SiPM Characterization
Lab session at Joinbon

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Introduction

- Radiation detection
- 3D Ranging & Sensing
- Biophotonics & Science
- High energy Physics
- Medical Imaging

Super unique device are urgently needed for ultra low flux photon detection
**Why SiPM**

Semiconductor micro-cells structure operated in avalanche breakdown mode with quenching mechanism. Excellent features make it as the best candidate for ultra low flux photon detection

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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<tr>
<td>High gain</td>
<td>• Internal gain up to $10^6$ for small signal</td>
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<tr>
<td>High sensitivity</td>
<td>• Response to single photon</td>
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<tr>
<td>Fast response</td>
<td>• Rising edge less than 1ns</td>
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<td>High photon detection efficiency</td>
<td>• More than 40% at peak</td>
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<tr>
<td>Low operation voltage</td>
<td>• Less than 50V, no need thousands voltages supply like PMT</td>
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<tr>
<td>Compatible with magnetic field</td>
<td>• Working in magnetic field strength up to 7T</td>
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<td>Compact &amp; Robust</td>
<td>• Suitable for detector array, stable with ambient conditions</td>
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About Joinbon

Focus on the innovative technologies in the field of ultra low flux photon detection

- Research at PETlab@HUST
- Initiate industrialization
- Got investment of Ezhou
- SiPM design finalization
- SiPM mass production
- Digital SiPM tape-out

2014.07
2015.09
2016.09
2017.12
2018.08
2019.03

SiPM prototype
Commercial SiPM product
Large area TSV-SiPM
Digital SiPM imager

Continue to explore the leading edge of research and industry
Lab platforms

Complete platforms from chip design to application module evaluation

Design&simulation
- Process&device simulation
- Analog/Digital mixed signal IC design
- Layout&verification

Electric testing
- Wafer level parameter probe
- Device Breakdown characteristics
- Small signal AC measurement

Photoelectric testing
- Single photon signal
- TOF performance
- Noise evaluation
- PDE measurement

Mass testing&selection
- Statistics analysis
- Quality Inspection
- Automatic selection&packaging

Application module R&D
- Evaluation board development
- Detector module development
- Typical application research

Device Layout ➔ Wafer ➔ Prototype ➔ Chip product ➔ Module

Students will have an overview of IC design workflow and go deep into physics of SiPM and technical characterization method
Experimental task for students

Static characterization of SiPM on wafer

Semiconductor physics of SiPM

Depletion
Dark current
Impact ionization
Avalanche breakdown

Technical characterization

CV curve
IV curve

Wafer of SiPM production
Electric testing platform
# Experimental task for students

## Evaluation of packaged chip

### Signal characteristics
- High sensitivity
- Fast response & recovery

### Noise observation
- Dark count
- Afterpulse

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**Evaluation board**

**Engineering board of array**

**Application module R&D platform**
Transportation to Joinbon

35 km from HUST, 50 minutes for Driving

Address: Building A03, East Lake Hi-Tech Innovation City, Phoenix Lake, Ezhou, Hubei, P.R.China
THANK YOU!