

Neutrino Puzzles Explained

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Tutorial

The Mass Spectrum: $\underline{\underline{=}}$ or $\underline{=}$?

Generically, grand unified models (GUTS) favor —

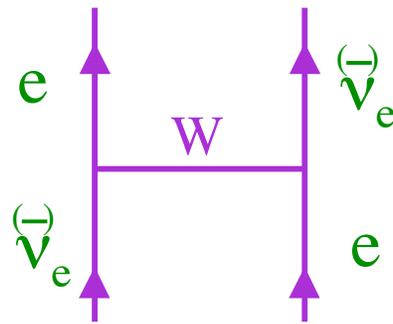
$\underline{\underline{=}}$

GUTS relate the **Leptons** to the **Quarks**.

$\underline{\underline{=}}$ is un-quark-like, and would probably involve a lepton symmetry with no quark analogue.

How To Determine If The Spectrum Is Normal Or Inverted

Exploit the fact that, in matter,

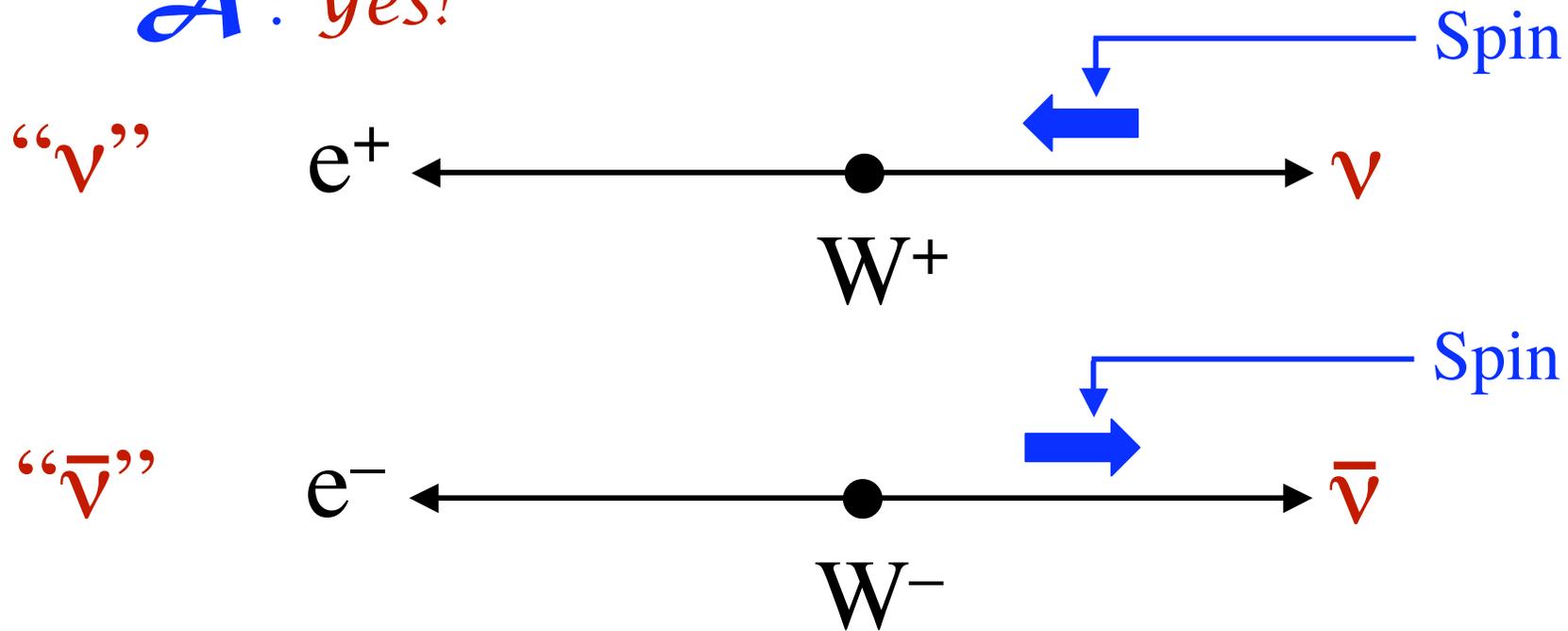


affects ν and $\bar{\nu}$ differently, and leads to —

$$\frac{P(\nu_{\mu} \rightarrow \nu_e)}{P(\bar{\nu}_{\mu} \rightarrow \bar{\nu}_e)} \begin{cases} > 1 ; \text{---} \\ < 1 ; \text{---} \end{cases}$$

Q : Does matter still affect ν and $\bar{\nu}$ differently when $\bar{\nu} = \nu$?

A : Yes!



The weak interactions violate *parity*. Neutrino – matter interactions depend on the neutrino *polarization*.

Q : *Can CP violation still lead to $P(\bar{\nu}_\mu \rightarrow \bar{\nu}_e) \neq P(\nu_\mu \rightarrow \nu_e)$ when $\bar{\nu} = \nu$?*

A : *Certainly!*

