Backgrounds and Radiation Loads in VLHC Detectors

Nikolai Mokhov
Fermilab

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Snowmass

Part 1. From IP

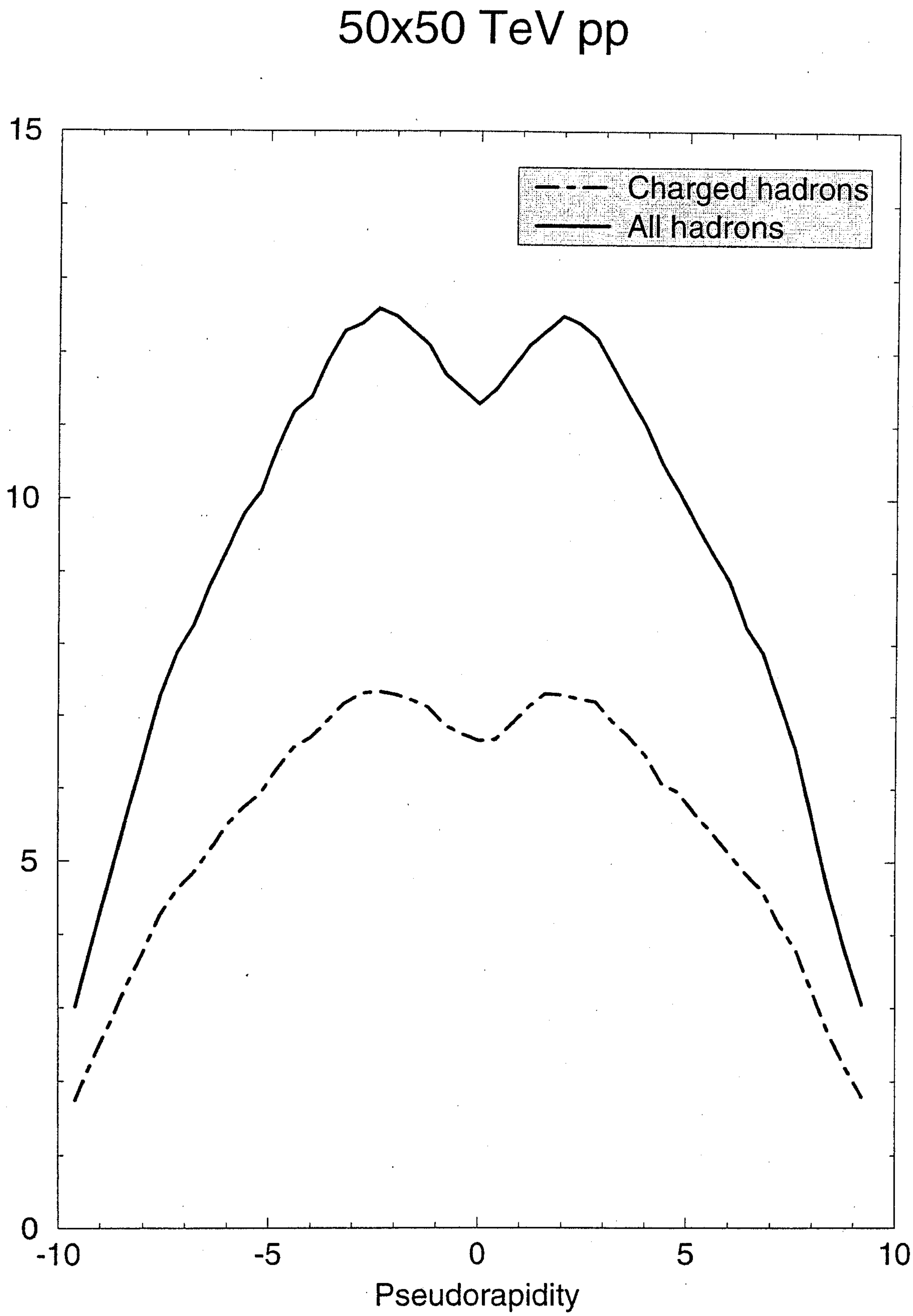
Part 2. From beam loss

100 TeV pp

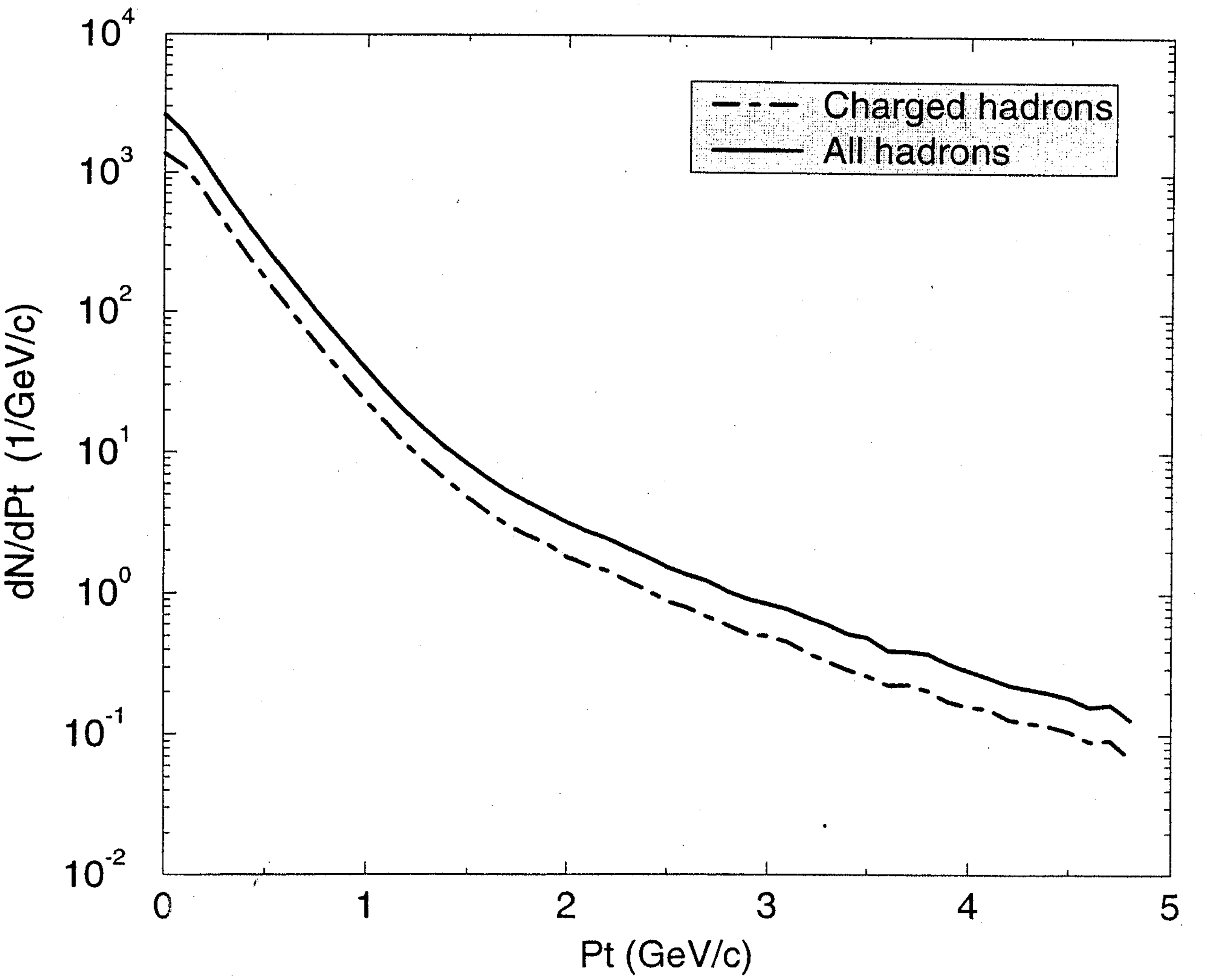
1) Event properties
2) Fluxes in central tracker

as calculated with

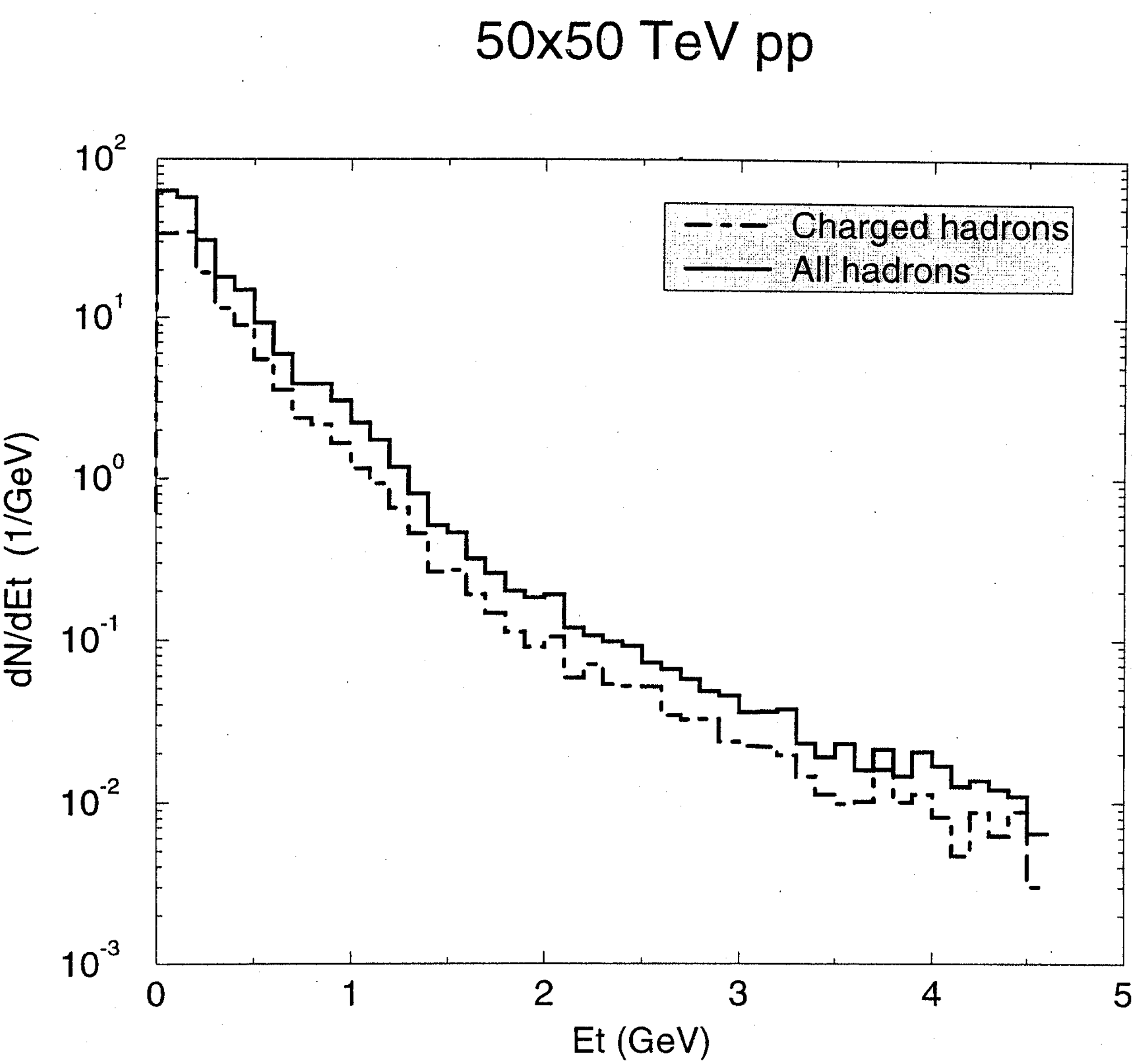
DPMJET / MARS


50x50 TeV pp
Charged hadrons
All hadrons
15
10
5
0
-10
-5
0
5
10
Pseudorapidity

50x50 TeV pp

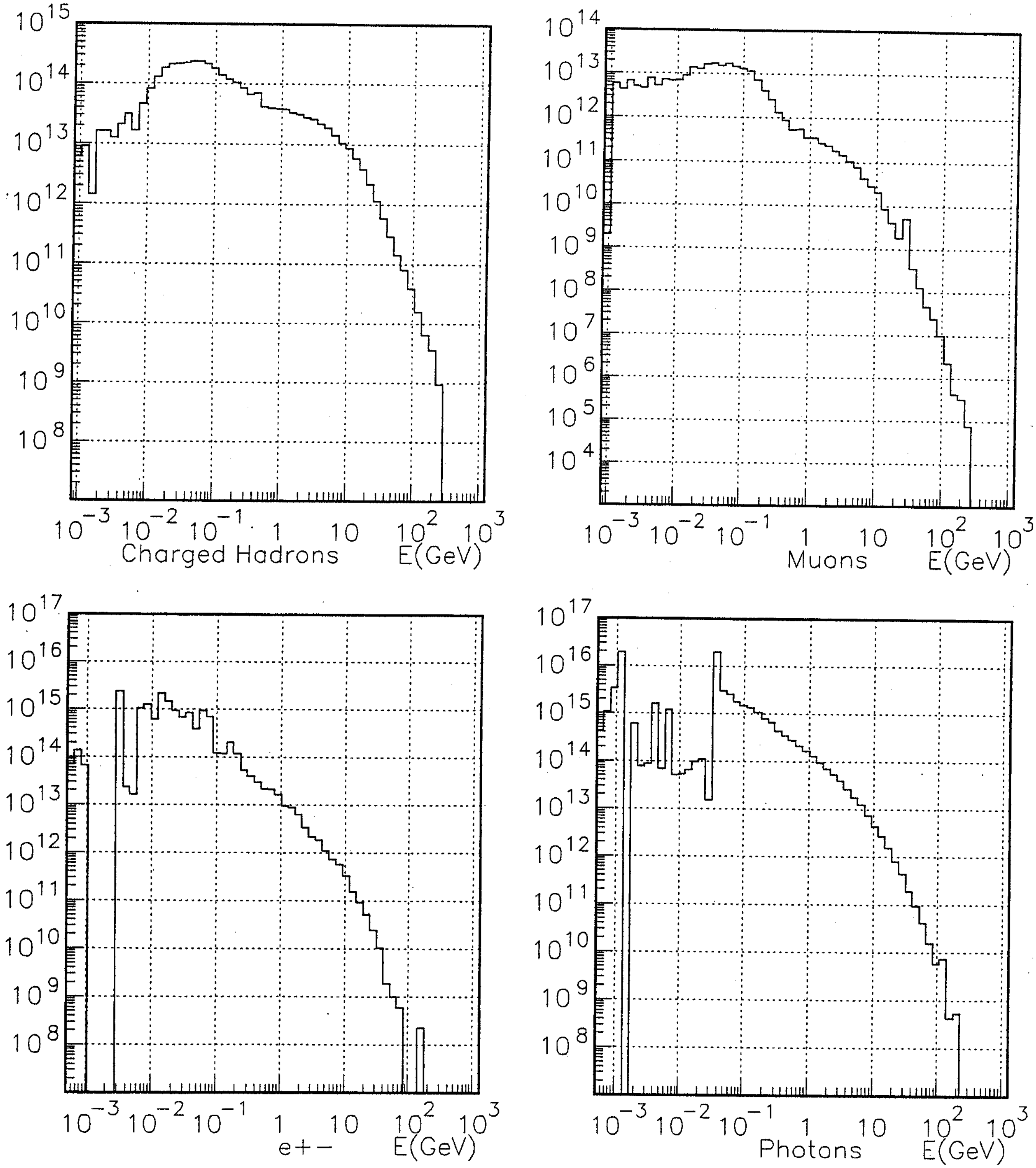


Charged hadrons
All hadrons
dN/dPt (1/GeV/c)
Pt (GeV/c)
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
0
1
2
3
4
5

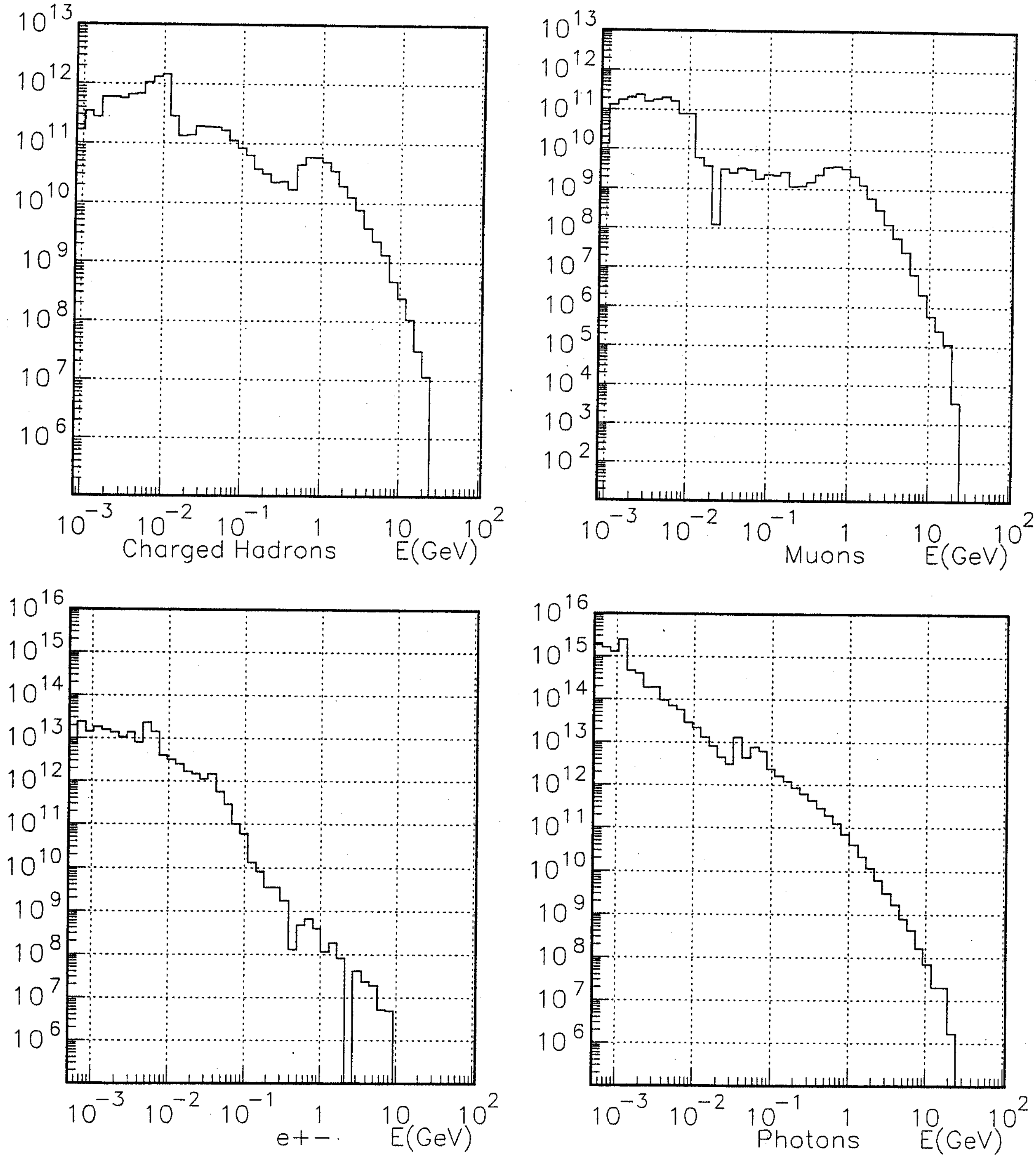


50x50 TeV pp
Charged hadrons
All hadrons
dN/dEt (1/GeV)
Et (GeV)
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
0
1
2
3
4
5

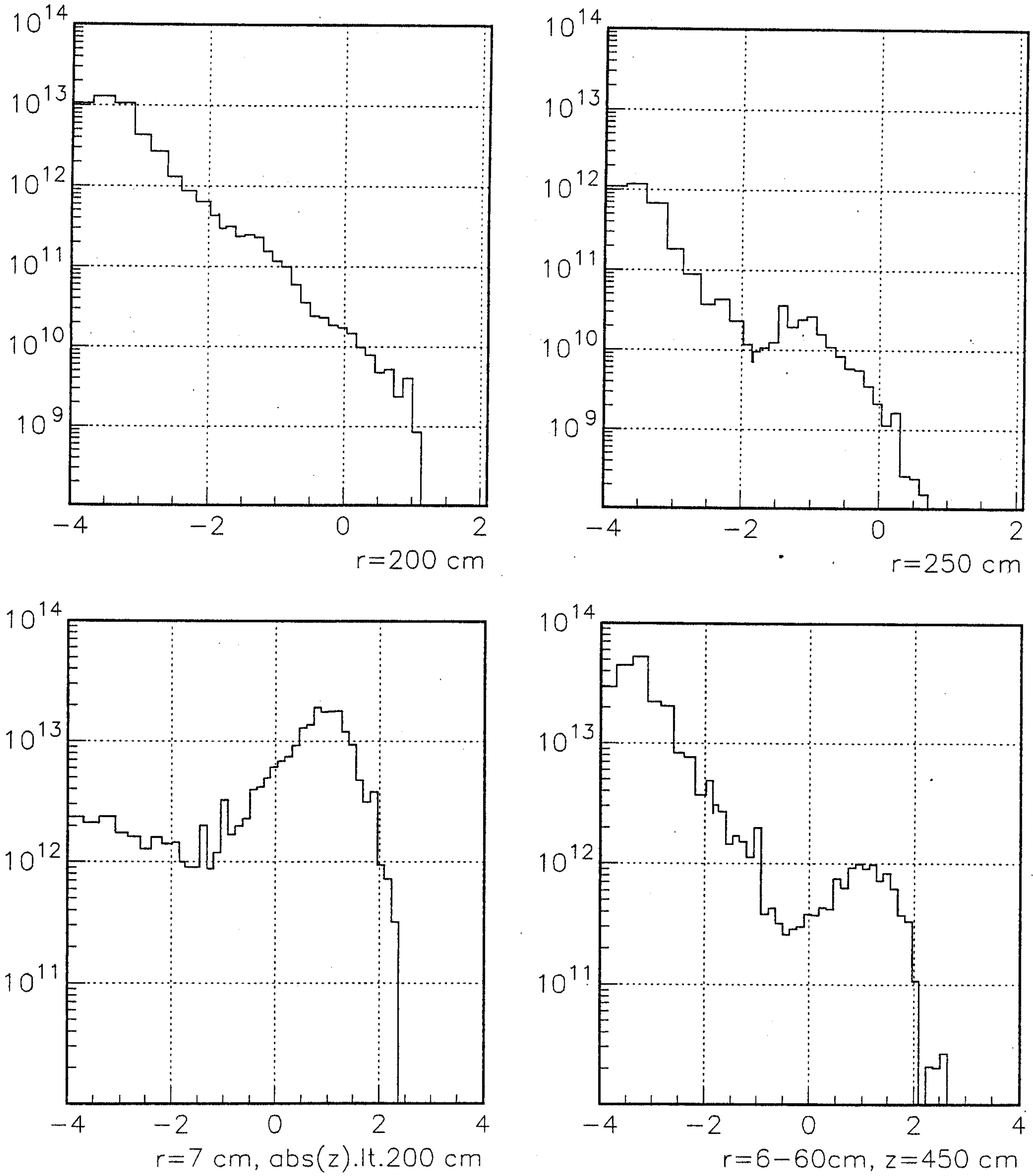
Particle	$< E >$, GeV	$< n >$
p	0.23597×10^5	0.46222×10^1
$\bar{p}$	0.16563×10^4	0.33840×10^1
e^+	0.12733×10^2	0.50200×10^{-1}
e^-	0.82923×10^1	0.55200×10^{-1}
ν_e	0.44893×10^1	0.20800×10^{-1}
$\bar{\nu}_e$	0.62834×10^1	0.15800×10^{-1}
γ	0.20317×10^4	0.77172×10^1
n	0.99829×10^4	0.40044×10^1
$\bar{n}$	0.16135×10^4	0.33946×10^1
μ^+	0.46361×10^1	0.16400×10^{-1}
μ^-	0.93866×10^1	0.19400×10^{-1}
K_L^0	0.19845×10^4	0.49982×10^1
π^+	0.17053×10^5	0.45827×10^2
π^-	0.14409×10^5	0.45155×10^2
K^+	0.23013×10^4	0.52018×10^1
K^-	0.19290×10^4	0.51542×10^1
Λ	0.23956×10^4	0.11880×10^1
$\bar{\Lambda}$	0.55848×10^3	0.10618×10^1
K_S^0	0.20078×10^4	0.49888×10^1
Σ^-	0.22324×10^3	0.23380×10^0
Σ^+	0.56489×10^3	0.26360×10^0
π^0	0.17115×10^5	0.50629×10^2
K^0	0.73638×10^0	0.20000×10^{-3}



50x50 TeV VLHC (r=7 cm, z.lt.200), dN/dE (cm^{-2} GeV^{-1} per year)



50x50 TeV VLHC (r=200 cm), dN/dE (cm^{-2} GeV^{-1} per year)



50x50 TeV VLHC neutrons, E*dN/dE (cm^{-2} per yr) vs log10(E/GeV)

1. Interaction Point

Stage 1: 40 TeV, $\mathcal{L} = 1 \cdot 10^{34}\,cm^{-2}s^{-1}$

Stage 2: 175 TeV, $\mathcal{L} = 2 \cdot 10^{34}\,cm^{-2}s^{-1}$

Central Tracker:	Stage 1	Stage 2	
$\Phi_{\pm} \sim 1/r^2$	$3 \cdot 10^7$	$(1 \cdot 10^8)$	
	$cm^{-2}s^{-1}$ at $r = 10\,cm$		
Φ_n ("gas", material dependent)	$3 \cdot 10^6$	$1 \cdot 10^7$	
$D =$	10	(30)	$\frac{Mrad}{yr}$

Endcap calorimeter: 2 to 3 orders of magnitude higher at small radii

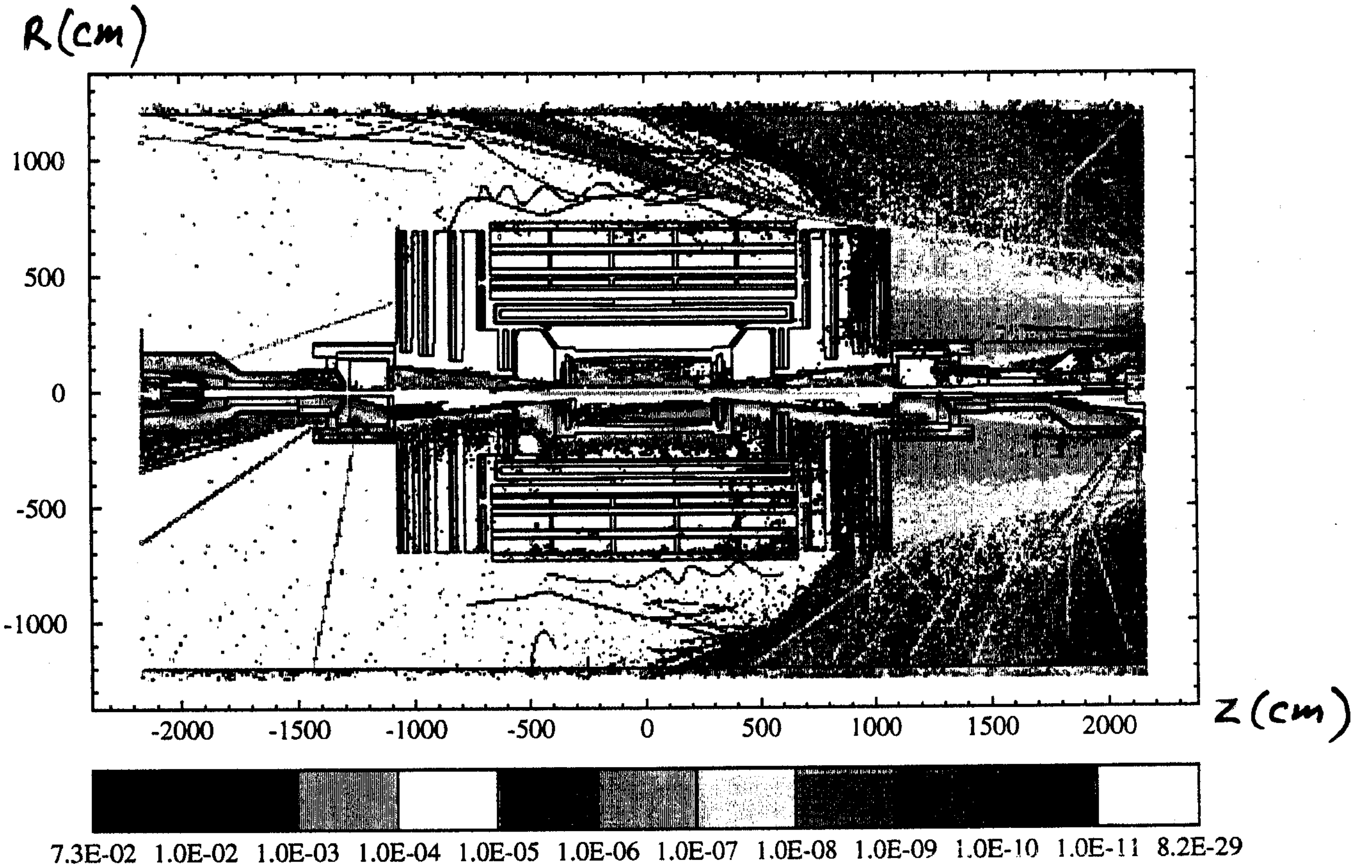
Forward μ-system: Hit rate (HR)

$HR = \Phi_{\pm} + 0.01 \cdot \Phi_{\gamma} + 0.003 \cdot \Phi_n$

2	12	kHz/cm^2
at $r = 1\,m$		
15	100	Hz/cm^2
at $r > 5\,m$		

All ↑ with appropriate shielding!

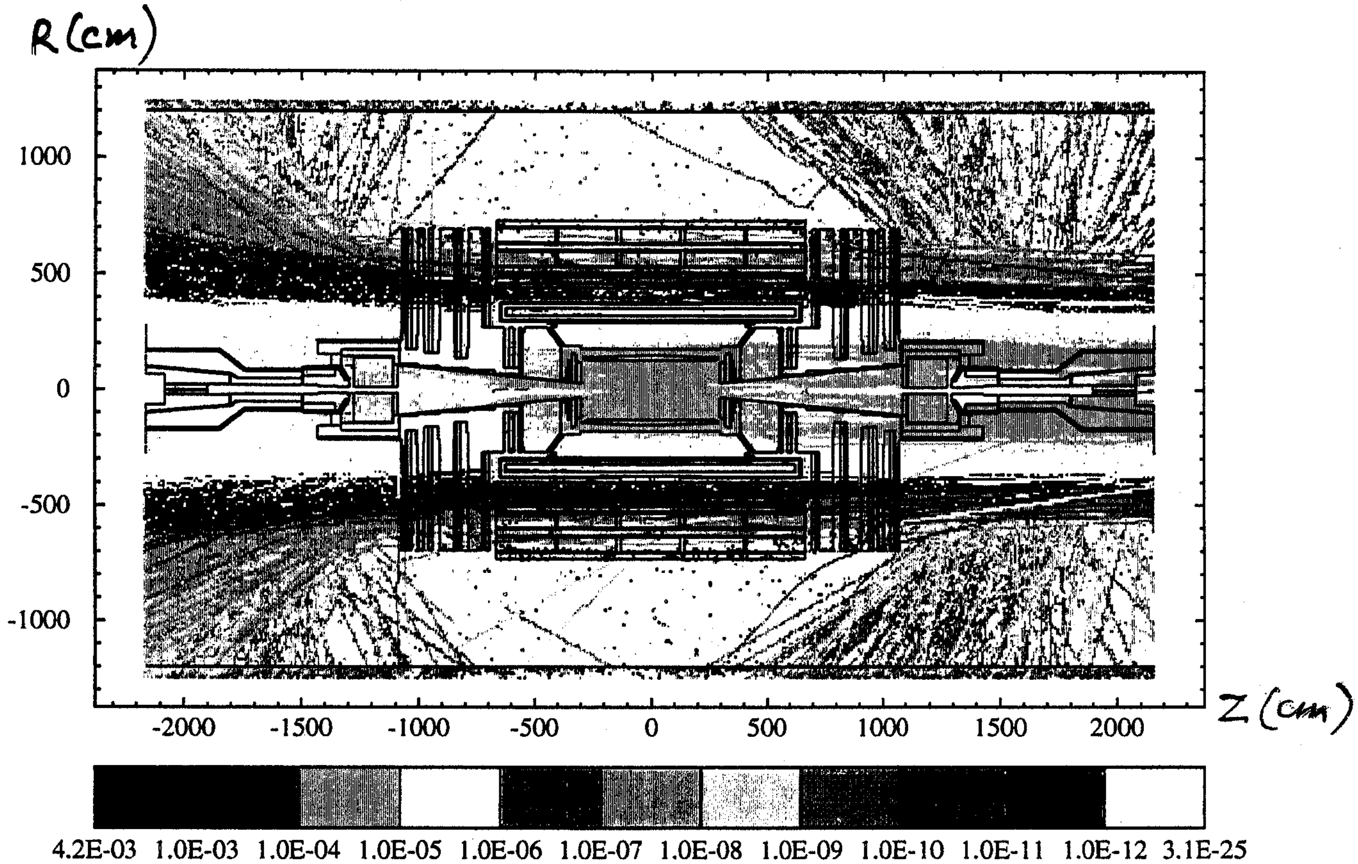
CMS Hall



Dose (Gy/accident) - no μ

IP6 Unsynchronized Abort (shadows in)

CMS Hall



Dose (Gy/accident) - μ only

IP6 Unsynchronized Abort (shadows in)

II. Beam Loss in IR

BL = 500 $m^{-1}s^{-1}$ warm/cold straights

$2 \cdot 10^4$ $m^{-1}s^{-1}$ cold arcs

MARS: ± 150 - 180 m @ 500 $m^{-1}s^{-1}$

<u>Appropriate shielding</u>

1) in detector (endcap and forward)
2) around front collimator
3) plug at hall/tunnel
4) around D1 - D2 pipe

$\frac{\text{machine}}{\text{IP}}$ ~ a few % (μ's)