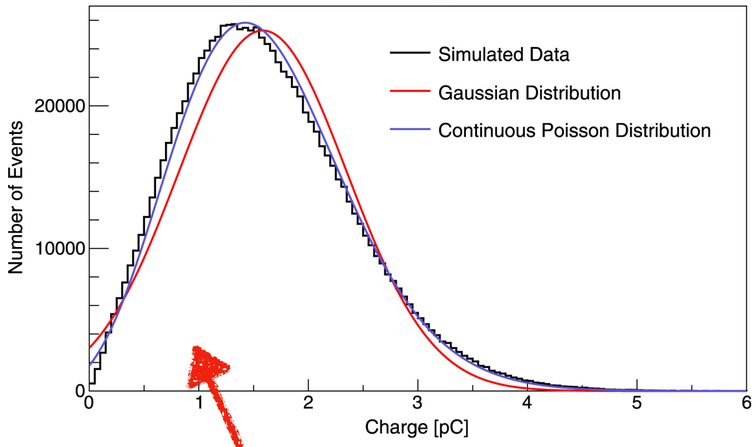
Waveform simulation

NIM A 1065, 169489 (2024)

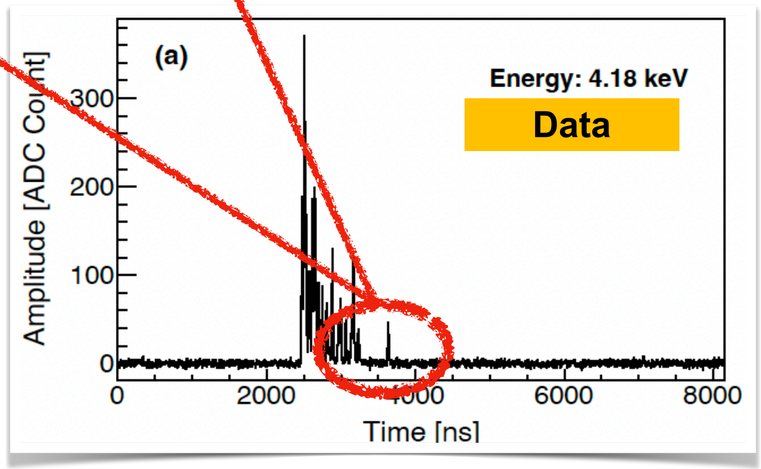
SPE pulse shape modeling



SPE charge modeling



Pedestal reproduce



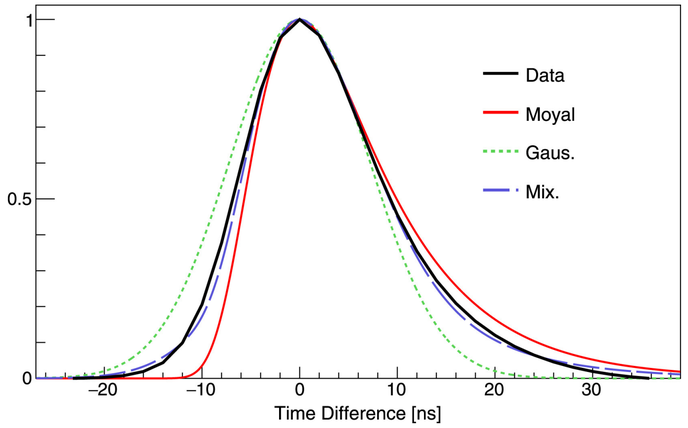
- **Pure & lots of scintillation sample** required for DL training.
- Studied about single photoelectron's **(SPE) charge & shape** characteristic from data.

Event selection

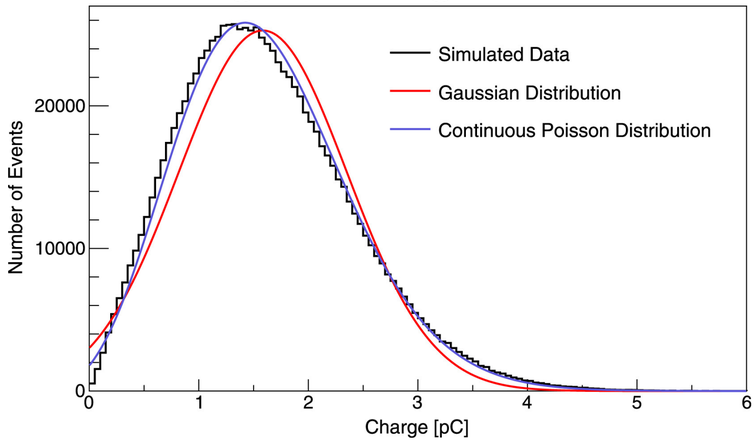
Waveform simulation

NIM A 1065, 169489 (2024)

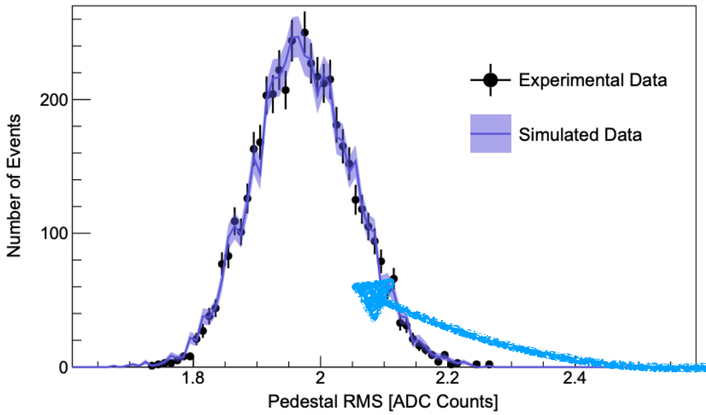
SPE pulse shape modeling

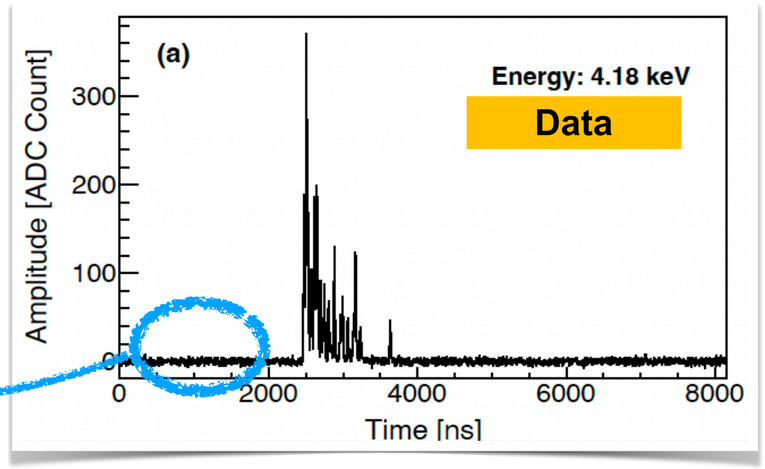


SPE charge modeling



Pedestal reproduce





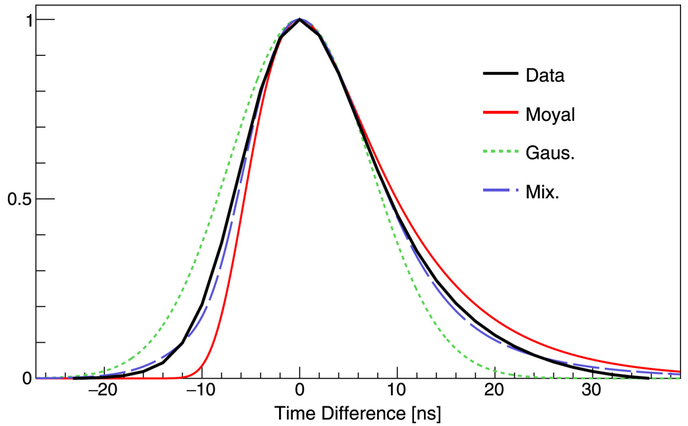
- **Pure & lots of scintillation sample** required for DL training.
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- Dark current (pedestal) behavior also extracted from data.

Event selection

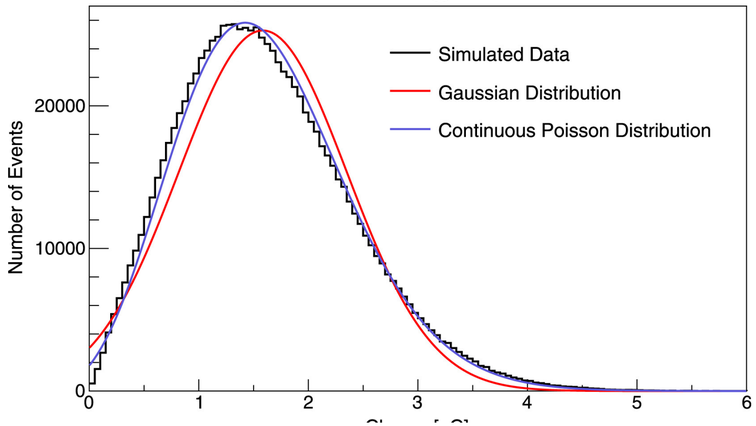
Waveform simulation

NIM A 1065, 169489 (2024)

SPE pulse shape modeling

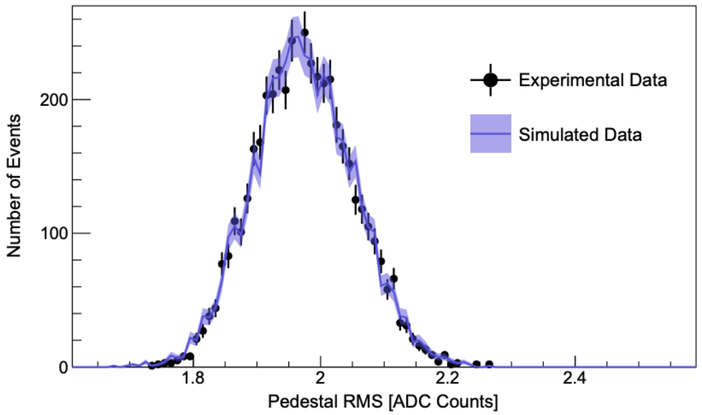


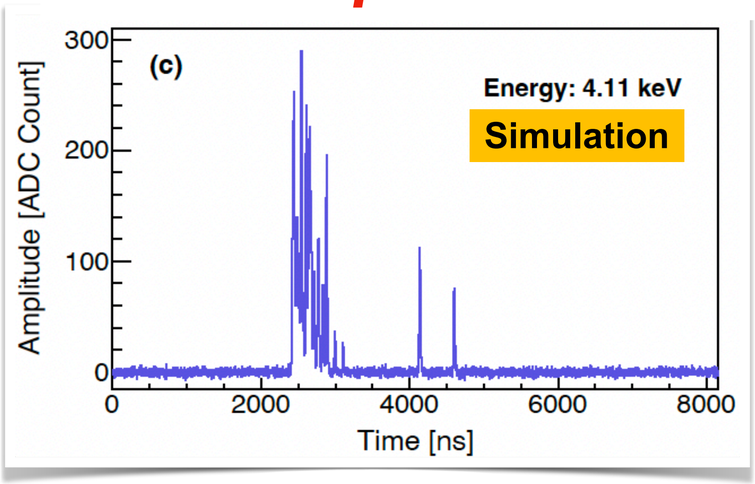
SPE charge modeling



Well reproduced!

Pedestal reproduce



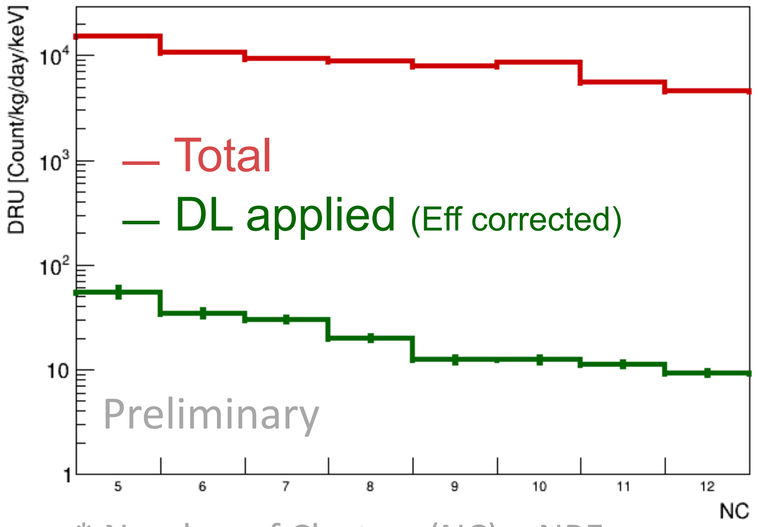


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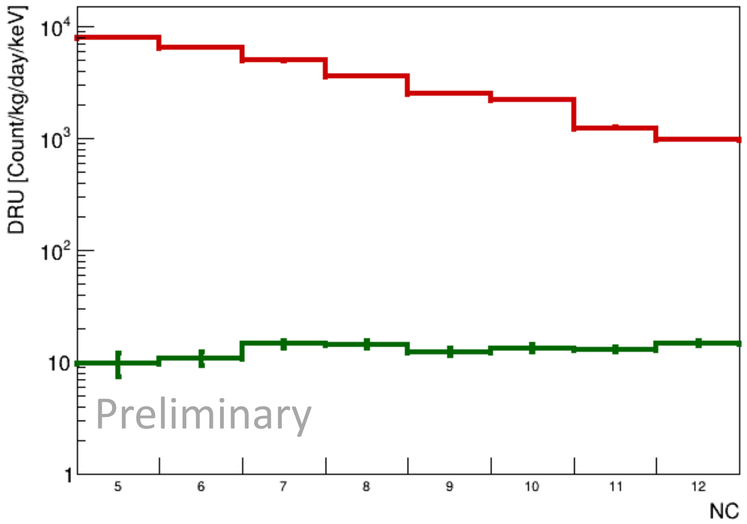
Deep Learning training

Single-Hit NC Distribution

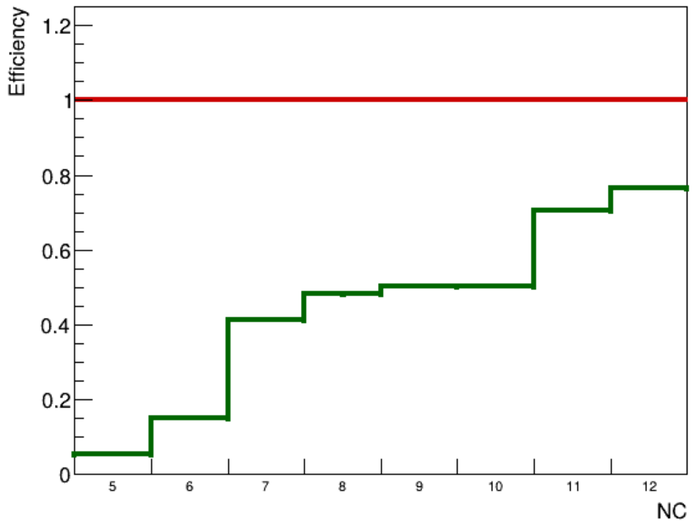


* Number of Clusters (NC) ~ NPE

Multiple-Hit NC Distribution

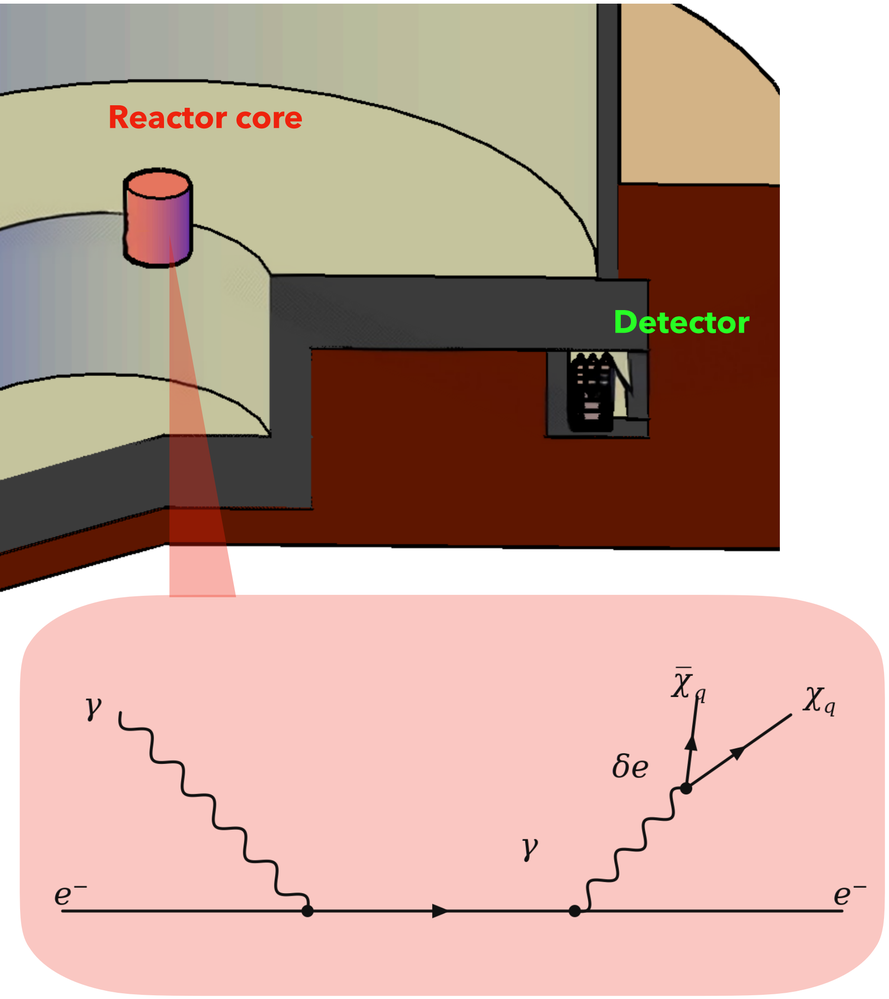


Efficiency



- After applying Deep learning, ~50 counts/kg/keV/day (DRU) has been achieved in 5 P.E. level.
- Multiple-hit shows consistent level with full noise selection

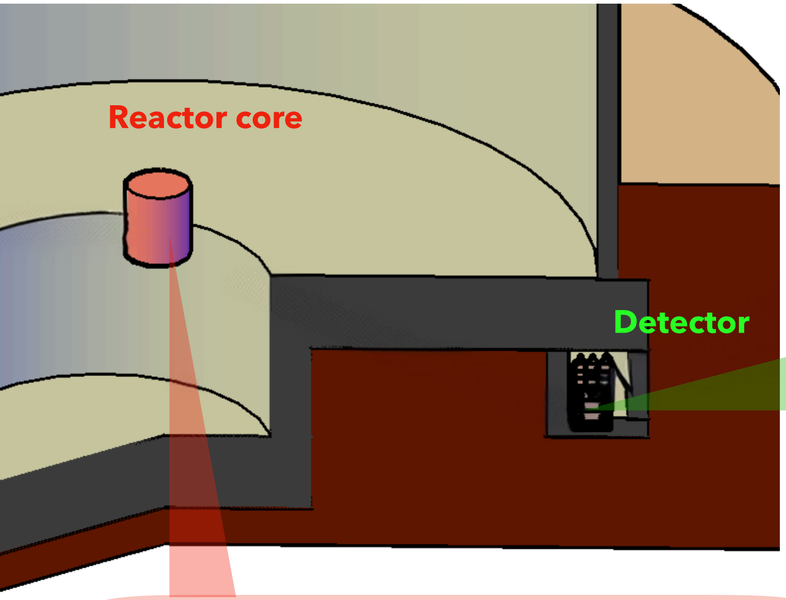
4. mCPs from reactor (planned)



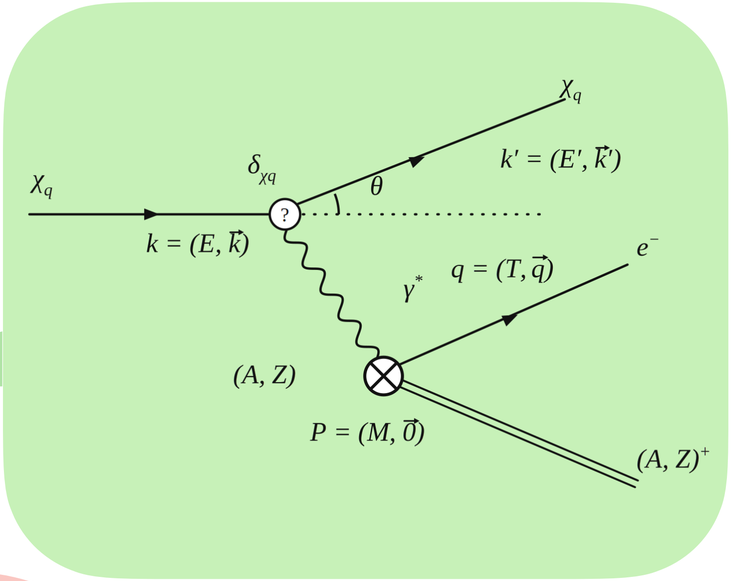
mCPs production from Compton-like process

- In certain BSM model, particles with very-small charge are predicted ($q_\chi = \epsilon e$, $\epsilon \ll 1$), and named as **mili-charged particles (mCPs)**
- Can be suggested as a **dark matter candidate** as
  - (Almost) Electrically neutral
  - Stable
  - Weak interaction
  - Can explain relic abundance
  - Naturally arise from dark-photon model.
- Can be **pair-produced from Compton-like scattering of high γ-rays from reactor.**

4. mCPs from reactor (planned)



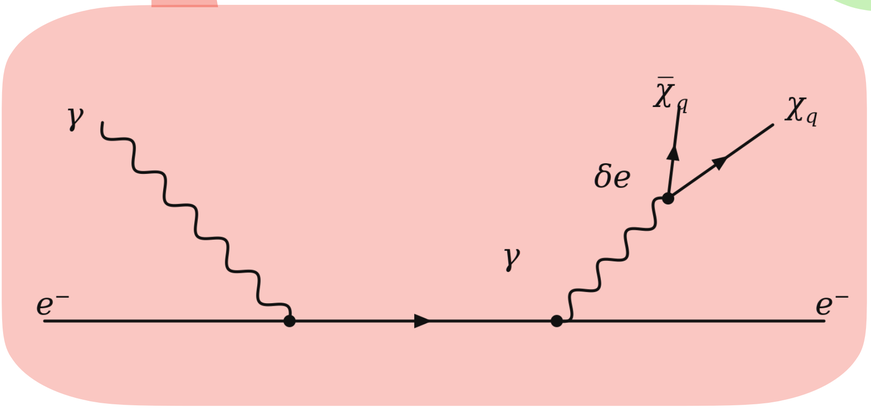
mCP-nuclear scattering



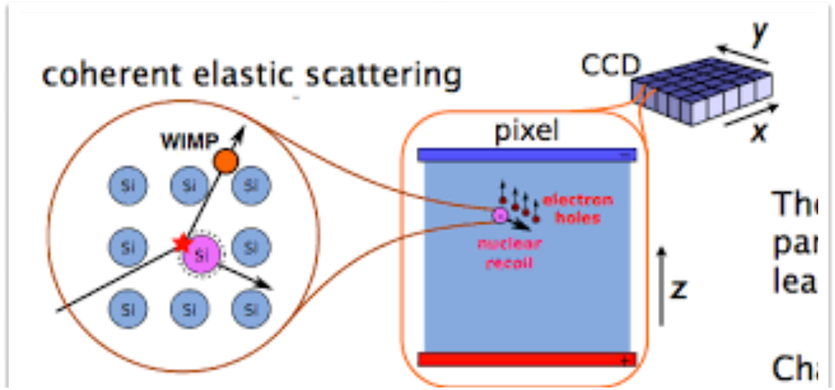
- mCPs interacts with electrons of target nuclides via virtual photons

	Region of Interest	Target	Exposure	∫(dσ/dE)dE
CONNIE	15 ~ 215 eV	Skipper CCD	~0.1 kg·day	1.7 x10^{-18} cm^{-2}

***simply assume flux is same**

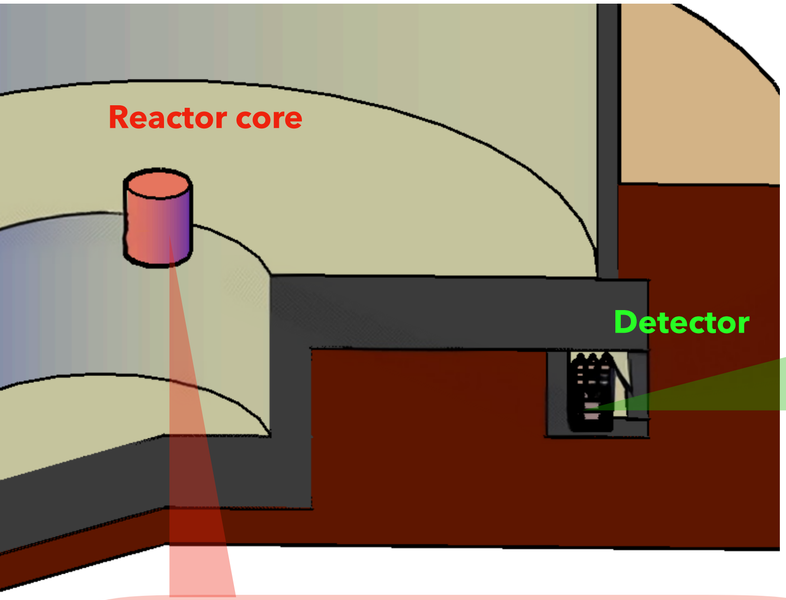


mCPs production from Compton-like process

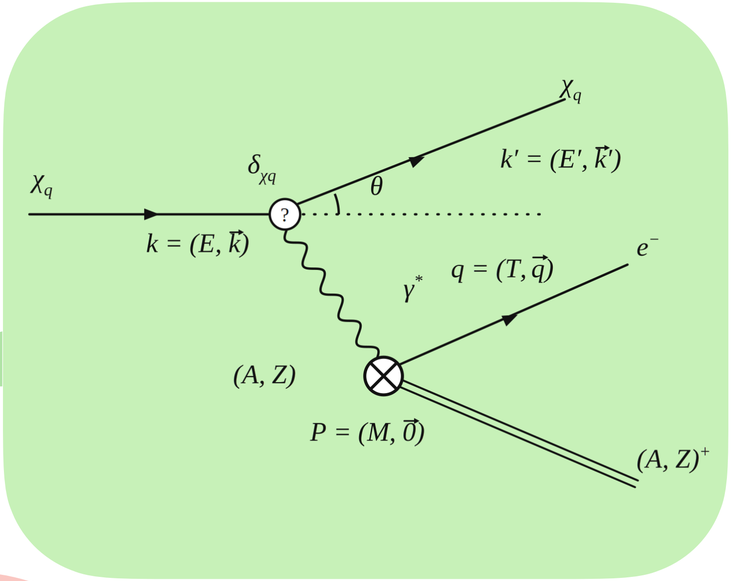


Current best sensitivity comes from Skipper-CCD experiment (Low threshold, small exposure)

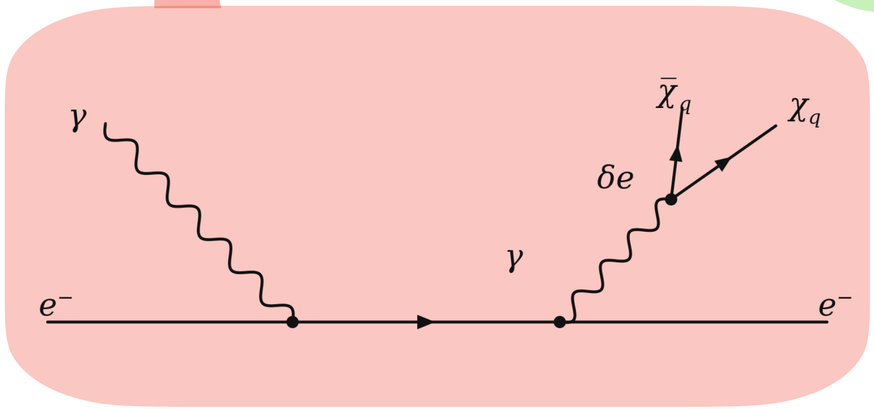
4. mCPs from reactor (planned)



mCP-nuclear scattering



*simply assume flux is same



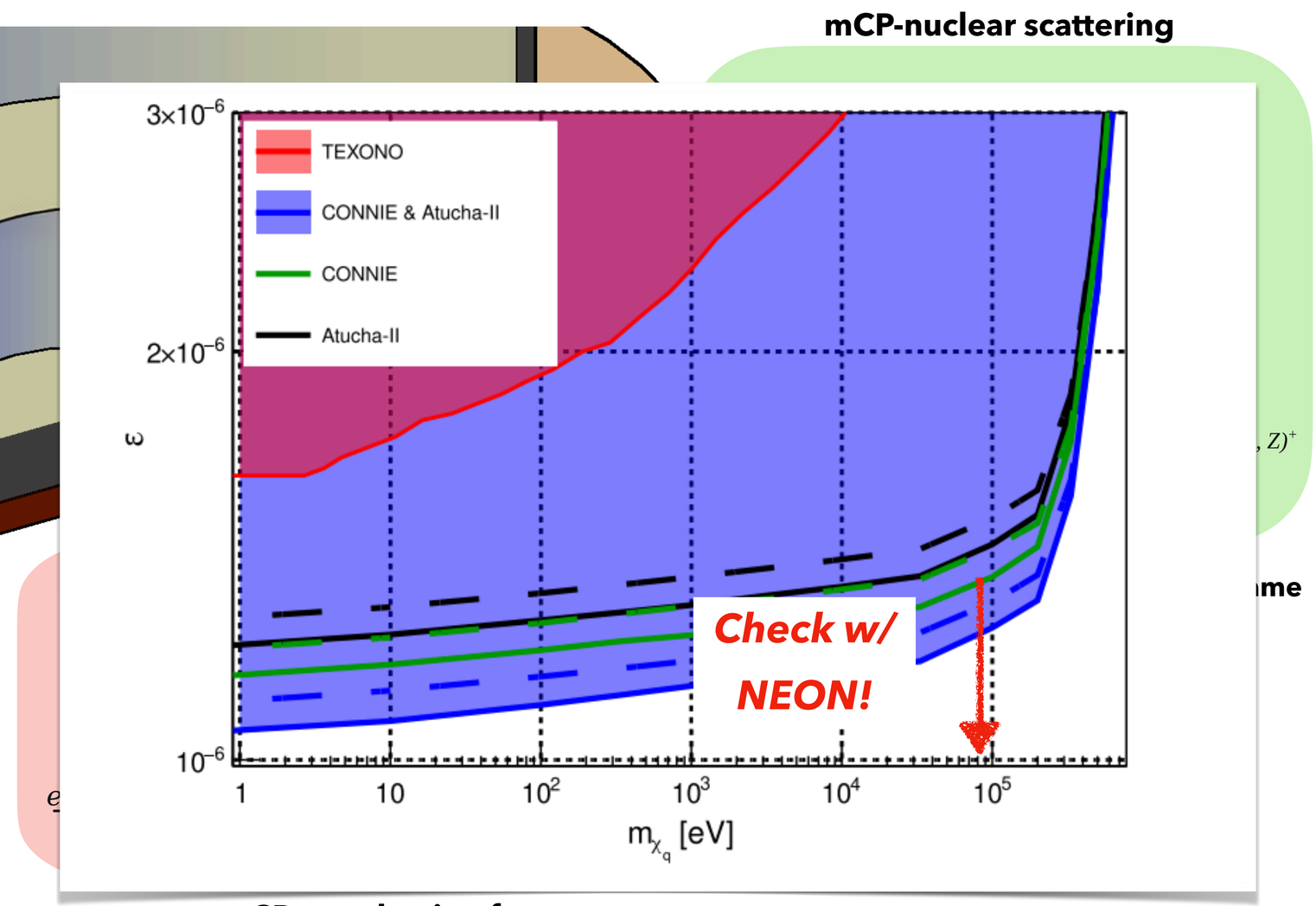
mCPs production from Compton-like process

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	Region of Interest	Target	Exposure	∫(dσ/dE)dE
CONNIE	15 ~ 215 eV	Skipper CCD	~0.1 kg·day	1.7 x10^{-18} cm^{-2}
NEON (Rough estimation	200 ~ 400 eV	NaI(Tl)	~10000 kg·day	1.6 x10^{-19} cm^{-2}

NEON : higher threshold, large exposure

4. mCPs from reactor (planned)



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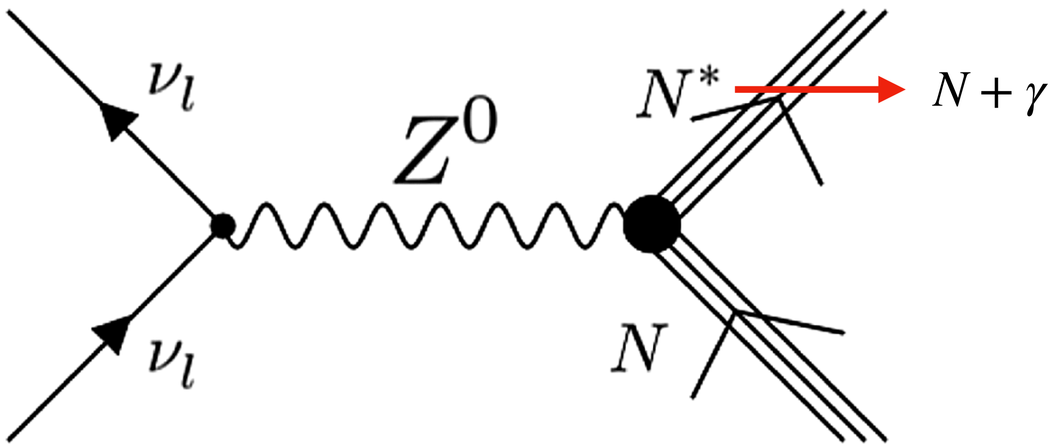
- **(Rough estimation)** $\epsilon^4 \propto \frac{\text{exposure}}{\text{events}}$

$$\rightarrow \frac{\epsilon_{CONNIE}}{\epsilon_{NEON}} \sim \left(\frac{1.7 \times 10^{-18}/0.1kg \cdot day}{1.6 \times 10^{-19}/10000kg \cdot day}\right)^{1/4} \sim 30$$

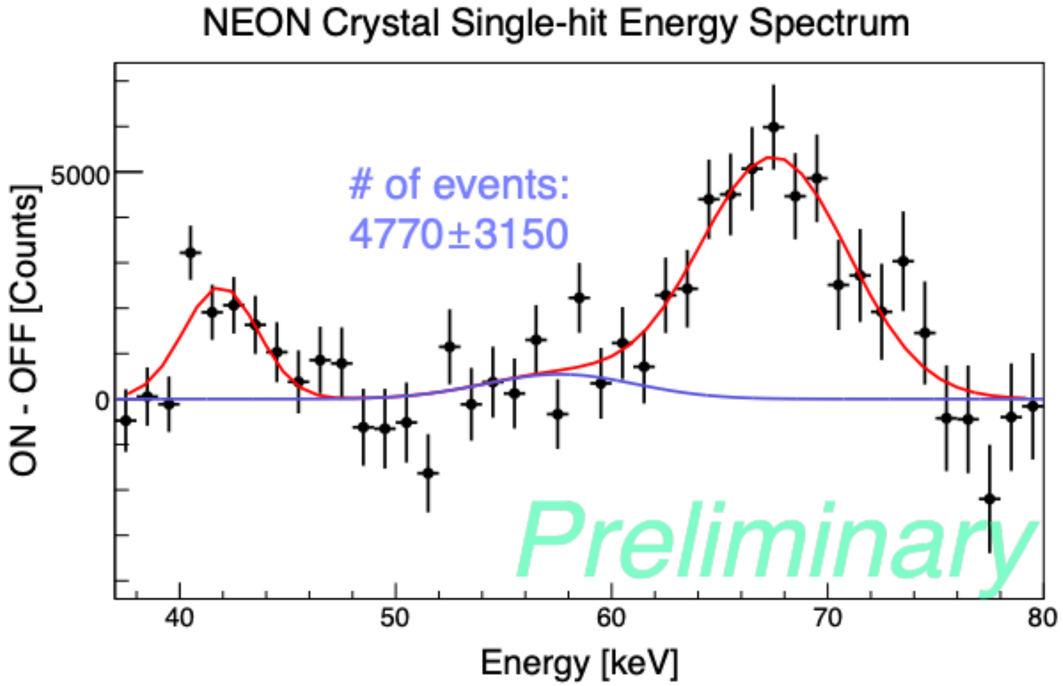
Competitive result with CONNIE expected ?

4. IvNS Search (ongoing)

Dutta *et al., Phys. Rev. D* 106, 113006 (2022)



IνNS



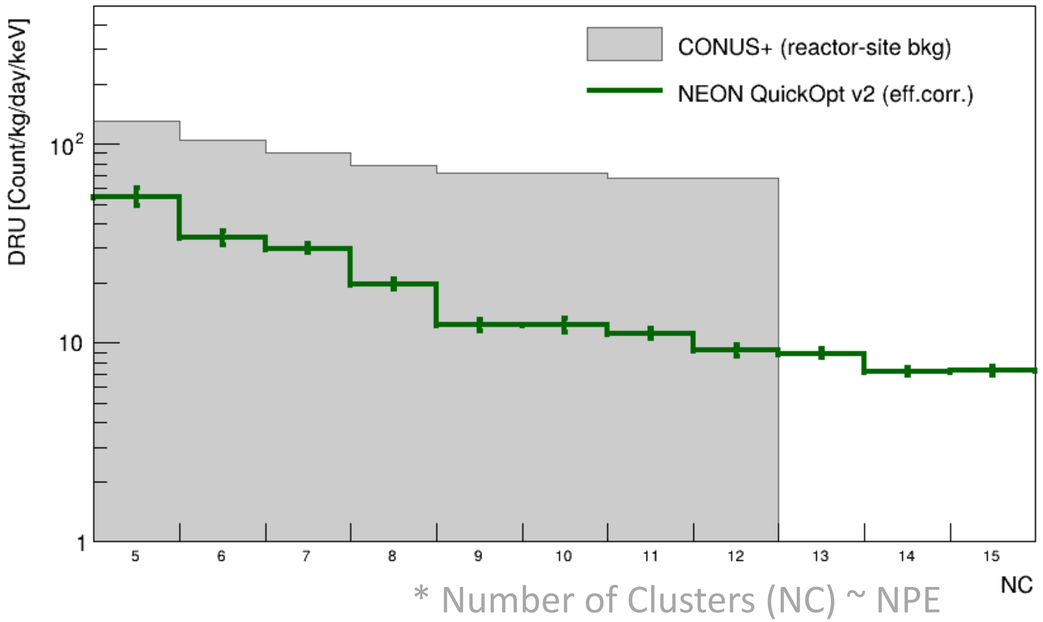
- **I**ncoherent ν - **N**ucleus **S**cattering **(IνNS)**
- γ detection from de-excitation of scattered nucleus.
- Signal expected at **57.6 keV from ^{127}I scattering**, using **Reactor On - Off data**
- **~ 2500 events** of IνNS expected with 700 days Reactor On data.

Analysis ongoing with detailed background modeling !

Plans and strategy

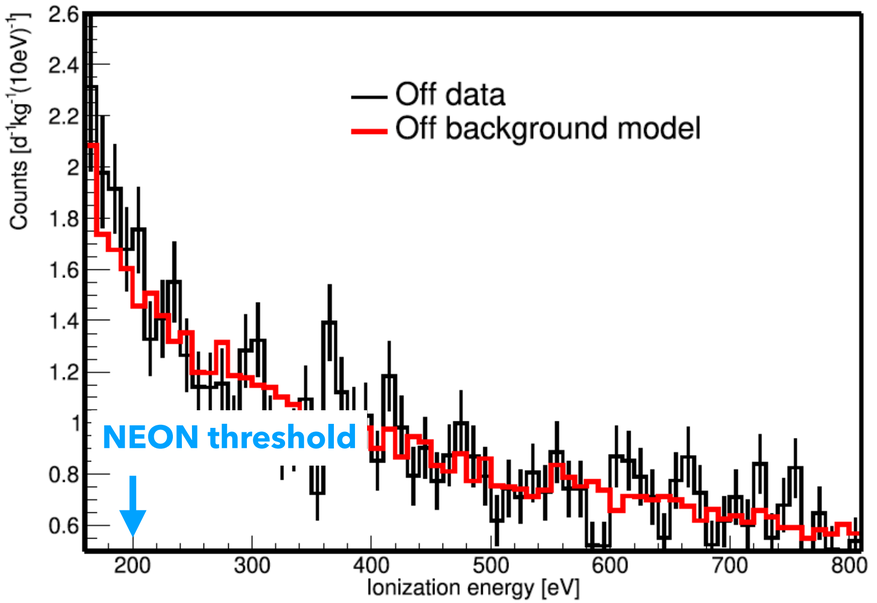
Comparison w/ CONUS +

NEON vs CONUS+ background



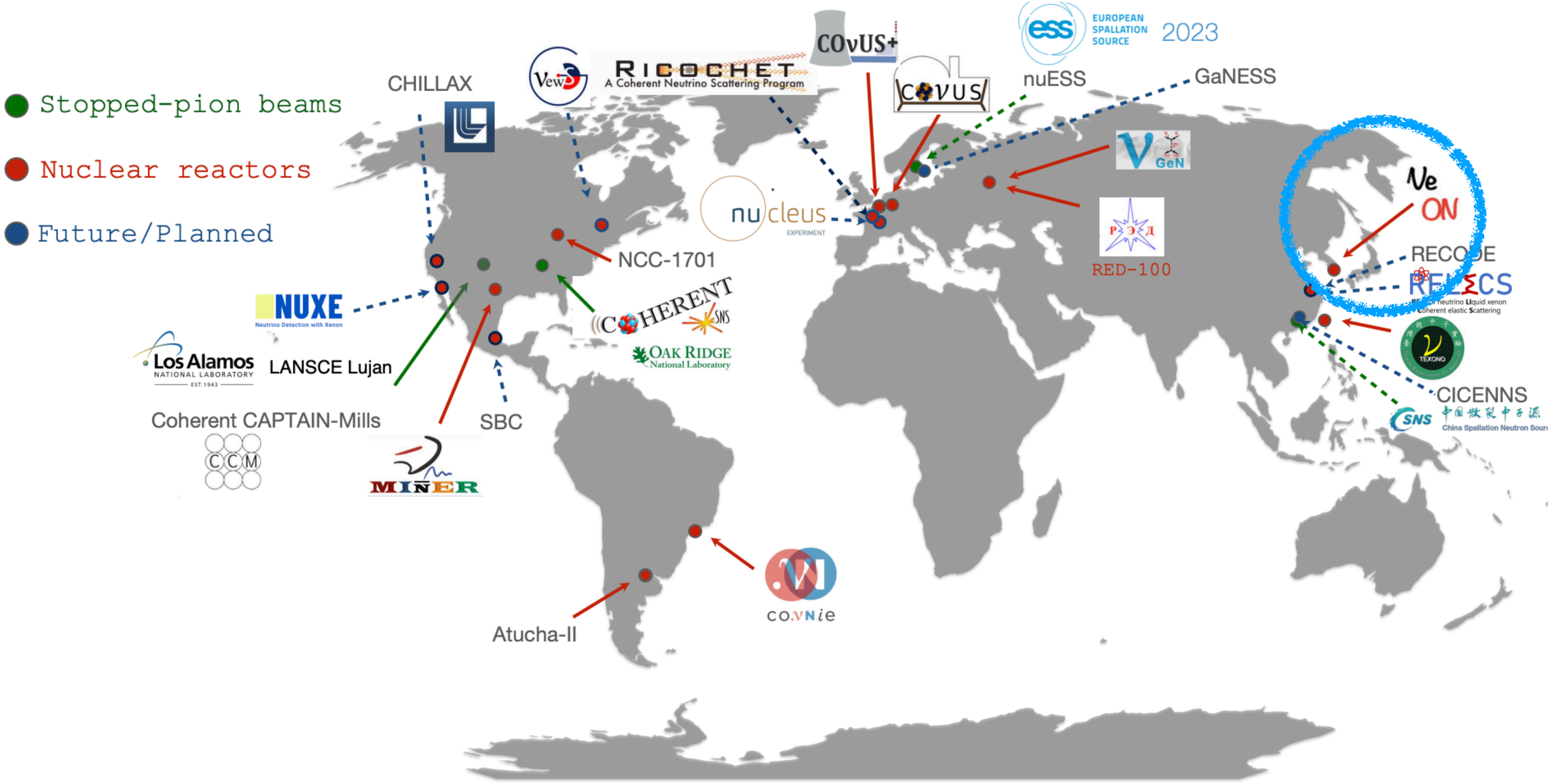
* Number of Clusters (NC) ~ NPE

CONUS+ Off background modeling



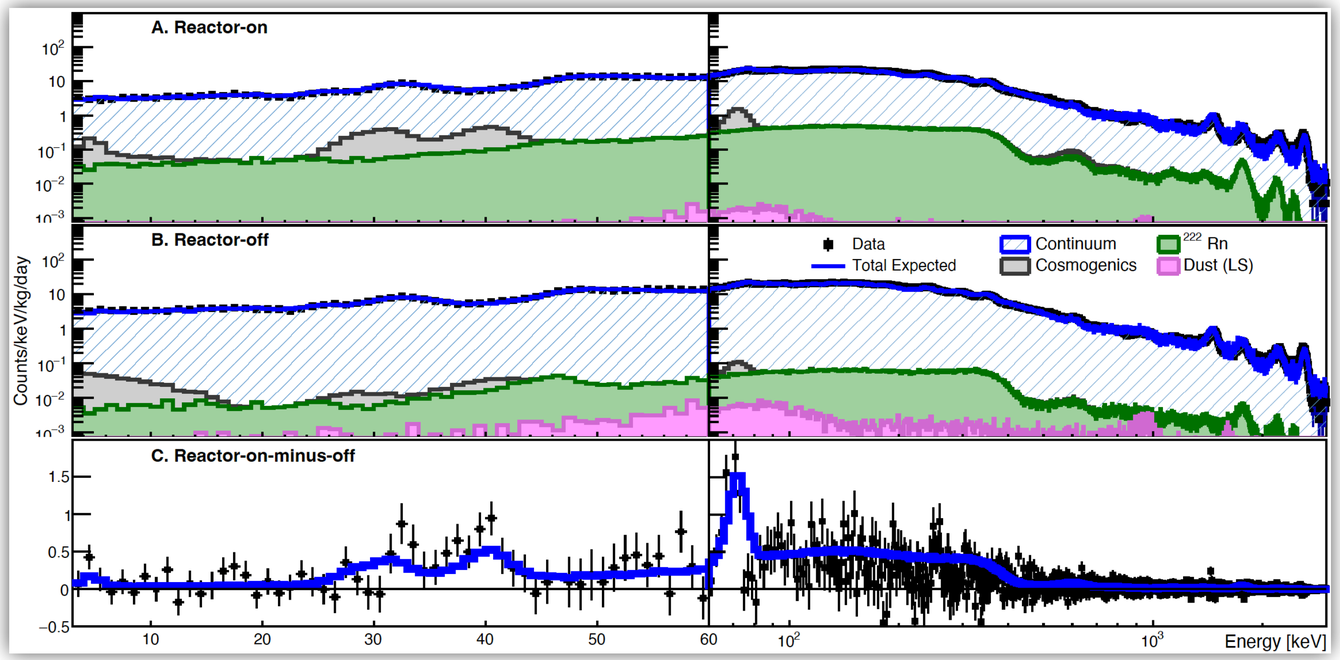
- Our background level is is comparable to or better than that of CONUS+ above NC5.
- As done in CONUS+, will model the background using Reactor-Off data and apply a likelihood fit to the On-period data to extract the CEvNS signal.

Worldwide CEvNS Detection



NEON Background understanding

NEON background modeling example



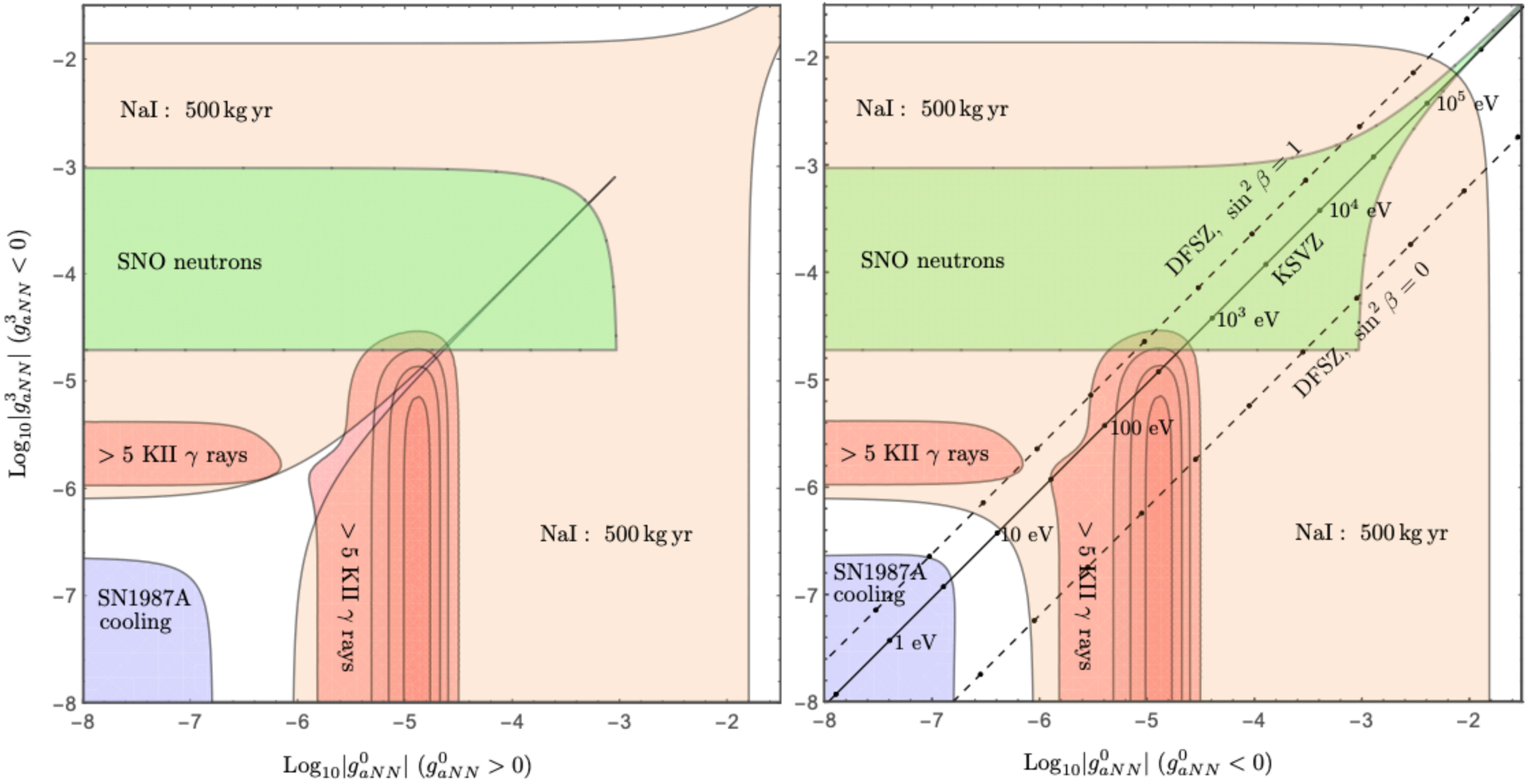
Example of background isotopes

Crystal internal	^{238}U, ^{232}Th, ^{40}K, ^{60}Co
Crystal cosmogenic	^{22}Na, ^{121m}Te, ^{129}I, ^{109}Cd, ^{3}H, ..
PMTs, Shields, ..	^{238}U, ^{232}Th, ^{40}K, ^{208}Tl, ^{235}U

- NEON scintillation events are dominated with background isotopes' radiation.
- Full Geant4 simulation has been conducted, and successfully modeled the data with likelihood method.
- Seasonal background change rom ^{222}Rn is also well described.

3. Galactic Axion Search (ongoing)

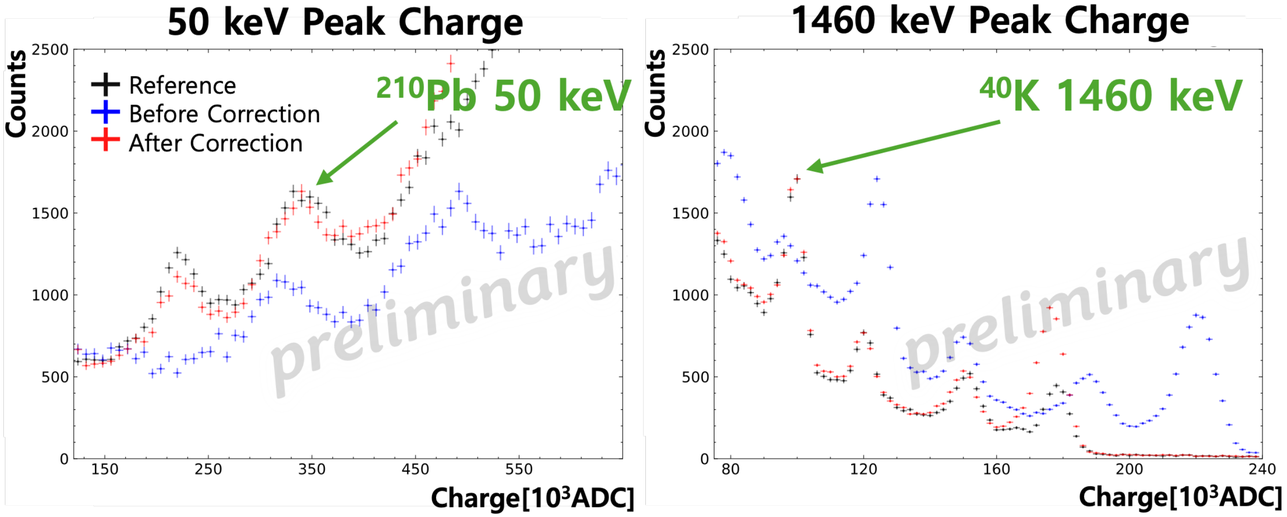
- *arXiv:2603.16998*



NEON Data control

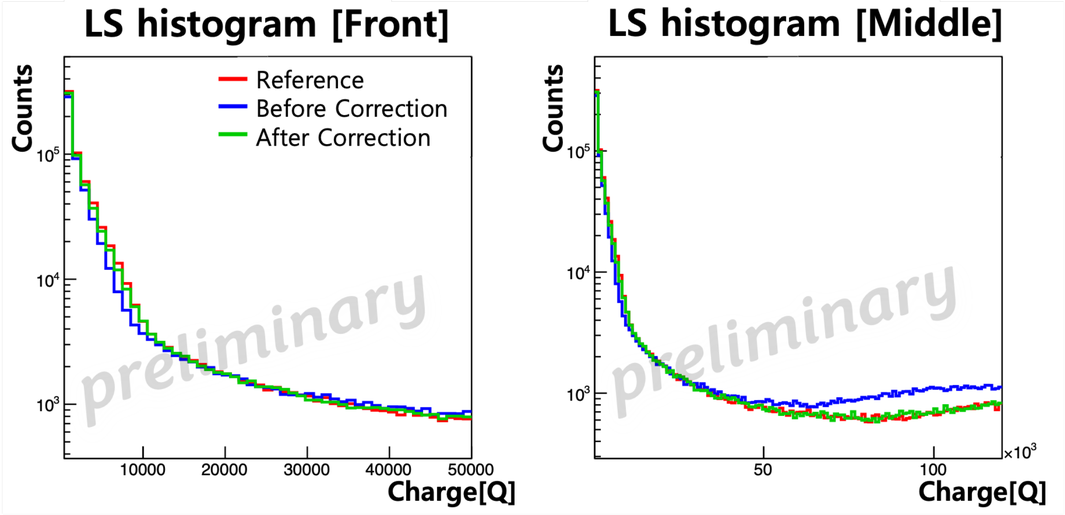
Crystal gain correction

- Low energy (Anode readout) → correction using **^{210}Pb 50 keV** γ peak
- High energy (Dynode readout) → correction using **^{40}K 1460 keV** γ peak

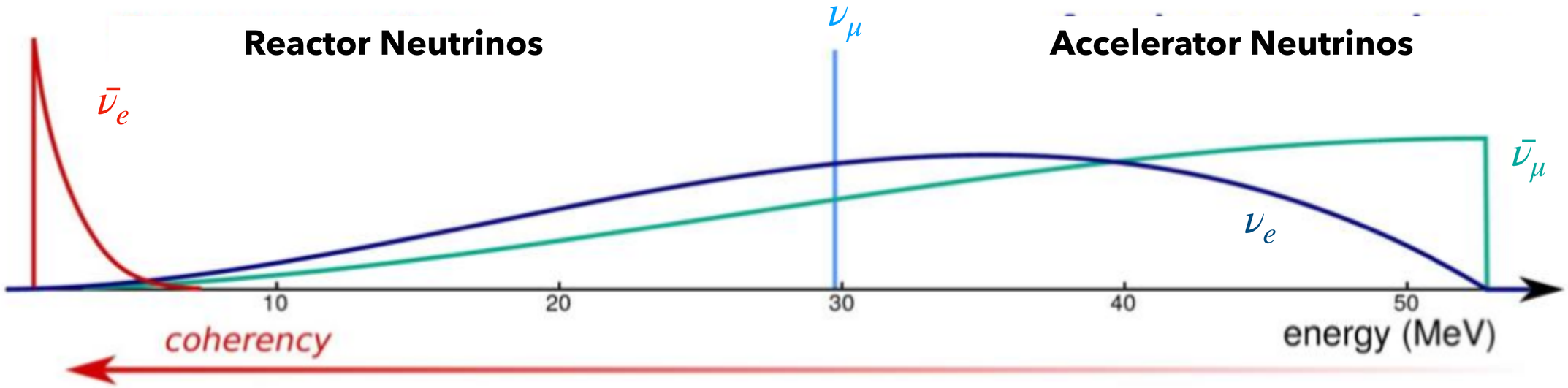


LS gain correction

- Correction by LS charge distribution slope.



CEvNS Detection w/ Reactor Neutrino



- Rich neutrino from fission products

  ~ 8.09 × 10^{12}/cm^2/sec at 24 m

  (2.8 GW_{th}, 24-m baseline, kopeikin model)

- Single flavor : $\bar{\nu}_e$

- Low energy → Fully coherent scattering !

- π DAR neutrino

- Different flavors $\nu_e, \nu_\mu, \bar{\nu}_\mu$

- 20–50 MeV, partially coherent.