Neutrino Mass Bounds from the $0\nu\beta\beta$ Dacays and Large Scale Structures

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The existence of the tiny neutrino masses qualifies as the first evidence of new physics beyond the Standard Model. The answers to the hottest questions on (1) whether neutrinos are Dirac or Majorana fermions ?, (2) the mass hierarchy pattern (normal or inverse hierarchy type ?), (3) the absolute value of the neutrino mass, will provide us the additional knowledge about the precise nature of this new physics, and in turn about the nature of new forces beyond the Standard Model. They also have the potential to unravel some of the deepest and most long-standing mysteries of cosmology and astrophysics, such as the origin of matter, the origin of heavy elements, and even the nature of dark-energy. In this talk, we will discuss the way how the total mass sum of neutrinos can be constrained from the neutrinoless double beta decay and the large scale structures with cosmic microwave background radiation. We will summarize the current state of the neutrino mass bounds within the flat $\Lambda CDM$ model. In addition, we will discuss the interacting neutrino-dark energy model, where the evolution of mass of neutrinos is determined by quintessence scalar field, which is responsible for cosmic acceleration today. Assuming the flatness of the universe, the constraint we can derive from the current observation is $\sum m_\nu < 0.87 \ eV$ at 95% C.L., which is consistent with $\sum m_\nu < 0.68 \ eV$ in the flat $\Lambda CDM$ model. Finally we discuss the future prospect of the neutrino mass bound with weak-lensing effects.

References