

The COHERENT experiment

Neutrino 2024

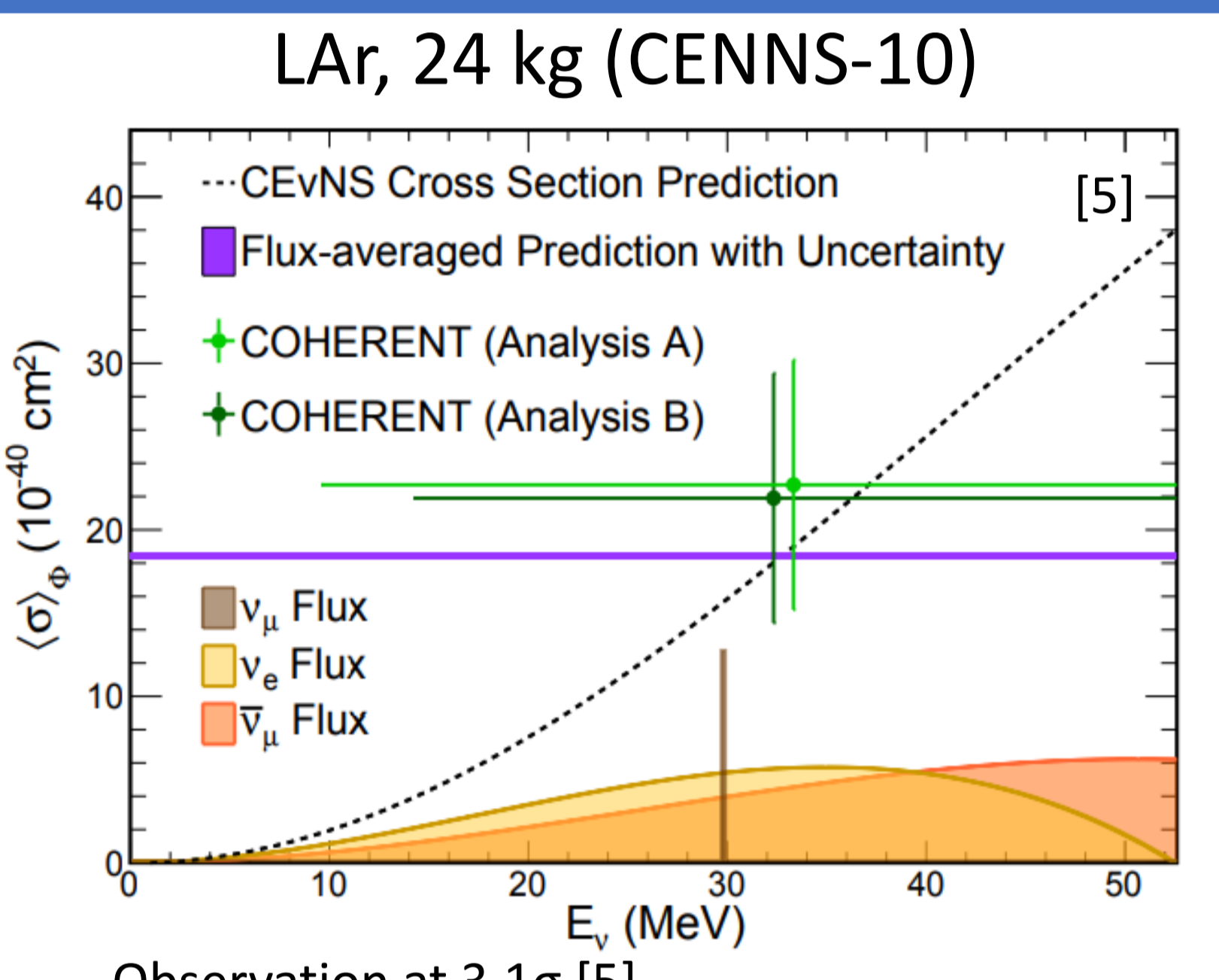
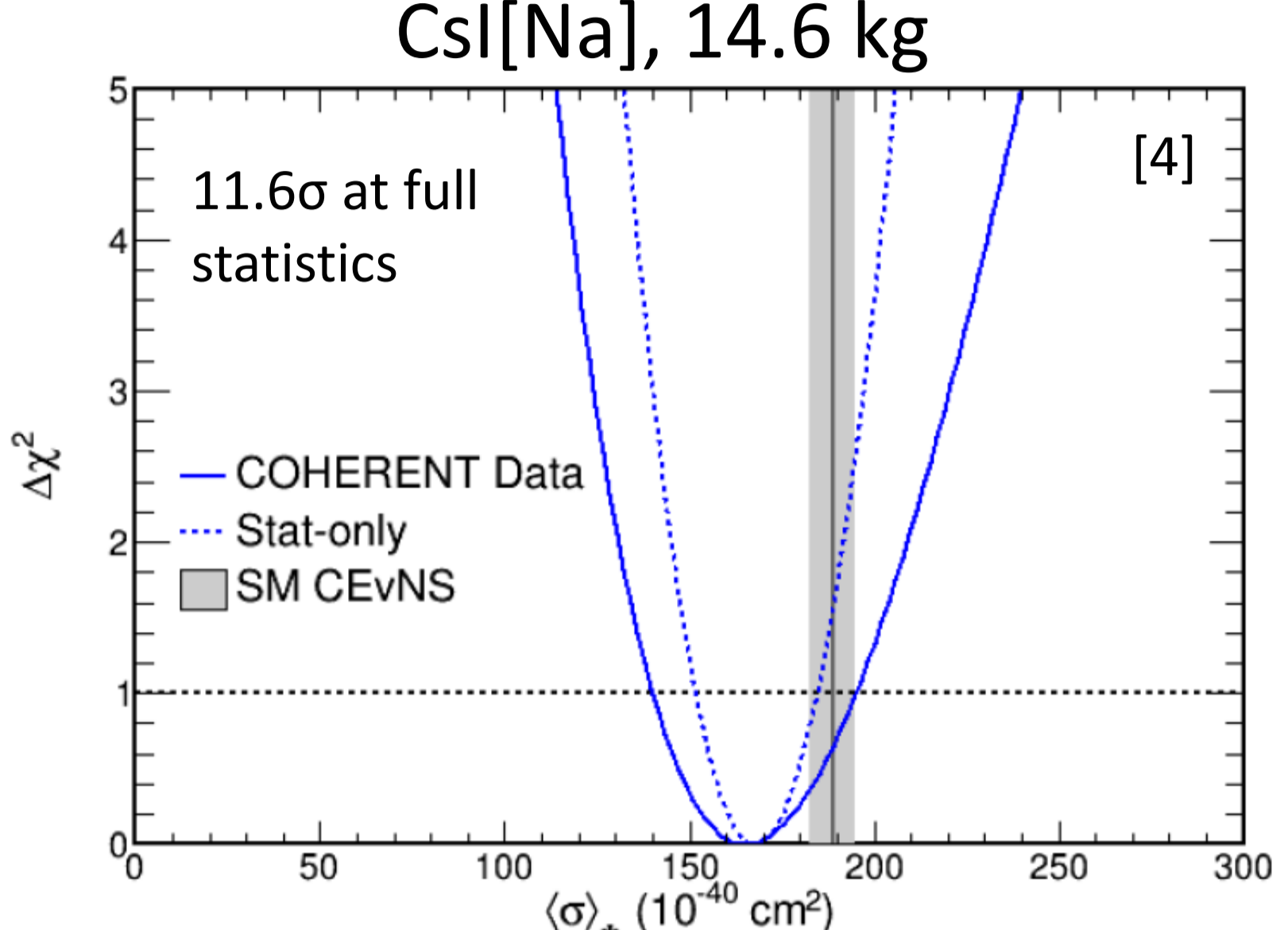
Dmitrii Rudik on behalf of COHERENT collaboration

Neutrino Alley
In your phone!

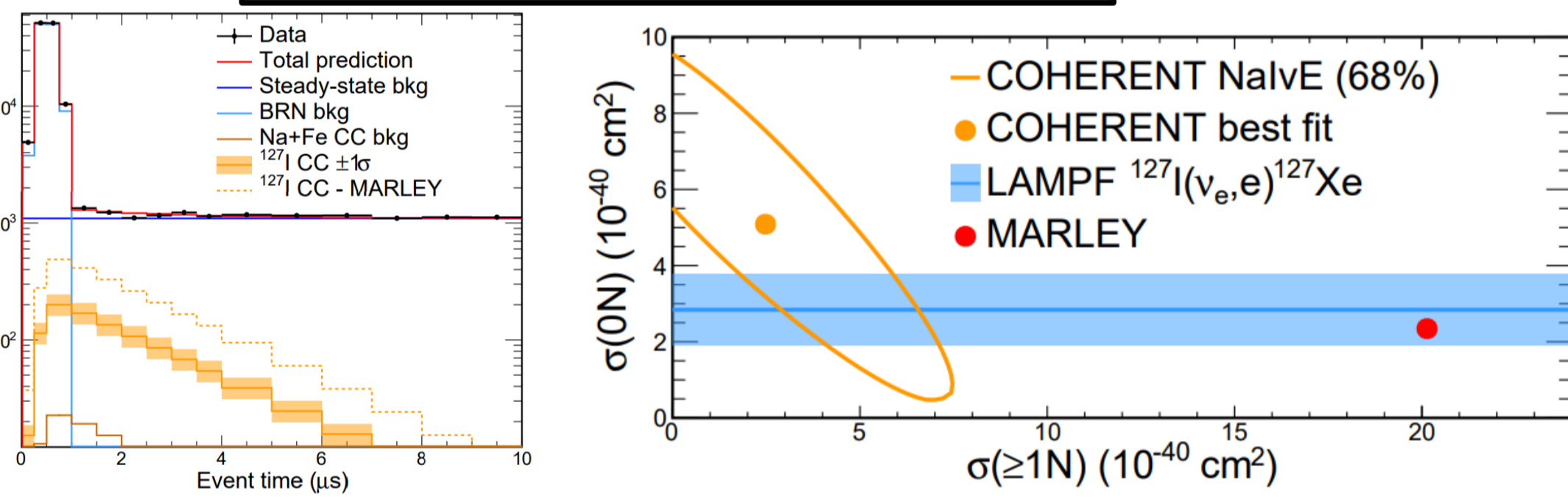
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Poster #265

- CENNS-10 (24 kg LAr)
 - NuThor (~3T Thor)
 - GeMini (18 kg HPGe)
 - D2O (185 kg)
 - Nal (185 kg)
- > 100 people, 28 institutions, 5 countries

We are measuring CEvNS since 2017!



NalVe
Motivation: $\nu_e + {}^{127}\text{I} \rightarrow e^- + {}^{127}\text{Xe}^*$ for solar ${}^7\text{Be}$ ν_e
Detector: 24×7.7 kg NaI(Tl) crystals
5.8σ CC signal (541 events), but 41% lower than MARLEY prediction [6]
See the poster #96 of Samuel Hedges

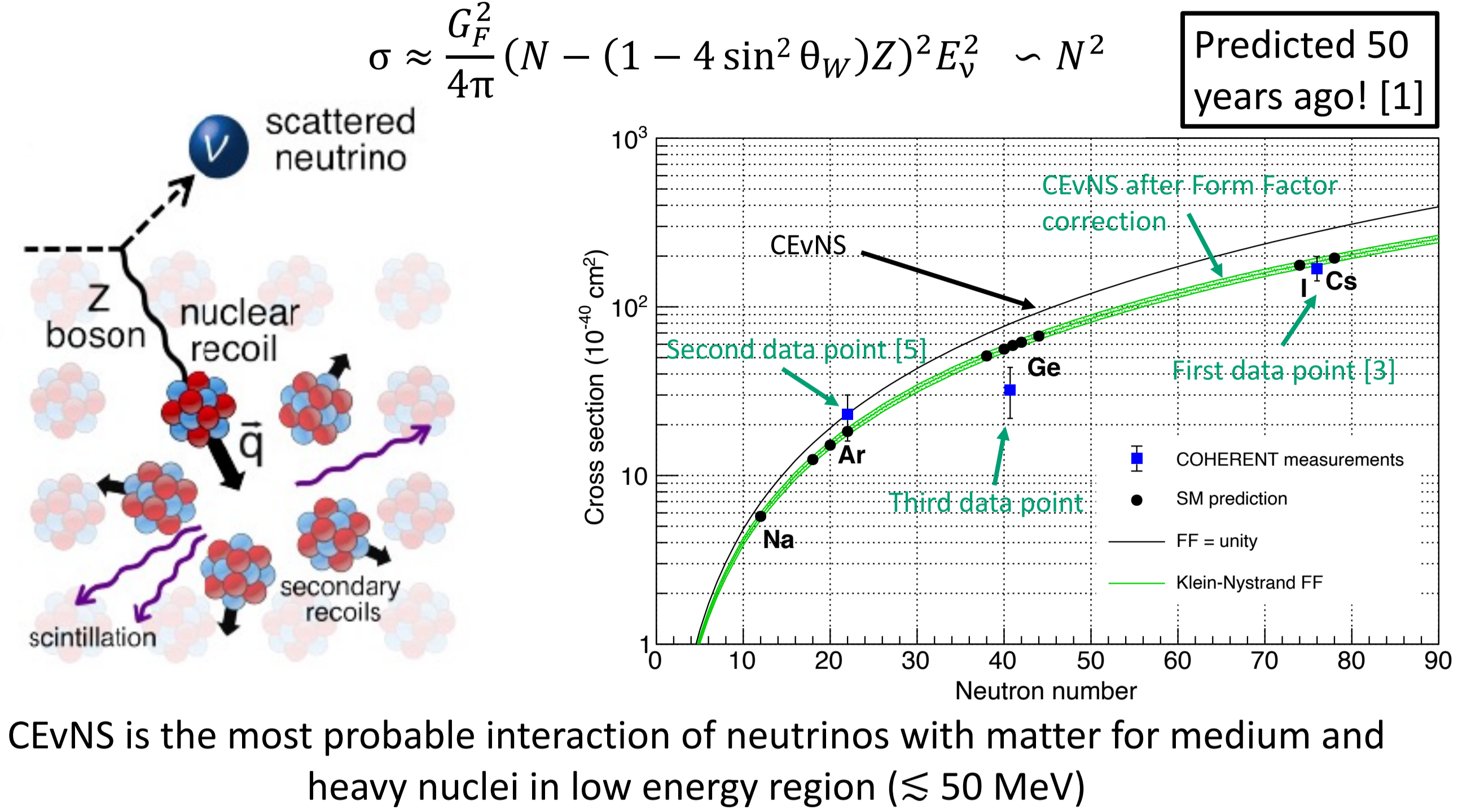


NalVETe
Nal(Tl): 2.4T→3.4T
1 crystal = 7.7 kg,
1 module = 63 crystals,
5->7 modules planned [3 currently deployed]
Sensitivity: 3σ in 3 years (3.4 T), $E_{\text{thr}}=13$ keV_{nr}

NuThor
Search for $\nu_e + {}^{232}\text{Th} \rightarrow e^- + {}^{232}\text{Pa}^*$
52 kg of thorium
800 kg of lead shielding
See the poster #200 of Tyler Johnson

Neutrino cube
Measuring inelastic neutrino induced neutrons [9]
Background for CEvNS, supernova ν detection
900 kg lead, EJ-301 LS, water bricks shielding
36 ev. observed vs. 346 predicted
1.8σ significance
>4σ disagreement

Coherent elastic neutrino nucleus scattering (CEvNS)



CEvNS is the most probable interaction of neutrinos with matter for medium and heavy nuclei in low energy region ($\lesssim 50$ MeV)

CEvNS at the SNS
Bunches of ~1 GeV protons on the Hg target with 60 Hz frequency
Bunch time profile with FWHM of ~350 ns
Total neutrino flux of $4.3 \cdot 10^7 \text{ cm}^{-2} \cdot \text{s}^{-1}$ at 20m

Recent CEvNS measurement!

Ge-Mini
8 HPGe PPC detectors deployed
~18 kg in total
3.9σ significance
See the poster #155 of Janina Hakenmüller

D2O
Leading syst. is 10% on neutrino flux [8]
Reduce to 3-5% by $\nu_e + d \rightarrow p + p + e$
See the poster #444 of Gen Li and Kirsten McMichael

MARS
Monitoring beam related neutrons (BRN) background [10]
12 BC-408 plastic scintillator of 2 cm thickness, interlayered with Gd-coated mylar
BRN flux is 1.2 n/m²/MWh (47% uncertainty)
75×25×100 cm³

Future of COHERENT

COH-Ar-750
750 kg total (610 kg fid.), 3000 CEvNS/year
128 PMTs, TPB for wavelength shifting
See the poster #453 of Vinicius Da Silva

Lead glass
Measuring inelastic neutrino scattering on lead
Prototype
40 kg lead glass
2 PMTs
No shielding
See the poster #568 of Nixon Ogoi

Cryogenic Undoped CsI

Like CsI[Na], but better [7]:
Higher light yield at or below 77 K
SiPMs: high QE, no Cherenkov radiation
low dark count rate (at low T)
See the poster #442 of Charlie Prior

H2O
 $\nu_e + {}^{16}\text{O} \rightarrow e^- + \text{F}^*$
100 L water to measure ν_e -O CC
10 cm lead shielding
Few tens of events in two SNS-years

LAr TPC
Proposal:
250 kg LAr TPC for DUNE-like CC detection
Main background cosmic muons
High voltage (HV) power supply ground = building ground
PicoAmmeter (Current measurement)
Nominal field: 500 V/cm (15 kV total)

Physics reach at Second Target Station
Second target station at around 2030s
Dedicated also for neutrino experiments
COHERENT is in contact with ORNL on this matter
Idea of 10T LAr detector...

References and acknowledgments

[1] PRD 9, 1389 (1974) [6] PRL vol. 131 221801 (2023)
[2] PRD 106, 032003 (2022) [7] PRD 109, 092005 (2024)
[3] Science 357 iss. 6456 (2017) [8] JINST 16 (08) P08048 (2021)
[4] PRL vol. 129 081801 (2022) [9] PRD 108, 072001 (2023)
[5] PRL vol. 126 012002 (2021) [10] JINST 17 (03) P03021 (2022)

