W trigger upgrade simulation

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Muon Physics and Forward Upgrades Workshop

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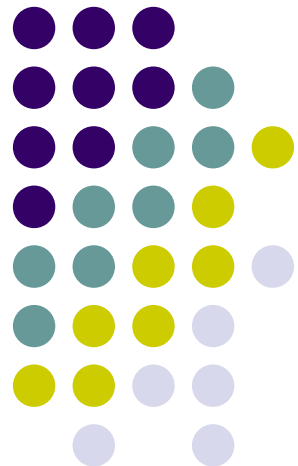
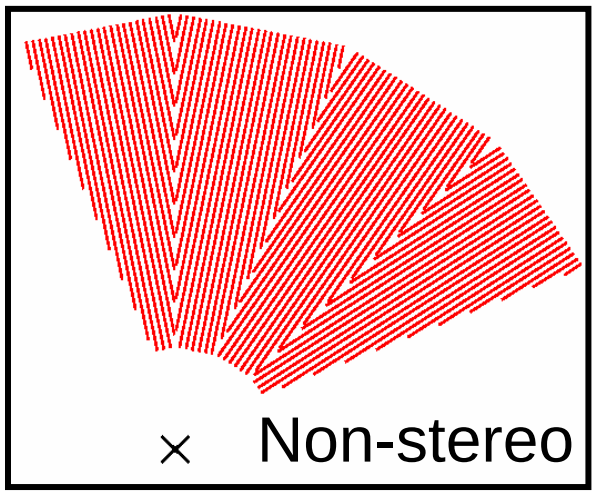


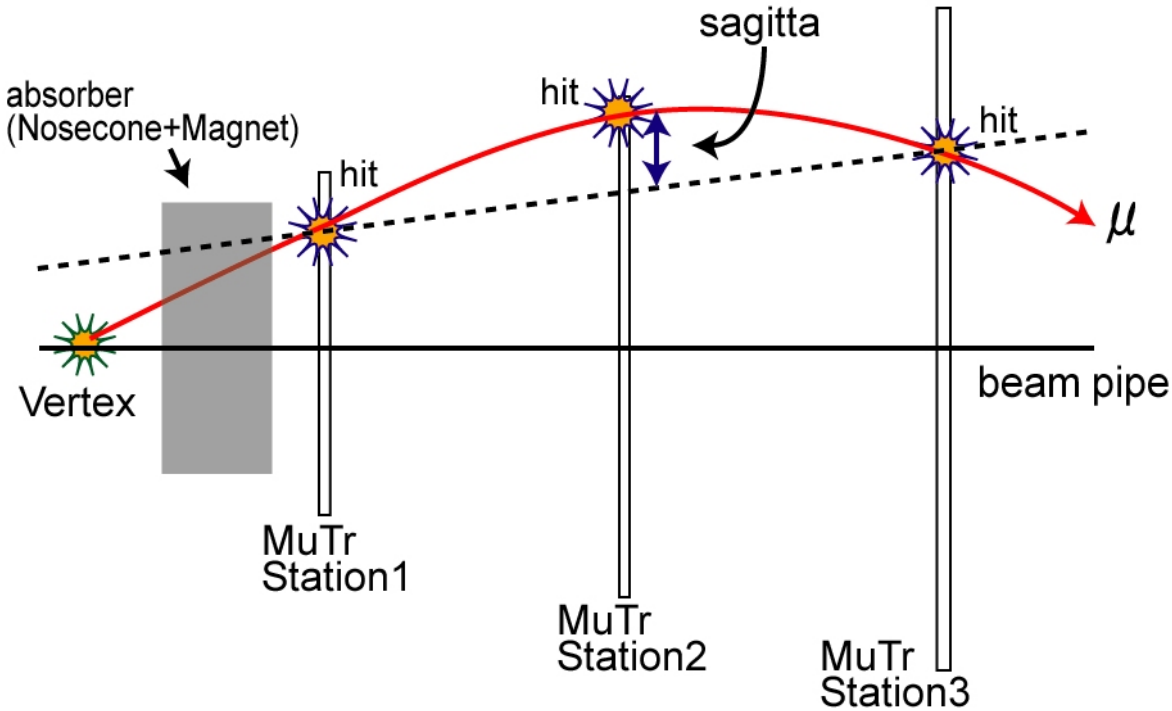
MENU

- MuTrLL1 idea
  - simulation results (Kazuya's)
  - influence on current system (Kohei's)
- MuPCLL1 idea
  - simulation results (Wei's)

MuTr LL1 - basic idea

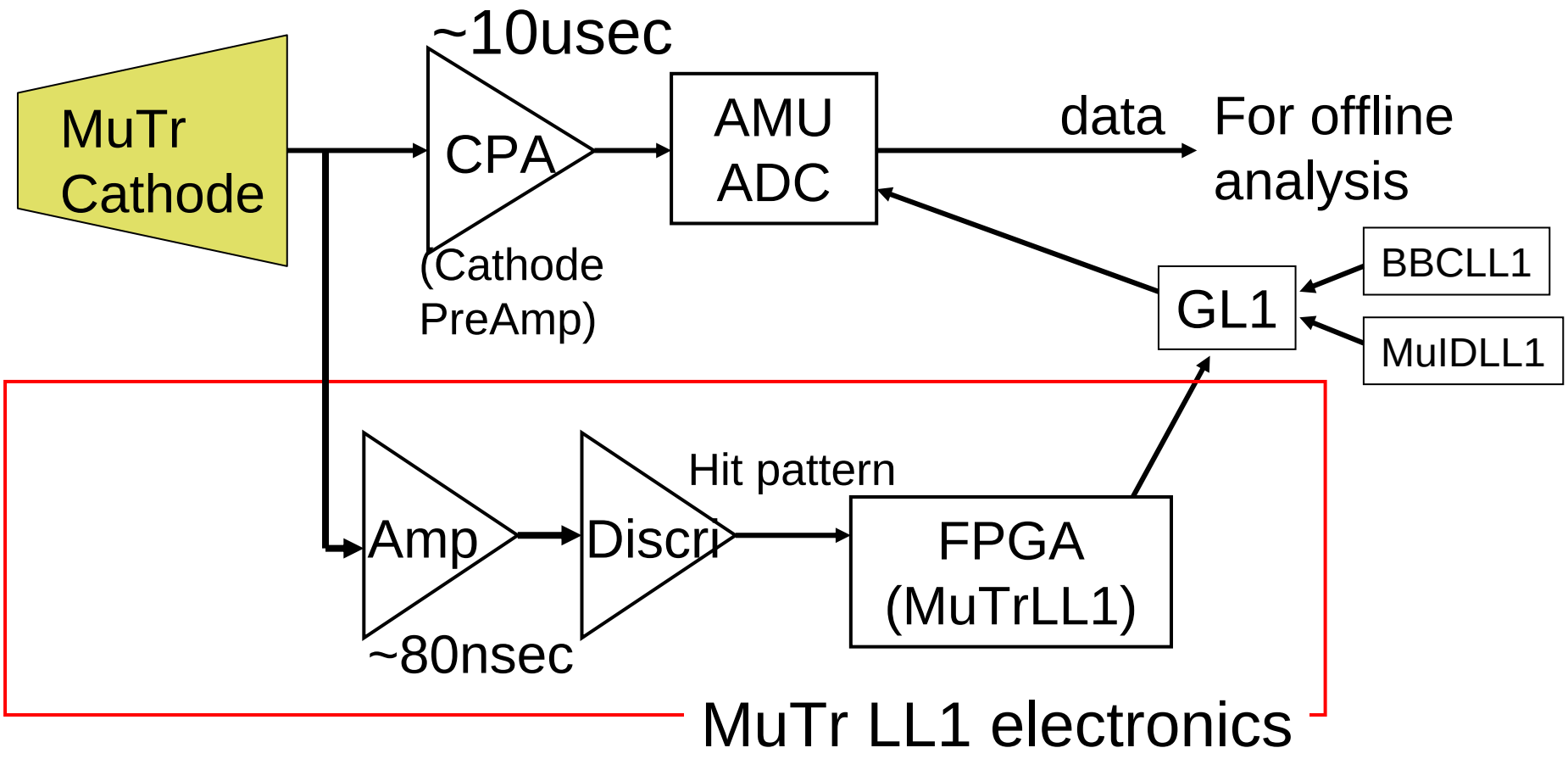
- Accept high momentum tracks.
- Measure sagitta using hits at station 1,2 and 3
- Read out 1 / 1 / 1 planes for LL1
  - We have 6 / 6 / 4 planes in MuTr
  - Read out non-stereo type planes



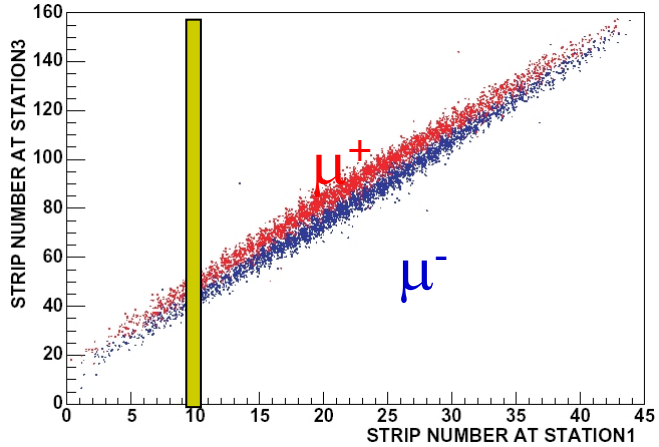


sagitta: the difference between
The actual hit at station#2 and
interpolated position

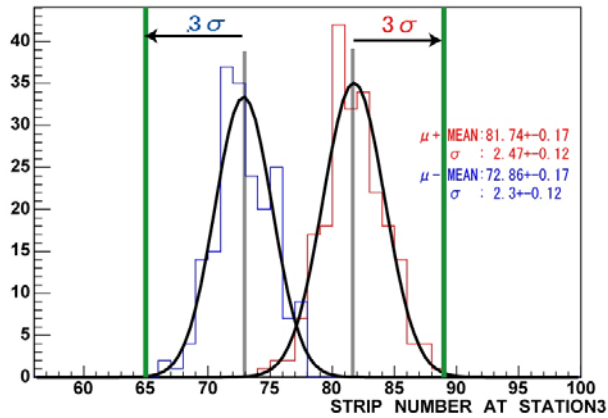
MuTr LL1 - electronics



MuTr LL1 - algorithm



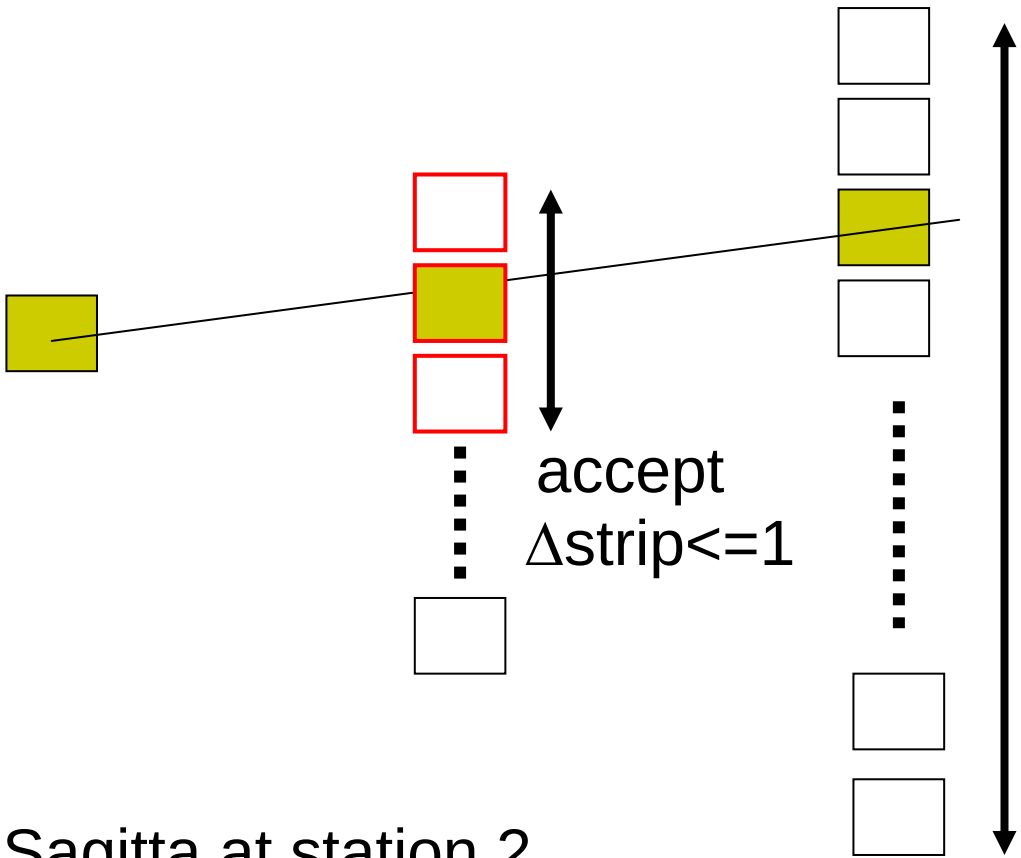
INPUT: single μ 15GeV/c
vertex z=0



Strips at Station 1

Strips at Station 2

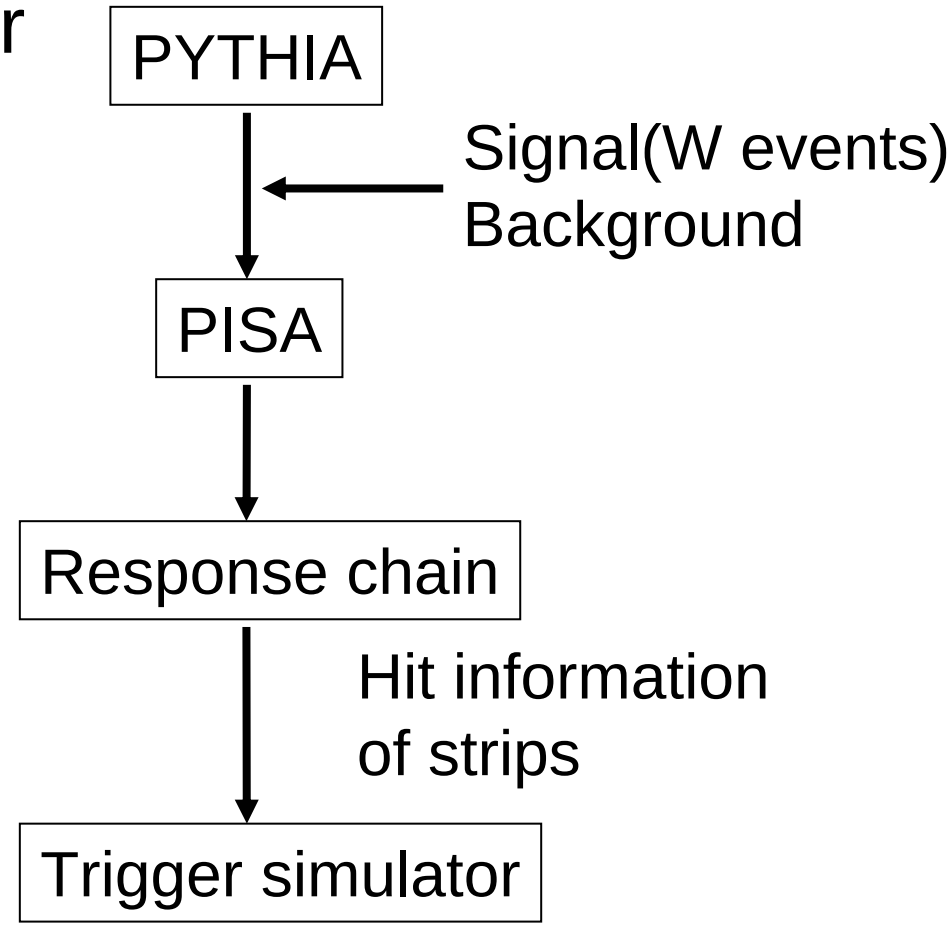
Strips at Station 3



Δstrip :Sagitta at station 2

Estimate RF and Eff ~Simulation procedure

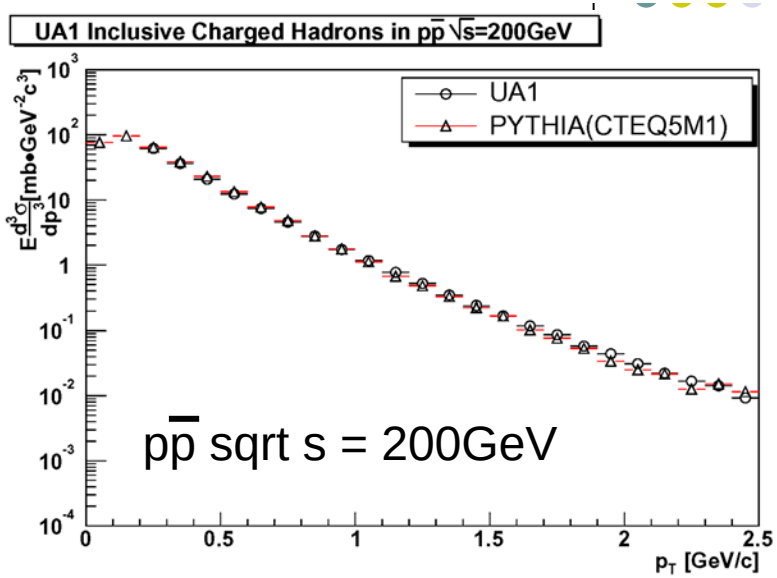
- Rejection Factor
- Efficiency

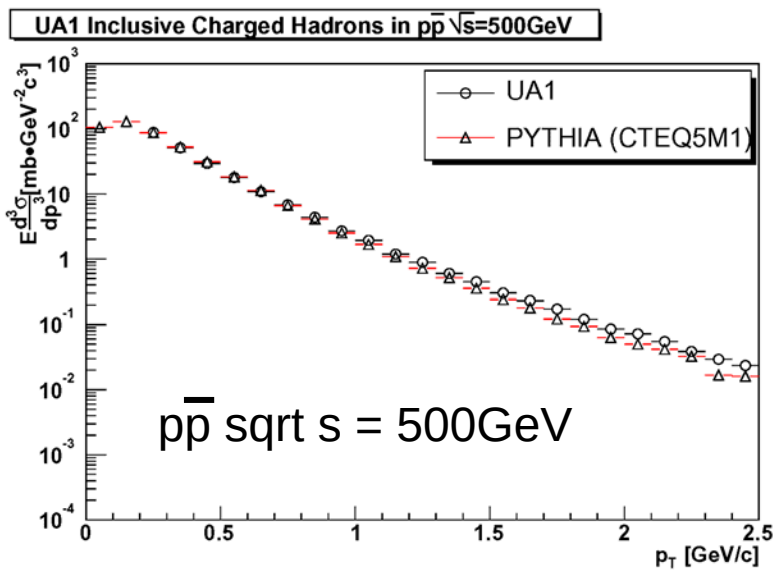


Simulation procedure ~ event generator

- Software and PDF
  - PYTHIA Ver6
  - CTEQ5M1
- Settings for background
  - $\langle k_T \rangle$=2.5GeV/c , k_T<10GeV/c
  - MSEL=2(MinBias : total σ)
  - No cuts applied
  - 1M events
  - Agrees well with UA1 data
- Settings for signal
  - MSEL=12
  - Cuts applied
    - W should decay into μ
    - The μ should have P_T>20GeV/c and -1.2>η>-2.2 or 1.2<η<2.4
  - 50k events

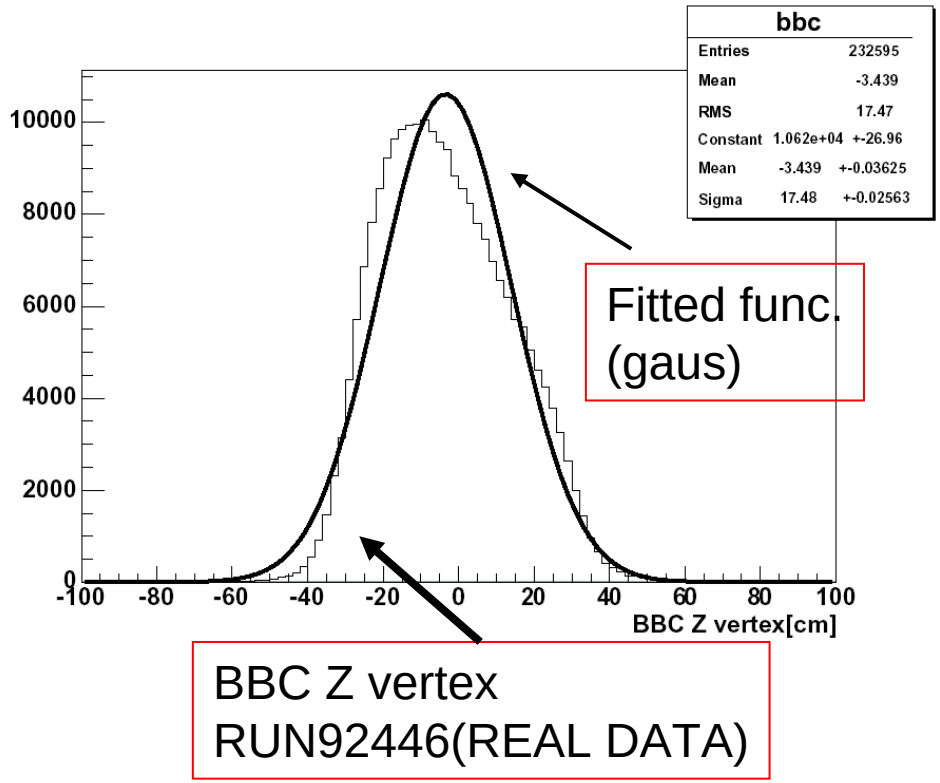
Inclusive charged hadron p_T spectra





Simulation procedure PISA

- Vertex distribution
  - rms of z = 17



Definitions

- Rejection Factor

$$\frac{\text{MinBias(Total s)}}{\text{\# of triggered events (MuTrLL1 X MuIDLL1)}}$$

- Efficiency

$$\frac{\text{\# of triggered events (MuTrLL1 x MuIDLl1)}}{\text{W decays into } \mu \text{ which satisfy the following: } p_T > 20\text{GeV/c and } -1.2 > \eta > -2.2 \text{ or } 1.2 < \eta < 2.4}$$

Rejection & Efficiency

Using only 2 stations

	MuTr x MuID	MuIDLL1 only
Rej	3200+-260	241 +-4
Eff	70%	95%

Using 3 stations (MuTr LL1 x MuID LL1)

	Δstrip<=1	Δstrip<=2	Δstrip<=3
Rej	23700 +-3450	10900 +- 1170	7180 +- 625
Eff	66%	66%	66%

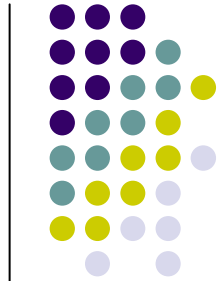
Enough rejection factor. Good efficiency

$$\text{Eff} = [\text{MuIDLL1}]_{95\%} \times [\text{MuTr acc}]_{79\%} \times \left[\frac{\text{MuTr trigger plane eff.}}{96\%}\right]^3$$

$$= 66\%$$

Δstrip :Sagitta at station 2

Requirement for preamp

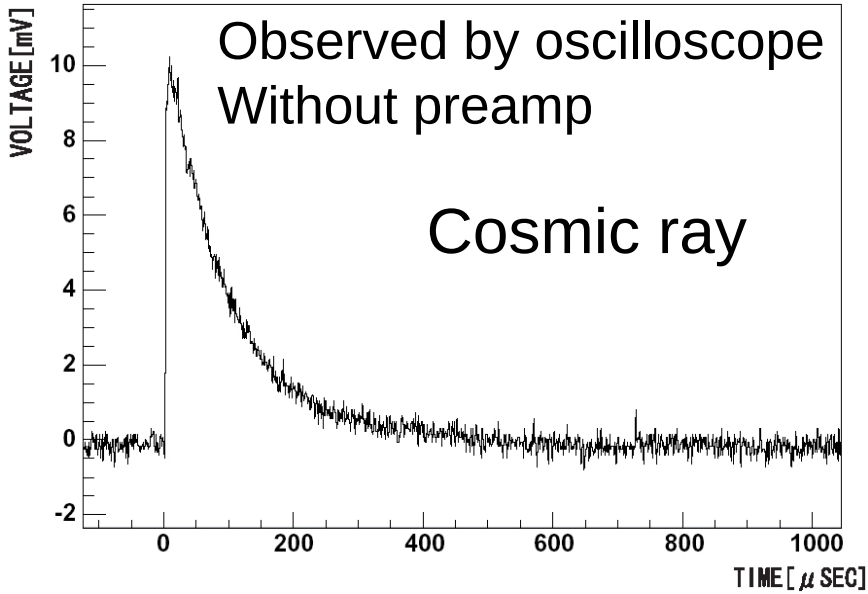


- Drift time ~80 nsec → within bunch interval
- Integration time of preamp should be less than 100nsec.

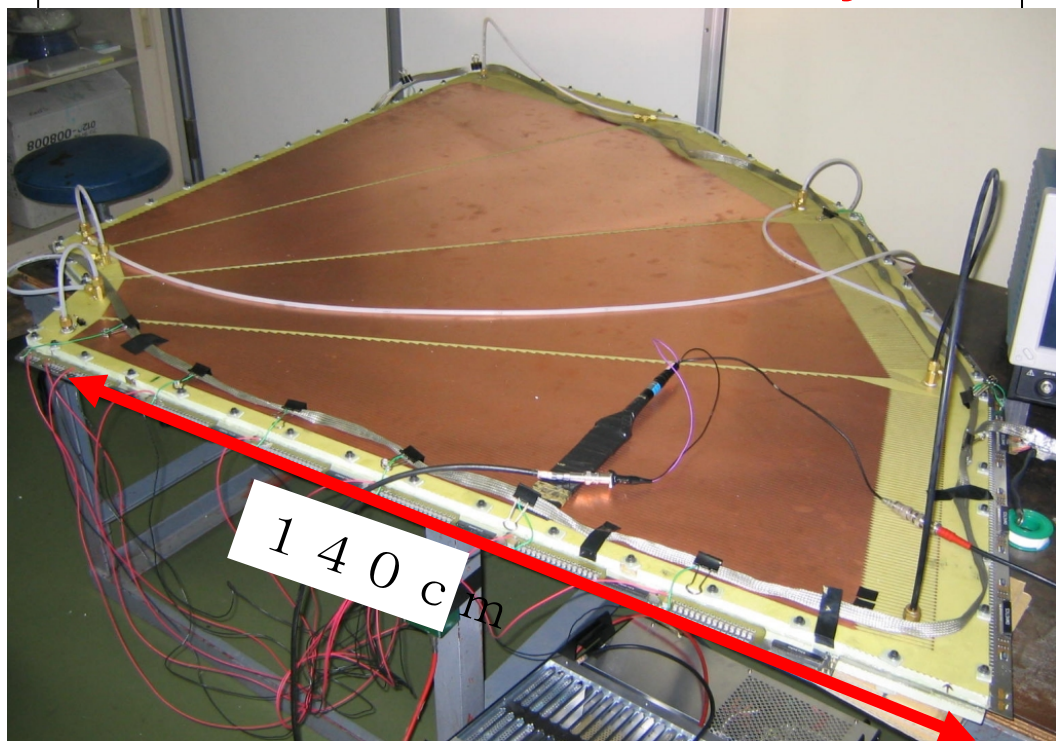
- We are testing Amp shaper discri chip (made by Tanimori et. al.) with chamber
  - 80 nsec shaping time.

MuTr test chamber

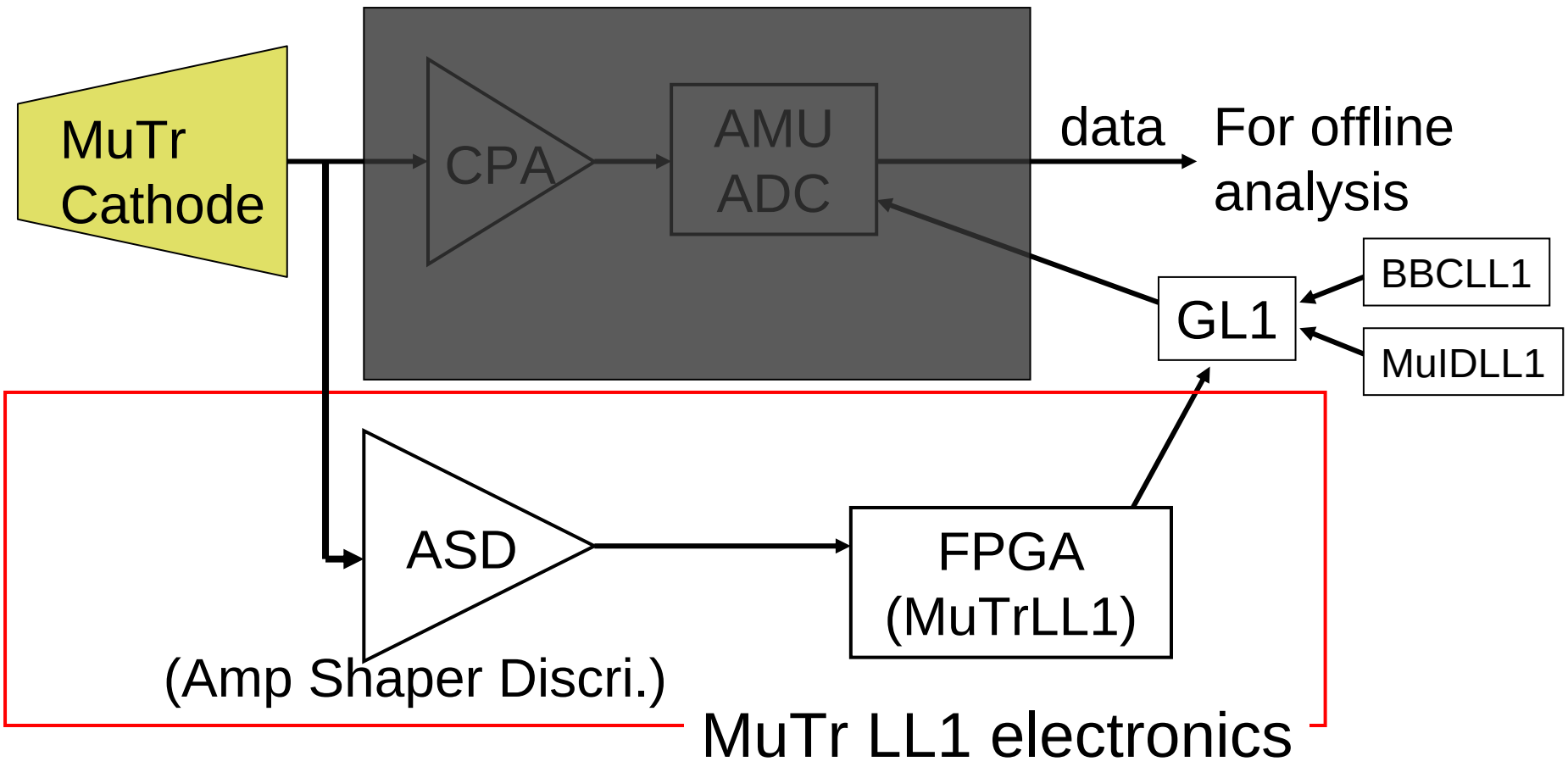
- Test chamber
  - Contribution from D. Fields
  - One layer of station 1
- Electronics R&D
  - Preamp
  - Trigger logic.



MuTr test chamber at Kyoto.



What happens when we just replace current electronics….

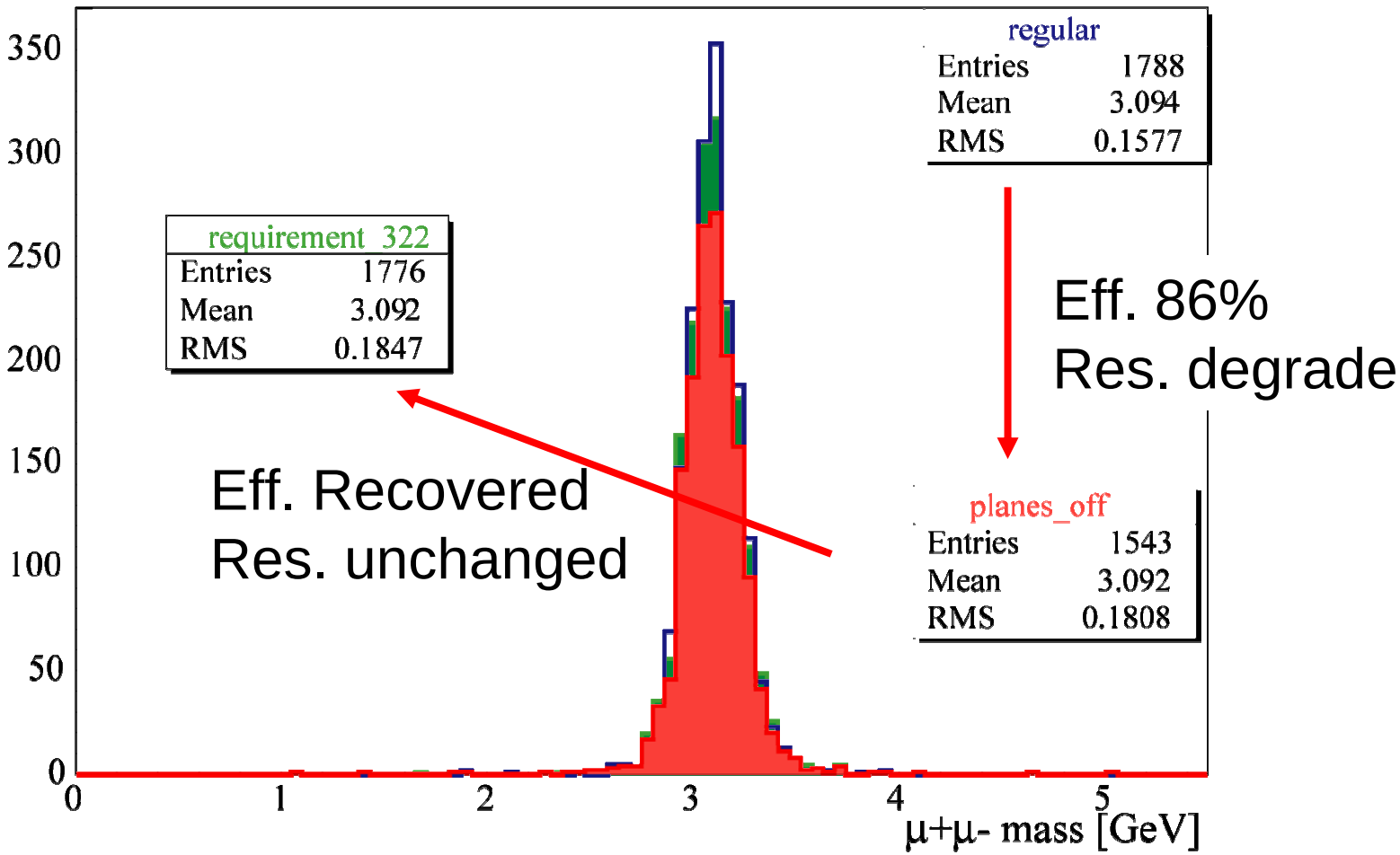


J/ψ mass resolution

Requirement for track

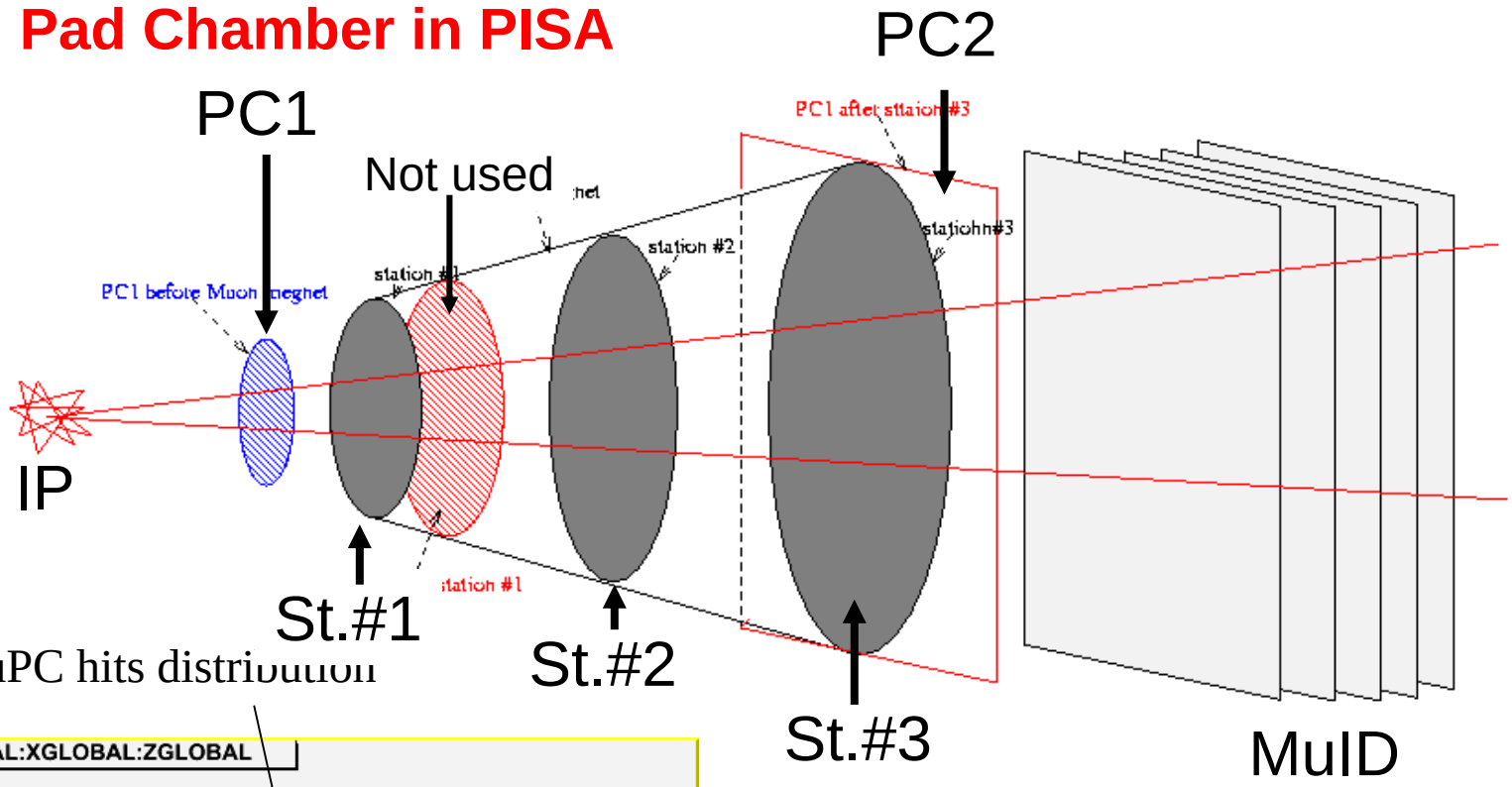
dimuon mass

432/664 → 432/553 → 322/553

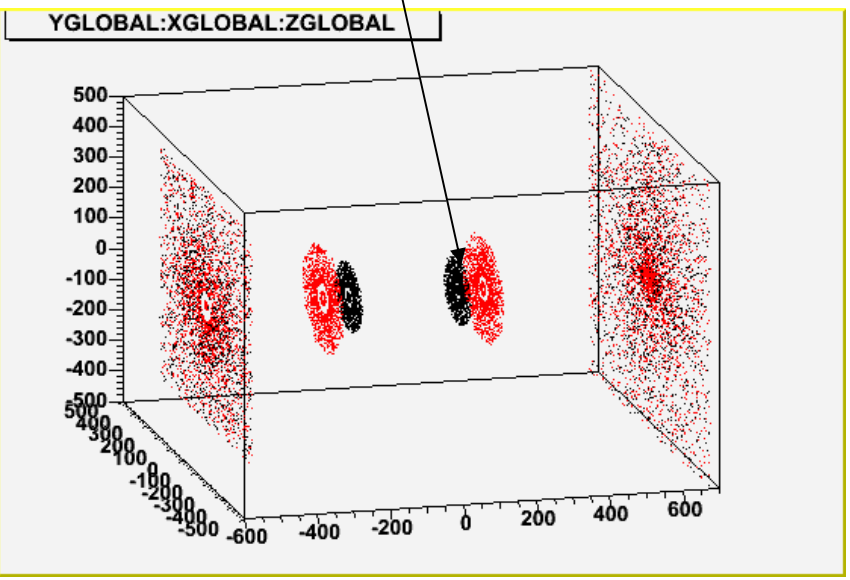


plots by Kohei

Pad Chamber in PISA



MuPC hits distribution

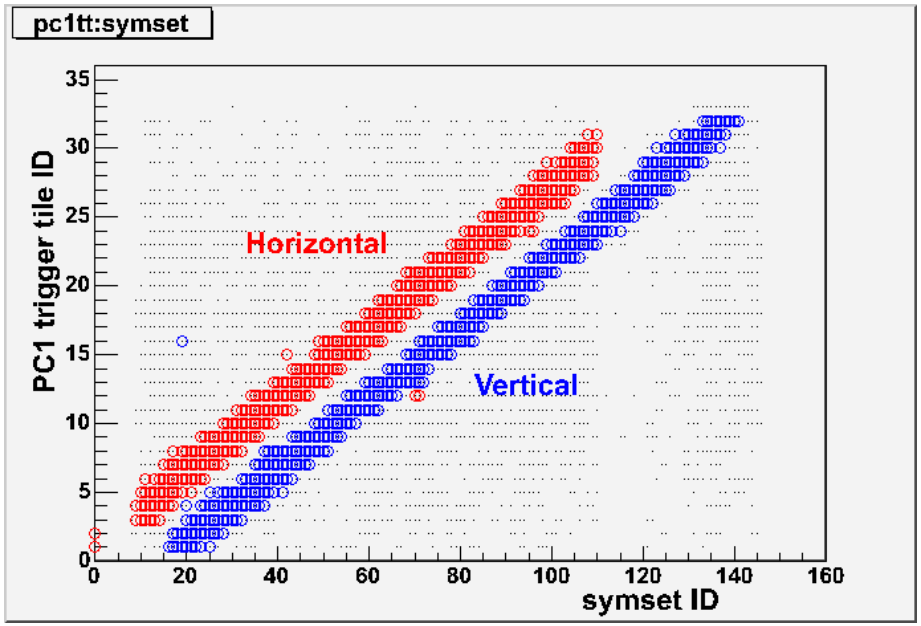


PC1/PC2/MuID symset matching
$\Delta\phi$ cut.

Two Pad Chamber, i.e. pc1/pc2 has been inserted into forward region. All are sandwich of 2 layers of 0.02cm s2 glass and 1,0cm G10 gas. PC1 is a 16 edge polygon with R=110/170cm when in front of /behind station #1. PC2 is a square with edge length 1000cm.

Simulation by Wei Xie

Tracking trigger: LUT between PC1/PC2/Symset



Then we do look-up among pc1/pc2/symset. Single muons with mom=4-10GeV/c is passed through PISA. Only multiple-scattering and energy loss are turned on. Here shows only tile size: PC1/10cm, PC2/30cm and PC1 in front of station #1

(1). PC1 is in front of station #1. Tile size PC1(10cm), PC2(30cm). Perfect resolution

$\delta(\phi)$ deg	<1	<2	<3	<4	<5	<6	<7	<8	<9	<10
eff	87%	90%	91%	91%	91%	92%	92%	92%	92%	92%
rej	85000	34000	12142	7727	6296	5000	3542	3091	2881	2464

Full PISA simulation including trigger processors

enough rejection factor is achieved.

Simulation by Wei Xie

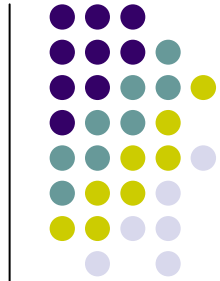
summary

- MuTr LL1 x MuID LL1 will have enough RF.
- R&D of Electronics in Kyoto.

- Pad chamber + MuID symset info will have enough RF.

- Hardware feasibility study is work in progress.

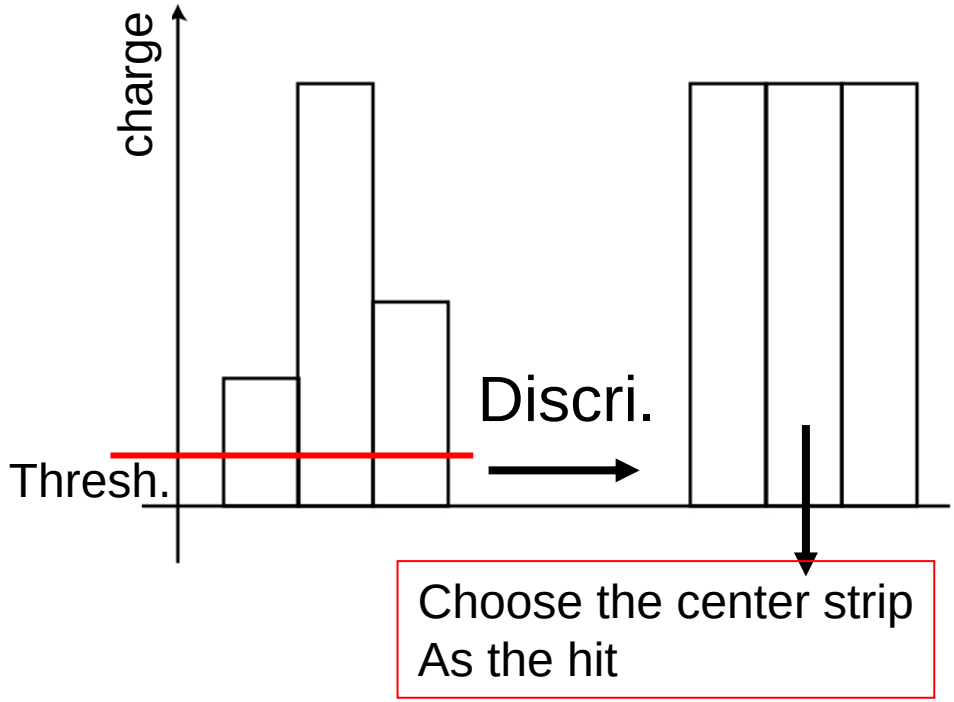
Backup slides

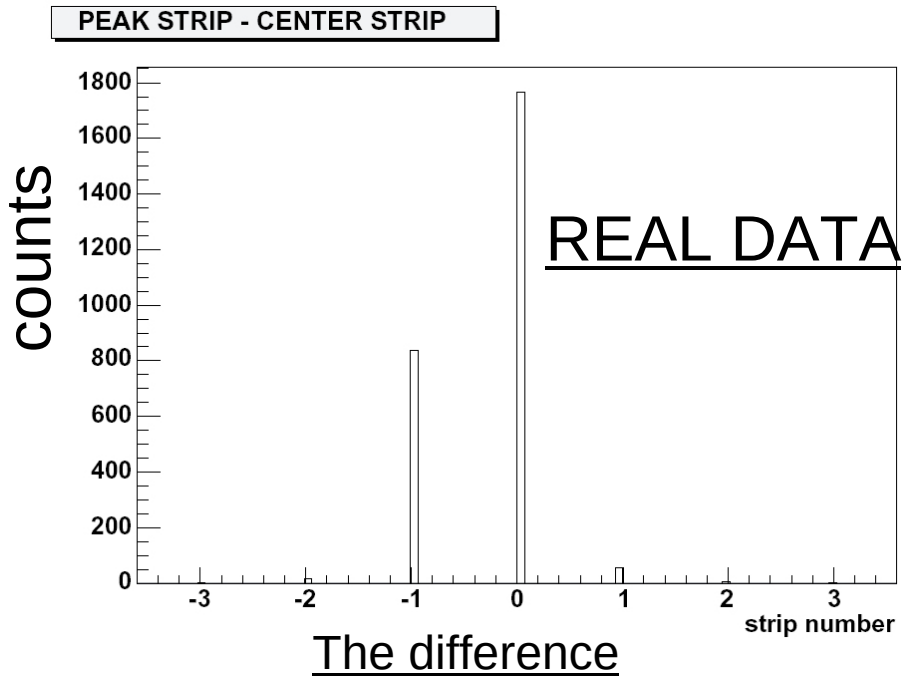


choose hit strip

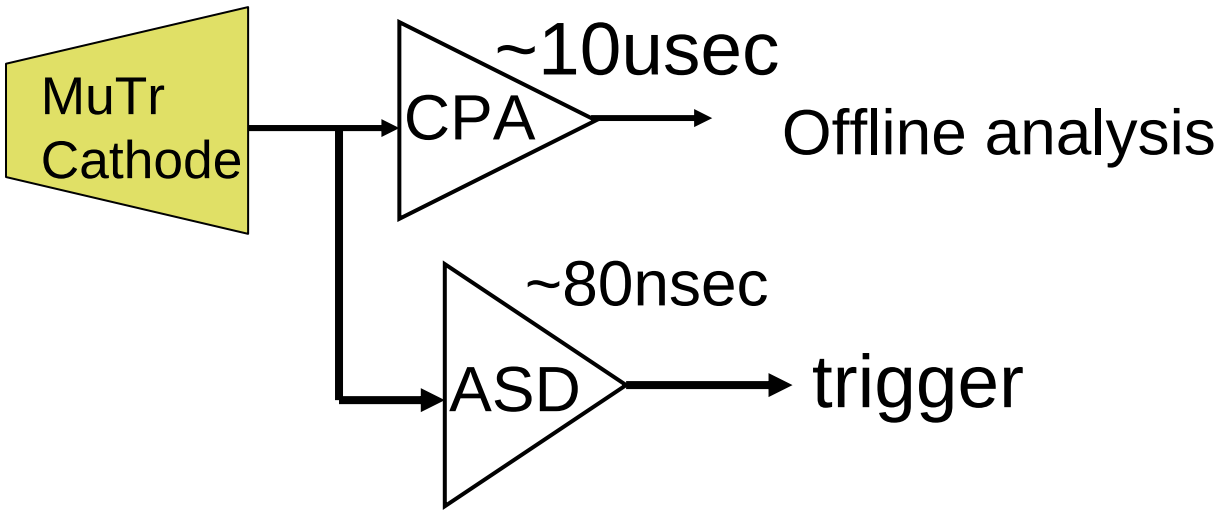
- Charge is induced 2 or 3 consecutive strips.
- Discriminate the signals
- Choose the center strip as the hit

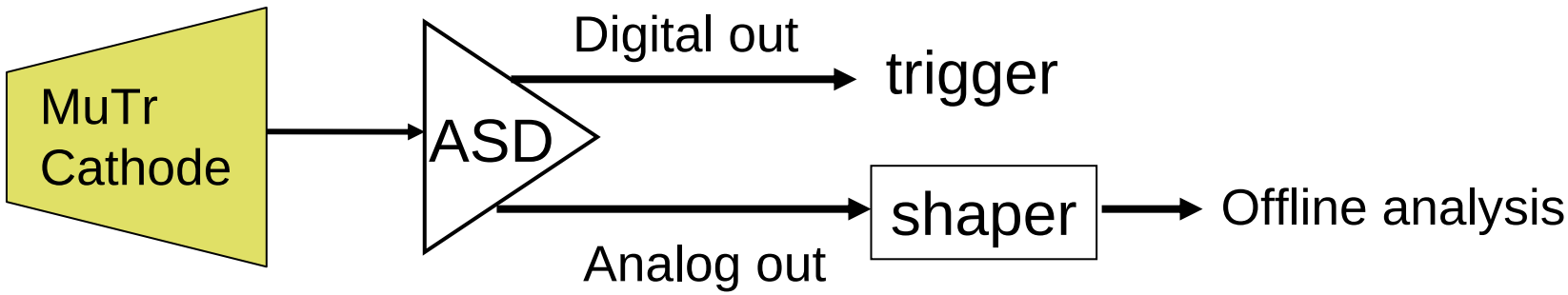
- The difference between peak strip and center strip is <=1
  - This is gives enough resolution





MuTr LL1 - electronics





MuTr LL1

MuTr

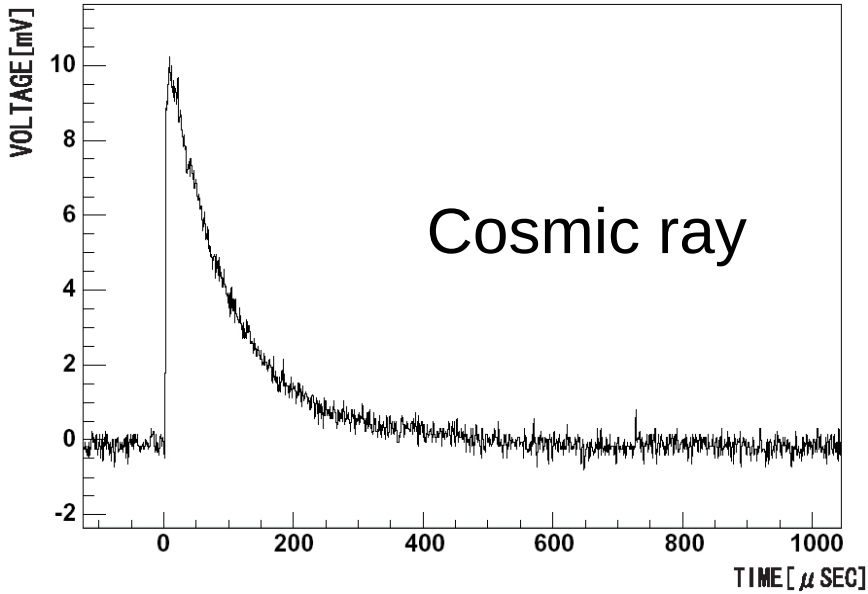
↓ signal

Amp-shaper-discri

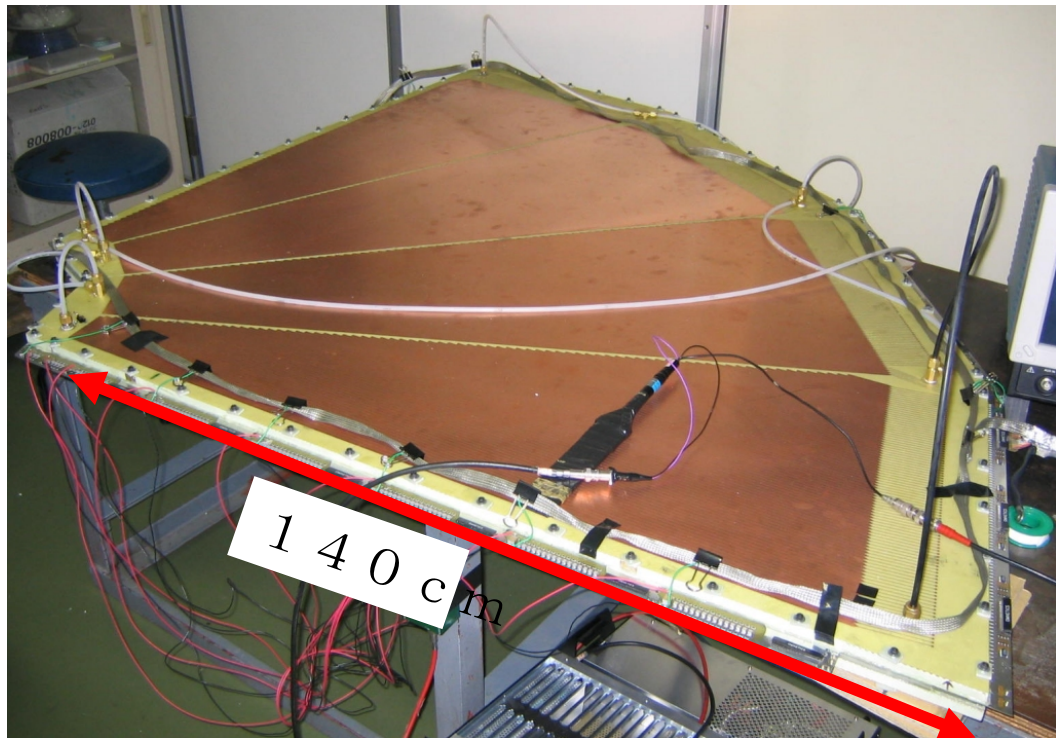
↓ Hit pattern

Programmable Circuit (FPGA)

↓ MuTr LL1

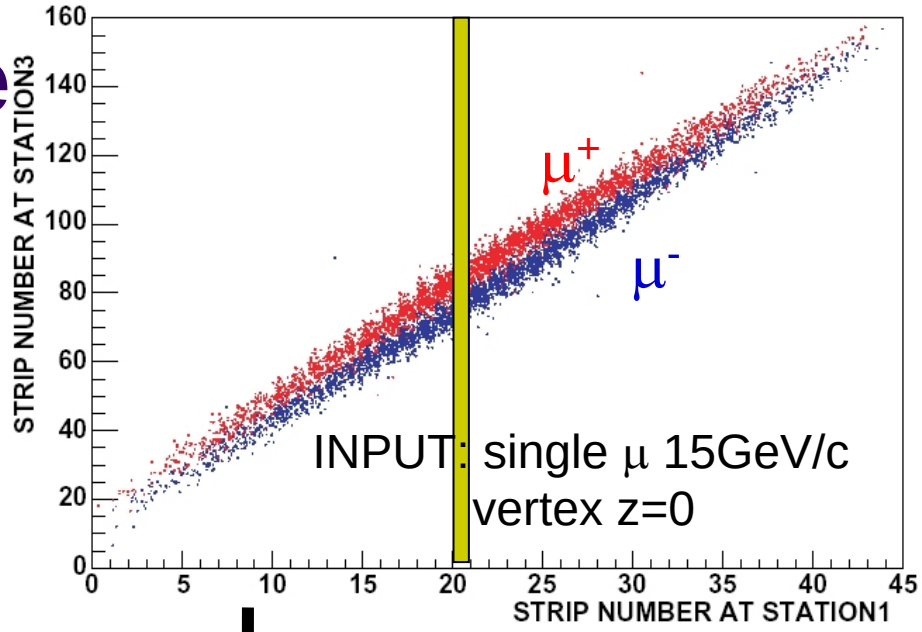


MuTr test chamber at Kyoto.

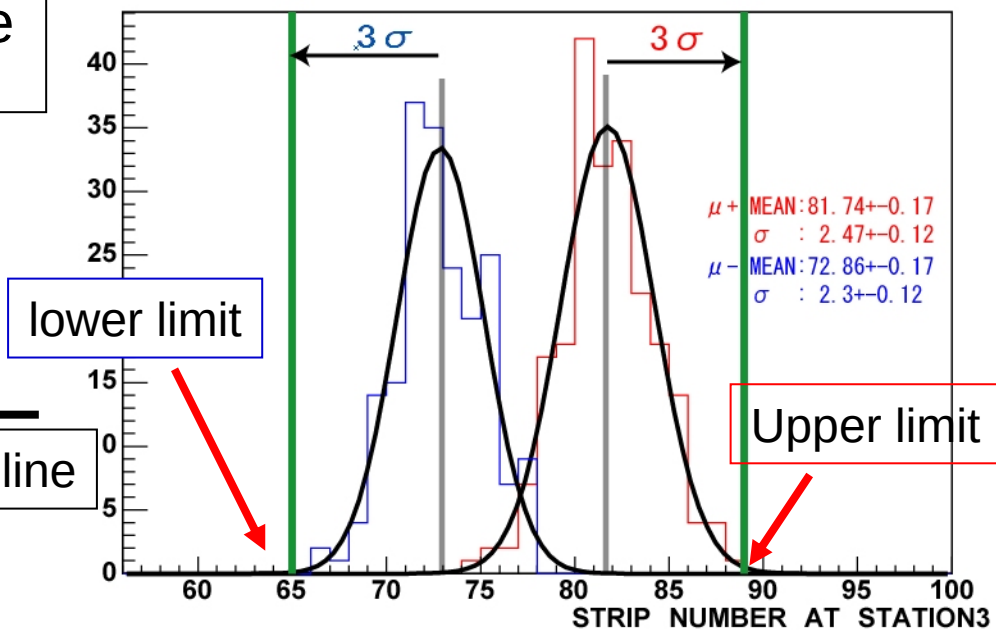


1.Making lookup table

- For each strip at St#1
  - get hit strip dist. at St#3
  - Fit with gaus func.
  - get lower and upper limit
    - (+/- 3σ from mean)
- To reduce the data size
  - Collect all lower and upper limits and fit with straight line



For each strip at St#1



Fit with straight line