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## Invisible neutrino decay : First vs second oscillation maximum

We study the physics potential of the long-baseline experiments T2HK, T2HKK and ESS $\nu$ SB in the context of invisible neutrino decay.

We consider normal mass ordering and assume the state  $\nu_3$  as unstable, decaying into sterile states during the flight and obtain constraints on the neutrino decay lifetime ( $\tau_3$ ).

We find that T2HK, T2HKK and ESS $\nu$ SB are sensitive to the decay-rate of

$\nu_3$  for  $\tau_3/m_3 \leq 2.72 \times 10^{-11} \text{ s/eV}$ ,  $\tau_3/m_3 \leq 4.36 \times 10^{-11} \text{ s/eV}$  and  $\tau_3/m_3 \leq 2.43 \times 10^{-11} \text{ s/eV}$  respectively at  $3\sigma$  C.L. We compare and contrast the sensitivities of the three experiments and specially investigate the role played by the mixing angle  $\theta_{23}$ .

It is seen that for experiments with flux peak near the second oscillation maxima, the poorer sensitivity to  $\theta_{23}$  results in weaker constraints on the decay lifetime.

Although, T2HKK has one detector close to the second oscillation maxima, having another detector at the first oscillation maxima results in superior sensitivity to decay.

In addition, we find a synergy between the two baselines of the T2HKK experiment which helps in giving a better sensitivity to decay for  $\theta_{23}$  in the higher octant.

We discuss the octant sensitivity in presence of decay and show that there is an enhancement in sensitivity which occurs due to the contribution from the survival probability  $P_{\mu\mu}$  is more pronounced for the experiments at the second oscillation maxima.

We also obtain the combined sensitivity of T2HK+ESS $\nu$ SB and T2HKK+ESS $\nu$ SB as  $\tau_3/m_3 \leq 4.36 \times 10^{-11} \text{ s/eV}$  and  $\tau_3/m_3 \leq 5.53 \times 10^{-11} \text{ s/eV}$  respectively at  $3\sigma$  C.L.

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