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Silicon Sensor R & D

*Lim K.S. Myongji University* on behalf of Korean MPC-EX group

- Introduction to minipad sensor
- Development up to now (Baseline+)
  - Metal trace spacing
  - Reduction of local electric field and current
  - Channel stop
- Research in progress
  Number of guardring
  Length of metal overhang
  Summary & Prospect
  Acknowledgement

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## Introduction to Minipad sensor

We performed R&D's of the silicon minipad sensor for PHENIX MPC-Ex upgrade. R&D has evolved into main production.





#### Minipad sensor



The "minipad" sensor has 128 miniature pads covering 6 (cm) x 6 (cm) of silicon surface, and operates under full depletion.

### Minipad geometry



Areal coverage of a pad is1.8(mm) x 15(mm).4 pads for a column,32 columns in total.

Particles passing a pad generate electric signals transported to bonding pad through metal trace.

Signals reaching bonding pad are digitized by SVX4.

### Baseline Minipad sensor design



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# Development

#### Metal trace spacing



Shorts between metal traces frequently occurred.

We increased distance between metal traces to overcome defects created in lithography.

 $10\mu m \rightarrow 20\mu m$ 





Reduction of electric field

Metals
 covering beyond
 p+ pattern edges.

2. Rounding of p+ pattern edges.



2. Guardring modification : Width







<P+ dicing line>





<N+ channel stop>

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Research

# Stop surface current from the edge. Gradual field degradation.



#### Guardring (main guardring only)



#### Guardring (main + 1 tertiary guardring)



#### Guardring (main + 3 tertiary guardring)



We added metal over tertiary guardrings. Metal over tertiary guardring reduces maximum local field.



#### Metal over tertiary guardring



<Without extension>

#### Metal over tertiary guardring



#### <Metal extended over P+ pattern>









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# Summary & Prospect

#### We

1) adjusted spacing between metal traces to avoid defects in metal etching process

2) **improved guardring design** to regulate electric field strength and reduce local current density

3) and studied channel stop to remove uncertainty in oxide trap charge and suppress defects created by dicing.

Development evolved into main production. Main production started by the end of September.

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# Acknowledgement

Current presentation is based on the collaborative work with BNL and Iowa state university, Ames.