Top Physics Program in LHCb

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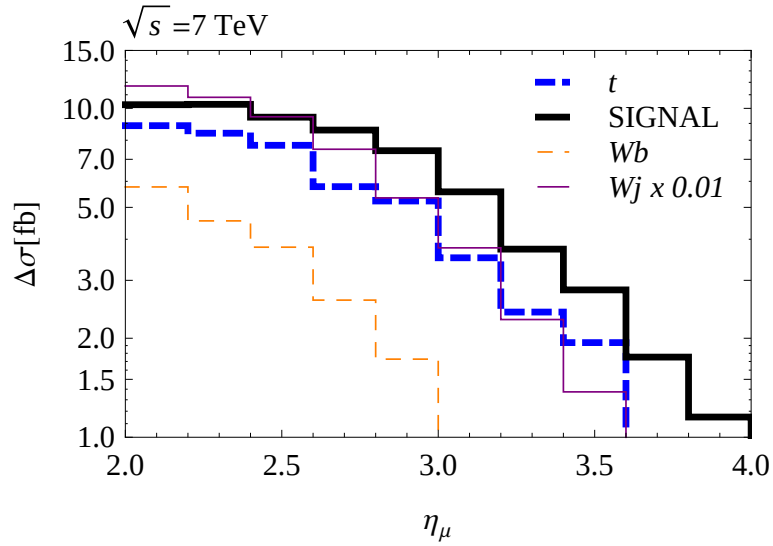
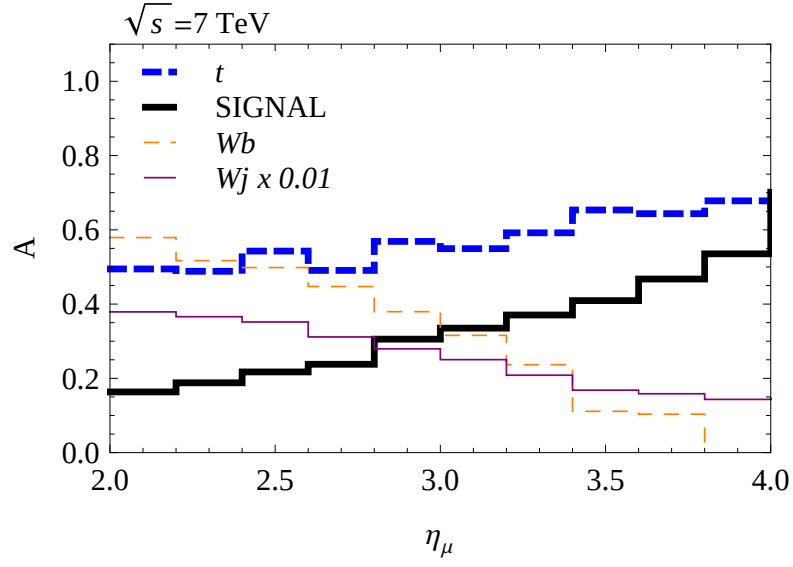
TOP LHC WG Meeting

CERN, 19.07.2012

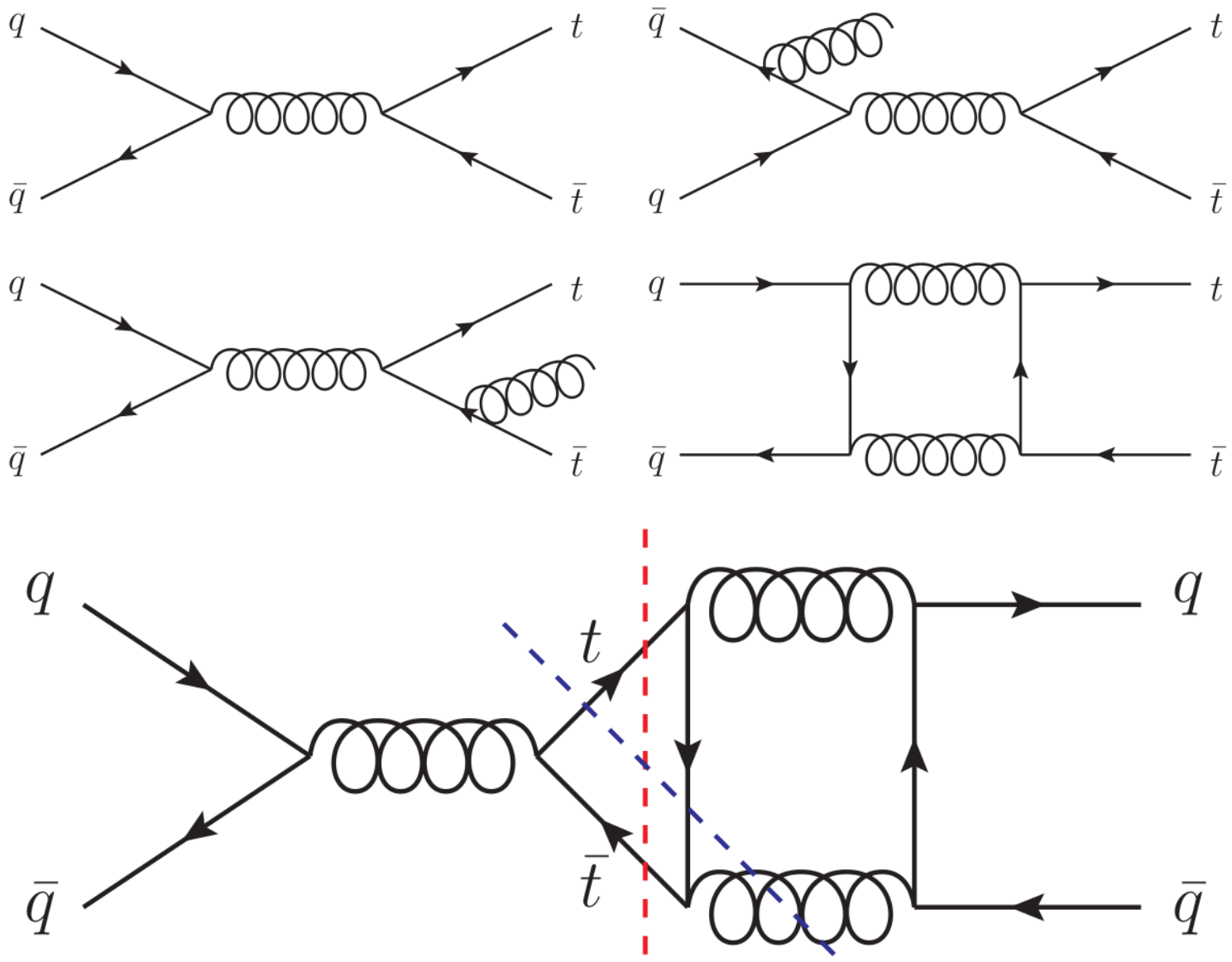
Motivation (arXiv:1103.3747v2 [hep-ph])

- top sector is sensitive to NP.
- LHCb is unique in η coverage.
- LHCb can measure $t\bar{t}$ FB asymmetry in the forward region.
- NP example: Z' exchange



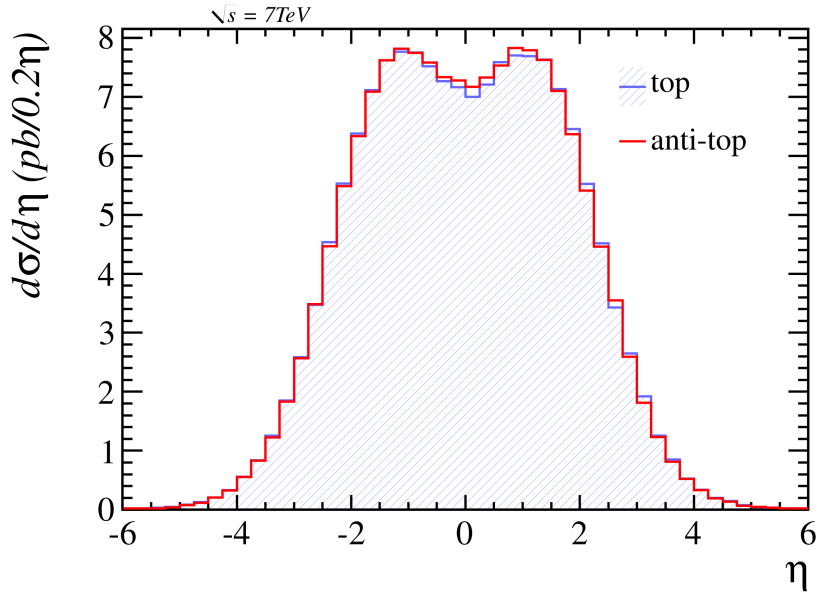


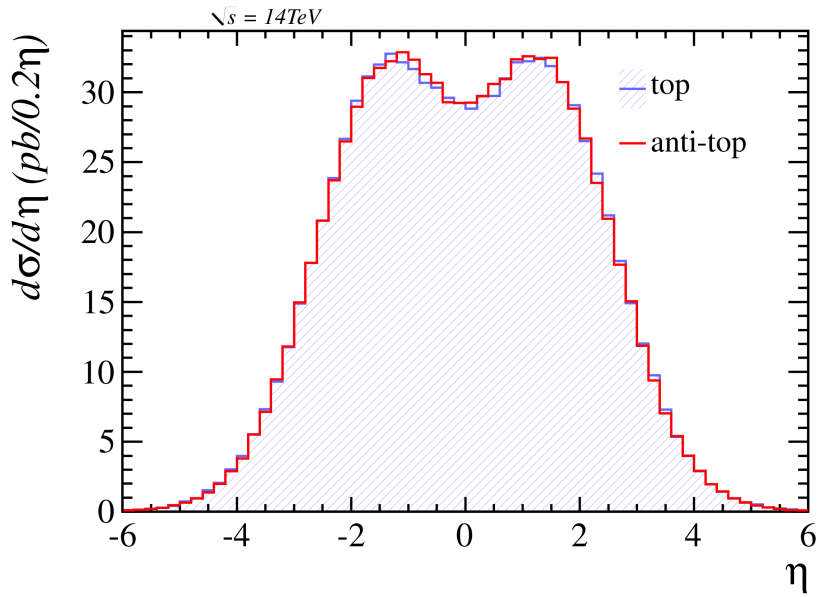
$t\bar{t}$ Asymmetry in the SM



Small SM Prediction in pp-Collisions

- LHC more difficult than Tevatron:
  - *pp* initial state
  - *gg* fusion dominates
- Distributions:
  - POWHEG with CT10 PDFs
  - $\sqrt{s}$ = 7 TeV (top)
  - $\sqrt{s}$ = 14 TeV (bottom)



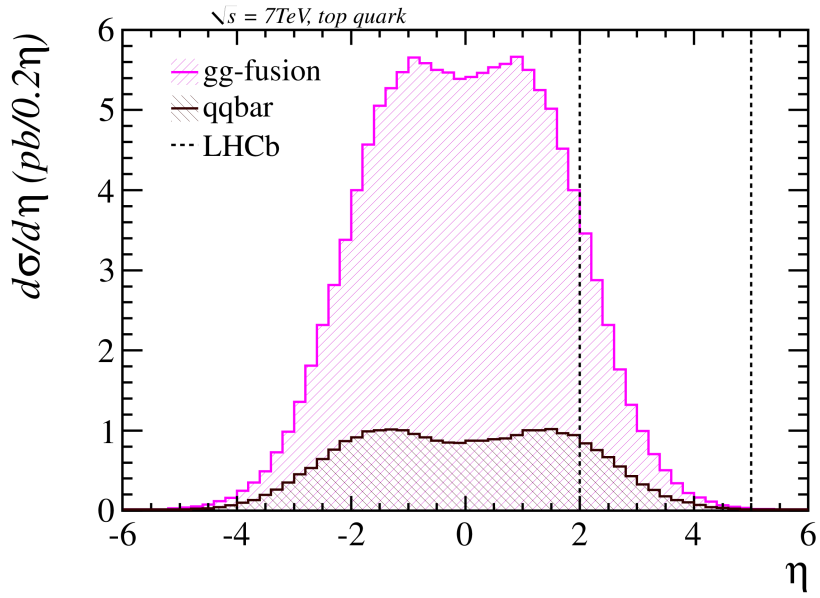


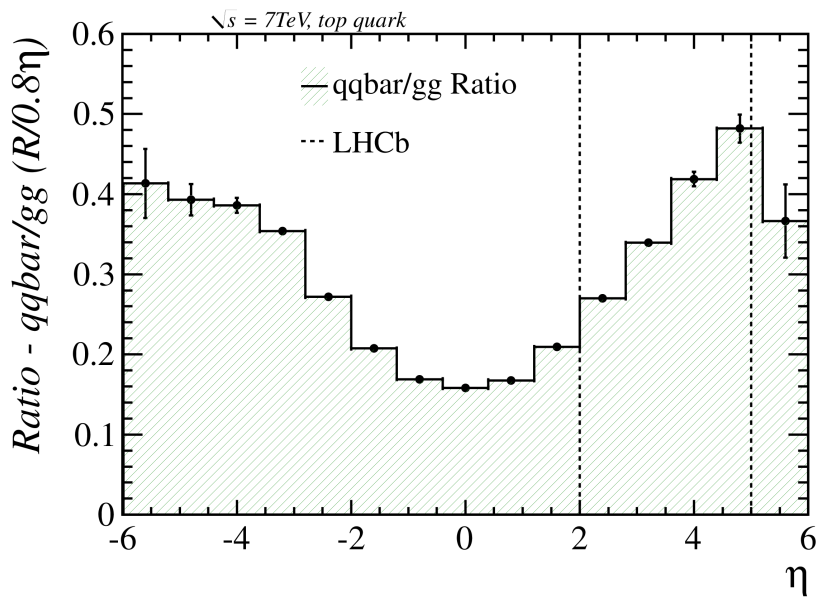
LHCb Acceptance

- $2 < \eta < 5$
- full reconstruction difficult.
- but in principle
  - $t\bar{t}$ cross section
  - $A_{\eta}^{t\bar{t}} = \frac{d\sigma^{t}/d\eta - d\sigma^{\bar{t}}/d\eta}{d\sigma^{t}/d\eta + d\sigma^{\bar{t}}/d\eta}$

  are possible!

Forward region more sensitive!





Signal & Background

Trigger on isolated l from W decay.

Signal

- $t \to Wb$, $W \to l\nu$
  - lb
  - lb_{any}
  - lbb
  - lbj
  - $lb_{any}j$
  - llb_{any}

Background

- Wj
- Wb
- t
- tWl
- Zj
- Zb

Requires good b-jet tagging with mistag rate < 1%!

Event Yields for 1 fb^{-1}

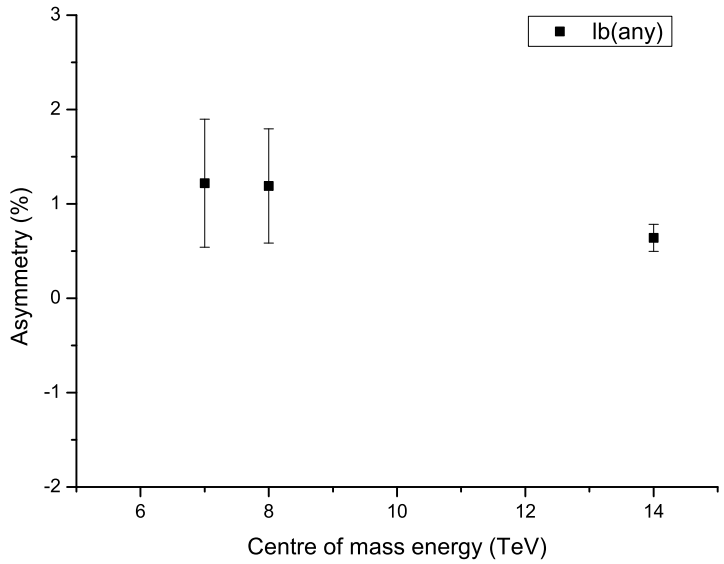
Channel	7TeV	8TeV	14TeV
lb	873±182	1566±245	11707±1649
lb_{any}	1398±277	2503±357	18643±2437
lbb	138±24	285±35	3139±377
lbj	182±41	385±53	4199±524
$lb_{any}j$	340±87	729±102	8092±1007
$lbbj$	44±13	111±13	1852±217
$lbjj$	24±14	59±11	975±118
$lb_{any}jj$	48±15	121±20	2036±249
$lbbjj$	7±3	20±3	515±65
l^+l^-	56±11	100±12	761±65
$l^+l^-b_{any}$	24±8	52±9	535±64

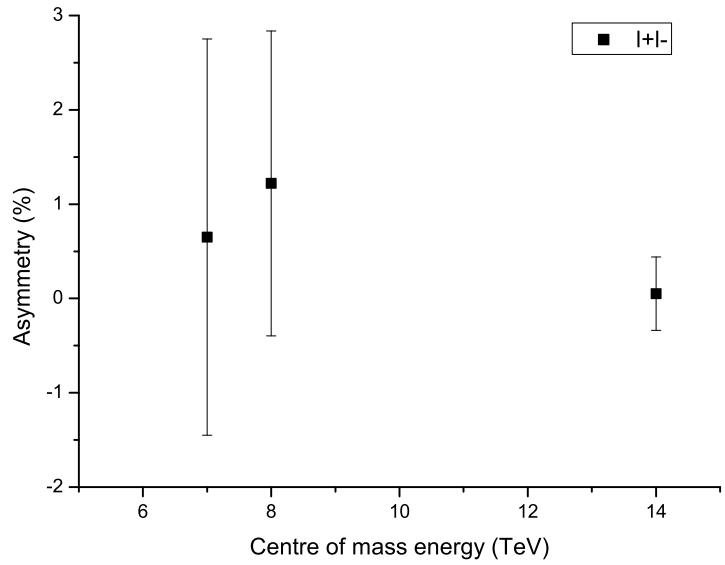
Cross Sections & Cuts

Channel	$l^{\pm}/j,b\ p_T > 20/30 GeV$	$l^{\pm}/j,b\ p_T > 20/50 GeV$
$l^- b_{any}/l^+ b_{any}$	0.42 / 0.44	0.30 / 0.36
$W^- j/W^+ j$	86 / 151	24 / 46
$W^- b/W^- b$	0.23 / 0.37	0.05 / 0.08
$\bar{t}/t$	0.11 / 0.41	0.10 / 0.34
$tW(l^+/l^-)$	0.03 / 0.03	0.03 / 0.03
Zj	8.1 / 8.1	2.7 / 2.7
Zb	0.15 / 0.15	0.04 / 0.04
Total Bckg.	1.46 / 2.55	0.49 / 0.98

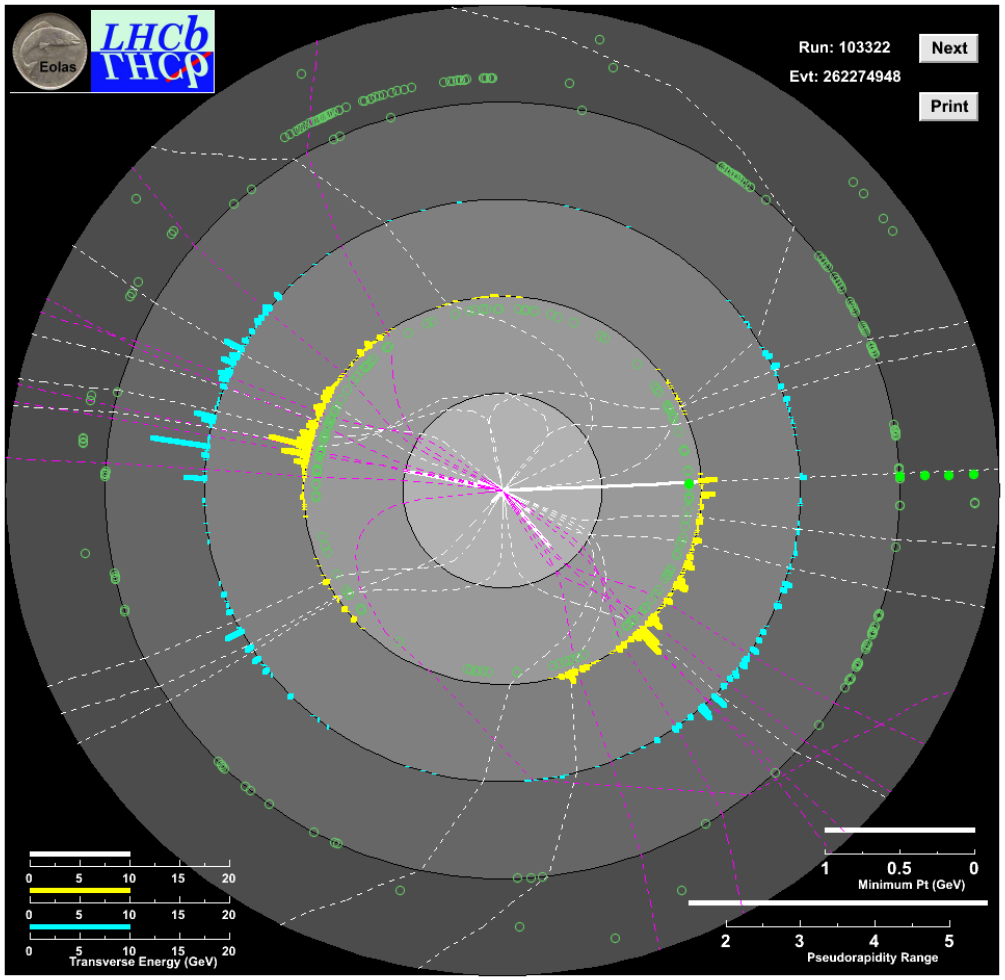
Expected Sensitivity at 1 fb^{-1}

lb_{any} @ 7TeV: 1.22±0.54±0.41 % l^+l^- @ 7TeV: 0.65±1.45±1.52 %





Looking at $t\bar{t}$ to $e\mu$ with two b-tags



- $P_{T_\mu} > 15$ GeV
- $P_{T_e} > 10$ GeV
- 30 GeV $< m_{e\mu} <$ 90 GeV
- $IP_l < 35\ \mu m$
- DOCA leptons $< 35\ \mu m$
- l energy isolation in $R < 0.5$ is $> 70\%$

Just for illustration!

Summary & Outlook

- Summary
  - Extensive generator studies have been conducted.
  - The *b*-jet tagging starts to look promising.
  - We had a first glimpse at data in the $e\mu$ final state.
  - LHCb has the potential to measure $t\bar{t}$ production and charge asymmetry in the range $2 < \eta < 5$.

- Outlook
  - Move generator studies to full simulation.
  - Further improve *b*-jet tagging and validate on data.