# 工 作 总 结

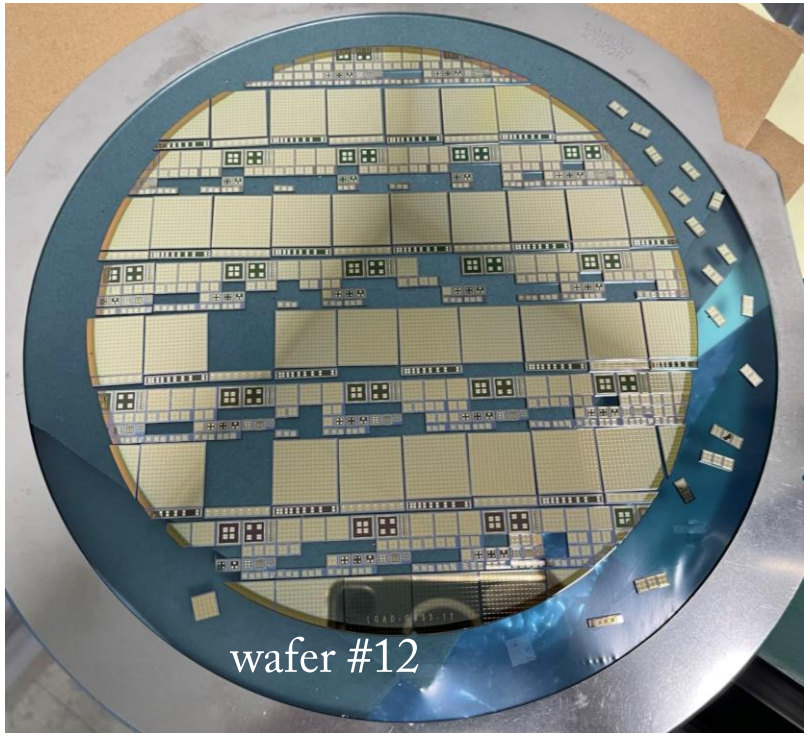
## 2023.01-04

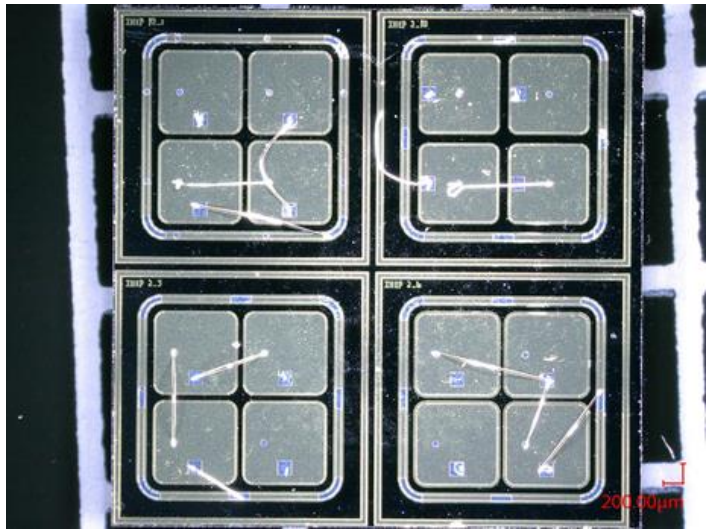
汇报：孙维益
导师：梁志均
2023.04

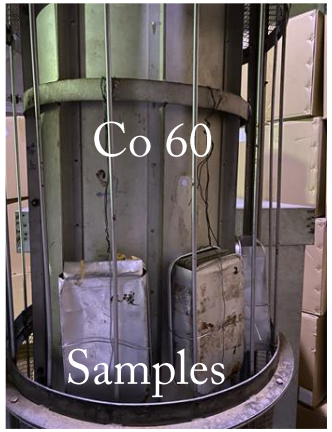
LGAD 抗辐照性能研究

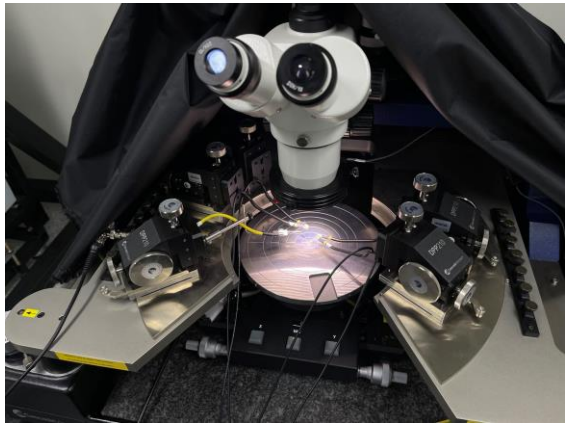
LGAD 时空分辨性能研究

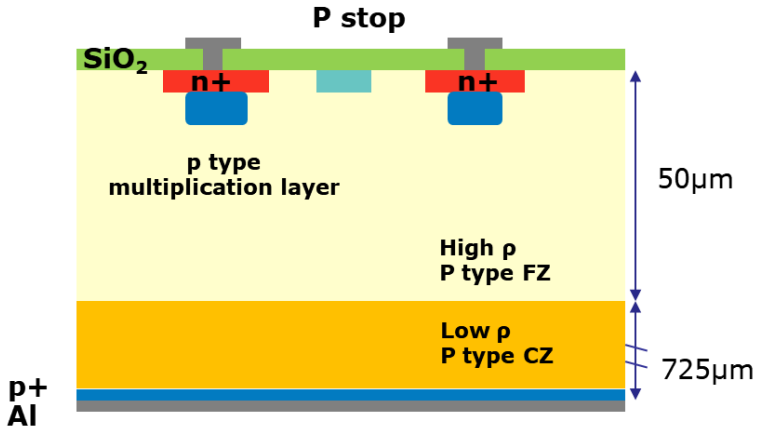
# IHEP-IME LGAD Sensor **with shallow carbon** (wafer 12)





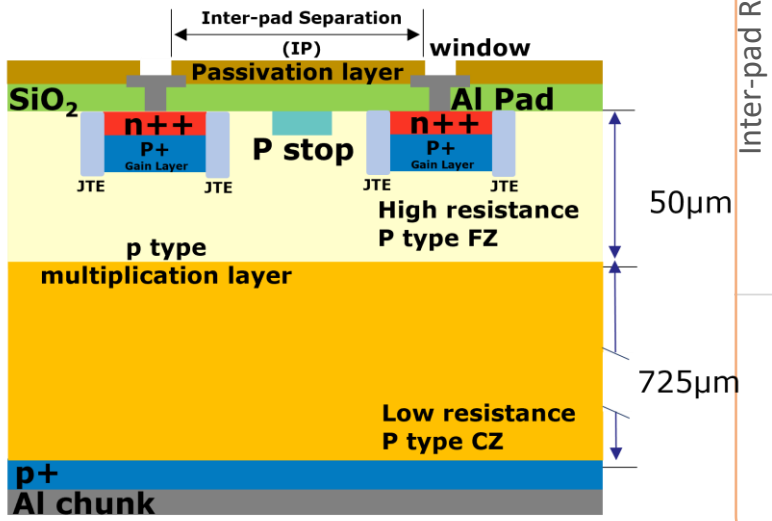





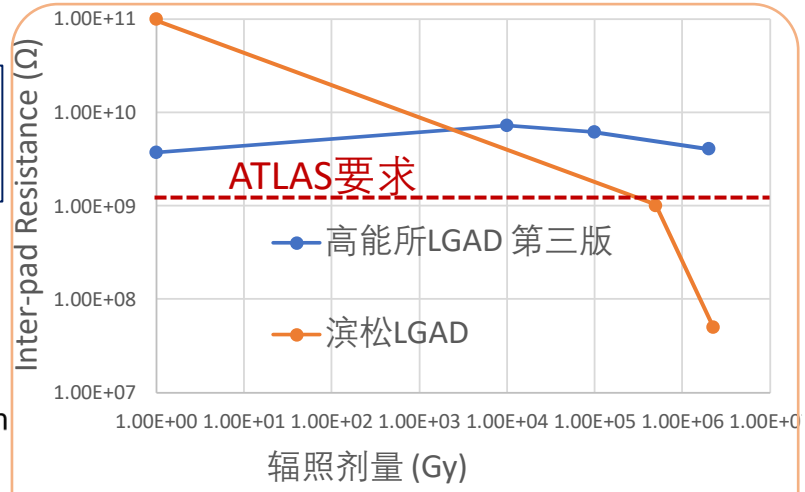

- IHEP-IME V3 LGAD
- Shallow carbon
- ATLAS Upgrade
- Optimize the design of LGAD
- Requirement:
  - Inter-pad Isolation
  - C<4.5pF
  - R>$10^9\Omega$
  - $2.5\times10^{15}$neq/cm2

# Ⅰ 抗辐照性能研究

**Interpad-Resistance: pad间电阻**
**电阻↑ pad间串扰↓ 信号质量↑**




第三版LGAD结构




IHEP v3 LGAD 未见下降 $> 10^9\Omega$

满足ATLAS 要求

滨松:fphy.2022.838463

滨松 LGAD 下降至$10^7\Omega$

文章:
已投稿Jinst **第一作者**

**初审已审回**

arXiv:2303.05839

报告:
第41届RD50 会议
*RD50：高亮度下高抗辐照器件*
indico.cern.ch/event/1132520/

多次ATLAS及HGTD会议

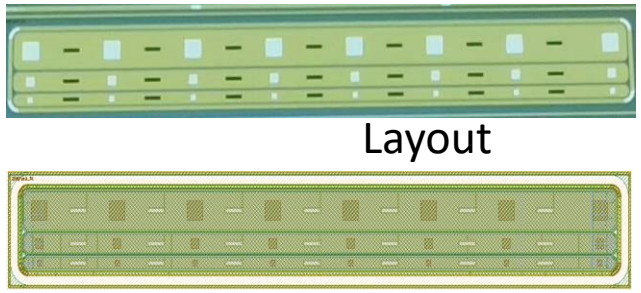
**Characterization of the response of IHEP-IME shallow carbon to Gamma Irradiation**

Weiyi Sun[a,b] Yunyun Fan[a,1] Han Cui[a,b] Chengjun Yu[a,b] Shuqi Li[a,b] Yuan Huang[a,b] Zhijun Liang[a,1] Xuewei Jia[a,b] Wei Wang[a] Tianya Wu[a] Mengzha Guimarães da Costa[a] and Gaobo Xu[c]

[a]Institute of High Energy Physics, Chinese Academy of Sciences

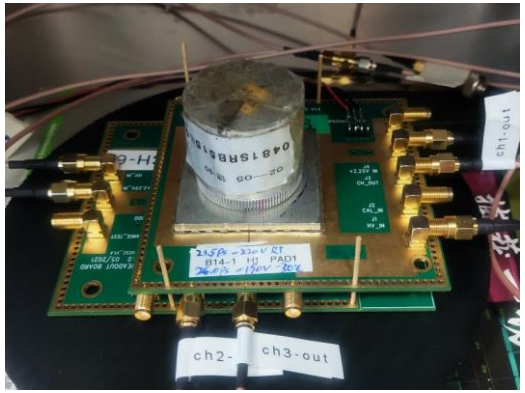
- ✓ 主要工作：测试分析LGAD抗辐照能力及其成因
- ✓ 新现象：关键工作参数 未显著改变 均满足ATLAS HGTD 要求
- ✓ 抗TID辐照提升：P Stop、trench与掺碳
- ✓ 辐照提升的机制与定量模型 有待研究 →下一步工作

# II时空探测性能研究| DC-LGAD Strip

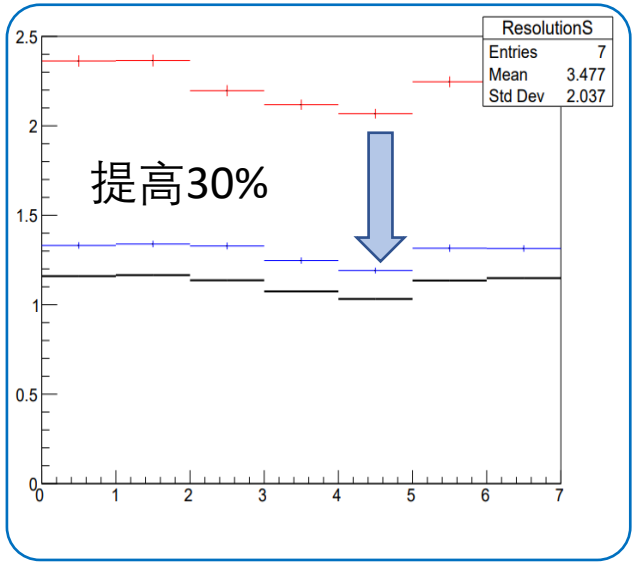


Layout

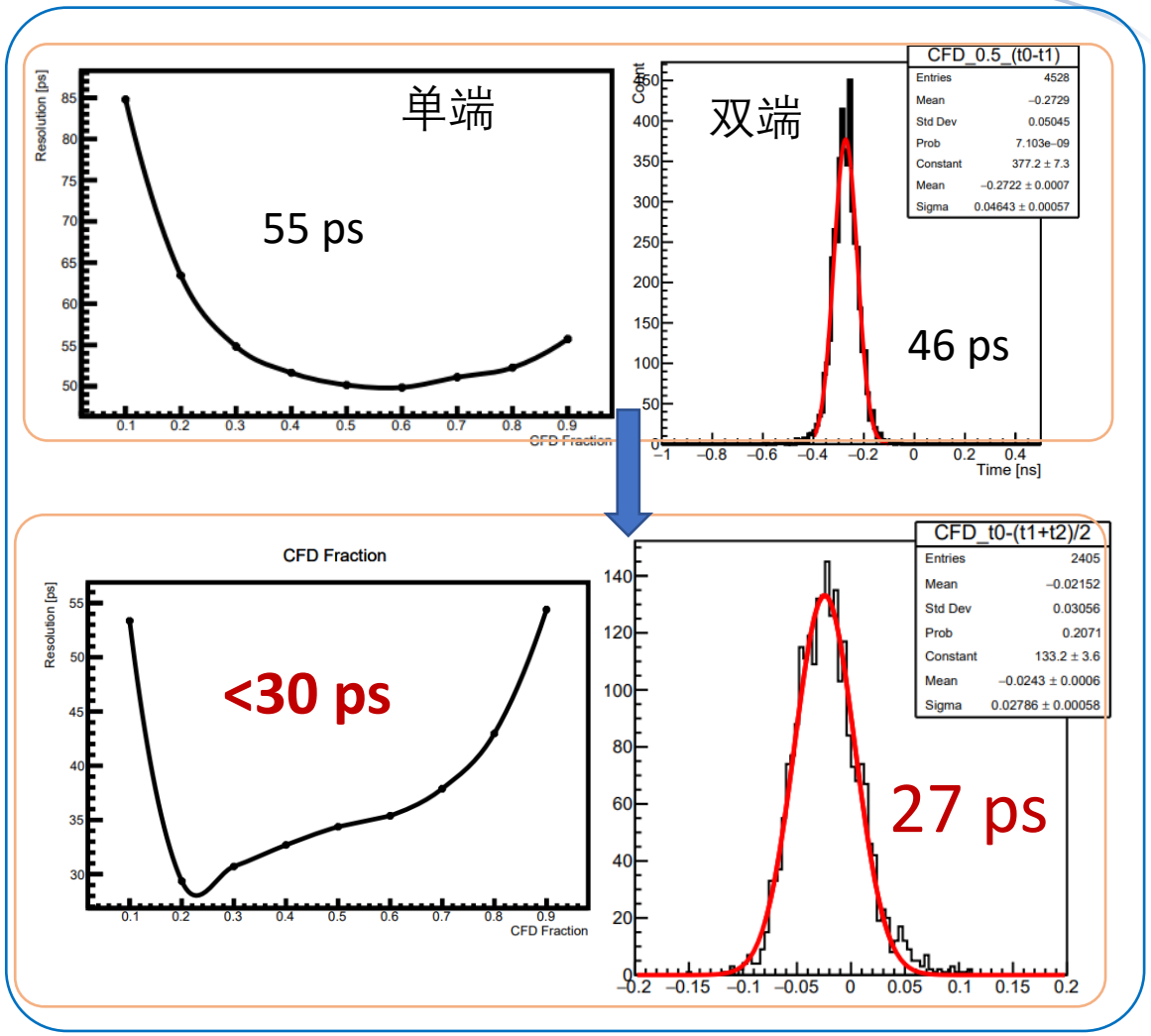
设计图




Beta测试



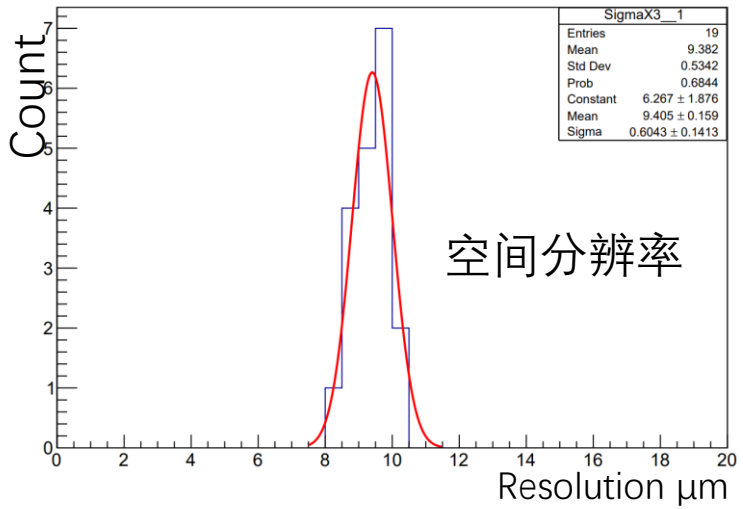

空间分辨率




时间分辨率

- ✓ 主要工作：优化提升既有重建方法
- ✓ 时间分辨 < 30ps
- ✓ 双端优于既有单端法 ~10%
- ✓ 空间分辨率提升>30%
- 正在撰文 一作 拟投 IEEE TNS

# II 时空探测性能研究| AC-LGAD Strip




重建法一：

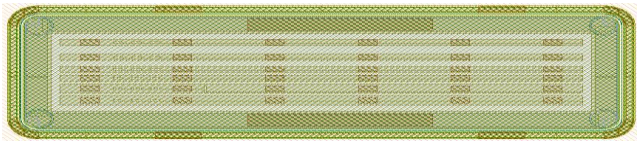
经典最大似然

最优:9.2$\mu m$

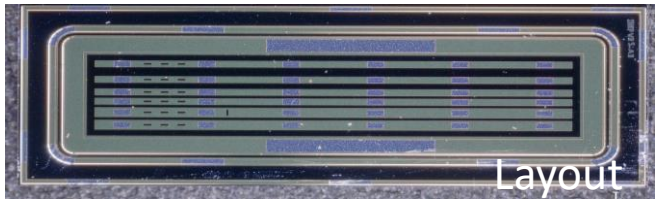
重建法二：

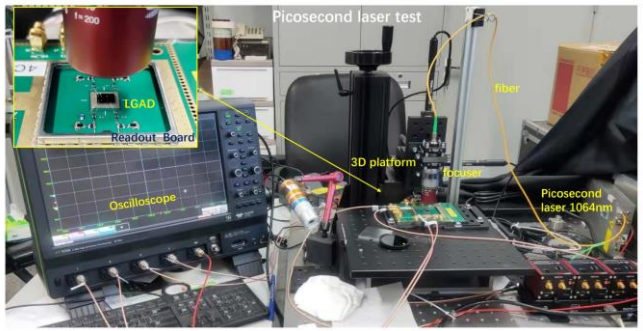
深度神经网络(DNN)

全局：8.24$\mu m$



设计图




TCT激光扫描

**BNL-HPK** AC-LGAD Strip

空间分辨率

DNN法: 15-40 μm

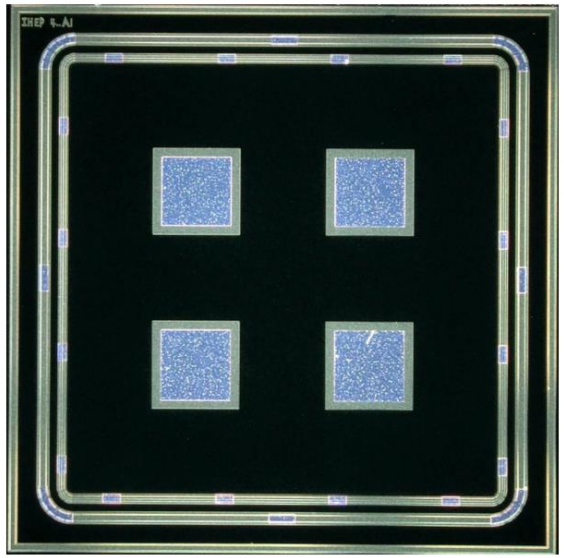
Polynomial法: 13μm

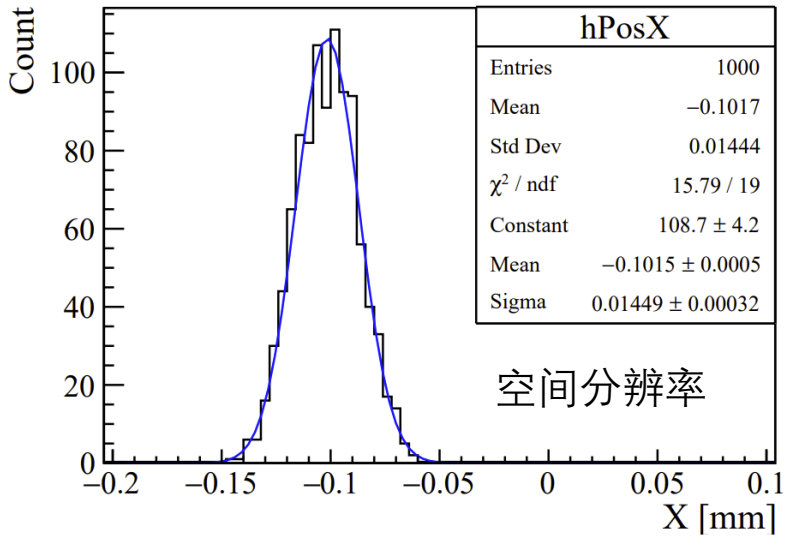
R. Heller *et al* 2022 *JINST* **17** P05001

- 完成TCT实验并设计开发新型重建方法
- 2种方法均优于10μm
- 相近或优于BNL-HPK LGAD
- Strip间距、N+层电阻率等关键工艺参数

下一步：提升探测性能 5μm

# II 时空探测性能研究| AC-LGAD






工作：优化既有重建方法 完成数据分析

结论：

时间分辨: 30ps

空间分辨: 20μm

文章：

完成撰写 已投稿IEEE TNS **共同第一作者**

--数据分析与重建部分写作

arXiv:2303.05839

- 小修 已修回

Comments and suggestions for the author
I enjoyed reading the manuscript titled " The performance of the large-pitch AC-LGAD with different N+ dose".
I find the results very interesting and worth publishing.

**The performance of large-pitch AC-LGAD with different N+ dose**

Mengzhao Li, Weiyi Sun, Zhijun Liang, Mei Zhao, Xiaoxu Zhang, Yuan Feng, Yunyun Fan, Tianya Wu, Wei W

AC-Coupled LGAD (AC-LGAD) is a new 4D detector developed based on the Low Gain Avalanche Diode (LGAD) technolog
layer dose on the spatial resolution and time resolution. The spatial resolution varied from 32.7 {\mu}m to 15.1 {\mu}m deper
and low noise level are beneficial to improve the spatial resolution of the AC-LGAD sensor.

# OUTLOOK

- 回复两篇审稿意见 完成DC-LGAD文章撰写
- 继续研究LGAD抗TID辐照机制
- 参与硬件设计 提高LGAD时空分辨率
- 学习并初步参与$HH \to bb\tau\tau$或Dark Higgs分析工作

# Thank You

Weiyi Sun
2023.04