Search for heavy neutrinos with the T2K experiment

Poster # 43, Wednesday session — *Presenter:* M. Lamoureux

How to explain neutrino masses (and consequently oscillations)?

A natural extension is one with 3 new right-handed neutrinos (**sterile**):

$$-\frac{1}{2}\begin{pmatrix}\overline{\nu_L} & \overline{\nu_R^c}\end{pmatrix}\underbrace{\begin{pmatrix}0 & m_D \\ m_D^T & m_R\end{pmatrix}}_{\mathcal{M}}\begin{pmatrix}\nu_L^c \\ \nu_R\end{pmatrix}$$

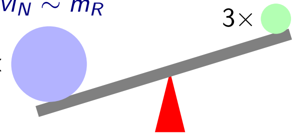
light neutrinos

$m_\nu \sim \frac{m_D^2}{m_R} \lesssim 0.1\,\text{eV}$

heavy neutrinos

$M_N \sim m_R$

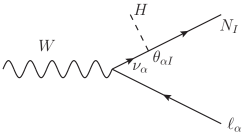
$3\times$ (heavy) $3\times$ (light)



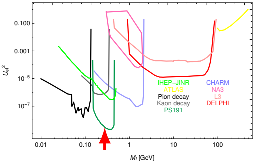
Three new heavy neutrinos at an unknown scale (eV → GUT)!

How to detect heavy neutrinos?

- N_I couple to W and Z with a strength $U_{\alpha I}^2 \equiv |\Theta_{\alpha I}|^2 \sim \mathcal{O}\left(\frac{m_\nu}{M_N}\right)$



- Can be produced e.g. in colliders or in **meson decays** (arXiv:1502.00477).
- For $0.1 < M_N < 100$ GeV/c^2, we have $\boxed{U_\alpha^2 \sim 10^{-10} - 10^{-8}}$.

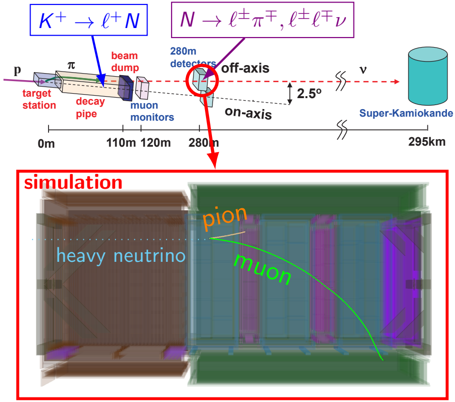


90% limits from current experiments on the mixing of heavy neutrinos to electron and muon.

Detection in T2K:

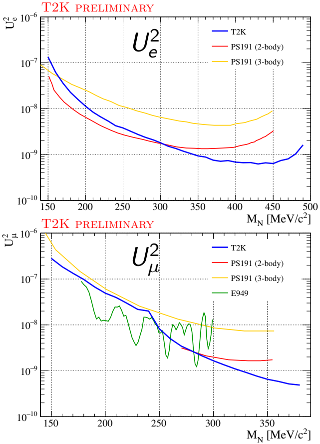
Heavy neutrinos are produced alongside standard neutrino beam.

They propagate and can decay in T2K near detector **ND280** $\rightarrow$ detection of 2 particles with opposite charges.



Analysis and results:

- *Remaining background after selection:* less than 2 evts (from active ν int.)
- Bayesian approach, marginalization with a **Markov Chain Monte Carlo**.



90% C.L.

T2K put the most stringent limits in the high mass region.