A search for a heavy neutrino decaying into a charged lepton and a W boson is presented.

- The HNLs are sterile,
- mixing angles with $V_{eN}$, $V_{\mu N}$, and $V_{\tau N}$
- The production cross section and lifetime of N depend on $|V_{eN}|^2$ and its mass $m_N$.

Right-handed HNL as potential solution for:
- Baryon asymmetry;
- dark matter candidate;
- Smallness of neutrino masses (seesaw mechanism).

Two categories: with or without an OppositeSignSameFlavor pair. Background two orders of magnitude higher in final state with an OSSF pair.

Main backgrounds:
- nonprompt leptons;
- WZ and ZZ;
- Conversion, Z$\gamma$ with $\gamma^*$ → $2\gamma$.

Introduction

Event selection

Only prompt decays are considered. Kinematically distinct cases for N masses below and above that of the W boson, two search regions are defined.

Search variables:
- $M_{3l}$, for background rejection;
- $M_T$, very high for high $m_N$;
- $M_{\text{min}}$, proxy for $m_N$.

Low mass ($m_N < m_W$)
- Only use events without OSSF → probing LNV, Majorana $\nu$;
- Compressed $p_T$ spectra, low $p_T$ thresholds;
- Categorize according to $p_T$.

High mass ($m_N > m_W$)
- Both events with and without OSSF;
- High $p_T$ thresholds;
- Relatively high $E_T$ and very high $M_{3l}$.

Results

Lifetime correction
- For small N mass and couplings, the decay length can be significantly large → reduced acceptance for this specific search;
- $p_T$ correlation applied to account for the finite lifetime → sensitivity degrades with decreasing $|V_{eN}|$;
- Effect is partially compensated by signal cross section growth $\propto |V_{eN}|^2$.

No deviations from the SM are observed; upper limits set on $V_{eN}N$ coupling strengths $V_{eN}$ and $V_{\mu N}$.

New sensitivity → These are the first direct limits for N masses above 500 GeV and the first limits obtained at a hadron collider for N masses below 40 GeV.

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