

Prospects of measuring the CKM matrix element $|V_{ts}|$ at the LHC

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Summary of Tevatron and LHC results:

- top mass at $\sim 1\%$
- top pair cross section at $\sim 5\%$
- single top cross section $\Rightarrow |V_{tb}| > 0.75$ at 95% CL

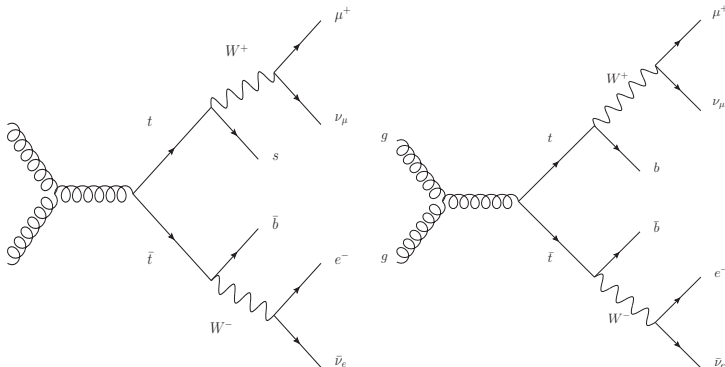
$$V_{\text{CKM}} \equiv \begin{pmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{pmatrix} .$$

In the Wolfenstein Parametrisation, this matrix is expressed as

$$V_{\text{CKM}} \simeq \begin{pmatrix} 1 - \frac{1}{2}\lambda^2 & \lambda & A\lambda^3(\rho - i\eta) \\ -\lambda(1 + iA^2\lambda^4\eta) & 1 - \frac{1}{2}\lambda^2 & A\lambda^2 \\ A\lambda^3(1 - \rho - i\eta) & -A\lambda^2(1 + i\lambda^2\eta) & 1 \end{pmatrix} ,$$

where A , λ , ρ and η are the Wolfenstein parameters.

In the SM $|V_{ts}| = 0.041 \pm 0.001$



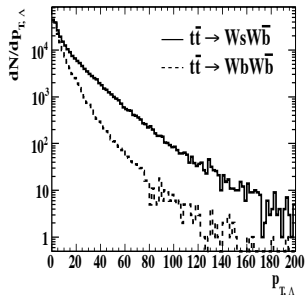
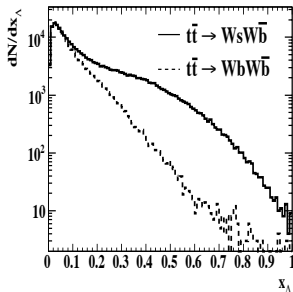
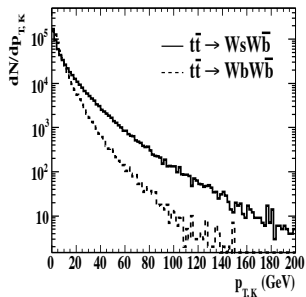
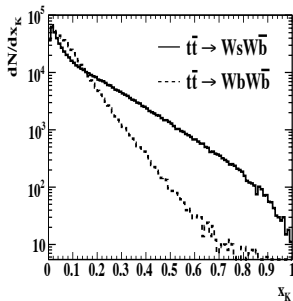
To distinguish between **s**– (signal) and **b**–jets (background) look at

- K_s^0 and Λ production, leading (soft) in **s**– (resp. **b**–) jets
- soft leptons present (absent) in **b**– (resp. **s**–) fragmentation
- secondary vertices associated to **b**–jets

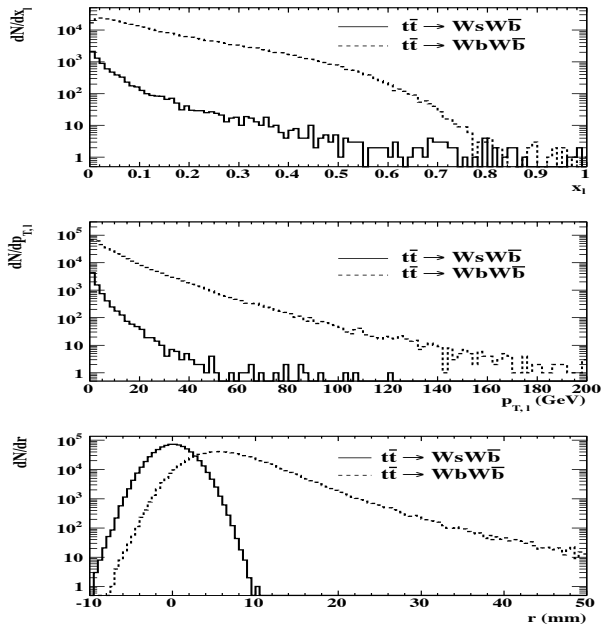
To this end we have generated 1M events with PYTHIA 6.4 with

$$|V_{ts}| = |V_{tb}| = 0.5.$$

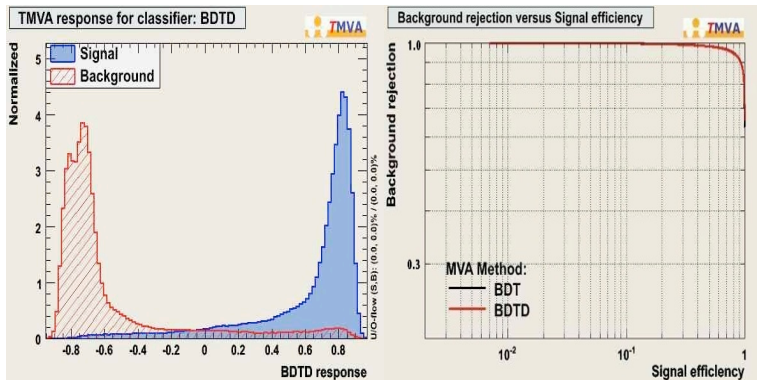
Strange particle production



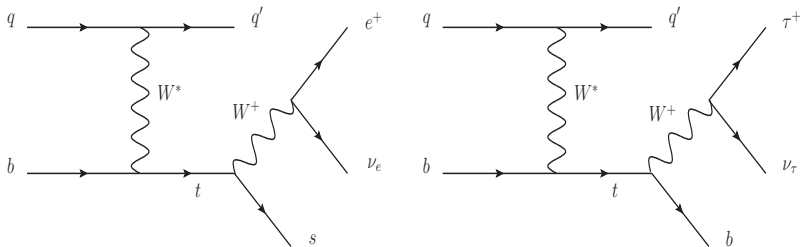
Soft leptons and secondary vertex distributions



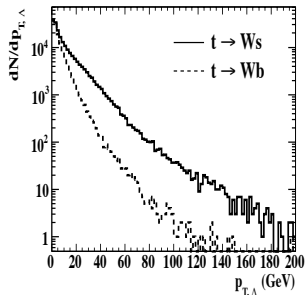
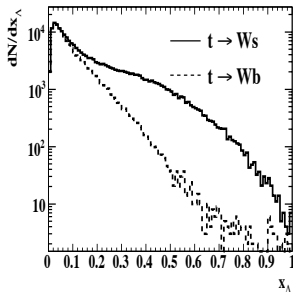
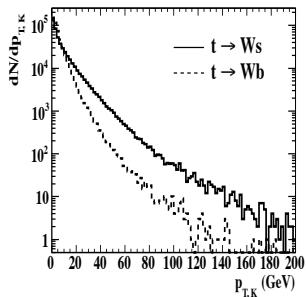
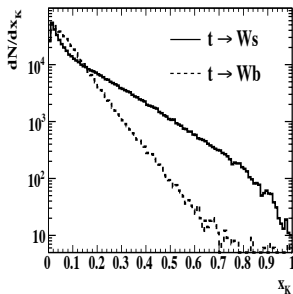
We have trained a BDT algorithm in the TMVA framework with the distributions shown above. The BDT response as well as the ROC curves (Signal efficiency versus background rejection) are shown below.



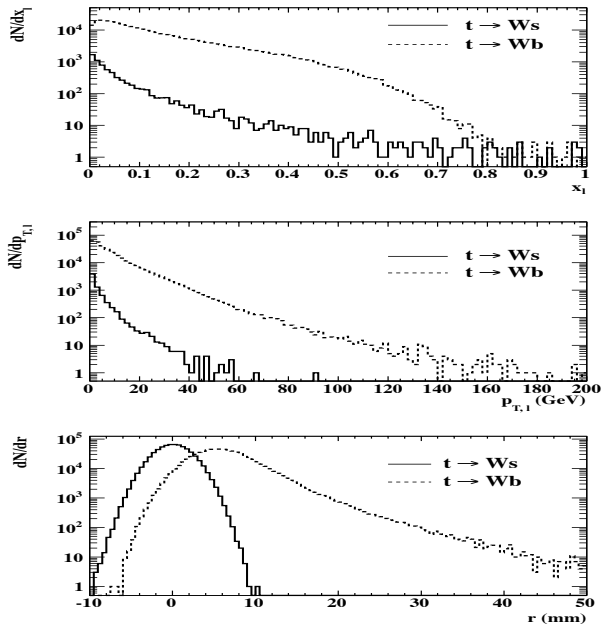
Single top production has also been studied.



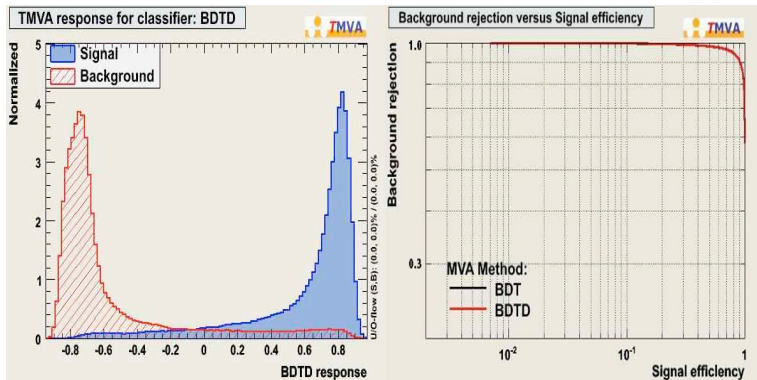
Strange particle production in single top



Soft leptons and secondary vertex distributions in single top



We have trained a BDT algorithm within the TMVA framework with the distributions shown above. The BDT response as well as the ROC curves (Signal efficiency versus background rejection) are shown below.



TMVA results in 5% efficiency for s-tagging with 10^3 b-jet rejection.

Oversimplified exercise for an integrated luminosity of 10 fb^{-1} at $\sqrt{s} = 14 \text{ TeV}$ taking $\sigma(t\bar{t}) \sim 1 \text{ nb}$:

- Number of signal events: $0.05 \times 2 \times 1.7 \times 10^{-3} \times 10^6 = 170$ events
- Number of back events: $10^{-3} \times 10^6 = 1000$ events

Expected significance $S = \frac{170}{\sqrt{1000}} \sim 6\sigma$.

Similar exercise for single top gives $S = \frac{100}{\sqrt{1000}} \sim 3\sigma$.

At 7 TeV scale down by factor of two for the same luminosity.

Need to do a more realistic analysis with ATLAS full simulation events.

Aim:

- Short and medium term: set limits
- Longer term: do a measurement