ν physics

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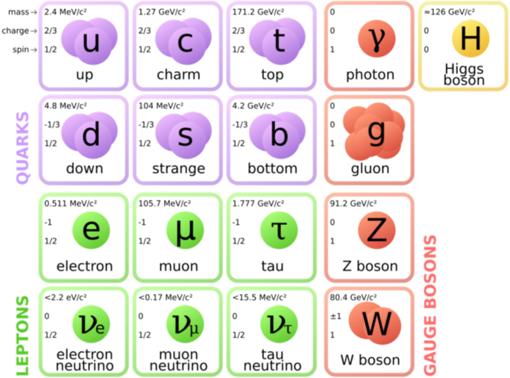

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- electron neutrino at least 200,000 times less massive than electron
- consequently, nearly impossible to detect
  - neutrino first theorized in 1930, not detected until 1956
  - about 10^{11} neutrinos pass through you every second
  - mean free path of a neutrino in water = 1600 light-years

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- Neutrinos are a superposition of flavor eigenstates, but the superposition varies with time.

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It makes sense to use particles the Standard Model doesn't explain to probe questions the Standard Model can't answer.

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Yes! Neutrino physics has profound implications for astrophysics.

Why are neutrinos relevant?
The Early Universe

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- *all* flavors of neutrinos can influence the final proton/neutron ratio of the universe (roughly 1:7 in standard cosmology)

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- Primordial abundances determine what could be formed in the early universe (e.g. the abundances in very old stars).
- Standard BBN (Wagoner, Fowler, Hoyle 1967) incredibly successful – can use experimental bounds on primordial abundances to put bounds on new physics (see my poster!)
- All heavier elements were formed during r process, which is also a neutrino-related process.

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- We know significantly less about r process than BBN – neutrinos may be a key part.
- Neutrinos were detected from SN1987a. Modern detectors are far better and should detect far more. (And can serve as an early warning system for optical astronomers – neutrinos pass through the outer layers of the dying star while optical photons scatter.)