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

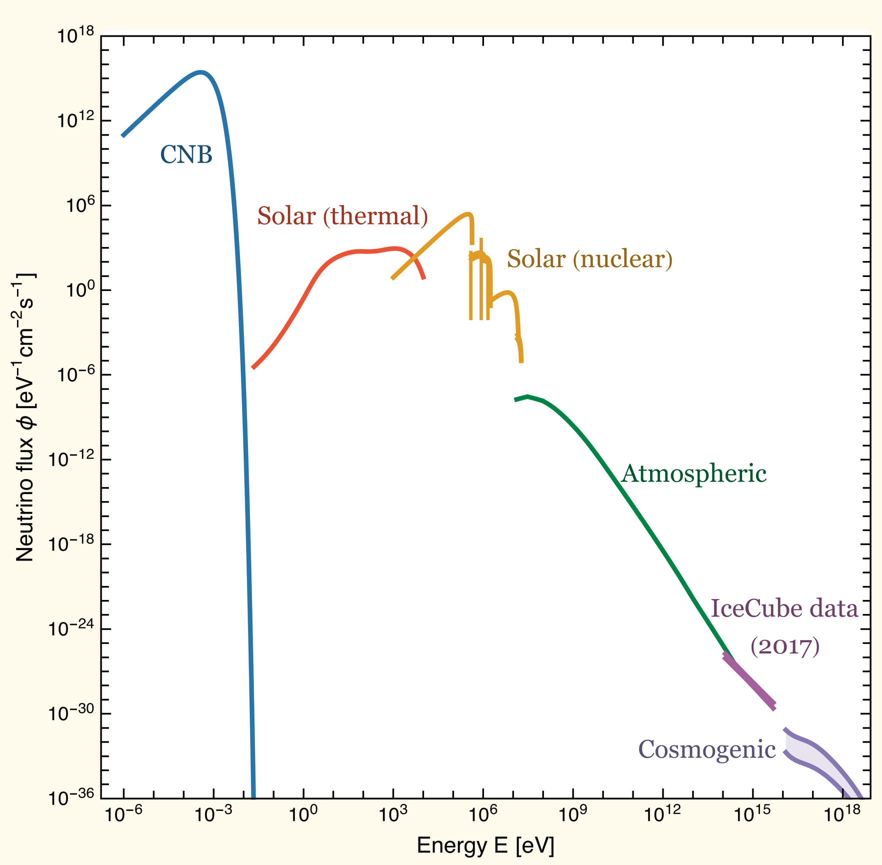
Noah Chavez[1], Amy Flather[2], Professor Ian Shoemaker[3]

1: Amherst College, 2: Rutgers University, 3: Virginia Tech

Rutgers University | New Brunswick

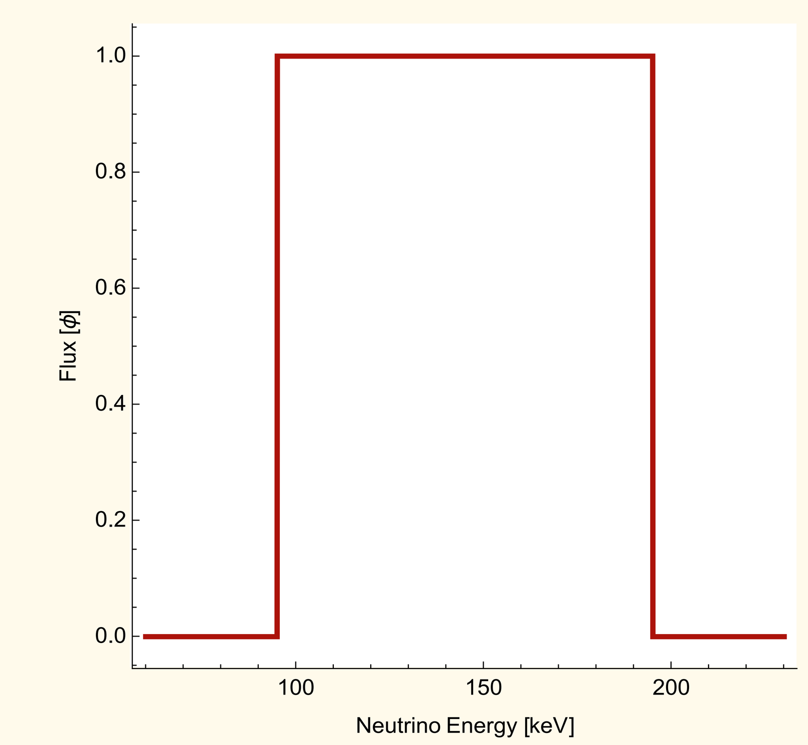
Amherst College

Sources of Neutrino Fluxes

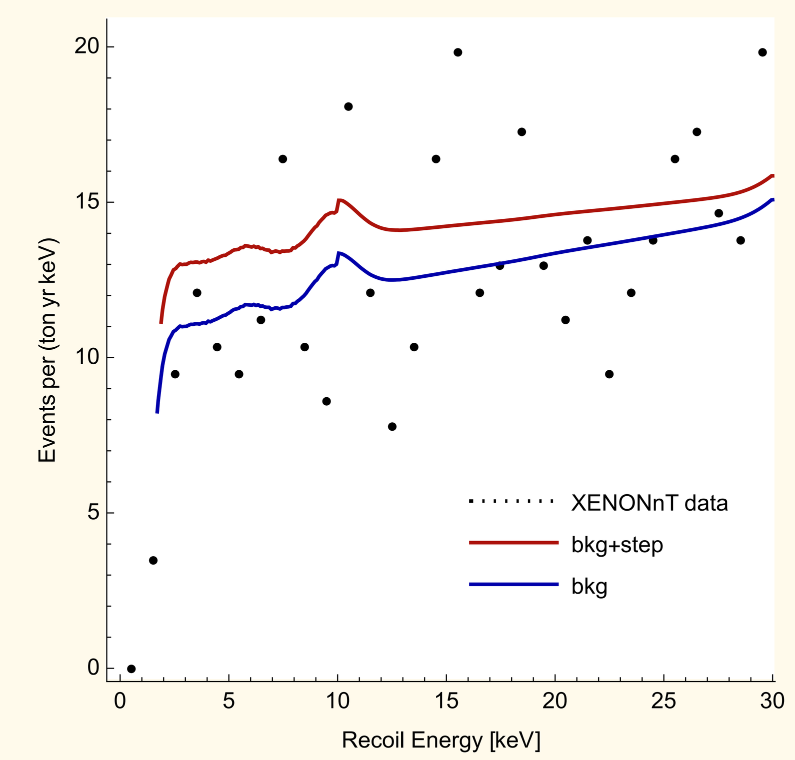


- The sun, atmospheric interactions, and other source produce neutrinos
- No sub-MeV neutrinos have been detected
- This work constrains neutrino fluxes at these low energies

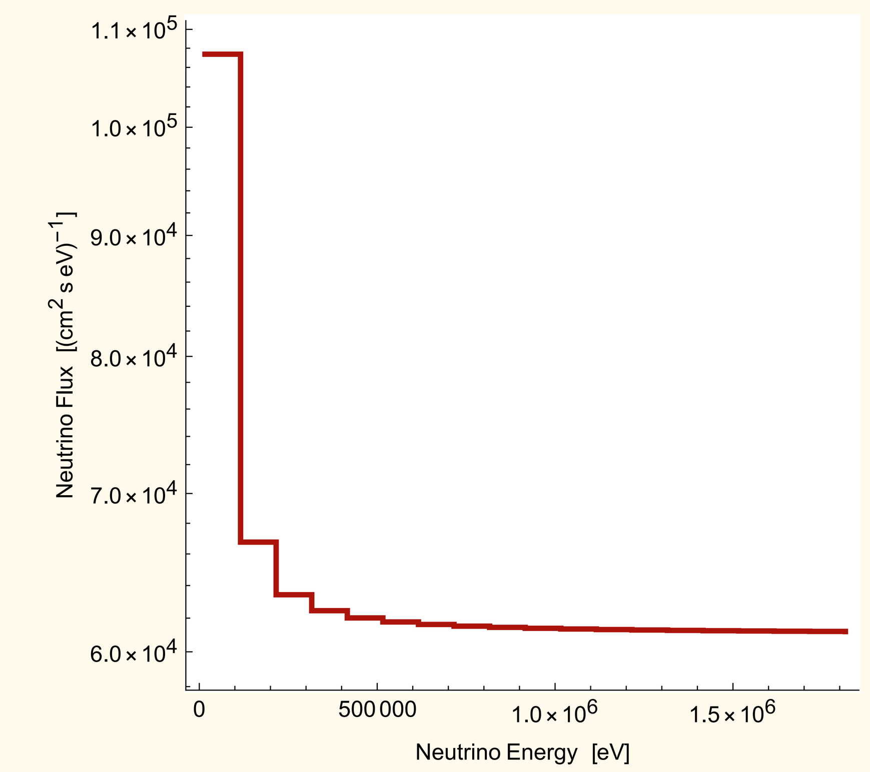
Methodology: Hypothetical Flux to Event Rate to Constraint



1. Create flux with variable height



2. Calculate expected recoil events

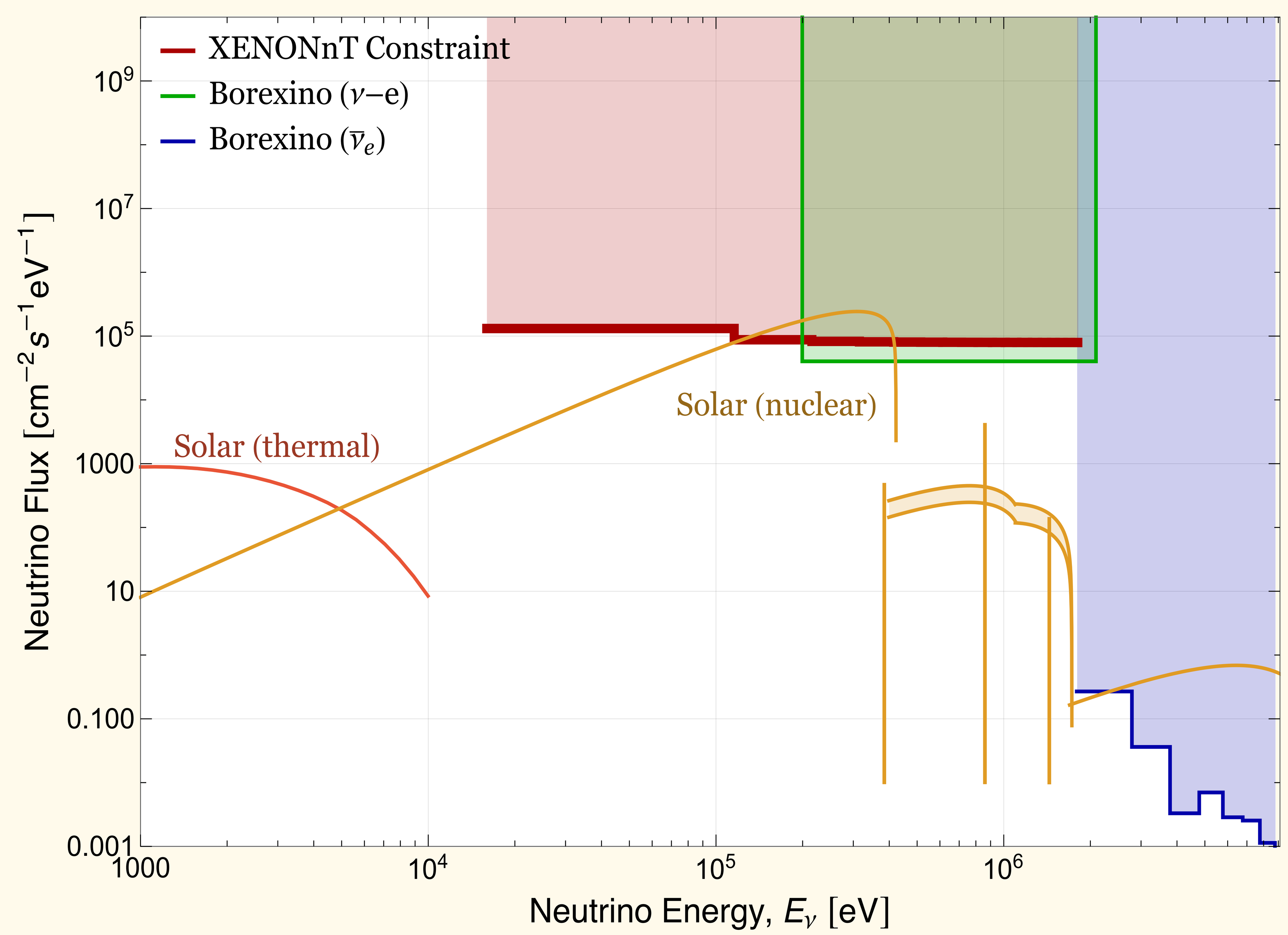


3. Constrain flux strength using statistics!

Beyond the Standard Model Neutrino Fluxes

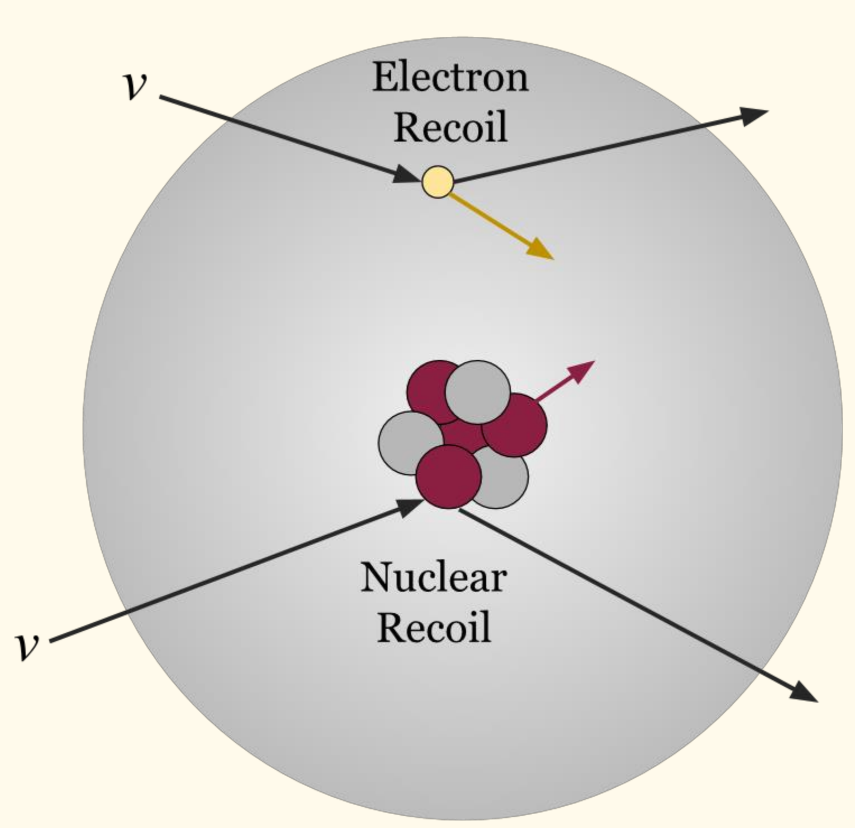
- Neutrino oscillations show that neutrinos have mass and require BSM physics
- Various BSM models such as decaying dark matter and primordial black holes predict sub-MeV neutrino fluxes
- We can rule out BSM models by applying flux constraints

Results: The first sub-MeV BSM neutrino constraints



- We obtain a model-independent neutrino flux constraint of $10^5\ (cm^2 * s * eV)^{-1}$
- 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

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

References

[1] E. Aprile et al. (XENON)
[2] E. Vitagliano et al.
[3] R. Essig, M. Sholapurkar, and T.-T. Yu
[4] T. Schwemberger and T. T. Yu
[5] R.L Workman et al. (PDG)

Acknowledgements

We are grateful to the Virginia Tech REU program for support. We would also like to thank Professor Ian Shoemaker for his guidance throughout this work.

The work of IMS is supported by DOE under the award number DE-SC0020250.
This work was supported under an NSF grant with award number PHY-2149165

College of Science Physics Virginia Tech