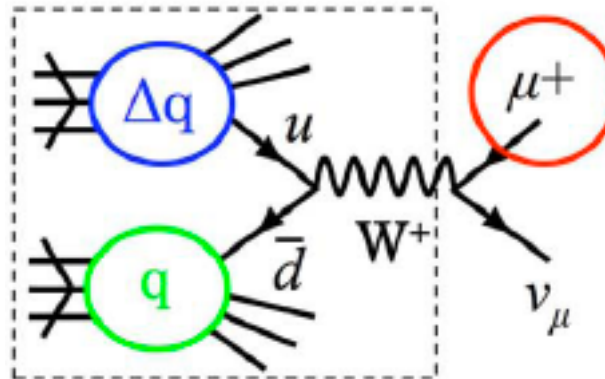
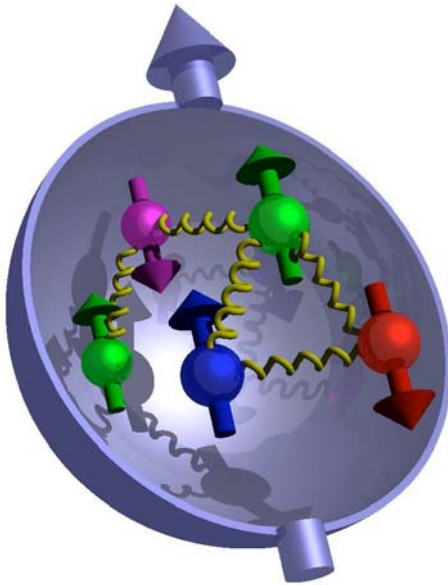


-- Performance Improvement of the Muon Tracker --

SNU, Korea Sept. 16, 2010

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Radiation Lab., RIKEN



Every Activity is for the detailed investigation of
the proton inner spin structure with the measurement of
the W-mediate process...

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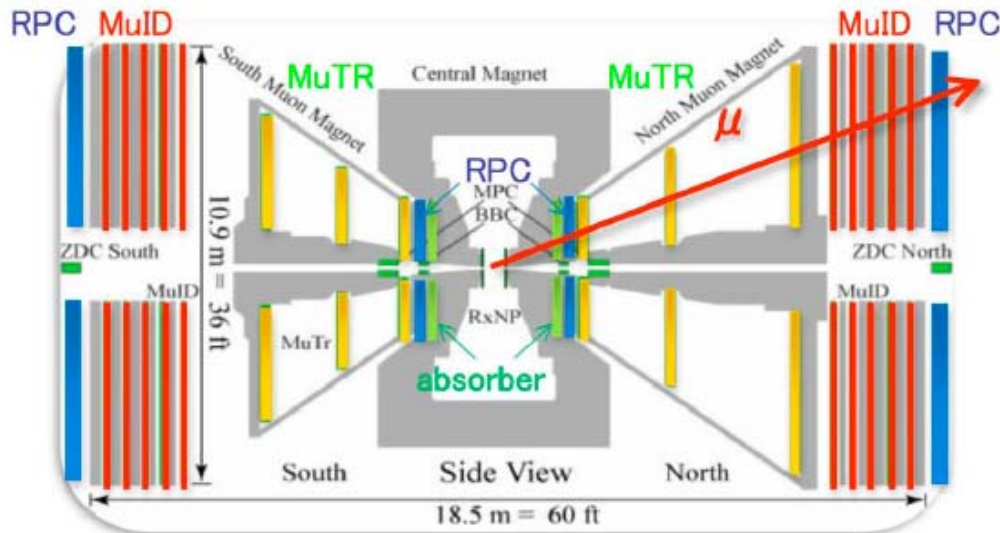
2. Cross Talk Effect

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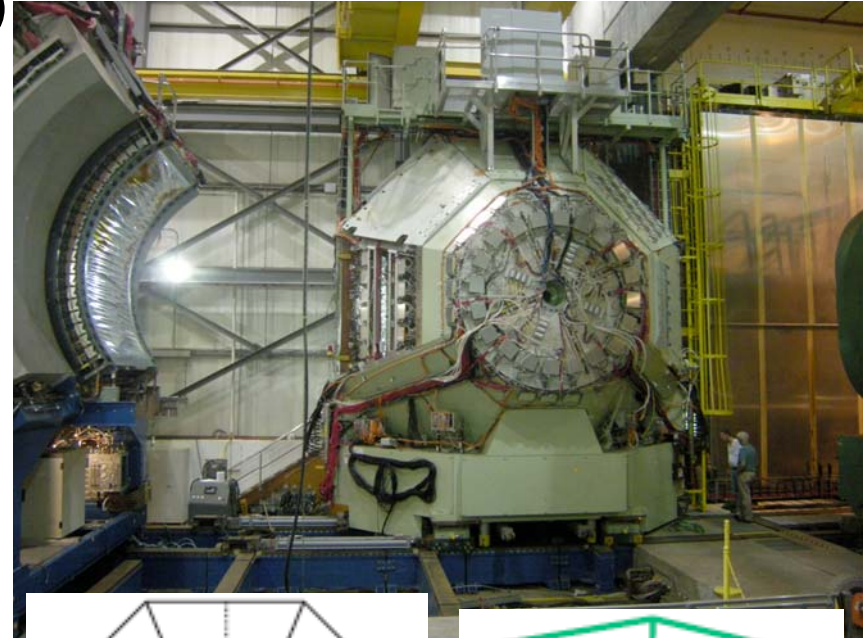
1. Motivation

- Subjects in the PHENIX Muon Tracker -

● PHENIX Muon Arm (MuTr)



Muon Arm (Side View)

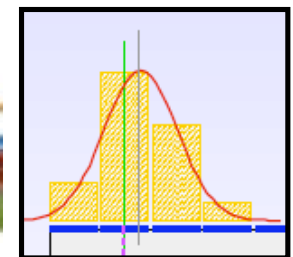
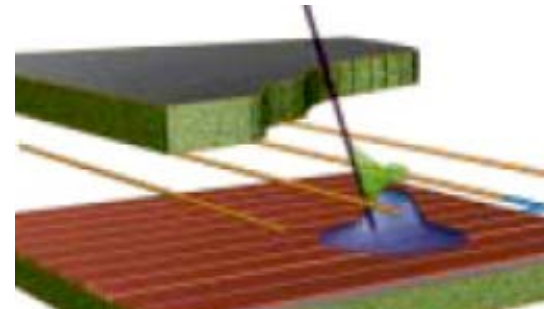
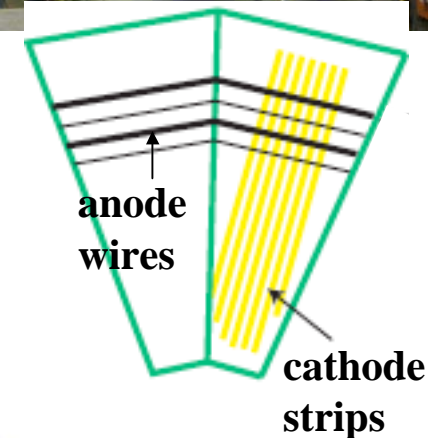
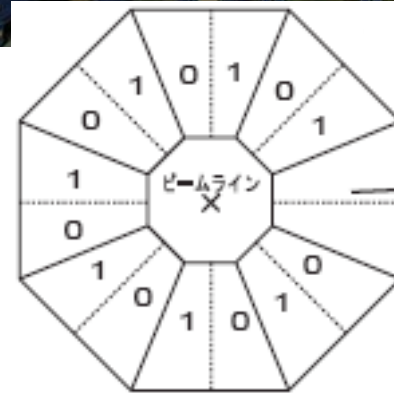


▪ Muon Tracker (MuTr)

- Consists of 3 Stations
particles are bended in ϕ direction
- Cathode Readout
Cathode strips in radial direction
(perp. to anode wires)
position resolution from charge deposits

▪ Muon Identifier (MuID)

▪ Resistive Plate Chamber (RPC)



● Roles of the MuTr and related subjects

Measurement of the W mediated process with the muon arm in 500 GeV run

- High momentum decayed muon ($>20\text{GeV}/c$)
- Rejection of Highly Dominant BG

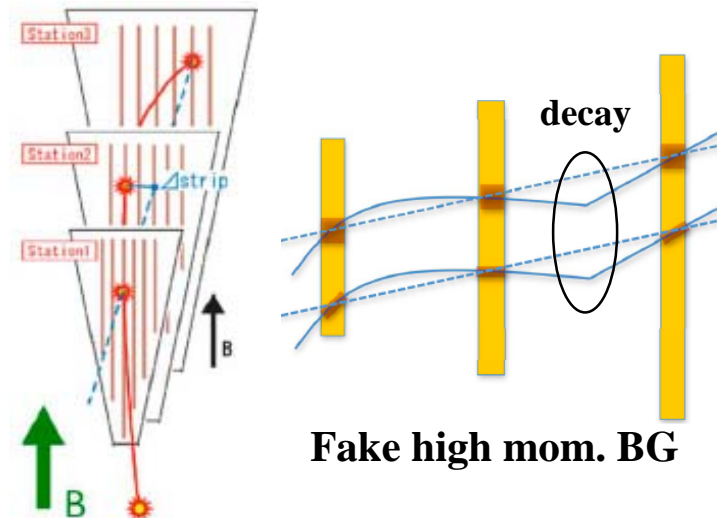
MuTr Plays the Crucial Role

● New Event Trigger (on-line)

specified for the high mom. events
(aiming at high BG rejection)

● High Resolution Requirement (off-line)

muon sagitta $\sim \text{O}(\text{mm})$ && Reject Fake BG
 $\rightarrow \sim 100\mu\text{m}$ resolution (now in $200\sim 500\mu\text{m}$)



Key of this project: maximally putting out its potential performance

New Challenge!

● Current Representative Subjects on MuTr Performance

On-Line :

● Elimination of Fake Trigger Rate

2009 commissioning data indicates the existence of severely high fake rate which can considerably spoil the trigger performance

→ considered to be coming from “**cross talk**” signals through anode wire

This Talk

● Construction of Full Trigger System

Merging with RPC signals and optimization of several parameters

Off-Line :

● Optimization of MuTr Alignment

Preceding study reports substantial movement ($O(100\mu m)$) of MuTr itself

→ Unfolding the contamination using OASYS system

● Optimization of Charge Deposits

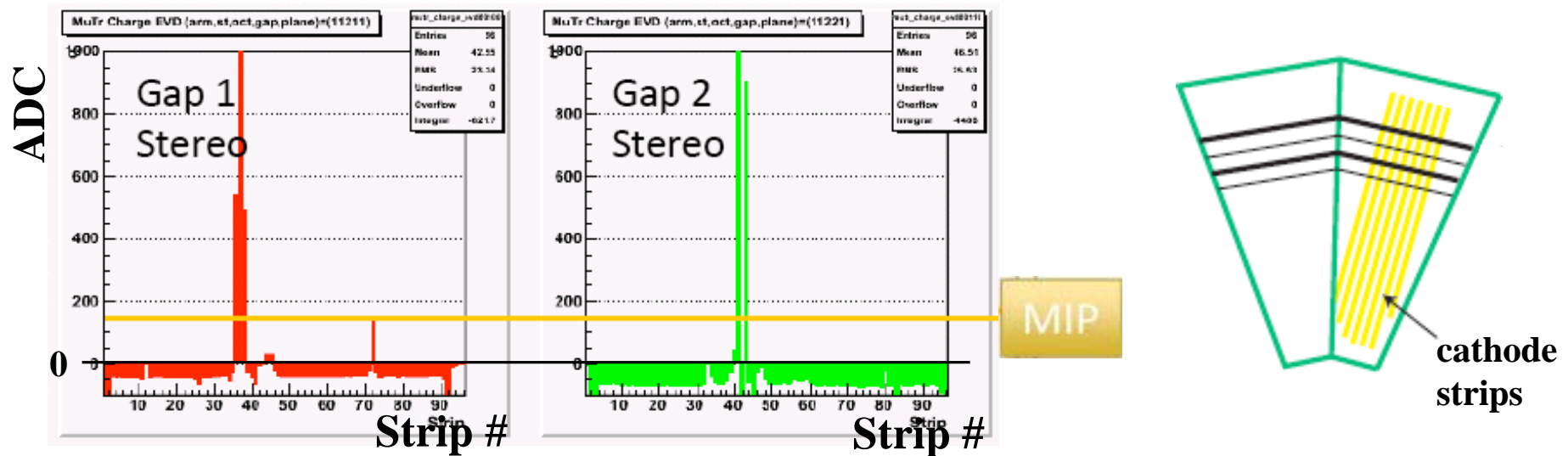
Current model to describe charge deposit on the cathode is inadequate

→ Modification to more realistic description of the charge distribution

2. Cross Talk Effect

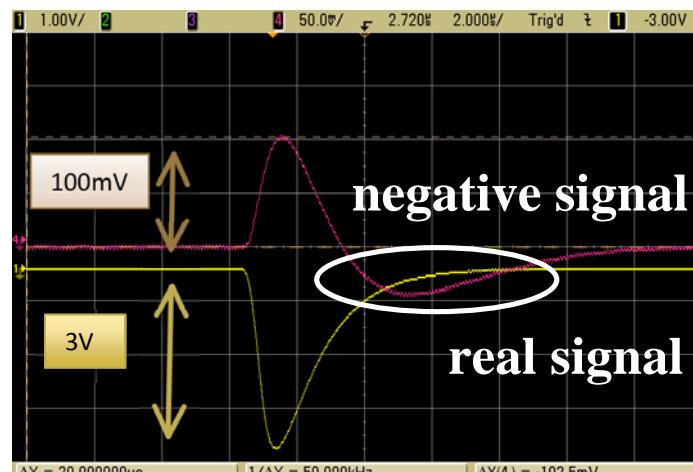
- Its Observation and Recent Activities to deactivate the contamination -**

● Observation of the Trace of the Cross Talk From run 2009 data



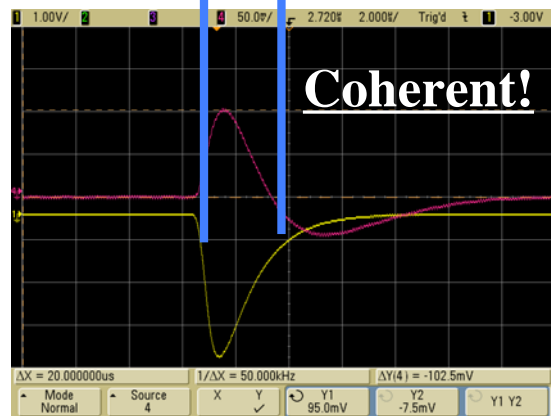
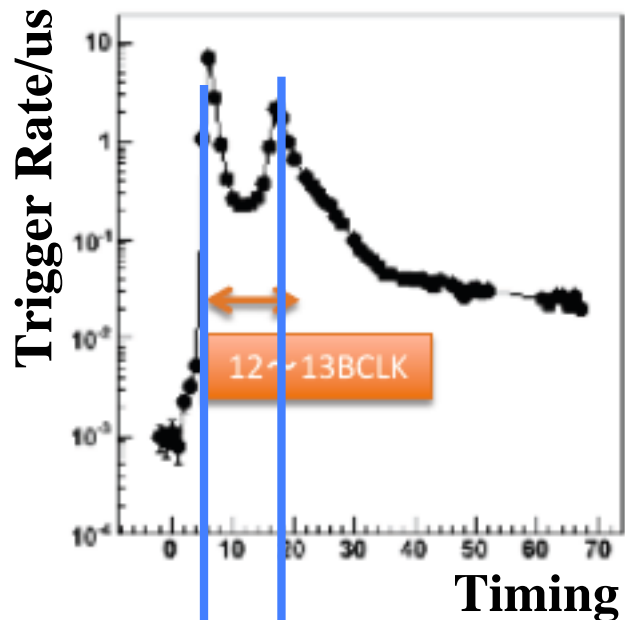
Observation:

- Existence of **unexpected big deposits** in MuTr exceeding those of MIP
 - Negative undershoots over whole strips accompanied by them
- the negative signals can fire the new muon trigger by the bipolar return

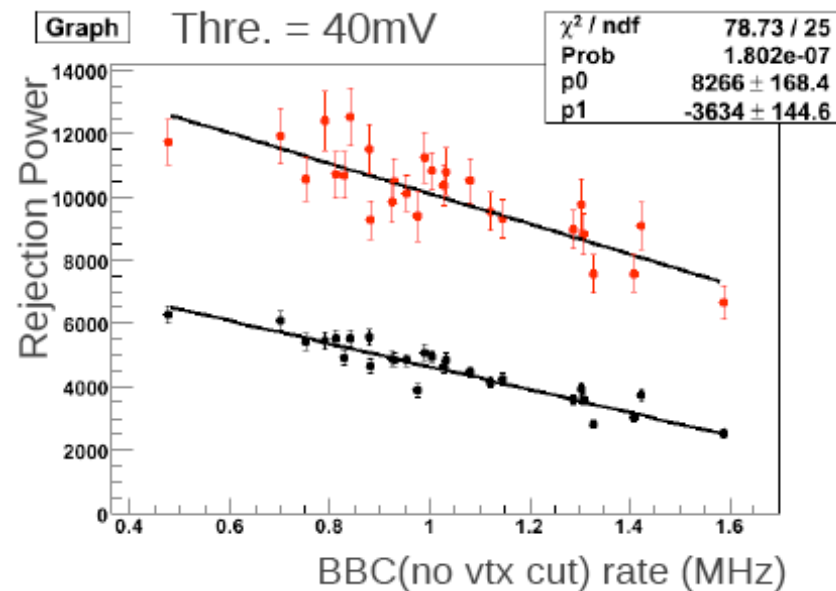


Signals obtained a test bench
(note: upside down)

Large bipolar return:
frequency dependence of the effect
(high frequency selective)



- Trigger rate survey supports the contamination from the negative signals along with the Big Pulse
- **Big Pulse Contamination:** expected to be 60% in the candidate events
- The origin of the big pulse is expected to be low energetic neutron coming from beam
high luminosity → high contamination



Deterioration of trigger performance depending on the beam luminosity
 → becomes crucial in run 2012 with designed luminosity
 (This issue also affects Off-line Analysis)

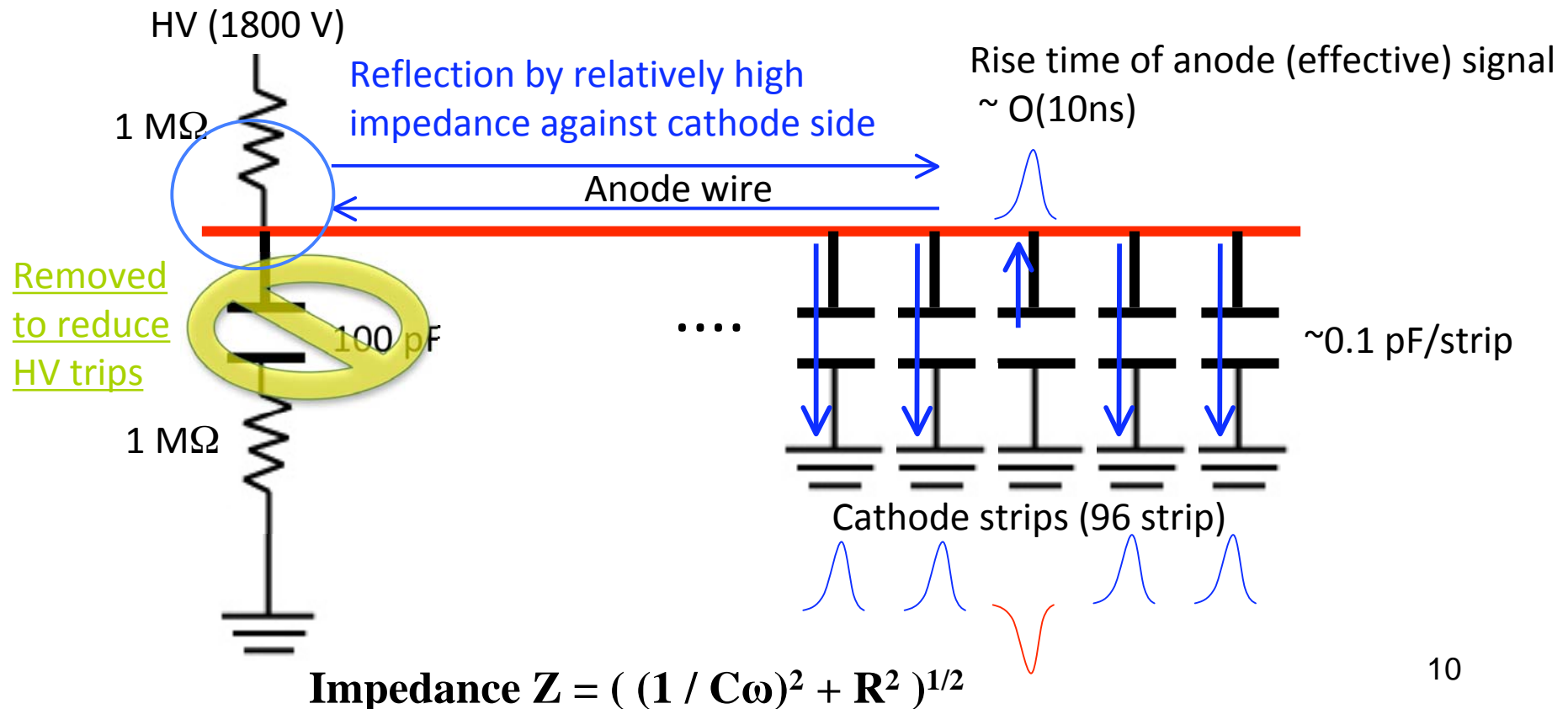
● Aids for the big pulse contamination

Need to be urgent

- cut off the source : absorber installation with its better understanding
- suppression of the following negative signals

The origin of the negative signals spreading over whole strips:

Cross Talk Effect through the shared anode wire



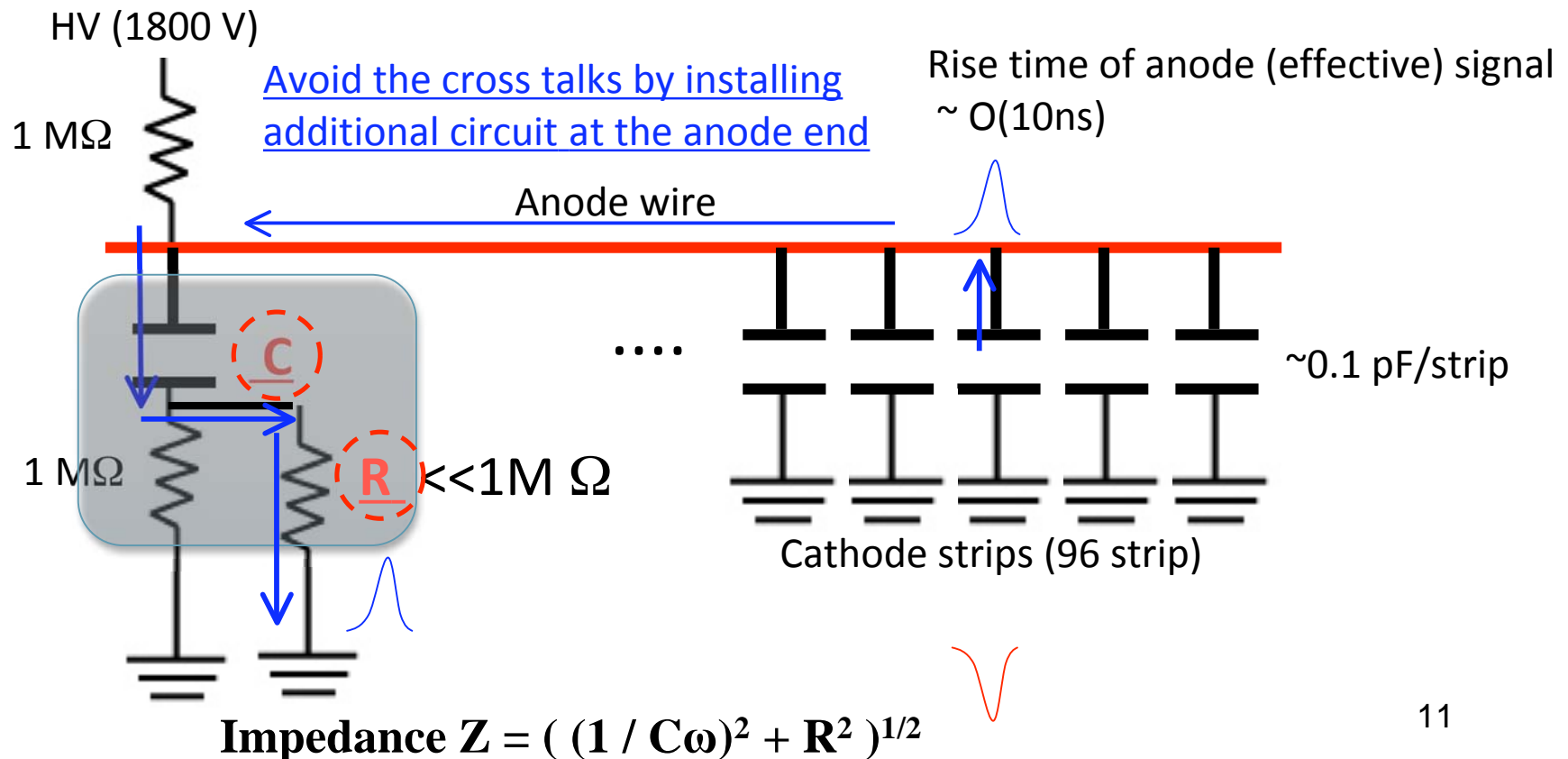
● Aids for the big pulse contamination

Need to be urgent

- cut off the source : absorber installation with its better understanding
- suppression of the following negative signals

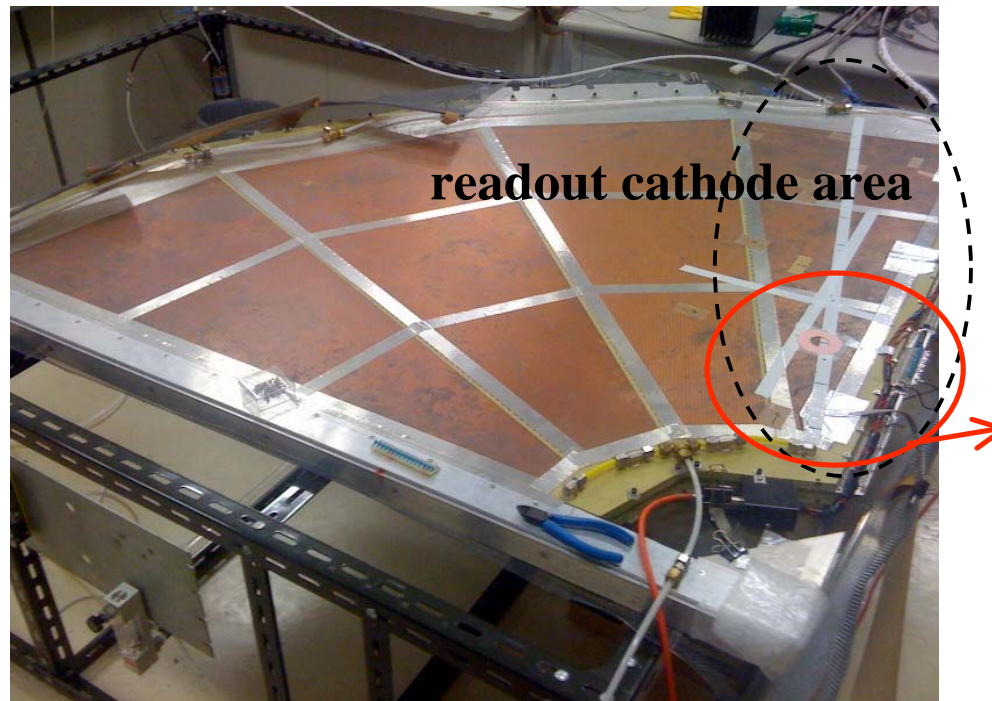
The origin of the negative signals spreading over whole strips:

Cross Talk Effect through the shared anode wire

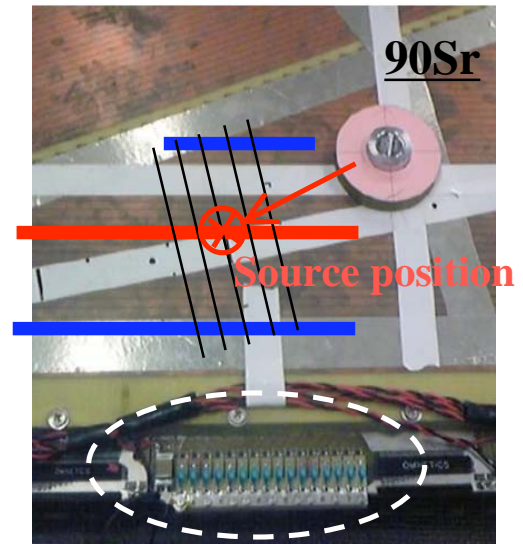


● Test of Cross Talk Effect with a Test Bench @RIKEN

- Observation and evaluation of the cross talk effect w/ or w/o the circuit
- Optimization of the circuit parameter (C, R)



Strip #30
↑
Strip #22
↓
Strip #14



anode edge

w/ the circuit

w/o the circuit

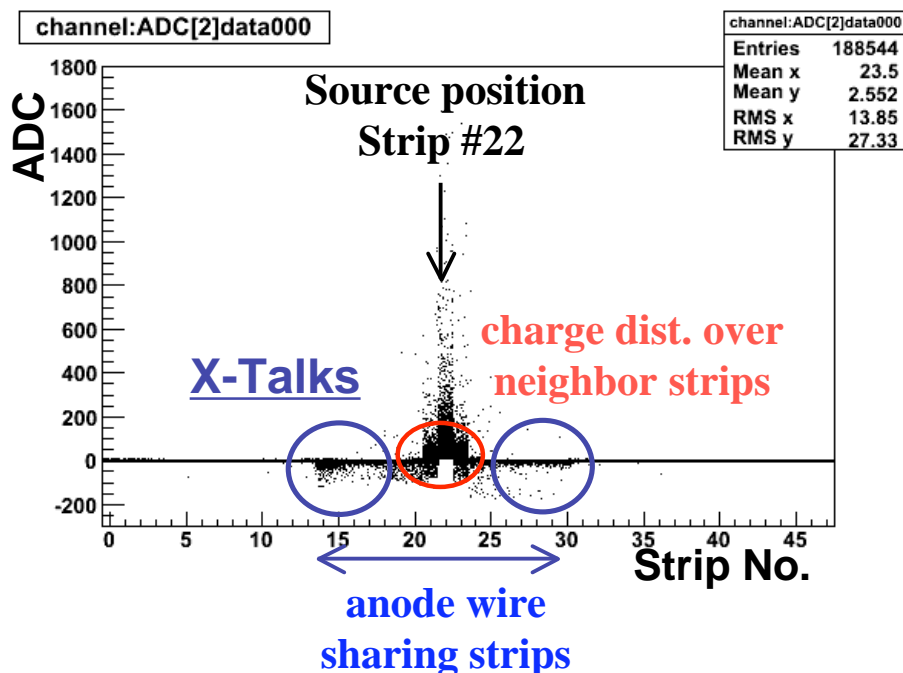


- Mechanical installation of the circuits (clamp): R&D @RIKEN

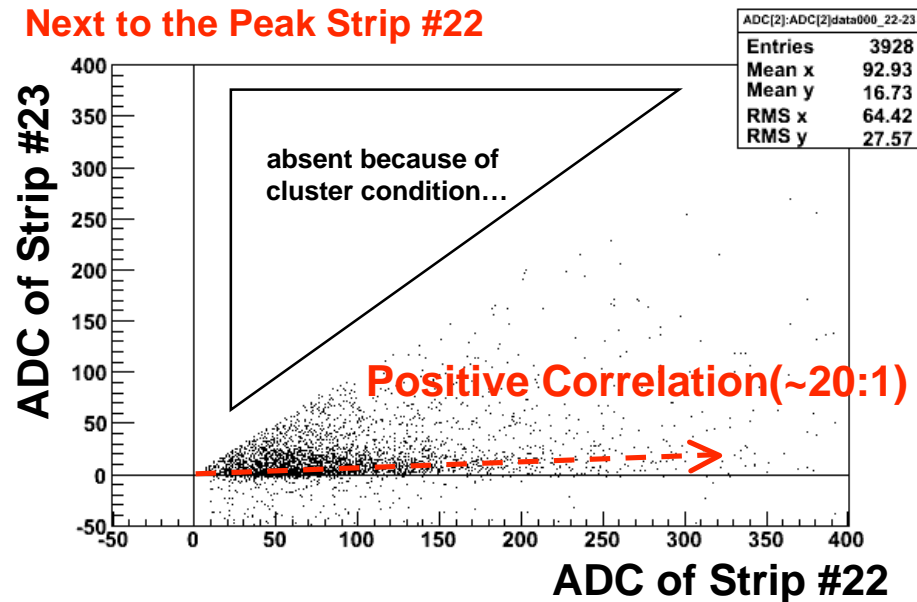


to be installed in the station 3

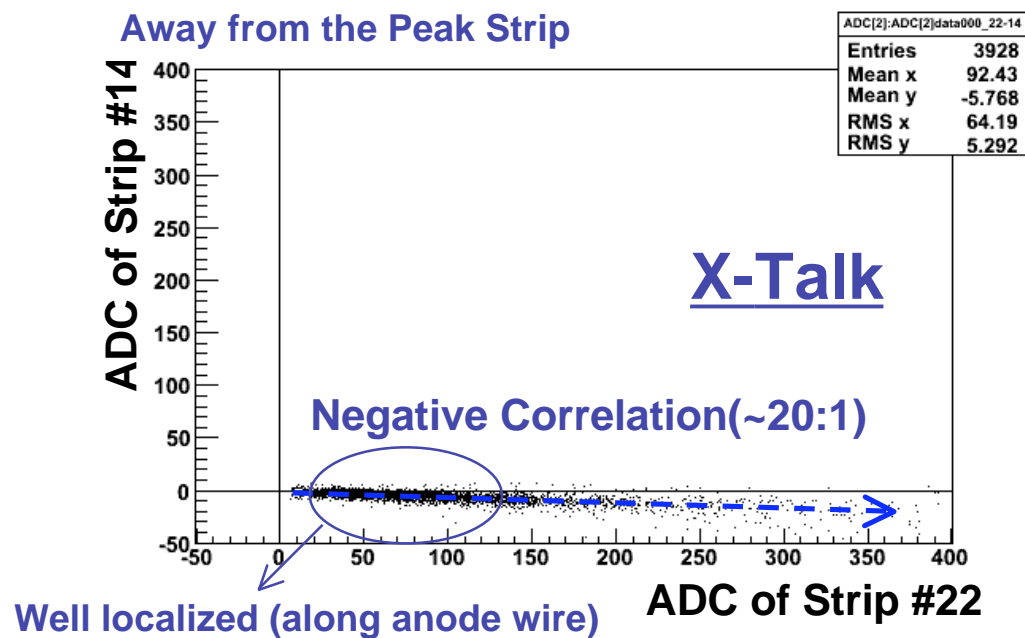
● Observed Cross Talk Effect w/o the circuit



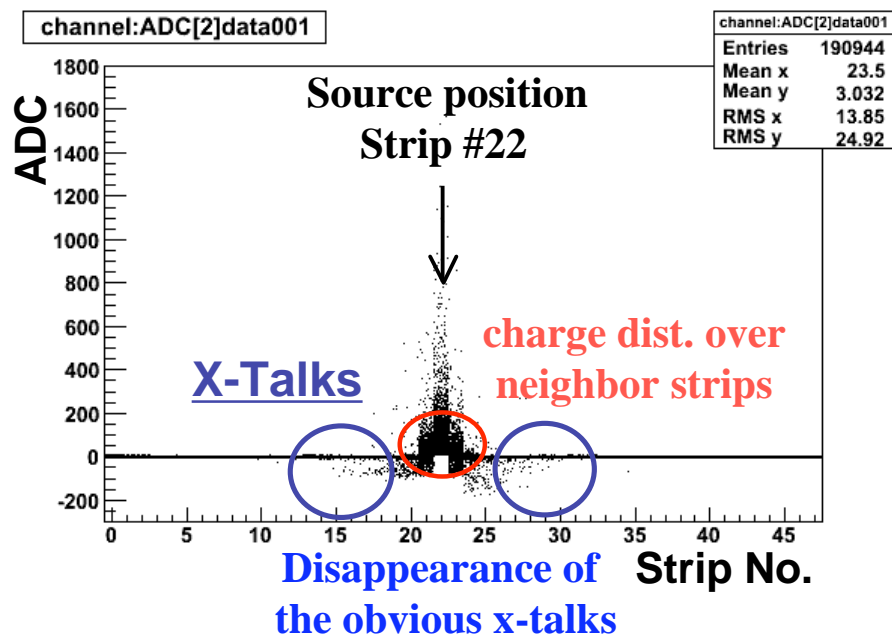
Next to the Peak Strip #22



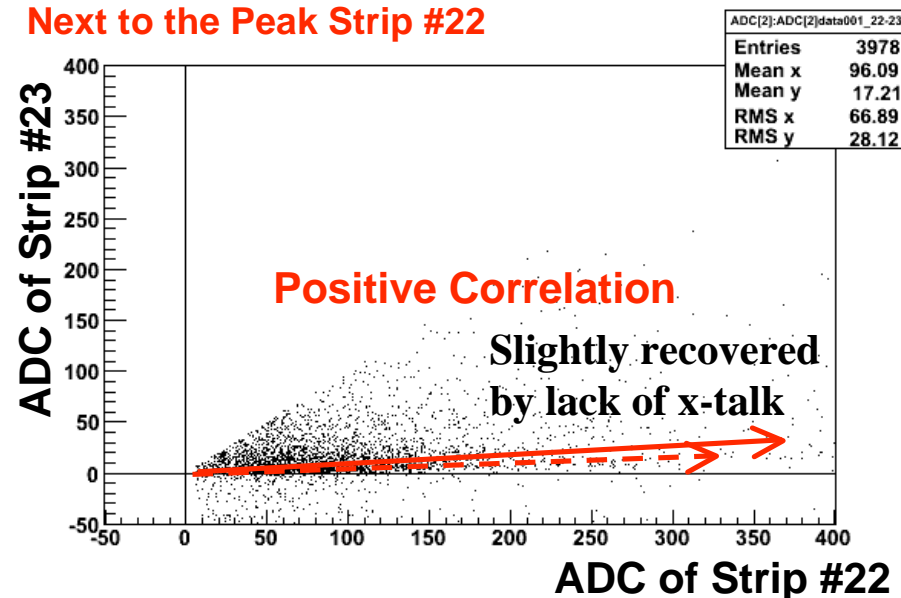
Away from the Peak Strip



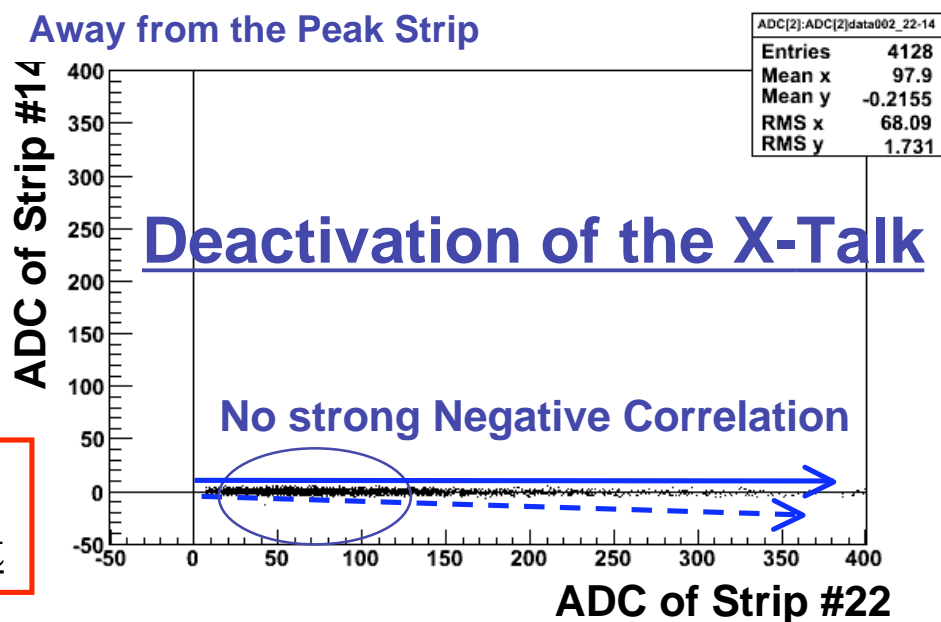
● Observed Cross Talk Effect w/ the circuit (C = 100pF, R=360ohm)



Next to the Peak Strip #22



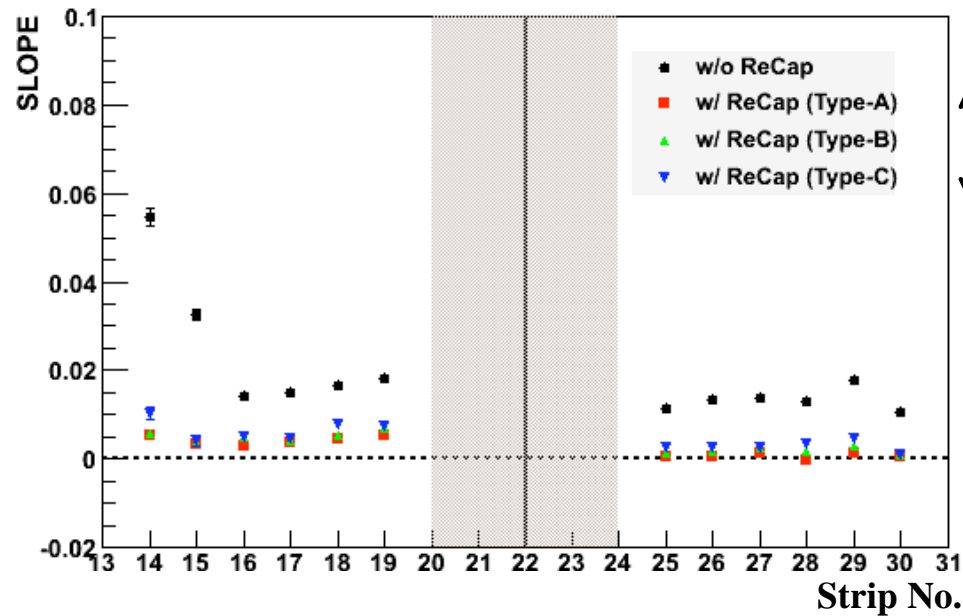
Away from the Peak Strip



The installation of the compensating
circuits surely suppress the x-talk effect

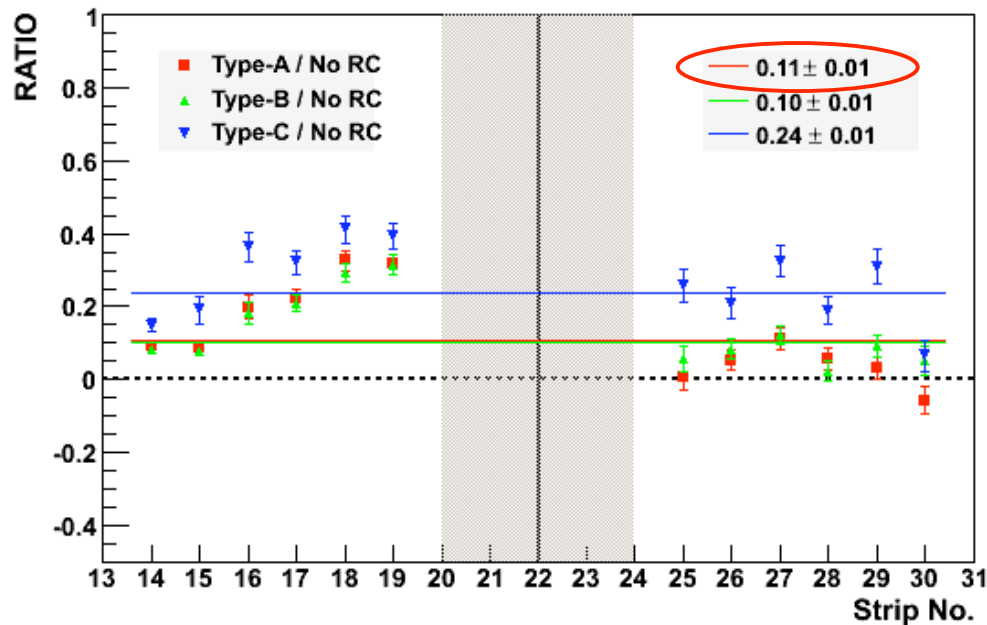
● Evaluation of the suppression effect by the circuit (ReCap) installation

- Based on the correlation slope



↕ Different types of C, R combinations

Type-A (100pF, 360Ω)



Formally confirmed ~1/10 suppression of the cross talks

(strip dependence: need further investigation)

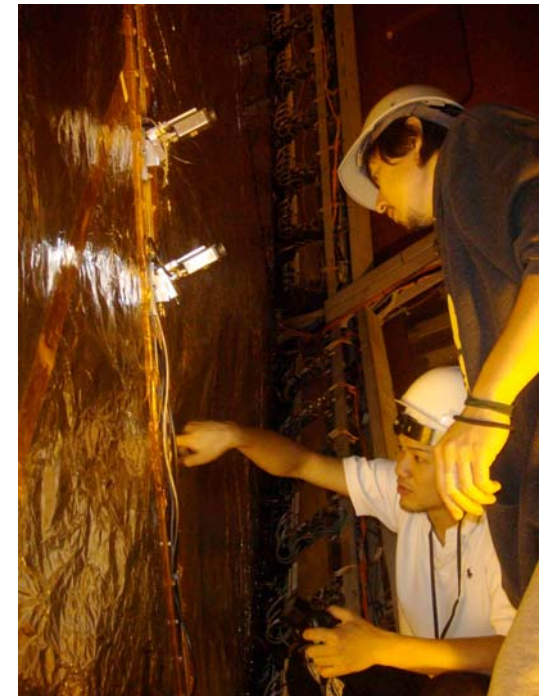
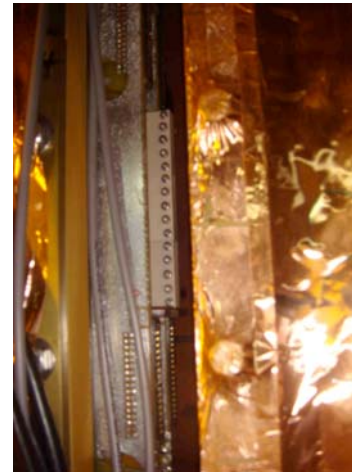
● Installation of Primitive Circuit in PHENIX Detector (this summer)



~ soldering of a thousand of capacitors in the outmost gap of the station 1

Circuit configuration: Type-A (100pF , 360Ω)

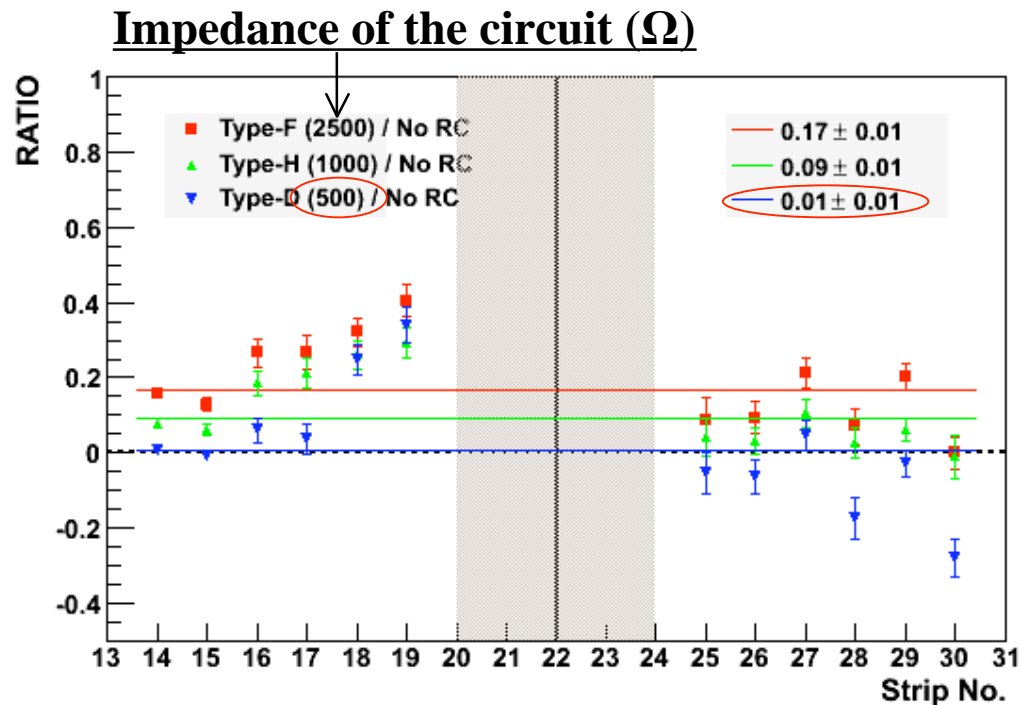
The actual effect of the circuit will be seen in this years run



Check also the conditions of the anode card surface of station 3, where the mechanical circuit will be installed

● Optimization of the Circuit Parameters (C, R)

Now Under Investigation



- Several types of the combinations are being tested
- Temporal results show the sign of much suppression of the order of 1/100
 - better impedance matching
 - cathode side impedance is supposed to be **$\sim 500\Omega$** (Type-A: $\sim 1500\Omega$)

- Low impedance requires higher capacity ($O(1000\text{pF})$)
- High capacity installation to the anode side could affect fundamental performance of the new muon trigger (signal height), no?
 - Investigation with the test bench, installing emulated trigger system too?

3. Summary

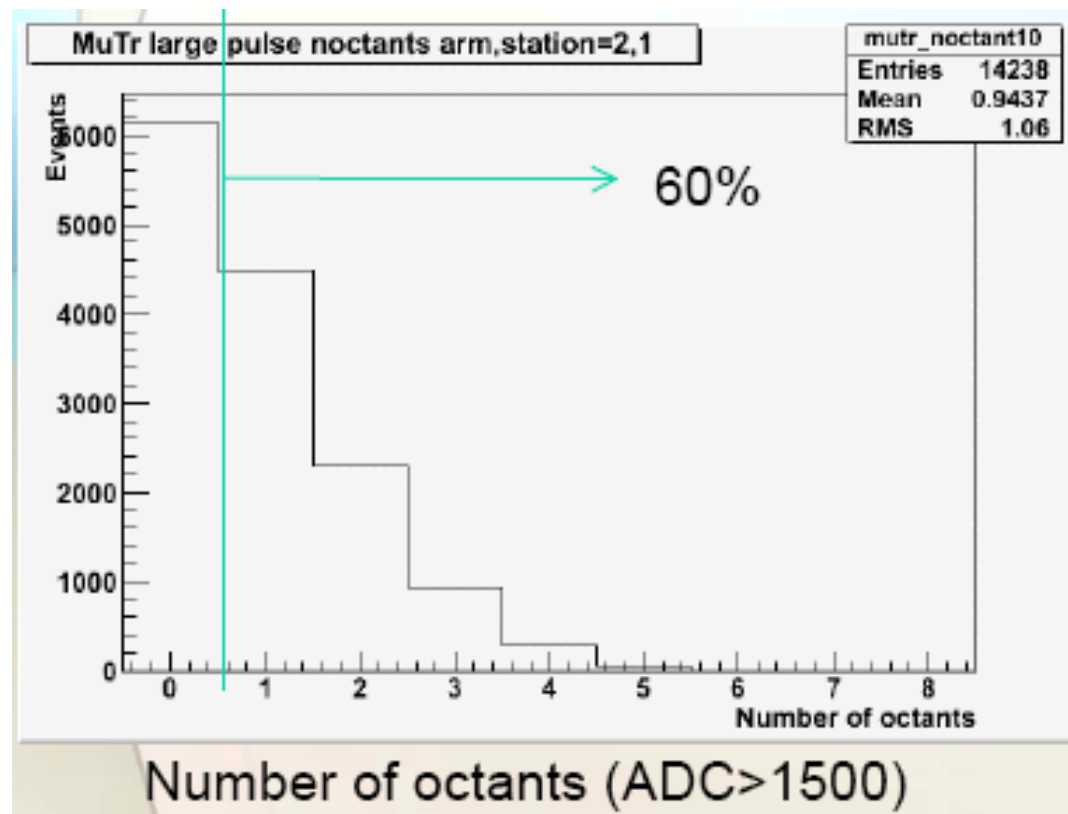
- **The MuTr plays a central role toward the measurements of the W mediated process**
- **Several challenging and significant improvements are still required to obtain the maximal MuTr performance**
- **The cross talk effect was observed from the run 2009 data, and it can substantially deteriorate the performance of the new muon trigger**
- **It was confirmed with the test bench that the installation of the compensating circuit to anode wires has ability to deactivate the cross talk contamination**
- **The primitive circuit has installed in some stations this summer and its actual effects will be seen in the next run 2010**
- **The optimization of the circuit parameters is now under investigation with the test bench**

Back Up Slides

● Fake High Pt Contaminations from hadron decay

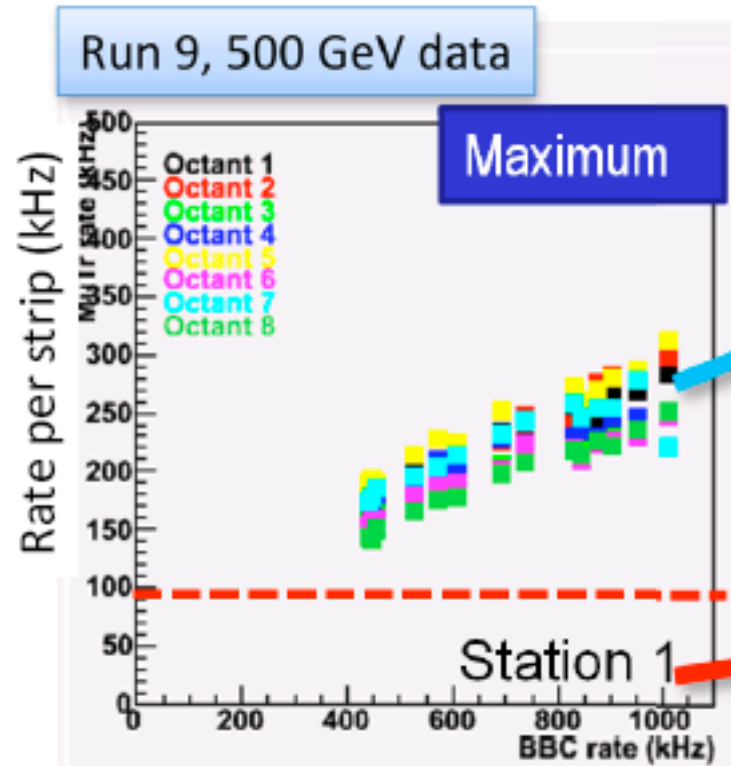
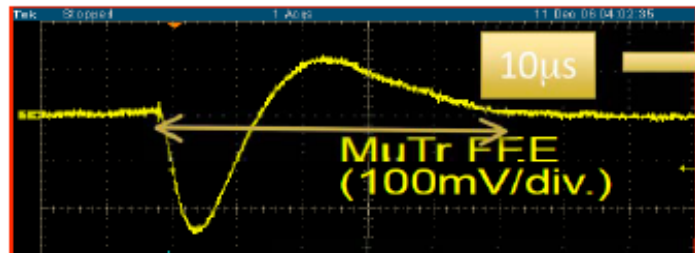
Fake rate with colored hist..

Impact of the Contamination by Big Pulse

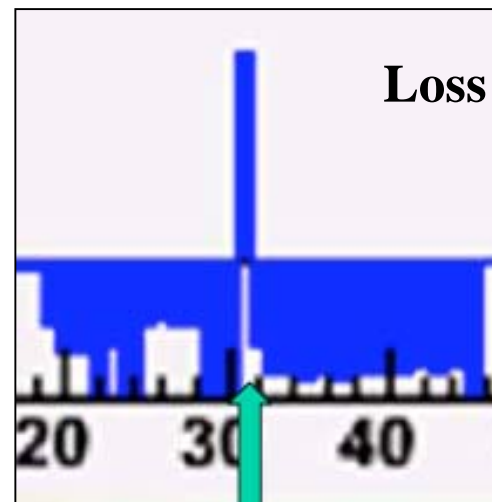
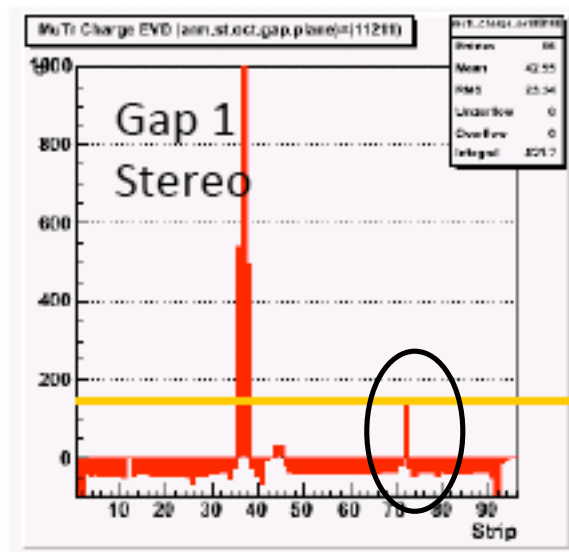


● Effect to Off-line Analysis

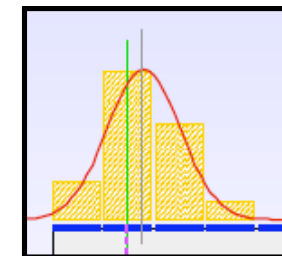
▪ Pileups



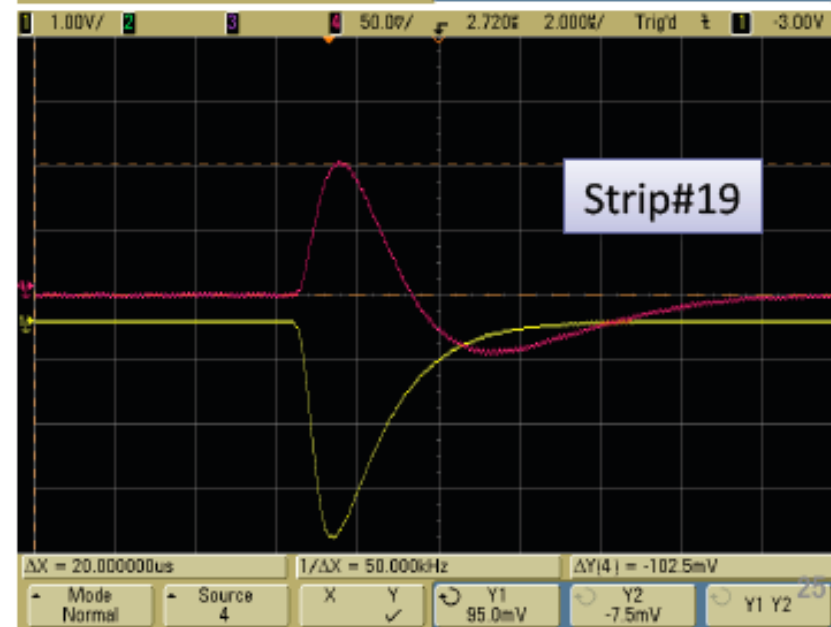
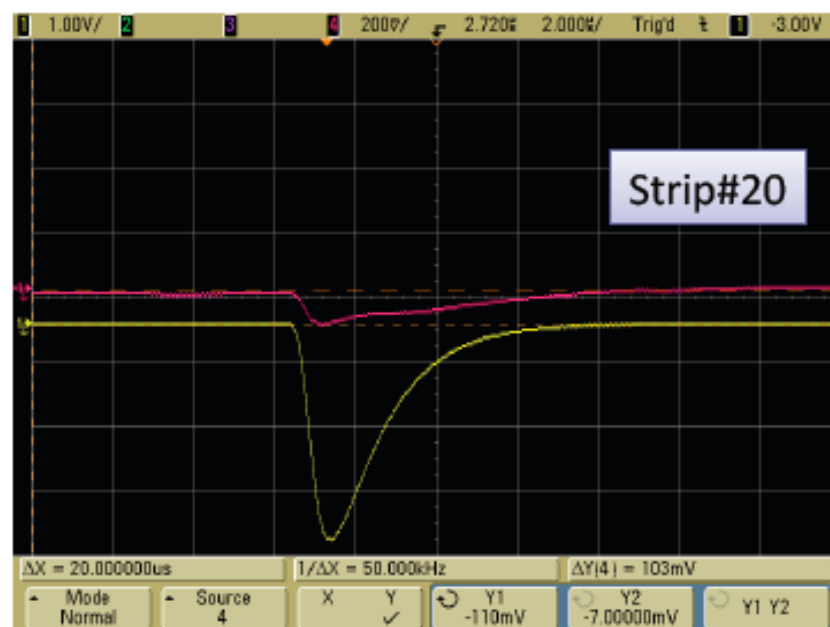
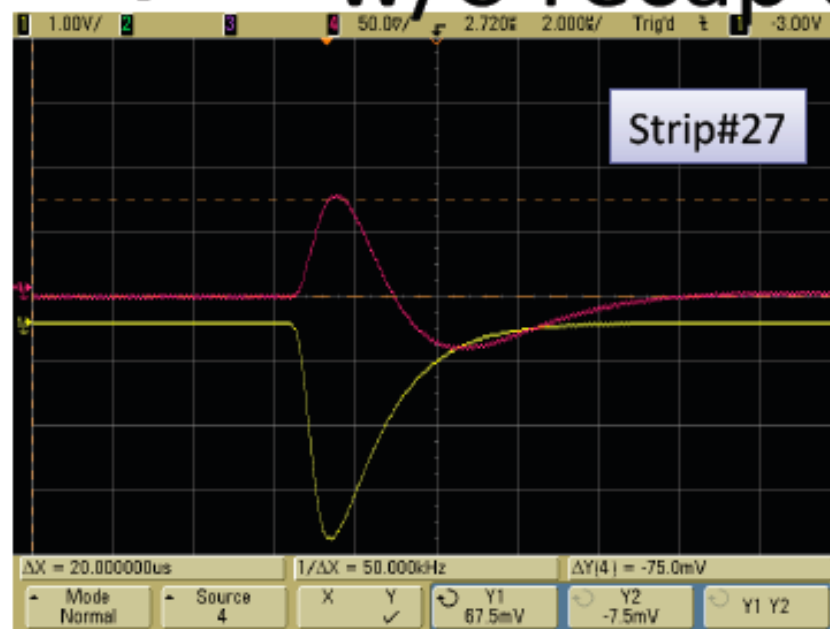
▪ Charge Distribution



Loss of real charge dist.



Source @ 21 ~ 22 w/o recap averaged pulse



Source @ 21 ~ 22 w/ recap averaged pulse

