Integrity of DØ Luminosity Measurement

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- Measurement principle
- Absolute value
- Halo dependence
- Time dependence
- Luminosity dependence

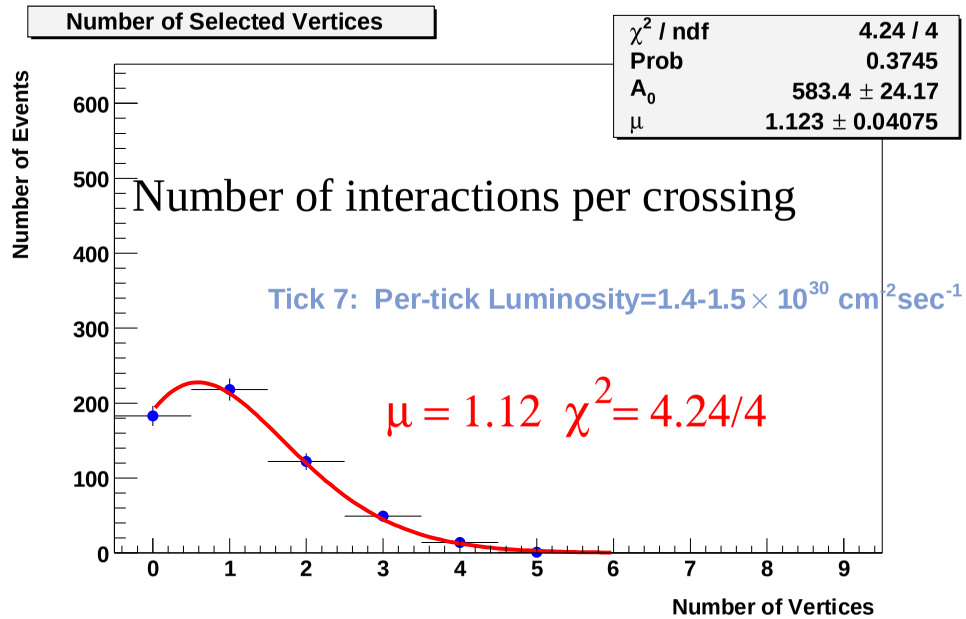
Measurement Principle

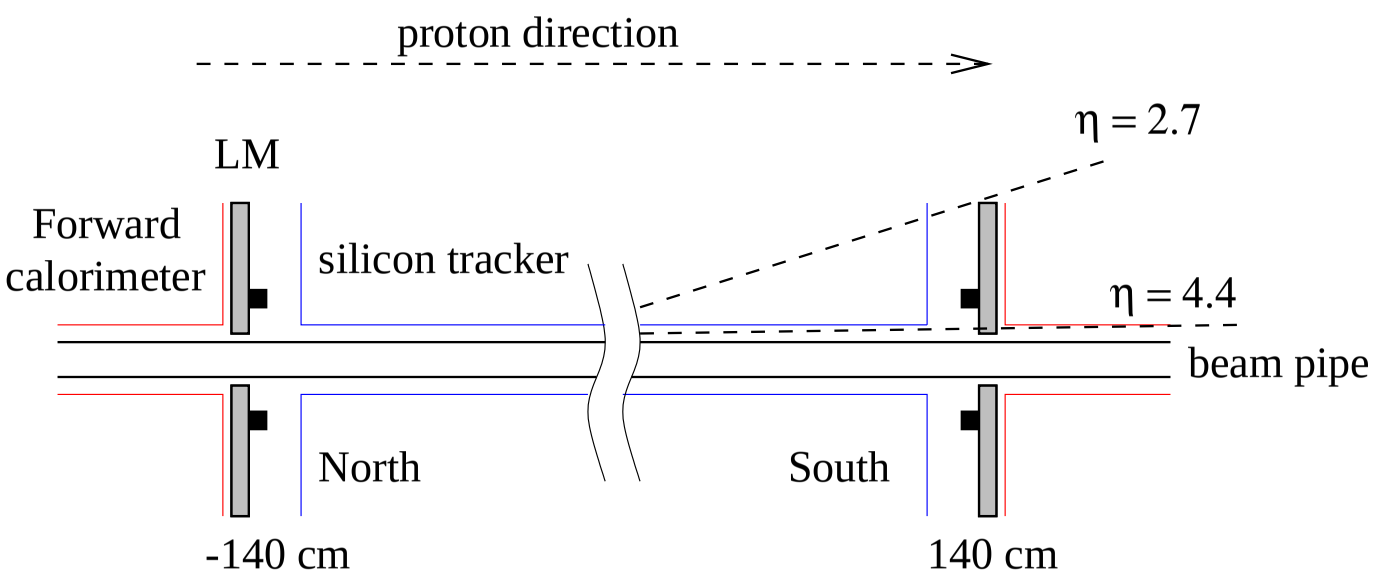
$$\mathcal{L} = \frac{1}{\sigma_{eff}} \frac{dN}{dt}$$

cannot count more than one N per crossing

assume Poisson distribution for N per crossing

$$\mathcal{L} = -\frac{1}{\sigma_{eff}} \log(1 - R)$$





Absolute Value

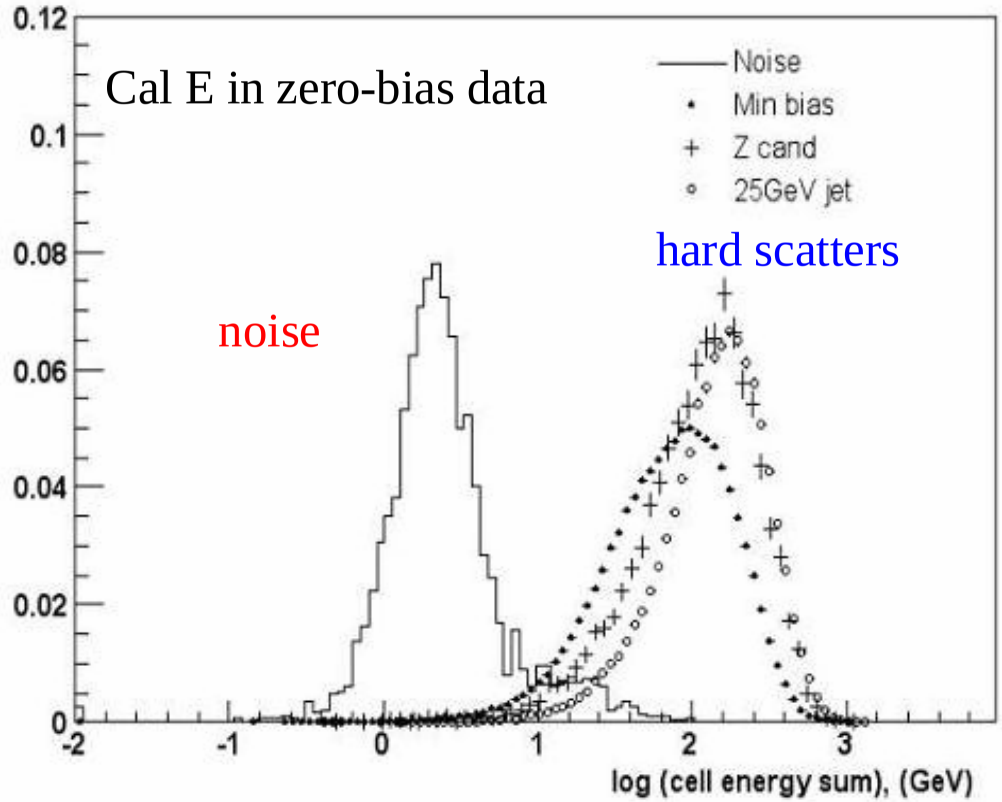
Absolute value is determined by σ_{eff}

$$\sigma_{eff} = \epsilon \times A \times \sigma$$

σ : measured by E811, CDF (same numbers used by DØ and CDF)

A : determined using MC (same MC used by DØ and CDF)

ϵ : determined using zero bias data and calorimeter information



Absolute value determined to $\pm 6.5\%$

largest contributions to error correlated with CDF

Halo Dependence

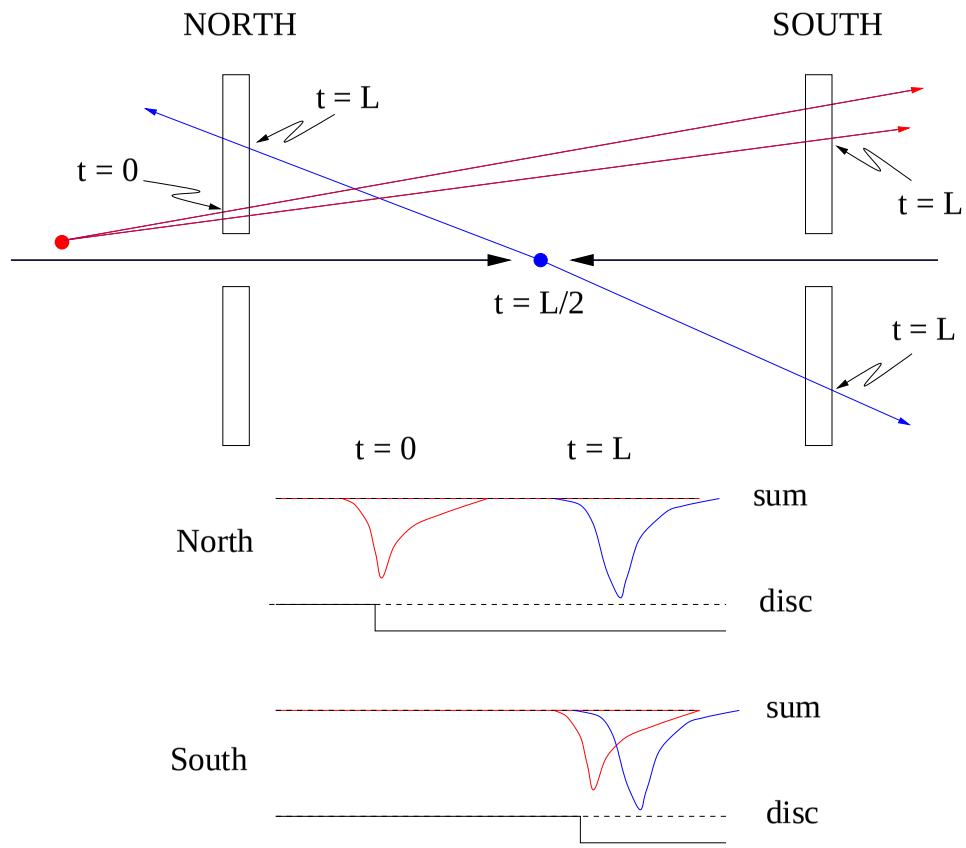
Overlapping inelastic collisions and beam halo are recorded as beam halo events

probability of an inelastic collision independent of upstream beam interactions.

N(inelastic)/N(total) = N(inelastic + halo)/N(halo)

1×10^{31} : $\sim$ no correction

5^{31} : $\sim 5 - 6\%$ correction



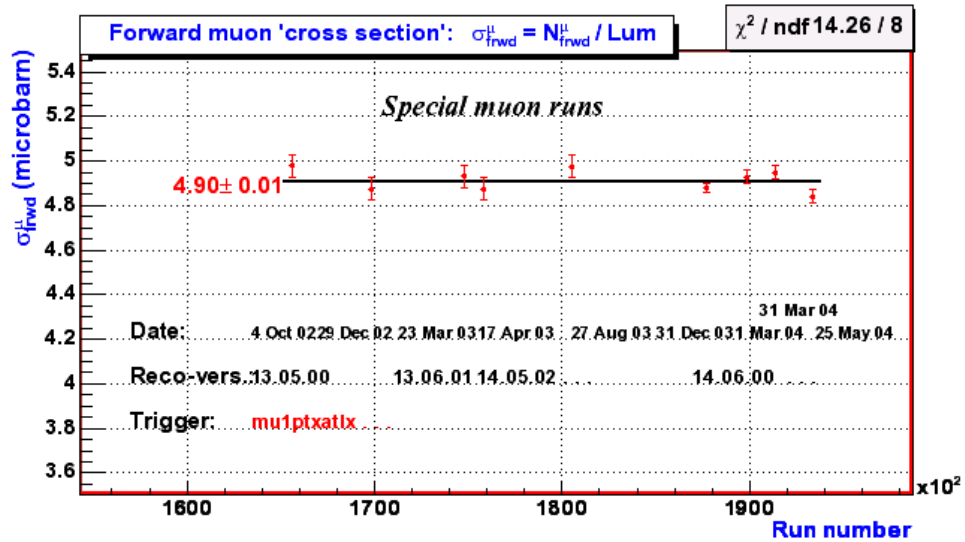
correction verified by counting primary vertices in halo data sample.

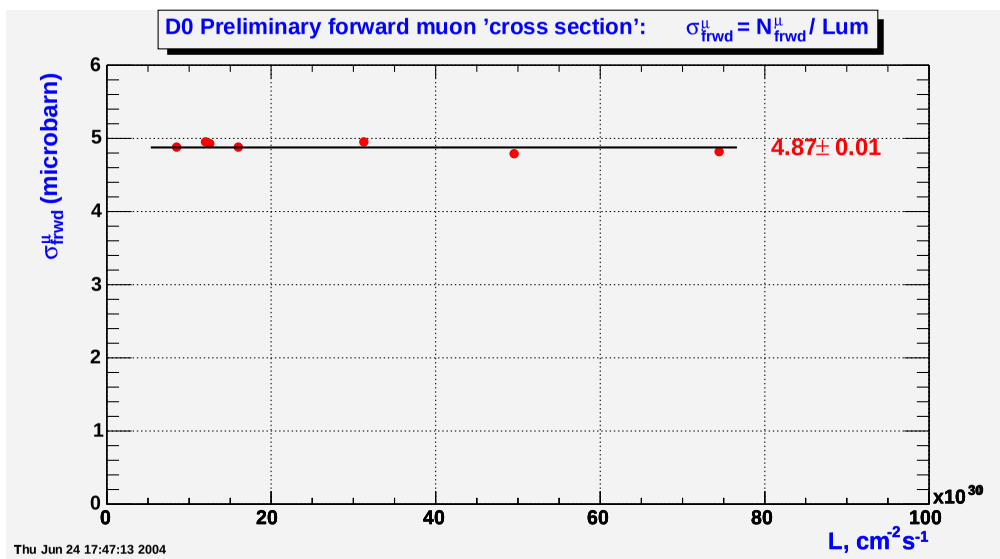
Time Dependence

verify stability with time using trigger cross-sections

μ, 125 GeV jets, di-EM

no indication of time dependence over entire Run II lifetime



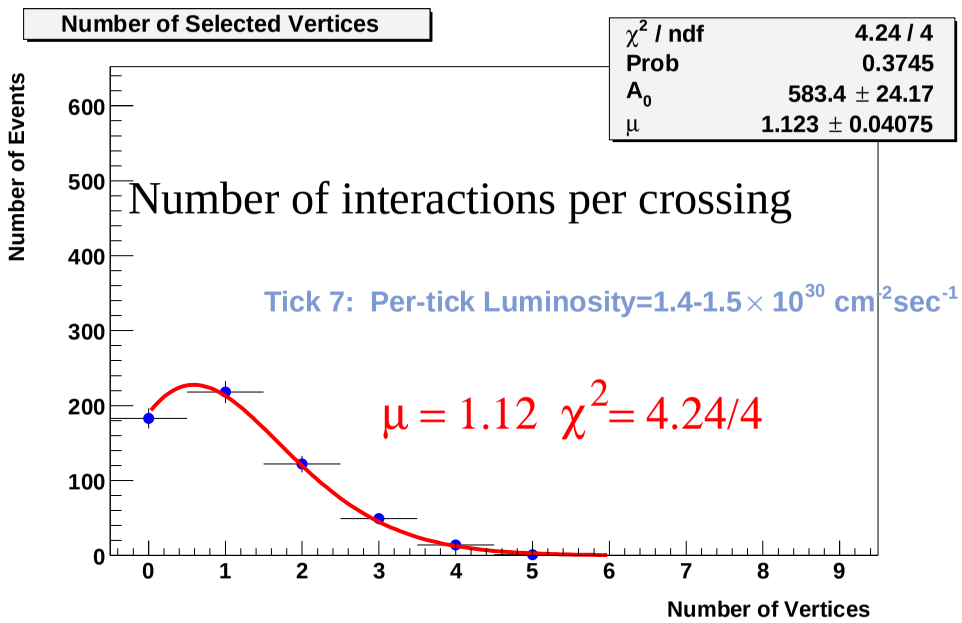


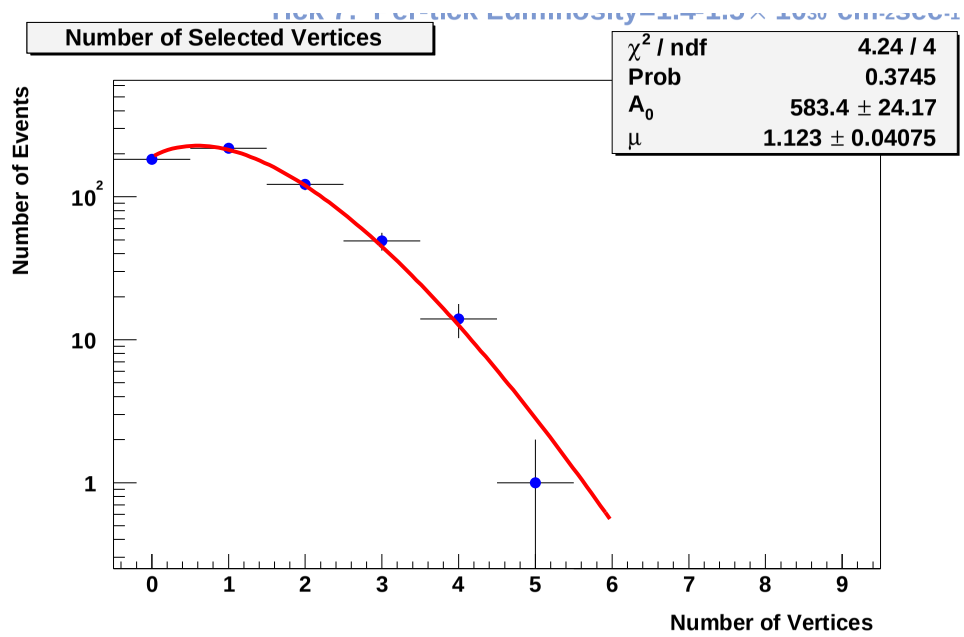
Luminosity Dependence

Two ways to perform overall check of luminosity dependence:

Trigger cross-sections

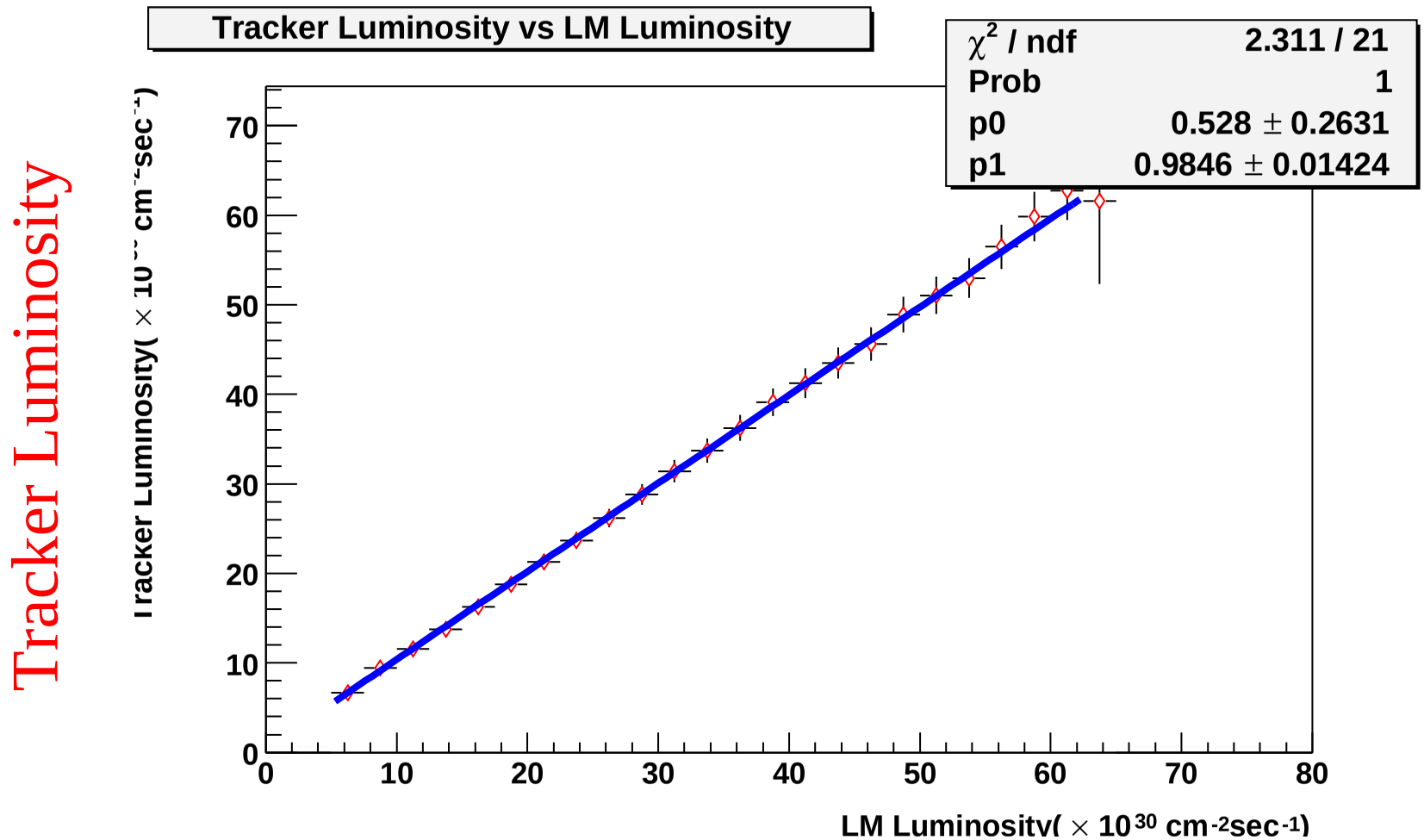
Measure luminosity independent of the luminosity detector by counting primary vertices using the silicon and fiber trackers.





$$\mathcal{L} = \frac{1}{\sigma'_{eff} f} \times \mu$$

Luminosity Dependence



Default Luminosity

No indication of saturation or nonlinearity up to $\sim 7 \times 10^{31}$

Conclusions

- We are determining the absolute luminosity delivered to DØ with ±6.5% accuracy.
  - good agreement between CDF/DØ/Theory $W \to e\nu$, $Z \to e^+e^-$ cross-sections.
- We have demonstrated the stability of the luminosity measurement as a function of
  - Halo, luminosity, time.
- These studies will continue throughout Run II.