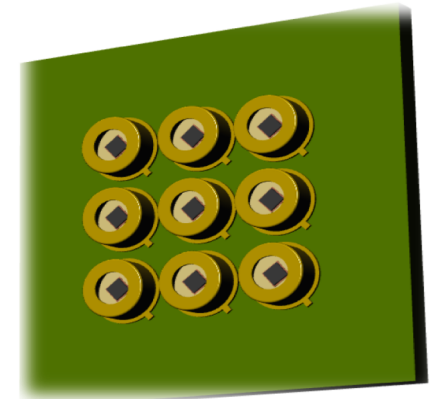
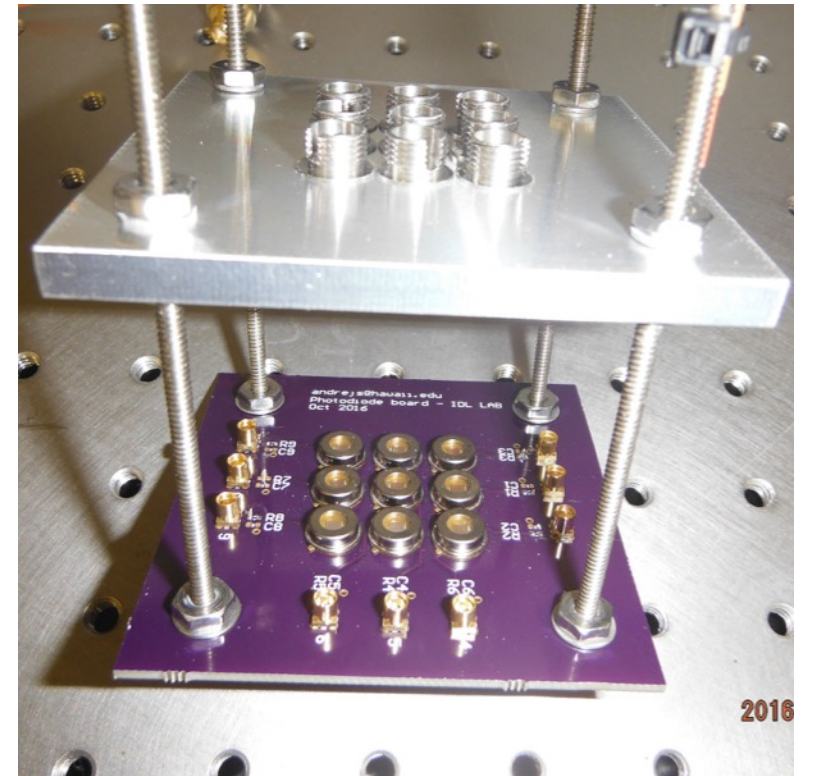


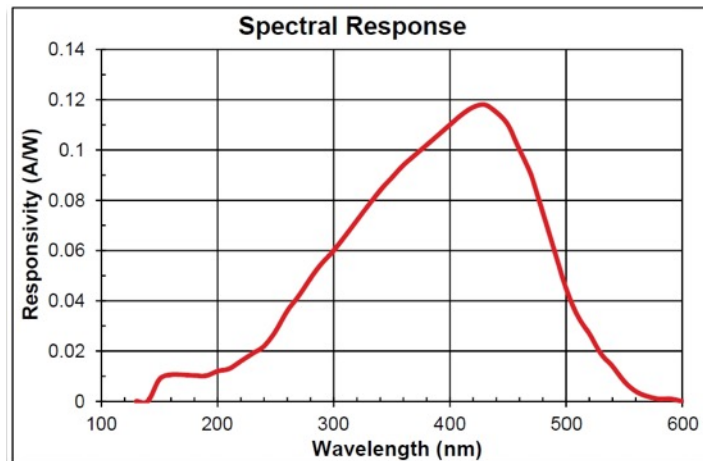
Laser Positioning System

Purpose of laser positioning system (LPS)

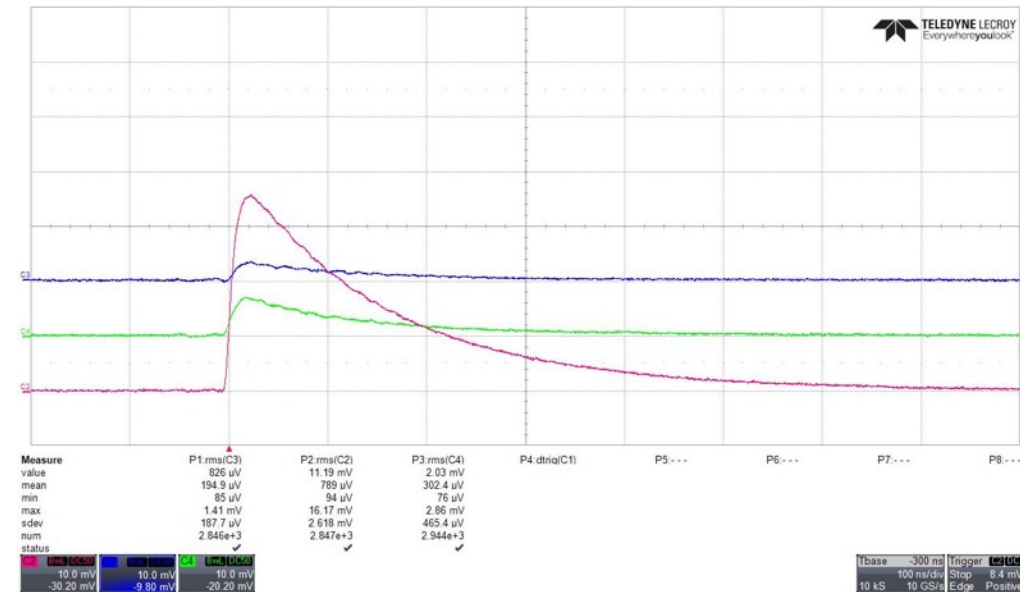
- Determining the laser track direction **in-situ** can be achieved by detecting the beam spot on the opposite side from the laser injection point.
- Such system is called Laser Positioning System
- Diagnostic tool for track laser.
- It is a simple passive system utilizing photodiodes that generate electric signal, when laser light shines on them.
- Place LPS on the floor under the FC opposite to laser insertion points; choose location so each can be seen by two laser across on – ideally, under the FC
- Carefully measure locations of LPS after installation with respect to APA and CPA



Candidate pin diode: UV sensitive GaP PIN diode operated passively



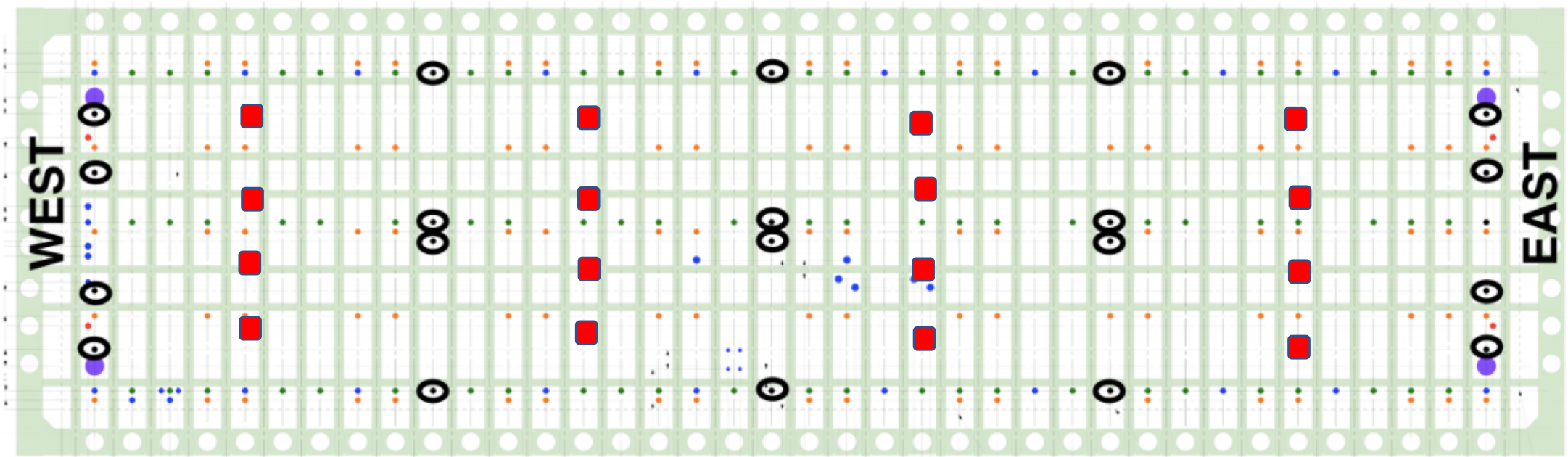
FGAP71 - GaP Photodiode, 1 ns Rise Time, 150-550 nm, 2.2 mm × 2.2 mm Active Area



Data of the latest LPS array before and after cryo cycling. The magenta trace is the center PIN, blue and green are outer ones. **Thus: LPS is able to detect the brightest region of the laser beam.**

Laser Positioning System Locations and Planning

- Each LPS pad will be visible by two lasers. Two pads per location for redundancy, longevity of operation, etc.
- 16 locations total with 2 LPS pads per location.
- Total of 32 LPS sensor pads.
- LPS placed on the central line under FC in each of four volumes.
- Locations carefully surveyed prior to detector closing.



LPS Cost

- The main cost of the system is pin diode ~\$90/each
- The cost of single LPS pad is \$1,000
- For 32 modules + 3 spares, the cost is \$35k
- Other cost include cables to be routed to the surface, but are minor.

Conclusion

- LPS presents a very useful way of verifying laser beam direction.
- Each LPS seen by 2 lasers for redundancy and track reconstruction cross-referencing
- System is affordable and does not interfere closely with other detector components.