Single Charged Heavy Lepton Production at the ILC

With Erin De Pree

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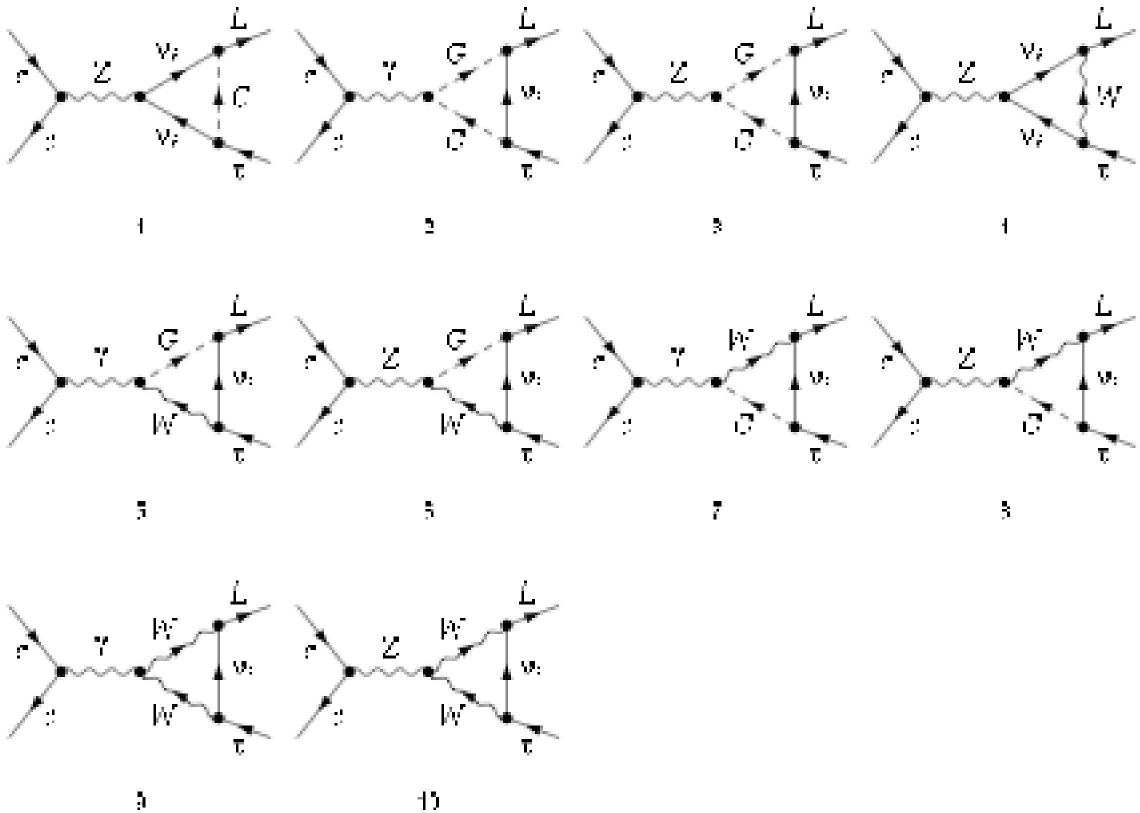
- If there is a sequential fourth generation, the heavy quarks can be easily detected at the LHC (if they aren't too heavy).
- But the charged lepton can not be. While no analysis has yet been done, it is likely that a heavy charged lepton heavier than 250 GeV can not be seen. The ILC would then be necessary to find it.
- But suppose that ILC has an energy of 500 GeV in the c.o.m. Then heavy leptons above 250 GeV can't be pair produced. Single production would be the only way to see them in the 250-500 GeV mass range.

We calculated the production cross section for e^+e^---> L τ, where L is a sequential heavy lepton with a mass between 250 and 500 GeV.

The diagrams are:



L
Z
γ
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τ
1
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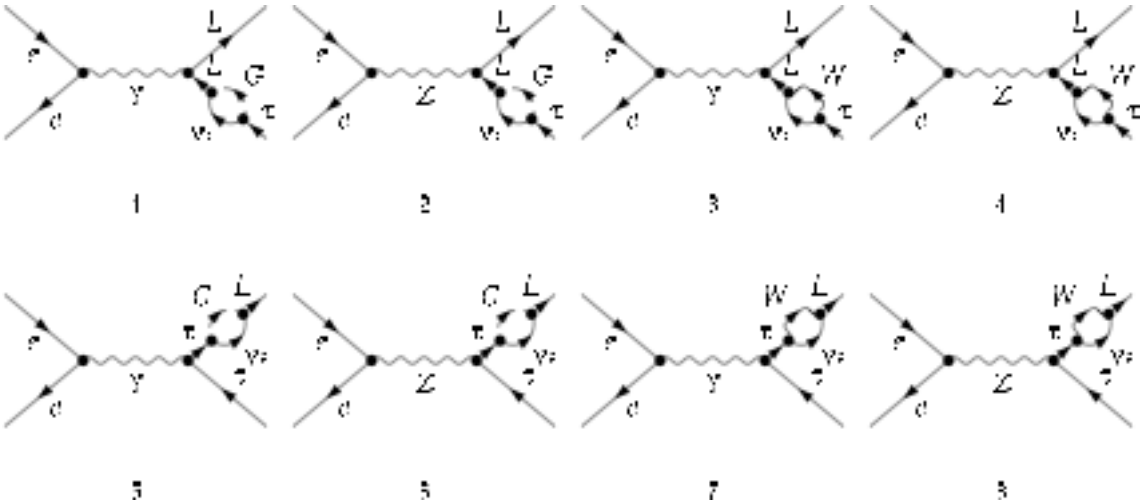
10


e
e
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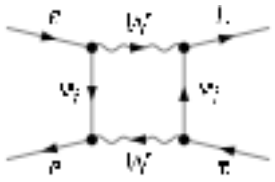
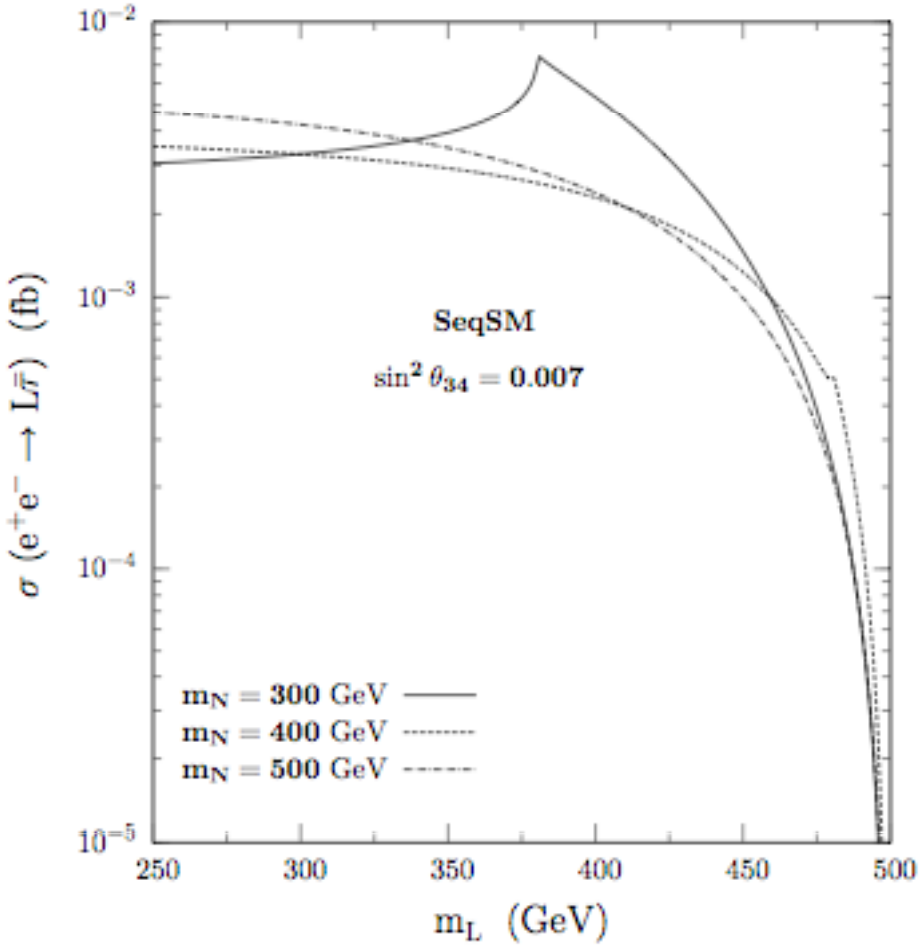
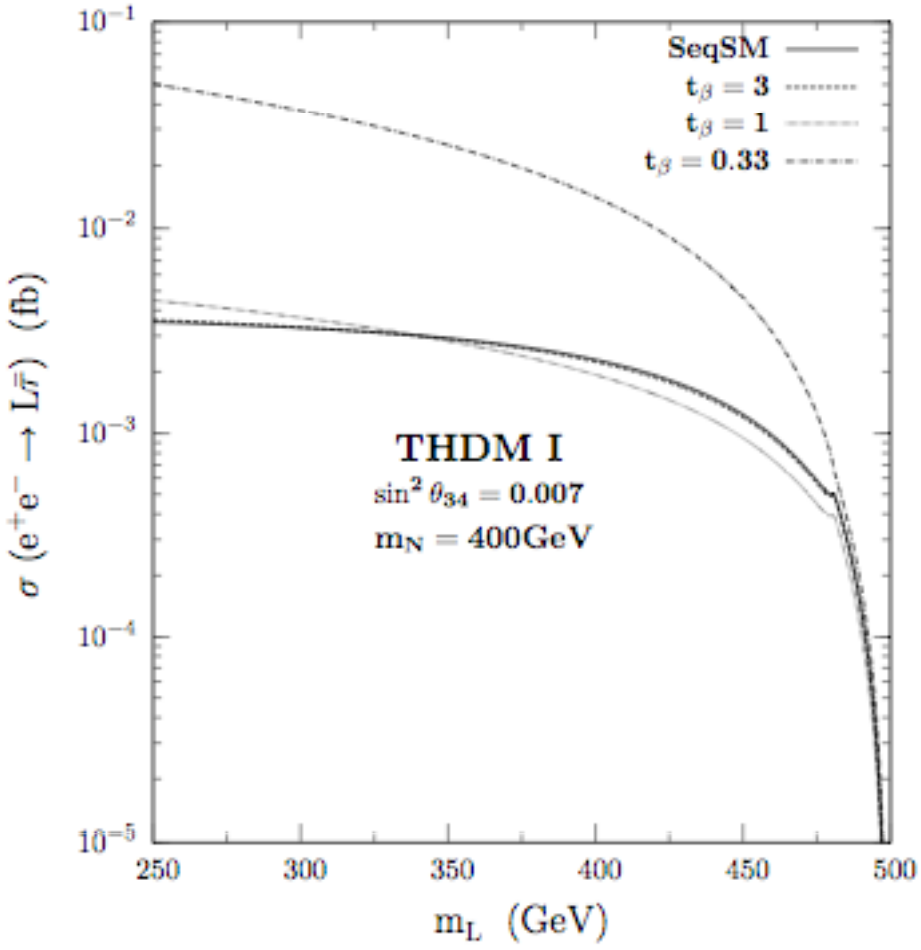


- The diagrams depend on the 3-4 mixing angle. If it is very small, it is hopeless. The experimental bound, based on tau decays, is $\sin^2\theta < 0.007$. This happens to be very close to the "Fritzsch" value of $(m_\tau/m_L) \sim 0.0035\text{-}0.007$ in the mass range of interest. So we will use this value.


10^{-2}
10^{-3}
10^{-4}
10^{-5}
$\sigma\ (e^+e^- \to L\bar{\nu})$ (fb)
SeqSM
$\sin^2\theta_{34} = 0.007$
$m_N = 300$ GeV
$m_N = 400$ GeV
$m_N = 500$ GeV
250
300
350
400
450
500
m_L (GeV)

- The cross section are very small, approximately 5 attobarns.
- However, in a two higgs doublet model, it can be bigger.


SeqSM
$t_\beta = 3$
$t_\beta = 1$
$t_\beta = 0.33$
THDM I
$\sin^2\theta_{34} = 0.007$
$m_N = 400\text{GeV}$
$\sigma\,(e^+e^- \to L\bar{\nu})$ (fb)
m_L (GeV)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
250
300
350
400
450
500

- Thus one might expect a handful of events. At these energies, the decay length of the tau is a little over a centimeter. It is monochromatic. The L decays into ν_τ + W, at the vertex, with a monochromatic W. Backgrounds are small, but still might overwhelm the signal. More analysis is needed.