Constrains on Neutrino Mixing Parameters by Neutrinoless Double Beta Decay Experiments

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Future searches for neutrinoless double beta decay ($0\nu\beta\beta$) will give us new valuable information that cannot be obtained by neutrino ocsillation experiments. We derive constraints for neutrino mixing parameters imposed by positive or negative results of $0\nu\beta\beta$ experiments together with the results of ocsillation experimants.

We display below a concrete example which comes out of our treatment, but we can give generic treatment with more profound implications if time permits.

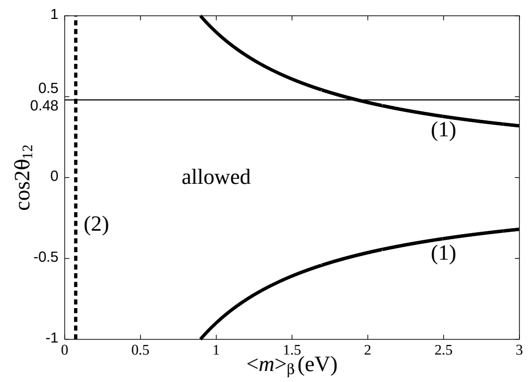
Suppose that an experimental upper bound $\langle m\rangle_{\beta\beta}^{\max}$ of $\langle m\rangle_{\beta\beta} \equiv |\sum_{i=1}^{3} U_{ei}^2 m_i|$ is obtained by $0\nu\beta\beta$ searches. Then, an inequality between $\langle m\rangle_{\beta\beta}^{\max}$ and theoretical lower bound on $\langle m\rangle_{\beta\beta}$ results in

$$\frac{m_2-m_1}{m_2+m_1} - \frac{\langle m\rangle_{\beta\beta}^{\max} + m_3 s_{13}^2(\mathrm{CH})}{\frac{1}{2}(m_2+m_1)c_{13}^2(\mathrm{CH})} \le \cos 2\theta_{12} \le \frac{m_2-m_1}{m_2+m_1} + \frac{\langle m\rangle_{\beta\beta}^{\max} + m_3 s_{13}^2(\mathrm{CH})}{\frac{1}{2}(m_2+m_1)c_{13}^2(\mathrm{CH})} \tag{1}$$

where $s_{13}^2(\mathrm{CH}) \simeq 0.03$ is maximum value of s_{13}^2 allowed by reactor experiments. On the other hand, experimental lower bound $\langle m\rangle_{\beta\beta}^{\min}$ is obtained if $0\nu\beta\beta$ is observed. Then, an inequality between $\langle m\rangle_{\beta\beta}^{\min}$ and theoretical upper bound on $\langle m\rangle_{\beta\beta}$ results in another bound

$$\cos 2\theta_{12} \le \frac{m_2+m_1}{m_2-m_1} - \frac{\langle m\rangle_{\beta\beta}^{\min} - m_3 s_{13}^2(\mathrm{CH})}{\frac{1}{2}(m_2-m_1)}. \tag{2}$$

One can argure that these bounds implies the allowed region in $\langle m\rangle_\beta$ - $\cos 2\theta_{12}$ space, where $\langle m\rangle_\beta$ is single beta decay observable. If we use, for example, the recently announced value $0.05\,\mathrm{eV} \le \langle m\rangle_{\beta\beta} \le 0.84\,\mathrm{eV}$ by Klapdor-Kleingrothous et al., it implies the bound $0.07\,\mathrm{eV}\ (0.05\,\mathrm{eV}) \le \langle m\rangle_\beta \le 2\,\mathrm{eV}$ for the normal (inverted) mass hierarchy at the best fit parameters of the LMA MSW solution ($\cos 2\theta_{12} = 0.48$).



Reference

[1] H. Minakata and H. Sugiyama, hep-ph/0202003, accepted in Phys. Lett. **B**.