

Search for heavy neutrinos with the near detector ND280 of the T2K experiment

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Heavy Neutral Leptons (HNLs, heavy neutrinos) with masses below the electroweak scale are introduced in some extensions of the Standard Model to address consistently such effects as neutrino oscillations, light neutrino masses, dark matter and baryon asymmetry. In the mass range below $500 \text{ MeV}/c^2$ these heavy neutrinos can be produced in pion or kaon decays, and further decay themselves into charged particles, hence giving a possibility for their detection.

The T2K long-baseline neutrino oscillation experiment utilises an intense neutrino beam, originating mainly from π and K parents. Usage of the K flux allows the study of a wider mass range of heavy neutrinos. The near detector complex ND280, located 280 m from the target and composed of various sub-modules operated inside a magnetic field, provides the tracking capabilities to identify the products of HNLs' decays.

A selection aimed to search for heavy neutrino events in the gas-filled ND280 TPCs was developed and optimised to significantly reduce the background from active neutrino interactions down to few events for the current dataset. After applying the selection to the T2K ND280 data ($12.34\nu + 6.29\bar{\nu}$) $\times 10^{20}$ protons-on-target, 2010-2017 statistics), no events in the signal region were observed. The results were used to extract limits on the mixing parameters between heavy neutrino and electron-, muon- and tau- flavoured currents in the mass range of $140 < M_{HNL} < 493 \text{ MeV}/c^2$. The T2K data allow an improvement of the limits provided by the previous experiments such as the CERN PS191 which, together with the BNL E949 data, put the most stringent constraints in the mass region studied by T2K.

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