New Readout Method for 2-D MSGCs

P. Siritiprussamee[a], H. Takahashi[a], K.Fujita[a], H. Niko[a], K. Nishi[a], M. Nakazawa[a], T. Ino[b], S. Kishimoto[b], and M. Furusaka[c]

[a] The University of Tokyo, [b] KEK, and
[c] Hokkaido University

Overview

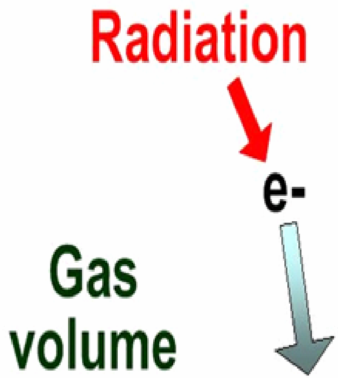
- Introduction
- Readout Method
  - Individual Readout Method
  - Charge Division Readout Method
  - Encoding Readout Method
  - Global-Local Grouping (G-LG) Readout Method
- Conclusions

Introduction

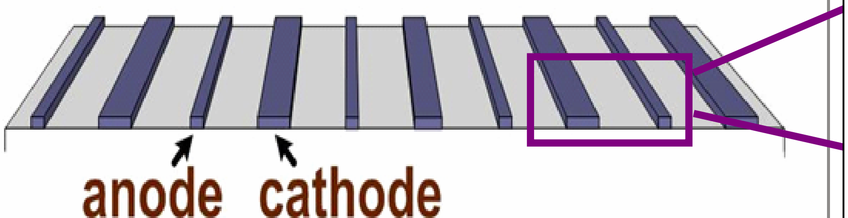
- Multi-grid-type MSGC(M-MSGC) is being developed in Japan for neutron applications.
  - Large sensitive area @low cost
  - High counting rate, High detection efficiency and high spatial resolution → high pressure gas
  - The number of interconnections through a high pressure gas vessel is limited.
- New readout method dedicated for 2-D M-MSGC neutron counters is being developed.

Introduction

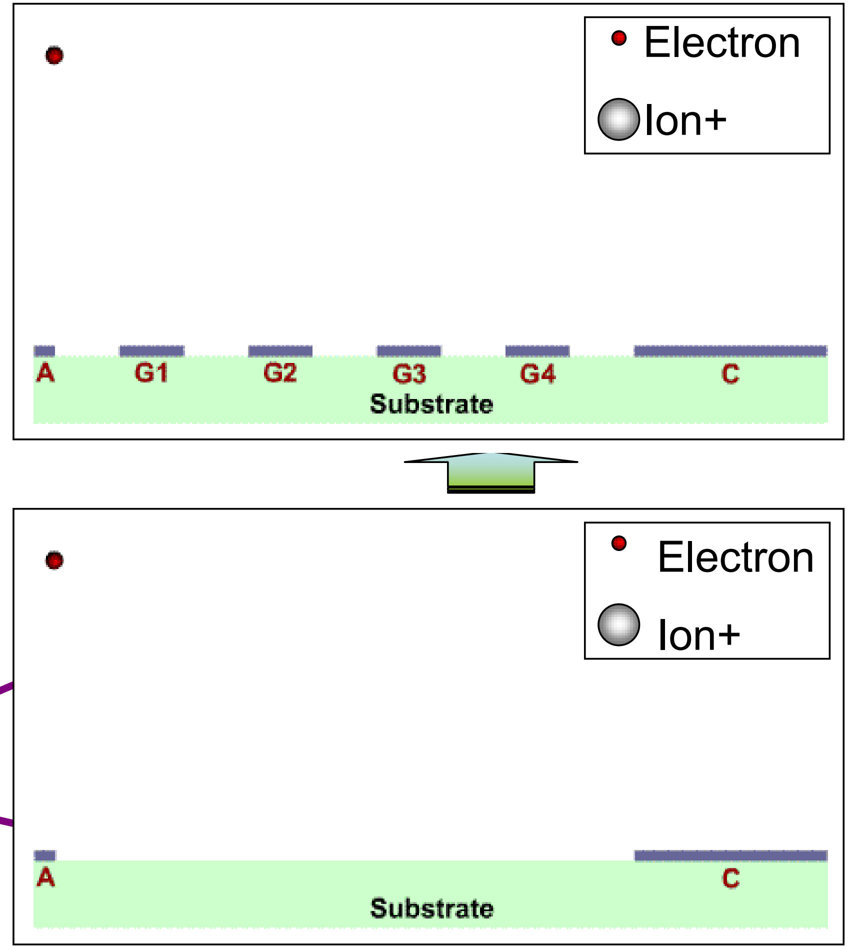
Microstrip gas chamber (MSGC)



- Photolithography
- Small pitch
- High counting rate
- Avalanche mode

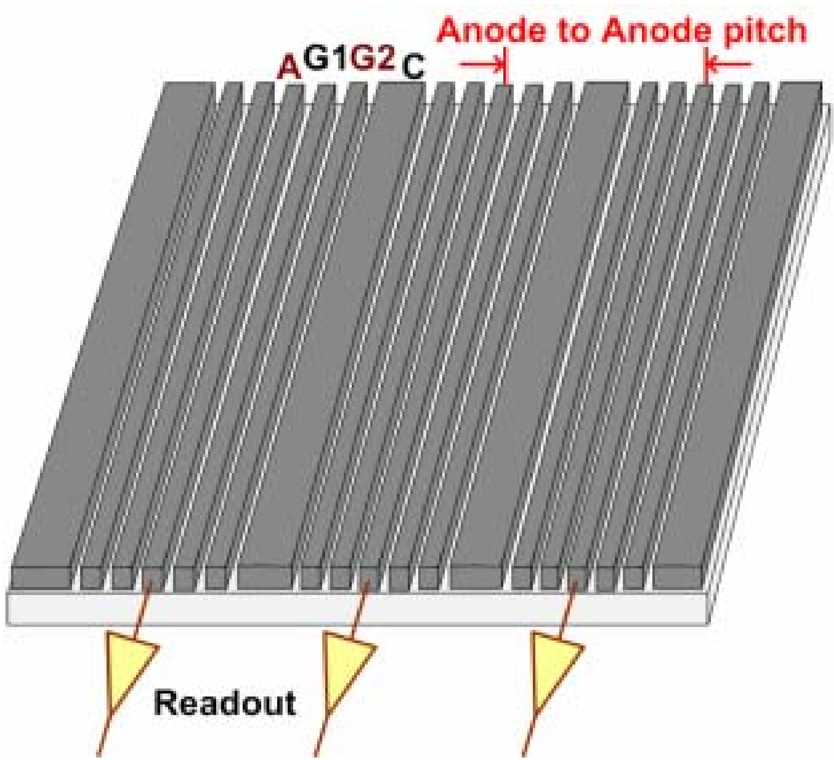


Multi-grid-type MSGC (M-MSGC)



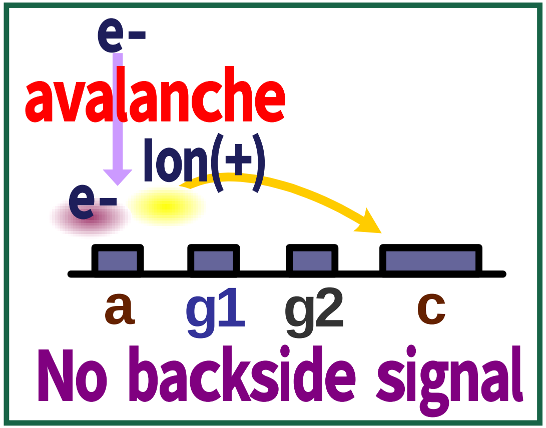
- **Discharge &low gas gain**

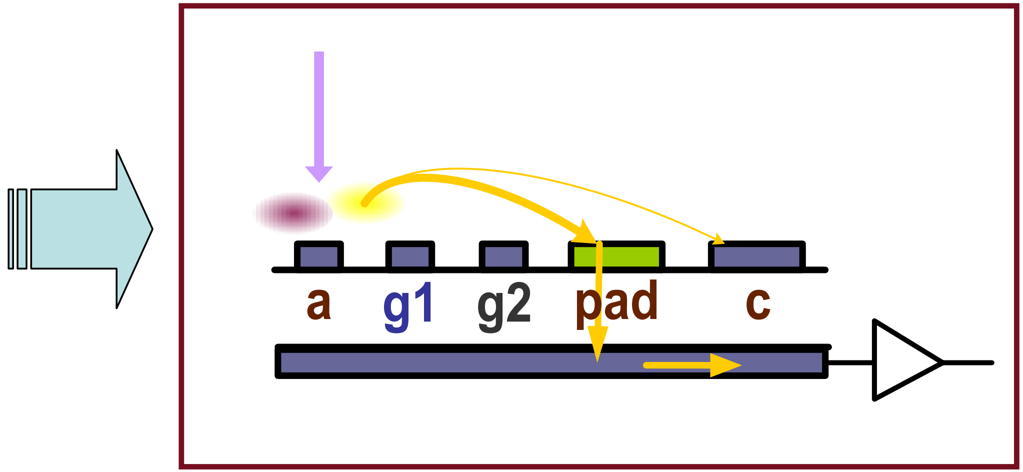
1. Individual Readout Method

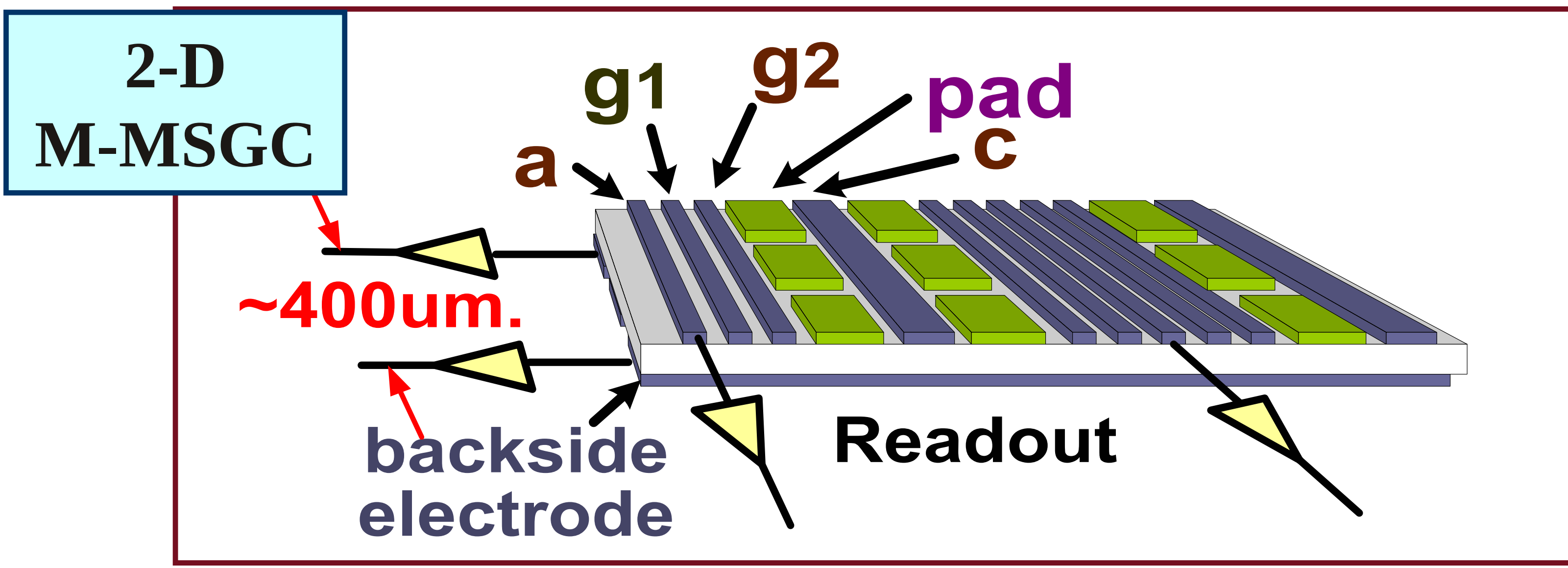


- One amplify per readout line → Many amplifiers
  - Huge electronics
  - Difficult to maintenance
- Spatial resolution
  ~Anode to Anode pitch → noise do not effect to the resolution
- Very high counting rate
  >10^6cps

M-MSGC with pad-readout

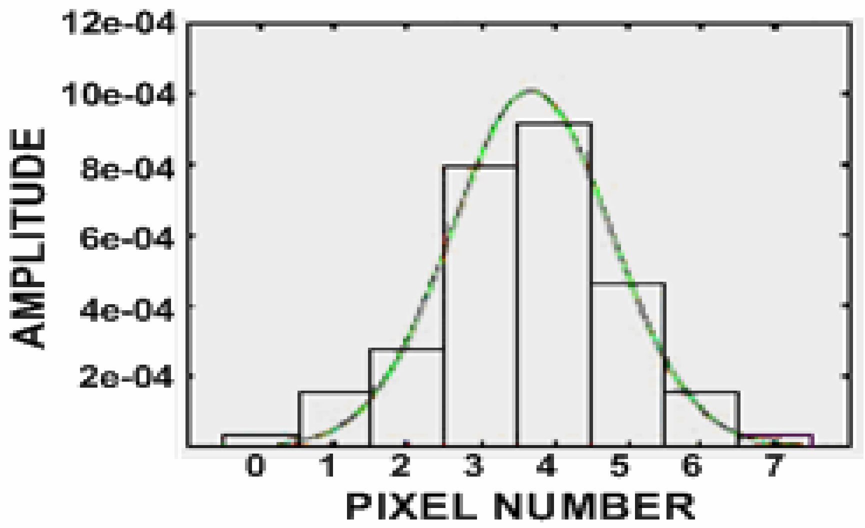


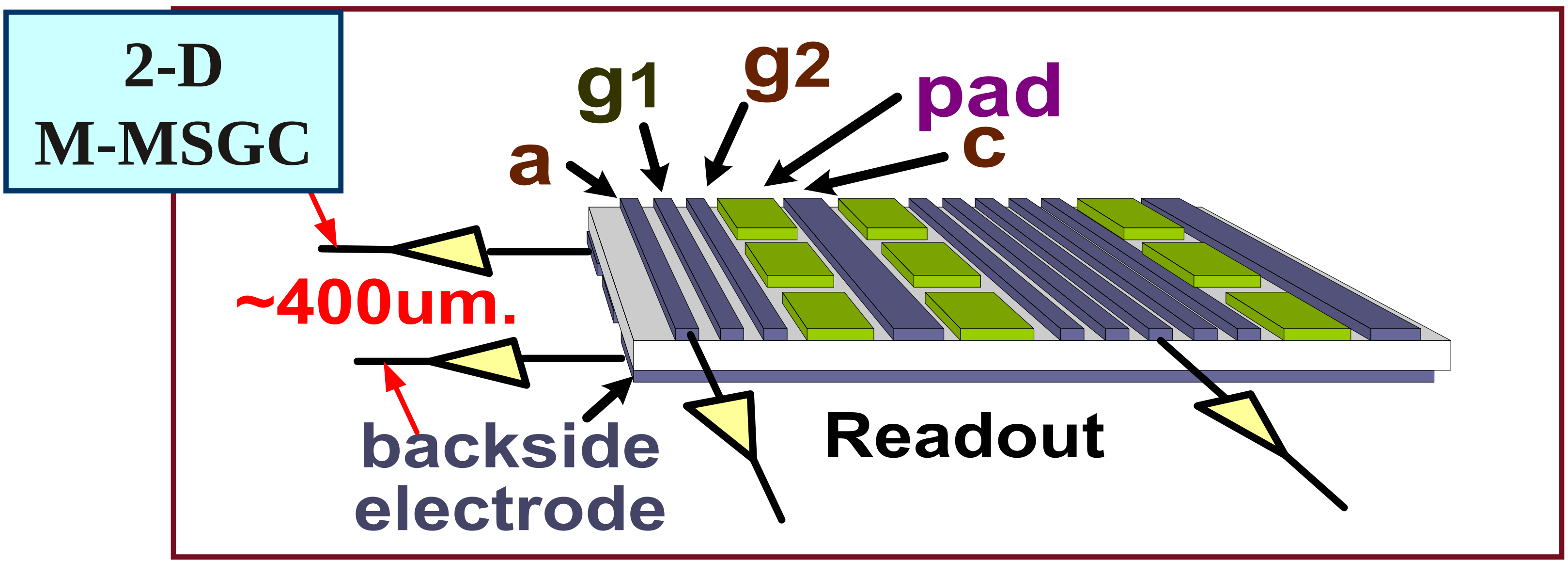




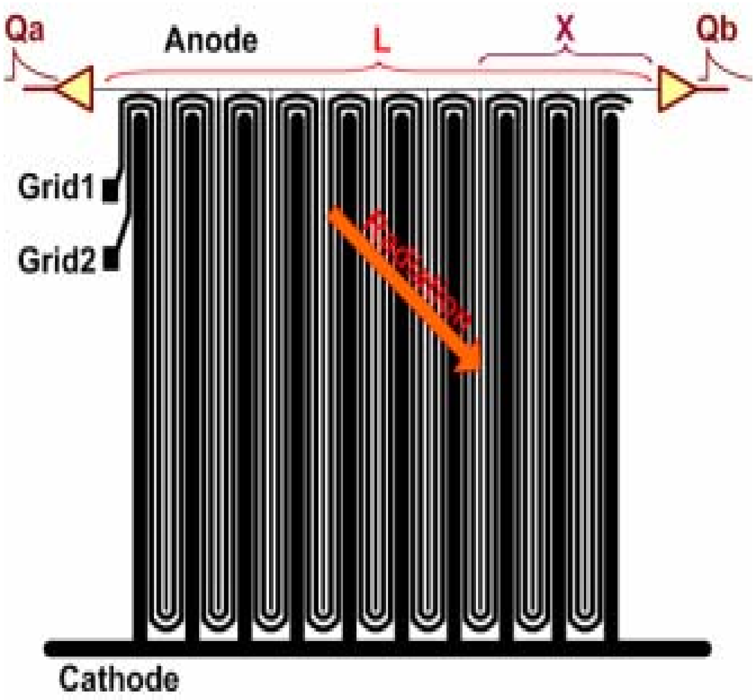
Backside distribution

- Backside distribution ~1.2 mm FWHM





2. Charge Division Method

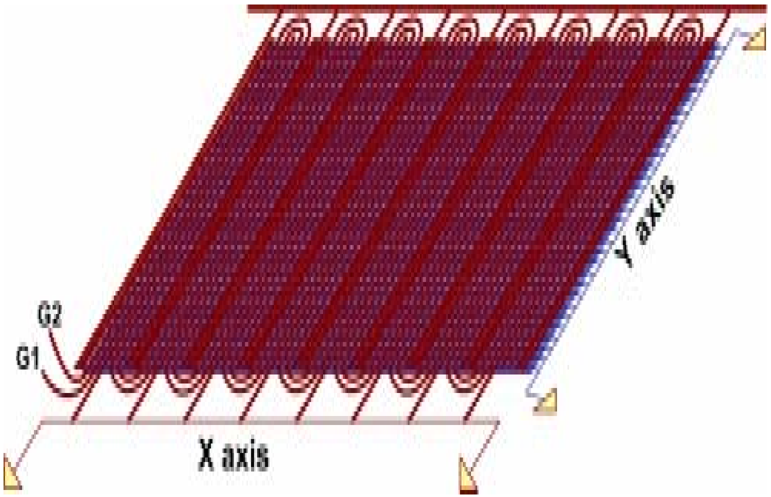


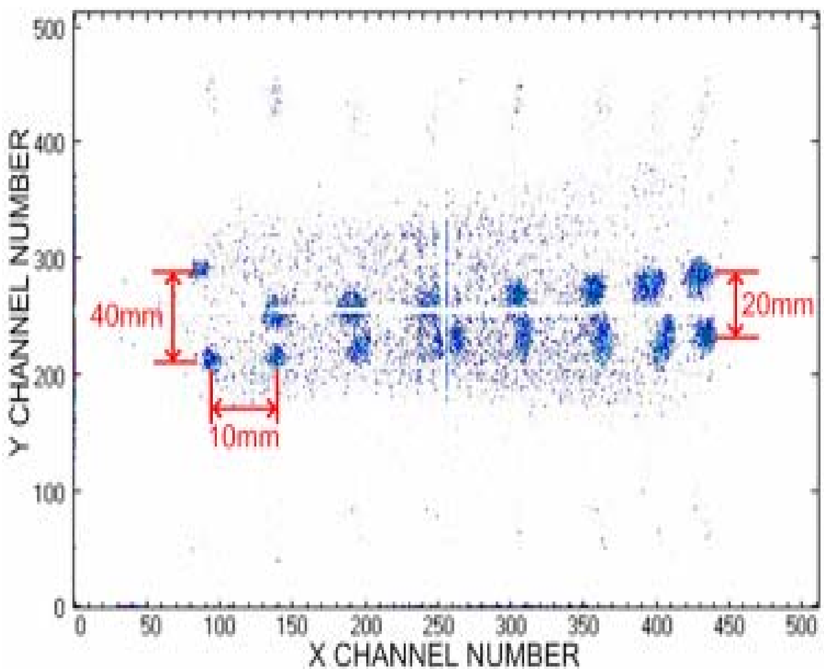
$$\frac{X}{L} = \frac{Qa}{Qa + Qb}$$

- Position of the event can be determined from the fraction of the charge reaching each end of the resistive network (charge-division encoding)
- Compact

- Slow
- Resolution limited by S/n
- Image distortion

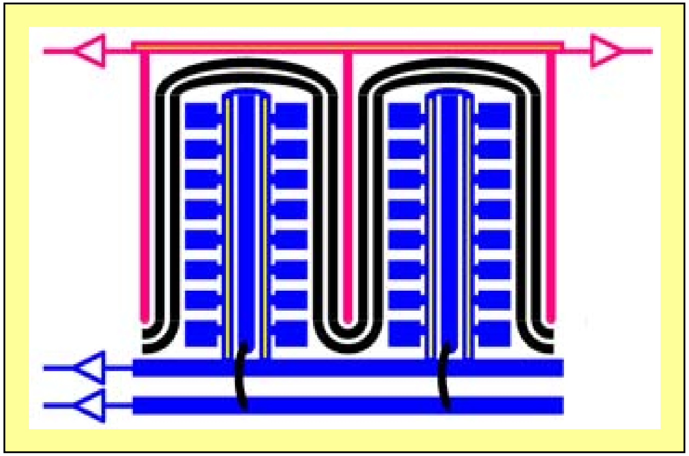
2-D Charge Division M-MSGC

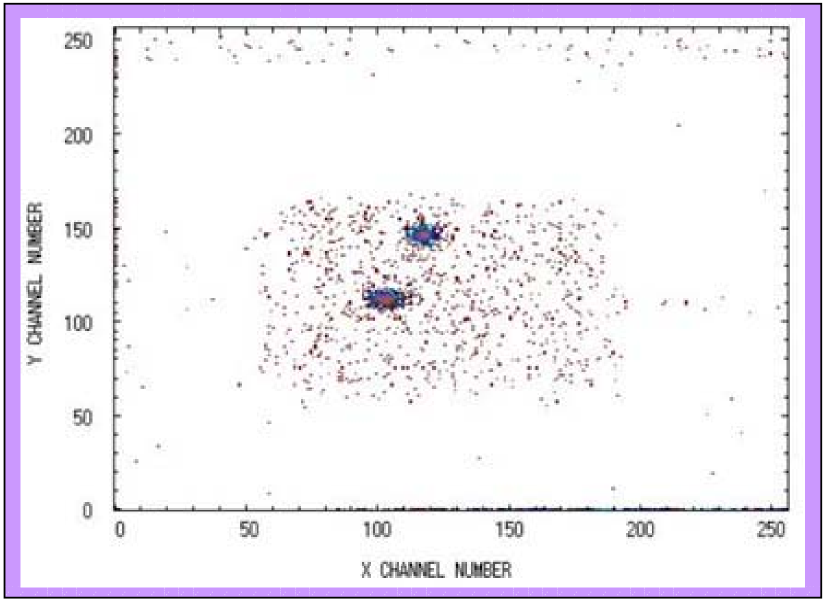




- Ö Using M-MSGC with PAD
- Ö 95x95mm^2 of sensitive area
- Ö 500um thickness
- Ö Gas mixture: 3He (0.4 atm) + CF4 (5 atm)
- Ö Backside signal is 60% of anode signal
- •Beam size 1mm
- •Gas gain of 25
- •X-axis (Anode) ~ 1.6mm.
- •Y-axis (Backside) ~ 4.6mm.

Surface charge division M-MSGC

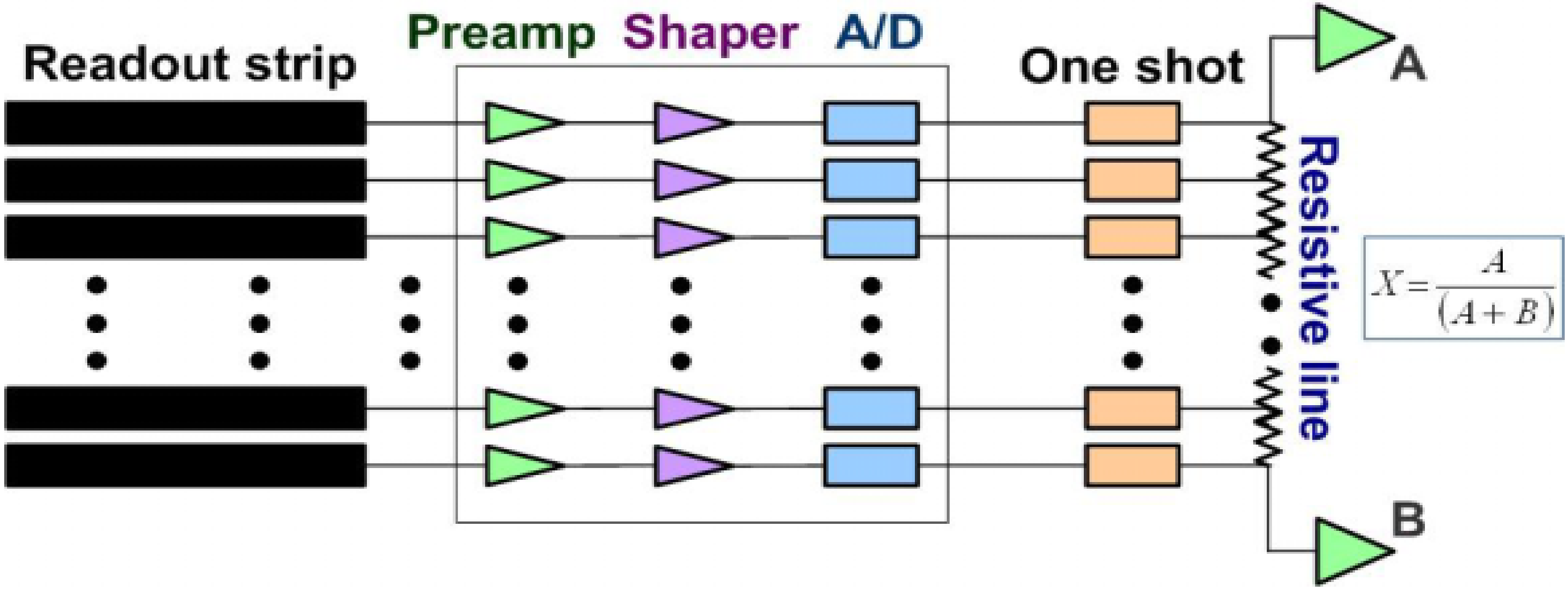




- Thick plate
- Low cost
- Readout by Charge division method
- 4 amplifiers

- Position resolution ~1.3mm.

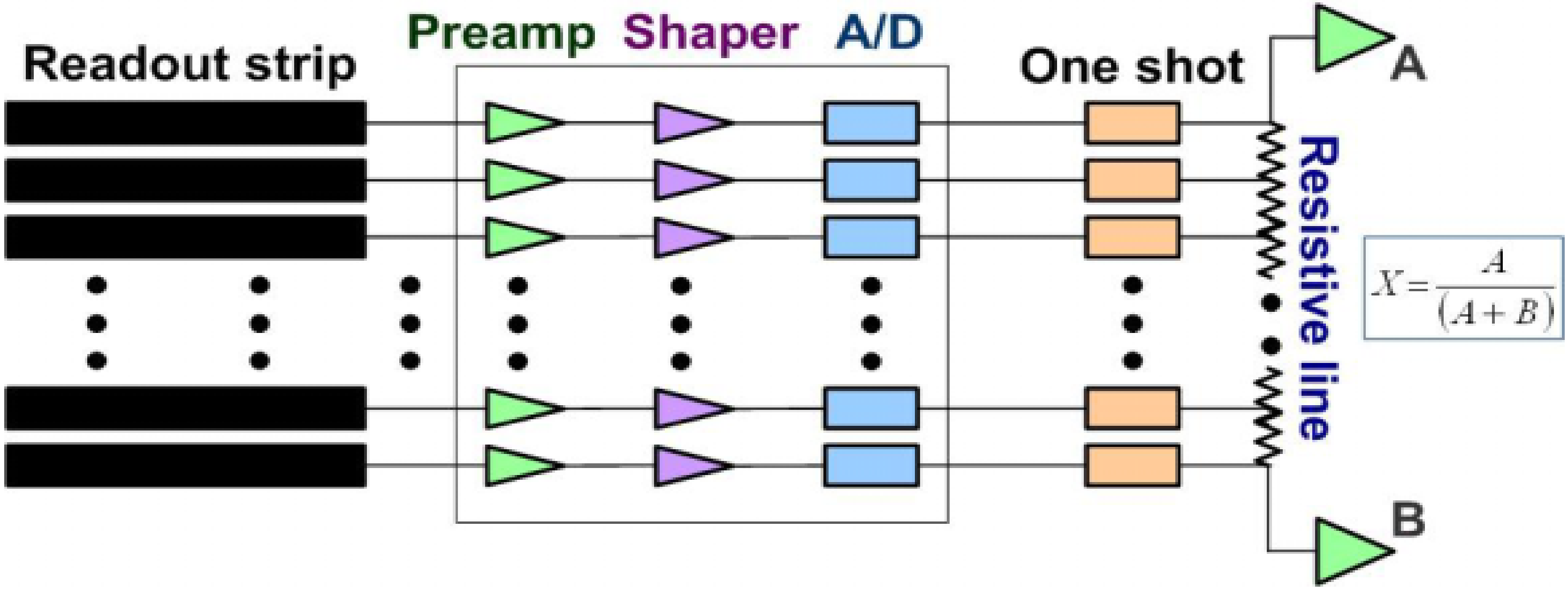
3. Encoding readout method



❖Individual readout from each strip Signal Processing → with ASICs (small size & low noise)

❖Processed signals are encoded into a set of two pulses using a resistive line based on the charge division method

3. Encoding readout method

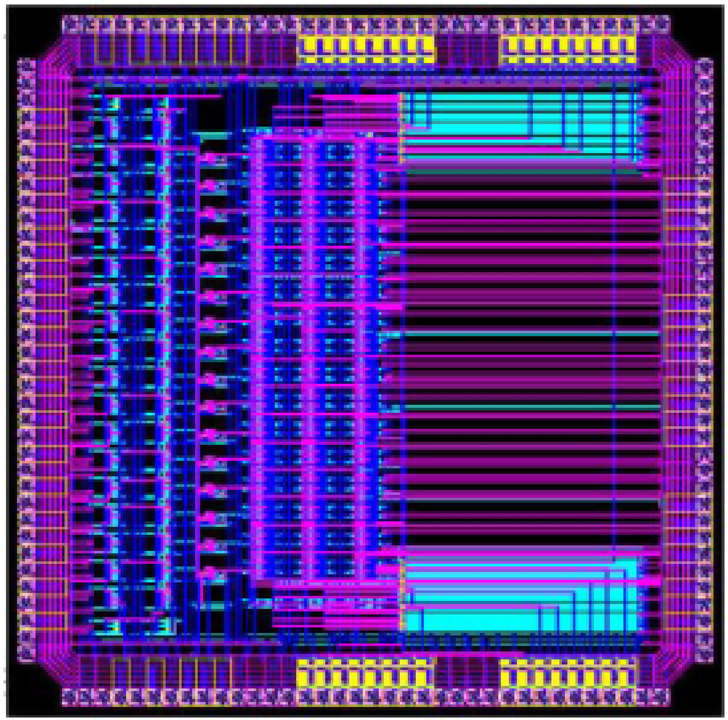


- ★Fast ~10^6cps per strip
- ★High resolution
- ★Compact size

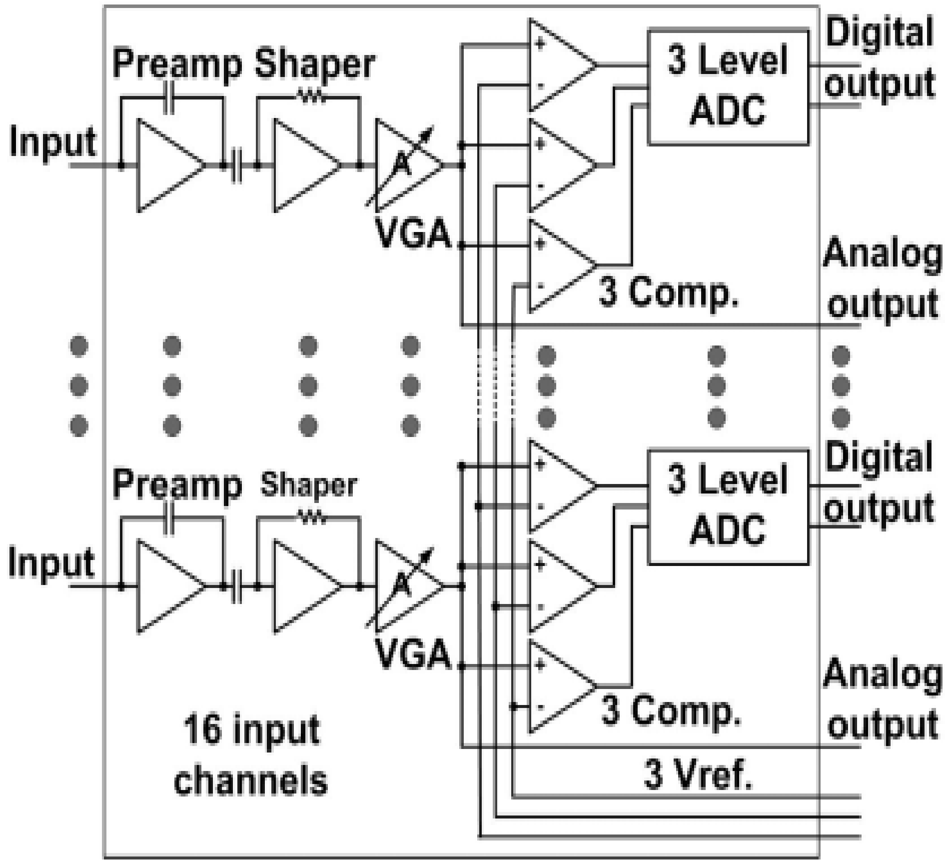
♦Difficult for maintenance

Individual-readout ASIC chip

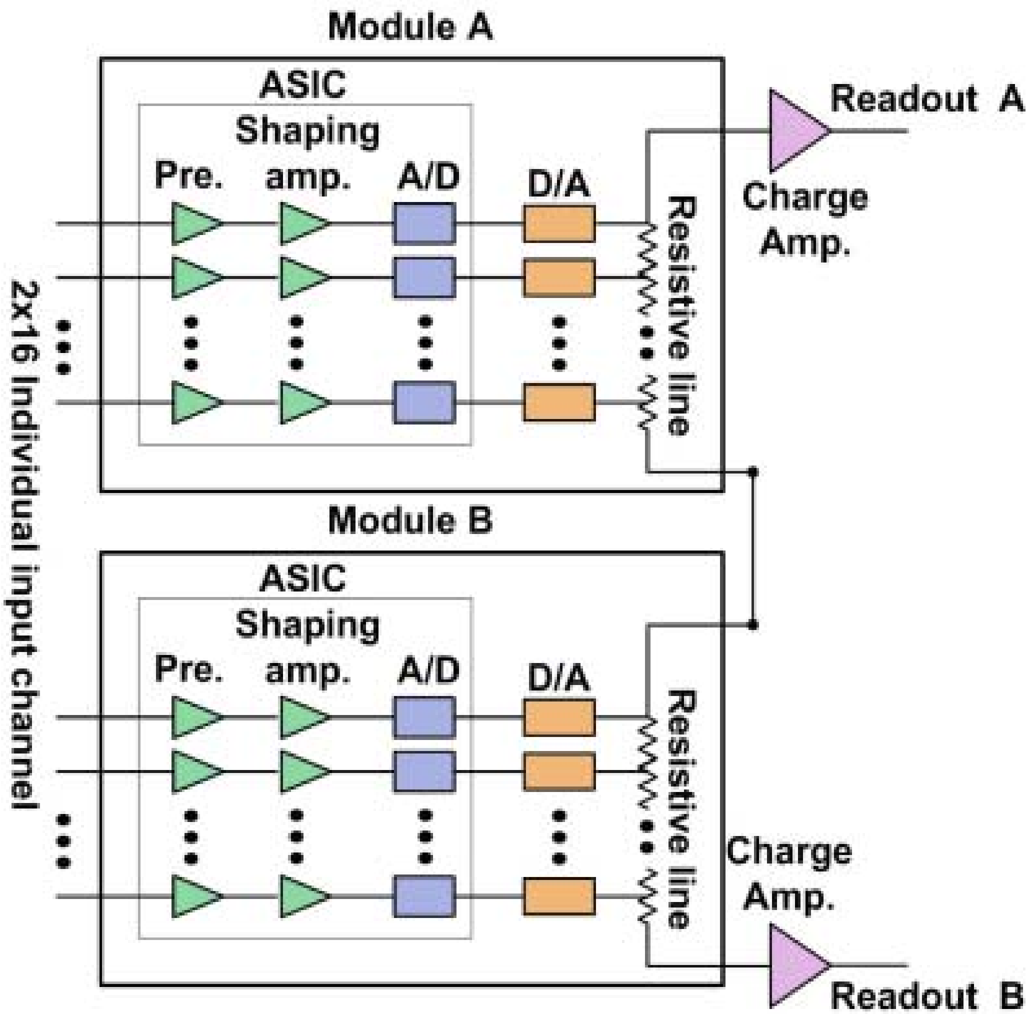
- ROHM 0.35um CMOS



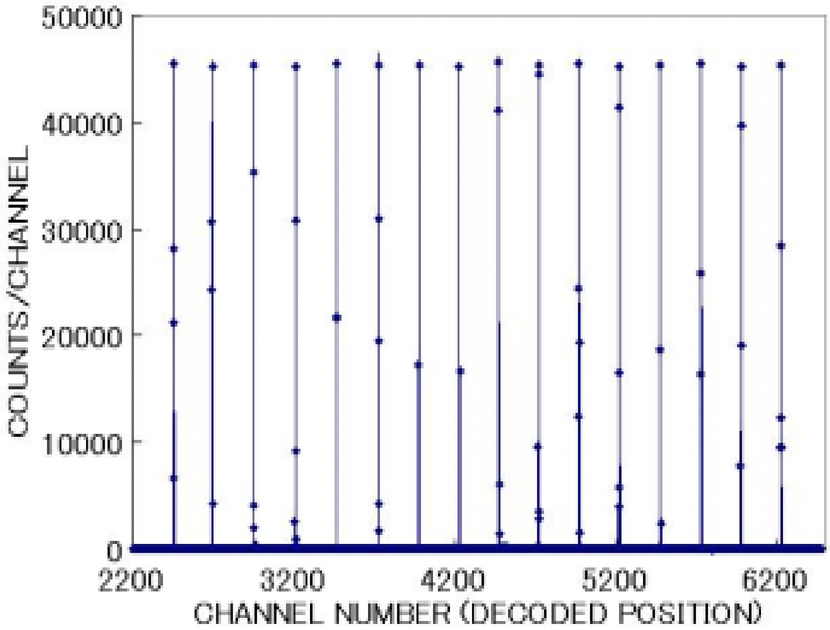
Shaping time 500ns

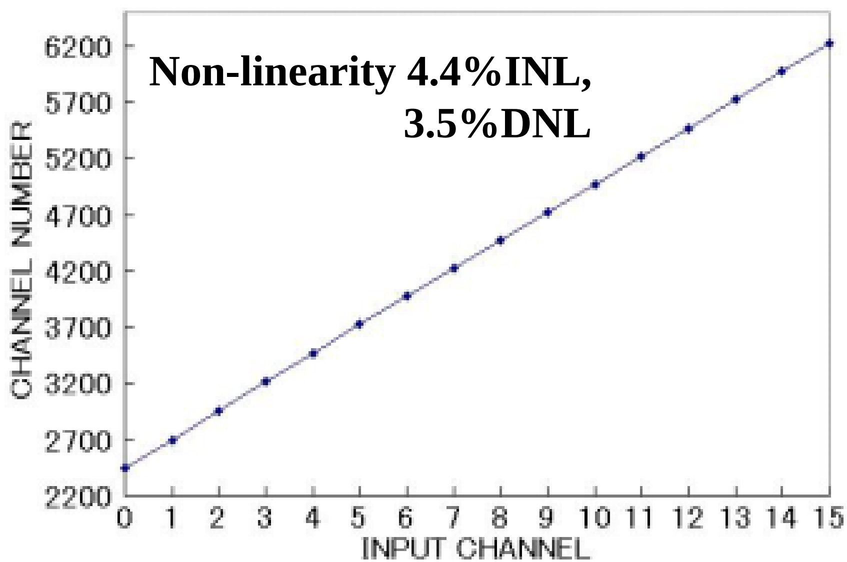


Scalable method



- Increase number of input channel
- Limit of number of input channel --> noise level





Position Identification

All 16 channels are successfully resolved as individual peaks.

FWHM Resolution of peaks corresponds to 1.05% of the distance between neighboring peaks.

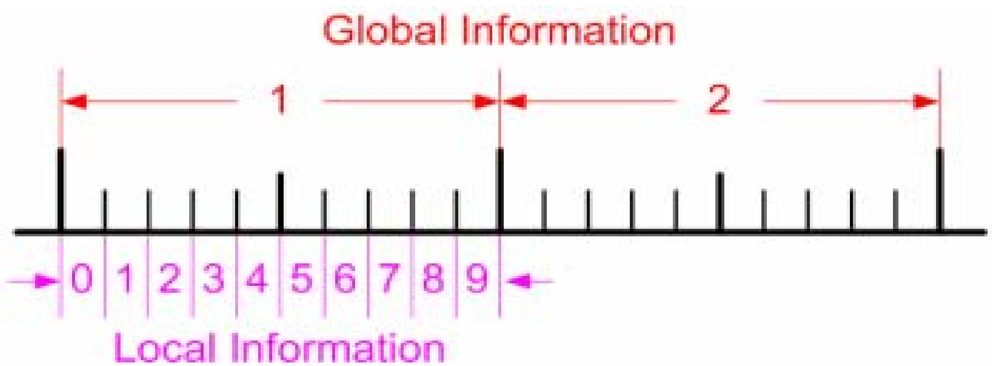
Thus,
16 * 100/1.05 ≅1500 pixels can be resolved.

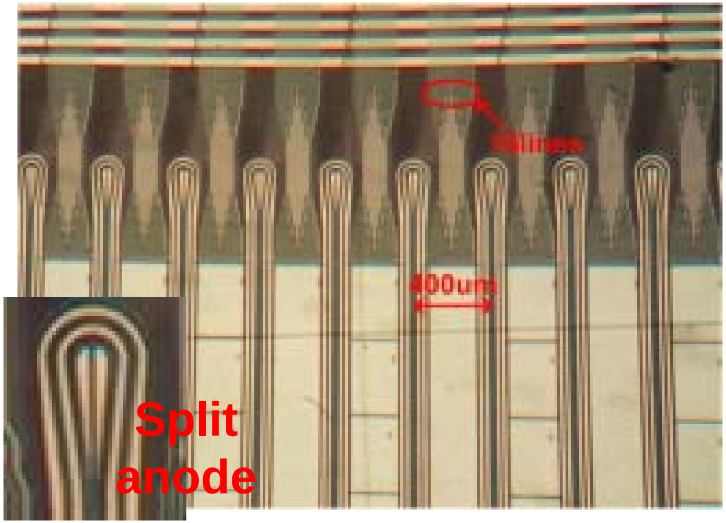
4. Global-Local Grouping (GLG) Readout Method

The principal of G-LG method is using global and local signals to locate the position :

- **Global information is used to define the coarse position**

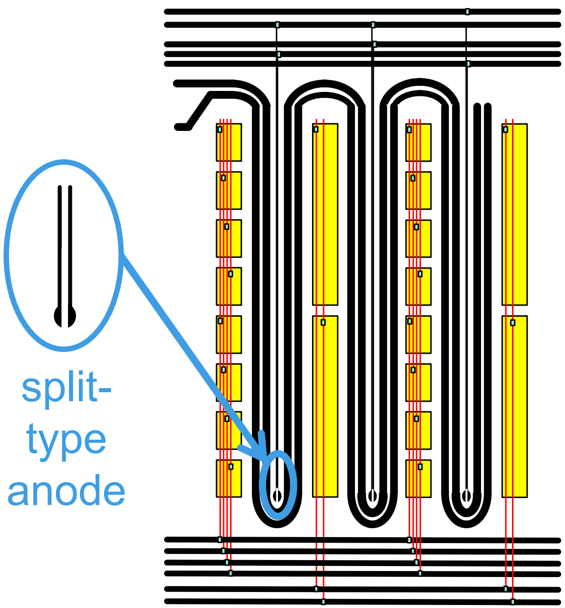
- **Local information is used to define the fine position in the coarse position**





G-LG Method

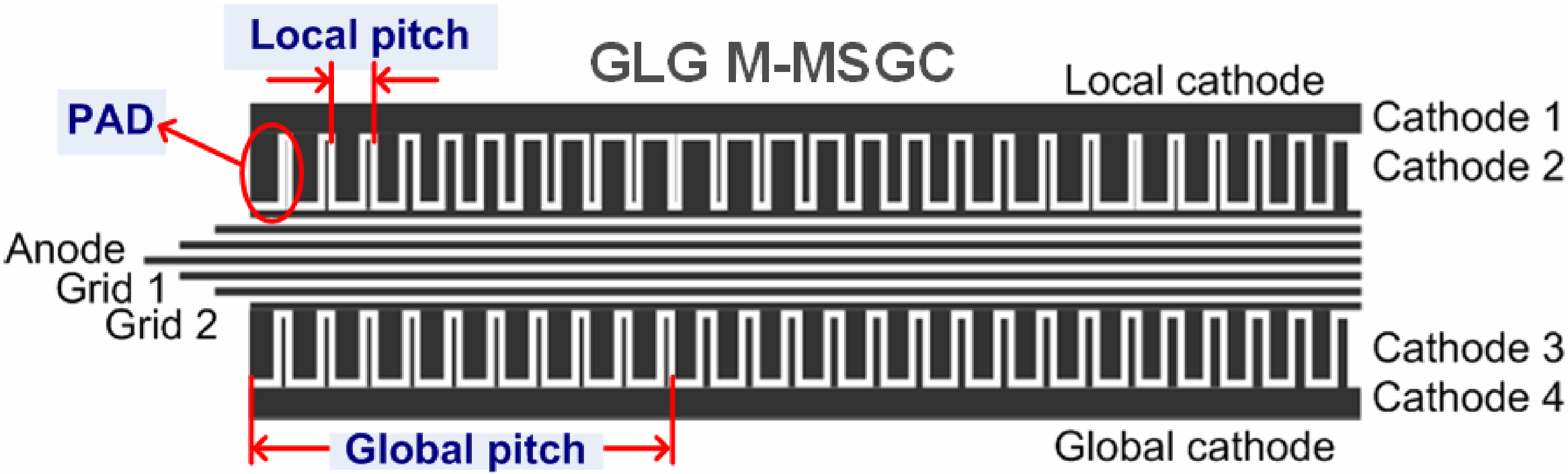
- High counting rate
- High resolution ~Anode pitch → micro fabrication technology (~16lines/400um)
- Compact → easy to maintenance
- Good uniformity
- Cost & High capacitance



$$Positions\ \ per\ readout\ line = \frac{(Global \times Local)}{(Global + Local)}$$

Presented by **K. Fujita** 26/1/2006

1-D GLG M-MSGC



- Position sensing → Geometrical Charge Division
- Periodical modulation on Local cathode.
- Using the same PAD size within global pitch

Presented by **K. Fujita** 26/1/2006

Conclusions

	Detection area	Resolution
Individual readout	Limited by the number of amplifiers	High (anode pitch)
Charge Division	Limited by expecting resolution	Limited by SNR
Encoding	Can be large	High
G-LG	Can be large	High (anode pitch)

Conclusions

	Counting rate	Image Distortion
Individual readout	High	-
Charge Division	Low	O
Encoding	High	o
G-LG	High	-

Conclusions

	Cost	Maintenance
Individual readout	Very high	Difficult
Charge Division	Low	Easy
Encoding	High	Difficult
G-LG	Reasonable	Not difficult