AC-LGAD activity in Japan

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US-Japan funding: Plan for FY2020

Japan side

First segmented AC-LGAD were fabricated at HPK in JPY2019

→ Optimization in JPY2020

US side

Read out: High speed amp (PCB → ASIC)
Hosting Fermilab testbeam
Environment of FTBF beam line

Performance testing (e.g., cross-talk, time/position resolution)

Different Approach
Exchange experience
Exchange samples

New

Performance testing
Irradiation
(CYRIC at Tohoku Uni)
Testbeam
(Fermilab)

4inch R&D fab line for LGAD
Development of AC-LGAD
Testing devices

16th Feb, 2020

US-JP hearing
Reminder: motivation of AC-LGAD

- Original segmented LGAD detector have quite low fill factor (20%) due to separated gain layer.
- Single gain layer with AC-coupled electrode may solve the issue.
  - Lower n+ doping concentration to reduce cross talk. How much lower?

First LGAD strip in 2015

DC-LGAD

AC-LGAD

12th Nov 2018

AUw @ CERN
AC-LGAD mask at HPK

**Pad type sensor** (4x 450umx450um)

**Strip type sensor** (16x 80um pitch)

**Pixel type sensor** (14x14 50umx50um)

- Poly-si resistor between DC ring and Bias ring (GND) → To free up charge in n+.
- Varied n+ and p+ doping concentration
- Varied Al size (AC coupling capacitance size)
- Transparent Electrode (Poly-si) for Photo-detector → application to the medical/imaging discipline

12th Nov 2018  AUw @ CERN
Preliminary results for first prototype

**Doping concentration variation**

<table>
<thead>
<tr>
<th>P+ doping concentration</th>
<th>N+ resistivity</th>
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<tbody>
<tr>
<td></td>
<td>A (~DC-LGAD)</td>
</tr>
<tr>
<td>1 (low)</td>
<td>A-1</td>
</tr>
<tr>
<td>2 (mid)</td>
<td>A-2</td>
</tr>
<tr>
<td>3 (high)</td>
<td>A-3</td>
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</tbody>
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**Basic property measurement by Pad detector (Tatsuki)**
- IV/CV characteristics
- Gain depends on bias voltage.
- Cross talk measurement
  - Dependence of n+ resistivity

**More advanced measurement by Pad and Strip detector (Sayuka)**
- Time resolution by β-ray
- Strip detector measurement
  - Cross-talk as a function of distance (i.e. number of strip)
backup