Mike Kirk
B-Workshop
Working Group 2
02/25/00

CDF: Semileptonic Trigger

Introduction

Run I Yields

Run II Trigger

Projected Run II Yields

Physics Prospects

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Introduction

- Investigate possible Run II Trigger scenarios.
  - Lepton Only (Run I).
  - Lepton + displaced track.
  - Two track trigger.
- Predictions for Run II yield and rate.
  - Use existing Run I data to study background.
  - Estimate number of events for:
    - » $B_s \to D_s \pi$.
    - » $\Lambda_b \to \Lambda_c l \nu$.
- Study Q^2 spectrum for $\Lambda_b \to \Lambda_c l \nu$

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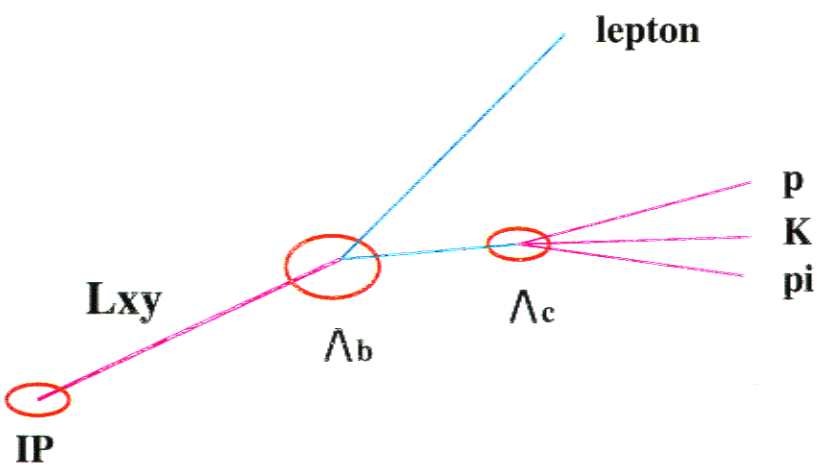
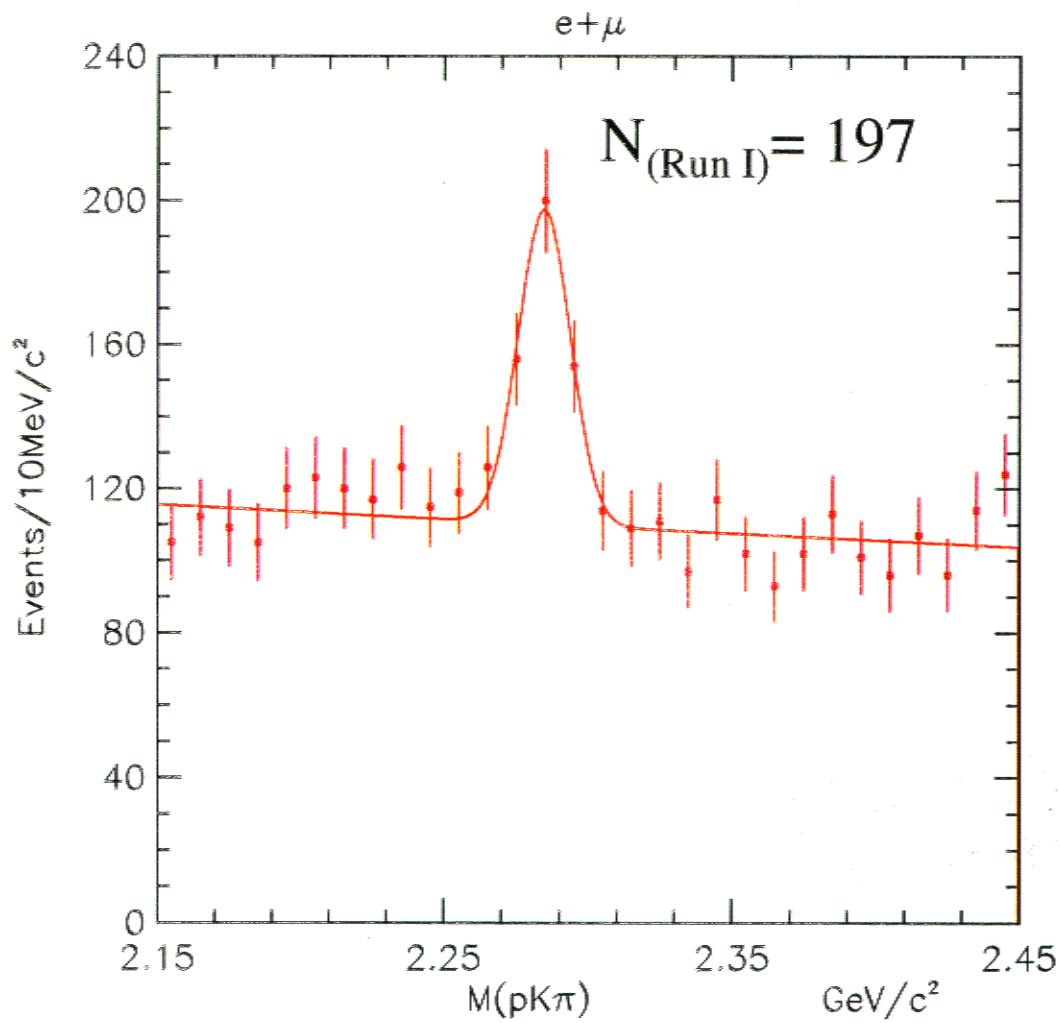
Run I Yield: $\Lambda_b \to \Lambda_c\, l\, \nu$

- Single Lepton trigger
- $P_T > 8$ GeV/c
- Measured lifetime and production fractions





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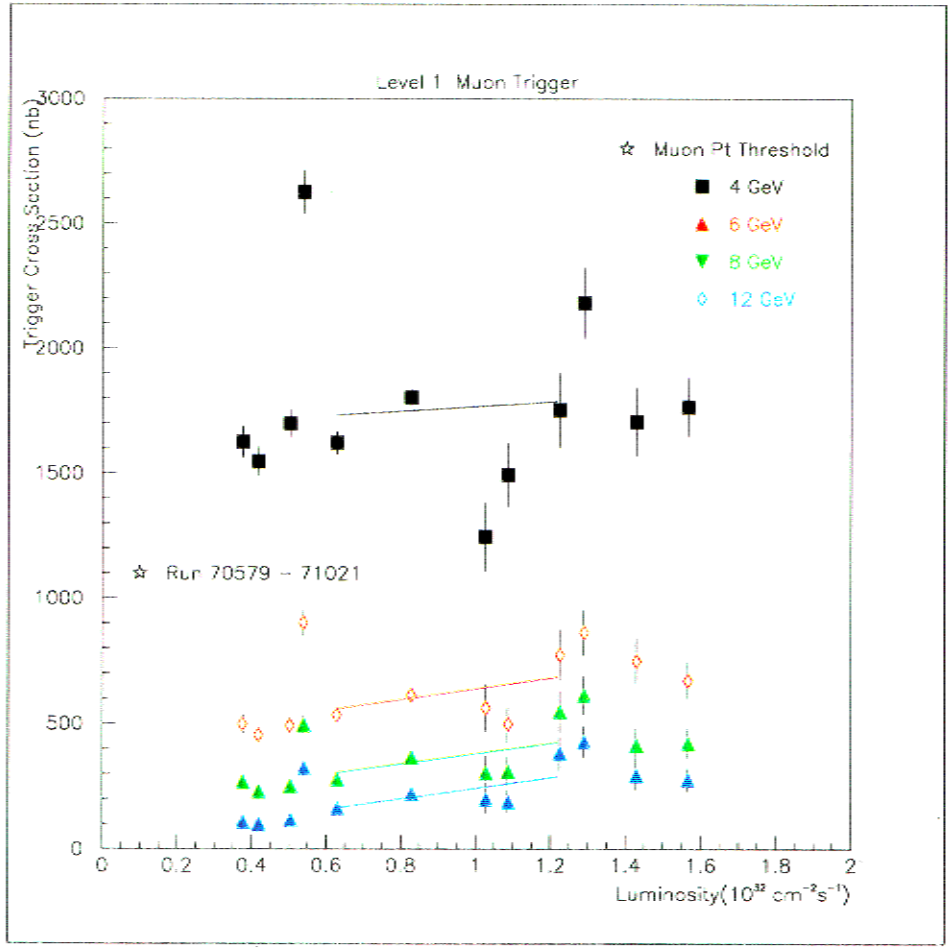
Level 1 Trigger

- Run II Trigger Framework:
  - Level 1: Tracking via eXtremely Fast Tracker.
- L1: $P_T^{\mu} > 4$ GeV/c and $|\eta| < 0.6$
- 1500 nb @ 10^{32} cm^{-2} s^{-1}.
  - Rate = 150 Hz.
  - Independent of Instantaneous Luminosity
- Level 1 Budget = 40 kHz



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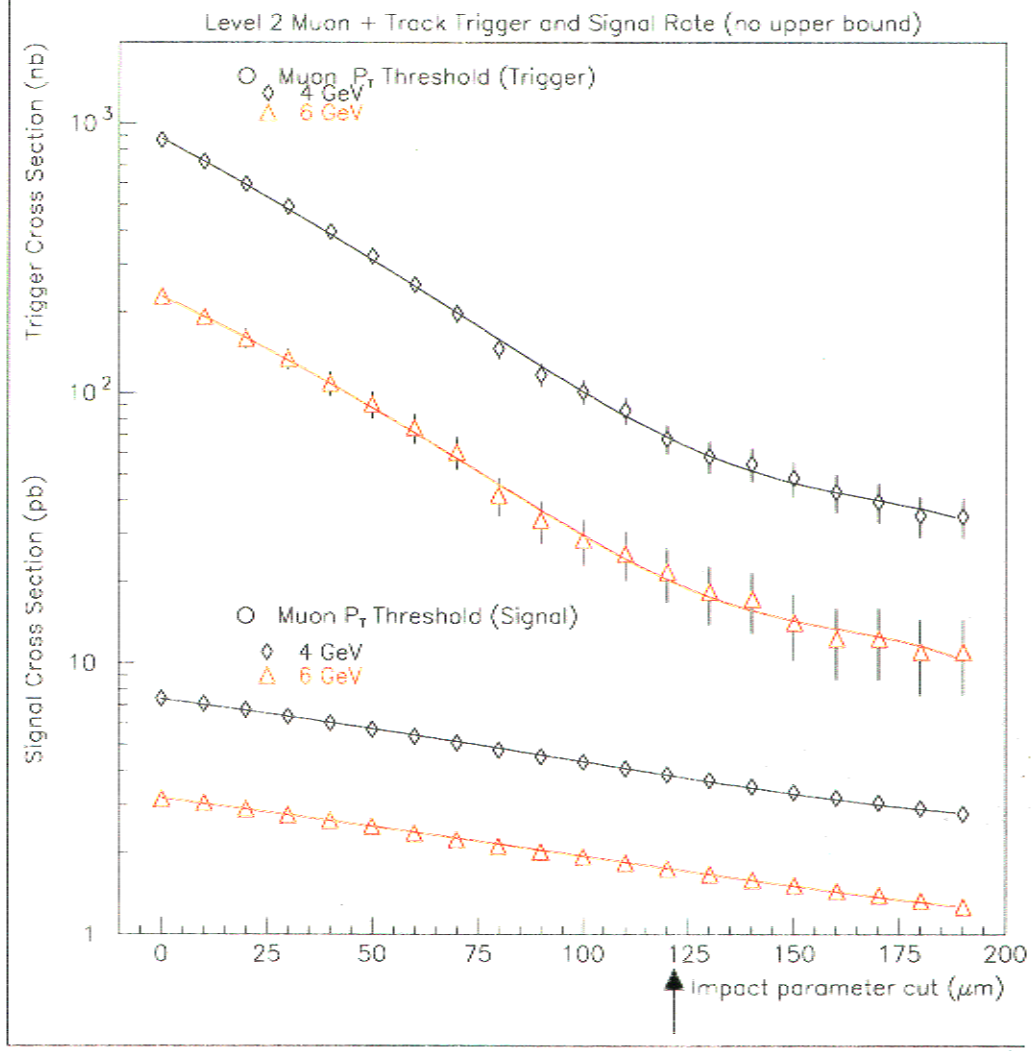
Level 2: Impact Parameter Study

- Level 2 Trigger:
  - Displaced track trigger via Silicon Vertex Tracker.
- Study highest impact parameter cut.
- $|d_0| > 120\ \mu m$.
- $P_T^{Track} > 2$ GeV/c, $|\eta| < 1$.
  - Same as 2 track trigger.



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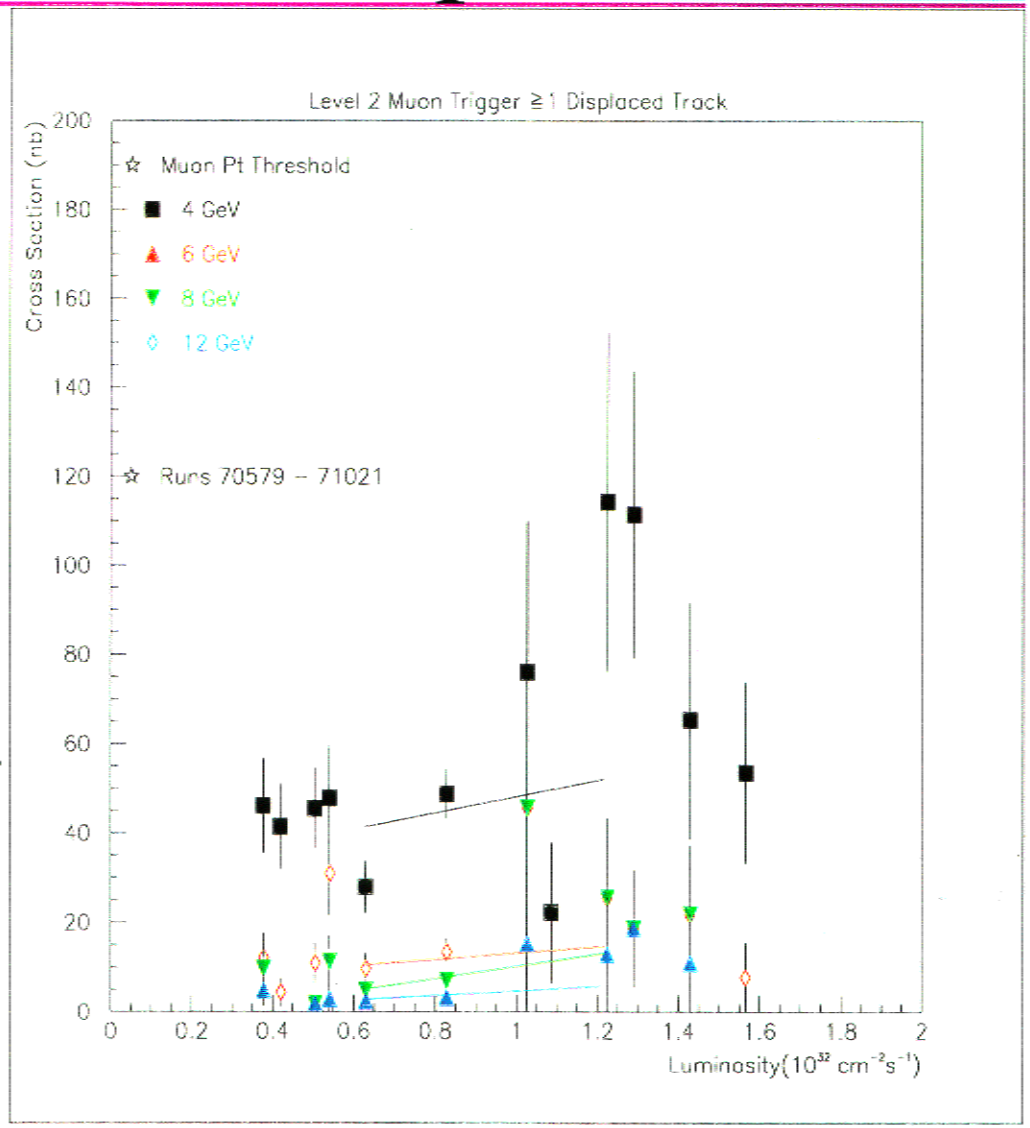
Level 2: Lepton + displaced track

- Level 2 trigger rate:
  - $P_T^{\mu} > 4$ GeV/c, $|\eta| < 0.6$
  - 50 nb @ 10^{32} cm^{-2} s^{-1}
  - $\rightarrow$ 5 Hz.
- Same study for electrons.
  - Also 5 Hz.
- Level 2 budget is 300 Hz.



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Run II Yields

- Scale for Acceptance.
- Use Run I events.

$$\frac{N(RunII)}{N(RunI)} = \frac{A(RunII)}{A(RunI)} \cdot \frac{\mathcal{L}(\mathrm{RunII})}{\mathcal{L}(\mathrm{RunI})} \cdot \epsilon_{(SVT)} \cdot A_{(SVXII)}$$

Trigger	A RunII/A RunI	ϵ_{SVT}	N(B_s)/ 2 fb^{-1}	N(Λ_b)/ 2 fb^{-1}
8 GeV/c L	1.0	1.0	14000	7900
2 Gev/c L + SVT	5.9	.75	64000	34900
3 GeV/c L + SVT	4.0	.75	43000	23600
4 GeV/c L + SVT	2.7	.75	30000	16000
5 GeV/c L + SVT	1.9	.75	21000	11200
2 SVT (A)	3.8	$.75^2$	31000	16900
2 SVT (B)	3.0	$.75^2$	25000	13300
2 SVT (C)	2.4	$.75^2$	20000	10600

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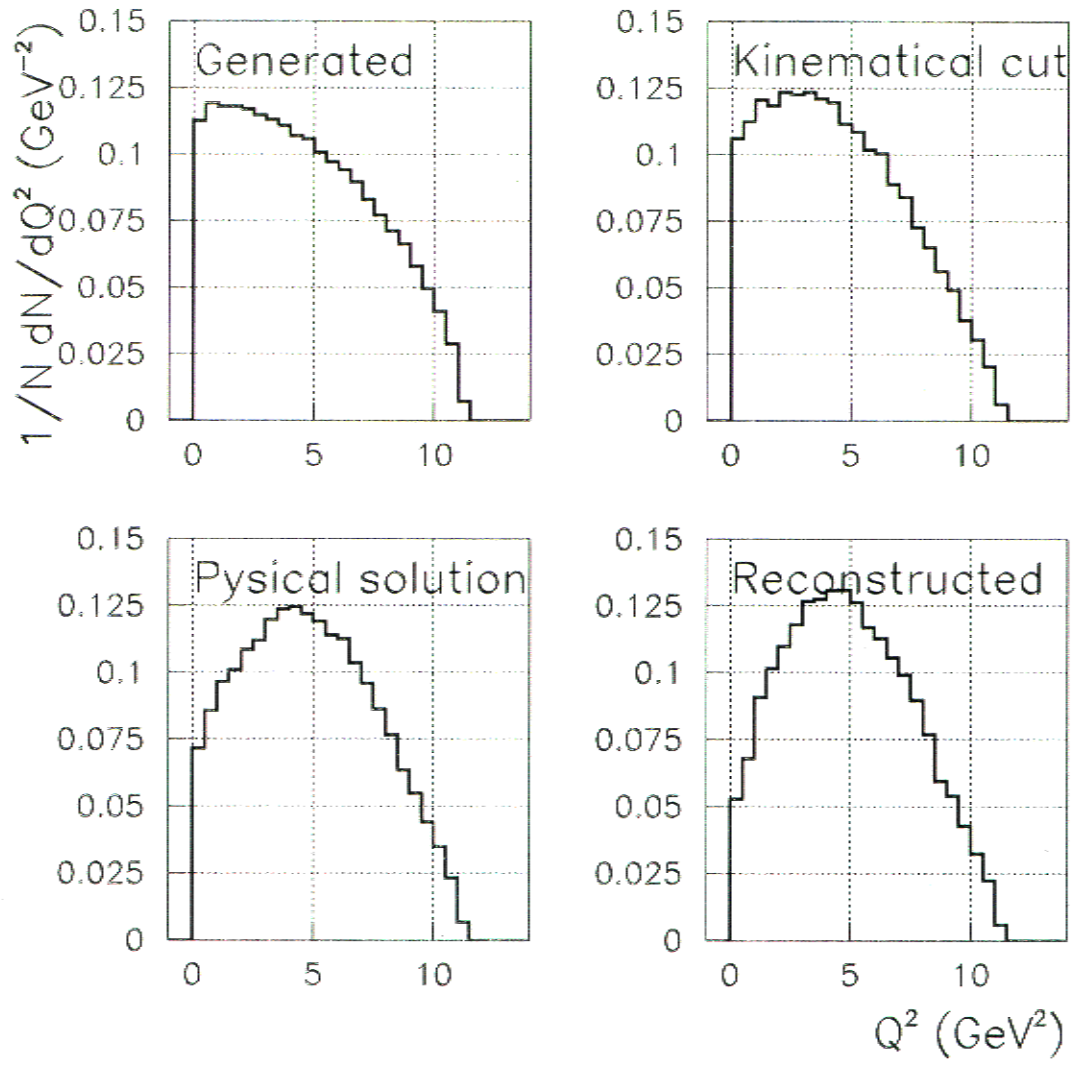
Toy MC: Q^2 Distribution

- Physics Goal:
  - Study HQET prediction.
- Generate $\Lambda_b \to \Lambda_c\, l\, \nu$.
- Know: $\hat{P}_{\Lambda_B}$, $\vec{P}_{\Lambda_c}$, $\vec{P}_l$
- Use 3-D vertexing and kinematic constraints to reconstruct $\vec{P}_\nu$.



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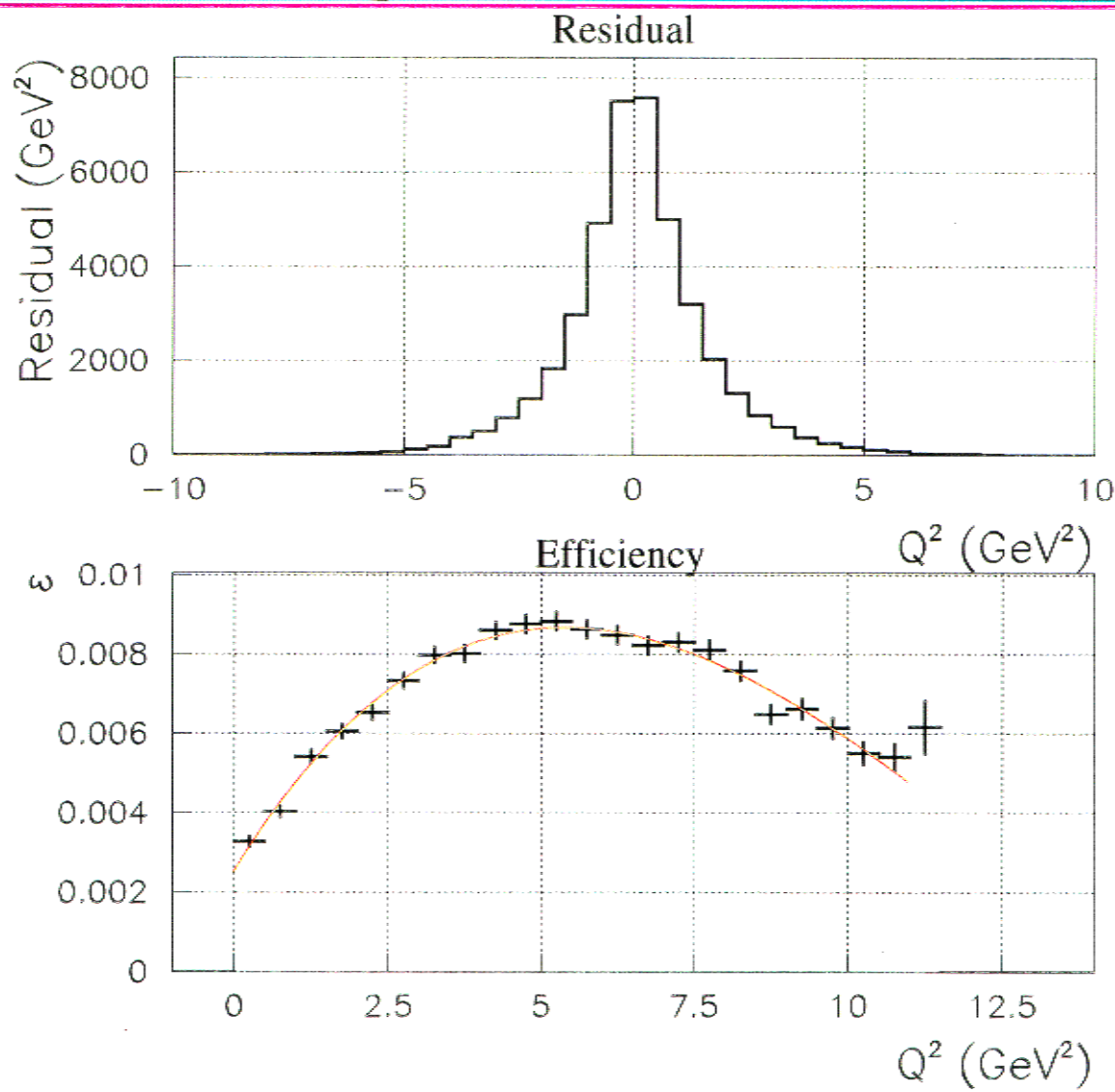
Q^2 Resolution



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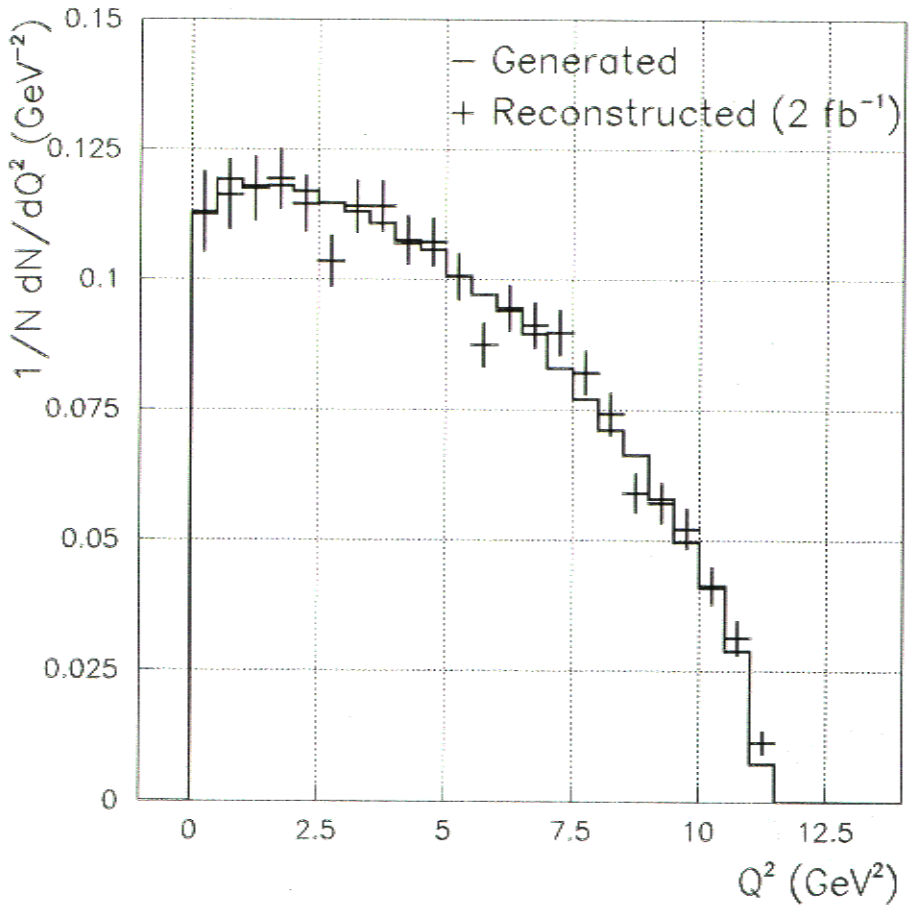
MC Experiment

- Check reconstruction of Q^2.
- 2 independent samples:
  - Generator level Q2 distribution.
  - Reconstructed Q2 distribution normalized to expected Run II yield.



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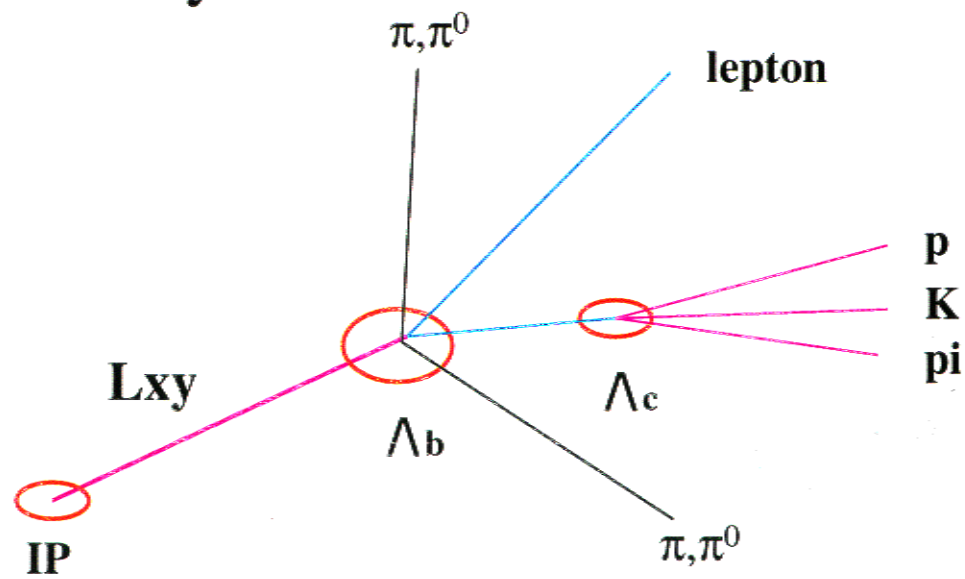
Conclusions

- Lepton + displaced track trigger decreases trigger rate by factor of 2 and increase physics rate by factor of 2 relative to Lepton only trigger.
- Need to study higher order decay contamination:
  - $\Lambda_b \rightarrow \Lambda_c^{**} l \nu$,
    - $\Lambda_c^{**} \rightarrow \Lambda_c \pi\pi$, $\Lambda_c \rightarrow pK\pi$
  - $\Lambda_b \rightarrow (\Sigma_c \pi)_{I=0} l \nu$,
    - $\Sigma_c \rightarrow \Lambda_c \pi$, $\Lambda_c \rightarrow pK\pi$