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β and $0\nu\beta\beta$ Decays with Sterile Fermions

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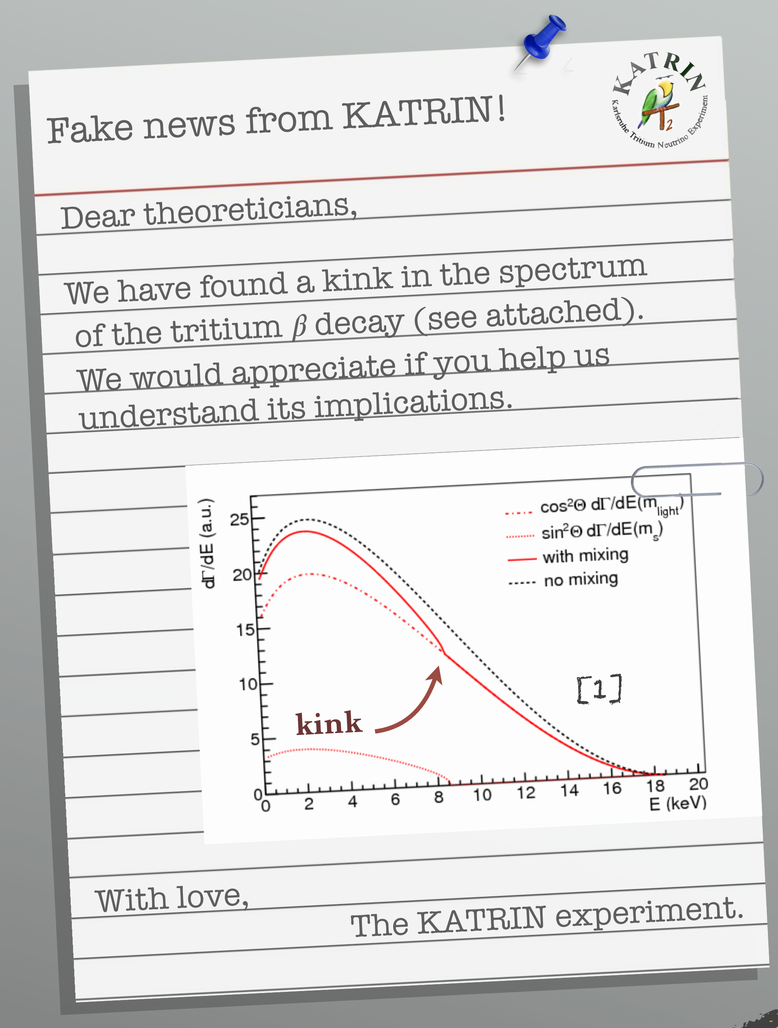
The KATRIN experiment

Searching for the neutrino mass scale and beyond

The KATRIN experiment aims to measure the Kurie plot of tritium β-decay

The end-point of the spectrum will tell us about the absolute neutrino mass scale

Measuring the full spectrum could reveal the presence of new neutral particles

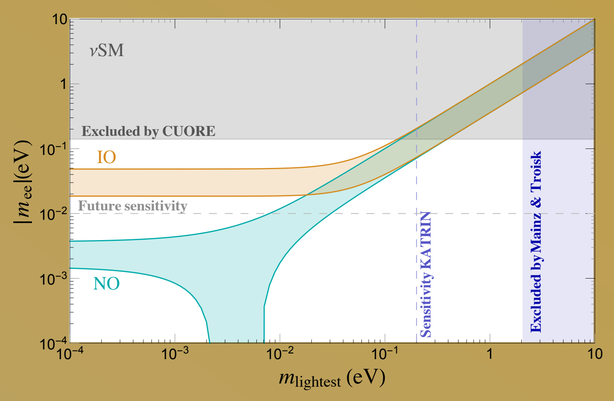


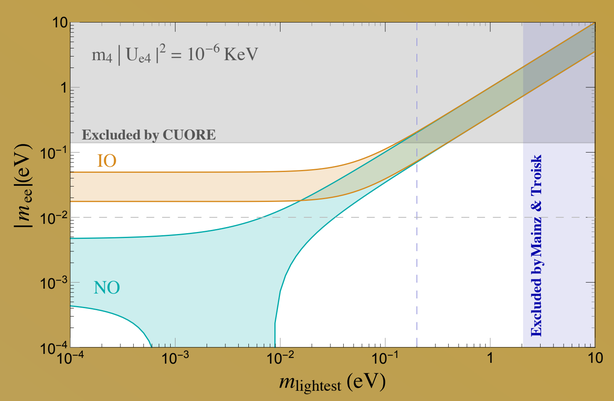
3+1 effective model

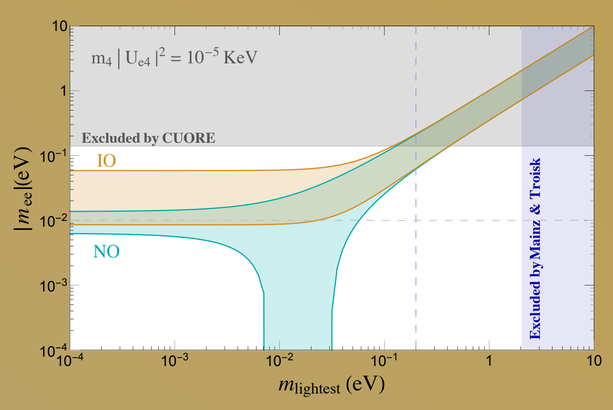
Minimal bottom-up approach

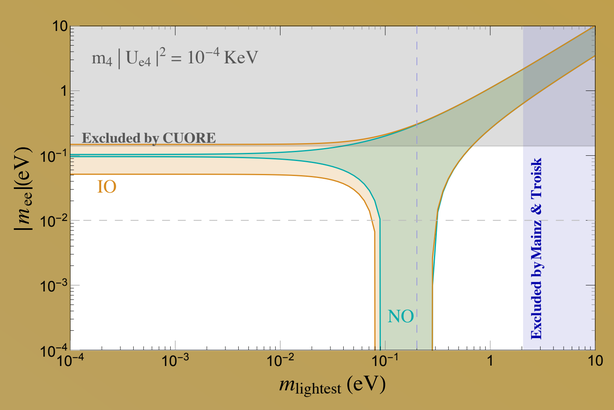
3 light active neutrinos + 1 sterile neutrino

If KATRIN discovers a sterile neutrino with a **mass of [1,18.5] KeV** and mixing to electrons $|U_{e4}|^2 > 10^{-6}$, it will impact the effective electron neutrino mass relevant for $0\nu\beta\beta$

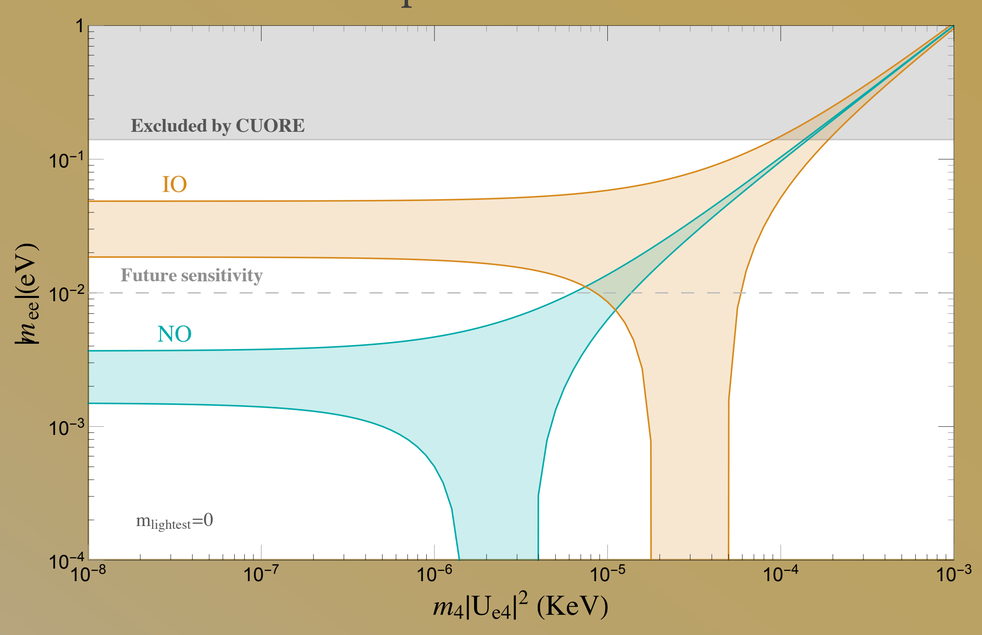








Minimal seesaw models predict one massless active neutrino



The relevant parameter combination for $0\nu\beta\beta$ is $m_4|U_{e4}|^2$

Type-I seesaw model

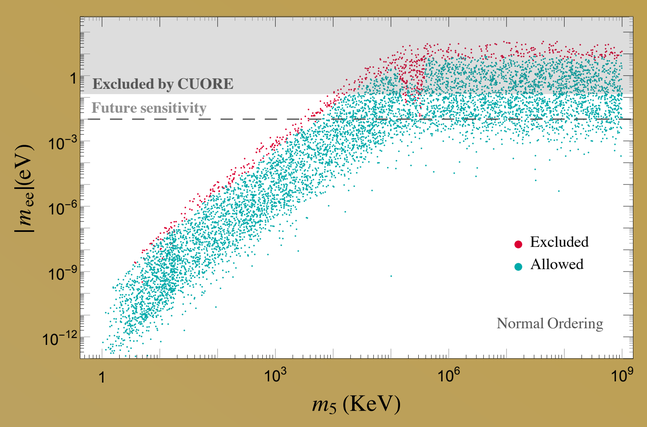
Minimal realization with 2 ν_R

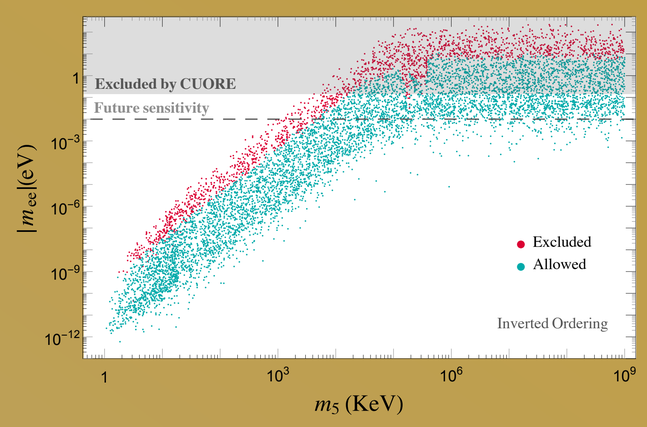
One of the ν_R is in the KATRIN regime and modifies the $m_{ee}^{(\nu SM)} \rightarrow m_{ee}^{(3+1)}$

The second ν_R modifies the effective mass according to:

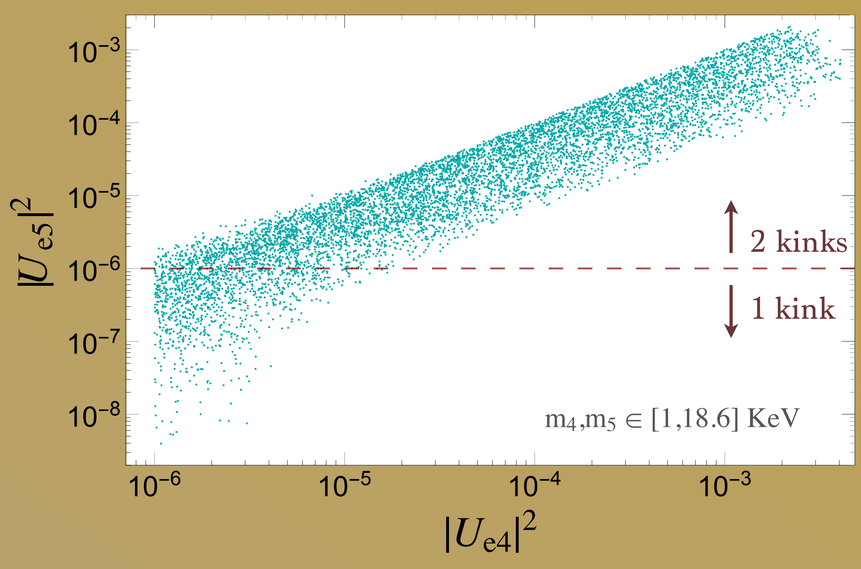
$$m_{ee} = \sum_{i=1}^{N} U_{ei}^2 \, p^2 \frac{m_i}{p^2 - m_i^2} \approx m_{ee}^{(3+1)} \left[1 - \frac{p^2}{p^2 - m_5^2}\right]$$

This implies a strong cancellation below $p^2 \sim 100$MeV and saturation above:





If no signal is observed in $0\nu\beta\beta$ it would point towards a light m_5, which could be observed as a **second kink** in KATRIN



Conclusions

The interplay between β and $0\nu\beta\beta$ could help revealing the mechanism behind neutrino mass generation

References: [1] S. Mertens et al, Phys. Rev. D91 (2015) 042005