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## Type-II Seesaw Triplet Scalar Effects on Neutrino Trident Scattering

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In Type-II seesaw model, an electroweak triplet scalar field  $\Delta$  with a non-zero vacuum expectation value (vev)  $v_\Delta$  is introduced to facilitate the generation of small neutrino masses. A non-zero  $v_\Delta$  also affects the W mass through the electroweak  $\rho$  parameter, making it to be less than 1 as predicted by standard model (SM). The component fields in  $\Delta$  come along introduce additional contributions to reduce the SM rare neutrino trident scattering cross section. These fields also induce new processes not existed in SM, such as  $l_i \rightarrow \bar{l}_j l_k l_l$  and  $l_i \rightarrow l_j \gamma$ . There are severe constraints on these processes which limit the effects on neutrino trident scattering and the  $\rho$  parameter and therefore the W mass. The newly measured W mass by CDF makes the central value of  $\rho$  parameter to be larger than 1, even larger than previously expected. Combining neutrinoless double beta decay, direct neutrino mass and oscillation data, we find a lower limit for  $v_\Delta$  as a function of the triplet scalar mass  $m_\Delta$ ,  $v_\Delta > (6.3 \sim 8.4)\text{eV}(100\text{GeV}/m_\Delta)$ . To have significant effect on  $\rho$  in this model,  $v_\Delta$  needs to be in the range of a GeV or so. However this implies a very small  $m_\Delta$  which is ruled out by data. We conclude that the effect of triplet vev  $v_\Delta$  on the W mass can be neglected. We also find that at  $3\sigma$  level, the deviation of the ratio for Type-II Seesaw to SM neutrino trident scattering cross section predictions is reduced to be below 1, but is restricted to be larger than 0.98.

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