



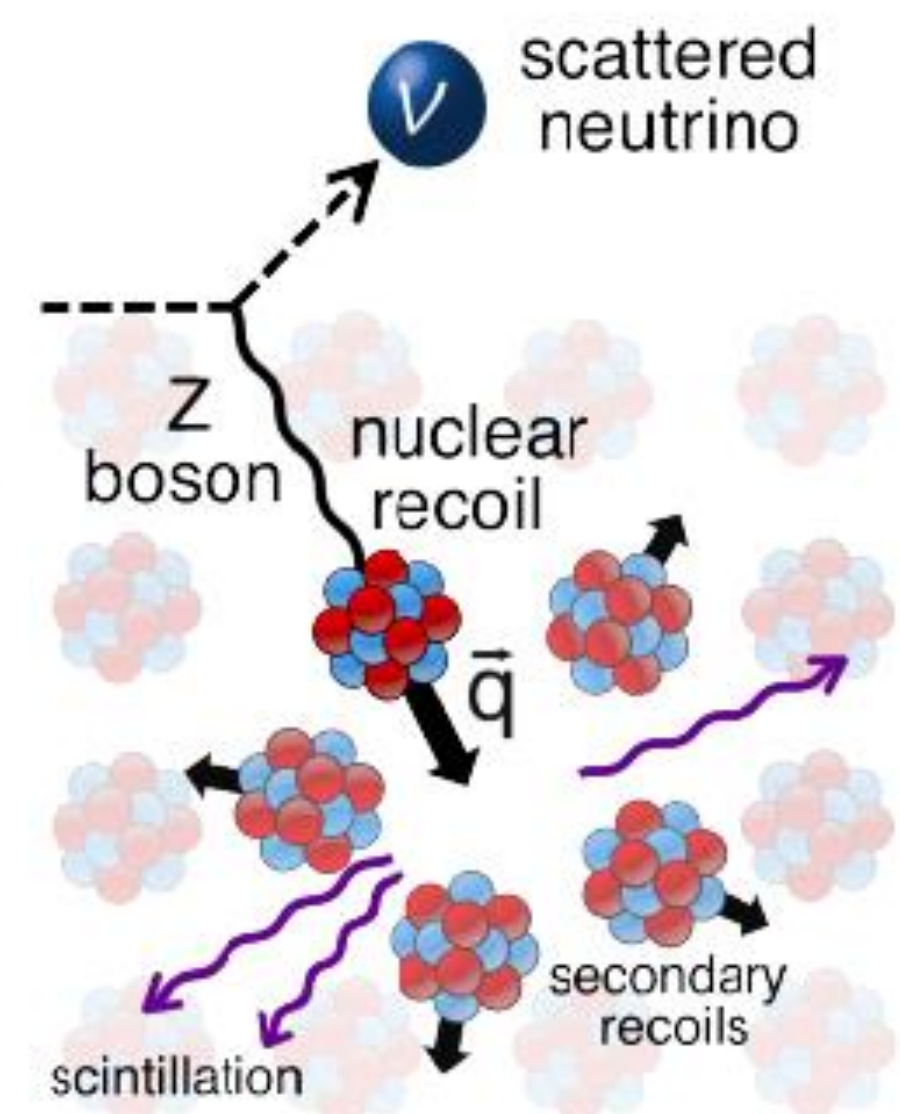
First Measurement of CEvNS on a Liquid Argon Target from the COHERENT Collaboration

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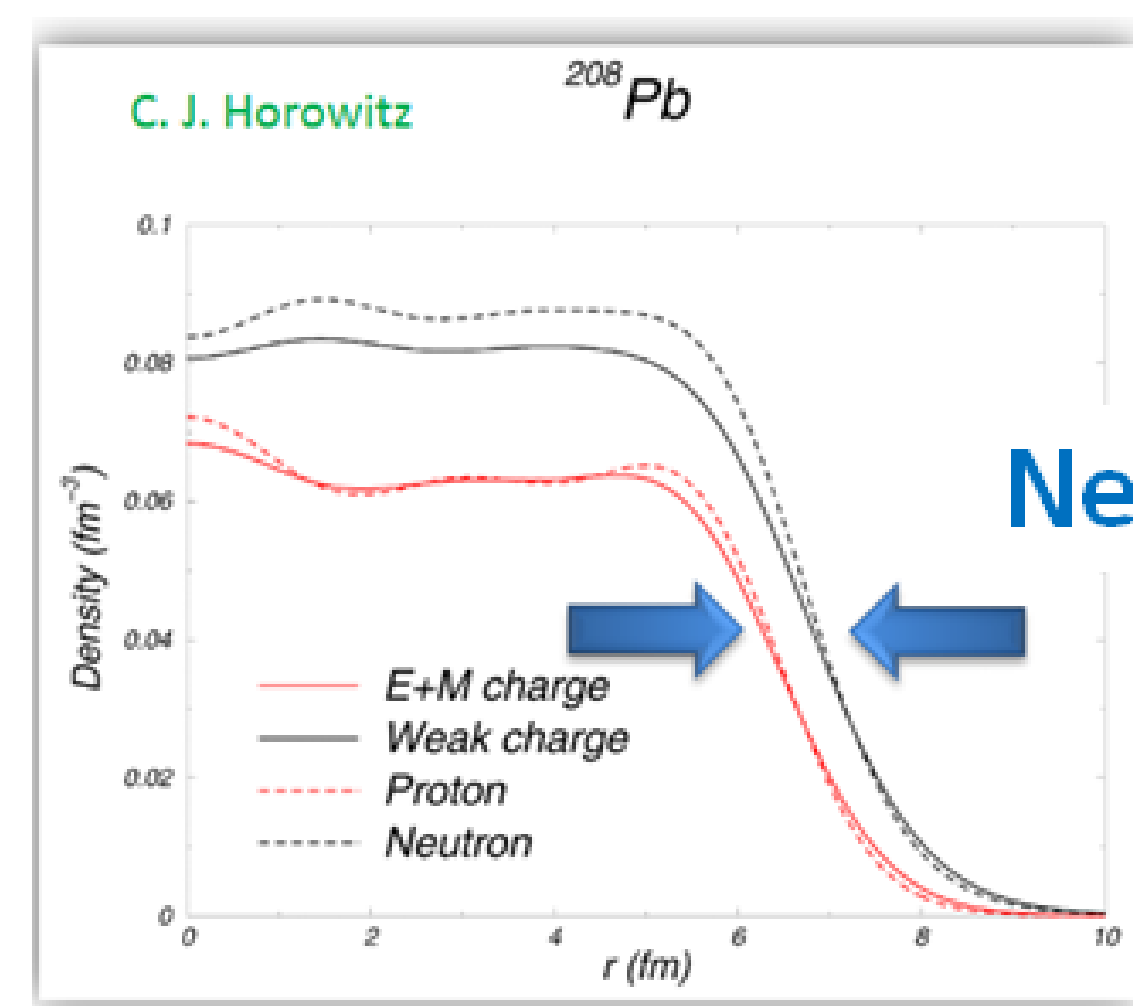
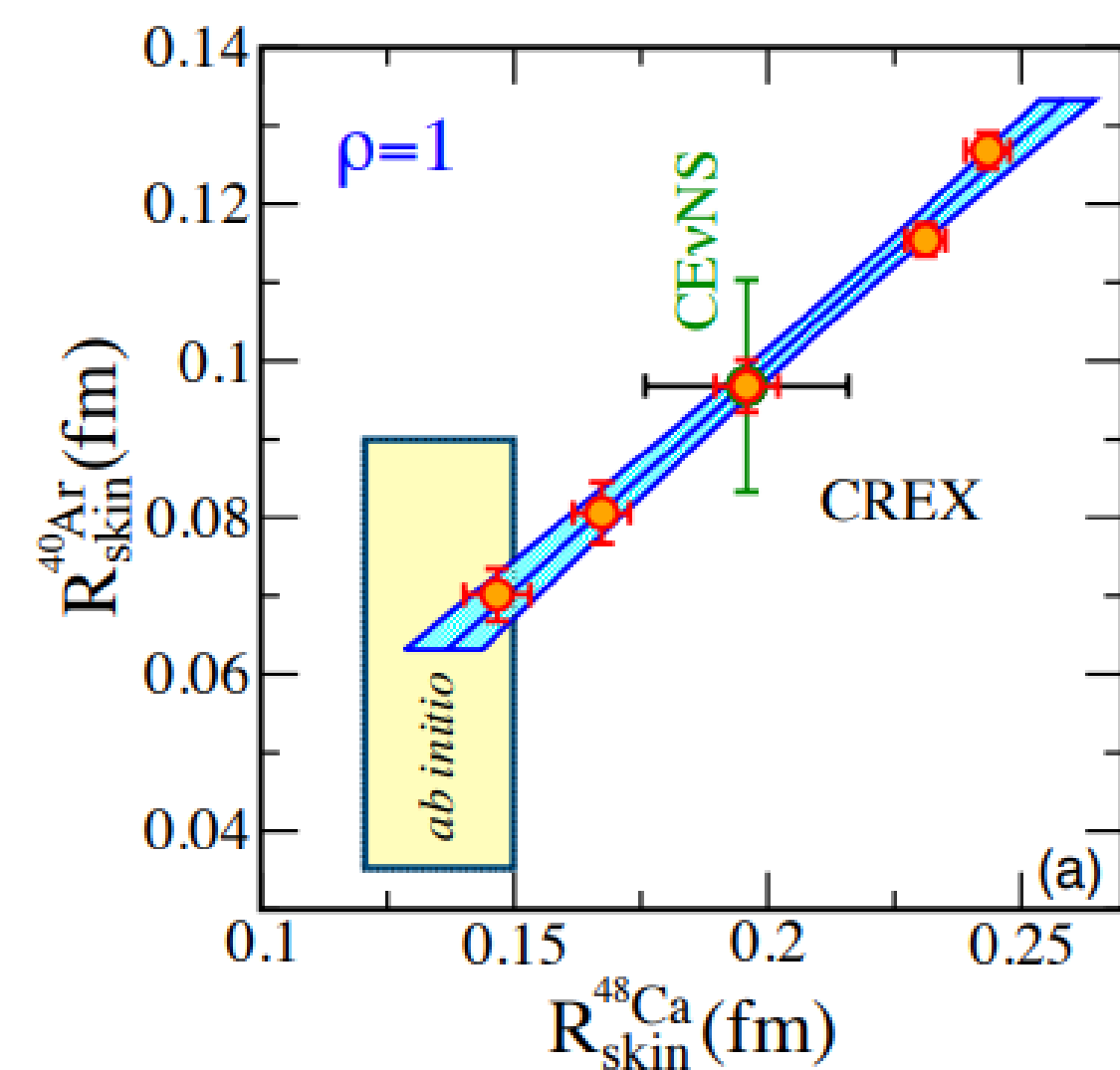
Physics with CEvNS

- CEvNS very cleanly predicted by Standard Model
- Deviations could indicate new physics
- NSI coupling constants
- Observation of CEvNS places constraints on nonstandard neutrino-quark interactions
- Weak mixing angle
- Weak nuclear radius
- Development of CEvNS-sensitive technologies useful for other physics searches
- WIMP dark matter searches
- Sterile neutrino searches



$$\frac{d\sigma}{dT_{coh}} = \frac{G_F^2 M}{2\pi} G_V^2 \left[1 + \left(1 - \frac{T}{E_\nu} \right)^2 - \frac{MT}{E_\nu^2} \right]$$

$$G_V = ((g_V^p + 2\epsilon_{ee}^{uV} + \epsilon_{ee}^{dV}) Z + (g_V^n + \epsilon_{ee}^{uV} + 2\epsilon_{ee}^{dV}) N) F_{nucl}^V(Q^2)$$

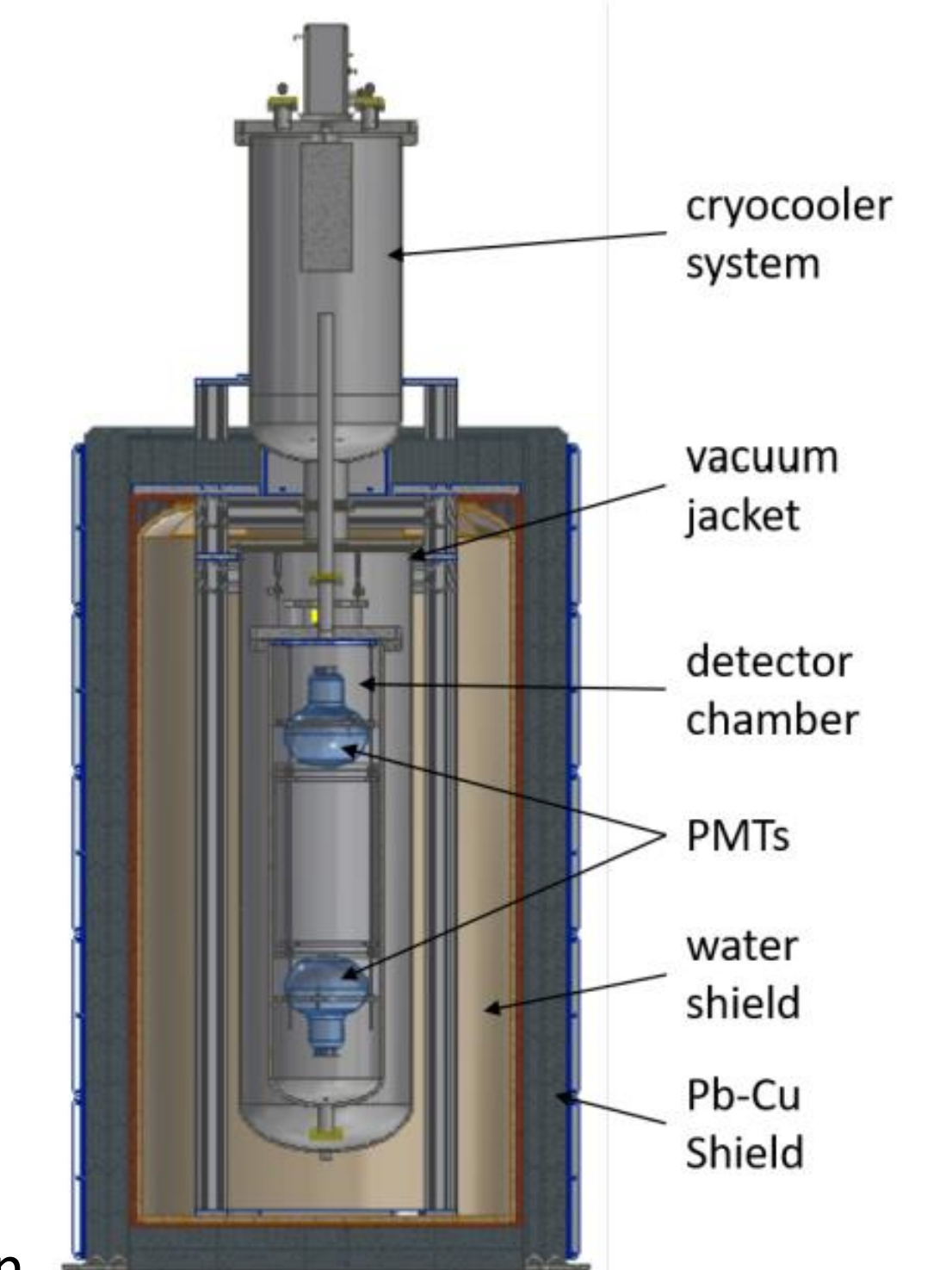
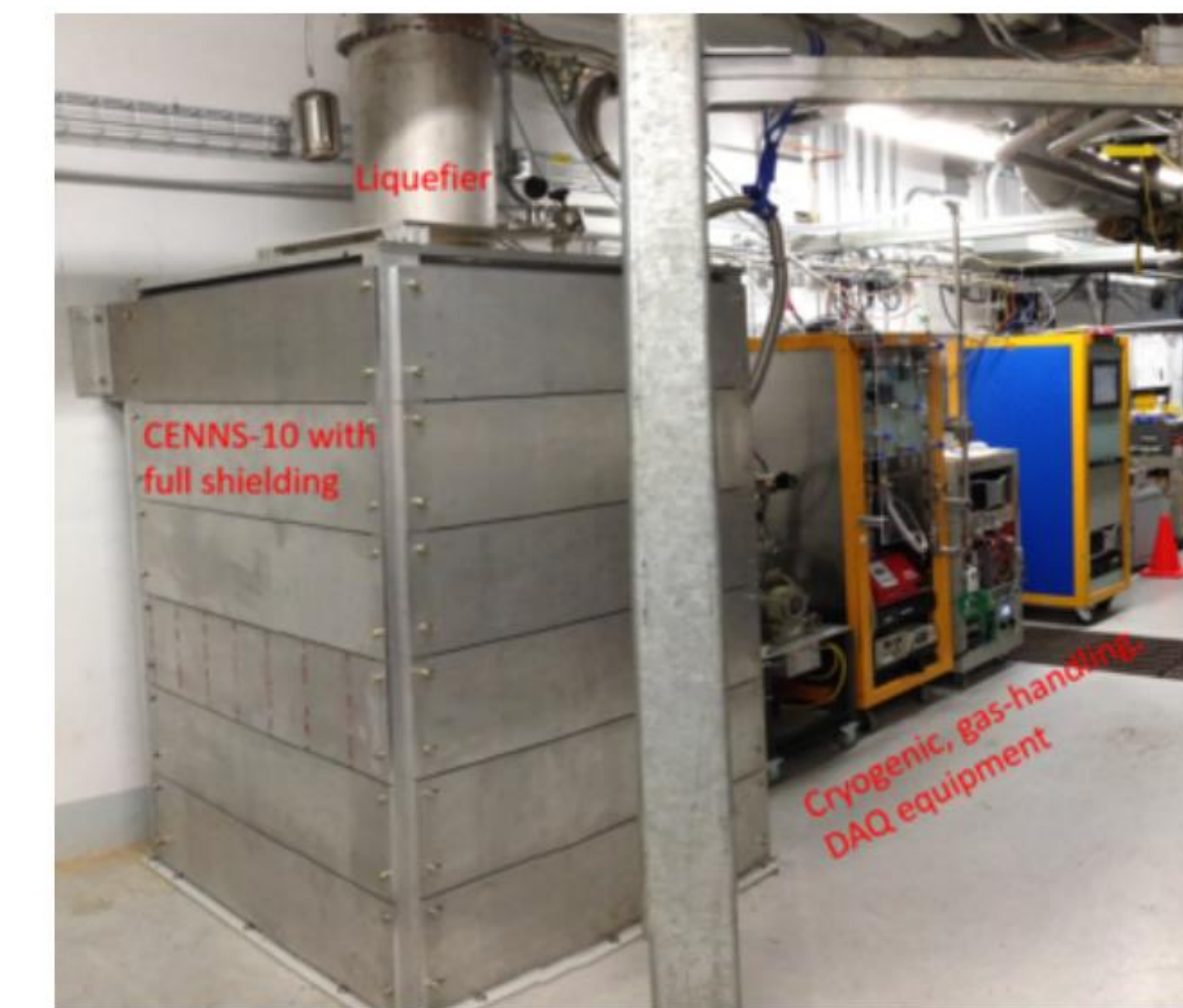


Neutron skin

Left: Constraints on weak nuclear radius⁴
Top: Cross-section with NSI parameters underlined

- Single-phase liquid argon detector deployed by COHERENT collaboration to the SNS, fall 2016
- Engineering run⁵: 1.8GWhr, ~80keVnr threshold. Early 2017
- Production run: 6.12GWhr, ~20keVnr threshold. June 2017-January 2019
- 24kg fiducial volume
- 99.6% abundance ⁴⁰Ar
- Tetraphenyl butadiene (TPB) coating to shift wavelength of scintillation light from 128nm to 400nm
- Shielding
 - 20cm of water shielding
 - 1.25cm of Cu shielding
 - 10cm of Pb shielding

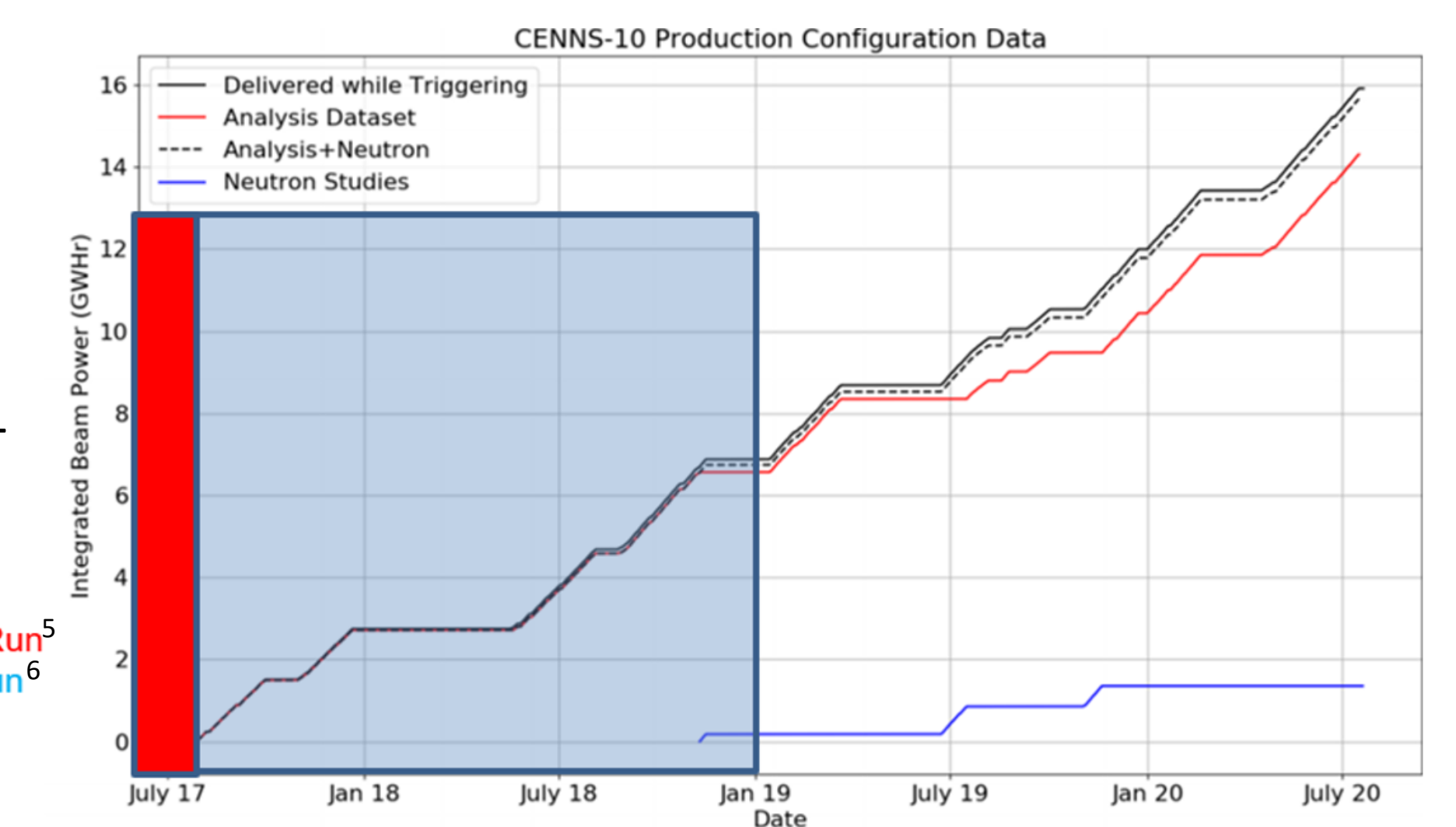
CENNS-10



COH-Ar-10 detector with shielding at location

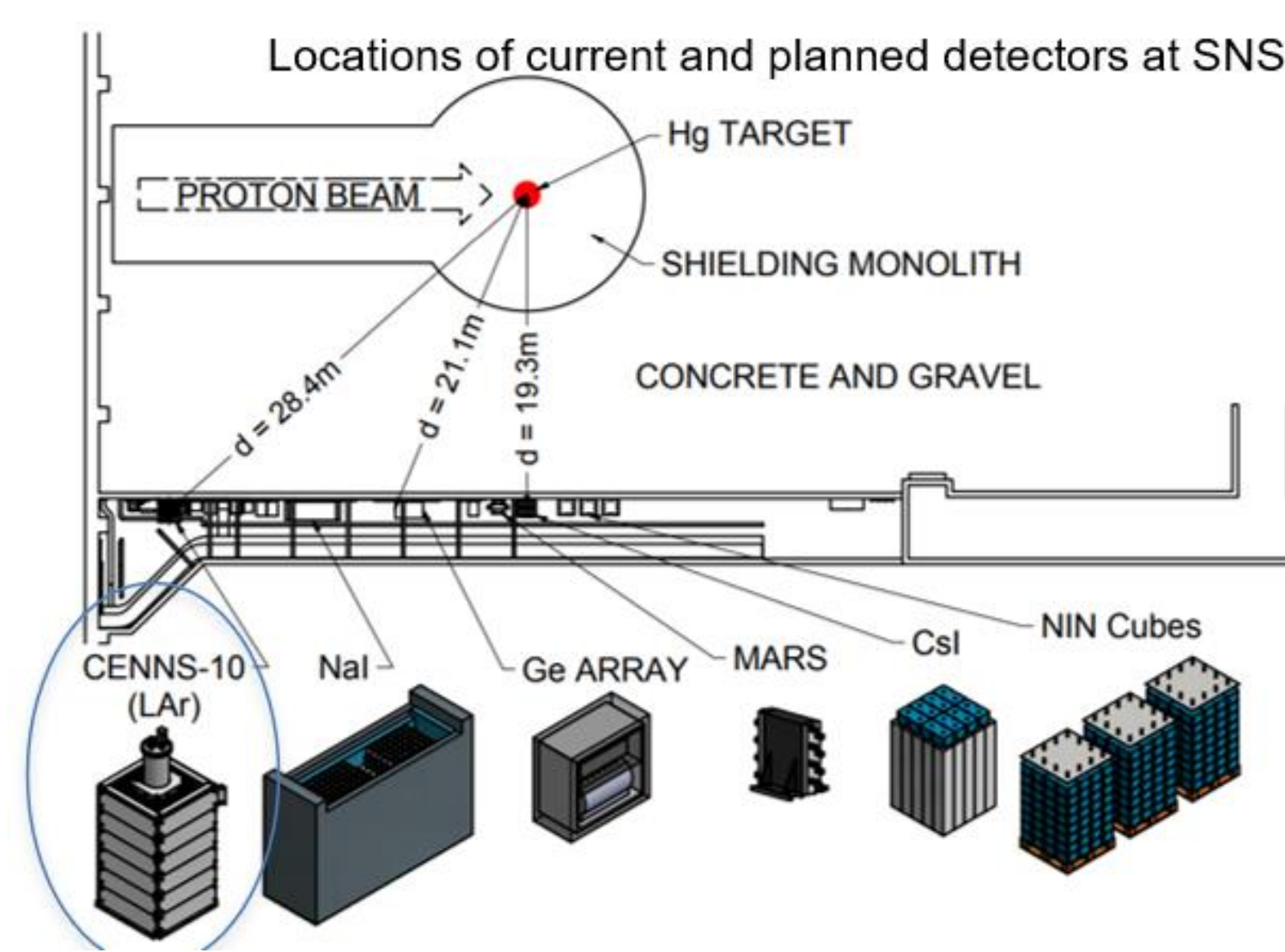
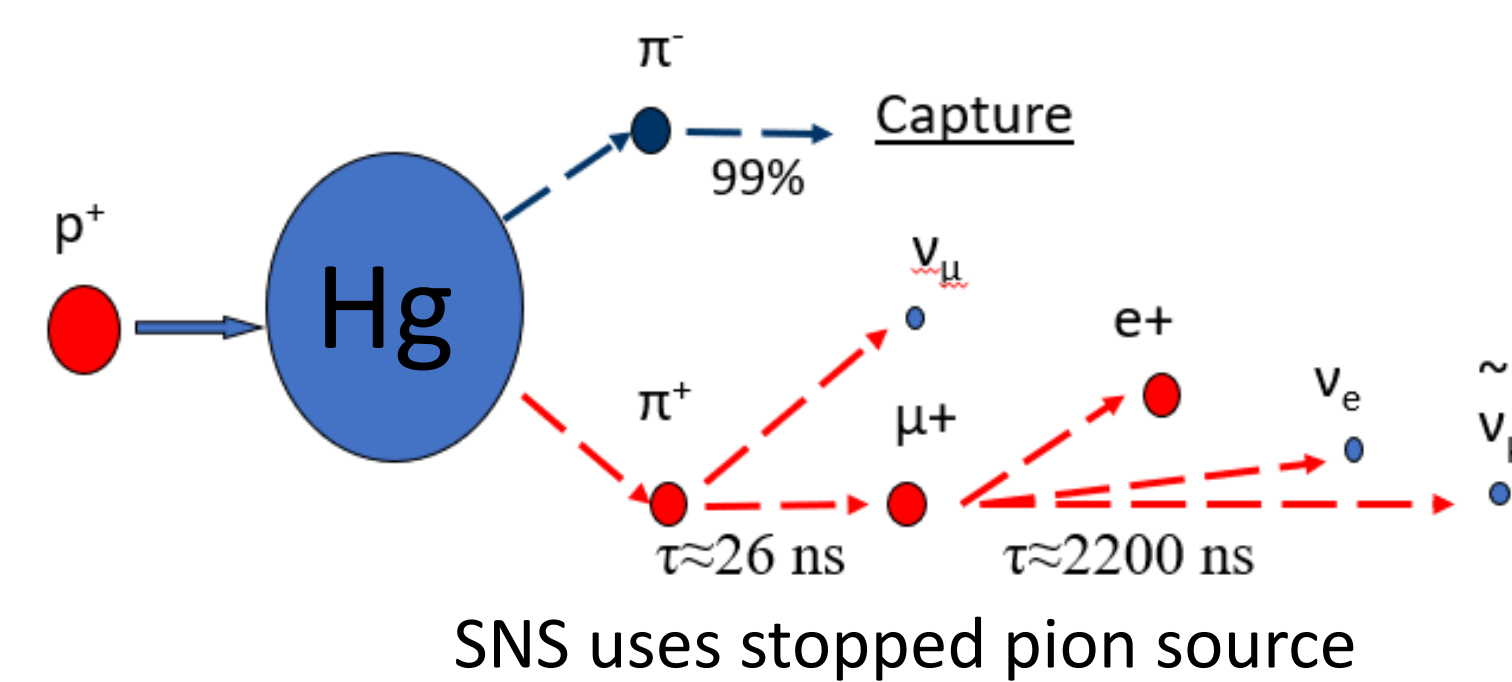
Total data collected by COH-Ar-10.
Expected 17GWhr collected by early 2021

■ CENNS-10 Engineering Run⁵
■ CENNS-10 Production Run⁶

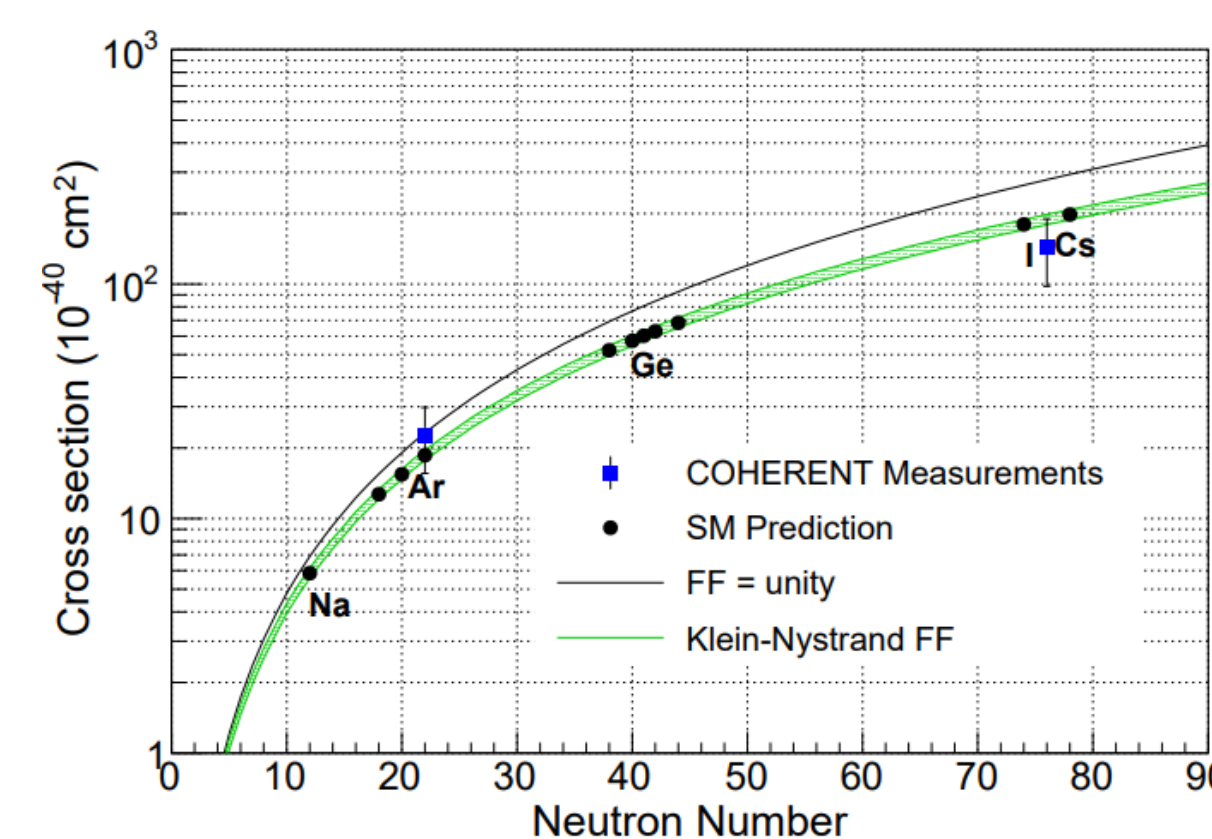


COHERENT at the SNS

- Spallation Neutron Source at Oak Ridge National Laboratory
- Highest flux of pulsed neutrinos in the world: $4.3 \times 10^7 \nu/cm^2/s$ at 20m
- Timing used for background rejection
- Multiple detectors with target nuclei in basement of SNS, "neutrino alley"
- Test N^2 dependence of cross-section
- First observation of CEvNS in 2017, using CsI[Na] crystal scintillator²
- First observation of CEvNS on Ar in 2020
- arXiv:2003.10630, submitted to PRL

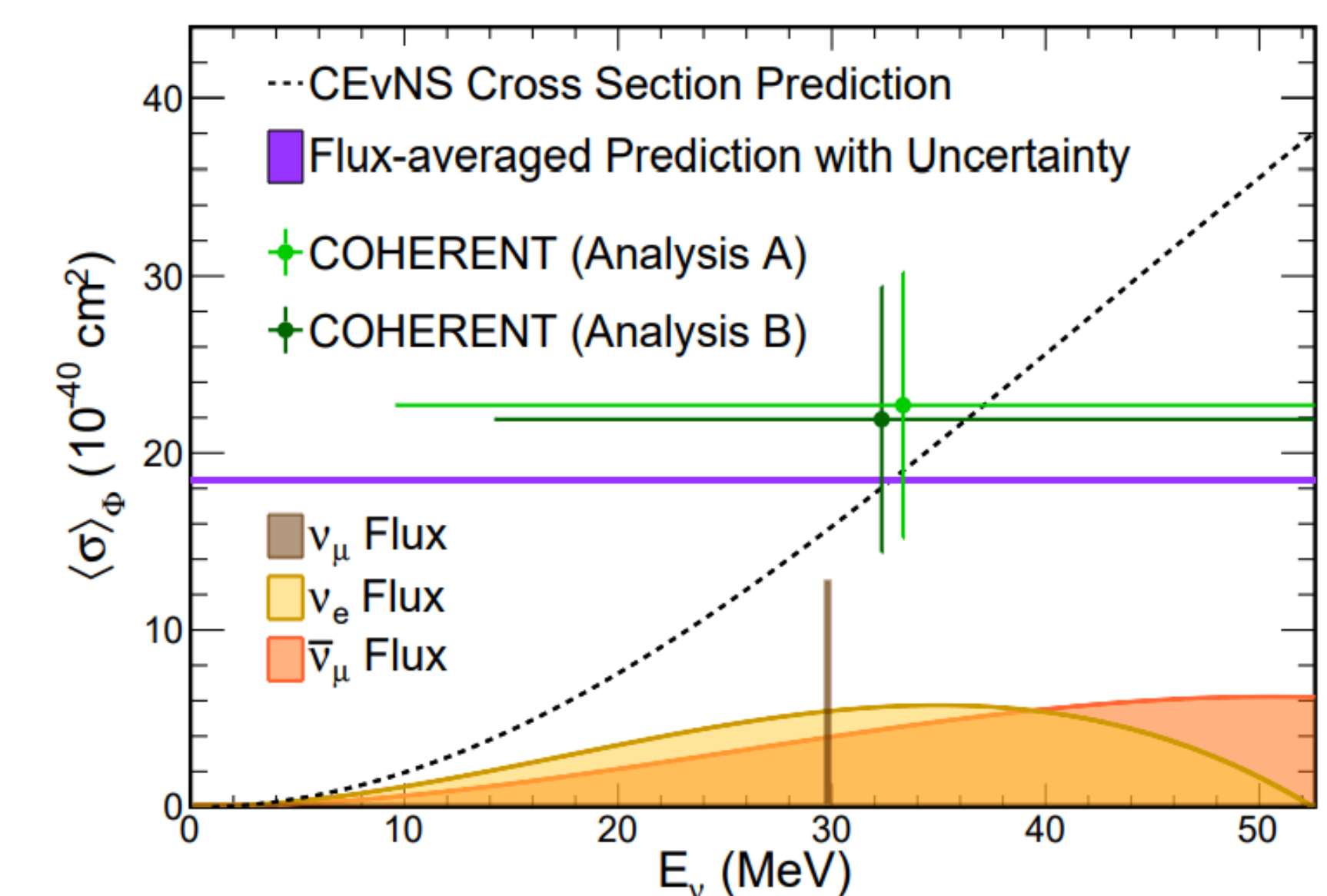
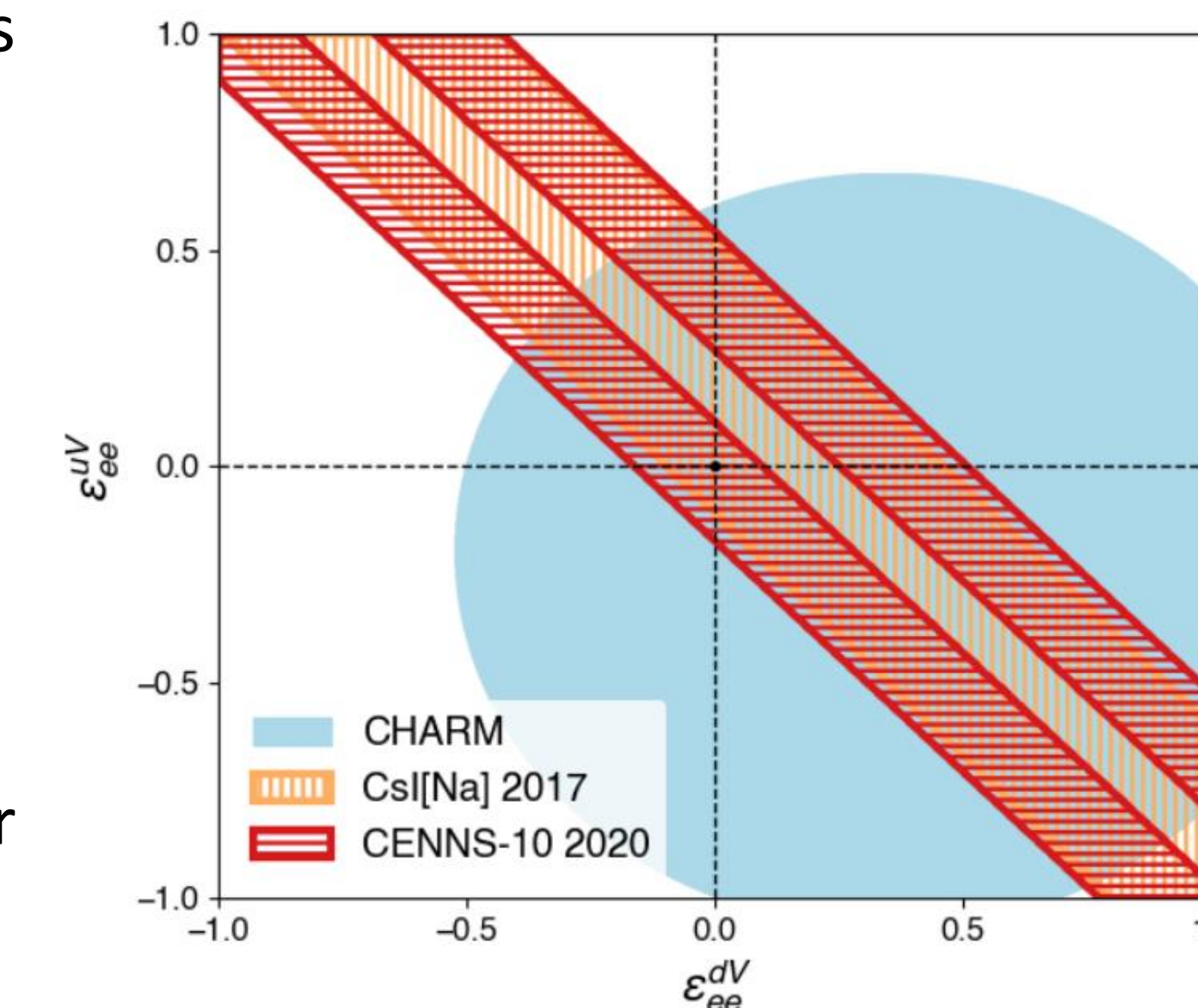


Left: CEvNS cross-section vs. N
Above: Current and planned detectors at the SNS

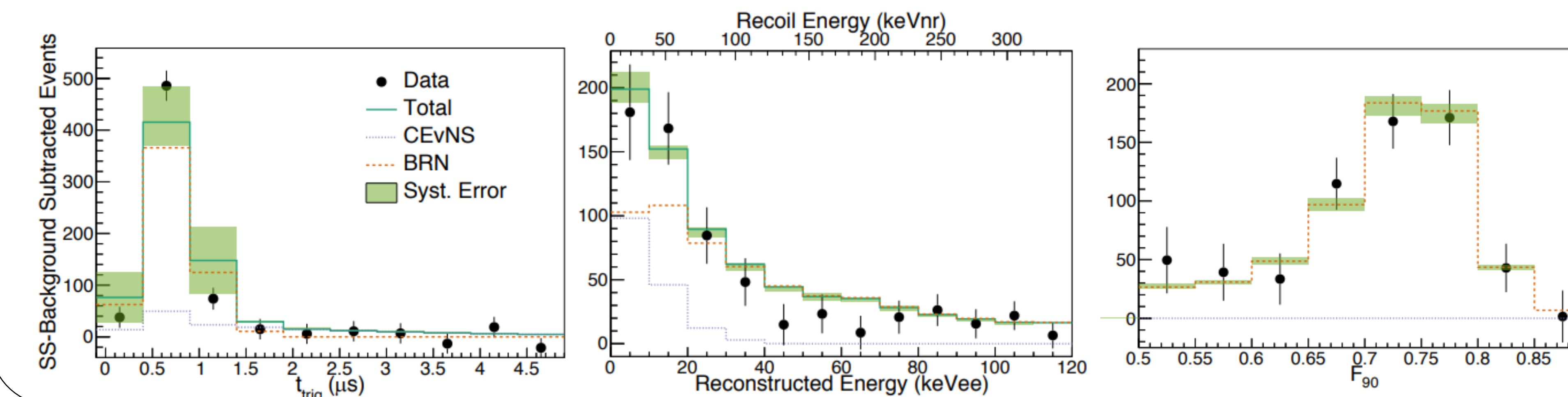


- Analysis result from 3D binned likelihood analysis in trigger time, energy, and F90 (see talk by J. Daughette)
- Dual parallel blind analysis, US and Moscow
- Excess of events within 1σ of SM prediction after background subtraction
- Plan to increase data set to yield 5σ result
 - Improved calibrations (see poster by E. Kozlova)
 - Lower energy threshold
- Further running for development of ton-scale LAr detector, COH-Ar-750 (see poster by M. Hughes)

Current Work



Top Left: NSI parameter sensitivity constraints set by COHERENT results alongside SM prediction²
Top Right: Measured CEvNS flux-averaged cross-section. Null CEvNS hypothesis rejected by both analyses at $>3\sigma$
Left: Projection of best-fit maximum likelihood probability density function



Acknowledgements

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References

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