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Exploring Lepton Number Violation through Same-Sign Lepton Processes at Future Colliders

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We consider an extension of the Minimal Standard Model with the seesaw mechanism by two right-handed neutrinos in order to account for the neutrino mass consistent with oscillation experiments.
In particlar, we discuss the case in which they have TeV-scale masses, since it may be possible to probe them at future colliders.
A key prediction of the seesaw mechanism is that neutrinos are Majorana particles, which naturally lead to lepton number violation (LNV).
In this presentation, we investigate the processes $l^{\pm}l^{\pm} \to W^{\pm}W^{\pm}(l = e, \mu)$, violating the lepton number by two units.

The electron channel is induced at the fourth order of the mixing elements of electron, and then is strongly suppressed by neutrinoless double beta ($0\nu2\beta$) decay.
% This is because the neutrinoless double beta decay gives a strong constraint.
In contrast, for the muon channel, one might think that a much larger cross section is possible being free from the above constraint.
However, in the seesaw model, the mixing elements of electron and muon are not completely independent.

We show that only in the normal hierarchy (NH) the hierarchy of mixing elements can be realized leading to the sizable cross section.
In addition, not only the constraint from $0\nu2\beta$ decay, but also that from electroweak precision measurements become important for large Majorana mass region.

As a consequence, future muon colliders such as μTRISTAN are possible to probe LNV signatures of TeV-scale seesaw model if neutrino is the NH.

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