# Majorana Nature of Neutrinos and $(\beta\beta)_{0\nu}$-Decay

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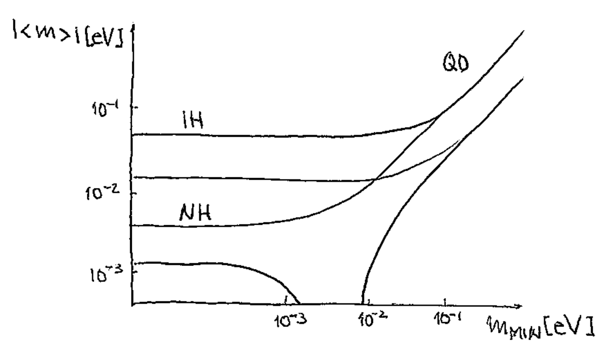
A massive neutrino can be a Dirac particle (like the electron and the quarks), possessing distinctive antiparticle, or a Majorana fermion, which is its own antiparticle. Only the electrically neutral fermions (neutrinos, neutralinos, etc.) can be Majorana particles. The smallness of masses of neutrinos can be related to their Majorana nature. The latter manifests itself in the existence of processes in which the lepton charge $L$ changes by 2 units: $\mu^- + (A, Z) \to e^+ + (A, Z-2)$, etc. The only feasible experiments, having the capability to reveal the possible Majorana nature of neutrinos, are those searching for the process of neutrinoless double beta ($(\beta\beta)_{0\nu}$) decay: $(A, Z) \to (A, Z+2) + e^- + e^-$, where $(A, Z) = {}^{48}Ca$, ${}^{76}Ge$, ${}^{82}Se$, ${}^{100}Mo$, ${}^{118}Cd$, ${}^{130}Te$, ${}^{136}Xe$, ${}^{150}Nd$. The searches for $(\beta\beta)_{0\nu}$-decay are conducted in many laboratories around the world and in Japan. The $(\beta\beta)_{0\nu}$-decay amplitude depends on the neutrino mixing parameters through the effective Majorana mass $<m>$. The figure shows $|<m>|$ as a function of the lightest neutrino mass, $m_{min}$, assuming 3-neutrino mixing. The regions corresponding to the normal or inverted hierarchical (NH or IH) and quasi-degenerate (QD) types of neutrino mass spectrum are indicated.




$$|<m>| = \left| m_1|U_{e1}|^2 + m_2|U_{e2}|^2 e^{i\alpha_{21}} + m_3|U_{e3}|^2 e^{i\alpha_{31}} \right|,$$

$m_i$ – Majorana neutrino mass,
$U_{ei}$ – neutrino mixing matrix element,
$\alpha_{21}, \alpha_{31}$ – Majorana CP violating phases.