

NEUTRINO CAPTURE ON NUCLEI AND CNB

Vogel, P. (2015). How difficult it would be to detect cosmic neutrino background?

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PandA @ UNM

- Why So Difficult
- Neutrino Capture on Nuclei
- What to Use as Detector
- Problems to be Solved
- Summary

“About every neutrino physicist goes through a phase in his or her career and asks ‘There’s got to be a way to measure the relic neutrino background...’” P. Fisher

Difficult

- Low energy
- Weak interaction

NEUTRINO CAPTURE ON NUCLEI

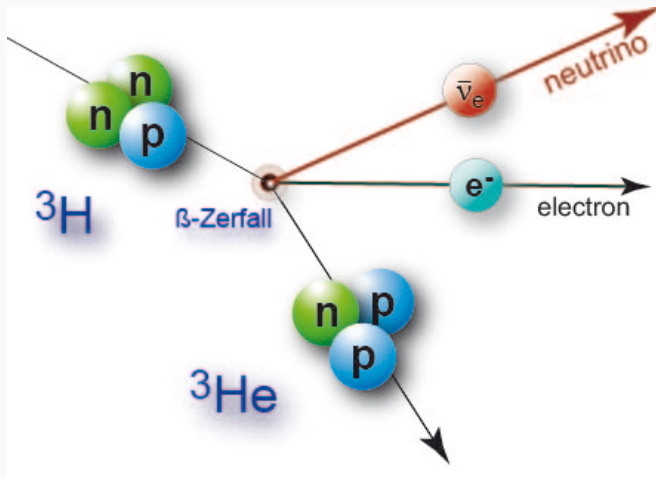


Figure: Beta decay

Chalkboard

- What is the process?
- What is the difference between this and beta decay?

Chalkboard

- Which nuclei is the choice?
- What is the required detector mass?

- Separate the CNB neutrino capture from the beta decay background requires a very good energy resolution.
- Tritium molecule captures a neutrino and becomes a $t\text{He}^3$ which has rotational and vibrational energy around 0.36eV. This sets a restriction on the energy resolution.
- Emitted electrons can be scattered by the tritium thus causing a energy redistribution.
- Other background neutrinos are not an big issue.

Chalkboard

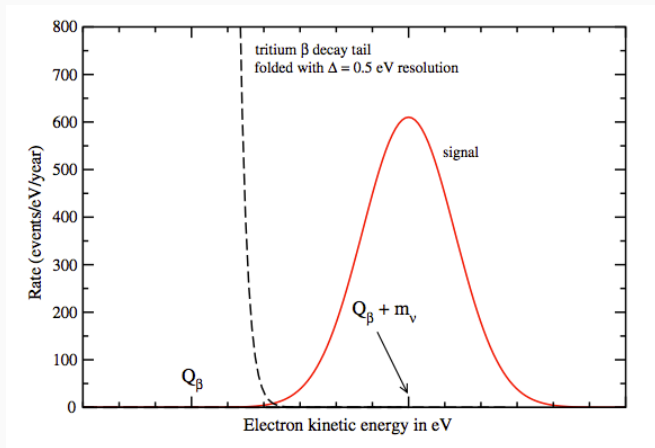


Figure: Energy resolution and the signal.

Chalkboard

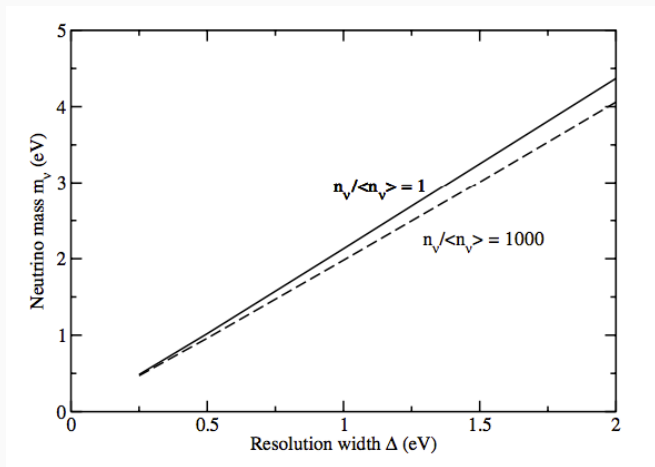
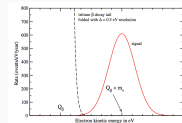
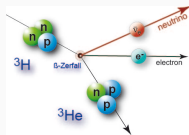


Figure: Energy resolution and mass



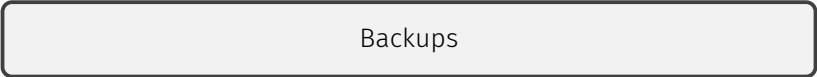
Neutrino Capture on Unstable Nuclei

- Spectrum is separated from beta decay
- Tritium is the best choice
- Energy resolution required is high
- Many other problems

Other Proposals for CNB

Coherent scattering

1. Vogel, P. (2015). How difficult it would be to detect cosmic neutrino background? (Vol. 025001, p. 140003). doi:10.1063/1.4915587 .
2. N. Cabibbo and L. Maiani, The vanishing of order-G mechanical effects of cosmic massive neutrinos on bulk matter. Phys.Lett. B114, 115 (1982).
3. arXiv:1304.5632
4. A. G. Cocco, G. Magnano and M. Mesina, JCAP 0706, 015 (2007). 22.
5. R. Lazauskas, P. Vogel and C. Volpe, J. Phys. G 35, 025001 (2008).



Backups

CLUSTERING OF CNB

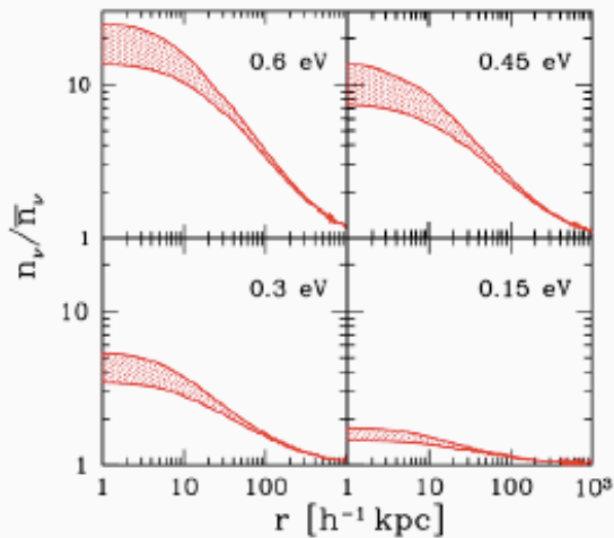


Figure: CNB clustering due to gravity