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19/03/96

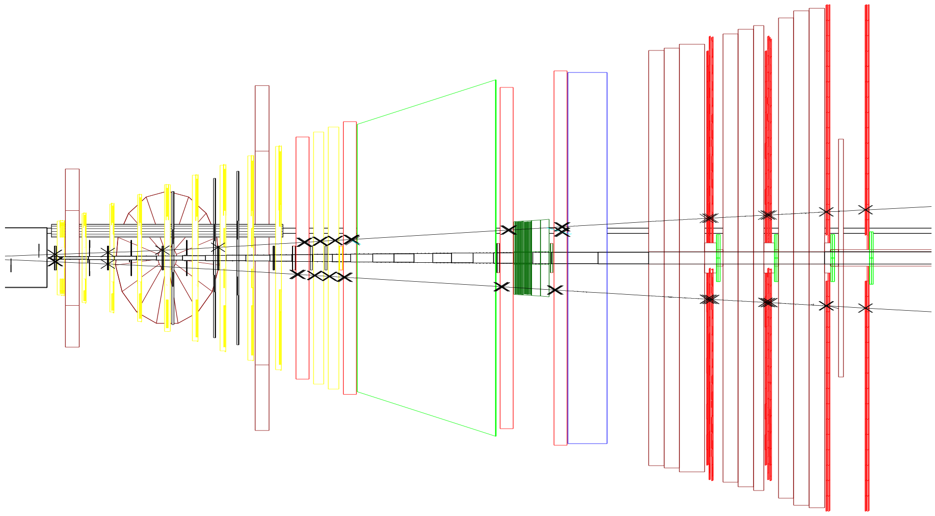
First Level Trigger
The Muon Story

- Muon system geometry
- Pretrigger logic
- Trigger processing
- Acceptance for muons from J/ψ
- Backgrounds: rates and sources
- FLT output rate

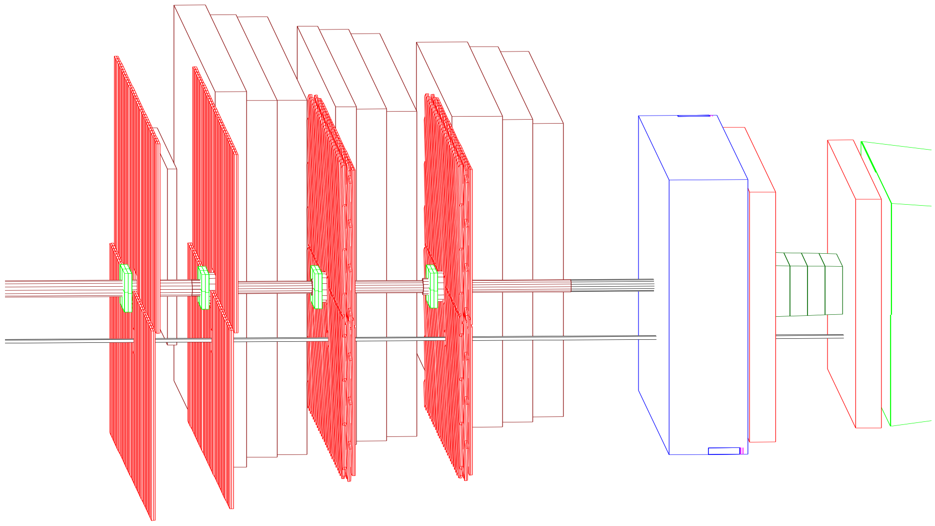
This talk could be found at **hera-b/x4u**:

/home/x4u/ftp/pub/herab/talks/HH-02-96/FLT_MUONS.ps

Muon registration in HERA-B detector

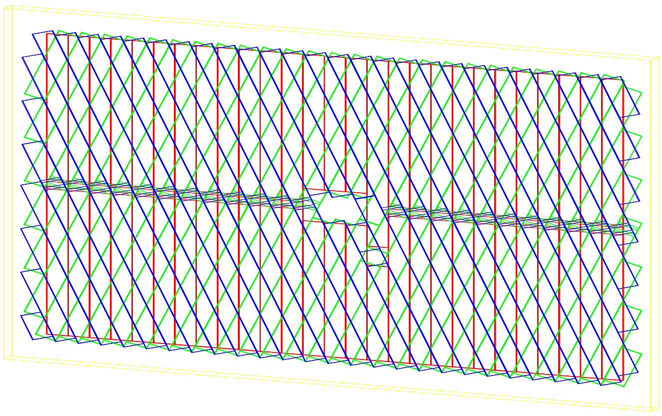


Muon system: Back view



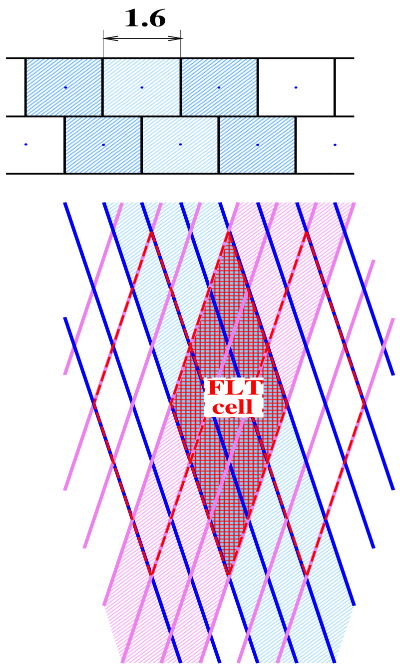
RIh

Wire chambers geometry (MU1)



$-20°$, $0°$, $+20°$ stereolayers

Cell geometry:



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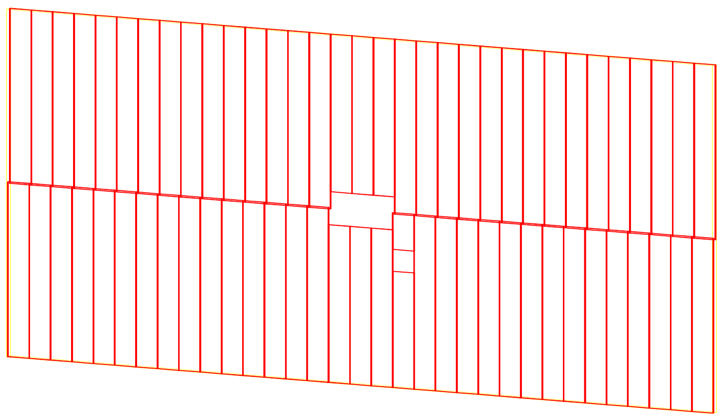
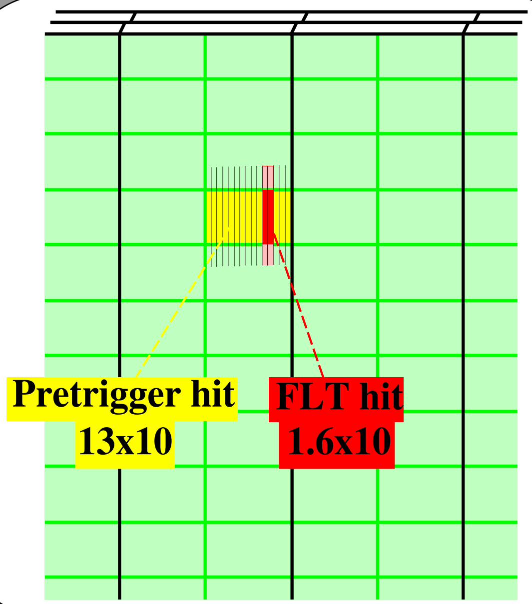
PAD chambers geometry (MU3/MU4)



0° layers only + PADs

Pad & cell geometry:



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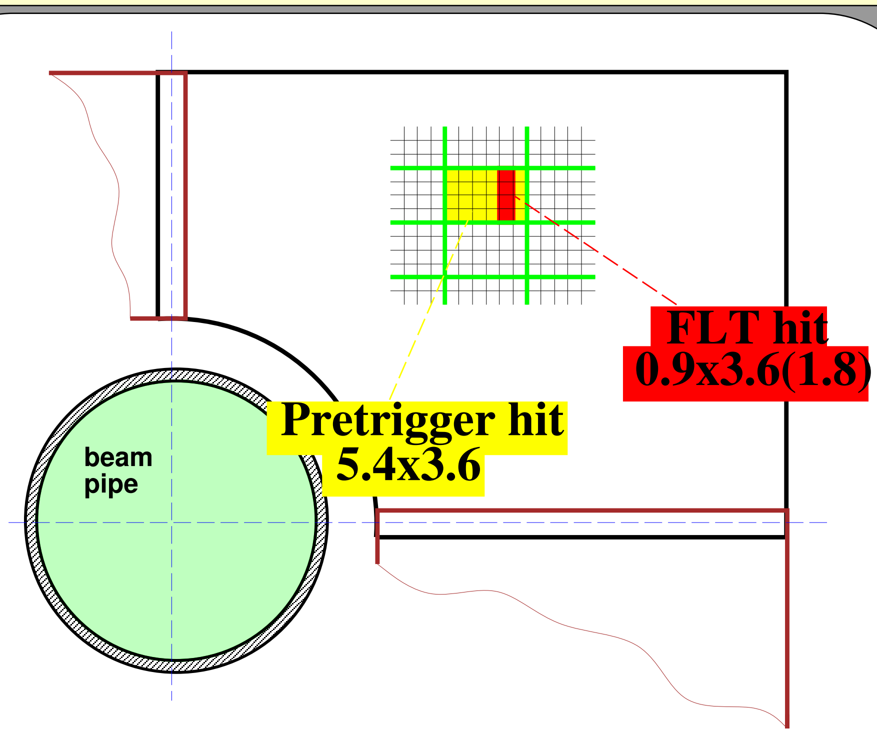
Central pixel chambers (MX1/MX3/MX4)



Physical cell is composed by pixel ORing:

- 1×2 in MX1
- 1×4 in MX3/MX4
- pretrigger "PADs": 6×4 in MX3/MX4
- projective geometry in MX3 & MX4

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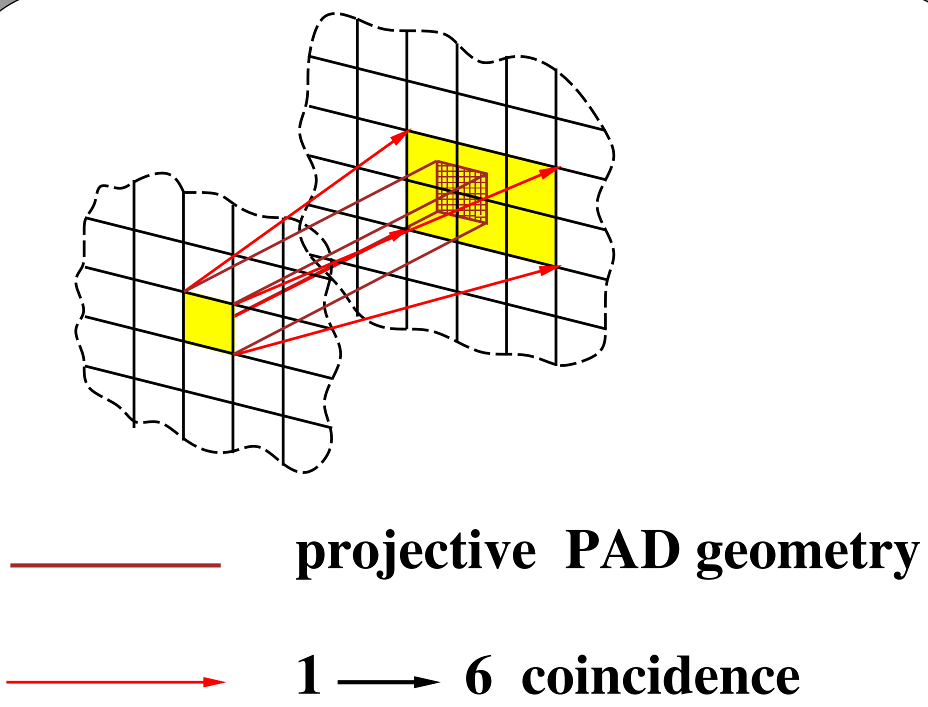
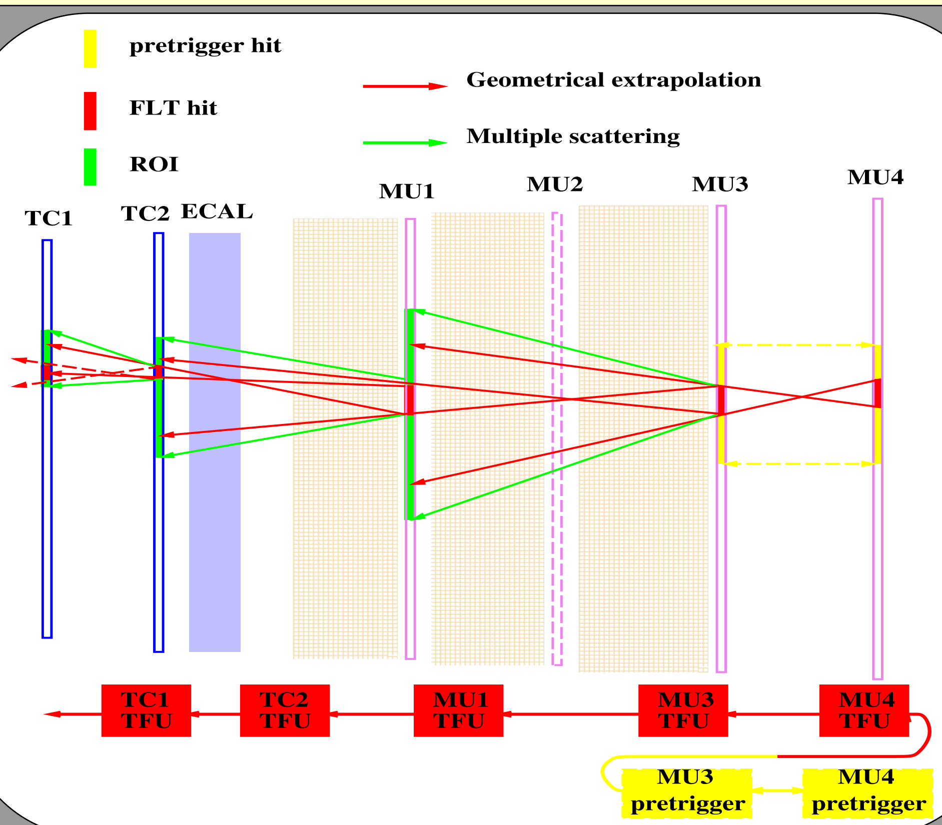
Muon pretrigger logic: PAD coincidences in MU3 & MU4



- projectivity in Y (1/2 cell shift)
- $1 \to 1$ projectivity in X (pixel chambers only)
- $1 \to 6$ PAD coincidence
  - $1 \to 3$ in X
  - $1 \to 2$ in Y

First Level Trigger procedure

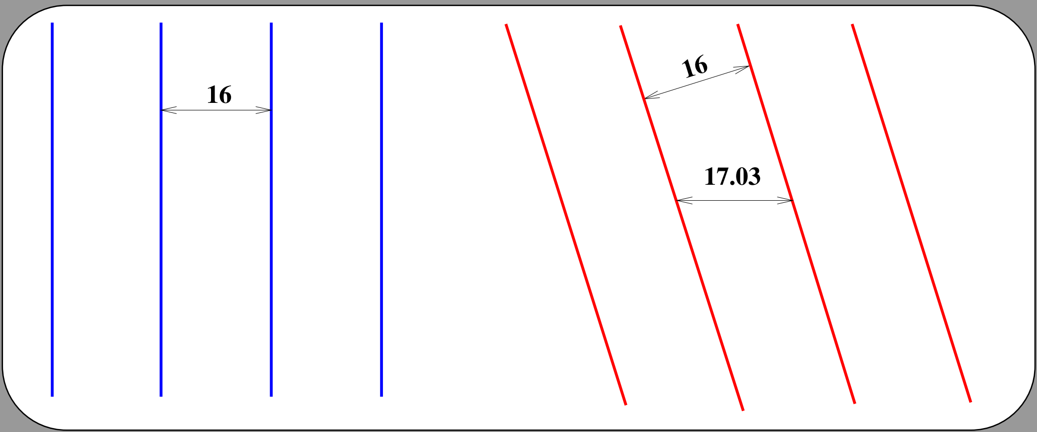


- hit position improvement in MU3/MU4
- multiple scattering in shielding
- standard procedure after TC1

Rlh

Muon specific problems

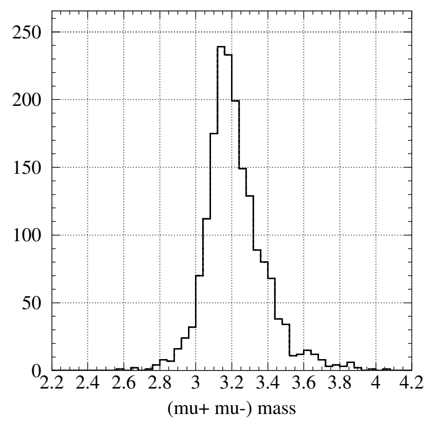
- Multiple scattering should be considered in track extrapolation
- the FLT detector unit is composed by many GEANT detectors (chambers): nontrivial detector/hit translation
- TFU coincidence matrix suppose equal spacing in X for all stereoangles; for muons one additional "0°" wire is needed per every 15 wires (20° stereoangle!!)

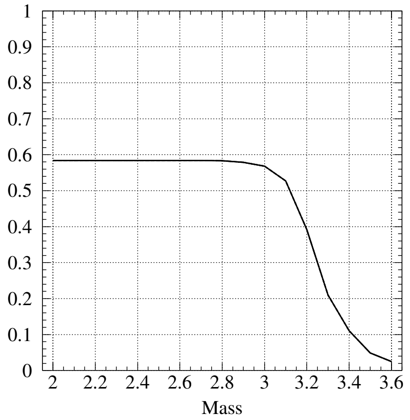


%

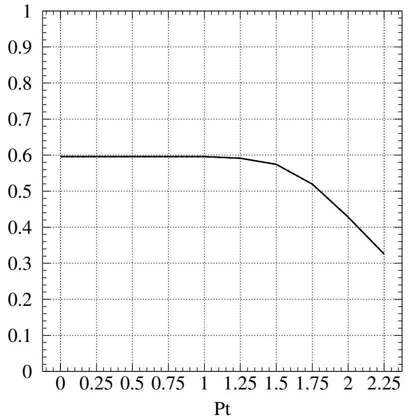
FLT efficiency for muons from $J/\psi \to \mu^+\mu^-$

$\mu^+\mu^-$ invariant mass





p_T dependence



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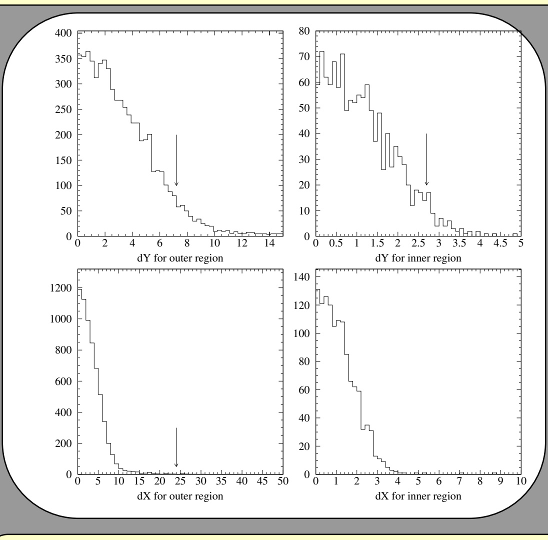
Muon Inefficiency Reasons: first 100 events study

- Geometrically accepted: 72
- Multiple scattering of slow particles: 4
- Walls between cells: 3
- Hole in the tracker (SW bug): 3
- Beam pipe hole in muon system: 2

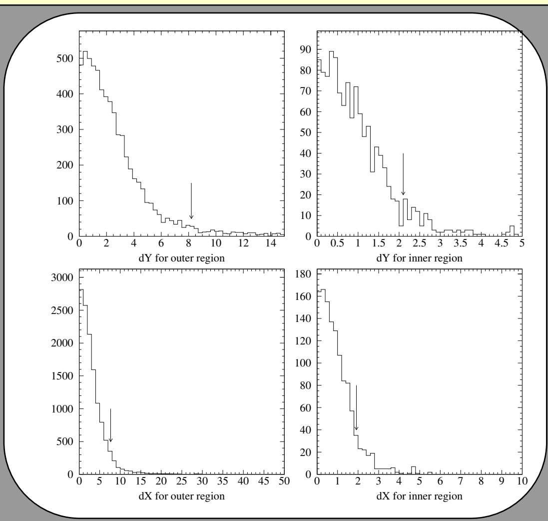
FLT accepted: 60

ROI sizes study

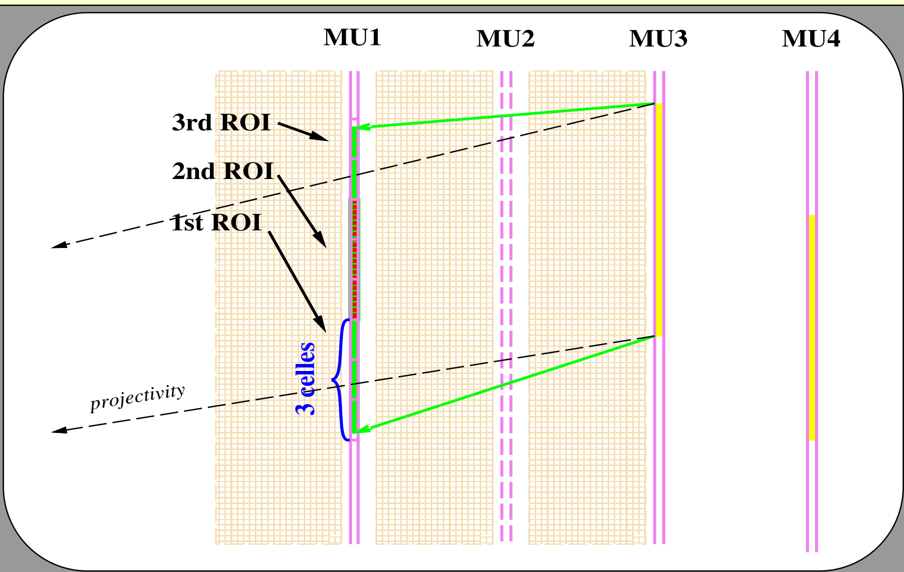
MU4+MU3→MU1



MU3+MU1→TC2



Messages could and should be splitted on pretrigger level:



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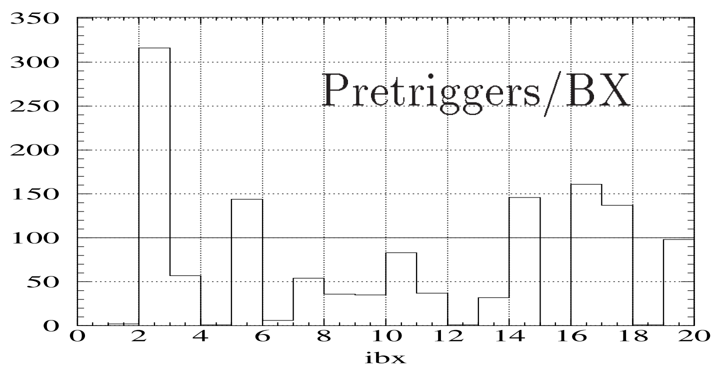
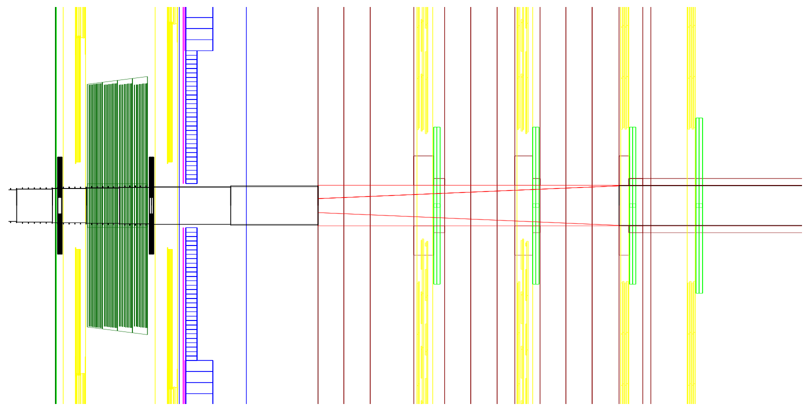
Reasons for muon pretriggers:

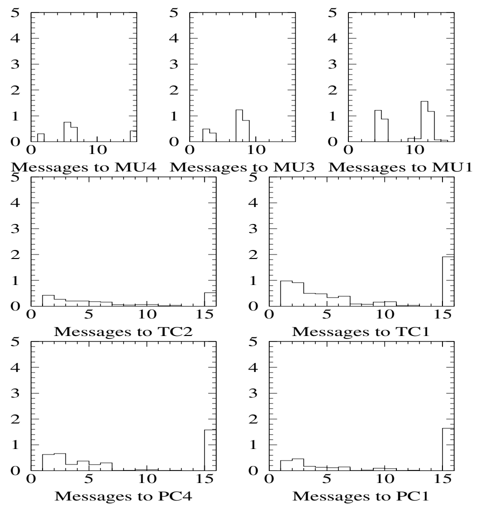
- K, π decays on flight $\rightarrow$ real muons in muon system
- slow products of primary particles (γ) interactions on the proton beam pipe



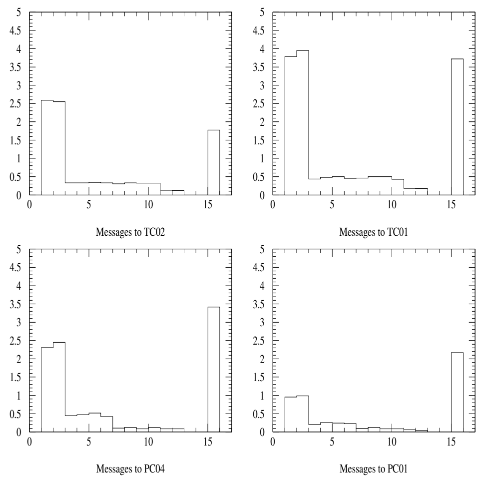
Will be suppressed with a special shape of the beam pipe:



Mean TFU loads



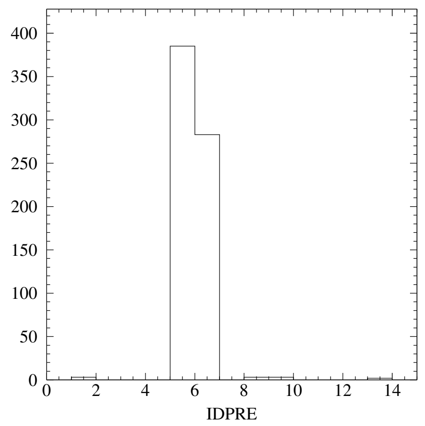
Load from electrons



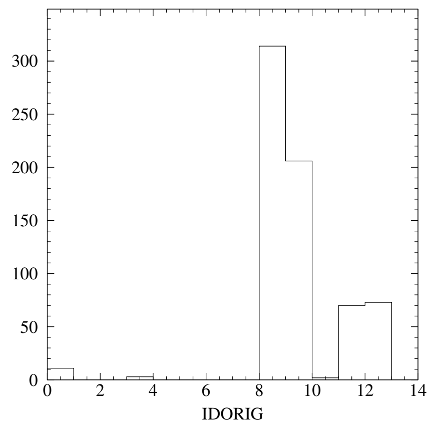
On the reasonable level...

Muon candidates

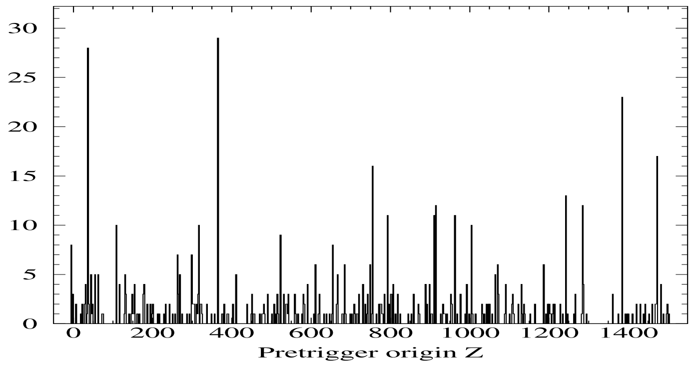
MC ID of the pretrigger particle



MC parent for the pretrigger particle



Z position of the pretrigger particle origin



Muons from weak decays...

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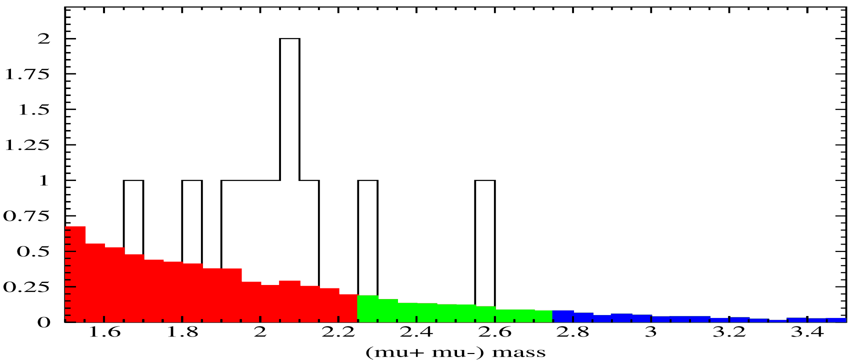
FLT output rates

Poor statistics: 760×5 minbias

Track candidates from different events could be combined together



Mass interval	Direct measurement	Combined estimation
$M(\mu^+\mu^-) > 1.5\ GeV/c^2$	10 ev	9 ev
$M(\mu^+\mu^-) > 2.25\ GeV/c^2$	2 ev	2 ev
$M(\mu^+\mu^-) > 2.75\ GeV/c^2$	0 ev	1 ev

Contribution to output FLT rate $\sim$ 13 kHz

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Conclusions

- Muon part is implemented in HBGEANT
- FLT procedure for muons
  is implemented in L1SIMU
- Reasonable efficiency 60% for muons
  from $J/\psi \to \mu^+\mu^-$ is obtained
- Contribution to TFU load ~ 1 message per BX
- Contribution to FLT output rate $\sim 13kHz$

The very first results:
following study/optimization is needed