

Luminosity Calibration using Gamma-Gamma Events

Luminosity monitors can be calibrated either:

(a) knowing $I_p, I_{\bar{p}}$ and both beam profiles $x(z)$ & $y(z) \sim 10\%$?

(b) Using a well-known process:

→ Coulomb scattering

→ Lumi-independent measure of

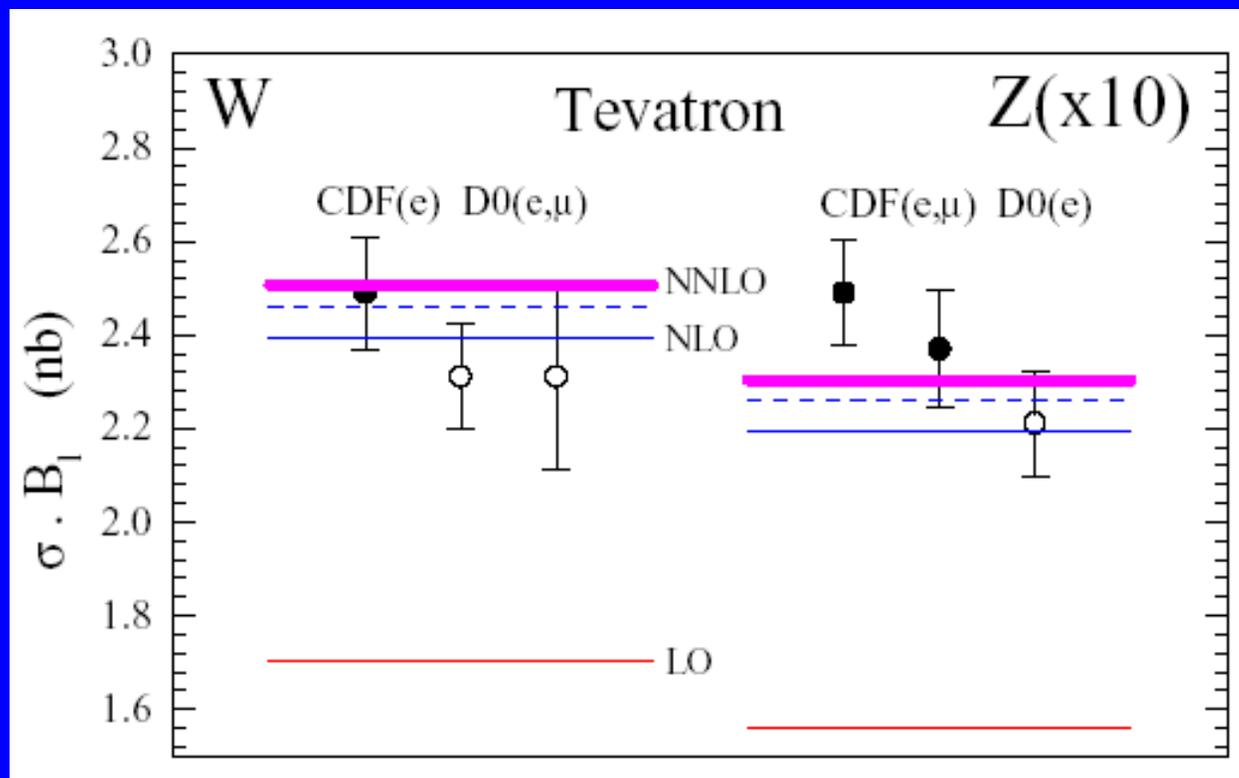
$\sigma_T, \sigma_{el} \rightarrow \sigma_{inel} \rightarrow$ model of interactions (e.g. MBR)

→ $\sigma(p\bar{p}) \rightarrow W + X$ CDF study/6411 (2003) ... 7% syst.

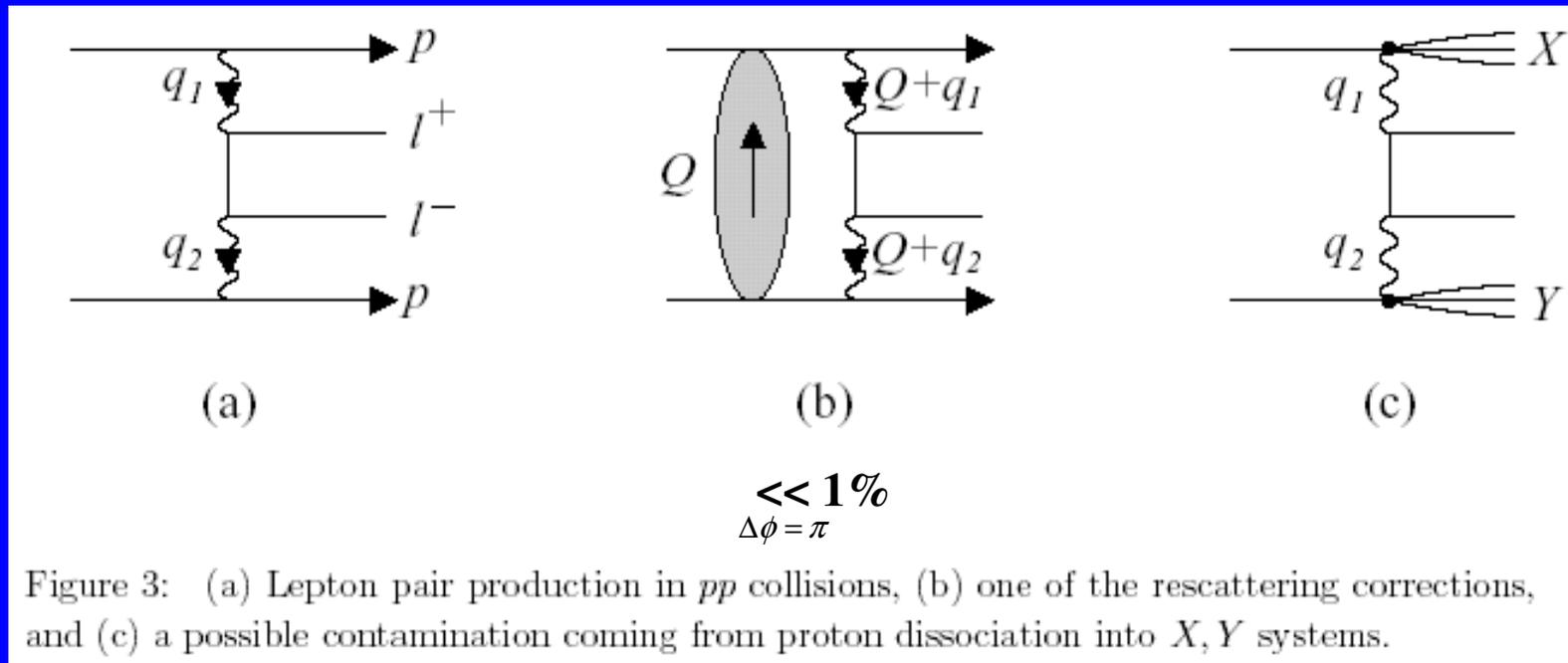
→ $\sigma(p\bar{p}) \rightarrow p \ell^+ \ell^- \bar{p}$ by $\gamma\gamma$ exchange

VERY RAW as of today

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Luminosity Monitors at the LHC



Large shift LO \rightarrow NLO, 4% shift NLO \rightarrow NNLO
Claimed uncertainty on NNLO is 2%
But 5% uncertainty on efficiencies and cuts.



(a) is known (QED) to $\ll 1\%$

(b) is a very small QCD correction

(c) background could be minimized by $\vec{p}_T(l^+) + \vec{p}_T(l^-) \approx 0$

K. Piotrowski

Luminosity with very forward pairs in CASTOR

QED process for luminosity monitoring

(KP & D.Bocian)

$pp \rightarrow pp e^+e^-$

Electrons are
in forward range

$$5 < \eta < 7$$

Cross section $\sim \mu\text{barns}$

EM calorimetry essential

Tracking important (T2?)

Can get the luminosity to 1-2%?

Need to measure lepton pair whether or not there was another interaction.

Cross section steeply falls with $M(\ell\ell)$

Measuring lepton pair tracks efficiently in SVX + COT is probably hopeless ... no trigger for soft electron pairs, and muon-pair threshold ~ 3 GeV is high. (Check $pT(\mu\mu)$)

Idea:

Forget about tracks, go very forward, use CLC + MP

2 beta=1 hits in CLC in front of two MP hits.

same E_T (within errors) and $\Delta\phi = \pi$

Are such pairs distinctive enough to see, (a) in otherwise empty events? (b) even with other interactions superimposed?

Very Forward Electron Detectors in CDF

CLC (Cerenkov Luminosity Counters)

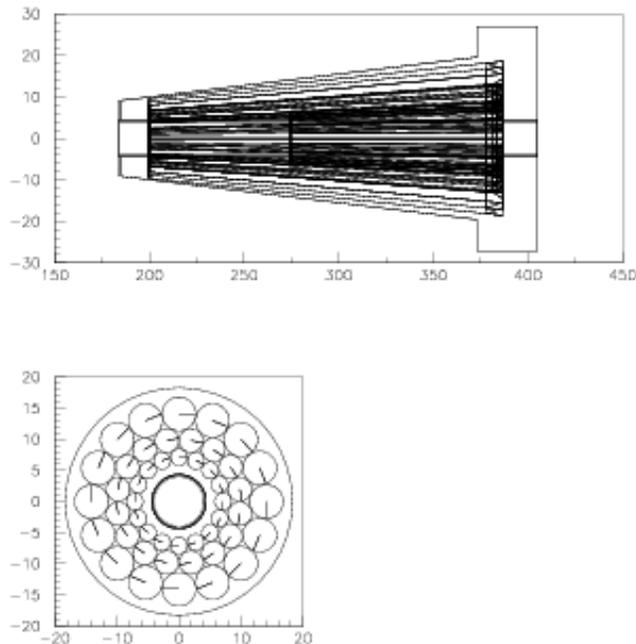


Figure 1: The CLC detector as described in GEANT. Longitudinal view of the CLC detector (top plot). Front view of the CLC detector at $z = 350$ cm. (bottom plot).

Isobutane in Al-mylar tubes

MiniPlug Calorimeters

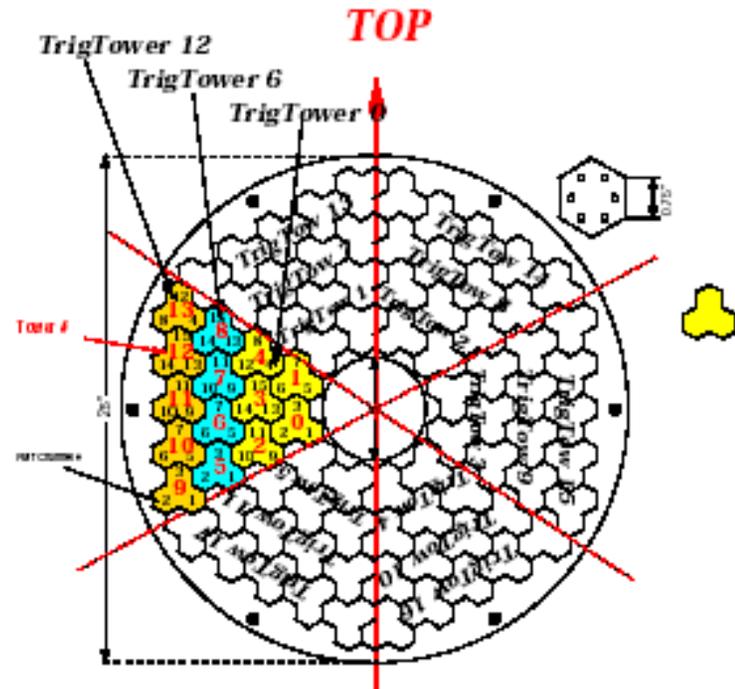


Figure 3. Tower geometry of the East Miniplug calorimeter (viewed from the interaction point).

Liquid scintillator with wls fiber R/O

A quick rough look: 9.5M 0-bias events (~ 3 seconds!)

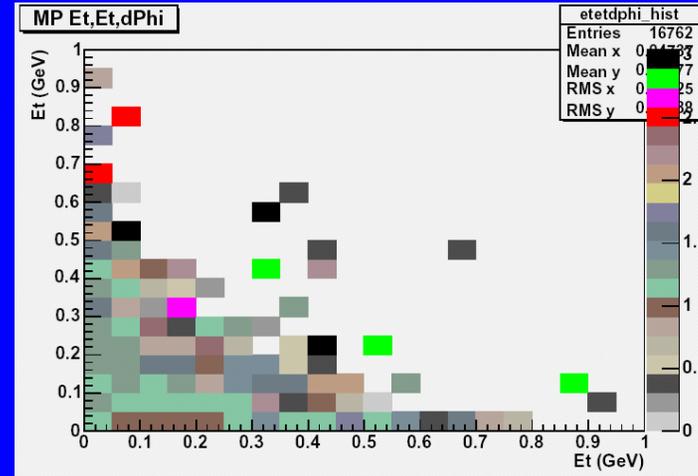
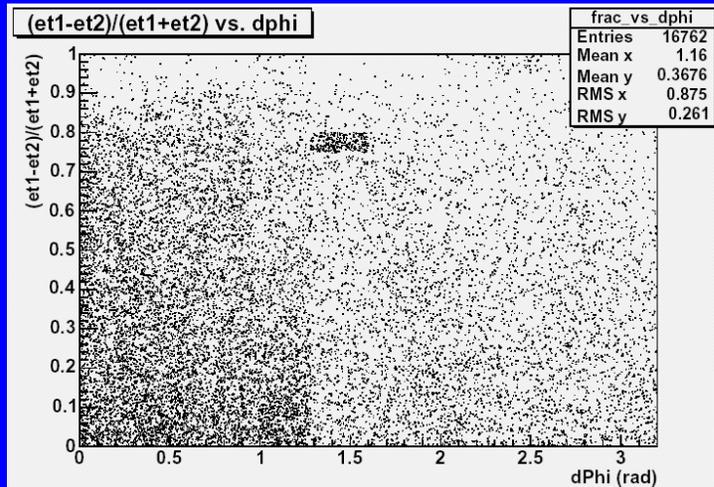
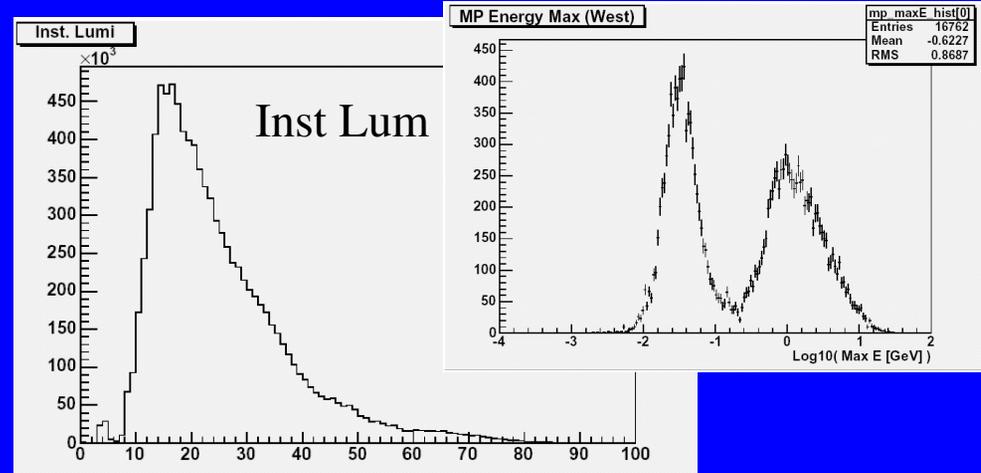
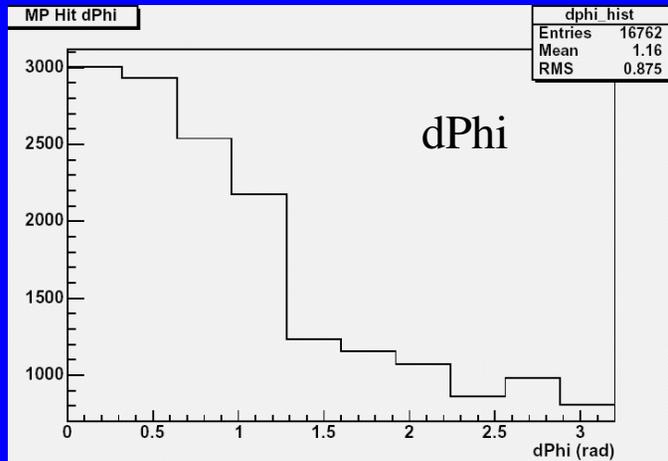
Andrew Hamilton

Luminosity profile → most crossings have an interaction.

Select clean: (0,2) or (2,0) hits in (E,W) Miniplugs → 16762 events

No good candidates apparent. Very preliminary - Today's plots!

MP E(max)



CLC
Not yet

Plan:

(1) Monte Carlo study to predict event rate and study acceptance

Brain Caron (Alberta) → Long Zhang (Alberta)

(1) Examine $\sim 10^7$ zero-bias events to look for candidates ($\sim 3s!$)

Andrew Hamilton (Alberta)

(1) If find some and looks clean and reasonable, make a special trigger: bunch crossing + just above noise in MP + ≥ 1 CLC
Test it at (very?) low luminosity. ($< 10^{31}$)

(4) Depending on above, ask for a dedicated few hours when luminosity is low (and pbars not ready?). Want $\sim 10^4$ events for 1% statistical uncertainty. Systematics? CLC acceptance.

(5) Need to do this before November (?) shut-down.

Comments

Maybe it's hopeless, but worth a look.

Tracking in that acceptance may be vital

Possibly can be applied at LHC (CMS + TOTEM) ?