New Readout Method for 2-D MSGCs


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Overview

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  - Individual Readout Method
  - Charge Division Readout Method
  - Encoding Readout Method
  - Global-Local Grouping (G-LG) Readout Method
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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
>10^6 cps
M-MSGC with pad-readout

2-D M-MSGC

~400um.

backside electrode

Readout
Backside distribution

~1.2 mm FWHM

2-D M-MSGC

~400um.

backside electrode

Readout
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

\[
\frac{X}{L} = \frac{Qa}{Qa + Qb}
\]
2-D Charge Division M-MSGC

- Using M-MSGC with PAD
- 95x95mm² of sensitive area
- 500µm thickness
- Gas mixture: 3He (0.4 atm) + CF4 (5 atm)
- 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 \( \sim 10^6 \text{cps per strip} \)
- High resolution
- Compact size

- Difficult for maintenance

\[
X = \frac{A}{(A+B)}
\]
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

Presented by K. Fujita 26/1/2006
G-LG Method

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

\[
\text{Positions per readout line} = \frac{(\text{Global} \times \text{Local})}{(\text{Global} + \text{Local})}
\]

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

<table>
<thead>
<tr>
<th></th>
<th>Detection area</th>
<th>Resolution</th>
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<tbody>
<tr>
<td>Individual readout</td>
<td>Limited by the number of amplifiers</td>
<td>High (anode pitch)</td>
</tr>
<tr>
<td>Charge Division</td>
<td>Limited by expecting resolution</td>
<td>Limited by SNR</td>
</tr>
<tr>
<td>Encoding</td>
<td>Can be large</td>
<td>High</td>
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## Conclusions

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<th>Image Distortion</th>
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<td>-</td>
</tr>
<tr>
<td>Charge Division</td>
<td>Low</td>
<td>O</td>
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<tr>
<td>Encoding</td>
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<td>○</td>
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## Conclusions

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<th>Maintenance</th>
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<td>Individual readout</td>
<td>Very high</td>
<td>Difficult</td>
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<tr>
<td>Charge Division</td>
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<td>Easy</td>
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<tr>
<td>Encoding</td>
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<td>Difficult</td>
</tr>
<tr>
<td>G-LG</td>
<td>Reasonable</td>
<td>Not difficult</td>
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