Single top production at $\sqrt{s} = 240$ GeV

Cross section checks

Alejandro Quiroga T. May 08 of 2025

Karlsruher Institut für Technologie

Single top production

- Process at 240 GeV

$$e^- + e^+ \rightarrow e^- + \bar{\nu}_e + t + \bar{b}$$

- We investigate the behavior of the cross section under various phase space cuts.

- Minimum p_T and η for charge leptons and B-quarks.

- Luminosity for FCC-ee 240 GeV
$\mathscr{L} = 10.8\ \text{ab}^{-1} = 1.0 \times 10^7\ \text{pb}^{-1}$

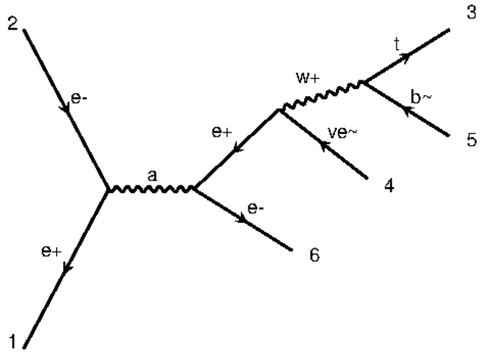


diagram 1 QCD=0, QED=4

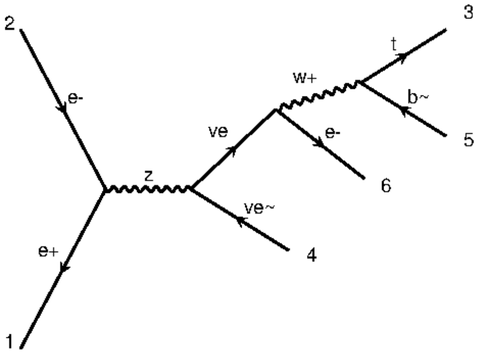


diagram 2 QCD=0, QED=4

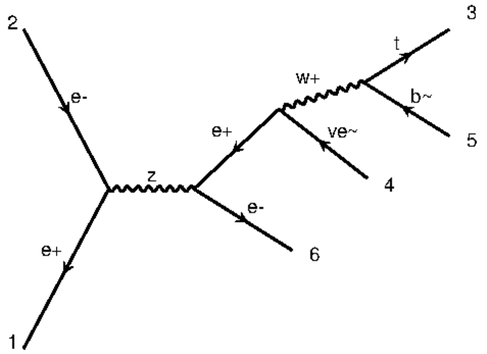


diagram 3 QCD=0, QED=4

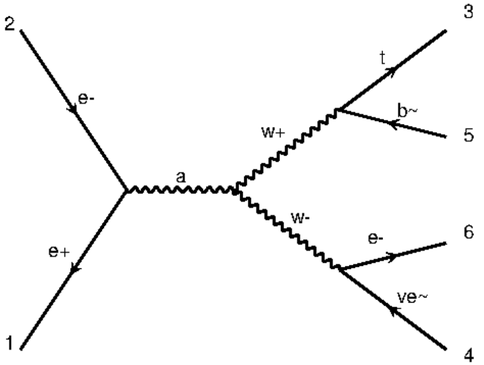


diagram 4 QCD=0, QED=4

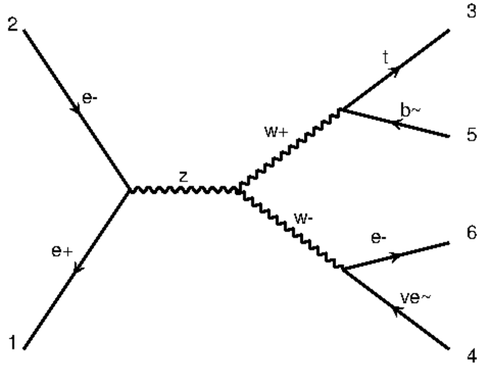


diagram 5 QCD=0, QED=4

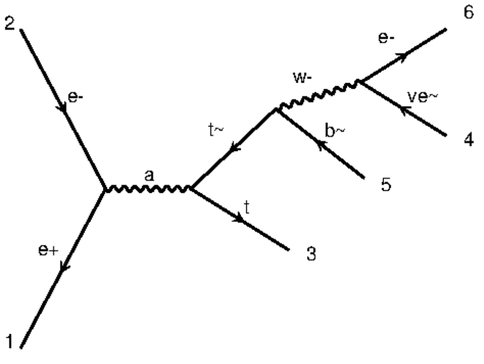


diagram 6 QCD=0, QED=4

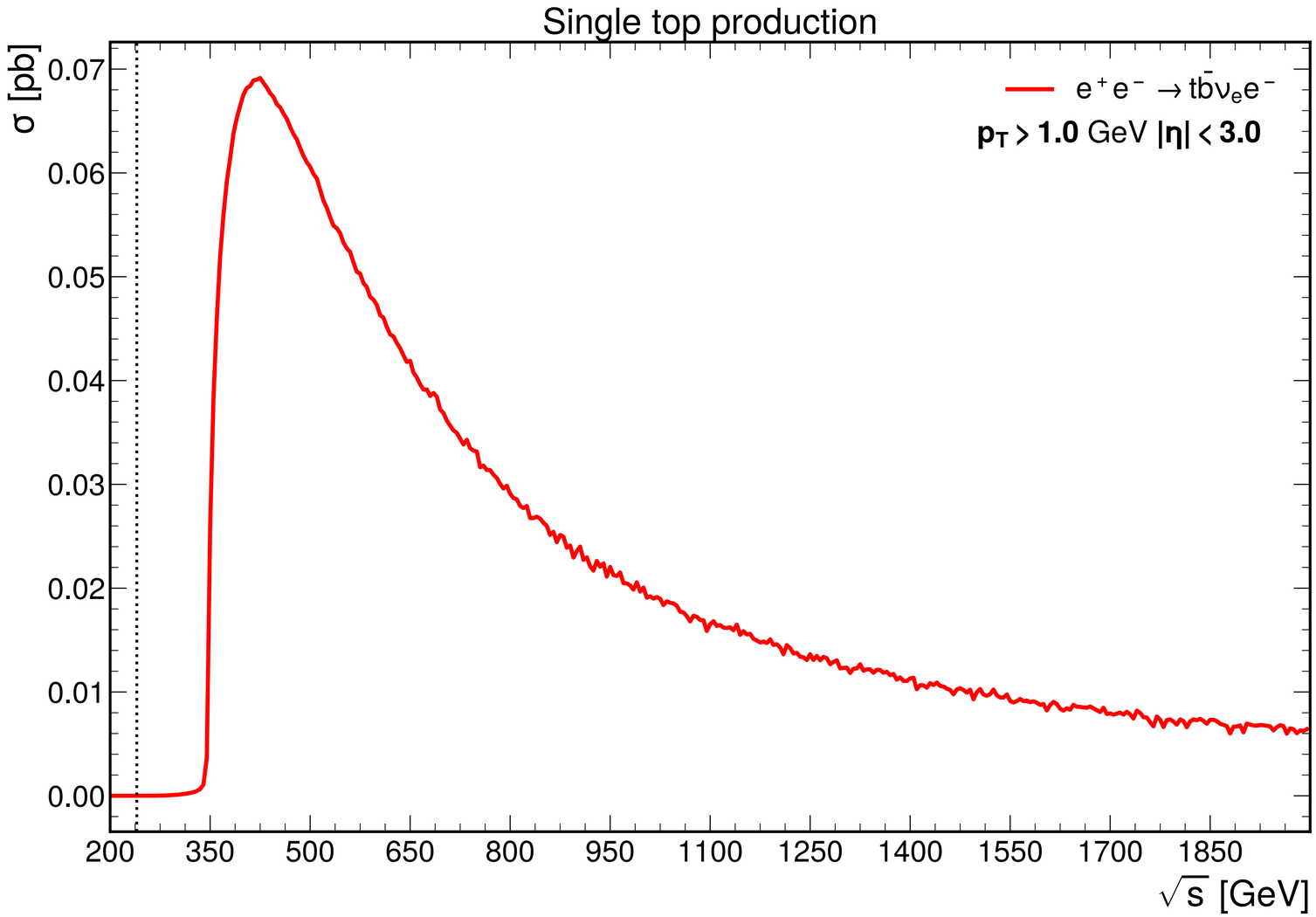
Cross section checks

p_T [GeV]	$\lvert\eta\rvert$	WHIZARD σ[pb]	MADGRAPH σ[pb]	Number of Events
No cuts	No cuts	$9.95 \times 10^{-3} \pm 1.818 \times 10^{-4}$	$11.09 \times 10^{-3} \pm 4.254 \times 10^{-5}$ *	≈ 100000
> 0.1	< 10	$5.053 \times 10^{-6} \pm 1.510 \times 10^{-8}$	$5.059 \times 10^{-6} \pm 1.548 \times 10^{-8}$	≈ 50
> 1.0	< 3.0	$1.663 \times 10^{-6} \pm 1.152 \times 10^{-9}$	$1.682 \times 10^{-6} \pm 4.90 \times 10^{-9}$	≈ 20
> 10	< 2.5	$1.806 \times 10^{-7} \pm 7.210 \times 10^{-10}$	$1.813 \times 10^{-7} \pm 9.003 \times 10^{-10}$	≈ 2
> 10	< 3.0	$1.807 \times 10^{-7} \pm 7.230 \times 10^{-10}$	$1.815 \times 10^{-7} \pm 2.394 \times 10^{-10}$	≈ 2

* No cuts for η, and only pT = 4.4 × 10−4 GeV for electrons.

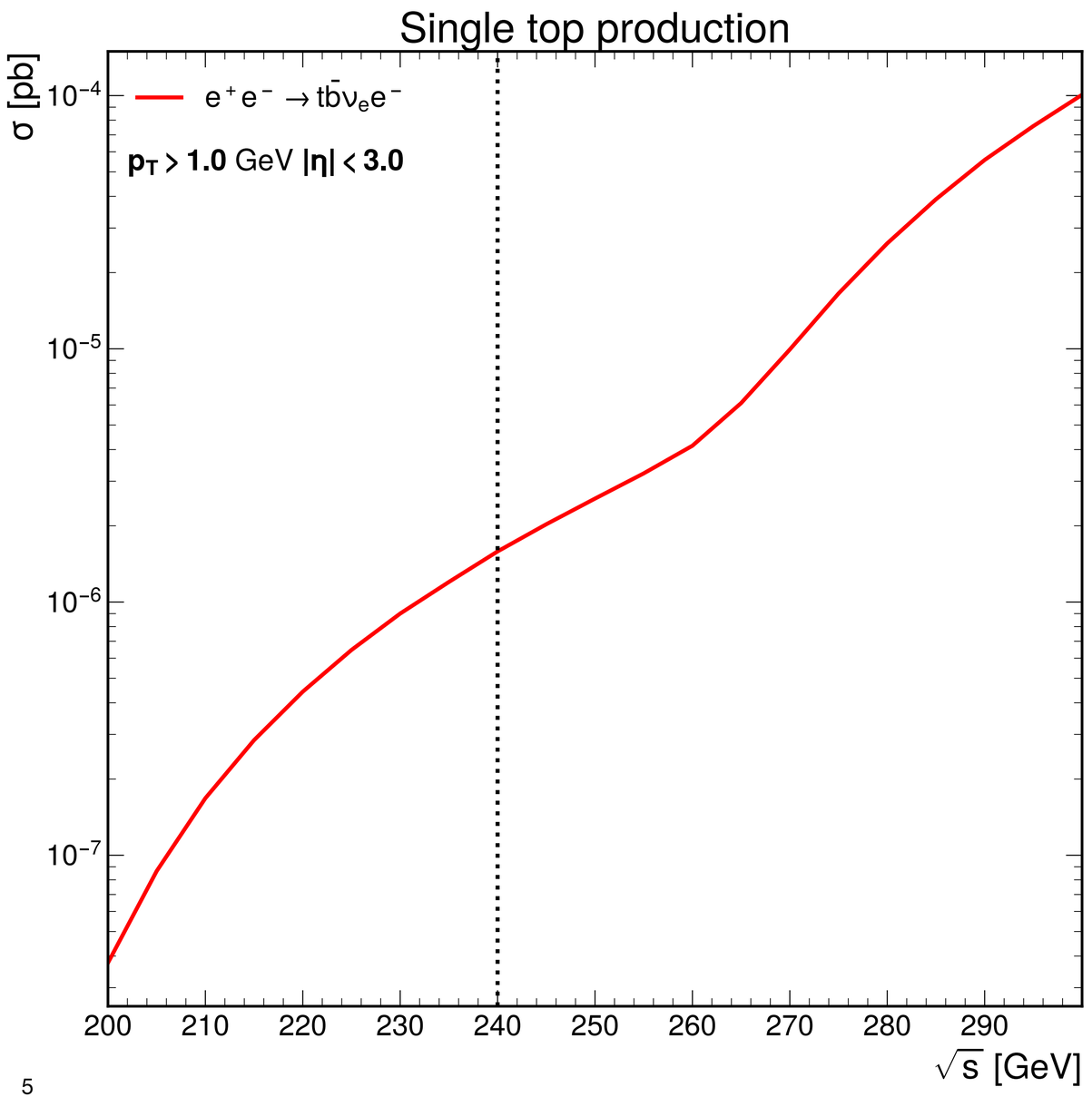
Cross section checks

- Cross section at LO for single top production according to MadGraph
- Energy range 200 GeV to 2 TeV
- Cuts:
  - $p_T > 1.0$ GeV for e^- and b
  - $|\eta| < 3.0$



Cross section checks

- Cross section at LO for single top production according to MadGraph
- Energy range 200 GeV to 300 GeV
- Cuts:
  - $p_T > 1.0$ GeV for e^- and b
  - $|\eta| < 3.0$
- Not many events expected in this region



Summary and further steps

- The Standard Model single top production is expected to yield limited statistics, potentially making a full analysis challenging.
- Alternative scenarios, such as those involving Flavor-Changing Neutral Currents (FCNC), could be interesting.
- A cross-check with efficiency studies is essential to evaluate their impact.