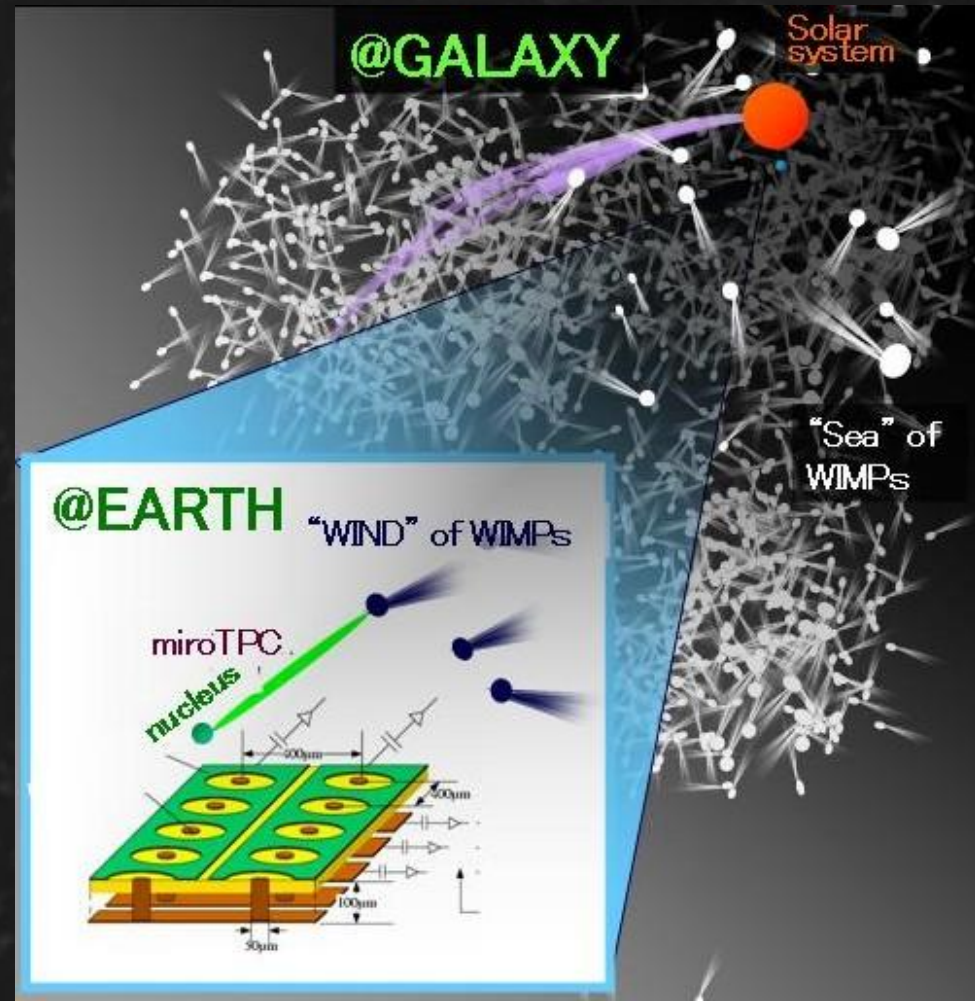


# NEWAGE electronics upgrade & QPIX

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with

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M. Tanaka (KEK),  
Matsuzawa, Vu Minh Khoa,  
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(Tokyo Institute of Technology)



# OUTLINE

- ◆ **Scaling-up issues**
- ◆ **Current electronics upgrade**
- ◆ **QPIX**
- ◆ **Discussions**

# Scaling-up

# Scaling-up : HOW LARGE?

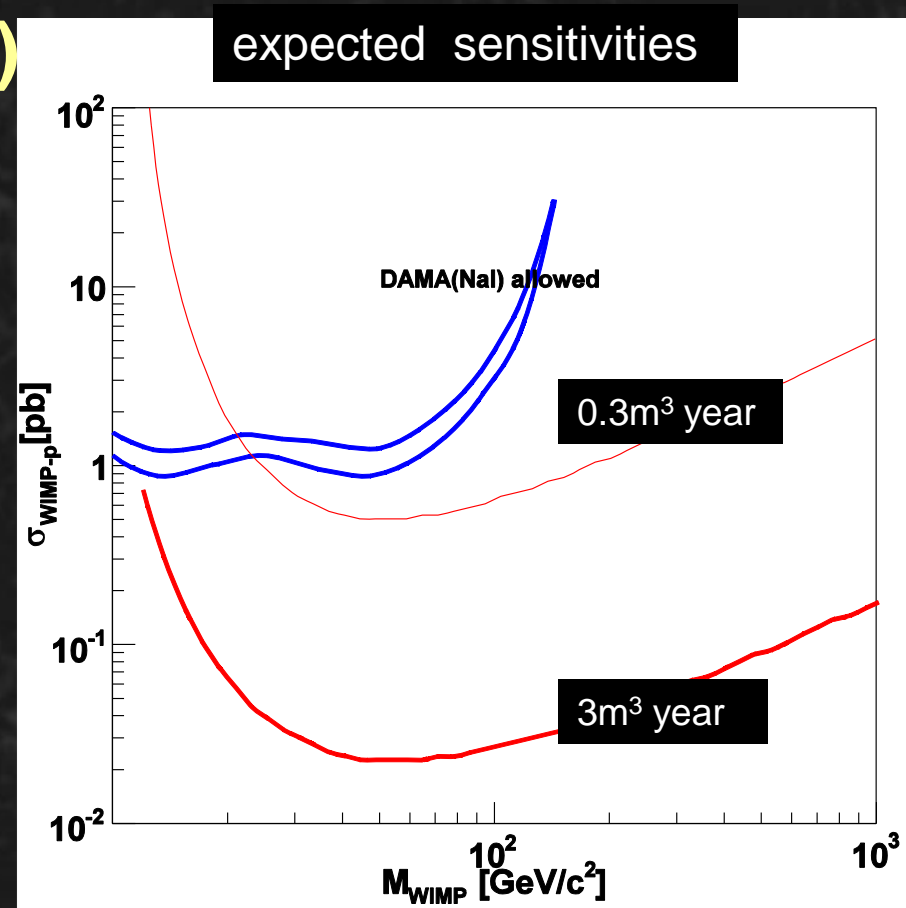
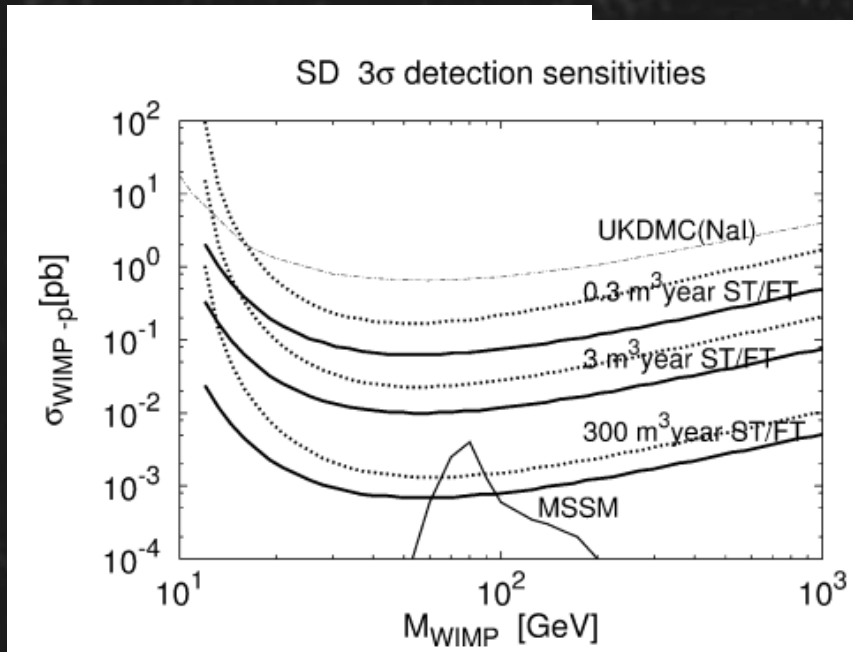
## 1st milestone: 1m<sup>3</sup> O(100g)

- readout pitch
- head-tail recognition
- (background)

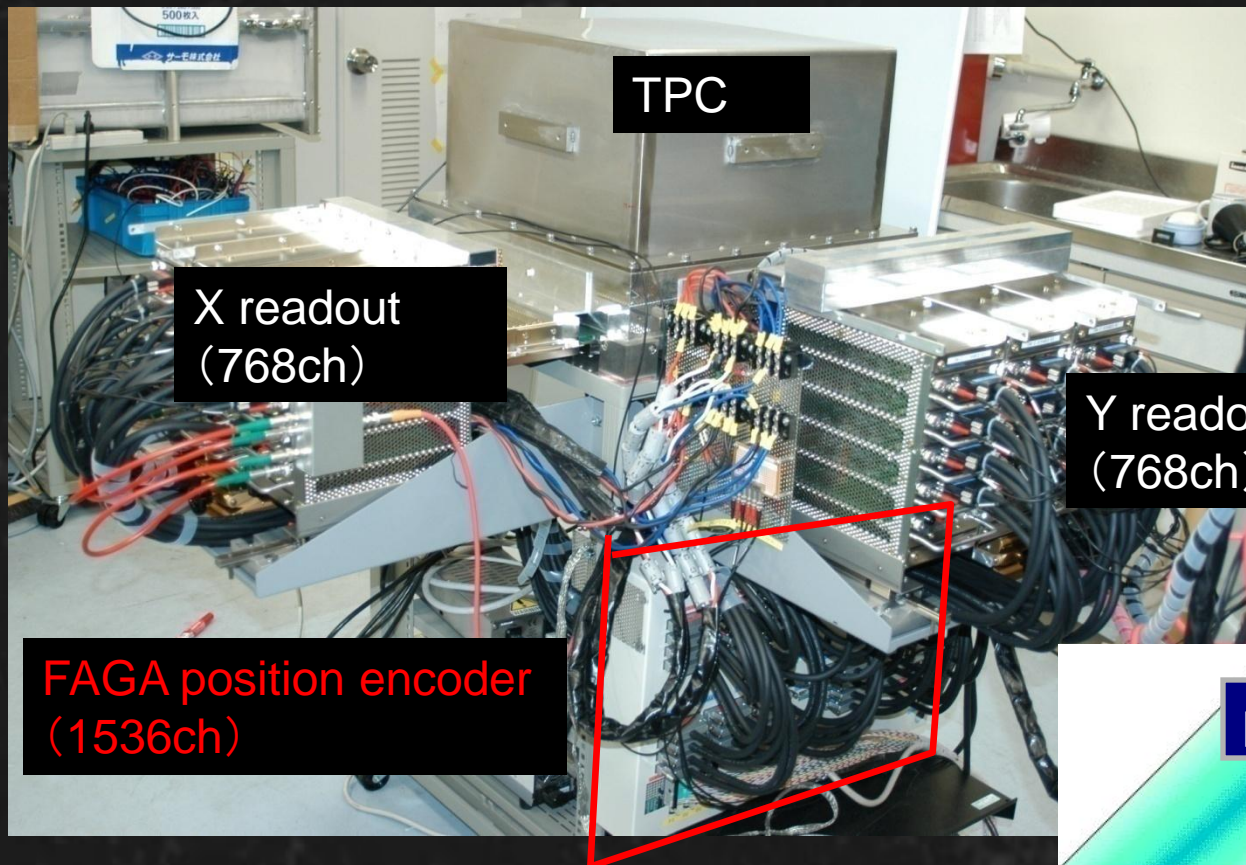
←  $\mu$ -PIC upgrades

## Goal: 100m<sup>3</sup> O(10kg)

- COST!!!
- ← QPIX



# NEWAGE-0.3a SYSTEM

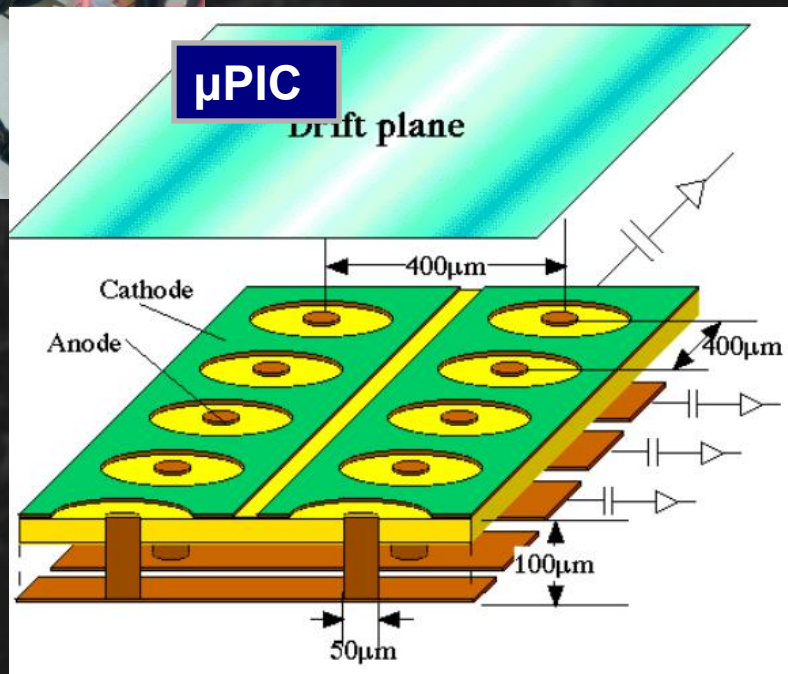


C  
× 10)  
0)

FAGA position encoder  
(1536ch)

## μ-PIC (30\*30cm<sup>2</sup>)

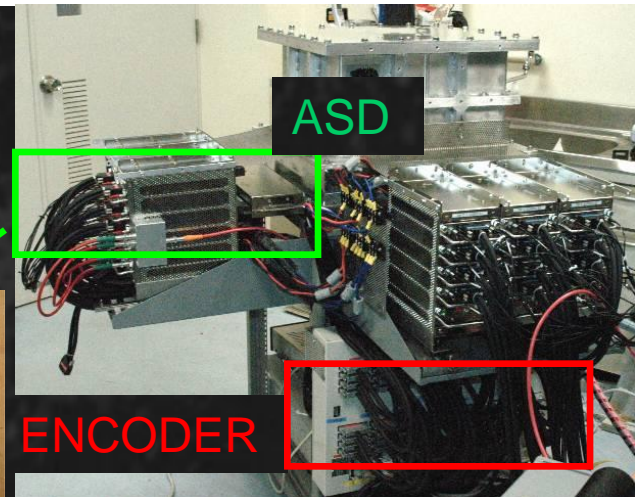
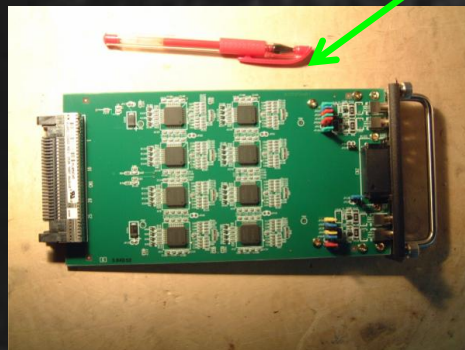
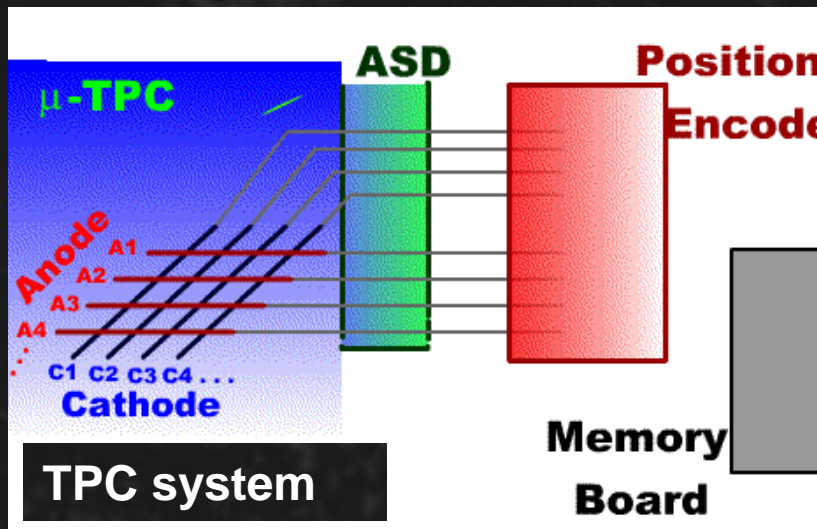
- Gas amplification + readout
- 400μm pitch
- 768+768 readouts



# Readout electronics

## DIGITAL : Tracking

- 768 anode + 768 cathode
- Digital (LVDS) signals at ASD
- (X,Y) coincidence at the position encoder
- 100MHz pipeline

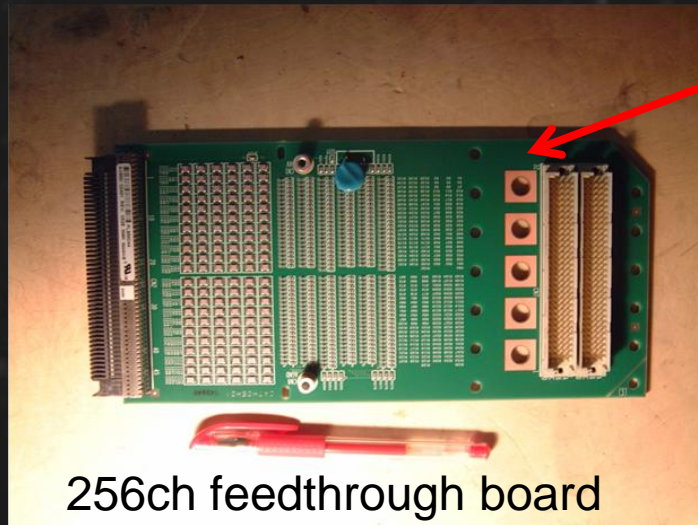
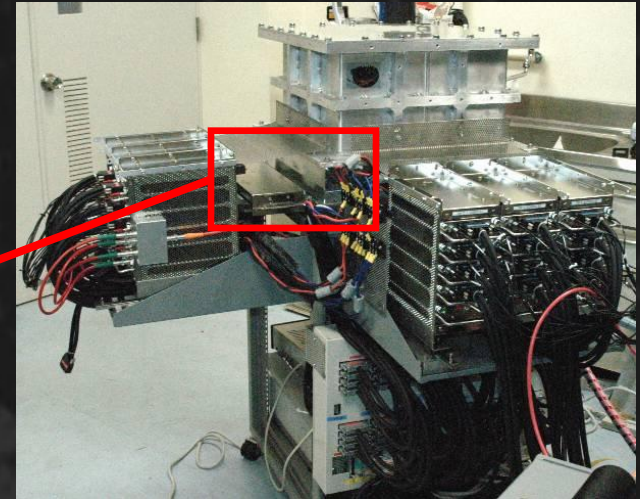


## ANALOG : energy

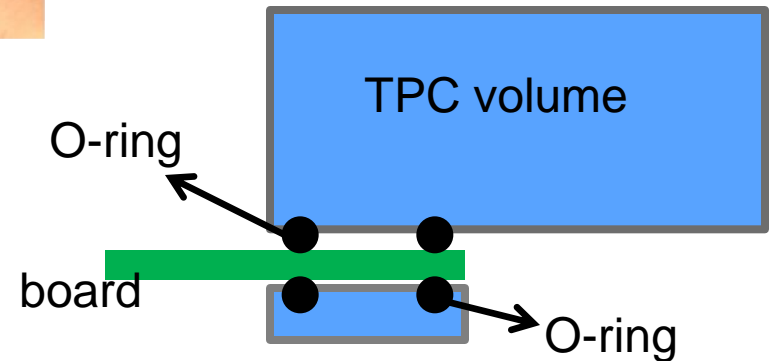
- 768 cathode –sum--> 4ch

# 1500ch feedthrough

- feedthrough board
- everything is out of the vessel
- easy to maintain
- keep the gas purity



256ch feedthrough board



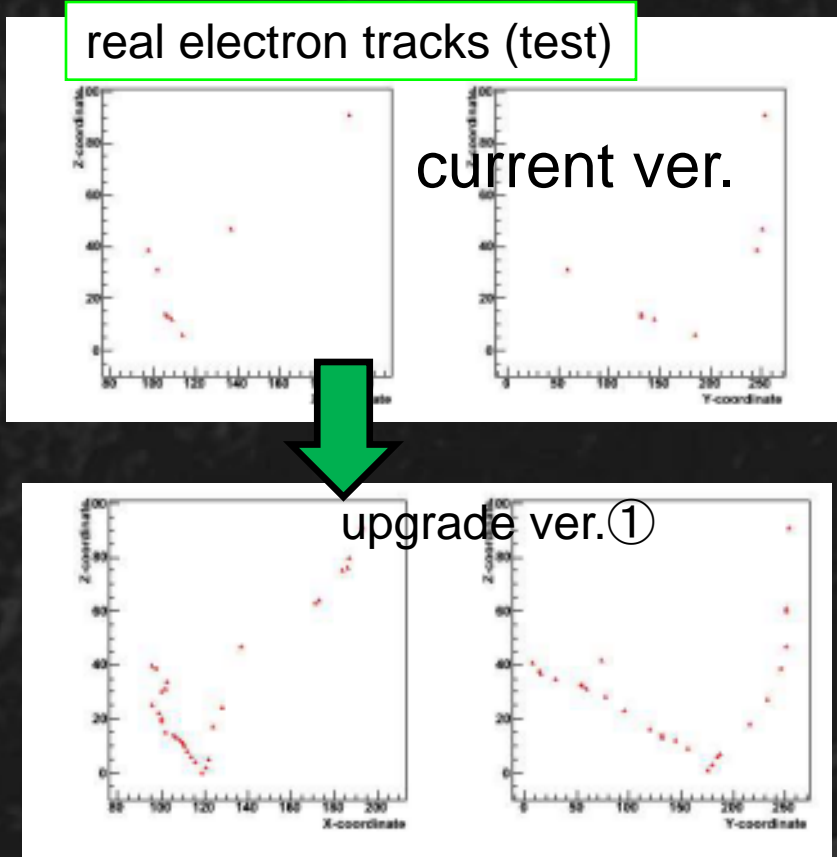
# Electronics(FPGA code) upgrade ①

- 100MHz is too fast...
  - X-Y coincidence in 10 ns
  - time-walk problems
  - online (FPGA) coincidence  $\Rightarrow$

upgrade ver.①  
 record all X or Y edges  
 offline(software)  
 loose coincidence

	current	upgrade①
	recorded	recorded
	NOT recorded	recorded

Upgrade ver① would improve  
 gamma-rejection  
 angular resolution





# Electronics(FPGA code) upgrade ②

## TOT (time over threshold)

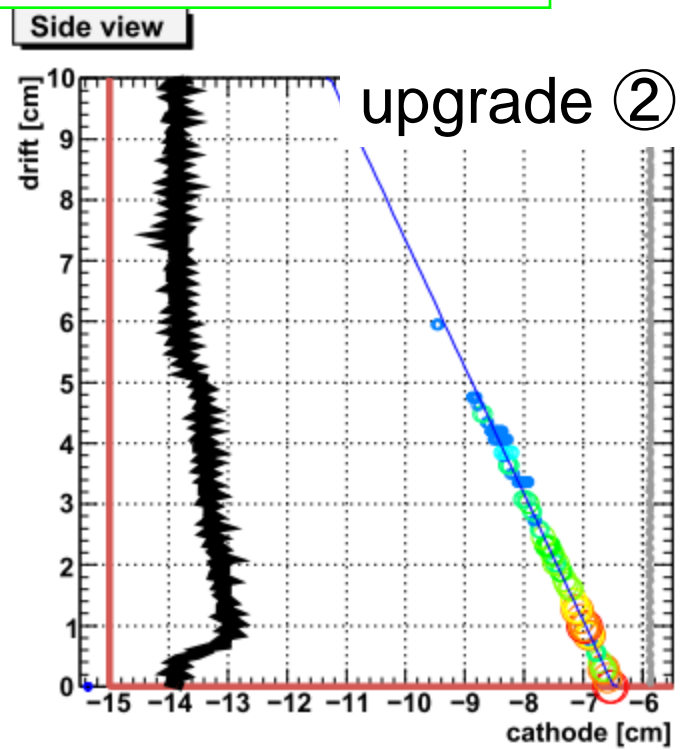
upgrade ver. ②

record all X- or Y-, pos or neg edges



Upgrade ver② would improve head-tail recognition

real alpha tracks (test)



# QPIX

# Pixel readout ASIC for MPGD

## Trend of Gas Tracking Device

reliable technology

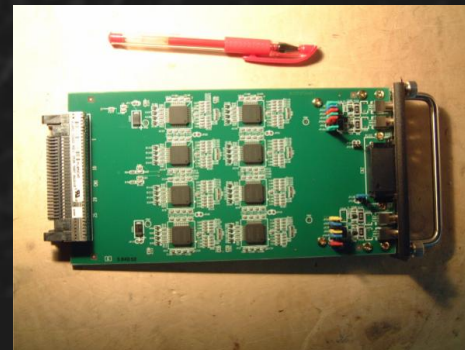
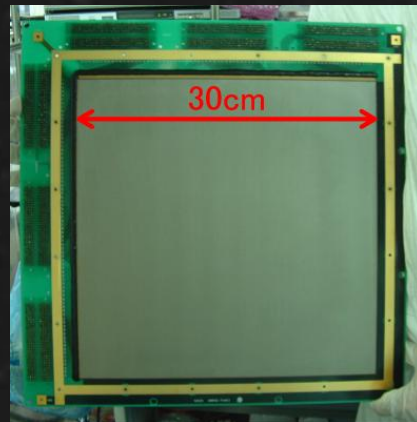
fine pitch  
(Micro-patterned...)

#of channel	~100	~10000
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- MWPC + discrete electronics

- MPGD connector, cable ASIC

- MPGD on ASIC

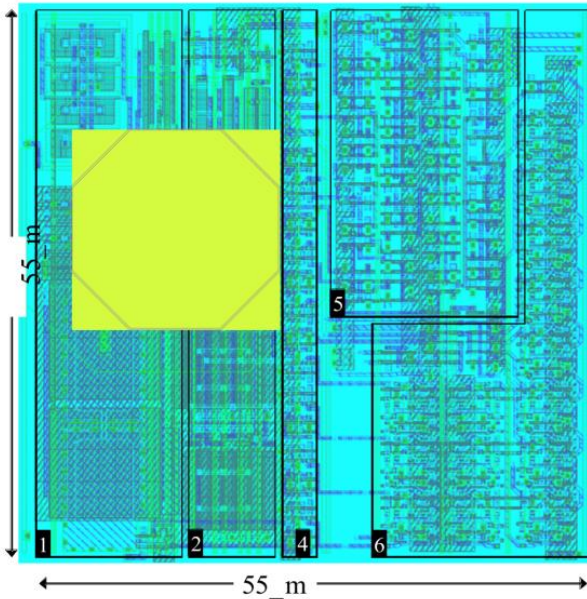


# TIMEPIX

## CERN + MEDIPIX consortium



Timepix pixel



CERN

- Timepix chip:
- 256x256 pixels
  - pixel: 55x55  $\mu\text{m}^2$
  - active surface: 14x14 mm<sup>2</sup>

## to measure TOT, TOF

TOF (Time of Flight)  
TOT (Time Over Threshold)

Timepix chip (1<sup>st</sup> version) produced Sept. 2006  
Available for use in detectors since Nov. 2006

1: Preamplifier; 2/3: Threshold discriminator; 4: 8-bit configuration latches  
5: Disc., 6: 14-bit Counter and overflow control

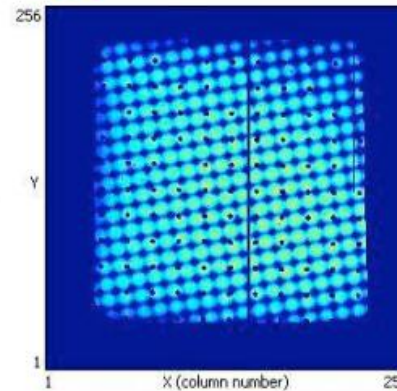
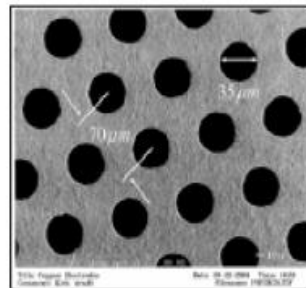


# TIMEPIX (continued)

## How to use

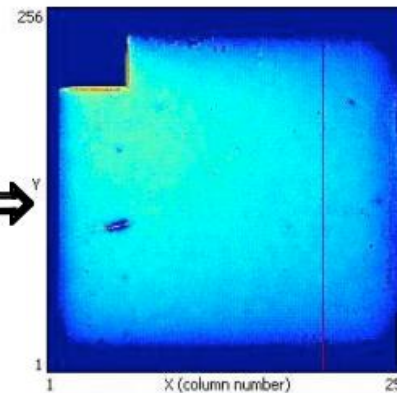
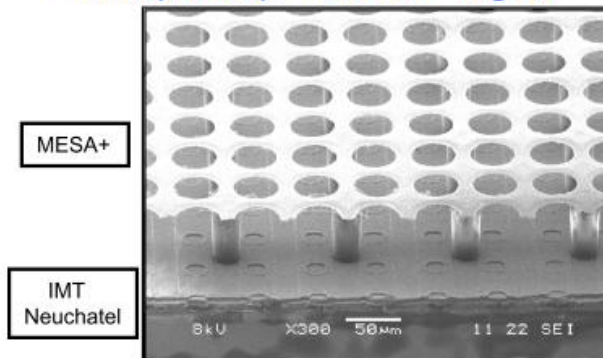
### Full post-processing of a TimePix

· Timepix chip + Micromegas mesh:



Moiré effects  
+ pillars

· Timepix chip + SiProt + Ingrid:



"Uniform"

"counting" mode

高抵抗のアモルファスSiをチップ表面にコーティングすることで放電対策も万全

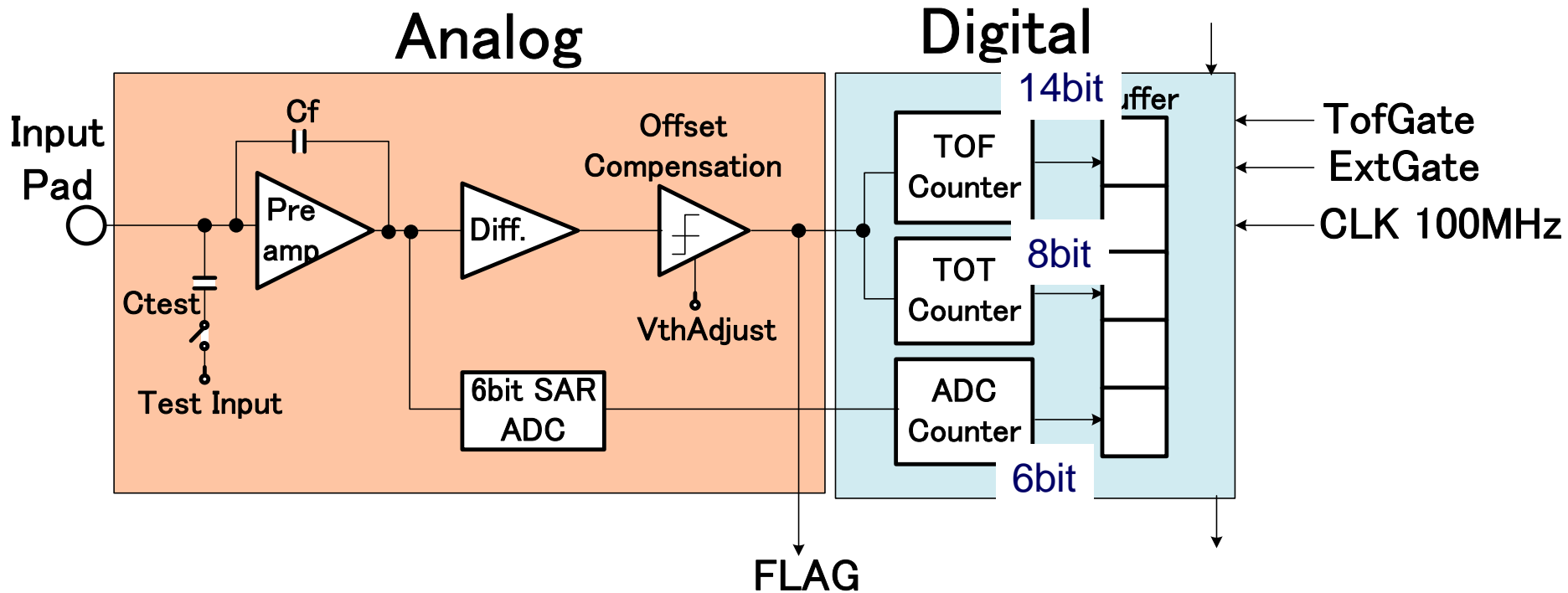
Direction Sensitive  
WIMP-search

NEWAGE

# ◆ QPIX development in Japan

- KEK + Kyoto(NEWAGE) + SAGA(Linear Collider)

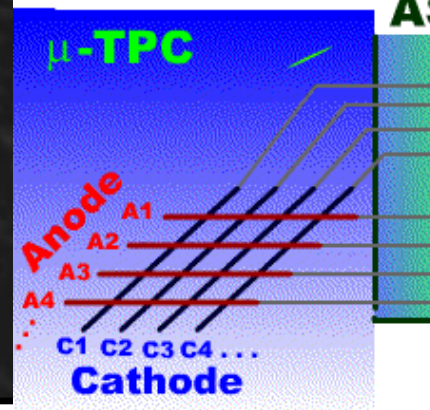
- To measure TOF, TOT, Charge



# WHY TOT+charge ?

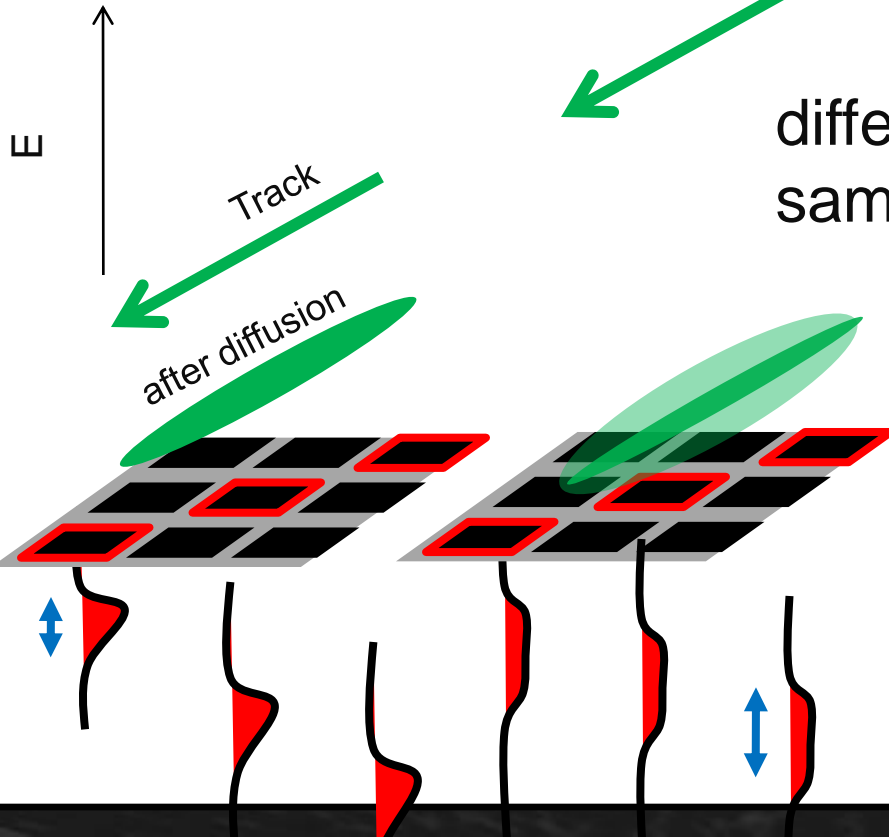
- track direction dependence
- longitudinal diffusion

$$\sim 0.1 \text{ mm}/\sqrt{\text{cm}}$$



short drift tracks

long drift tracks



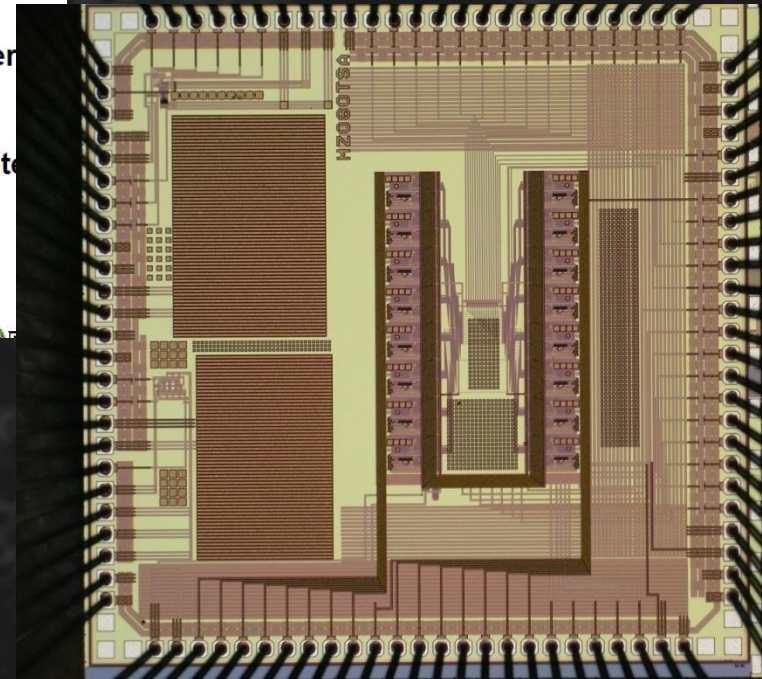
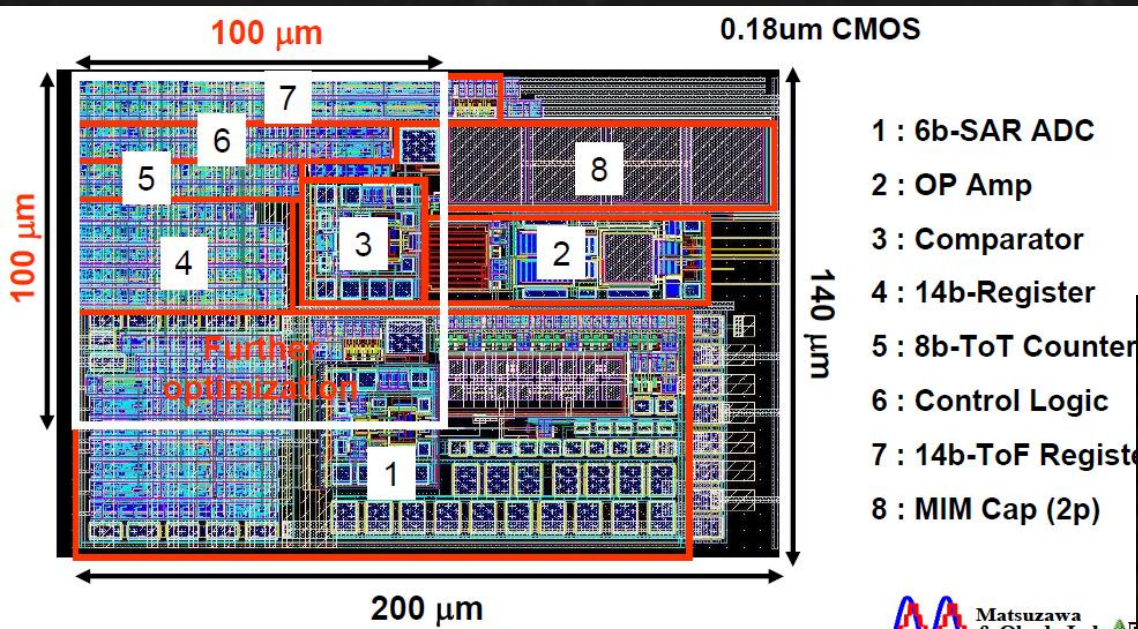
different TOT (blue)  
same charge (red)

TOT + ADC is essential to know  
the shape of the electron cloud

would help to know Z

# ◆ CURRENT STATUS

- 1st prototype (16ch) was made
- electric test completed
- preparing for GEM+QPIX test





# ◆ CURRENT STATUS

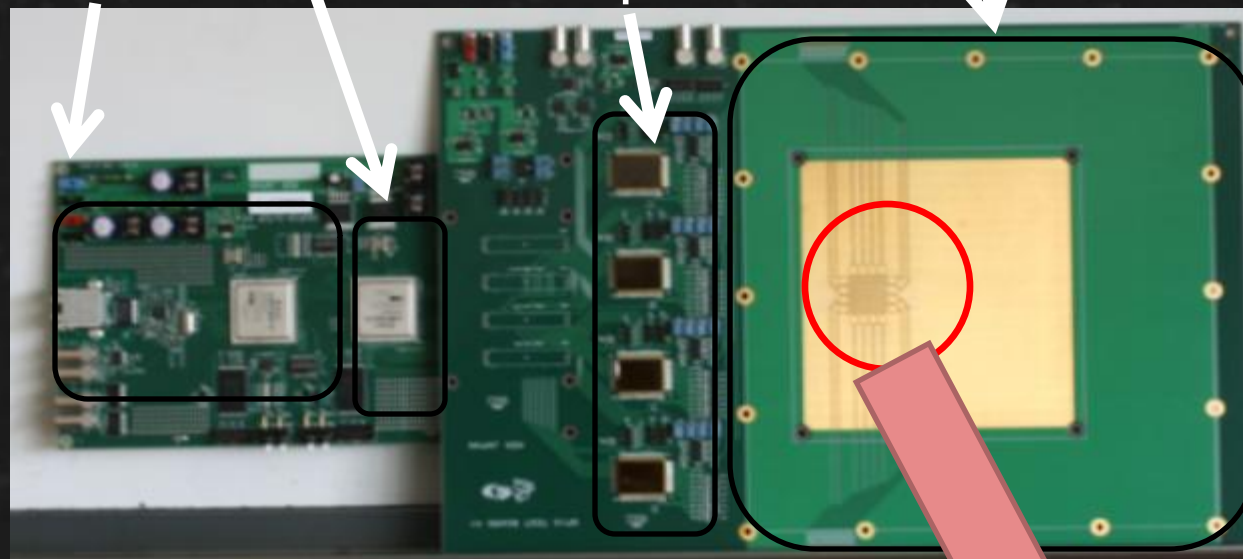
## ● preparing for GEM+QPIX test

SiTCP  
TCP/IP

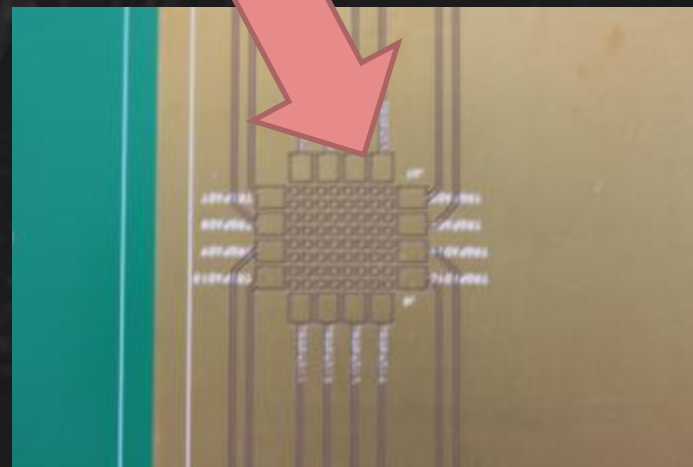
interface FPGA

Qpix

gas detector PADS



NEXT ver. should have PADS  
on QPIX.



# DISCUSSION

# Scaling-up : HOW MUCH?

- 1st milestone 1m<sup>2</sup> 5000ch

CURRENT ver. \$30,000/1500ch

reasonable cost-down should work

- To cover > 100m<sup>2</sup>

- COST MATTERS

- 400 $\mu$ m pitch

~1e6 ch by strip readout

←  $\mu$ -PIC + QPIX like ASIC

~1e12 ch by pixel readout

← QPIX + post process MPGD

feasibility study in a couple of years