Study of ttbar Production Mechanism

Plots and Results to Bless…

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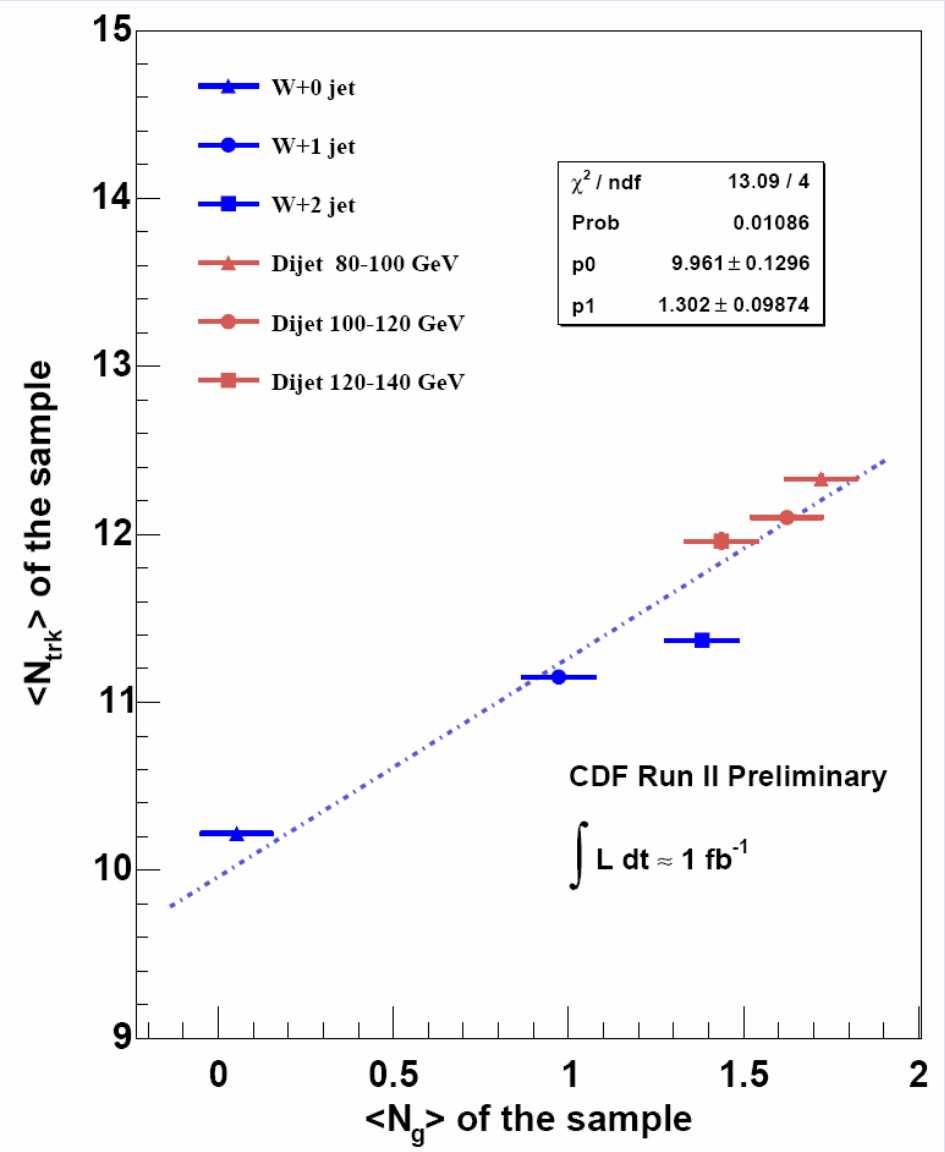
Correlation between $\langle N_g \rangle$ and $\langle N_{trk} \rangle$

Sample	MC $\langle N_g \rangle$	Data $\langle N_{trk} \rangle$
W+0 jet	0.05 ±0.10	10.22±0.01
W+1 jet	0.97 ±0.10	11.15 ±0.03
W+2 jets	1.38 ±0.10	11.37 ±0.07
80-100 GeV	1.72 ±0.10	12.33 ±0.02
100-120 GeV	1.62 ±0.10	12.10 ±0.02
120-140 GeV	1.44 ±0.10	11.96 ±0.04

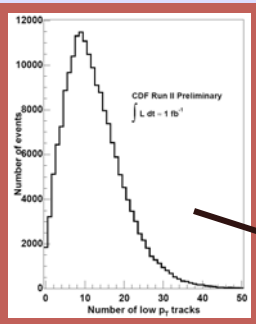


using the fit to find $\langle N_g \rangle$ for other samples $\langle N_{trk} \rangle$

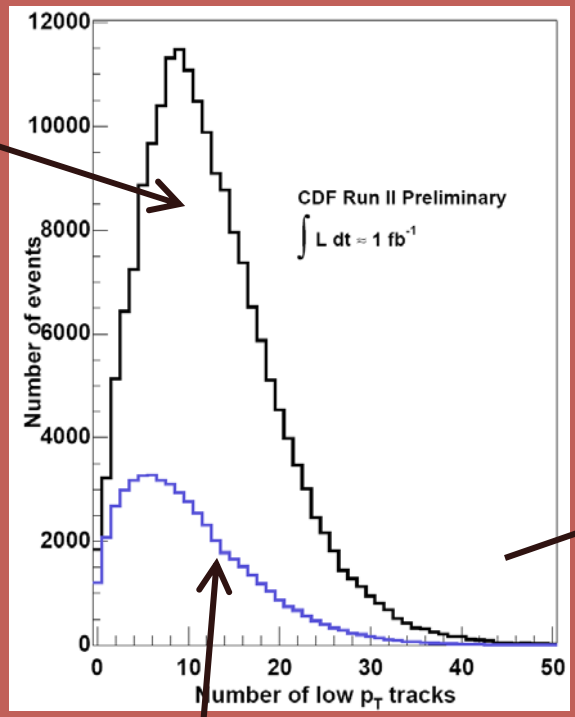
Sample	MC prediction	Fit result
140-160 GeV	1.26 ±0.04	$1.41^{+0.07}_{-0.04}$
160-180 GeV	1.13 ±0.04	$1.25^{+0.06}_{-0.05}$
180-200 GeV	0.99 ±0.07	$1.11^{+0.05}_{-0.06}$
200-220 GeV	0.92 ±0.10	$0.91^{+0.04}_{-0.08}$
220+ GeV	0.67 ±0.10	$0.68^{+0.04}_{-0.10}$

Uncertainties are statistical only

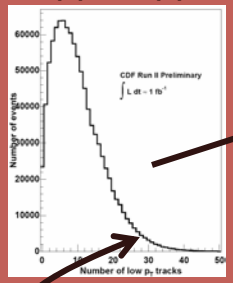
Gluon rich and 0-gluon distributions



DATA
dijet 80-100 GeV
Based on MC
27% $qq \rightarrow qq$
<Ng> = 2.36
for the rest

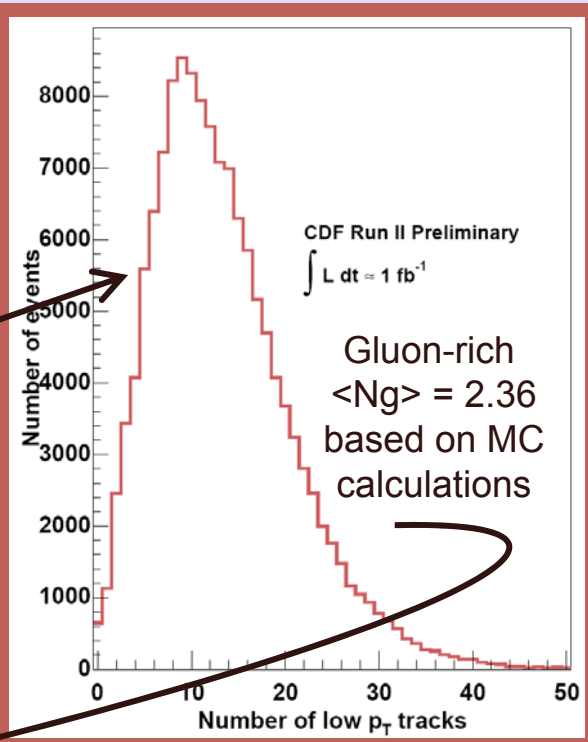


DATA
W+0 jet
Similar to
$qq \rightarrow qq$



Normalized to dijet
80-100 GeV
Scaled by 0.27 to
represent $qq \rightarrow qq$

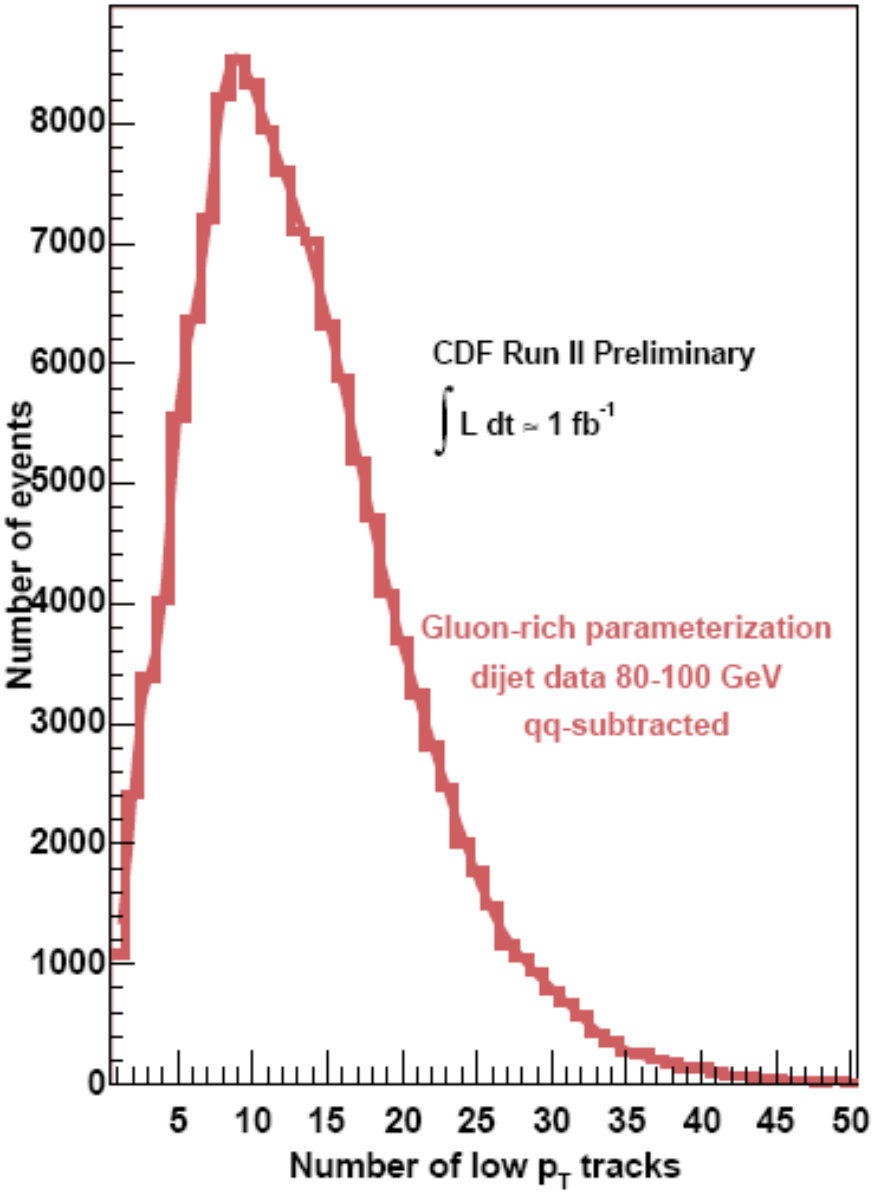
Subtract

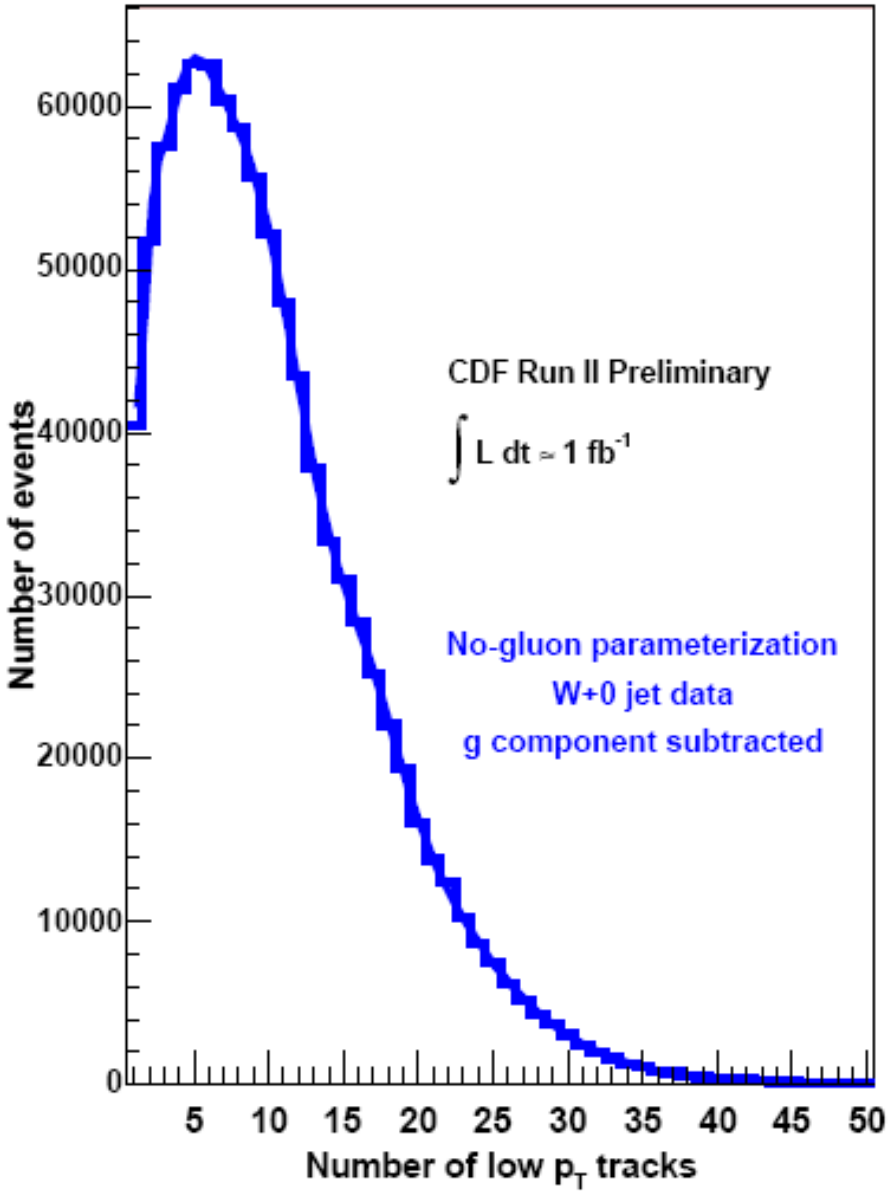


Gluon-rich
<Ng> = 2.36
based on MC
calculations

Iterate to subtract gluon contributions
from W+0 jet data distribution

Parameterization





Fit and MC values for different calibration samples

Sample	f_g *from the fit*	MC prediction
80-100 GeV	0.734 ± 0.004	0.73 ±0.03
100-120 GeV	0.685 ± 0.006	0.69 ±0.03
120-140 GeV	0.654 ± 0.010	0.63 ±0.04
140-160 GeV	0.621 ± 0.005	0.57 ±0.04
160-180 GeV	0.564 ± 0.005	0.52 ±0.04
180+ GeV	0.479 ± 0.005	0.42 ±0.05

Uncertainties on fit results are statistical only
MC uncertainties are both statistical and systematical

Estimating gluon-rich fraction in background

Sample	f_g - no tag	f_g - tagged
W+1 jet	0.37 ± 0.01	0.55 ± 0.06
W+2 jet	0.48 ± 0.02	0.34 ± 0.09
W+3 jet	0.50 ± 0.05	0.28 ± 0.13
Extrapolated W+4$^+$ jet, (f_g^{LF}) (f_g^{HF})	0.70 ± 0.05	0.00 ± 0.22
LF fraction in background (f_b^{LF})	-	0.55 ± 0.13
HF fraction in background (f_b^{HF})	-	0.45 ± 0.11

- We calculate f_g^{bkg} assuming Gaussian distributions for the variables used in the following equation using the above values

$$f_g^{bkg} = f_b^{LF} f_g^{LF} + f_b^{HF} f_g^{HF}$$

- We find f_g^{bkg} = 0.46 ± 0.08 (calculation) ± 0.06 (nonW variation)

- HF background is anything that can have a real tag (Wc, Wcc, Wbb, Single Top and half of nonW) and the rest is what we consider LF

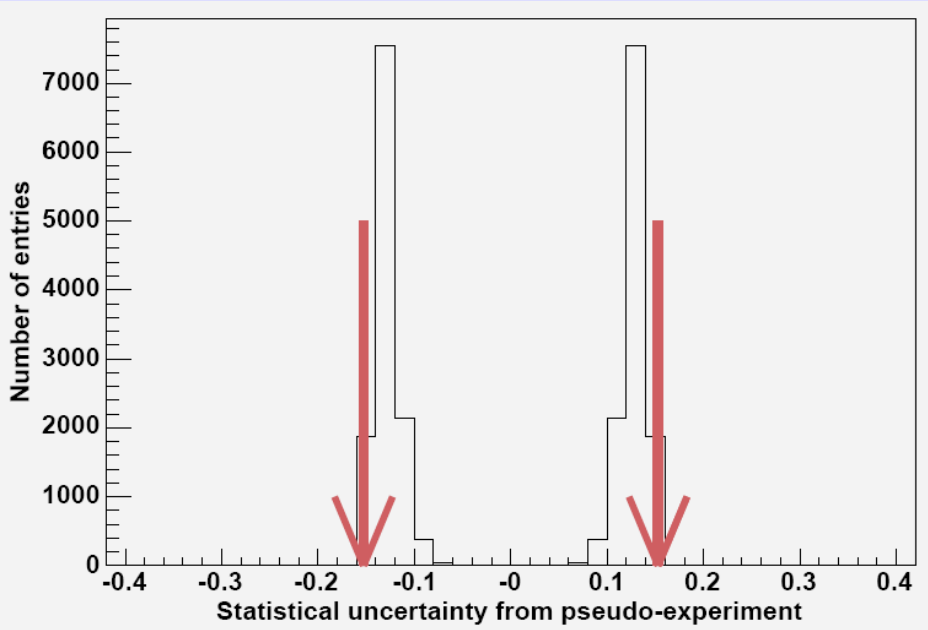
gg and qq to ttbar Acceptance

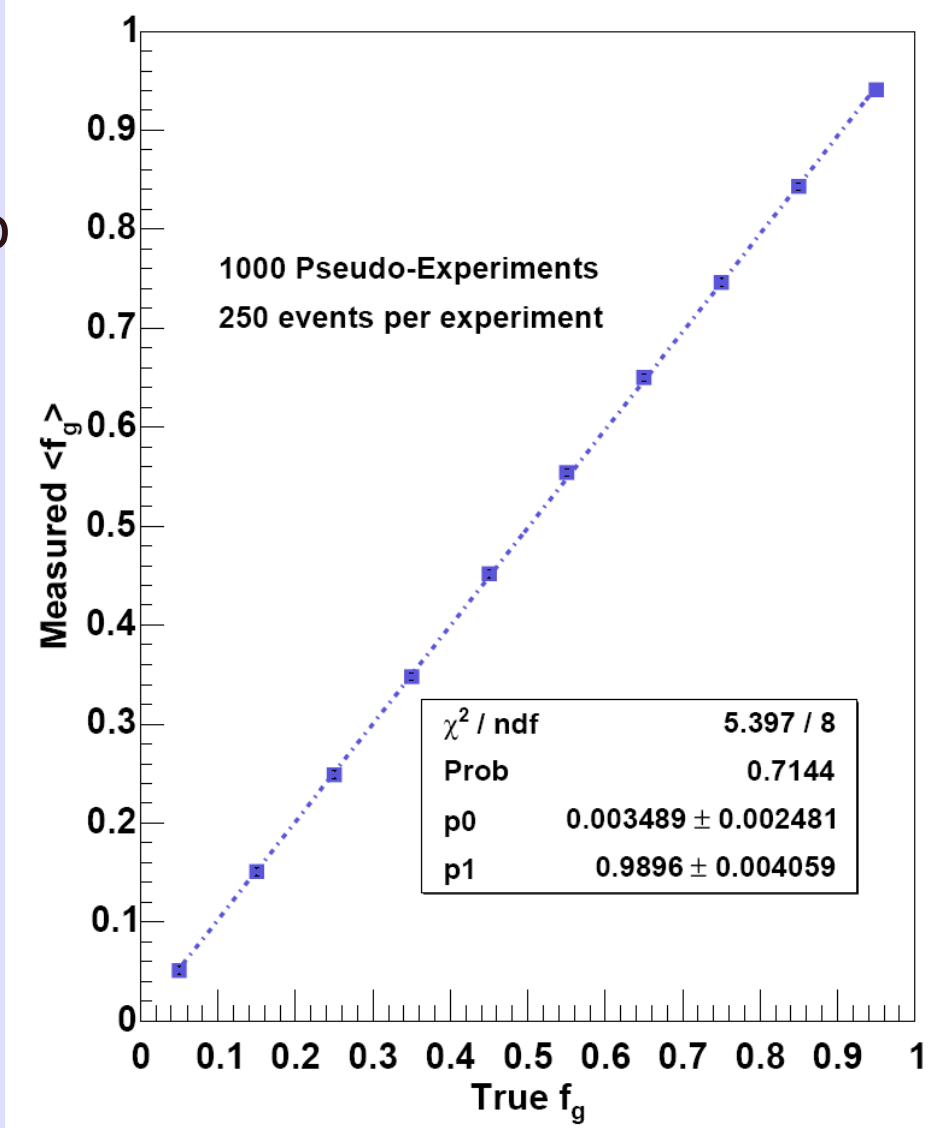
	$gg \rightarrow tt$, ≥ 4 jets	$qq \rightarrow tt$, ≥ 4 jets
$\mathcal{A}_{tagged}$	0.099 $\pm$0.002(stat + syst)	0.088 $\pm$0.002(stat+syst)

Used ttop75 PYTHIA MC Sample

Pseudo-experiments

- Performed 1000 pseudo-experiments with 250 events, using the parameterizations to generate the track multiplicity distributions for different true gluon-rich fractions





Systematic uncertainties-I

- Uncertainties affecting track multiplicity and f_g^{bkg}
  - ✓ Change the central values and observe the changes in relevant variables except for the last one which comes from calculation on slide 7

	f_g	f_g^{bkg}
Track/jet correction	±0.051	±0.001
Low jet E_T cut	±0.021	±0.035
Dijet qq→qq fraction	±0.002	±0.019
W+0 jet f_g	±0.036	±0.001
nonW background composition	-	±0.057
f_g^{bkg} calculation	-	±0.080
Total	±0.066	±0.106

Systematic uncertainties-II

- Uncertainties due to f_g, f_g^{bkg} and f_b

	f_g^{tt}
f_g	±0.08
f_g^{bkg}	±0.02
f_b	±0.01
Total	±0.08

Systematic uncertainties-III

- Uncertainties due to f_g^{tt} and acceptances

	$\sigma(gg \rightarrow tt)/\sigma(pp \rightarrow tt)$
f_g^{tt}	± 0.07
$\mathcal{A}_{gg \rightarrow tt}$	± 0.0003
$\mathcal{A}_{qq \rightarrow tt}$	± 0.0003
Total	± 0.07

Result

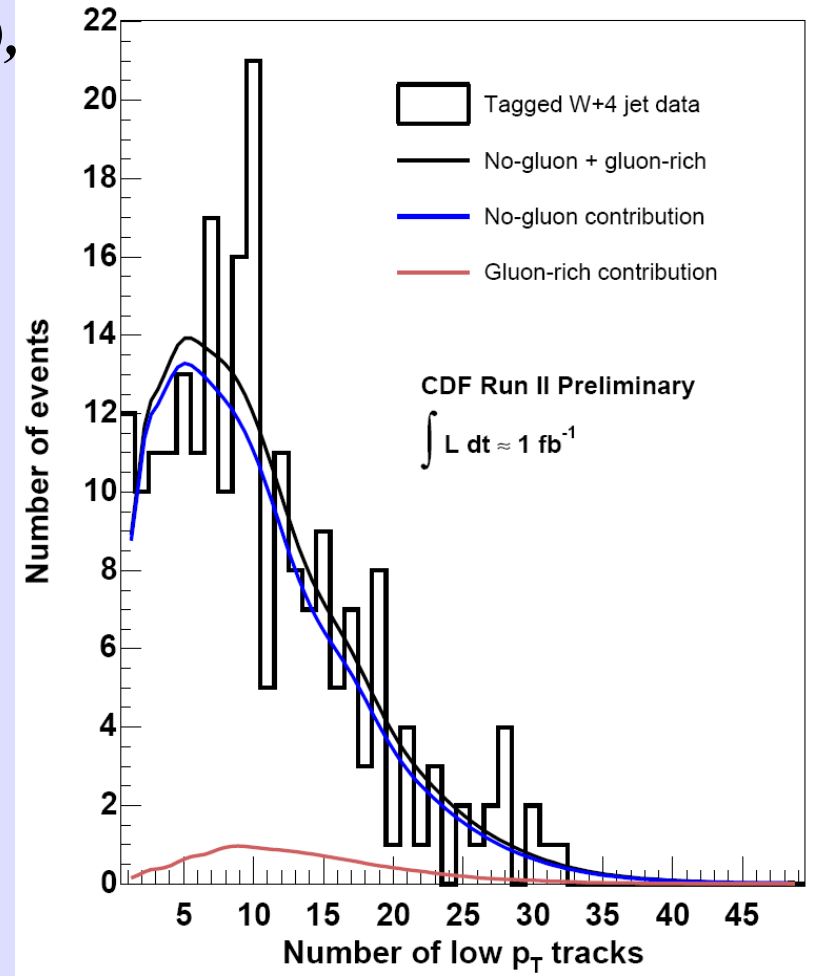
- Using

$$f_g^{W+4\,jet} = 0.07 \pm 0.15(stat) \pm 0.07(syst),$$

$$f_g^{bkg} = 0.46 \pm 0.11(stat + syst)$$

and a background fraction of (13 ± 2)%, we get

$$f_g^{tt} = 0.01 \pm 0.18(stat) \pm 0.08(syst)$$

- and using a ttbar acceptance of 0.099 ± 0.002 and 0.088 ± 0.002 for gg fusion and qqbar respectively, we find

$$\frac{\sigma(gg \to t\bar{t})}{\sigma(p\bar{p} \to t\bar{t})} = 0.01 \pm 0.16(stat) \pm 0.07(syst)$$