中国科学院高能物理研究所

Institute of High Energy Physics Chinese Academy of Sciences

NDL LGAD sensor R & D in China

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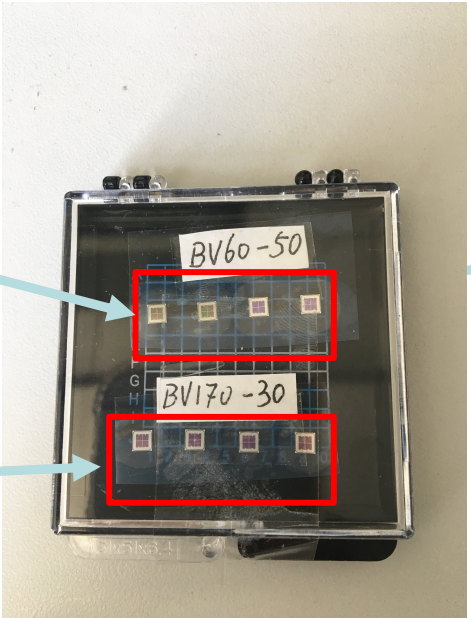
HGTD 3 day meetings in upgrade week

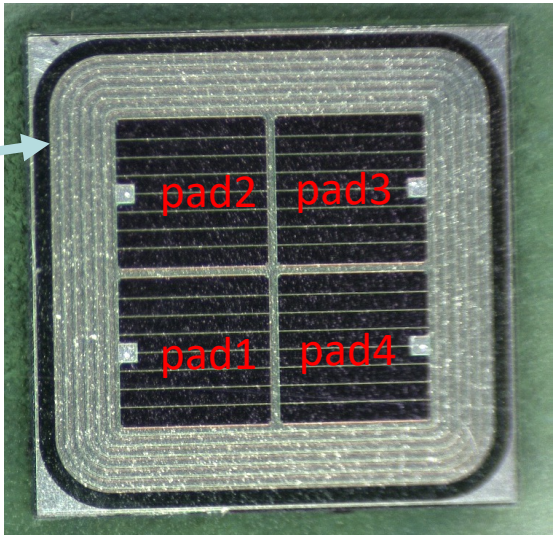
LGAD sensor R & D in China : Epitaxial layer wafer

- LGAD sensor with Epitaxial layer
  - NDL is foundry for SipM. They can provide LGAD as well.
  - First batch LGAD sensor fabricated. (~100 2x2 sensors)
    - Thickness of epitaxial layer: 33um
    - epitaxial layer Resistivity: 300 Ohm.cm

http://www.ndl-sipm.net/contacteng.html

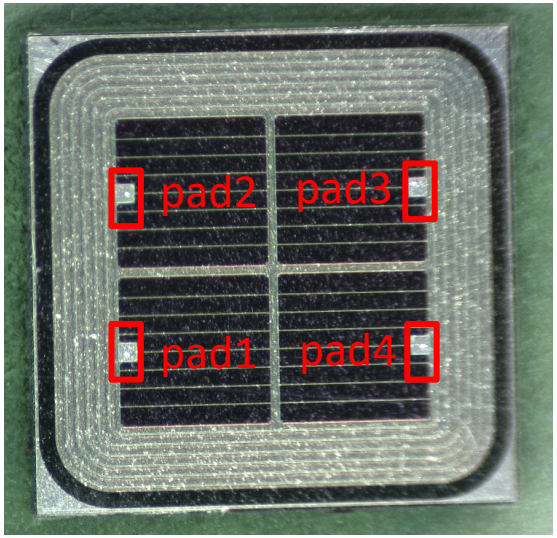
Two type of sensors BV170-30-B, BV60-50-B

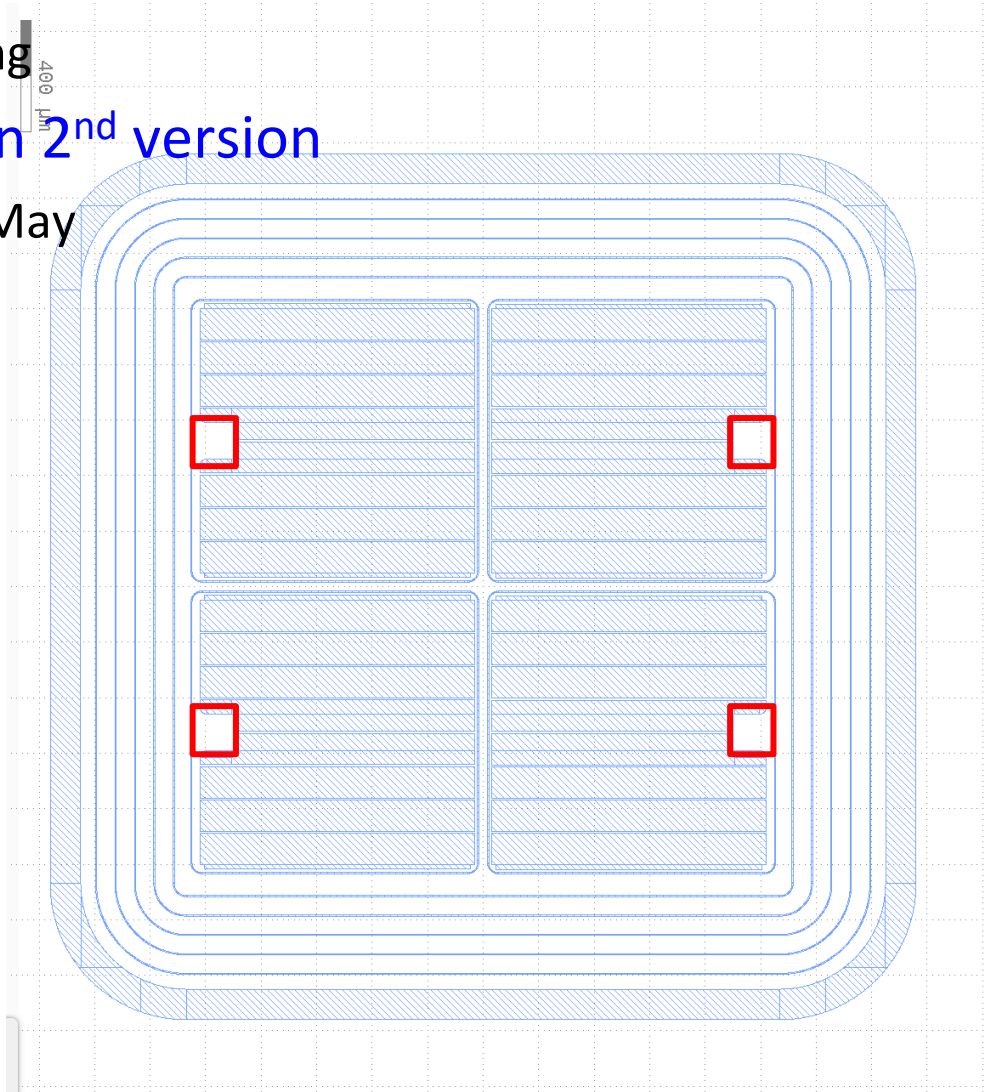




schematic with the wire bond pads highlighted

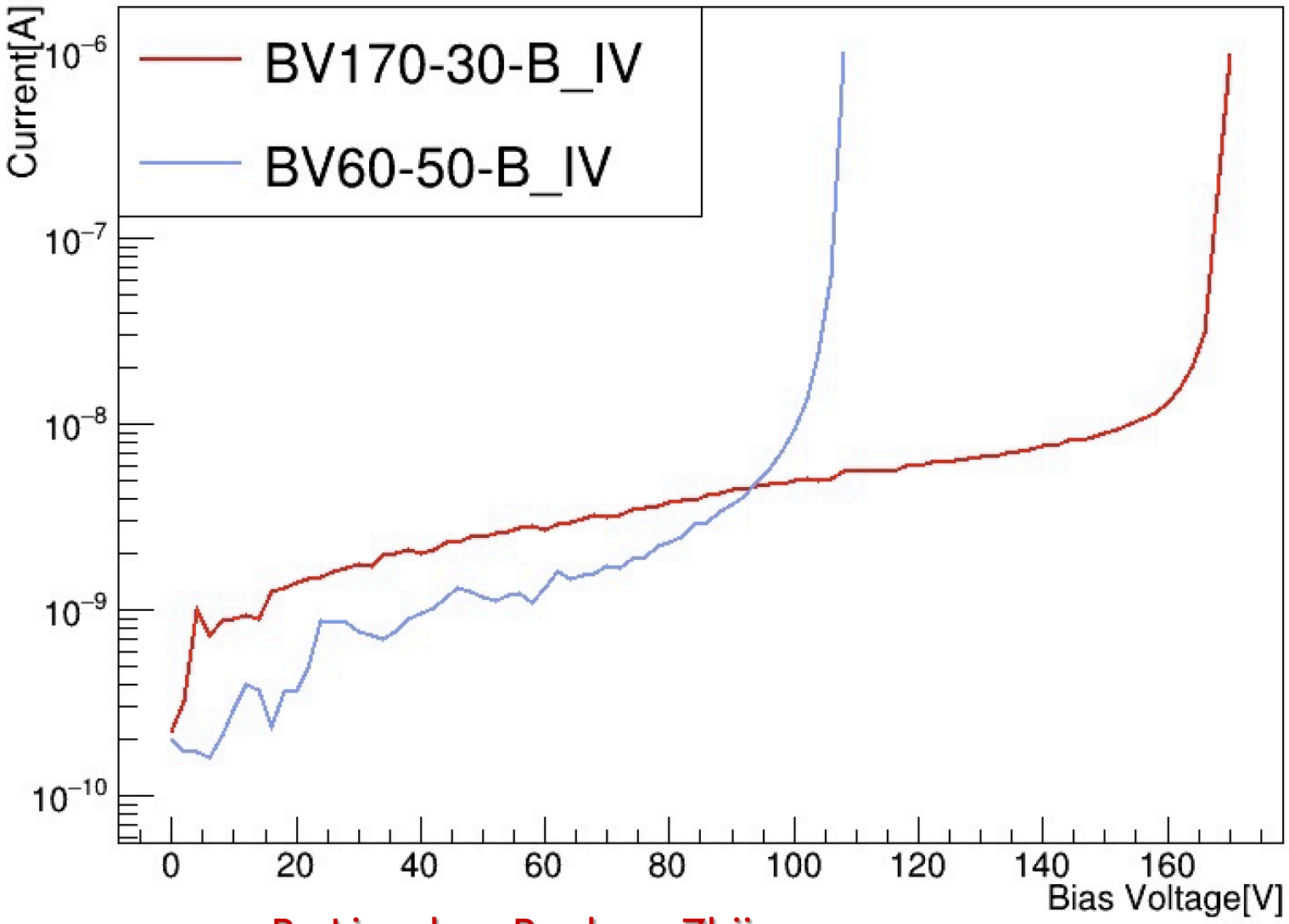
- 4 pads for 2x2 LGAD arrays
- No pads for GR in 1st version of NDL LGAD sensor
  - GRs are supposed to be floating
- Pad for GR will be available in 2nd version
  - Will be available in middle of May





I-V and gain for NDL LGAD sensor

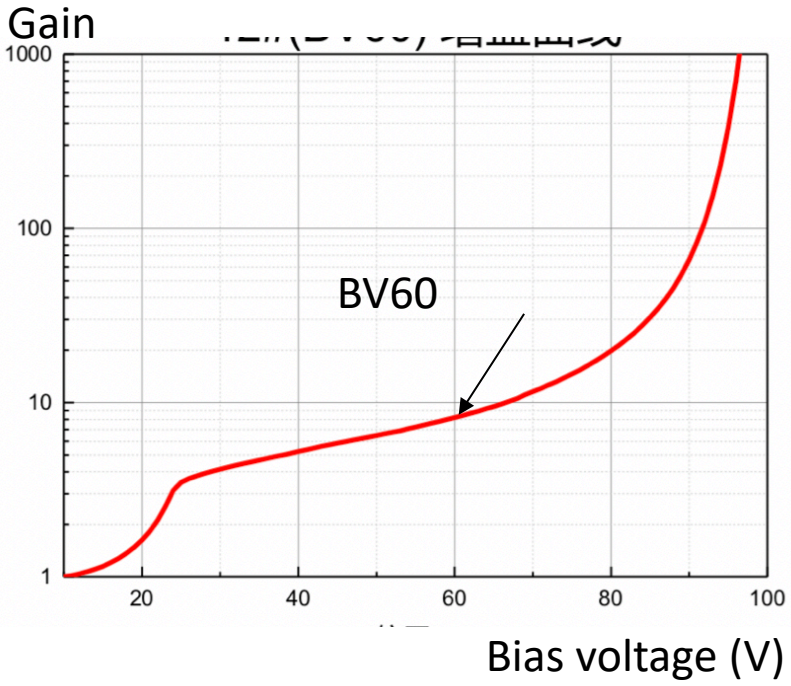
- Two type of NDL sensors (BV170 and BV60)

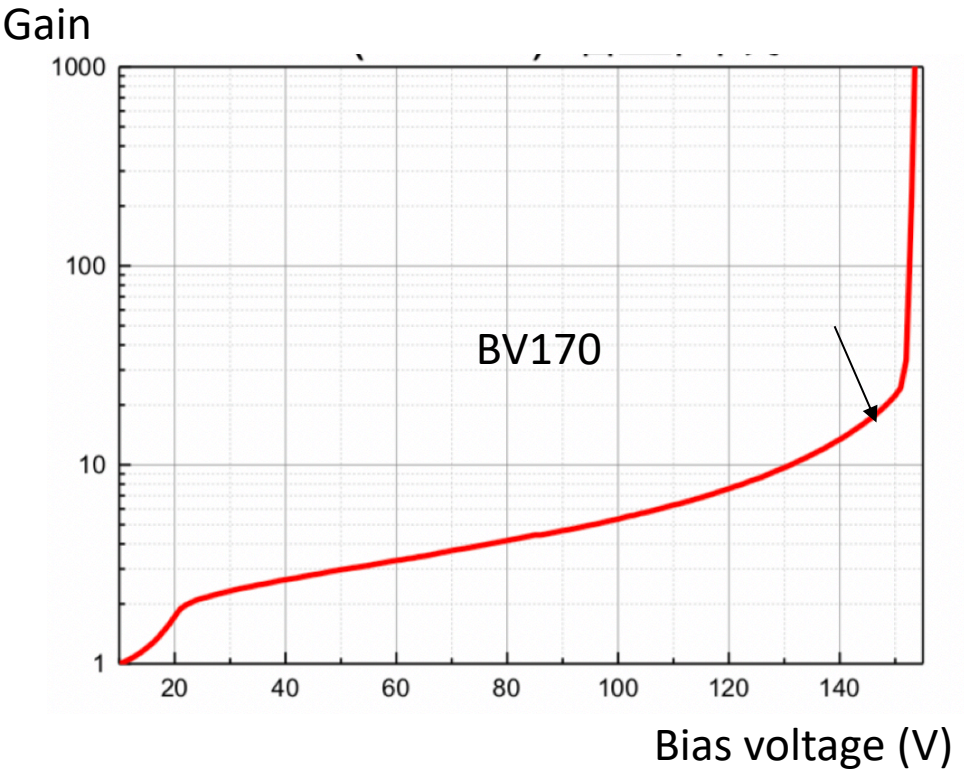


By Liaoshan,Baohua, Zhijun

Gain for NDL LGAD sensor

- Two type of NDL LGAD sensor (gain=10 for working voltage)

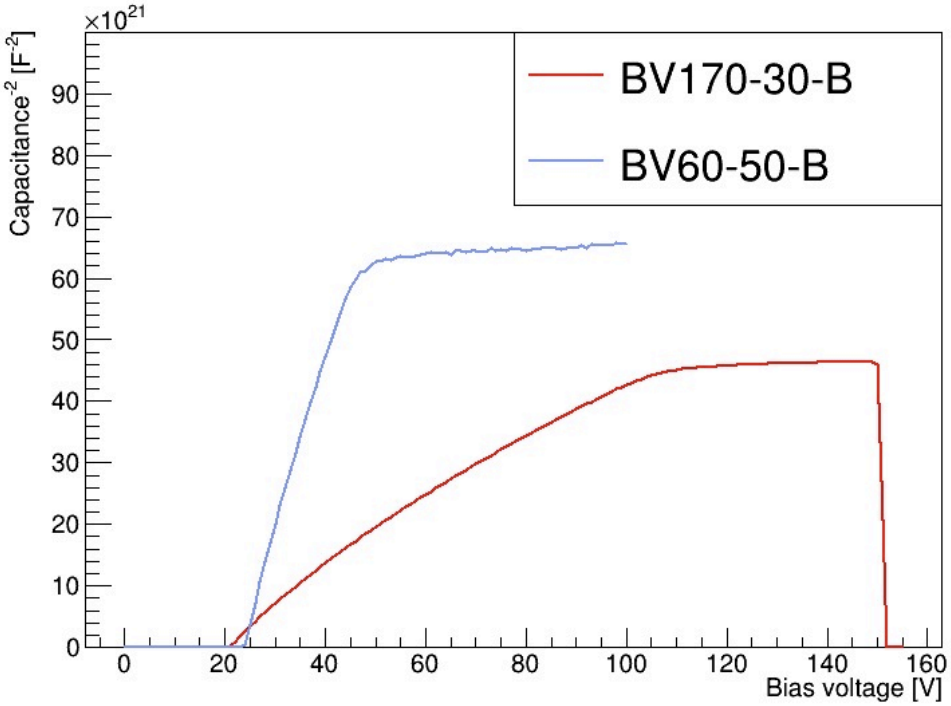


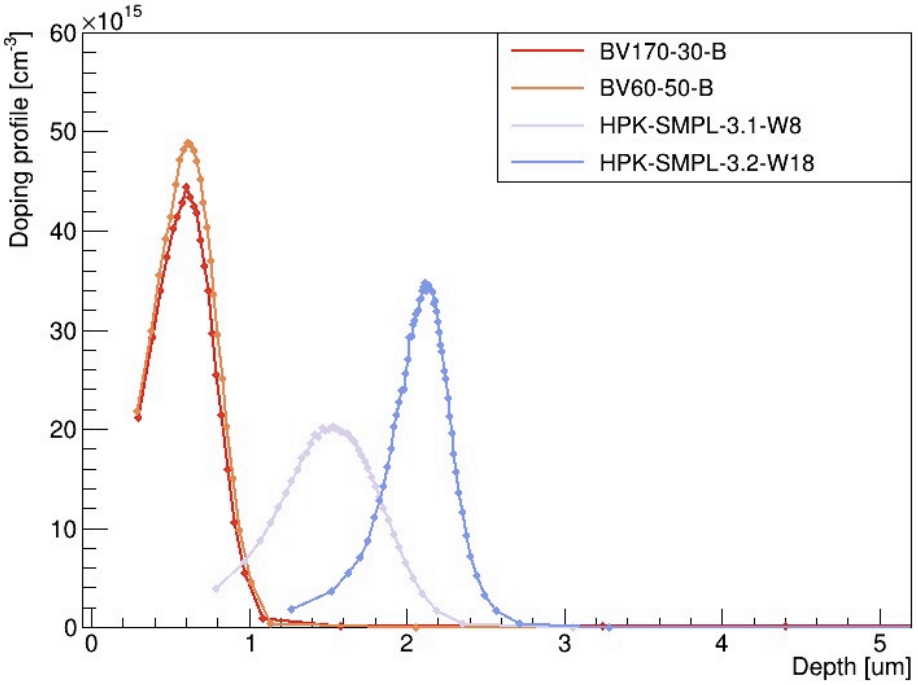


By Liaoshan,Baohua, Zhijun

C-V and doping profile

- BV60 depleted at 50V , BV170 depleted at 110V
- Doping depth for p+ layer is lower compared to HPK
  - Will ask foundry to try deeper p doping

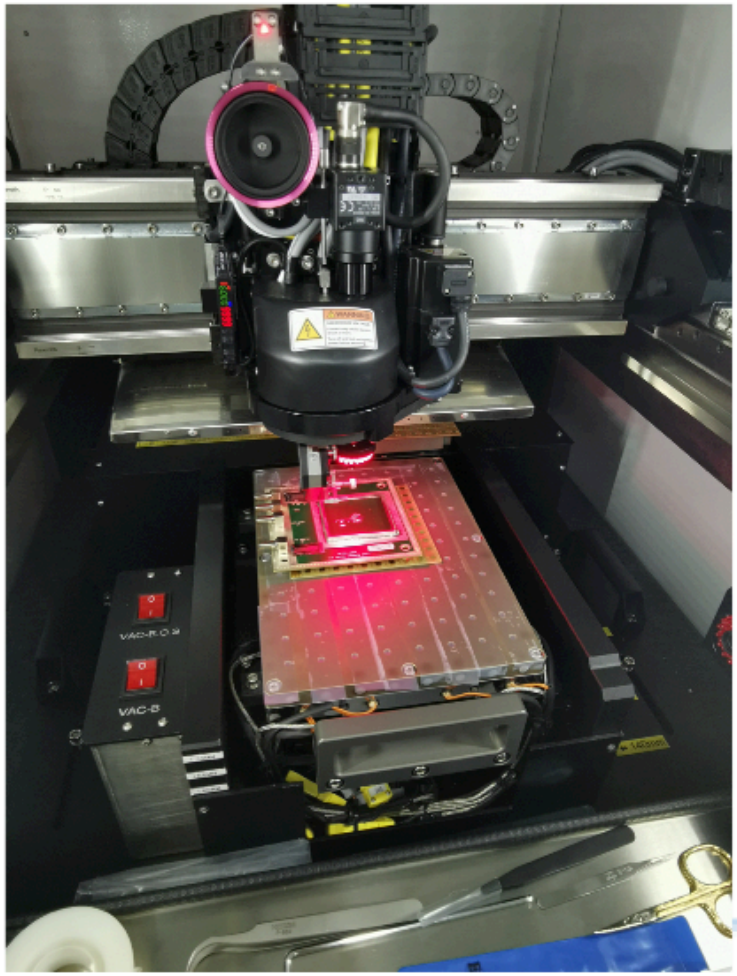


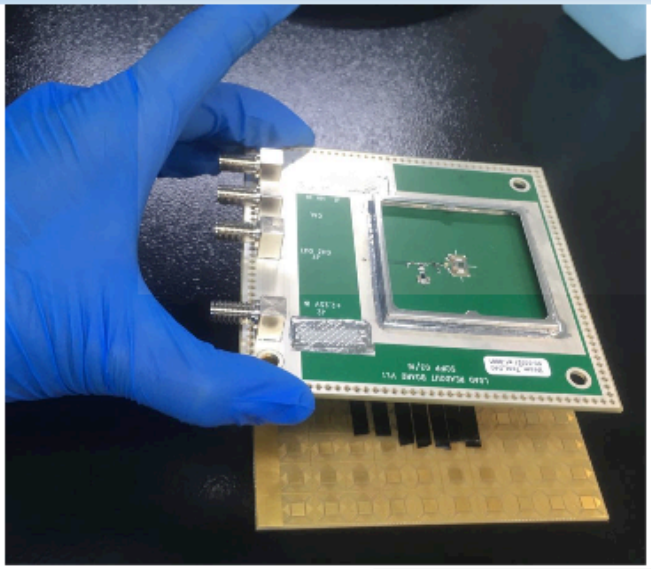


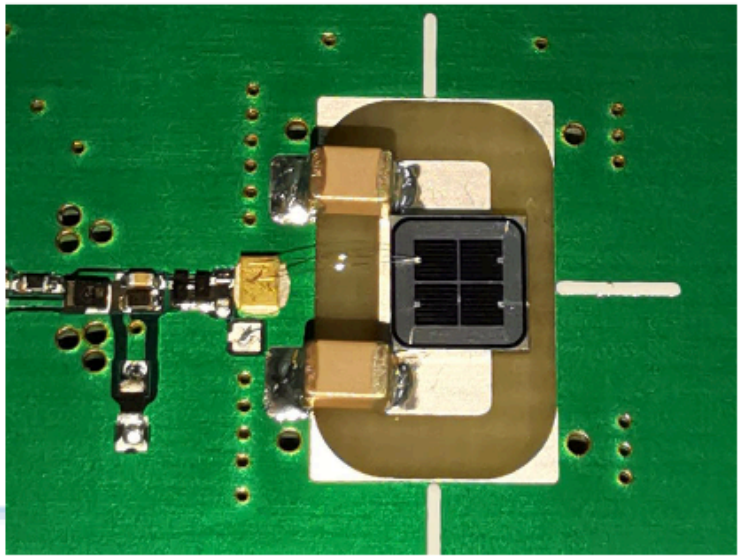
By Liaoshan,Baohua, Zhijun

Assembly and Wire bonding

Yuzhen, Zhijun

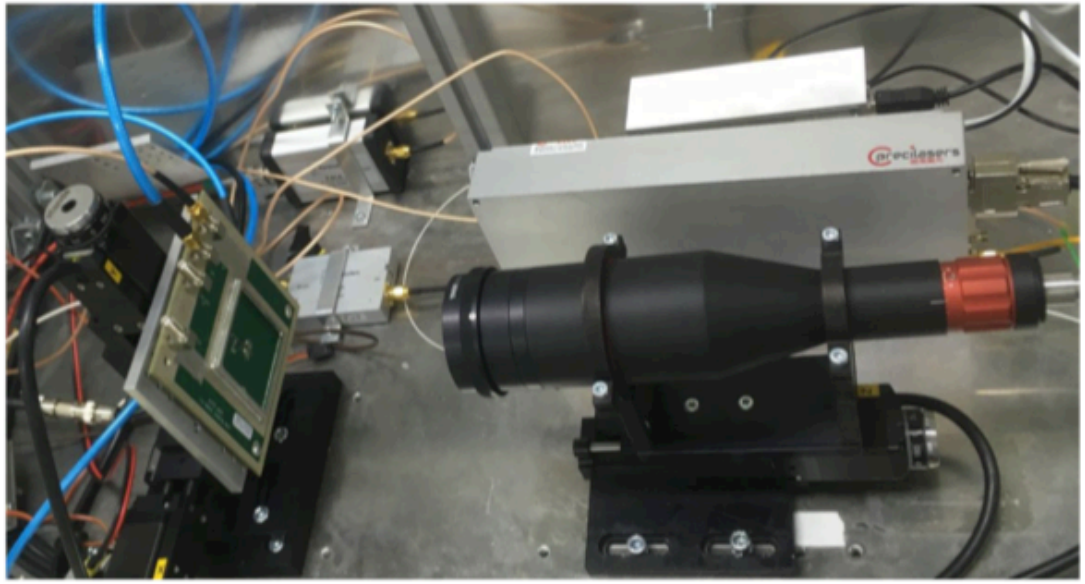


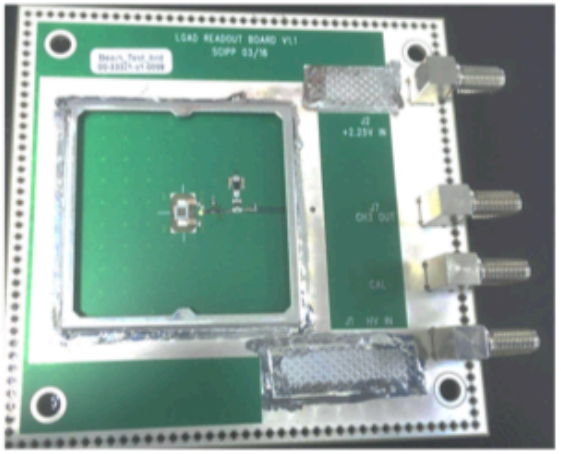


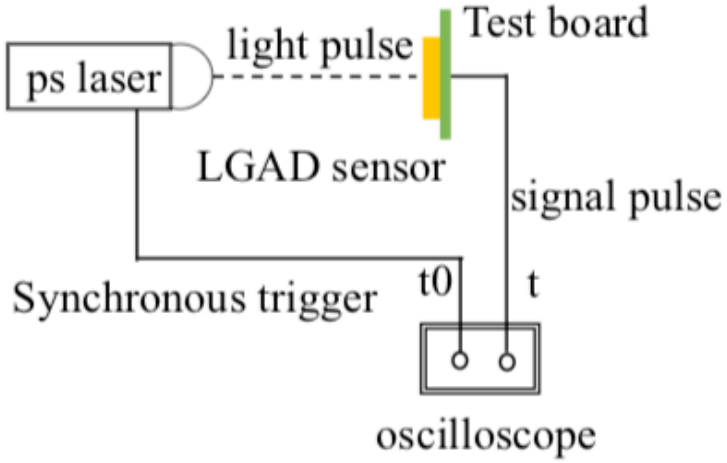


Time resolution test system

- Pico second laser: 1064nm wave length, 7.5 ps pulse width, 20.97MHz frequency
- Oscilloscope: Lecroy 8254M, 2.5 GHz bandwidth, 40GS/s sample rate
- High voltage power supply: Keithley 2410
- Low voltage power supply: 1.4V for amplify

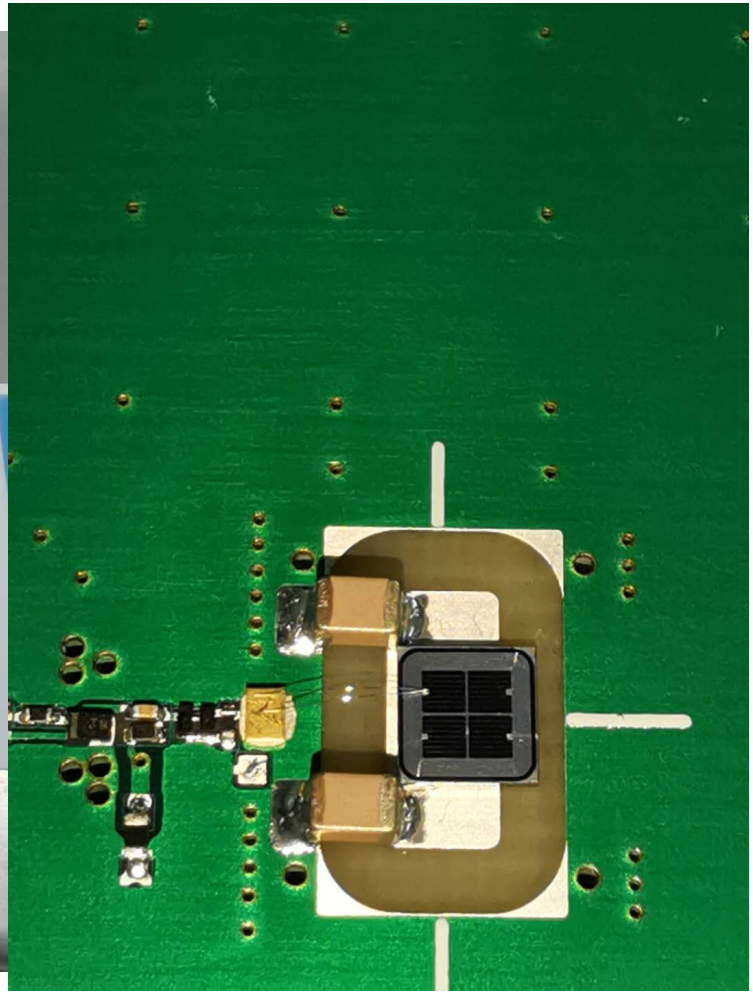






Wire bonding

- Wire bonding NDL sensor to NDL single channel board.



Laser test for NDL LGAD sensor

- Red is LGAD sensor signal
- blue is trigger signal for pico second laser.

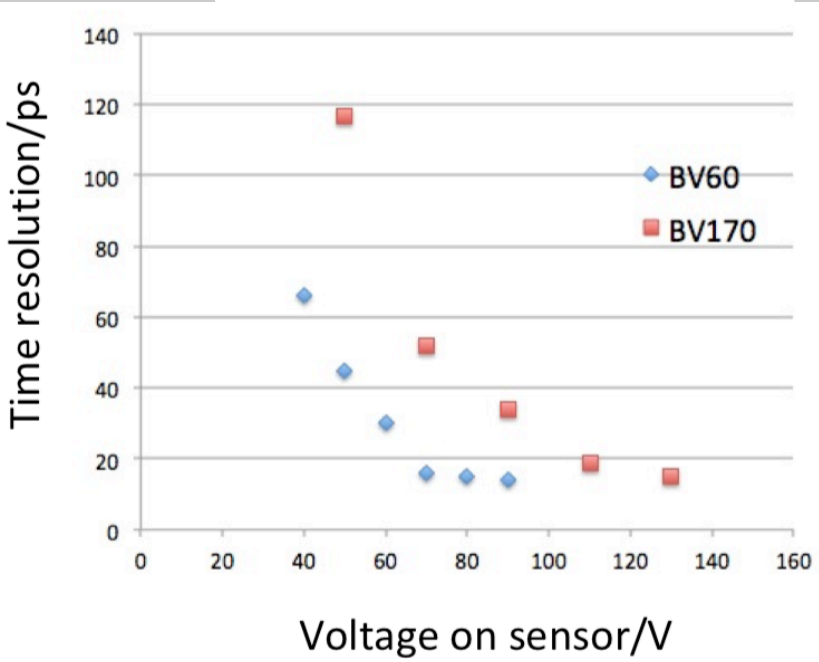
Time resolution of NDL sensor in laser test

NDL BV60 LGAD sensor

V_bias	Time Resolution (ps)
90V	14
80V	15
70V	16
60V	30
50V	45
40V	66

NDL BV170 LGAD sensor

V_bias	Time Resolution (ps)
130V	12
110V	19
90V	34
70V	52
50V	117



To do:

- I-V in low temperature (-30)
- Analysis of timing resolution
  - /afs/ihep.ac.cn/users/l/liangzj/work2/LGAD