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Jet substructure shedding light on heavy Majorana neutrinos at the colliders

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The existence of tiny neutrino masses and flavor mixings can be explained naturally in various seesaw models, many of which typically having additional Majorana type SM gauge singlet right handed neutrinos (N). If they are at around the electroweak scale and furnished with sizable mixings with light active neutrinos, they can be produced at high energy colliders such as LHC and ILC. A characteristic signature at the LHC would be same sign lepton pairs, violating lepton number, together with light jets – $pp \to N\ell^{\pm},\ N \to \ell^{\pm}W^{\mp},\ W^{\mp} \to jj$. We propose a new search strategy utilising jet substructure techniques, observing that for a heavy right handed neutrino mass M_N much above $M_{W^{\pm}}$, the two jets coming out of the boosted $W^{\pm}$ may be interpreted as a single fat-jet (J). Hence, the distinguishing signal topology will be $\ell^{\pm}\ell^{\pm}J$. Performing a comprehensive study of the different signal regions along with complete background analysis, in tandem with detector level simulations, we compute statistical significance limits. We find that heavy neutrinos can be explored effectively for mass ranges 300 GeV $\leq M_N \leq$ 800 GeV and different light-heavy neutrino mixing $|V_{\mu N}|^2$. At the 13 TeV LHC with 3000 fb^{-1} integrated luminosity one can competently explore mixing angles much below present LHC limits, and moreover exceed bounds from electroweak precision data. We also study the production of such particles at the linear collider so that a higher mass of N ($M_N > 800GeV$) can be probed using the jet substructure technique. In this talk we will also cover the scenario at the prospective Large electron Positron Collider (LHeC).

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