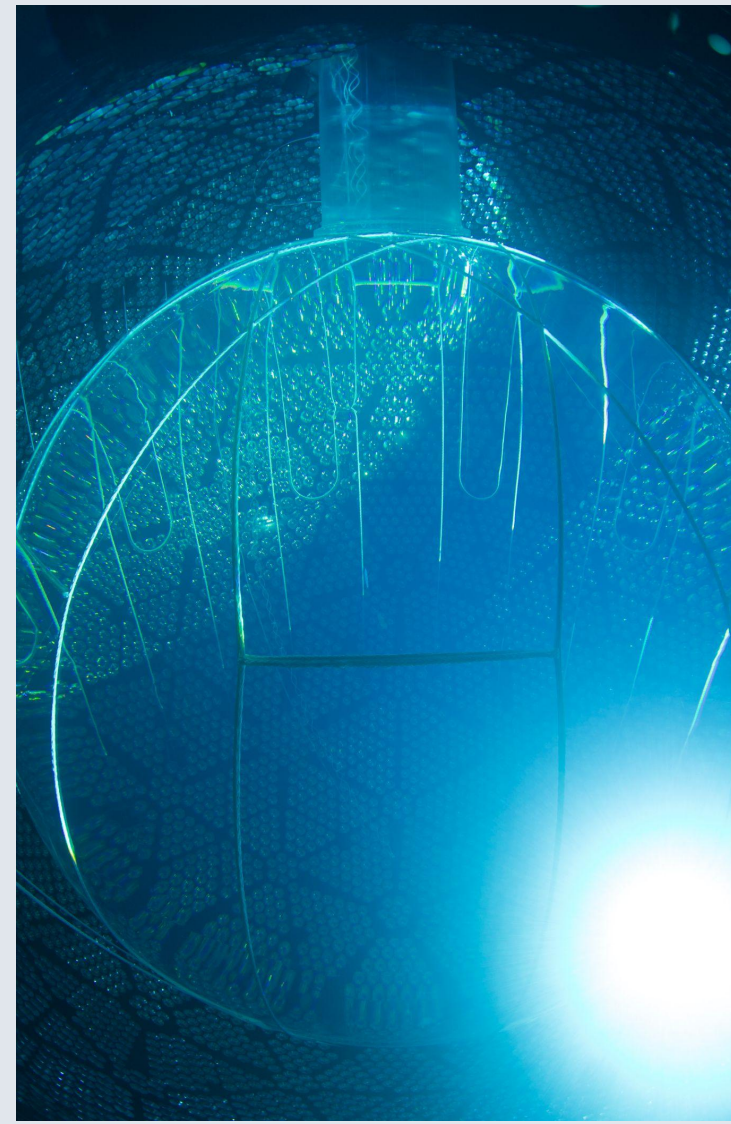


The SNO+ Experiment

- A 780 tonne, multi-purpose **liquid scintillator** neutrino experiment [1]
- See poster by Ana Sofia Inácio, Will Parker & Ben Tam for more details



Data & Method

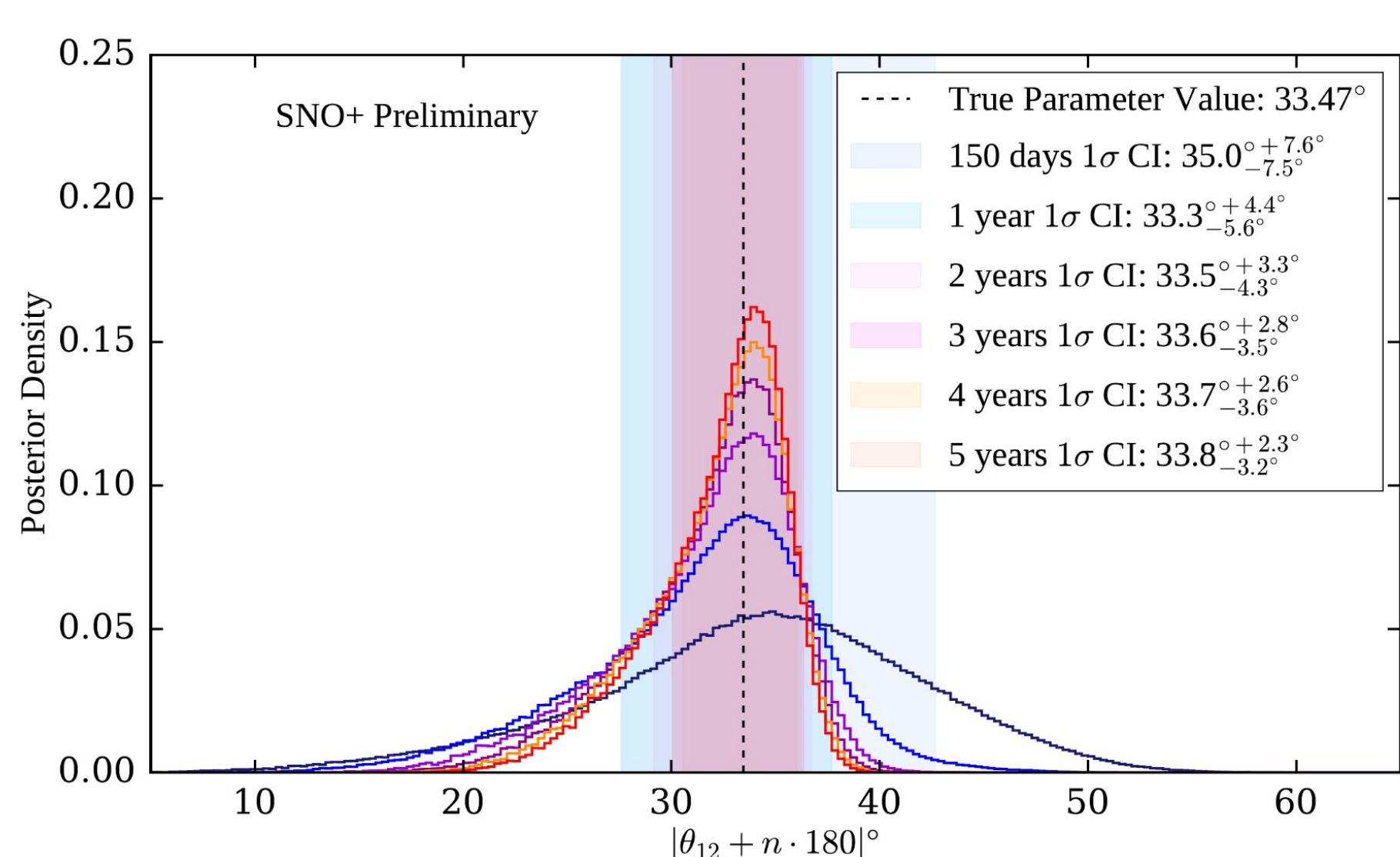
- **80.6 days of livetime** (after cuts) of data used between 17th May - 30th November 2022
- **Cuts** applied to triggered events:

20 second muon & high-NHit veto
Data cleaning cuts
Reconstructed energy in range 2.5-14.0 MeV
Reconstructed radius < 5.0 m (removes external backgrounds)
Removal of coincidence pair events (BiPo-212/214 and (α,n))
BiPo-212/214 in-window coincidence decay removal via classifier
External background removal via classifier

- Data & MC binned in **2D: reconstructed energy & radius**
- MC fit to data using a **binned maximum likelihood** test statistic, via **Markov-Chain Monte Carlo**
- **Fit floats** θ_{12} , Δm_{21}^2 , Φ_{8B} , background rates, and energy scale systematic, according to various constraints

Future Sensitivity

- **Asimov fake datasets** generated from MC, at a variety of livetimes between 150 days and 5 years
- Background rates (generally) set by data fit results; **same analysis approach used**

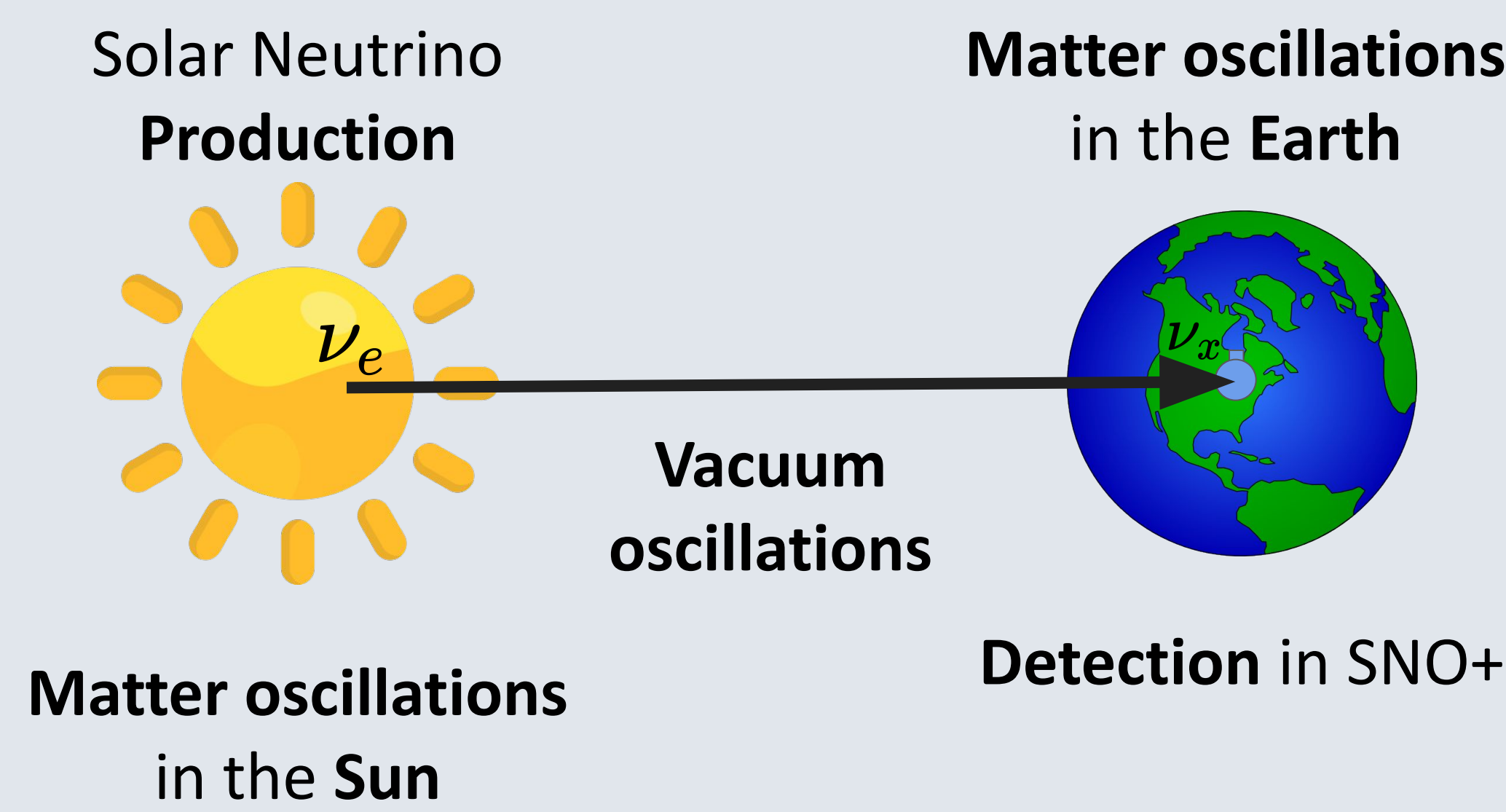


- **Factor of two improvement in precision** of θ_{12} expected in 2 years of livetime
- **Further improvements** possible from e.g. expanding fiducial volume, combined fit with reactor antineutrino oscillations

References

[1] Albanese, V. et al., "The SNO+ Experiment", JINST (2021)
 [2] Bergström, J. et al., "Updated determination of the solar neutrino fluxes from solar neutrino data", JHEP (2016)
 [3] Esteban, I. et al., "The fate of hints: updated global analysis of three-flavor neutrino oscillations", JHEP (2020); also [NuFIT 5.2 \(2022\)](https://nu-fit.org), www.nu-fit.org

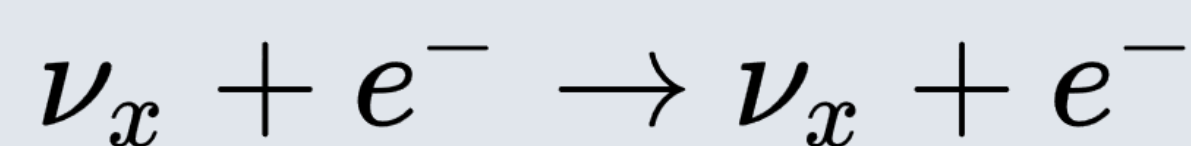
Detection of Solar Neutrinos in Scintillator



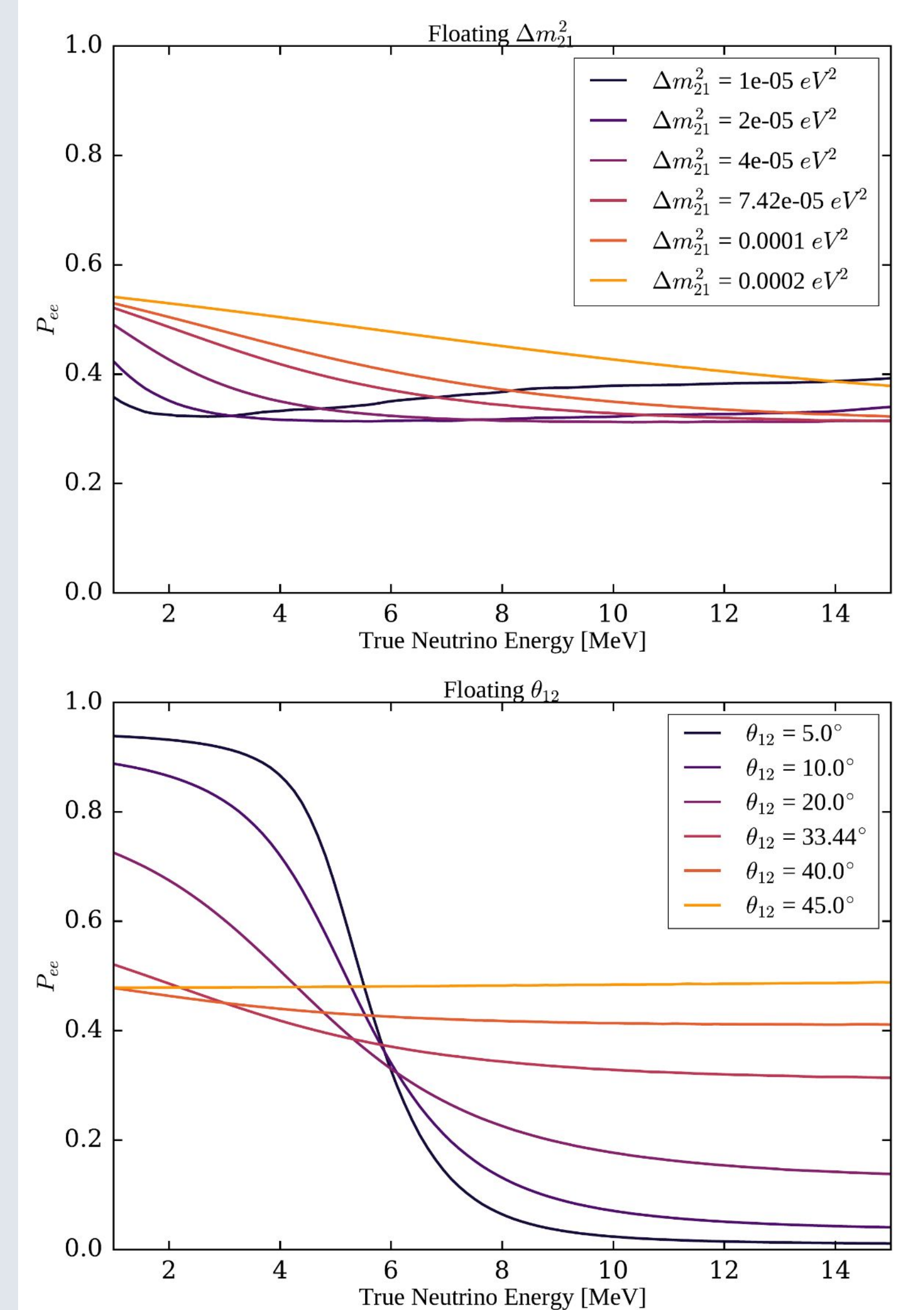
⁸B solar neutrino flux **global fit constraint** [2]:

$$\Phi_{8B} = 5.16^{+0.13}_{-0.09} \times 10^6 \text{ cm}^{-2} \text{ s}^{-1}$$

Detection via neutrino-electron **elastic scattering**:

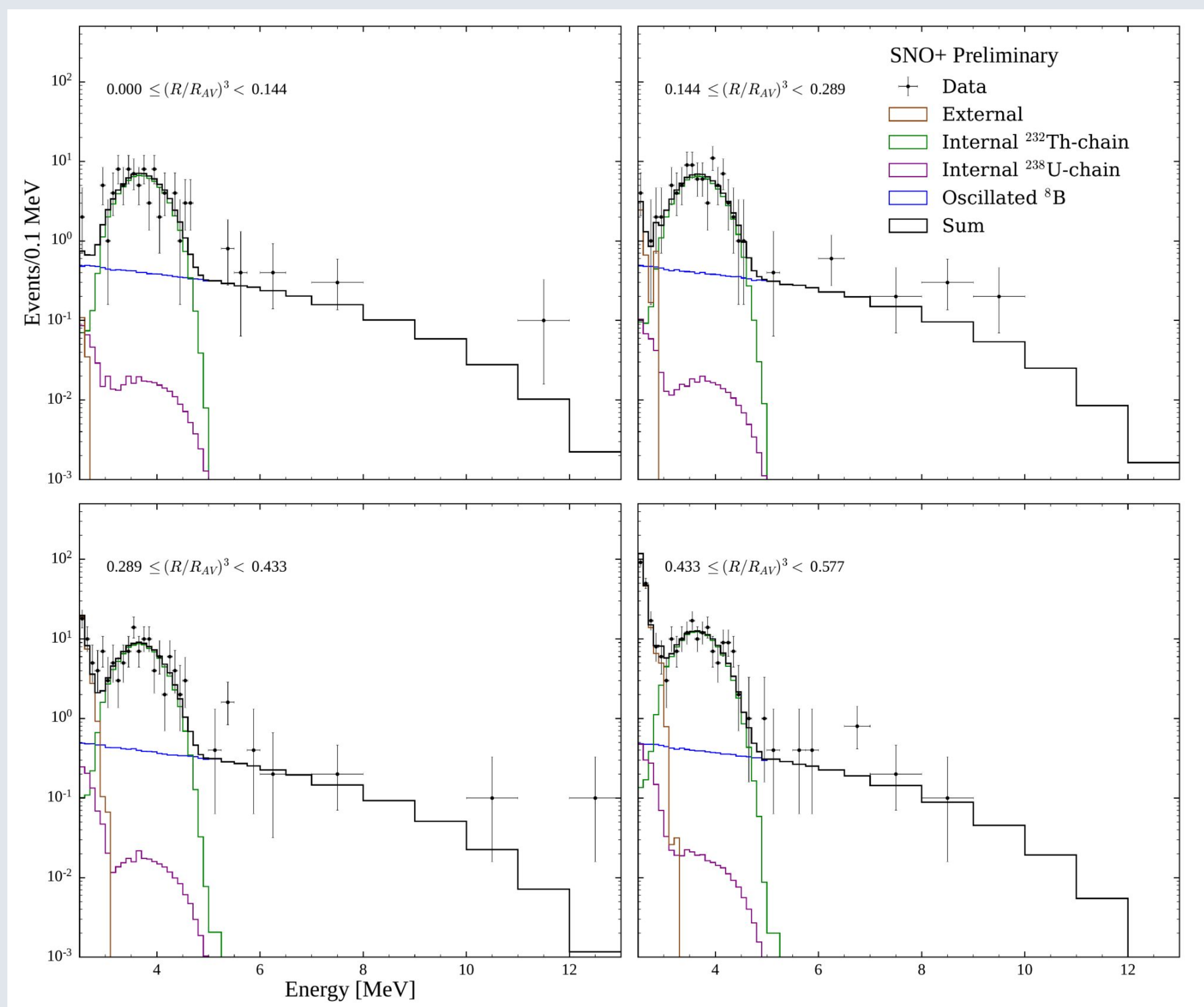


Difference in cross-section between ν_e and $\nu_{\mu,\tau}$, and **correlation** between ν and scattered e^- energies, allows for **measurement of solar neutrino oscillations**



⁸B solar neutrino **survival probabilities**, versus true neutrino energy for various solar neutrino **oscillation parameters**

Results from 80.6 Days of Data



Data vs MC comparison, for each equal-volume slice, using fit parameters with maximal-likelihood

R/R_{AV} : reconstructed radius of event, divided by radius of the SNO+ Acrylic Vessel

Bayesian 1σ Credible Interval:

$$\theta_{12} = 36.4^{+8.0}_{-7.9}$$

Current global fit value by NuFit 5.2 [3]:

$$\theta_{12} = 33.41^{+0.75}_{-0.72}$$

Results statistically-limited.

