Triggers for Drell Yan, J/ψ and direct photons production at NICA SPD

Guskov Alexey (JINR)

NICA-SPIN 2014

Prague, 12.2.2014

Main points of SPD physics program

- Production of direct photons
- Drell Yan process
- J/ψ production

$\mu^+\mu^-$

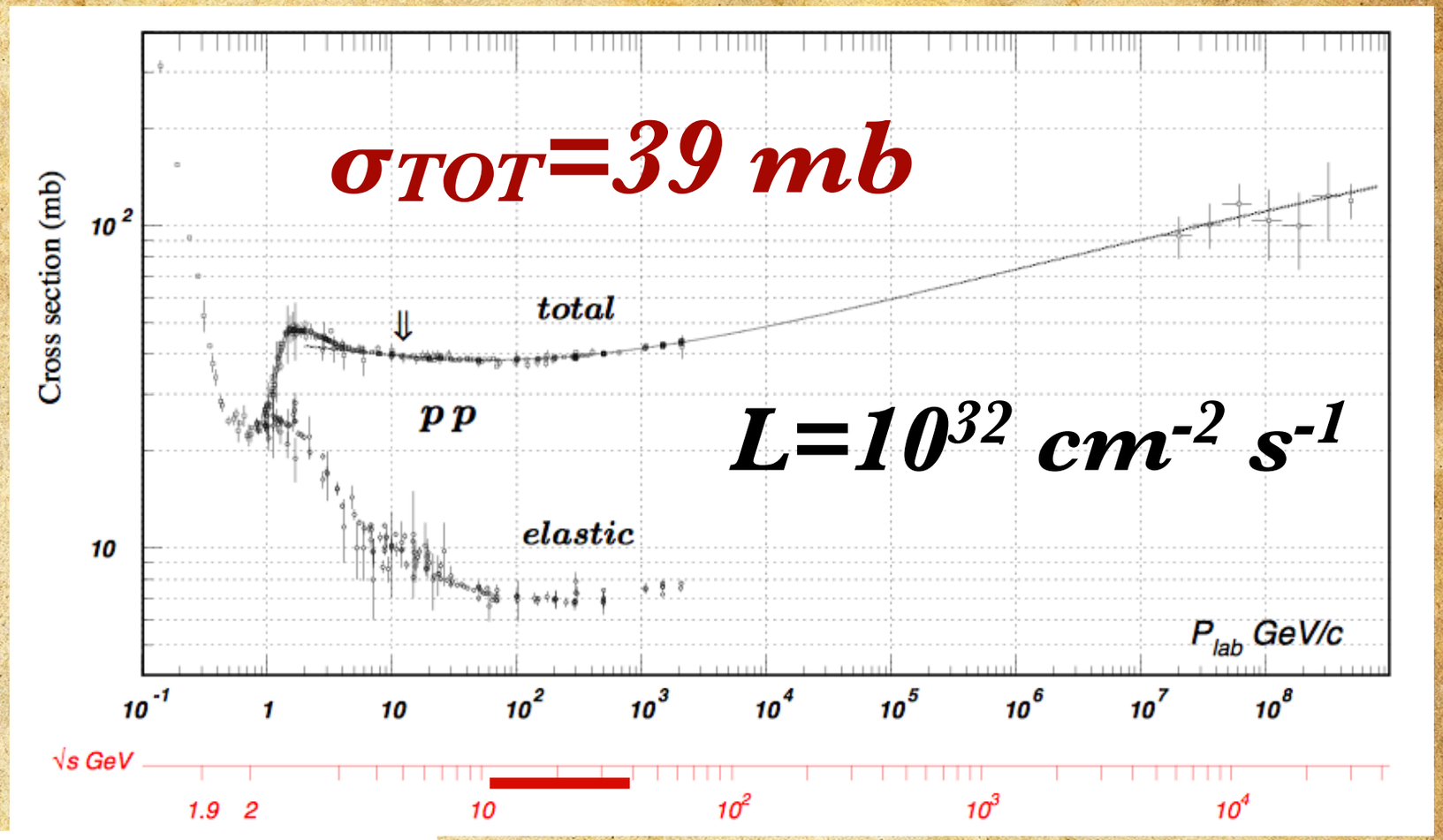
e^+e^-

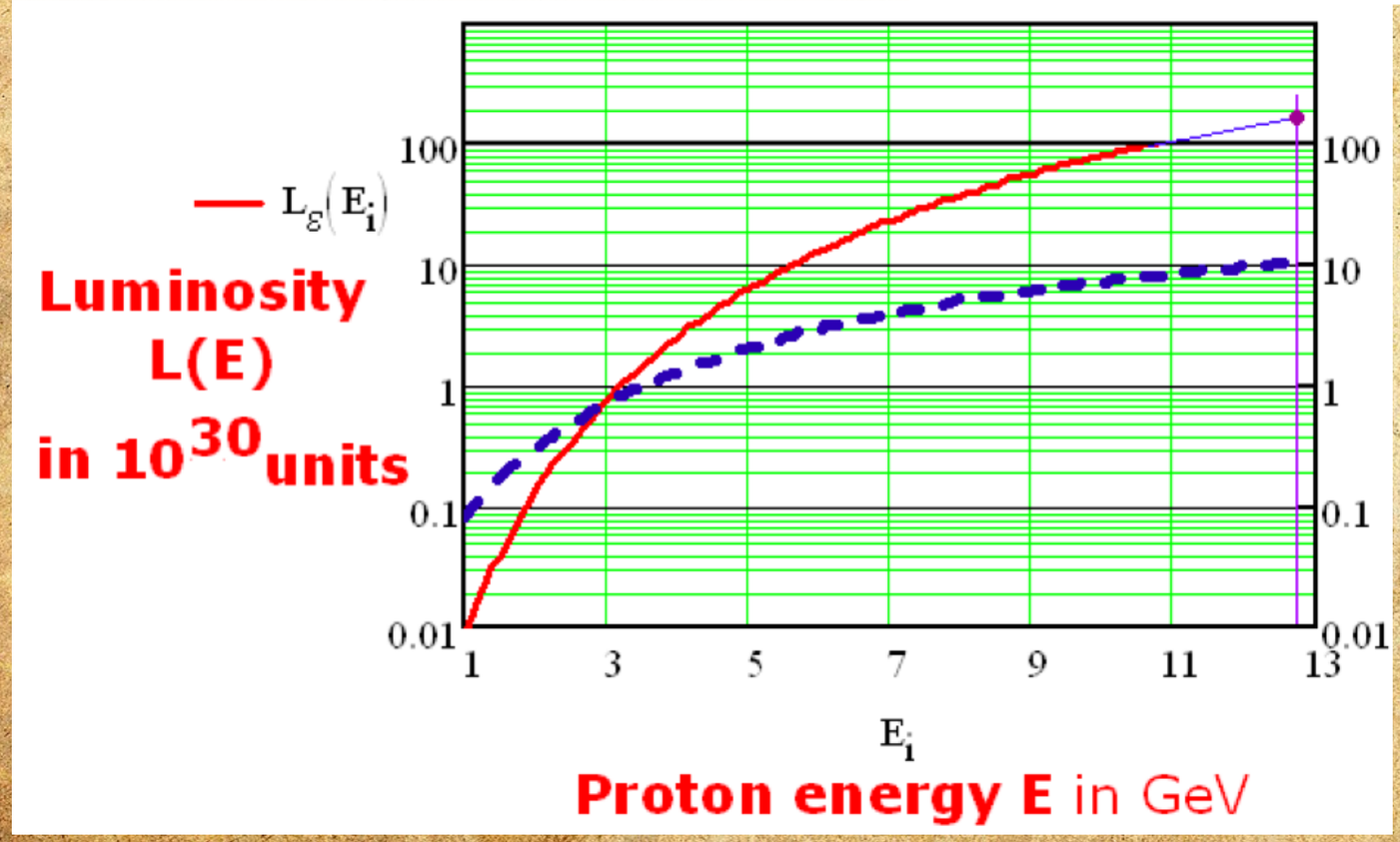
γ

Muon system

Electromagnetic calorimeter

General rates

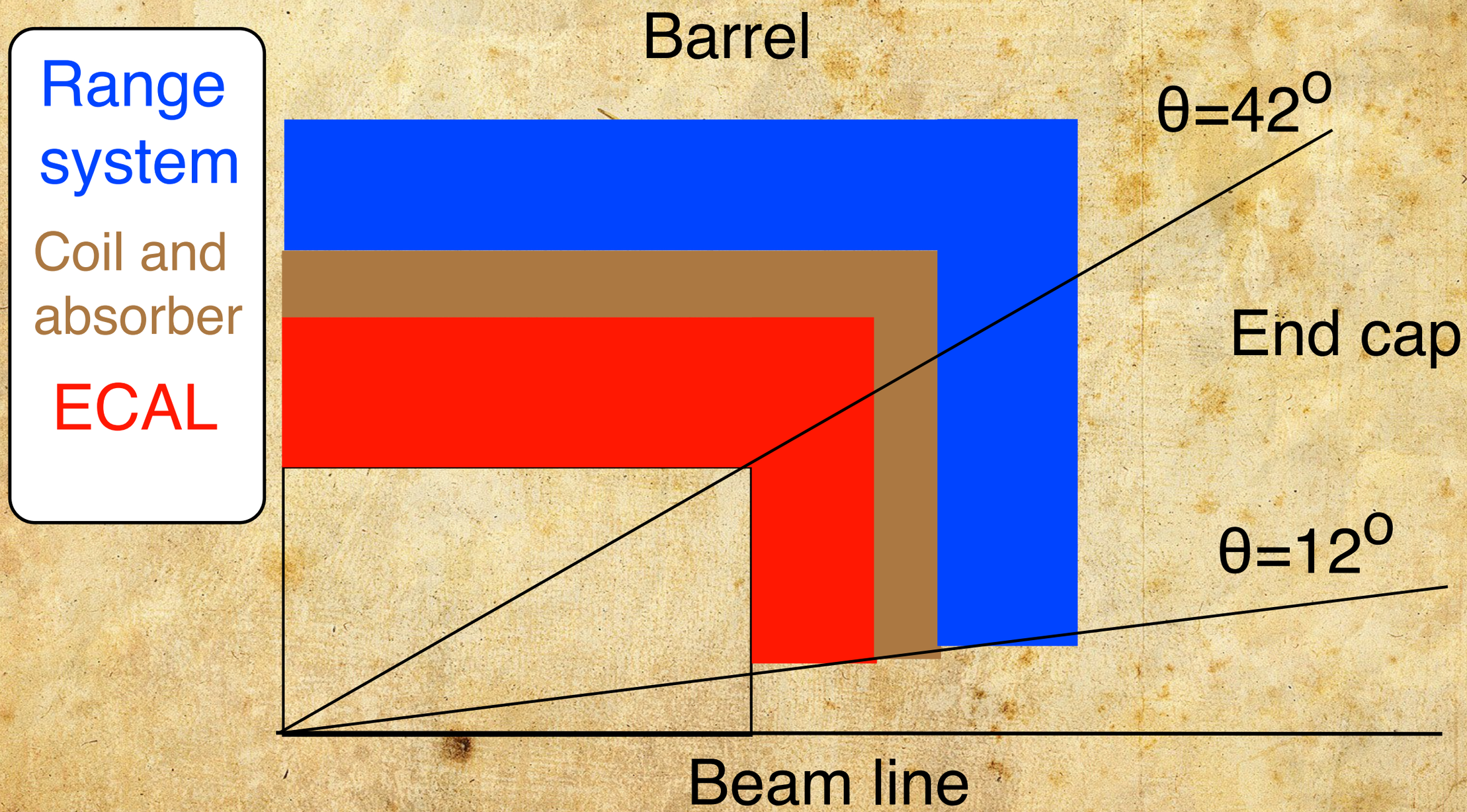




Interaction rate: 3900 kHz
Event rate in SPD setup: 3000 kHz

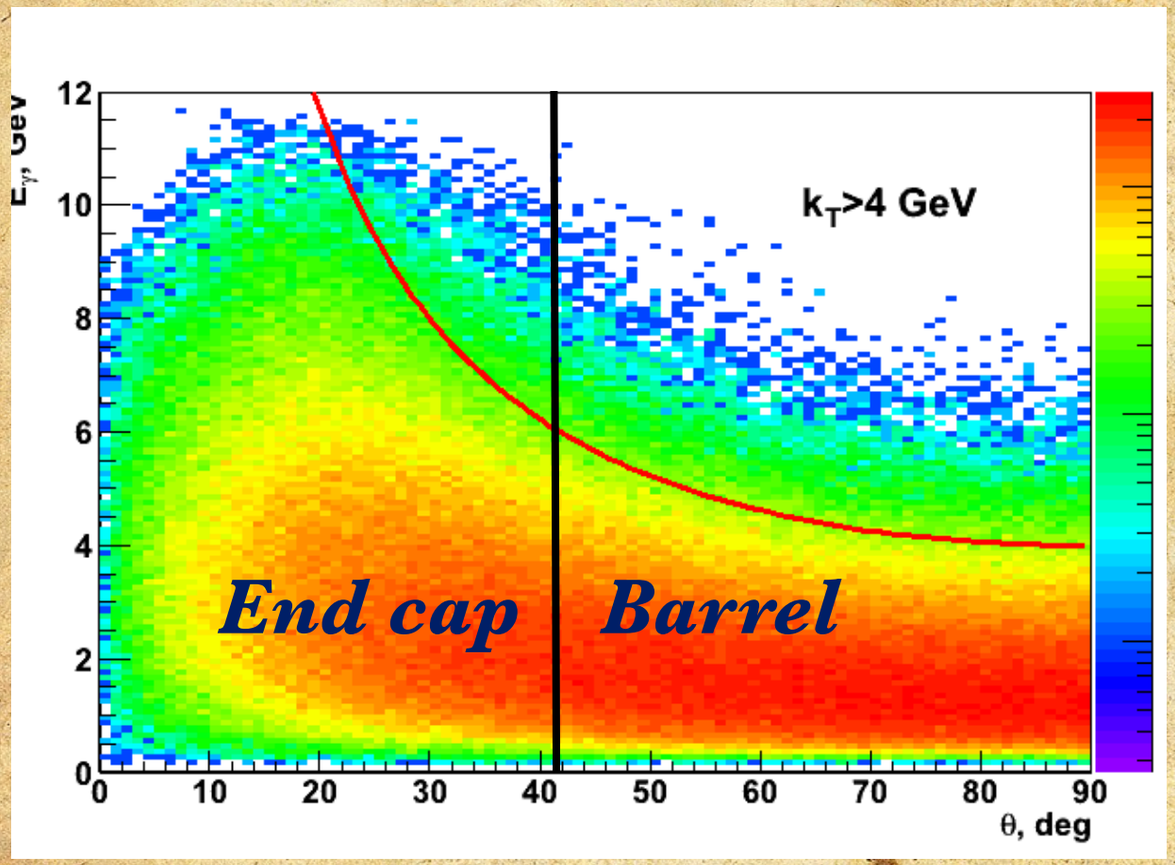
We plan 100-150 kHz bandwidth for DAQ

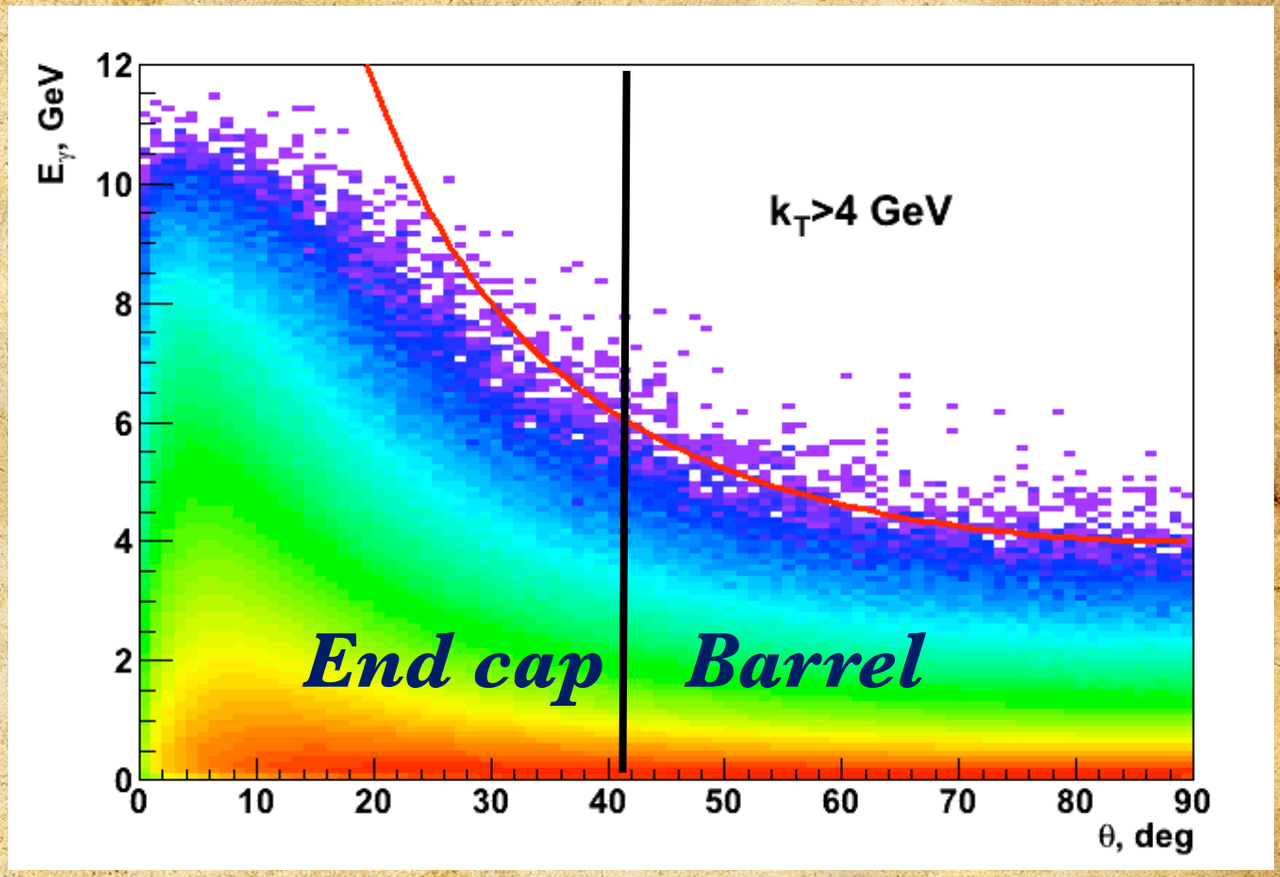
SPD trigger elements (for toy simulation)

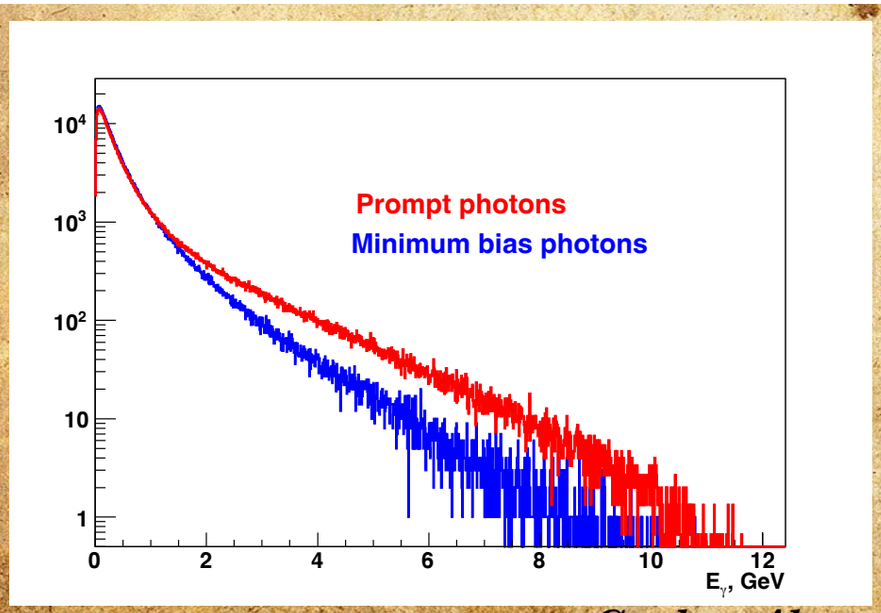


Direct photons

Physics requirements: we need for photons with high p_T



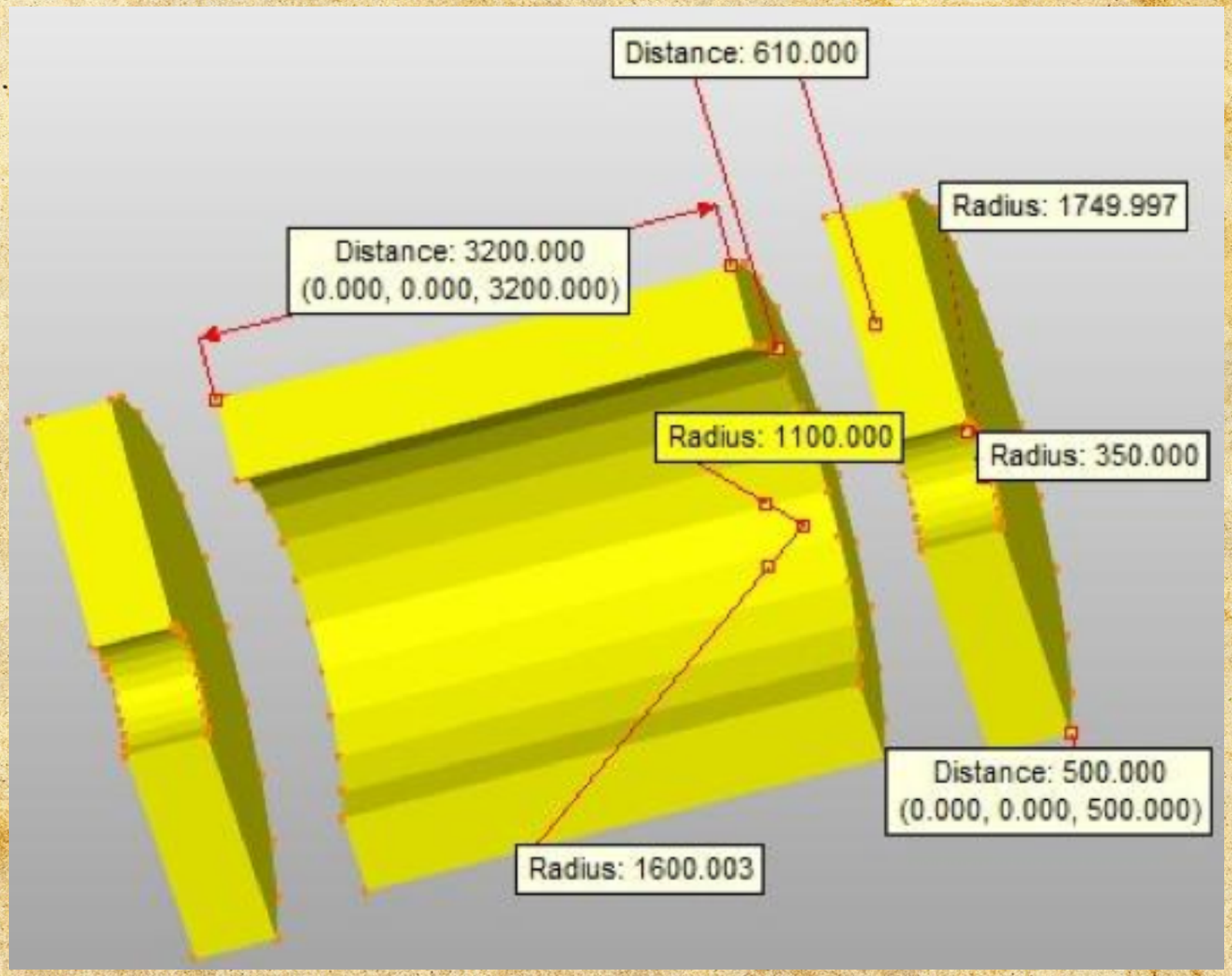




Direct photons ***Minimum bias photons***

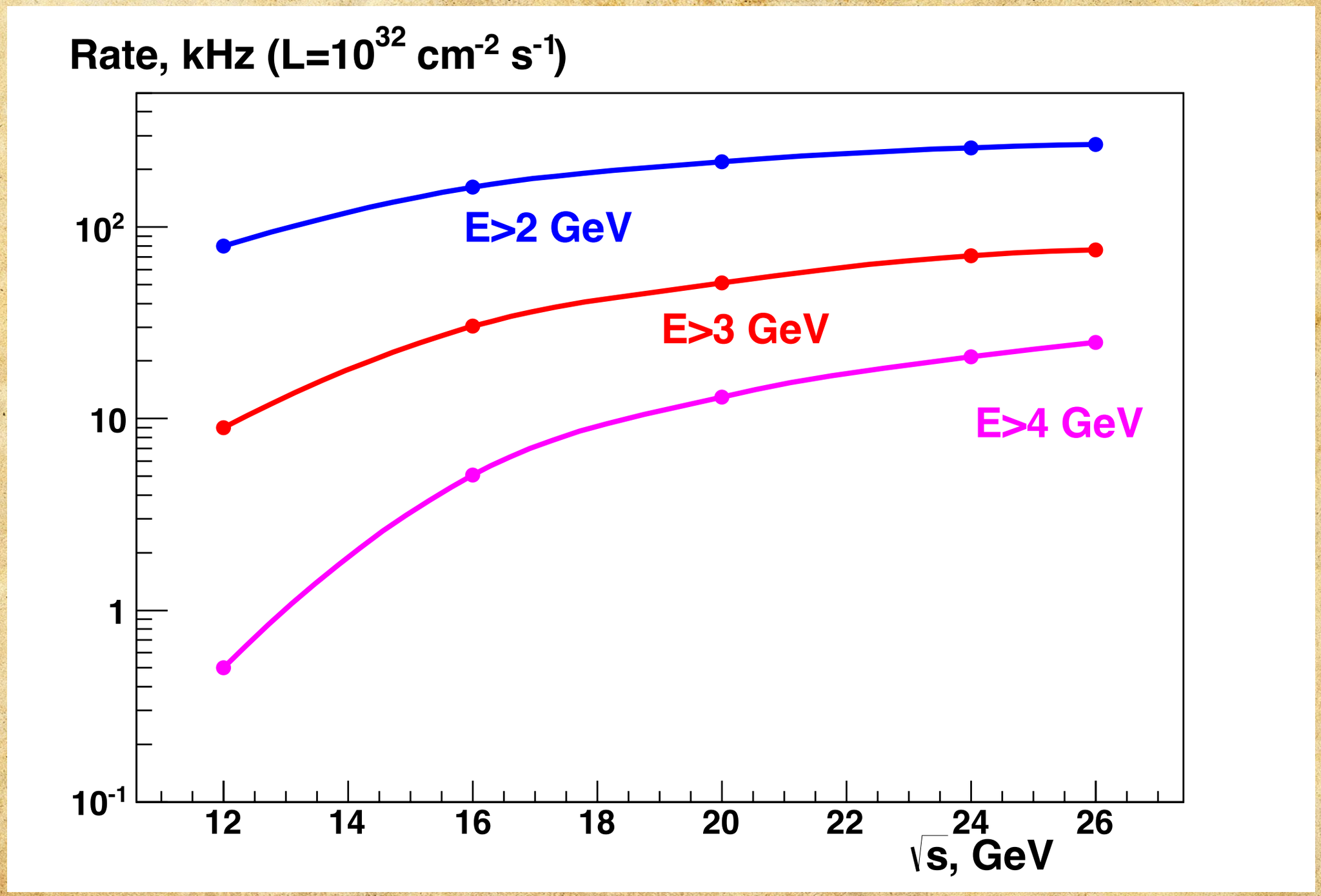
$\sqrt{s}$=24 GeV/c

ECAL-based trigger for DP (DP trigger)

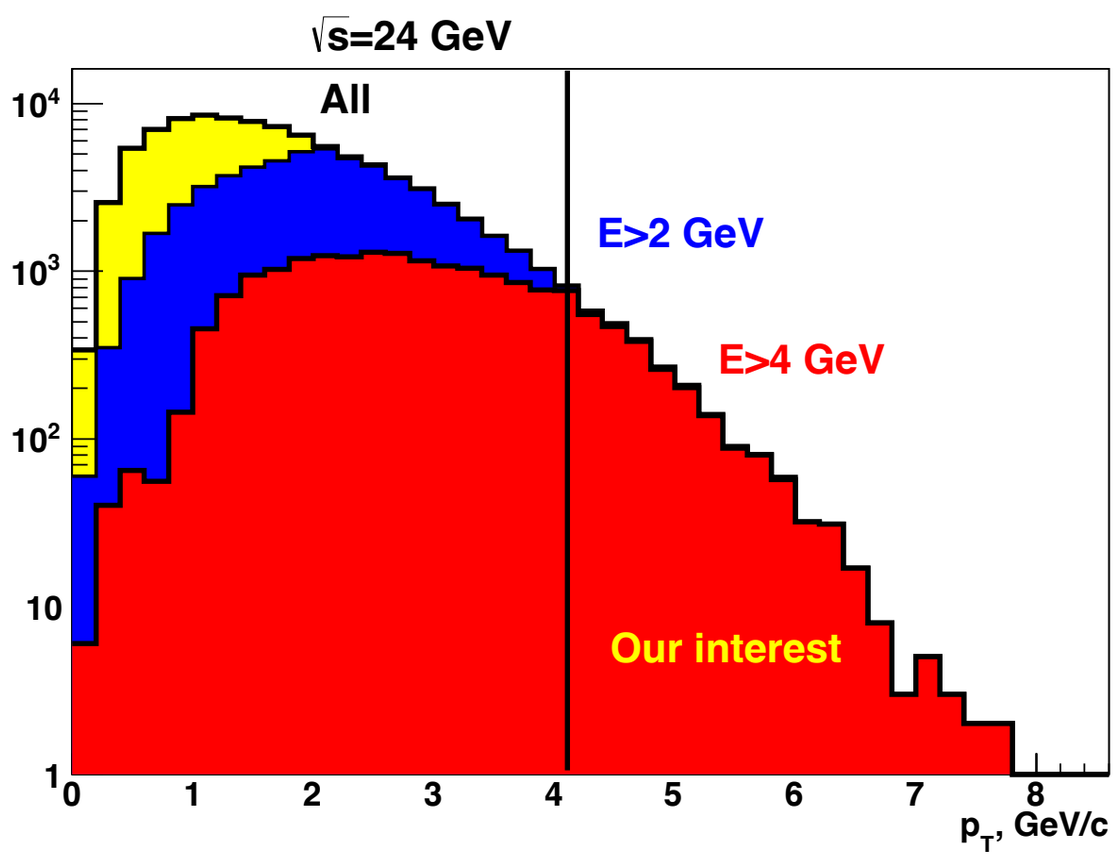


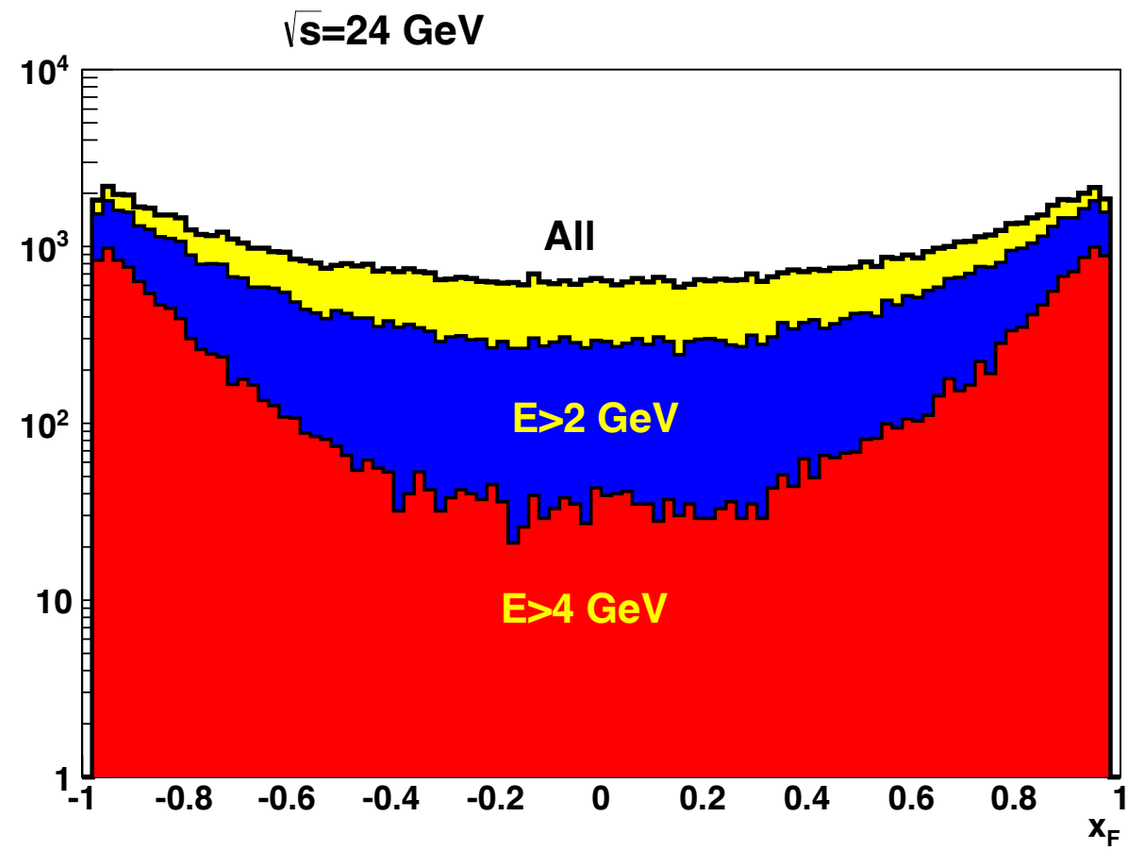
At least 1 cluster in ECAL wih energy above threshold

DP trigger rates



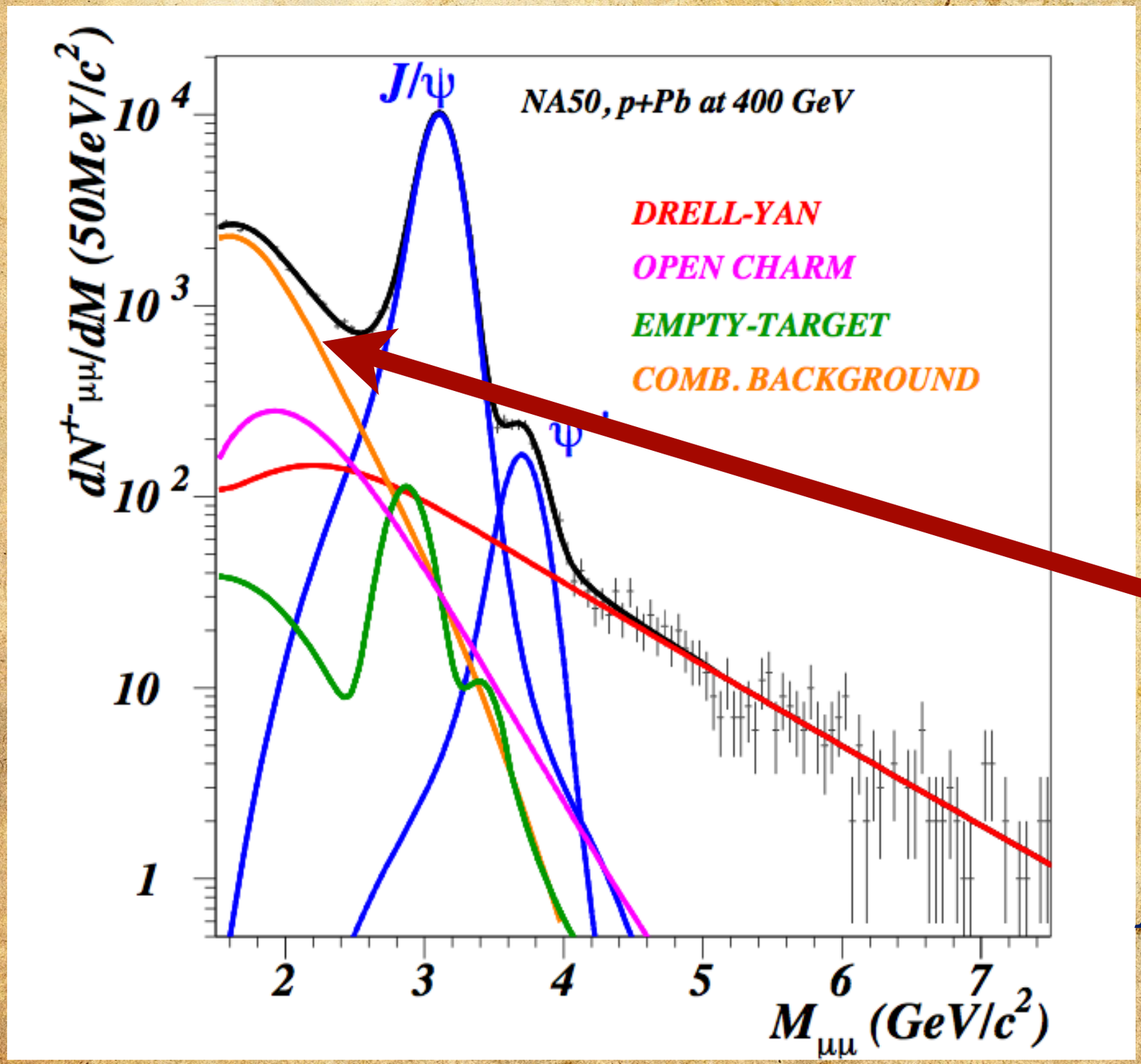
DP trigger acceptance





Possible option:* *different thresholds for barrel and end-cap

Drell Yan + J/ψ production



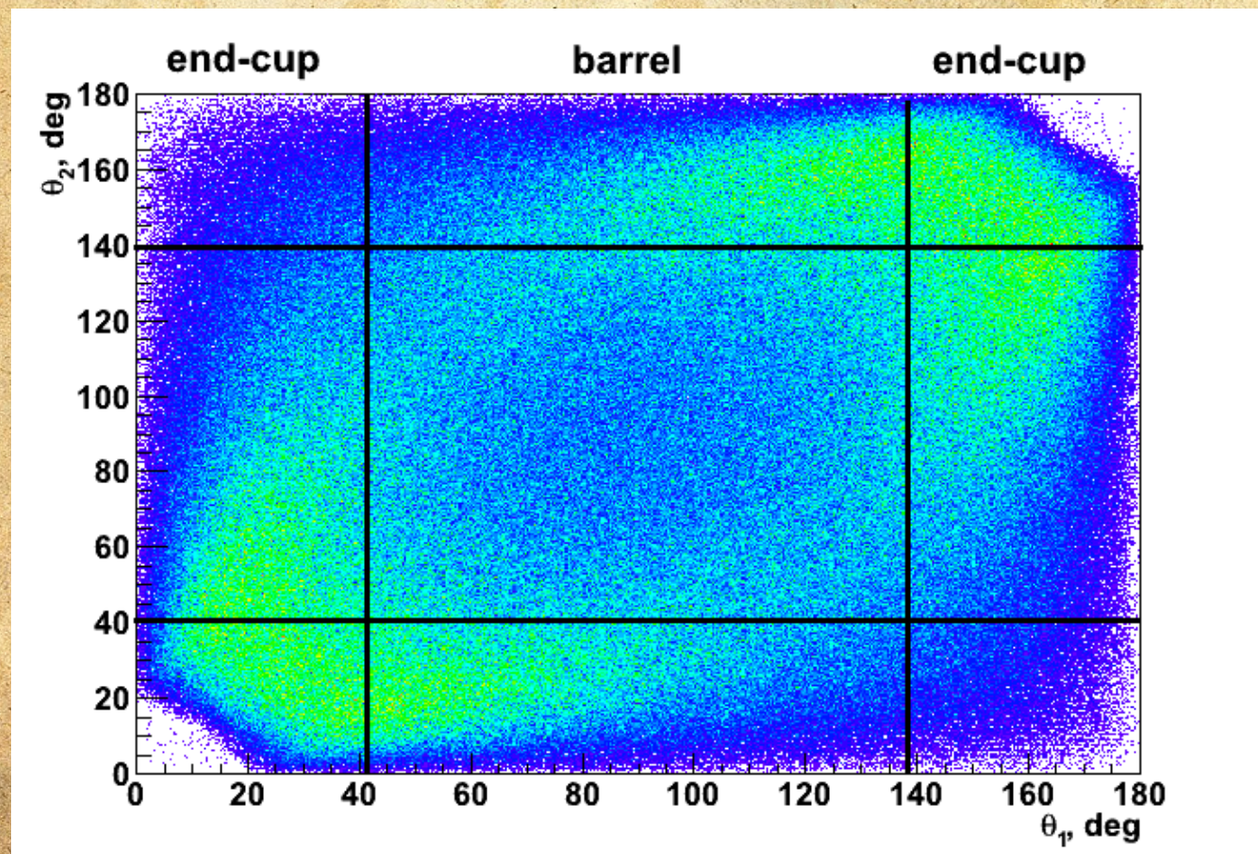
Safe range for DY dimuons is M>4 GeV

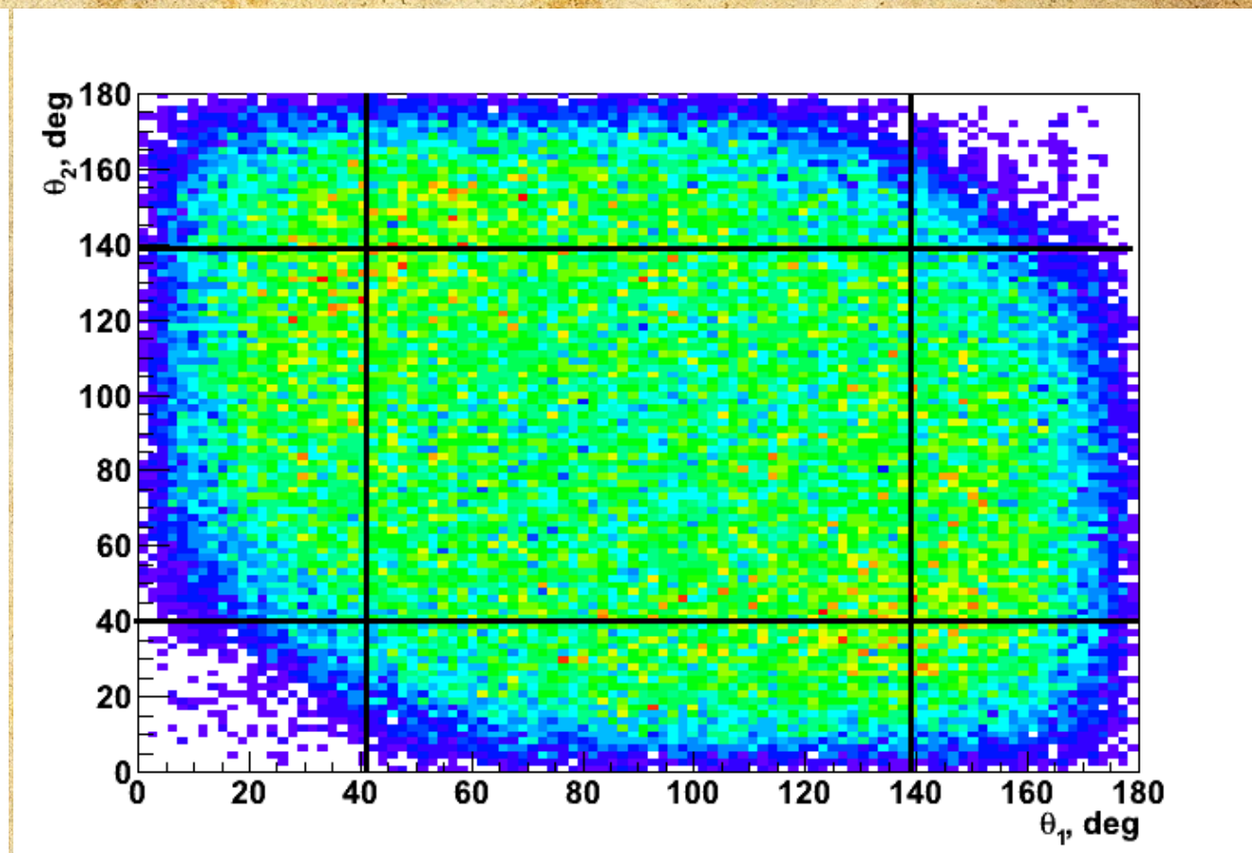
muons from pion decay

dielecrons may provide possibility to go below J/ψ peak

DY dileptons in SPD

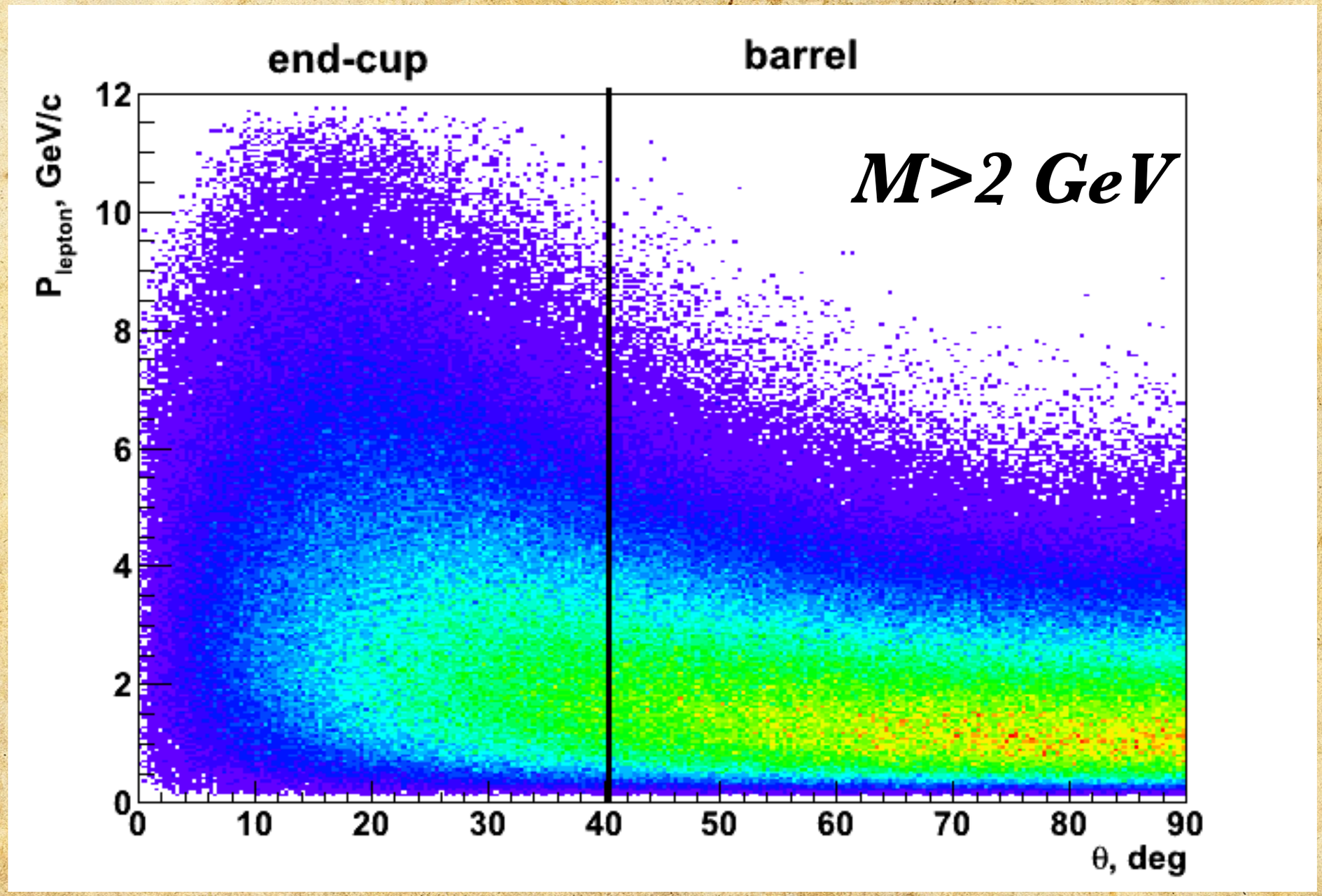
M>2 GeV **√s=24 GeV/c** **M>4 GeV**





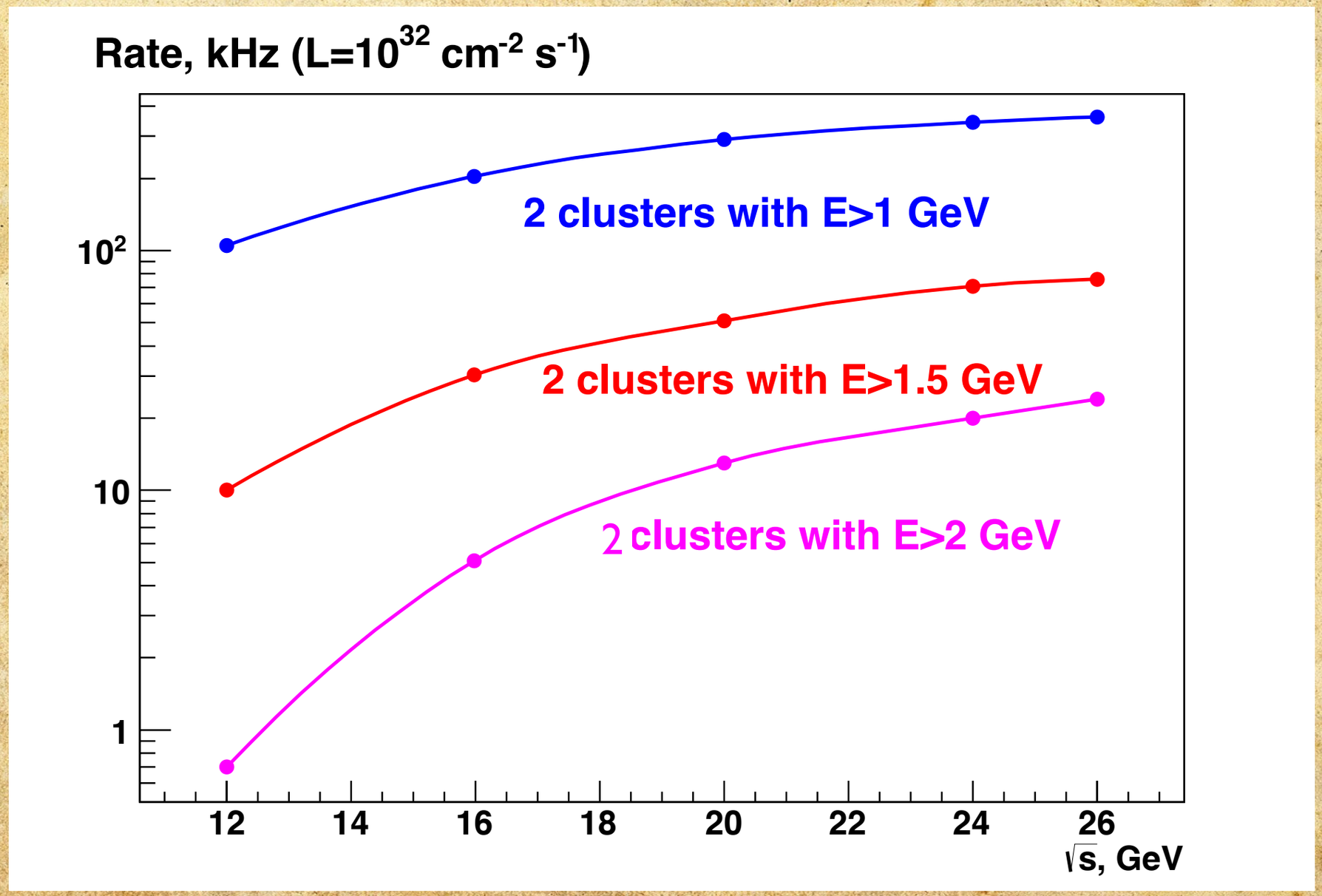
Small masses: "end-cup - end-cup" event configuration dominates

DY dileptons in SPD

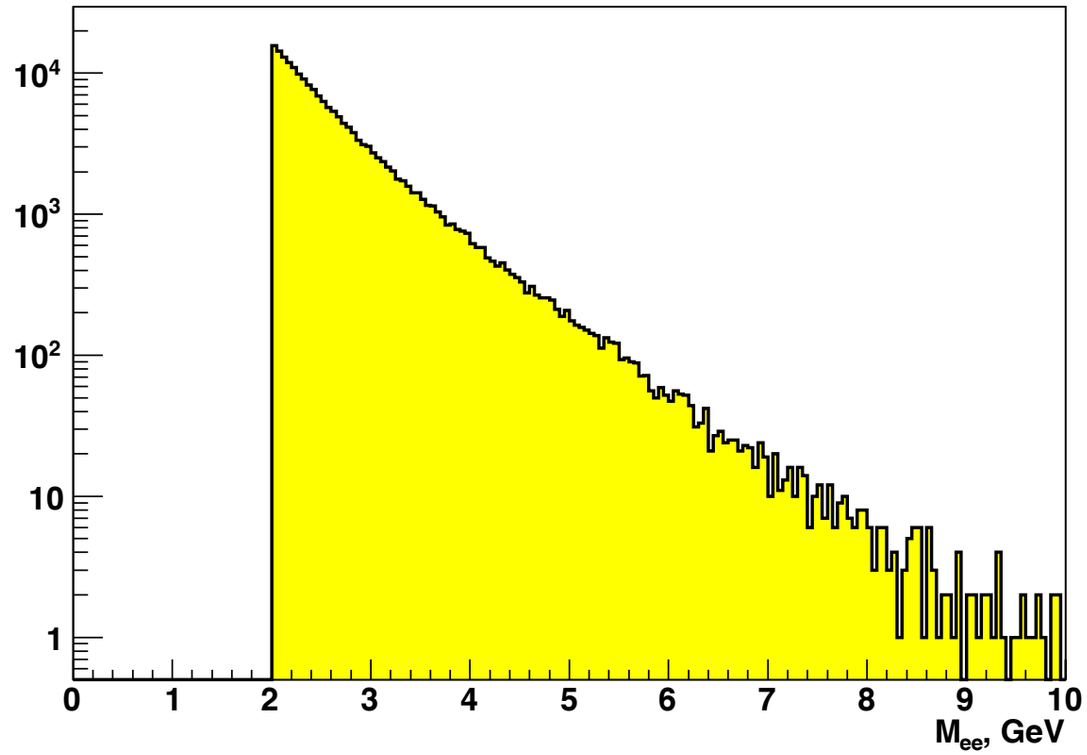


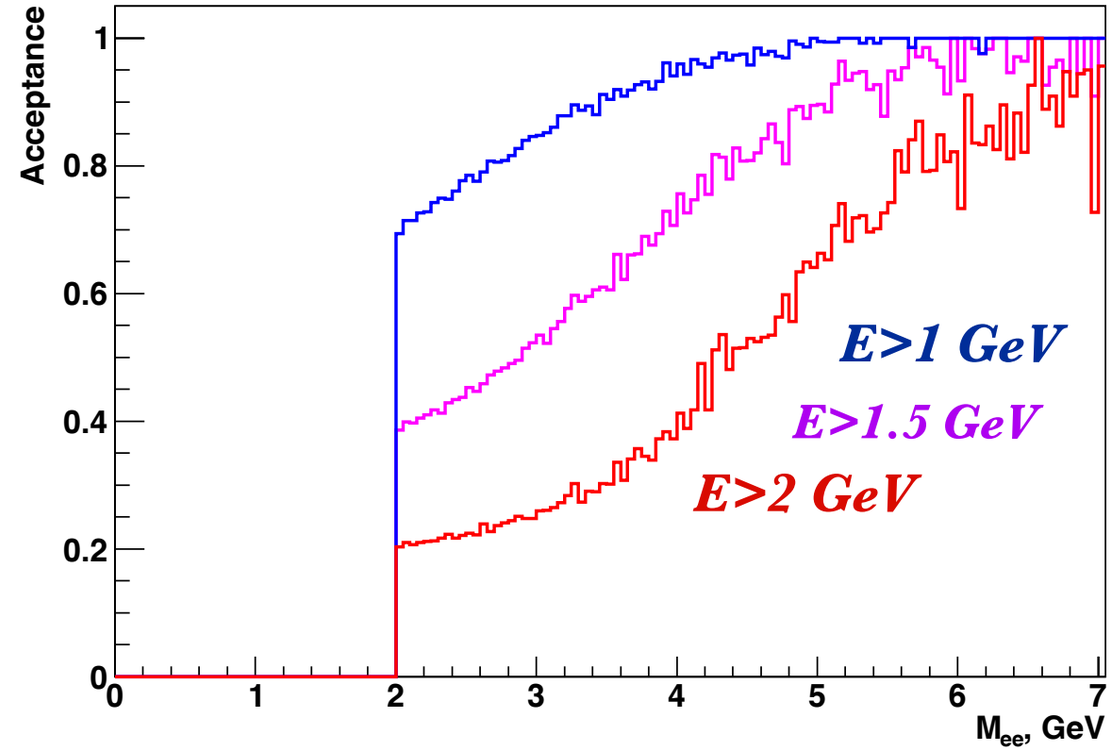
Simple 2e trigger rates

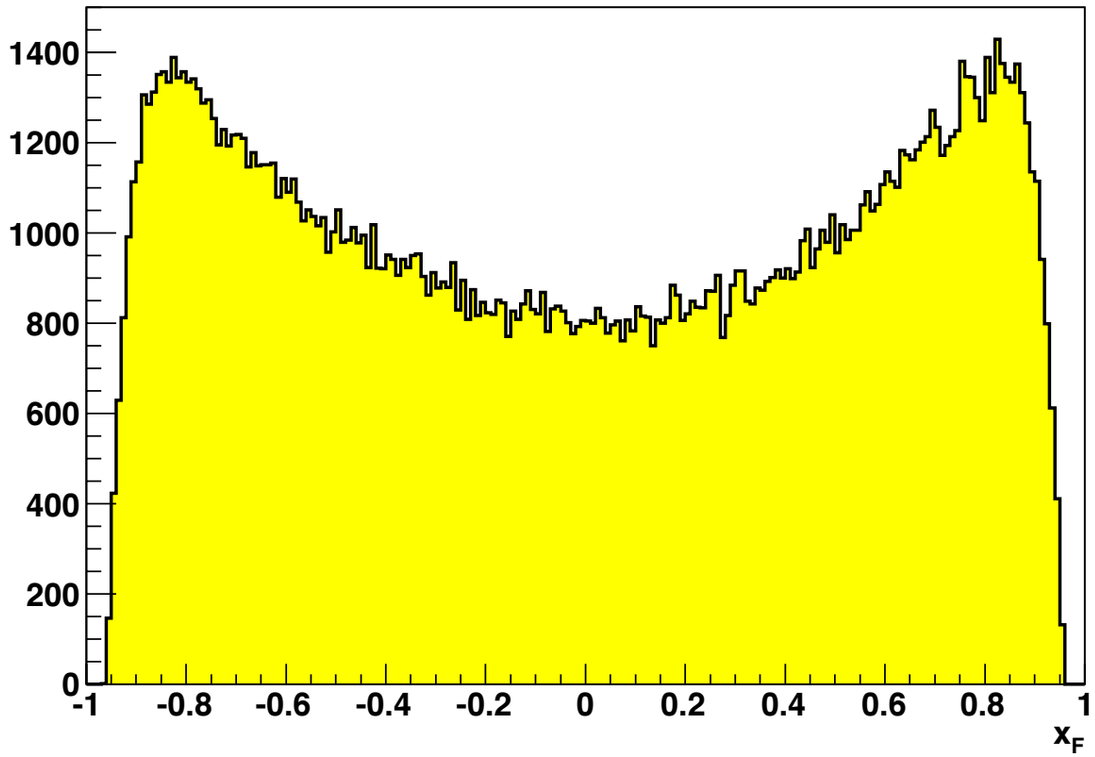
2 clusters in ECAL with energy above some threshold

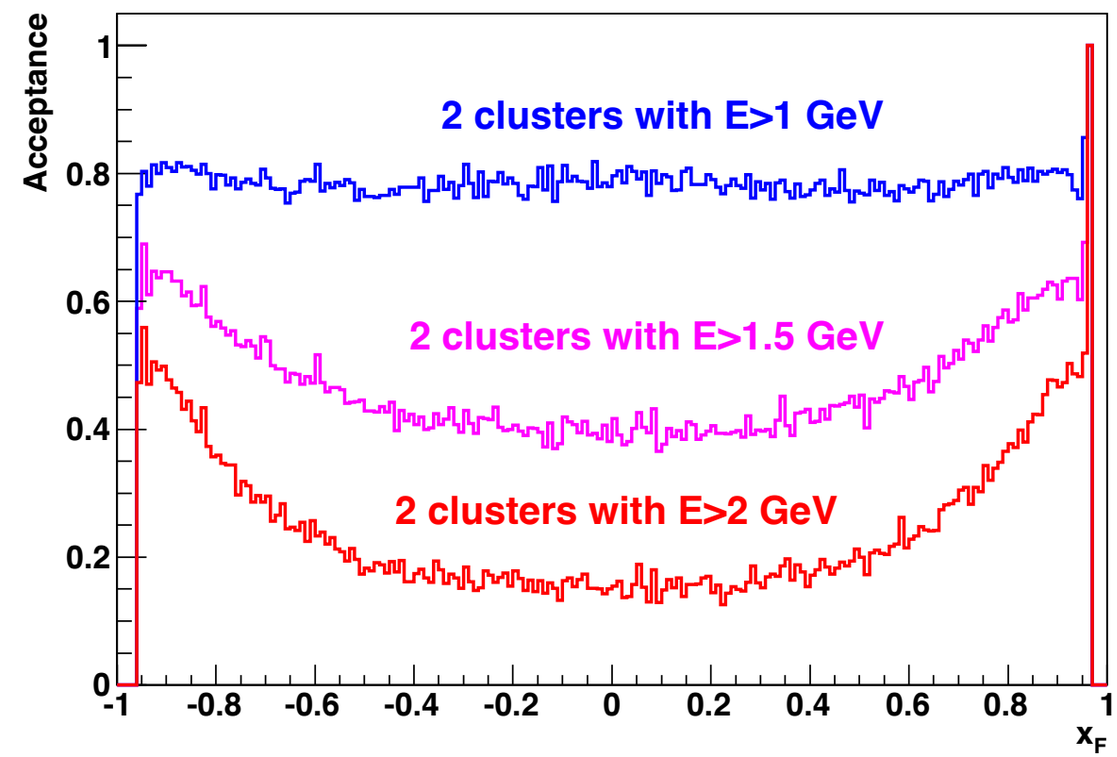


2e trigger: M and x_F distributions







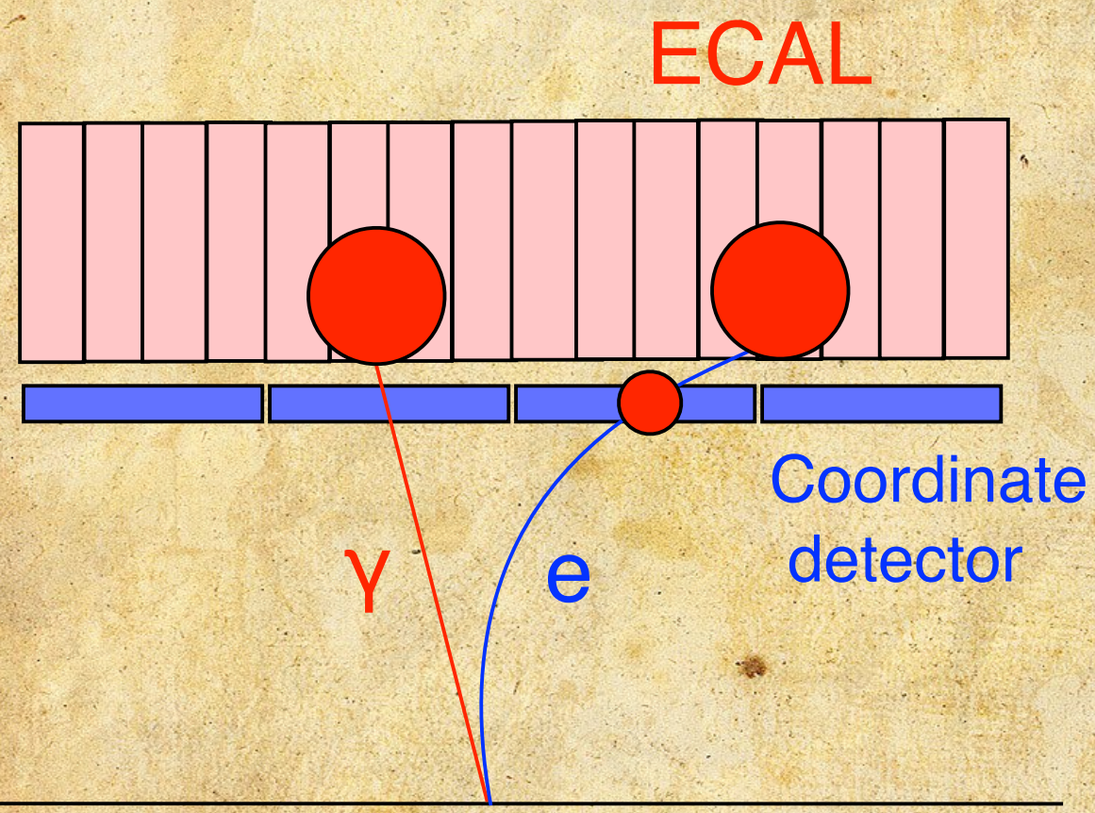


Overlapping of DP and 2e triggers

DP threshold, GeV	2e threshold, GeV	DP rate, kHz	2e rate, kHz	DP+2e rate, kHz	(DP+2e)-(DP)-(2e), kHz
3	1.5+1.5	71	81	131	21
4	1.5+1.5	21	81	96	6
4	2+2	21	20	38	3
2	2+2	260	20	260	20

Complex dielectron trigger 2e(c)

2 charged clusters in ECAL with energy above some threshold

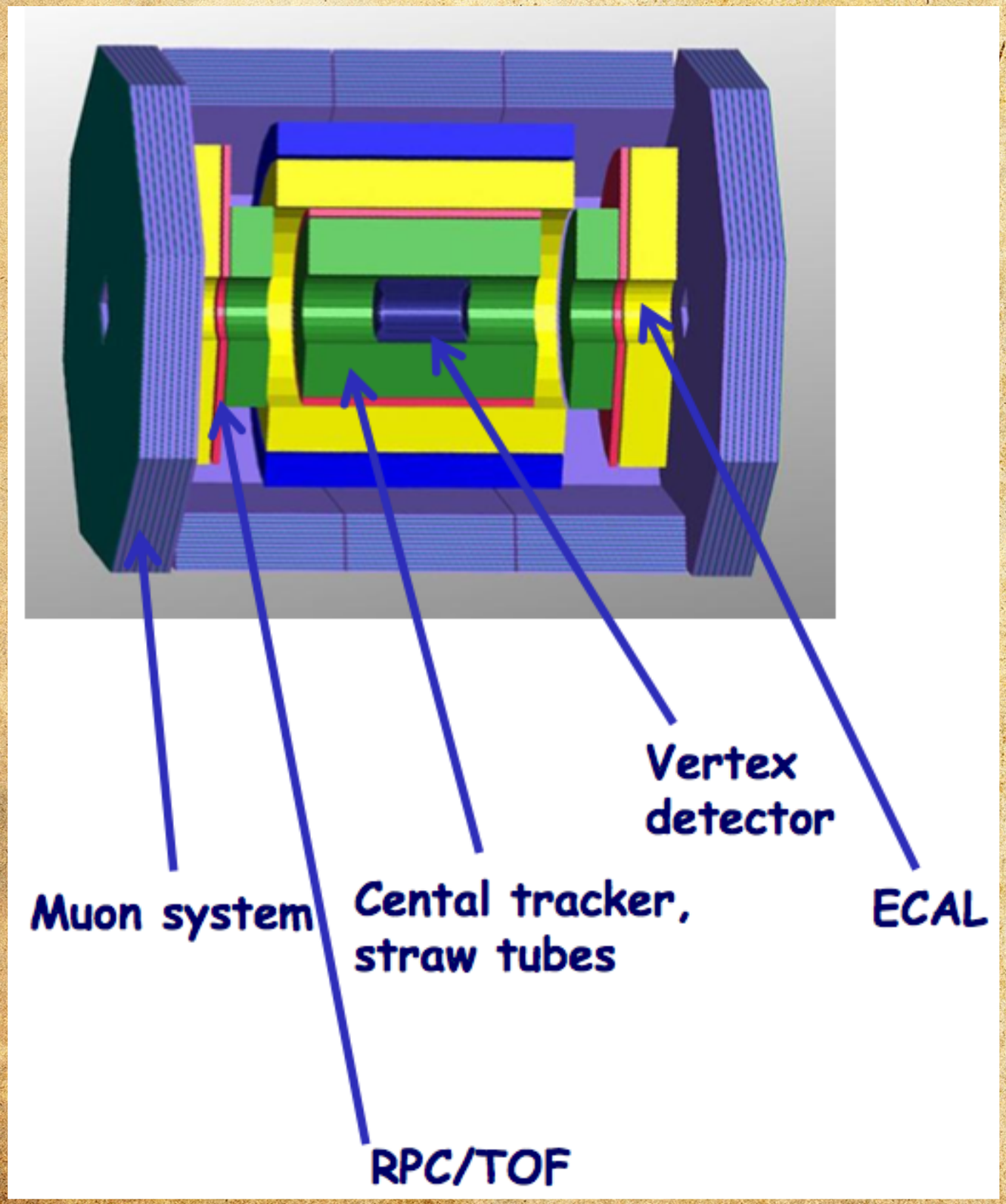


Coordinate detector:
- fast enough for trigger
- segmented

Possible variants:
- scintillator
- RPC (could be used also as TOF)

Rate depends on particular trigger implementation and amount of material in the central region of the setup. I would expect ~5 times lower rate than for simple 2e trigger

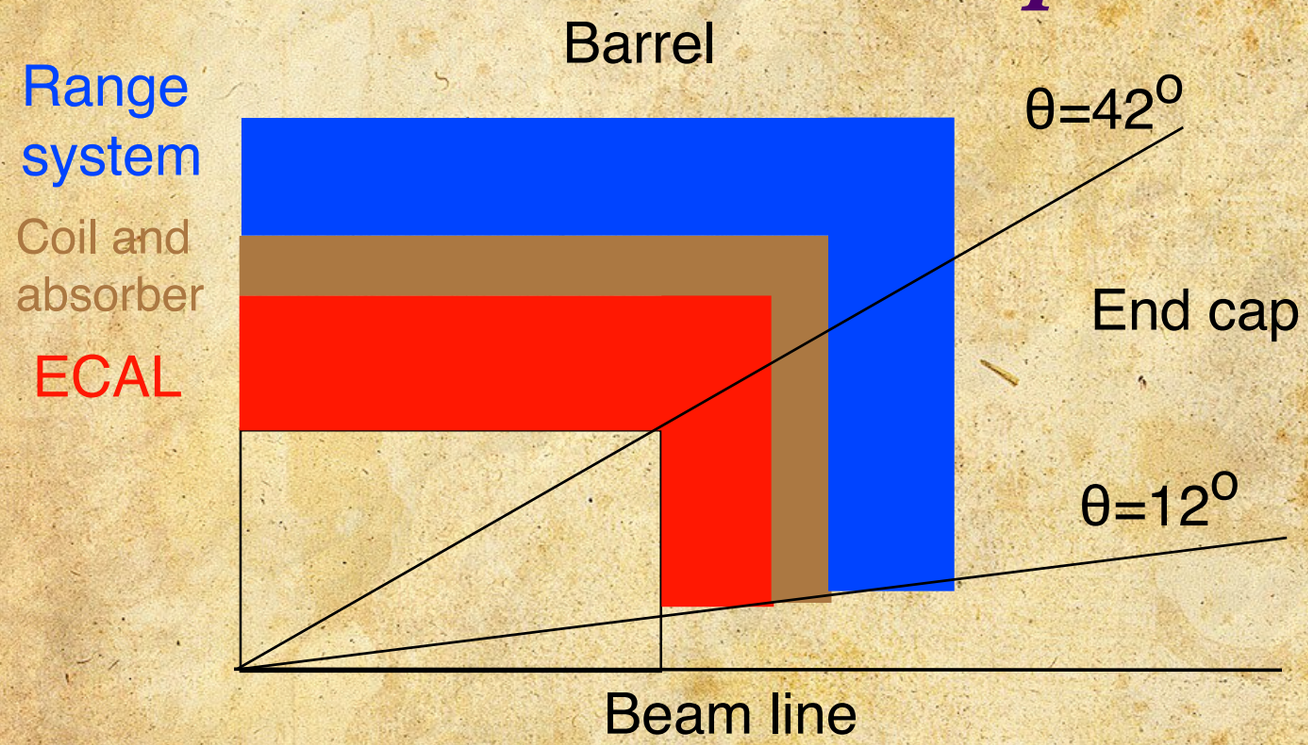
Dimuon (2μ) trigger



2 particles in the muon system

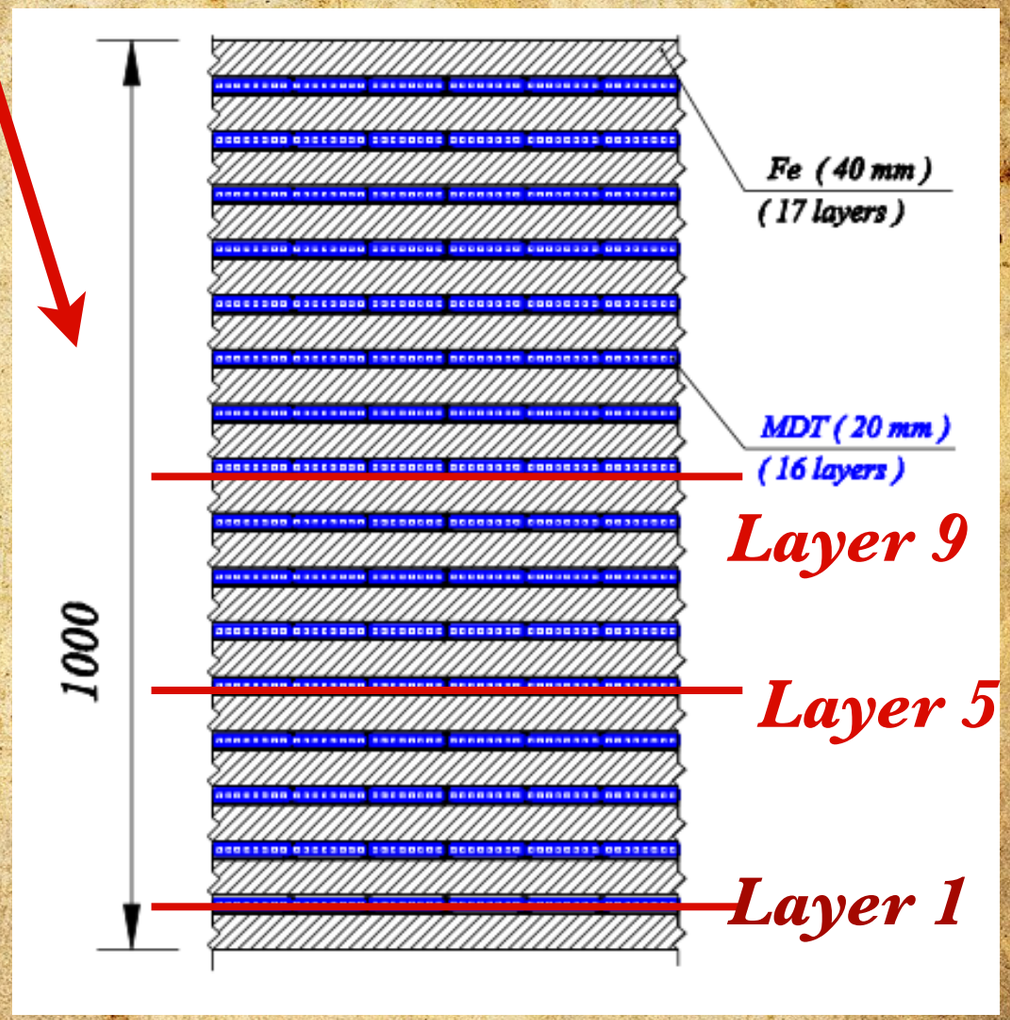
Material budget

3 possibilities for trigger planes



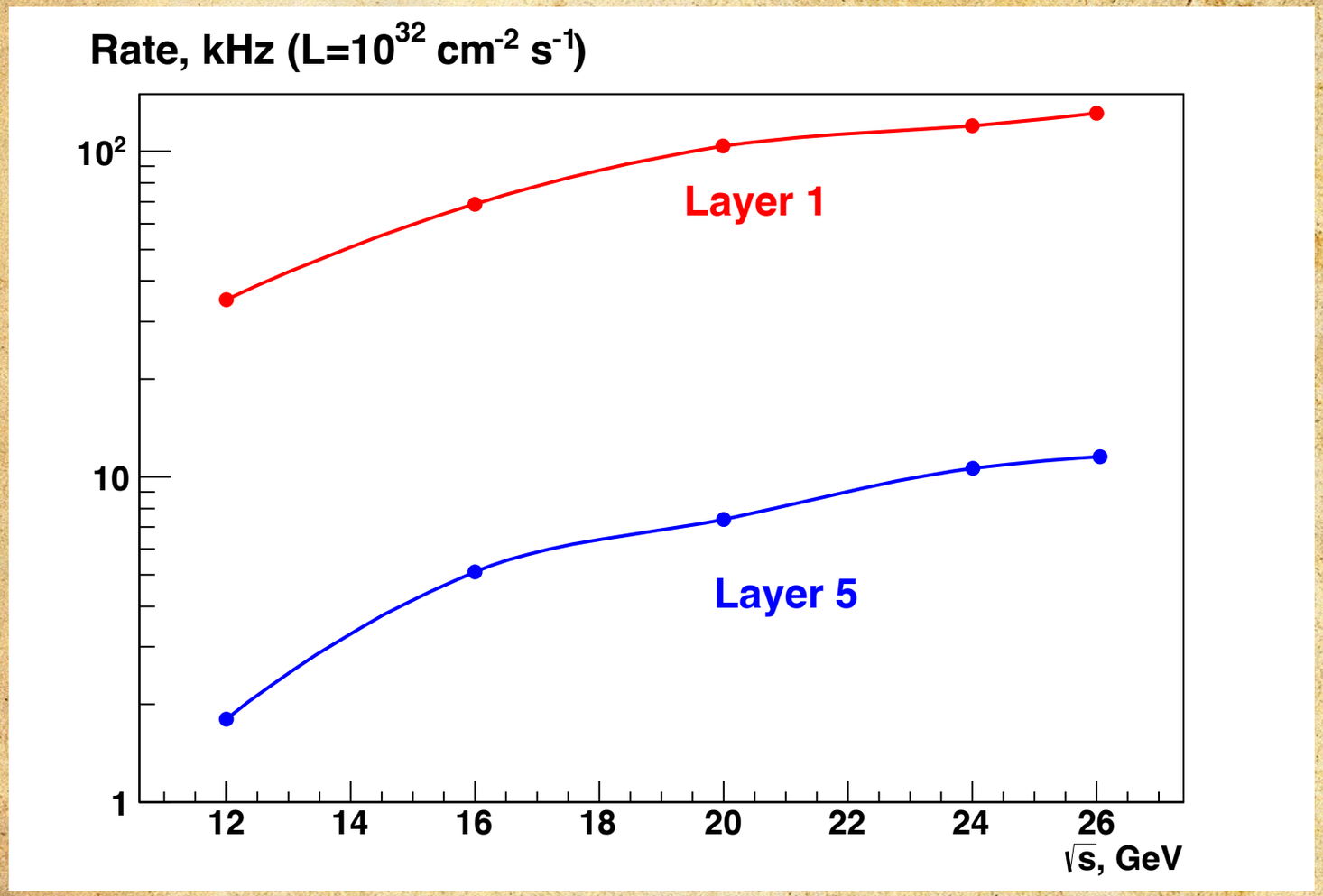
Structure	H/λ_π	dE, GeV
Internal part	~0.0	~0
ECAL	0,8	0,2
Coil/absorber	1,6	0,6
Range system	3,3	1,1
TOTAL	5,7	1,9

Range system

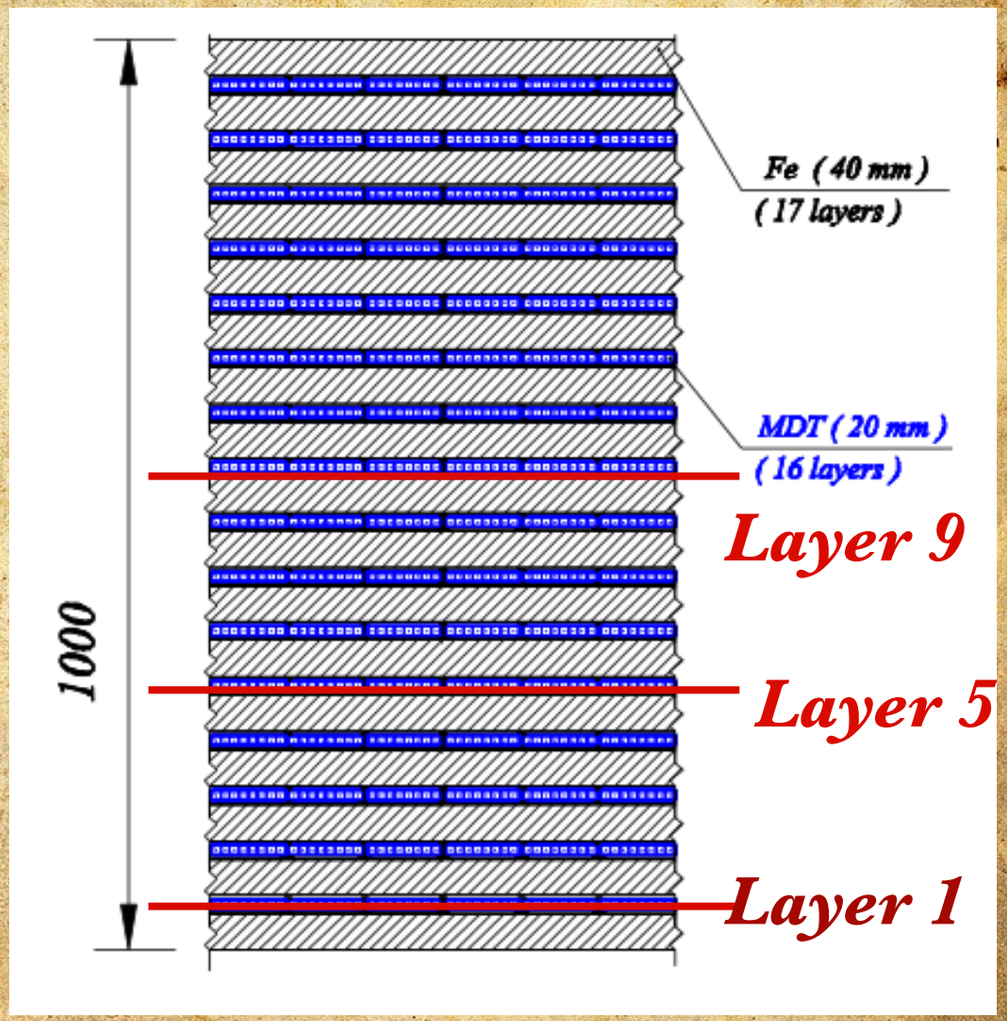


2μ trigger rates

$\sqrt{s}$=24 GeV/c

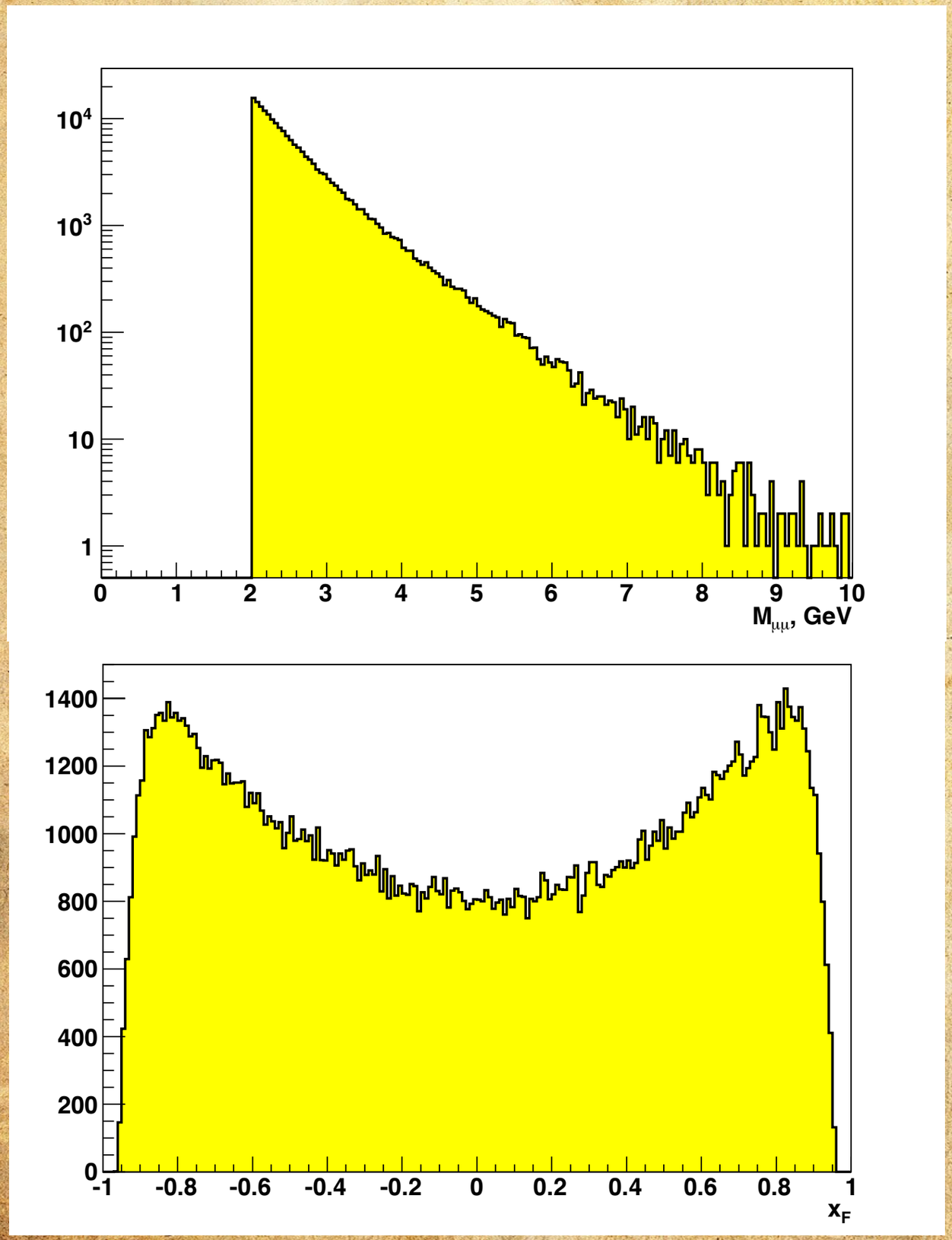


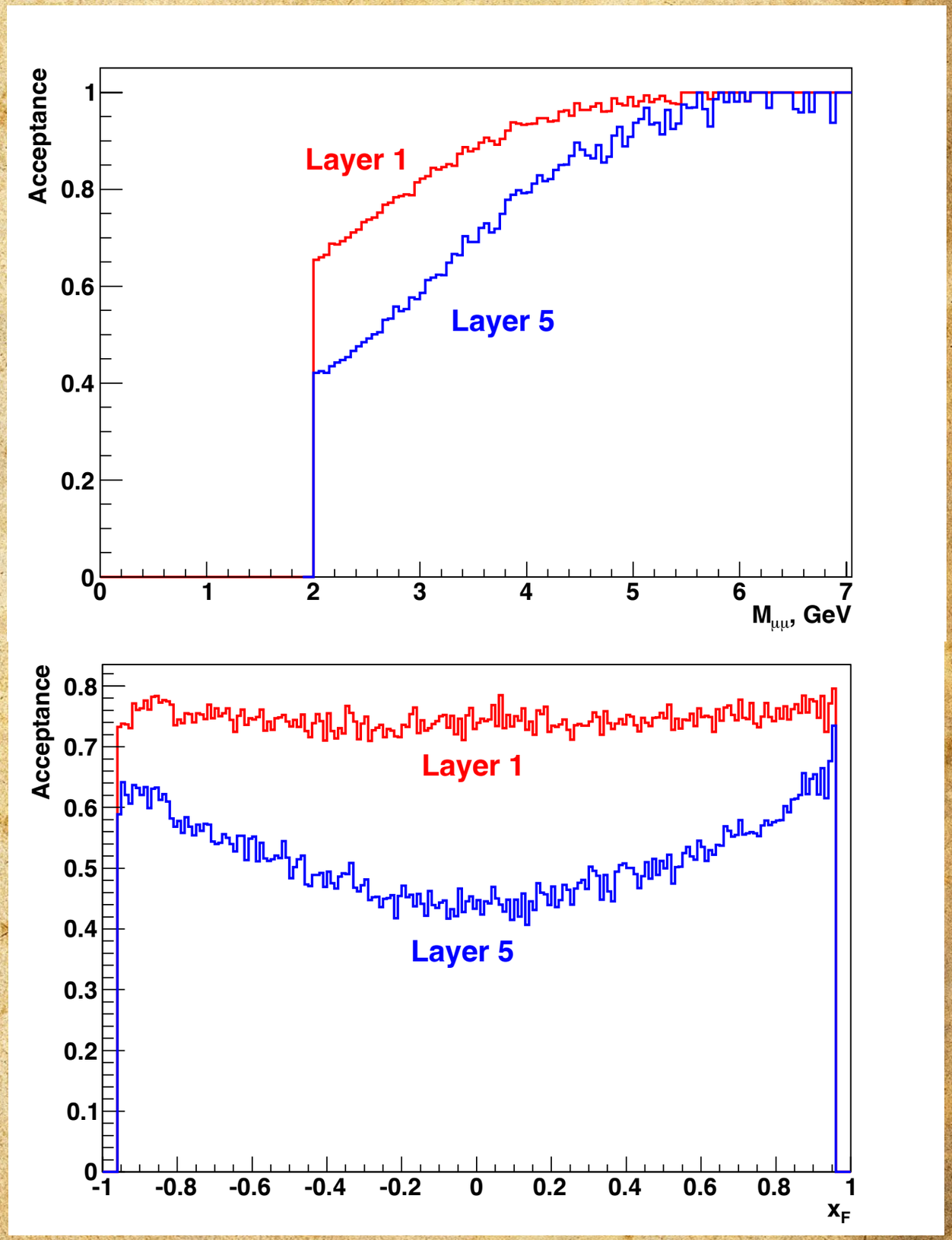
Layer	Rate, kHz
1	120
5	11
9	1,2



At $\sqrt{s}$=24 GeV/c main contribution comes from pions passed through the ECAL and absorber without interaction

2μ trigger: M and x_F distributions





Examples of triggers set

Trigger	Rate, kHz
DP, E>3 GeV	71
2e, E>2 + 2 GeV	81
2μ, layer 5	11
TOTAL RATE	142

Trigger	Rate, kHz
DP, E>4 GeV	21
2e(c), E>2 + 2 GeV	16
2μ, layer 5	11
TOTAL RATE	45

Event rate could be fitted to DAQ bandwidth

Rates of physical events

Process	Cross section, nb	Event rate, Hz
Direct photons	50	4.9
DY	3	0.2
J/ψ	10	1
TOTAL	73	6.1

Event rate 3 MHz

Primary trigger

DAQ acceptance 100-150 kHz

Secondary trigger

Rate of useful events <10 Hz

Summary

- *SPD trigger rate should be reduced from 3000 kHz to 100-150 kHz (DAQ limitation)*
- *3 triggers is proposed: ECAL-based triggers for direct photons and dielctrons (J/ψ and DY) and dimuon trigger.*
- *Two variants of dielectron triggers are discussed: trigger on any 2 clusters and 2 charged clusters above some threshold*
- *Rates of the proposed trigger fits desired DAQ bandwidth while acceptance for physical events remains reasonable*
- *Advanced study requires full detector description*
- *Huge gap between DAQ acceptance and the rate of useful events gives occasion to thing about the secondary trigger.*