Constraining Beyond the Standard Model Sub-MeV Neutrino Fluxes Using the XENONnT Detector

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Sources of Neutrino Fluxes

- The sun, atmospheric interactions, and other sources produce neutrinos
- No sub-MeV neutrinos have been detected
- This work constrains neutrino fluxes at these low energies

Beyond the Standard Model Neutrino Fluxes

- Neutrino oscillations show that neutrinos have mass and require BSM physics
- Various BSM models such as decaying dark matter and primordial black holes predict sub-MeV neutrino fluxes
- We can rule out BSM models by applying flux constraints

The XENONnT Detector

- XENONnT has great sensitivity because it is a dark matter direct detection experiment
- Measures electron recoils in the (1-30)keV energy range

Methodology: Hypothetical Flux to Event Rate to Constraint

1. Create flux with variable height
2. Calculate expected recoil events
3. Constrain flux strength using statistics!

Results: The first sub-MeV BSM neutrino constraints

- Using XENONnT, we obtain a model-independent neutrino flux constraint of $10^5 \text{ (cm}^2 \text{s eV)}^{-1}$
- First constraints from 16keV to 1.8MeV
- This work helps to determine the validity of BSM models
- Future detectors with greater exposure and lower threshold will place stronger constraints

References

[1] E. Aprile et al. (XENON)
[5] R.L Workman et al. (PDG)

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