E161 2 μ OPTION

- **REMINDER OF EXPERIMENT**
- **1 MUON PROBLEMS**
- **2 MUON RATES, RANDOMS ETC.**

HOW TO MEASURE $\Delta g(x, Q^2)$ DIRECTLY

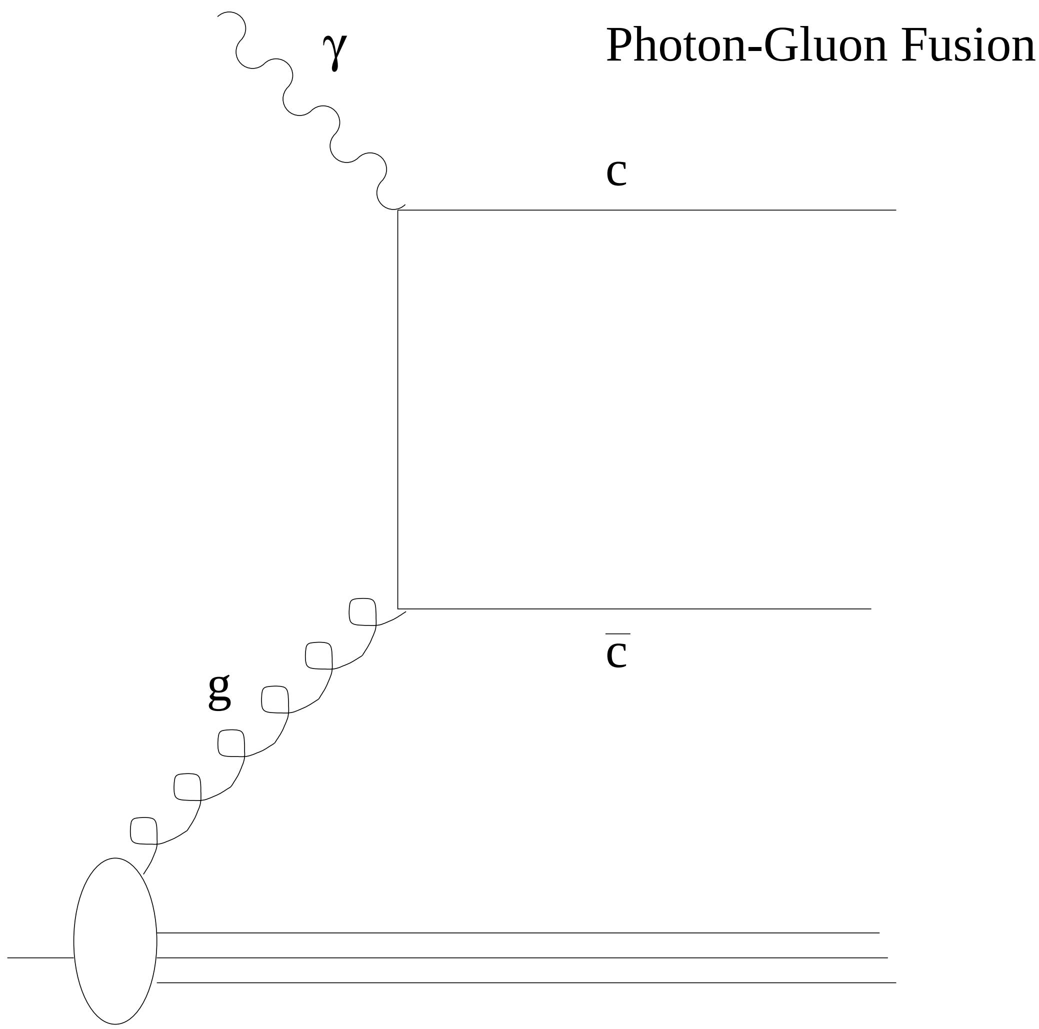
POLARIZED PHOTON BEAM

POLARIZED LiD TARGET

PHOTON-GLUON FUSION ($\sim 10^{-3}\sigma_{tot}$)

$\mathbf{c} \rightarrow \mathbf{D} \rightarrow \mu$ (prompt)

$\mathbf{c} \rightarrow \mathbf{D} \rightarrow \mathbf{K} \rightarrow \mu$ (delayed)



PROPOSAL BEAM PARAMETERS

Electron Energy (GeV) ♡	45.1	48.3	51.5 **
Electron Current (10^{10}/spill)	2.0	2.0	2.0
Peak Photon Energy (GeV)	35.0	40.0	45.0
Photons (10^7/spill)	2	1.5	1.1
Circular Polarization	0.75	0.80	0.84
x_{min}	.10	.12	.14
μ/day($p_t > .5; P > 5$)	160,000	140,000	120,000
μ/spill($p_t > .5; P > 5$)	0.019	0.016	0.014
days (at 120 Hz, 100% efficiency)	9	10	11

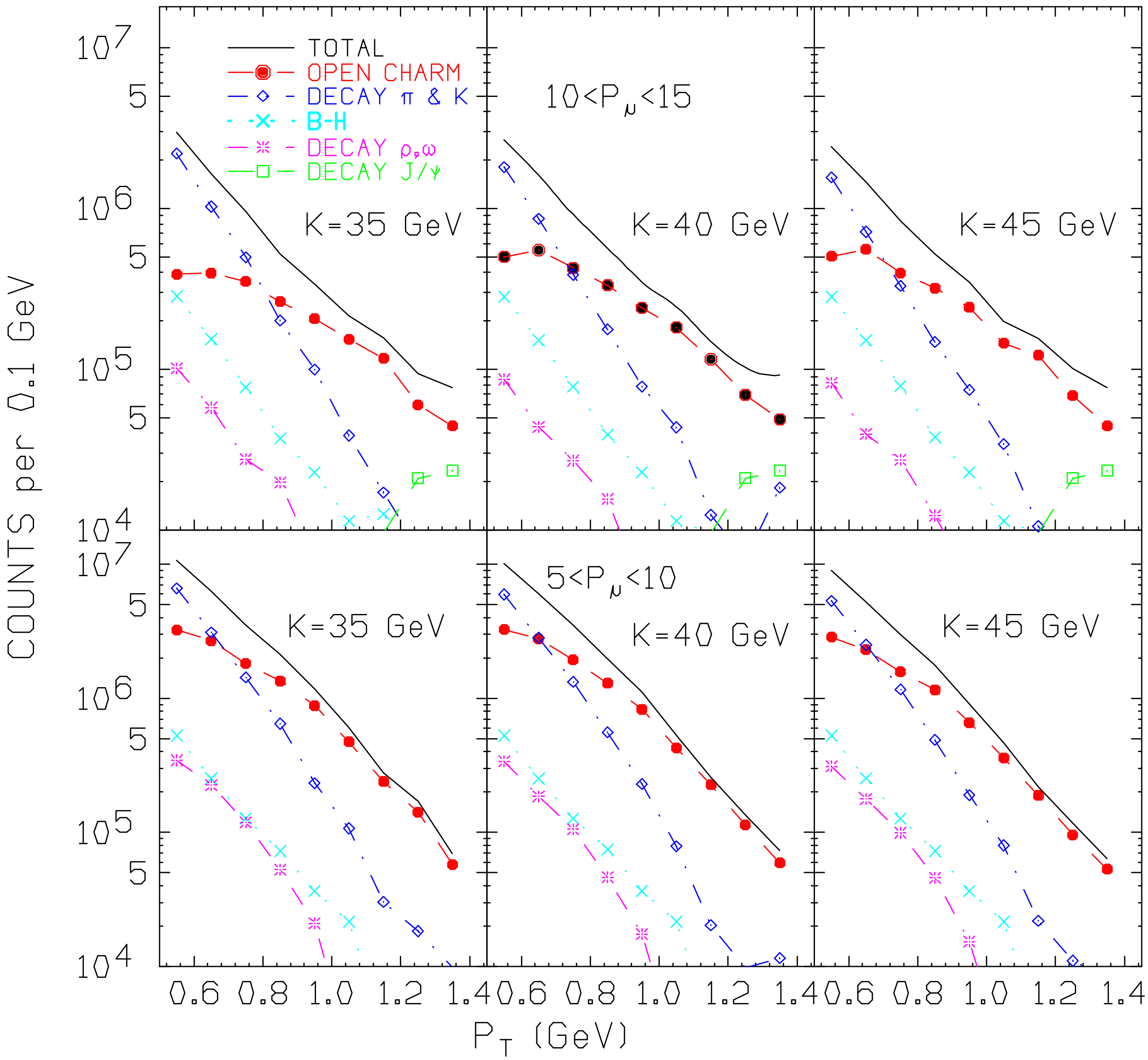
**** Use 48.3 GeV, Different Diamond Orientation**

♡ **E158 had** 3.5×10^{11} e^- **at 48 GeV, 250 ns spill**

NUMBER OF EXPECTED SINGLE μ

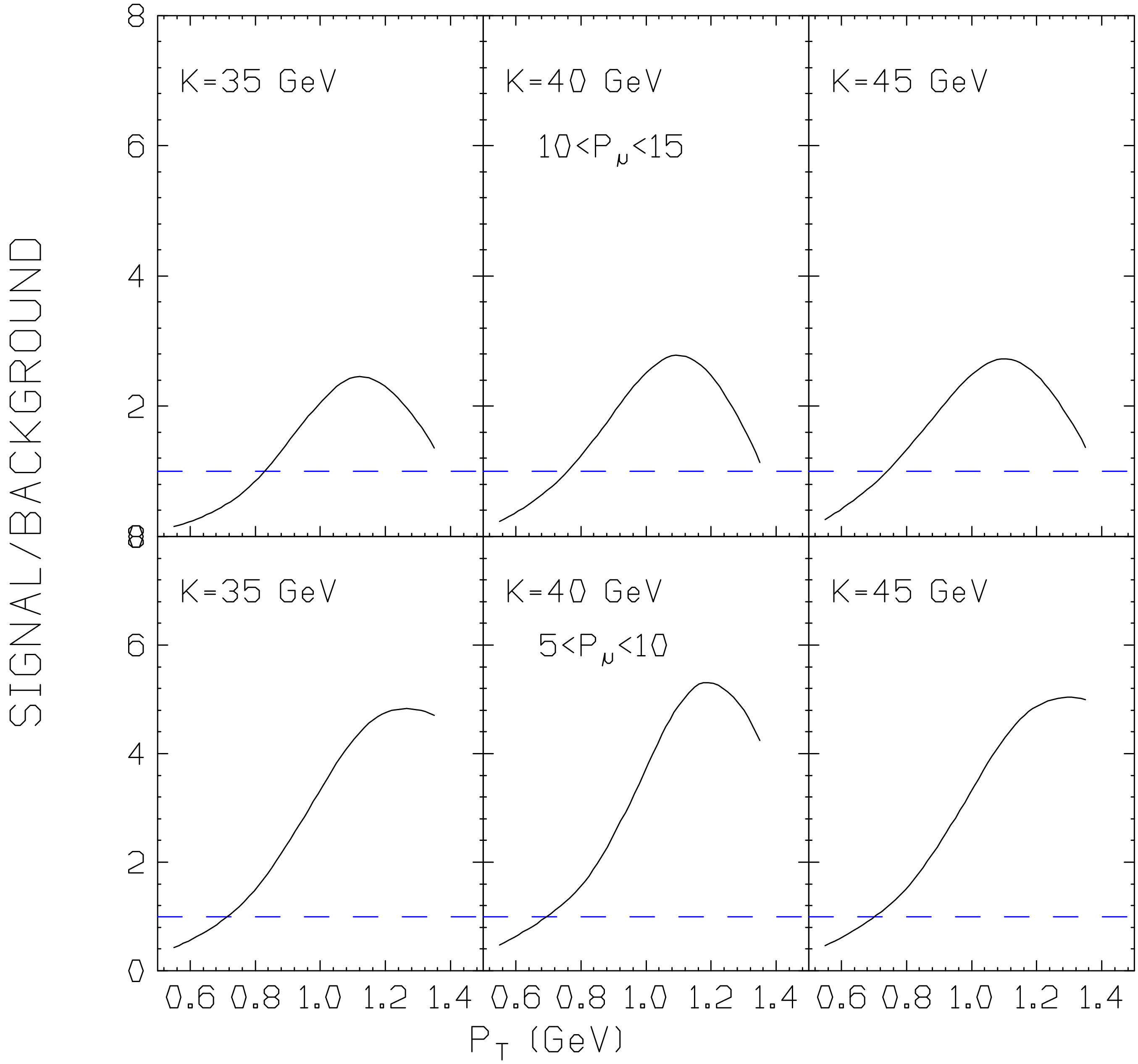
SIGNAL and BACKGROUNDS

BEFORE BACKGROUND SUBTRACTION



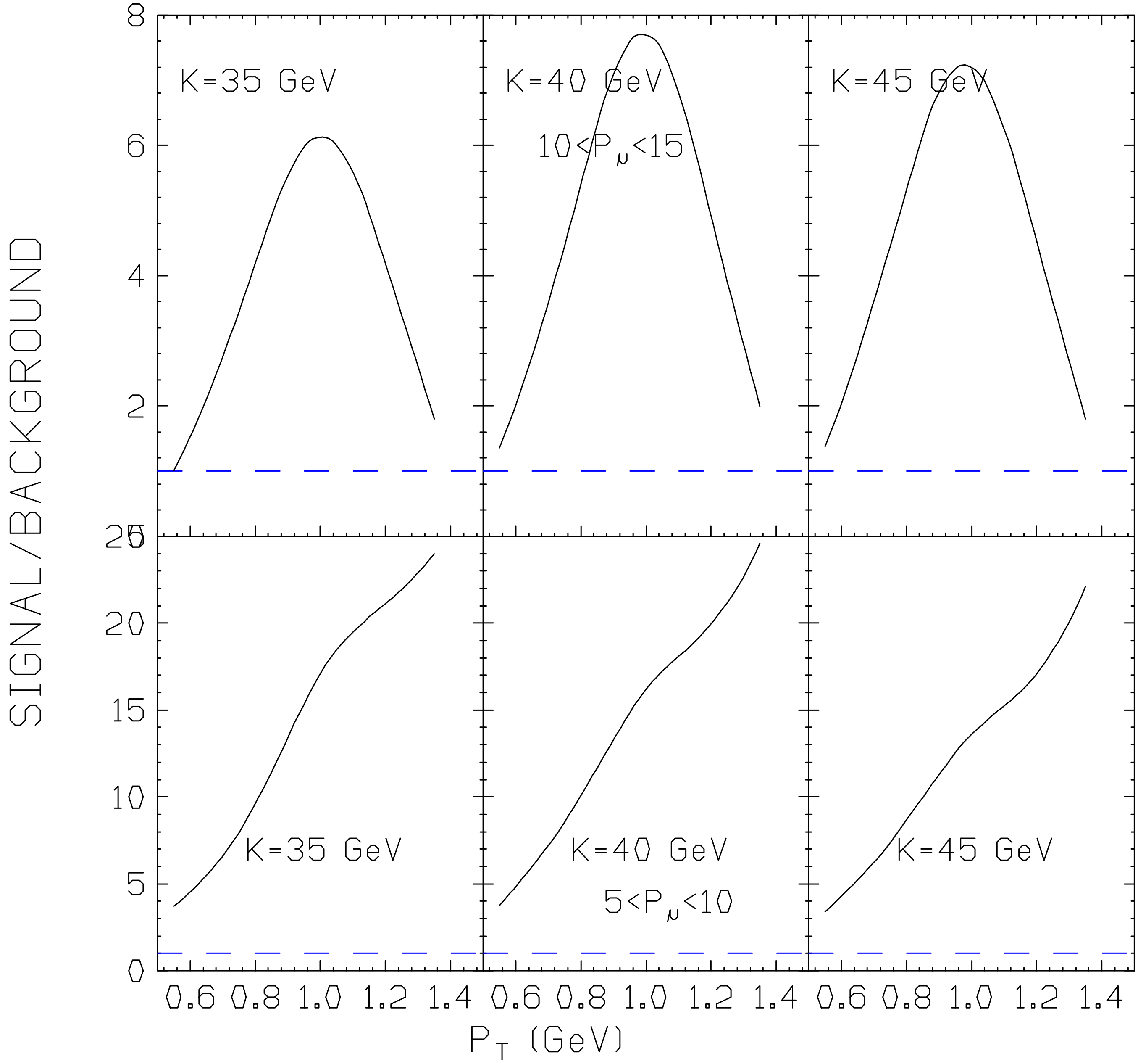
SIGNAL/BACKGROUNDS

BEFORE DECAY SUBTRACTION



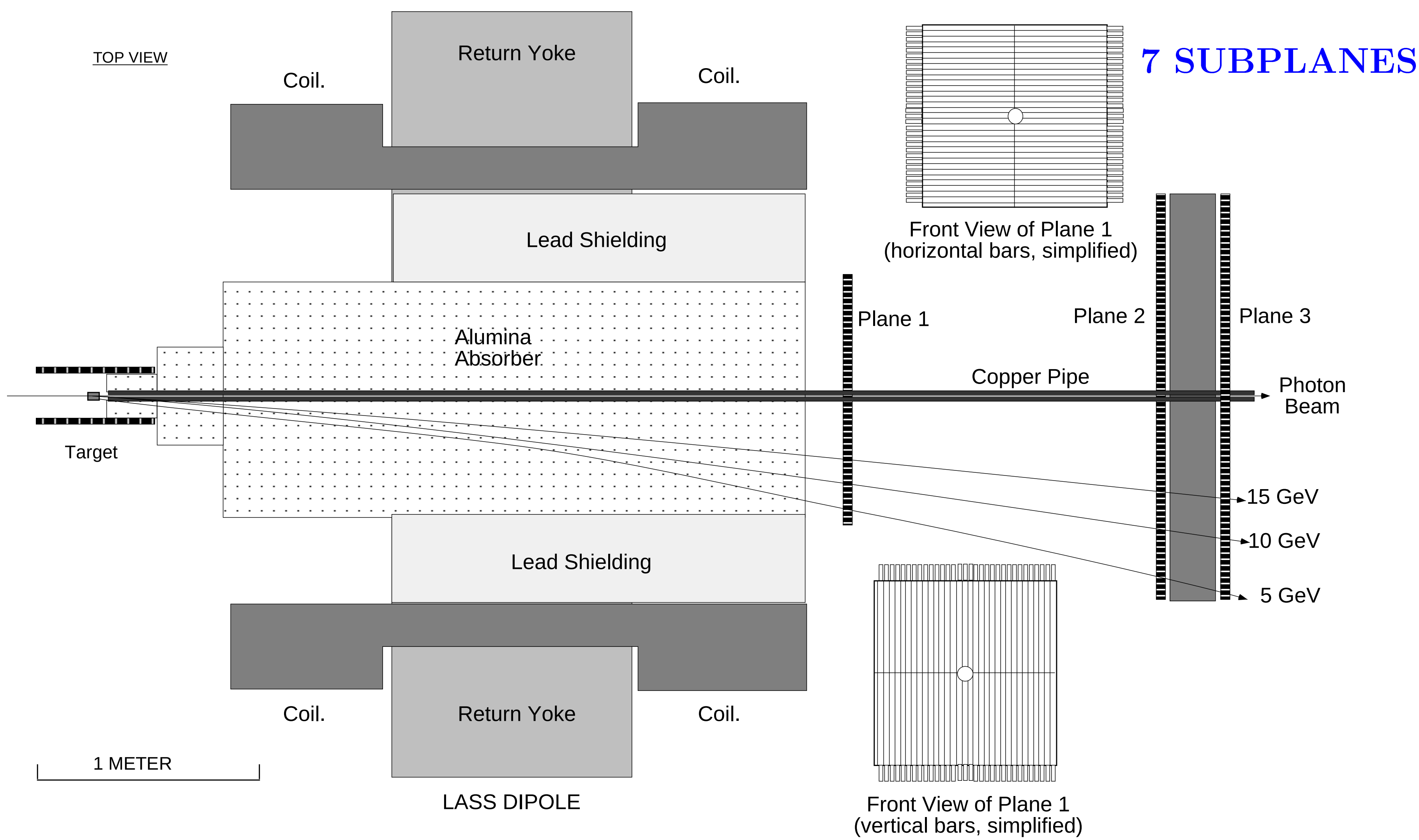
SIGNAL/BACKGROUNDS

DECAY SUBTRACTED

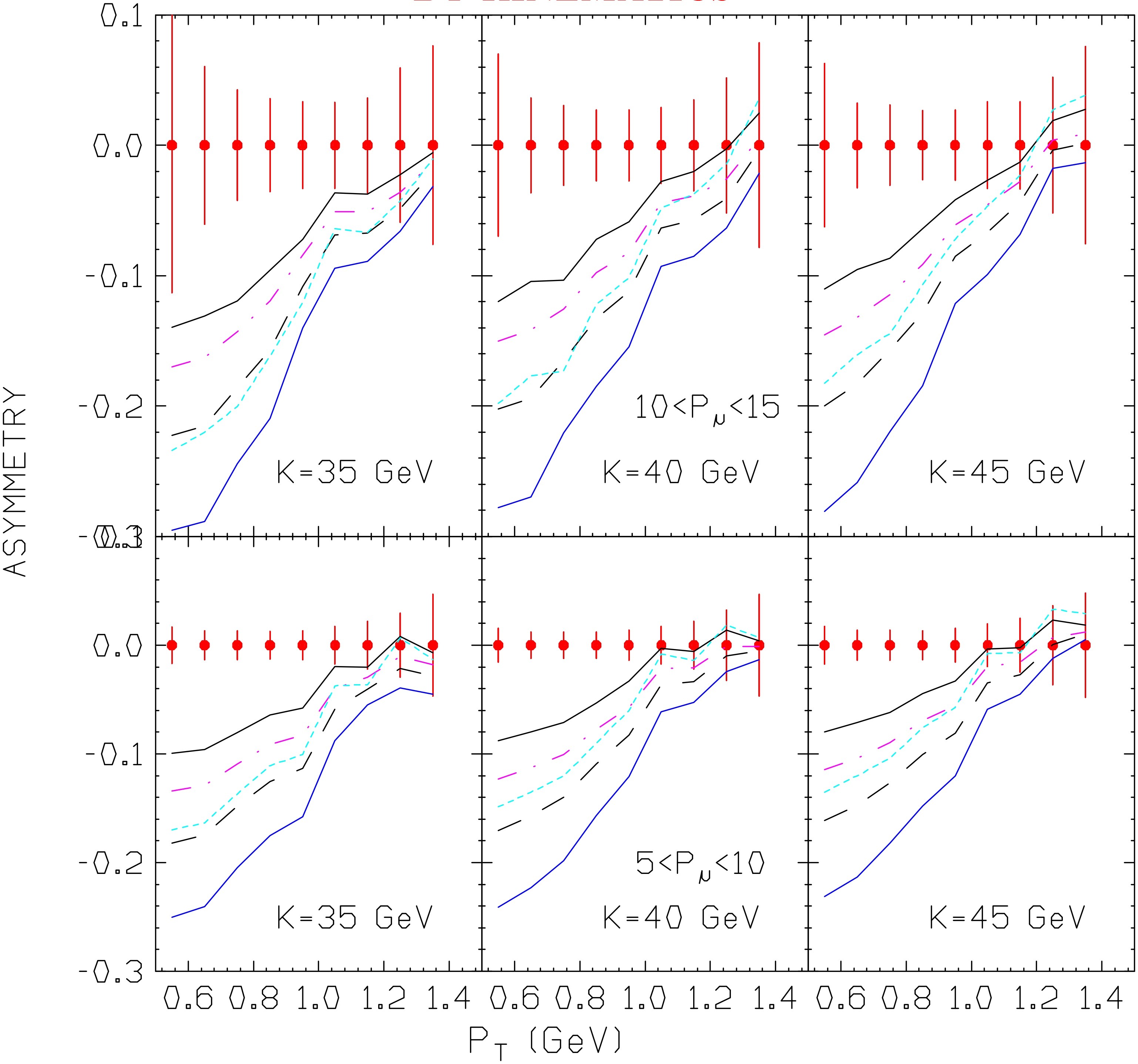


μ SPECTROMETER

NORMAL MODE



EXPECTED RESULTS BY KINEMATICS



E161

DIFFERENT WAYS

- **OPEN CHARM**
  - **DETECT SINGLE MUON**
  - **ORIGINAL PROPOSAL**
  - **VERY LOOSE CONSTRAINTS ON $c\bar{c}$ KINEMATICS**
  - **BACKGROUNDS: B-H, μ FROM π and K DECAY**
  - **MORE DIFFICULT THAN ANTICIPATED**
- **OPEN CHARM**
  - **DETECT 2 μ FROM CHARM DECAY**
  - **SMALLER RATES?**
  - **SMALLER BACKGROUNDS?**
  - **SOMEWHAT BETTER KINETMATICAL CONSTRAINTS ON $c\bar{c}$**
  - **NO SEPARATE LOW ABSORBER RUN**

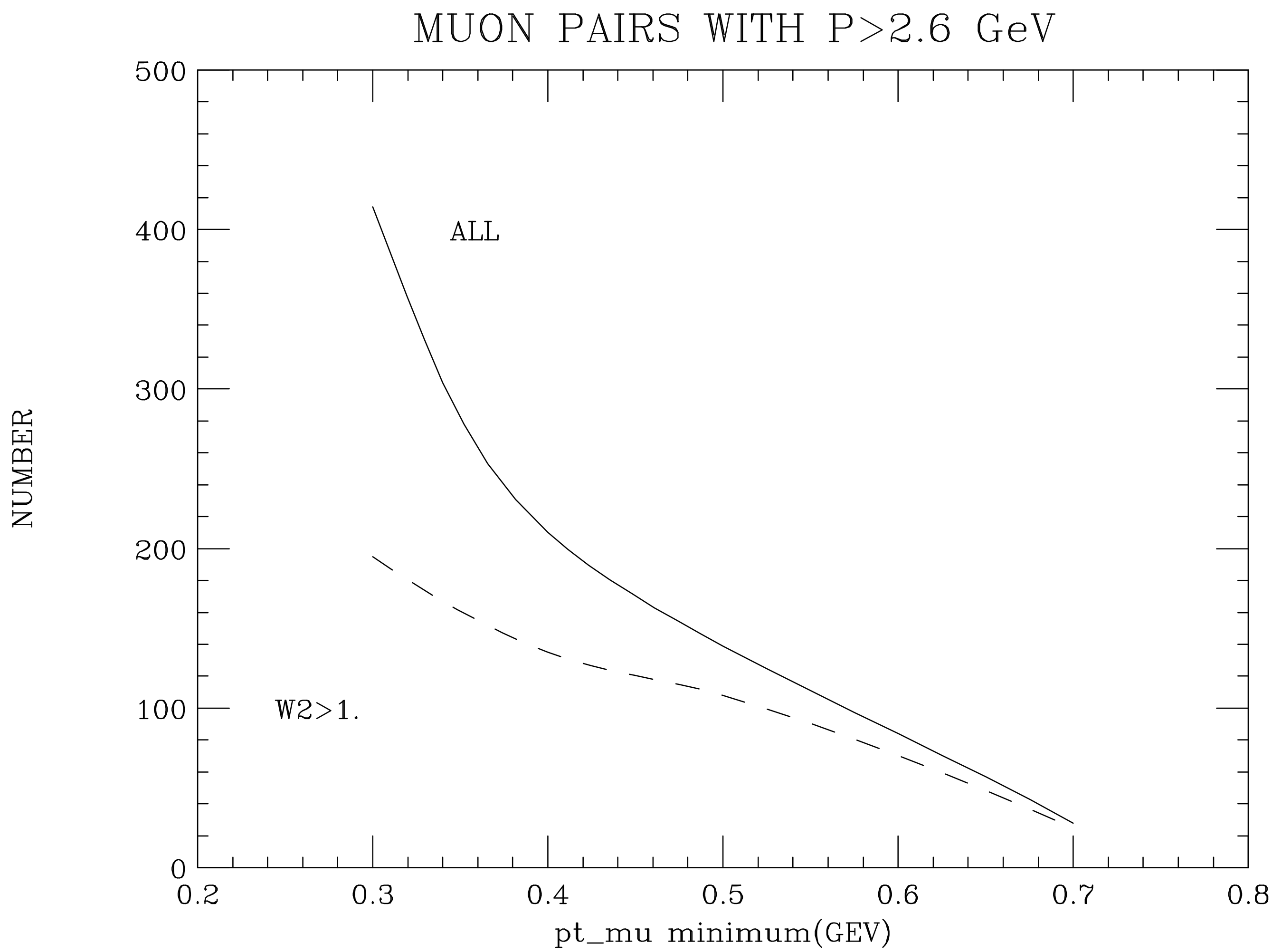
E161 2 μ

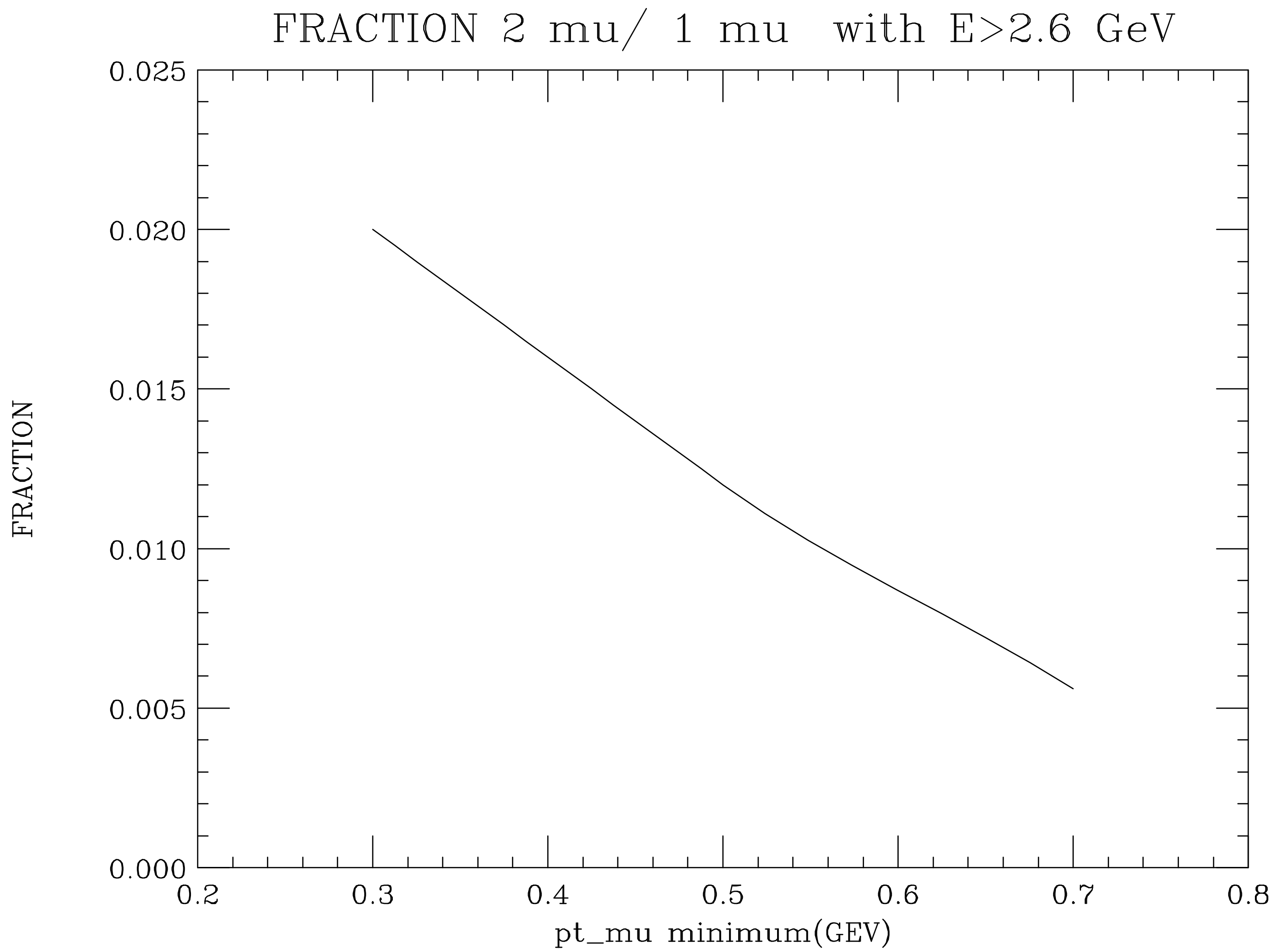
- LOWER RATES
  - BRANCHING RATIO
  - CUTS ON MINIMUM P_T and P
- COMPENSATE WITH
  - HIGHER BEAM CURRENT
  - THICKER DIAMOND
  - LOWER P_T and P CUTS
- LOOSE 2 GeV/c in ABSORBER
  - MINIMUM P $\sim$ 2.6 GeV
  - $P_T > .4$? (backgrounds)
- PAIR BACKGROUNDS
  - Bethe-Heitler ($(E_1+E_2) \sim E_{beam}$)
  - VECTOR MESON DECAY ($W^2 < 1$)
- RANDOM COINCIDENCES FROM SINGLES
  - TIGHT COINCIDENCE TIMING
  - EASY SUBTRACTION UNDER PEAK
  - KINEMATIC SELECTION

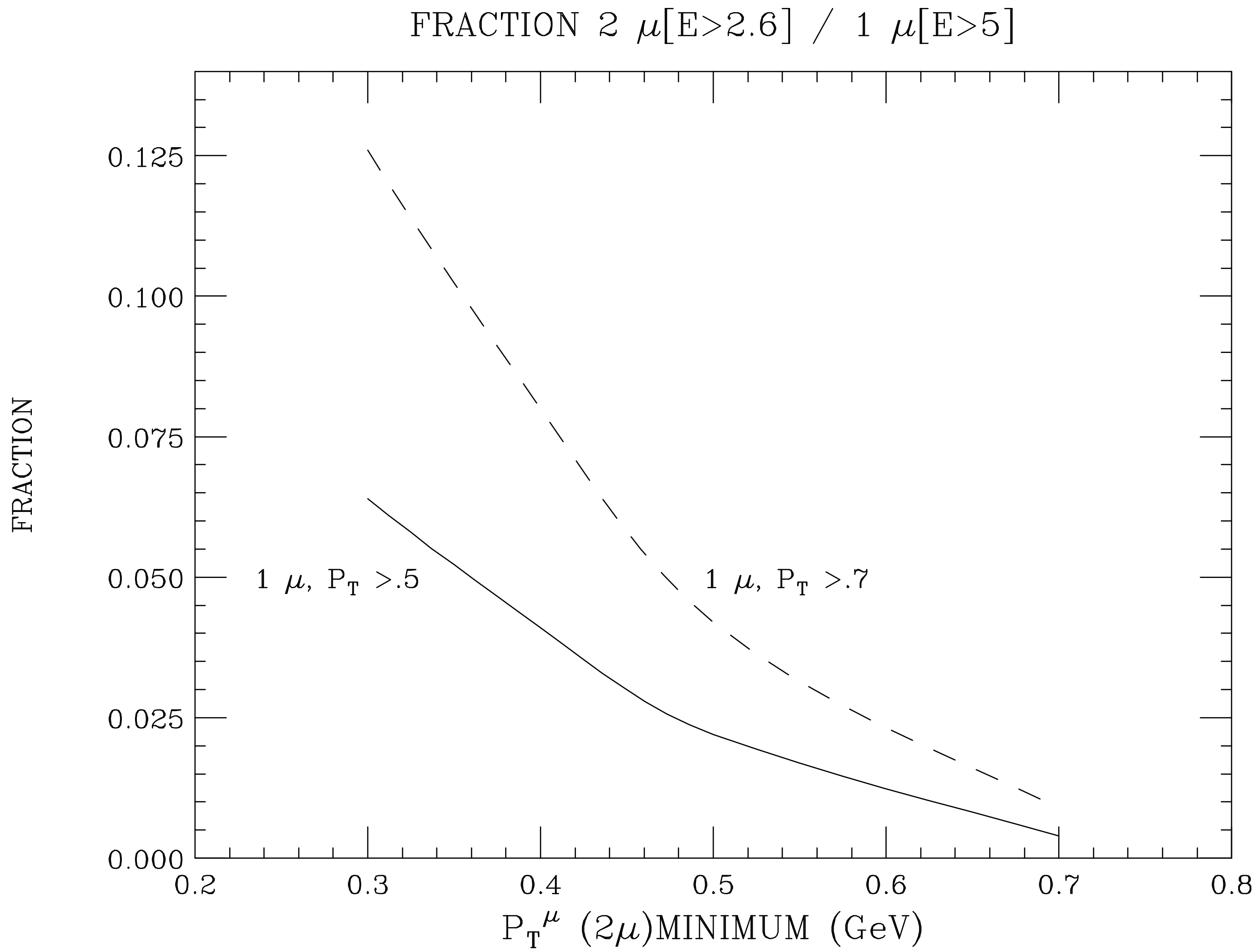
MONTE CARLO SIMULATION

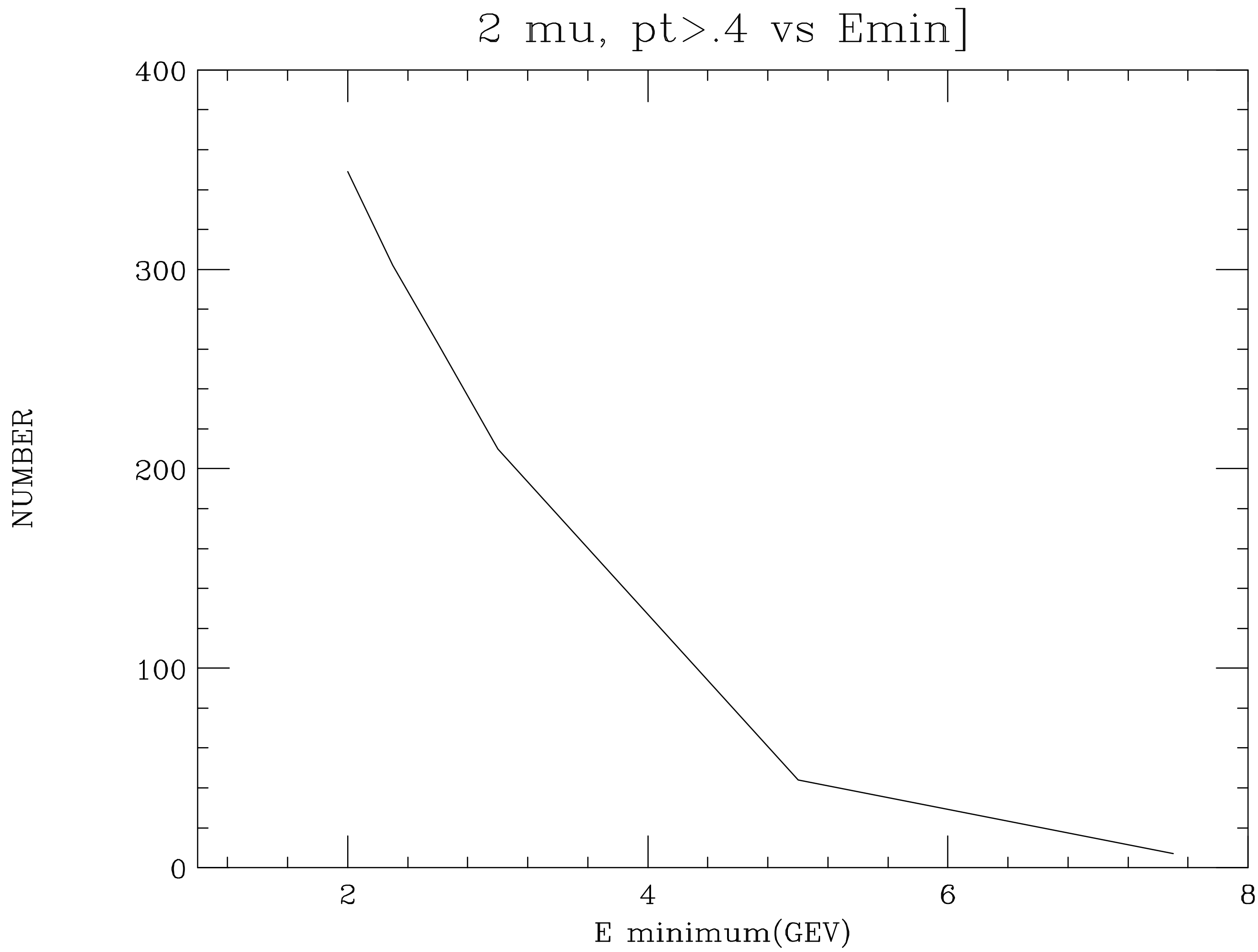
- **HERWIG 6.4**
  - **INCLUDE INERACTION OF UNDERLYING EVENT**
  - **MONOENERGETIC $E_\gamma = 45$ GeV**

    → **WILL DO BREMSTRULUNG SUBTRACTION**
  - **PROTON TARGET (NEUTRON SIMILAR)**
  - **PRODUCES $D_s^- > D_s^+$**


MUON PAIRS WITH P>2.6 GeV
NUMBER
pt_mu minimum(GEV)
ALL
W2>1.
0
100
200
300
400
500
0.2
0.3
0.4
0.5
0.6
0.7
0.8


FRACTION 2 mu/ 1 mu with E>2.6 GeV
FRACTION
0.000
0.005
0.010
0.015
0.020
0.025
0.2
0.3
0.4
0.5
0.6
0.7
0.8
pt_mu minimum(GEV)


FRACTION 2 μ[E>2.6] / 1 μ[E>5]
FRACTION
0.000
0.025
0.050
0.075
0.100
0.125
0.2
0.3
0.4
0.5
0.6
0.7
0.8
1 μ, P_T >.5
1 μ, P_T >.7
P_T^μ (2μ)MINIMUM (GeV)


2 mu, pt>.4 vs Emin]
NUMBER
E minimum(GEV)
0
100
200
300
400
2
4
6
8

TIME RESOLUTION

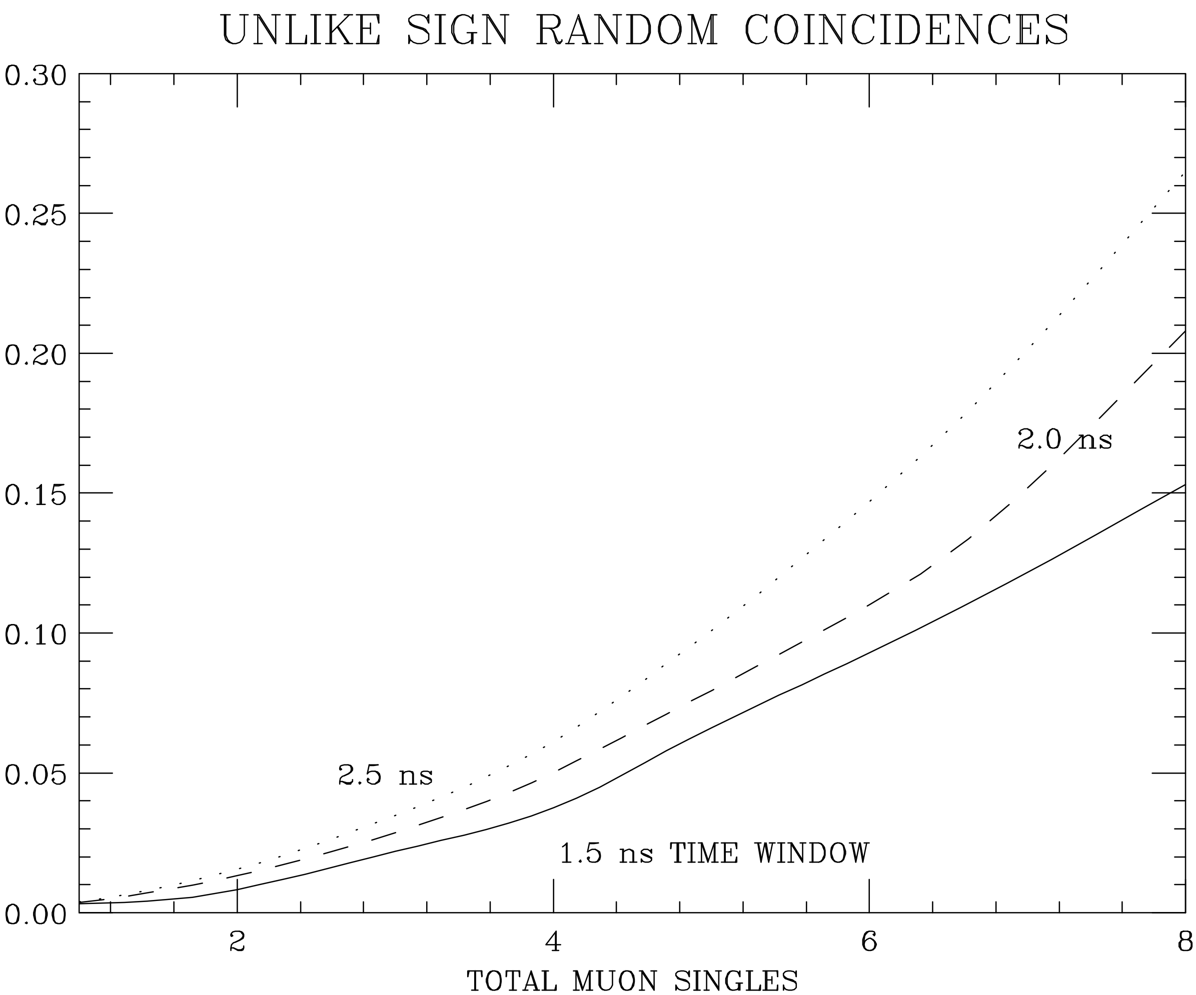
(Real Photon Collaboration Technical Note RPC-1)

TDC LSB	PULSE RESOLUTION sigma(ns)	HITS per TRACK	TRACK RESOLUTION sigma (ns)
.5	.2	1	.32
.5	.3	1	.39
.5	.4	1	.47
1.0	.2	1	.54
1.0	.3	1	.59
1.0	.4	1	.65
.5	.2	5	.15
.5	.3	5	.18
.5	.4	5	.21
1.0	.2	5	.24
1.0	.3	5	.26
1.0	.4	5	.29

Table 1: Table 1. Summary of Time resolution dependence on TDC LSB (Least Significant Bit), Pulse Resolution(sigma) and number of hits on a track.

IF $\sigma \sim 0.2$ ns, $\Rightarrow$

FULL WIDTH $= \pm 3\sigma = 1.2$ ns


UNLIKE SIGN RANDOM COINCIDENCES
0.30
0.25
0.20
0.15
0.10
0.05
0.00
2
4
6
8
TOTAL MUON SINGLES
2.0 ns
2.5 ns
1.5 ns TIME WINDOW

EXPERIMENTAL RATES

	E161 PROPOSAL	E161 POSSIBLE		
	1 mu	1 mu	2 mu	randoms
radiator	.07%	1.5%		
e-beam/spill	2E10	5E10		
photons(top 10%	1.5E7	1E9		
single mu/spill (Pt>0.5 ; P>5)	0.020	1.3		
single mu/spill (Pt>0.7 ; P>5)	0.010	.7		
mu/spill (Pt>0.5 ; P>3)	0.034	2.2	0.024	.013
mu/spill (Pt>0.6 ; P>3)		1.5	0.011	.006
		2(tot)		.009
		3(tot)		.026
		4(tot)		.038
		6		.09

REQUIREMENTS FOR EXPERIMENT

- **2 μ**
  - **ACCEPTANCE AND RESOLUTION FOR $P_T > .5$, $P > 3$**
  - **EXCELLENT TIME RESOLUTION**
  - **LOW BACKGROUND SINGLES RATES**

- **REDUCE SINGLES RATES**
  - **B-H BACKGROUND**
    - → **MEASURE BOTH μ**
    - → **CUT ON $E_1 + E_2 \sim E_\gamma$**
    - → **DO BREMS SUBTRACTION**
  - **LOW μ RATE FROM K π DECAY**

OTHER SCHEMES

- **COINCIDENCE BETWEEN**
  $\mathbf{c} \rightarrow \mathbf{D} \rightarrow \mu$
  $\mathbf{c} \rightarrow \bar{\mathbf{D}} \rightarrow \bar{\mathbf{K}} \rightarrow \bar{\mu}$
  - **LESS ABSORBER BY TARGET FOR K decay**
  - **SOME OF THIS IN RANDOM BACKGROUND**

2 μ CONCLUSIONS
POSSIBLE

- RANDOMS BIGGEST PROBLEM
- BACKGROUND CLEANLY SUBTRACTED
- NO NEED FOR SECOND ABSORBER SETUP
- NEED OPTIMIZATION OF CUTS
- COULD USE SOME OF BACKGROUND