



Micromegas Particle Detector

Nuclear Physics SBIR/STTR Exchange Meeting

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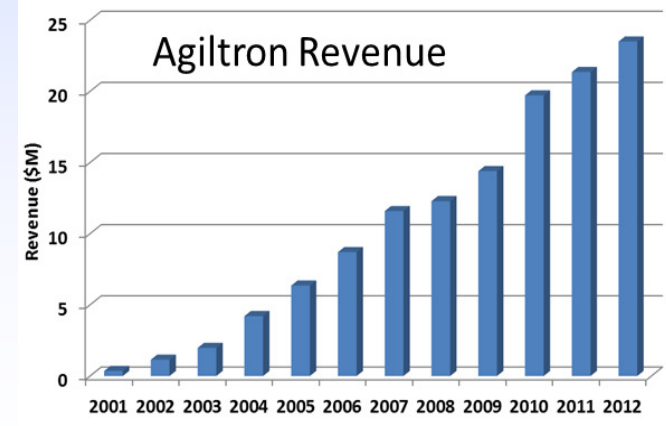
Agenda

- ❖ Company Background
- ❖ The Need
- ❖ Agiltron Approach
- ❖ Results
- ❖ Summary

Agiltron At A Glance



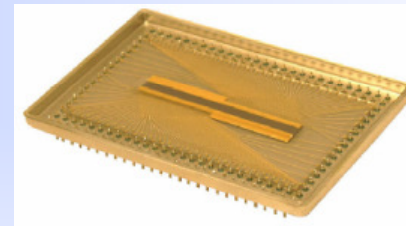
- ❖ Established 2001
- ❖ Over 100 employees
- ❖ \$23 million 2012 revenue
- ❖ 60,000 sq. ft. R&D, manufacturing, and administrative facilities
- ❖ ISO 9001 certified optical systems manufacturer
- ❖ Inc 500, Deloitte Fast 50 & 500, SBANE Innovation Awards



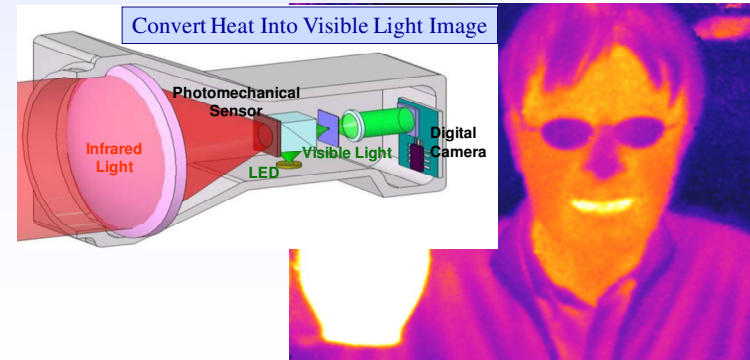
Key Development Areas



- ❖ Chem/Bio/Radiation Detectors
- ❖ IR Detectors and Optics
- ❖ HFI Sensors
- ❖ Photomechanical Imaging
- ❖ Nanomaterials and Devices

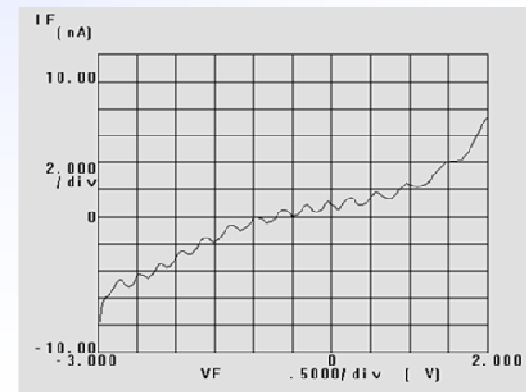
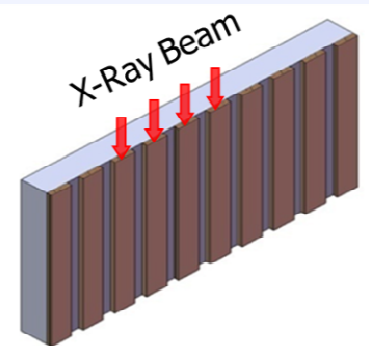
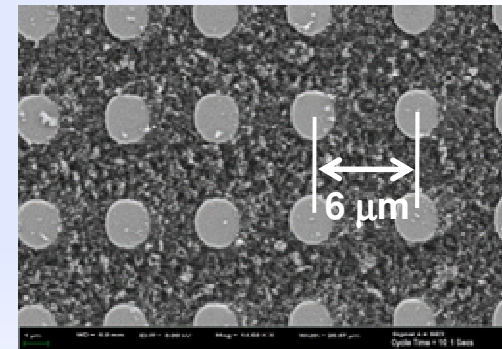
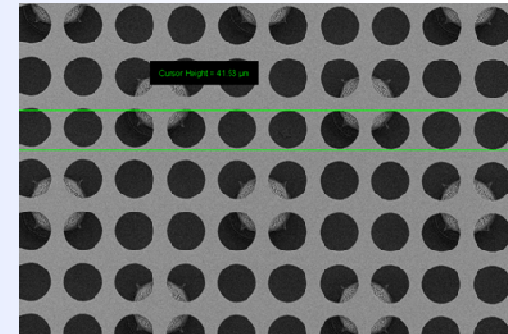


PbS / PbSe IR Detectors



High Energy Particle Detection Programs in Agiltron

- ❖ Micromegas
 - DOE SBIR Phase II
- ❖ Silicon Microfabricated Neutron Detectors
- ❖ Nano-Particle Loaded Polymer X-Ray Detector
- ❖ Low Cost Microfabricated Gamma Detectors

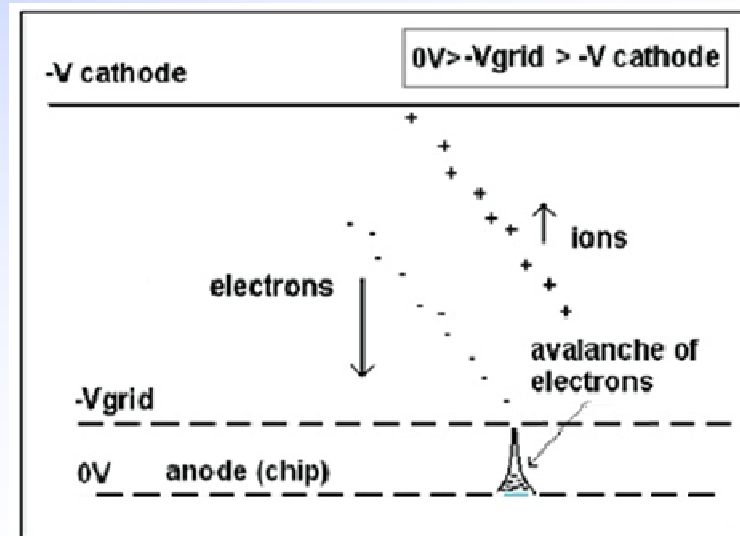


The Need



Nuclear physics research need position sensitive high energy particle tracking devices

- Micromegas exhibits excellent stability, fast response, excellent spatial uniformity and energy resolution, and exceptionally high positive ion collection efficiency.
- But needs further improvements in manufacturability in large areas which can be achieved by microfabrication.



Agiltron's Approach

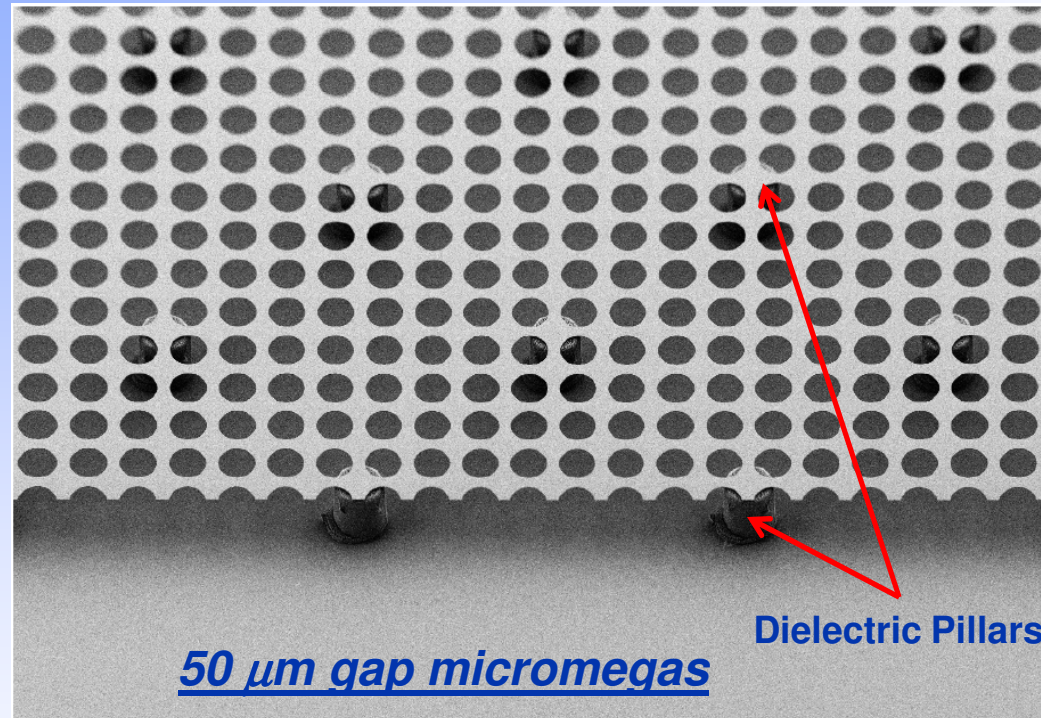
- ❖ Design and fabricate mesh with necessary structural integrity, flatness, parallelism and spark-resistance.
- ❖ Develop and fully optimize micromegas device structures, and micro-fabrication and assembly procedures for low cost manufacturing in large areas.

Agiltron's goal is to become a leading commercial supplier of instrument-grade; and compact/low cost/high volume radiation detectors

Features & Benefits

Features	Benefits
Specially Designed Mesh Electrode	<ul style="list-style-type: none">• Spark-resistance and long life• Excellent structural integrity• High energy resolution and gain• High yield
Micro-Fab Process	<ul style="list-style-type: none">• Accurate dimensional control• Uniform performance in large areas• Design flexibility• Scalable• Low manufacturing cost

Micromegas via Micro-Fab Process



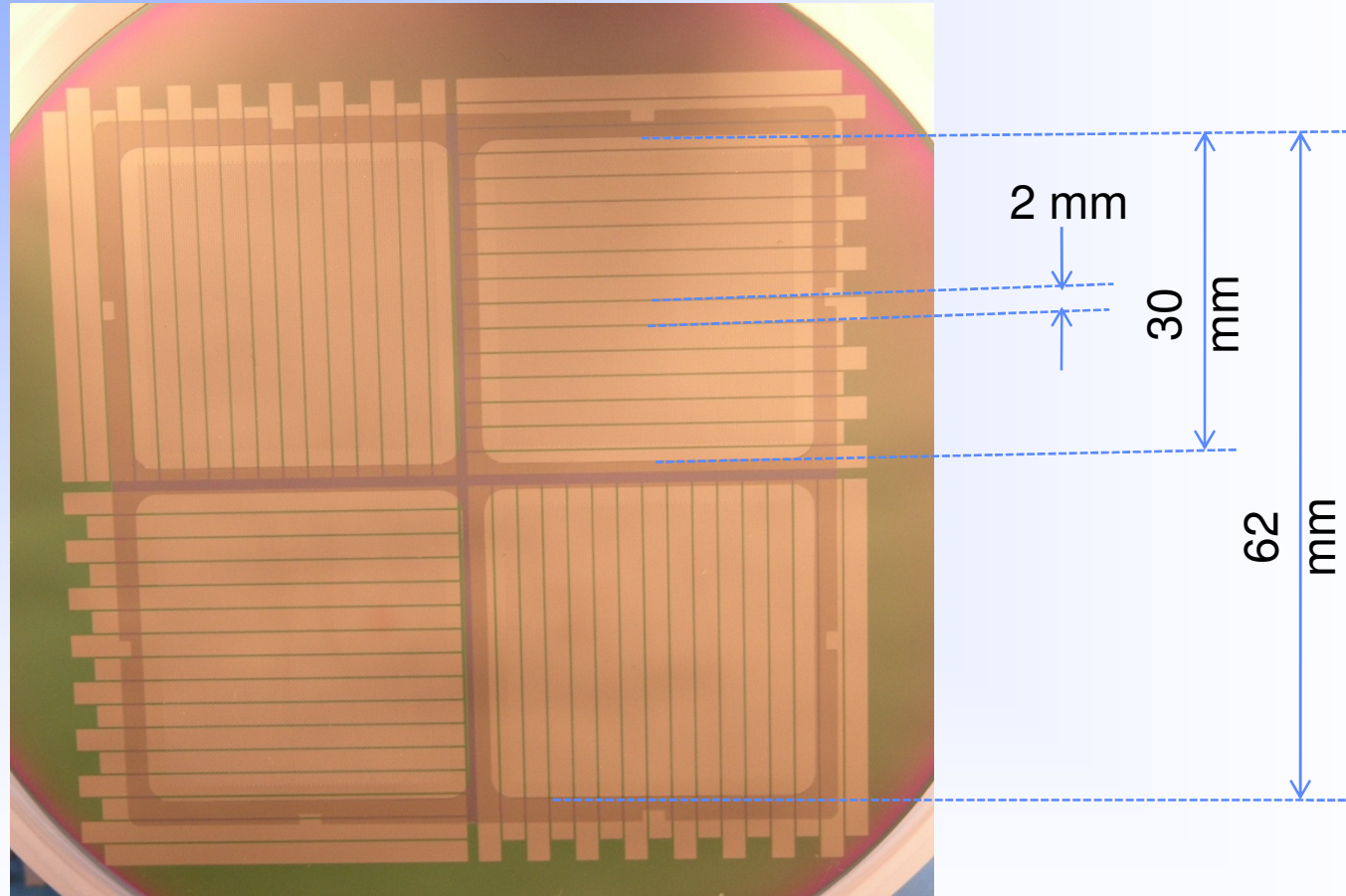
There are 474 X 474 36 μm diameter holes within one square inch mesh area, 54 μm pitch. Pillars are 54 μm diameter on a 312 μm pitch.

Micromegas Design Parameters

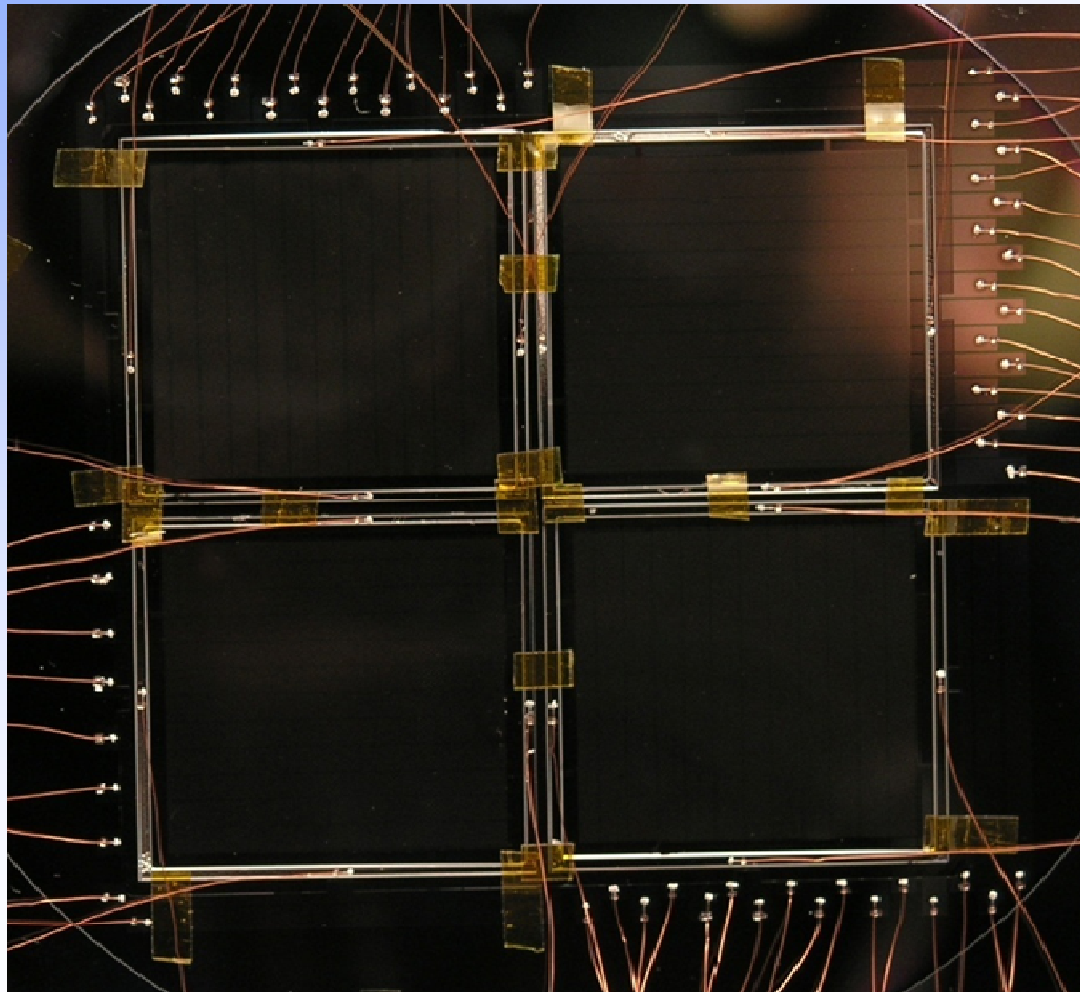


Parameters	Specifications
Mesh Gap, μm^{**}	75
Mesh Hole Diameter, μm	36
Mesh Hole Pitch, μm	54
Mesh Material ^{**}	Ti coated Silicon
Mesh Thickness, μm^{**}	20
Drift Gap, cm	1.5
Pillar Height, μm^{**}	75
Pillar Diameter, μm	54
Pillar Pitch, μm	304
Pillar Material	SU-8
Anode Strip Width and Length, mm	2 by 30
Anode Strip Pitch, mm	2.2

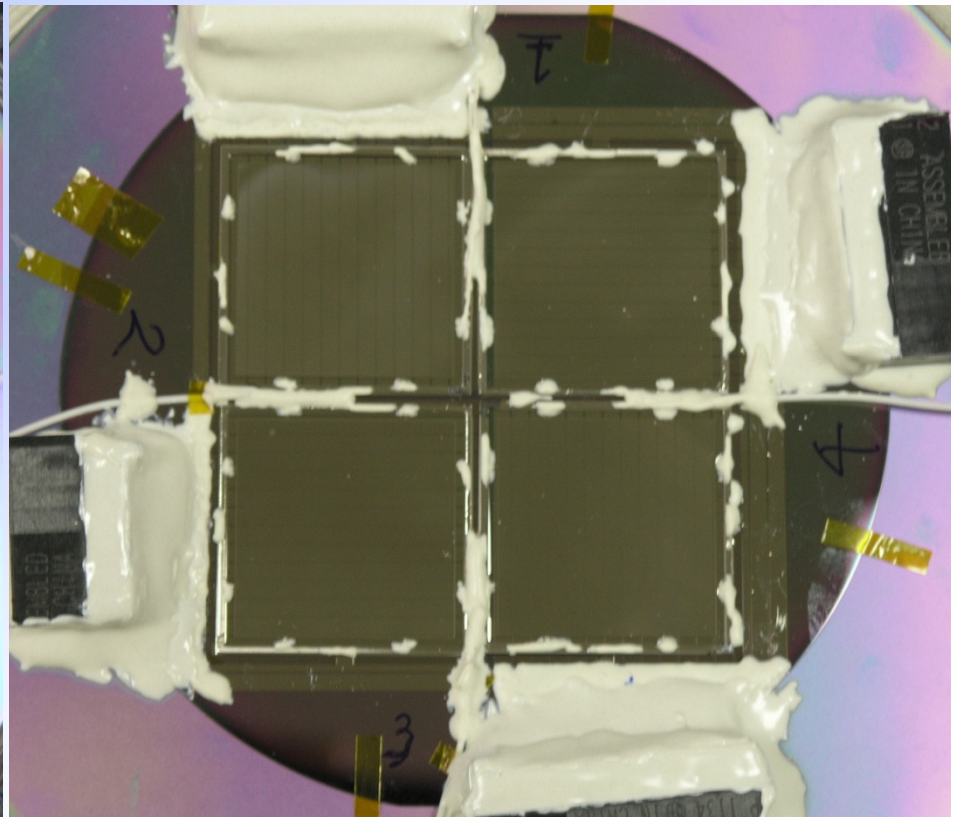
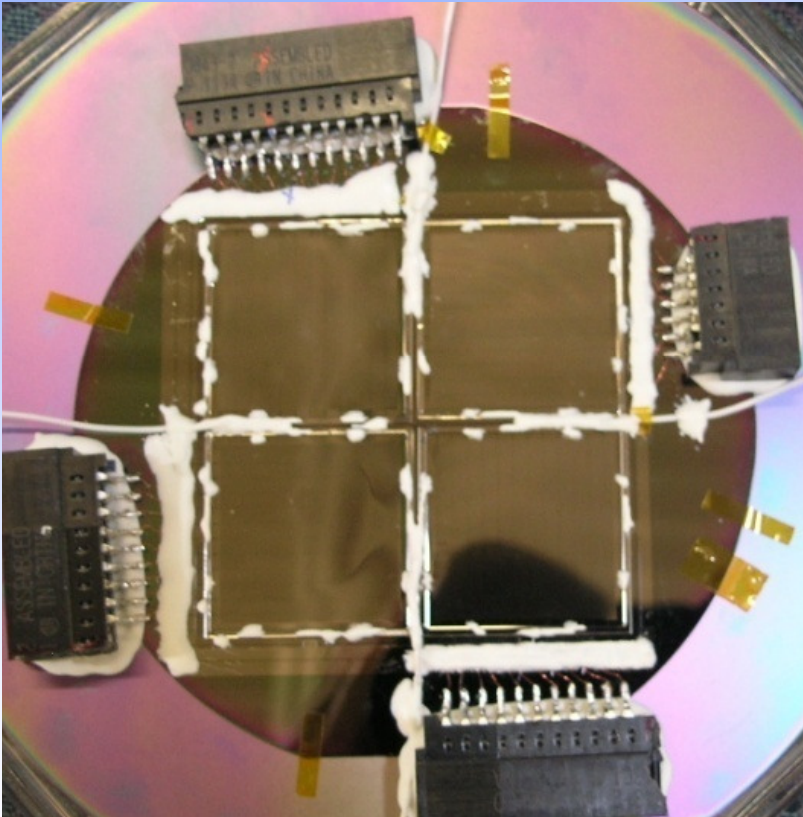
Strip Pixelated Anode



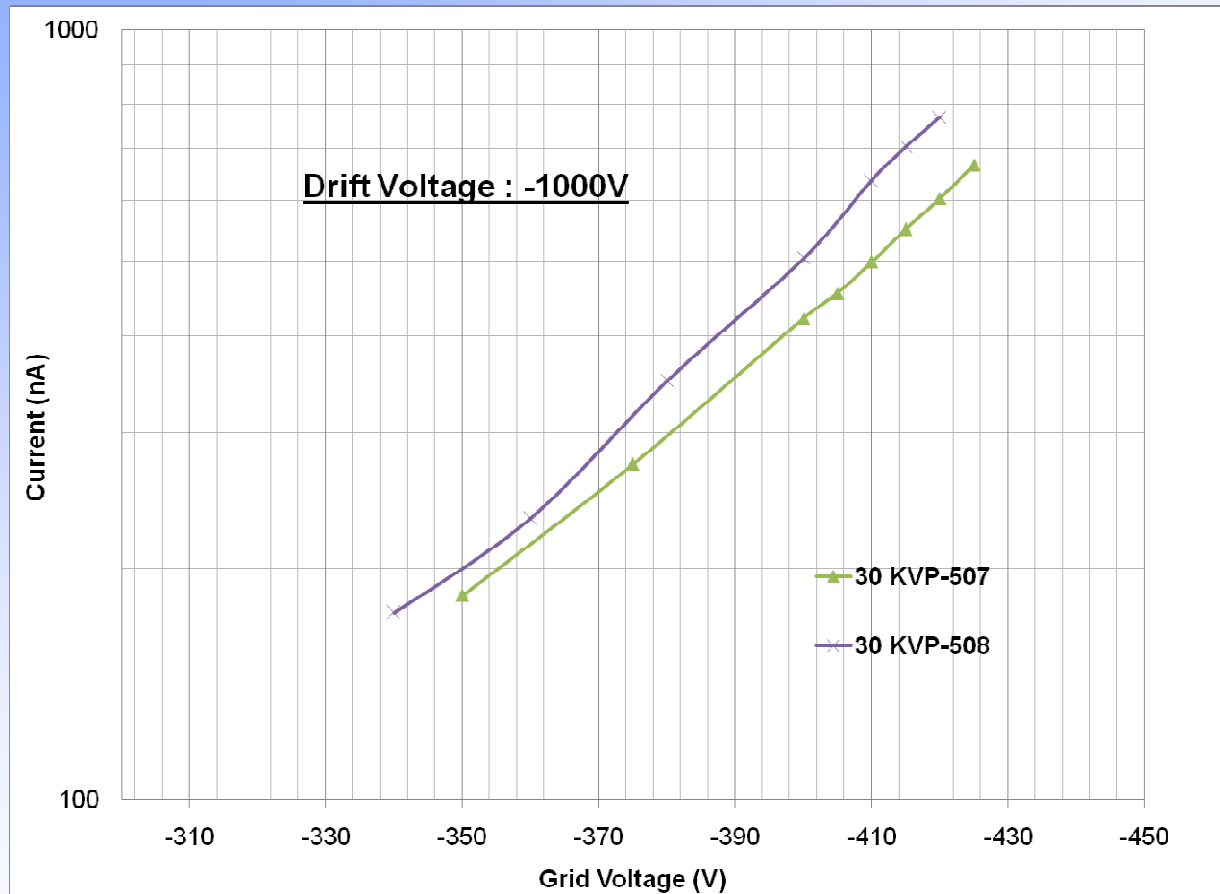
Attach Leadwires to Anode Strips and Meshes



Dielectric Shielding

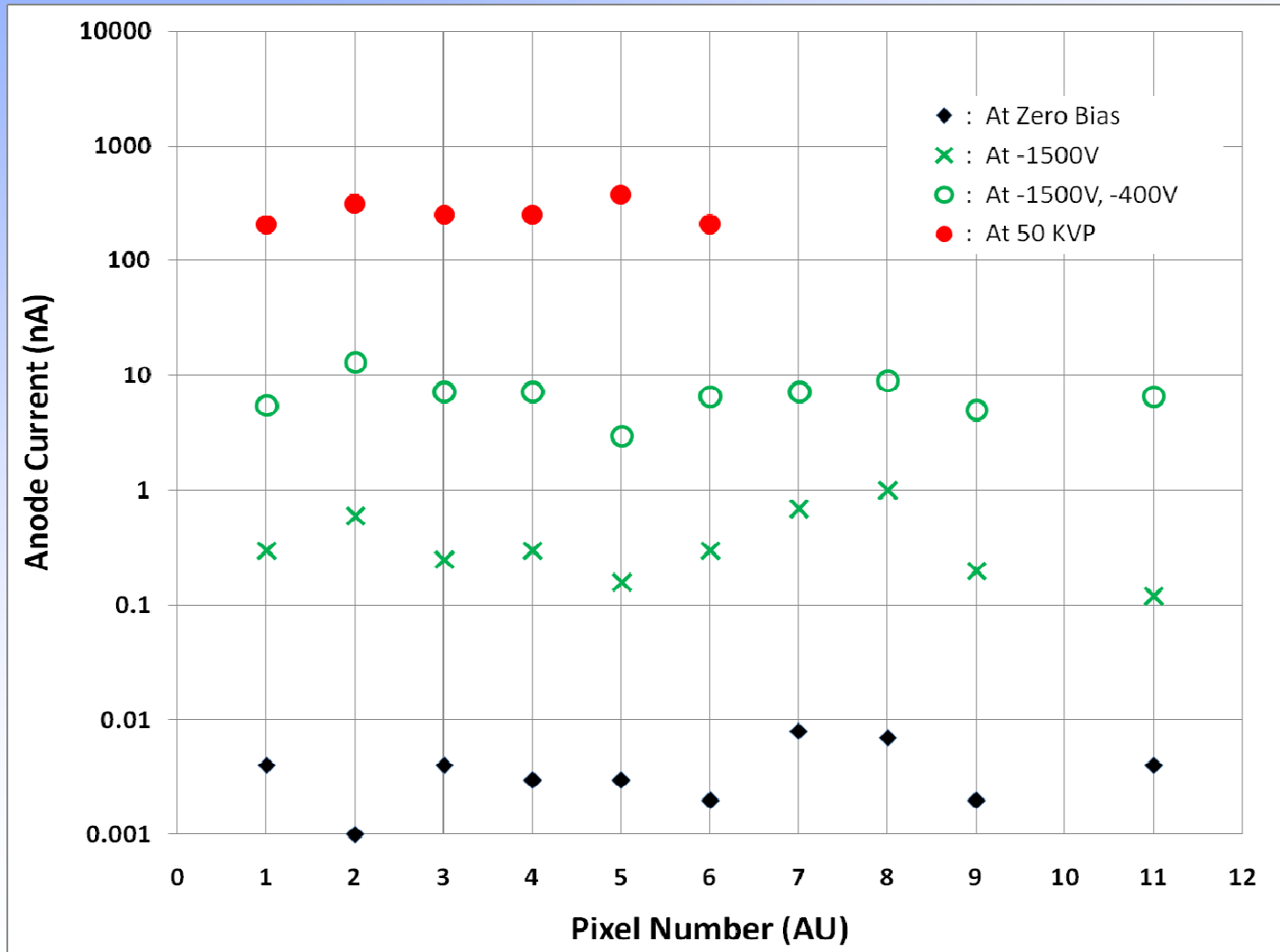


Excellent Linearity



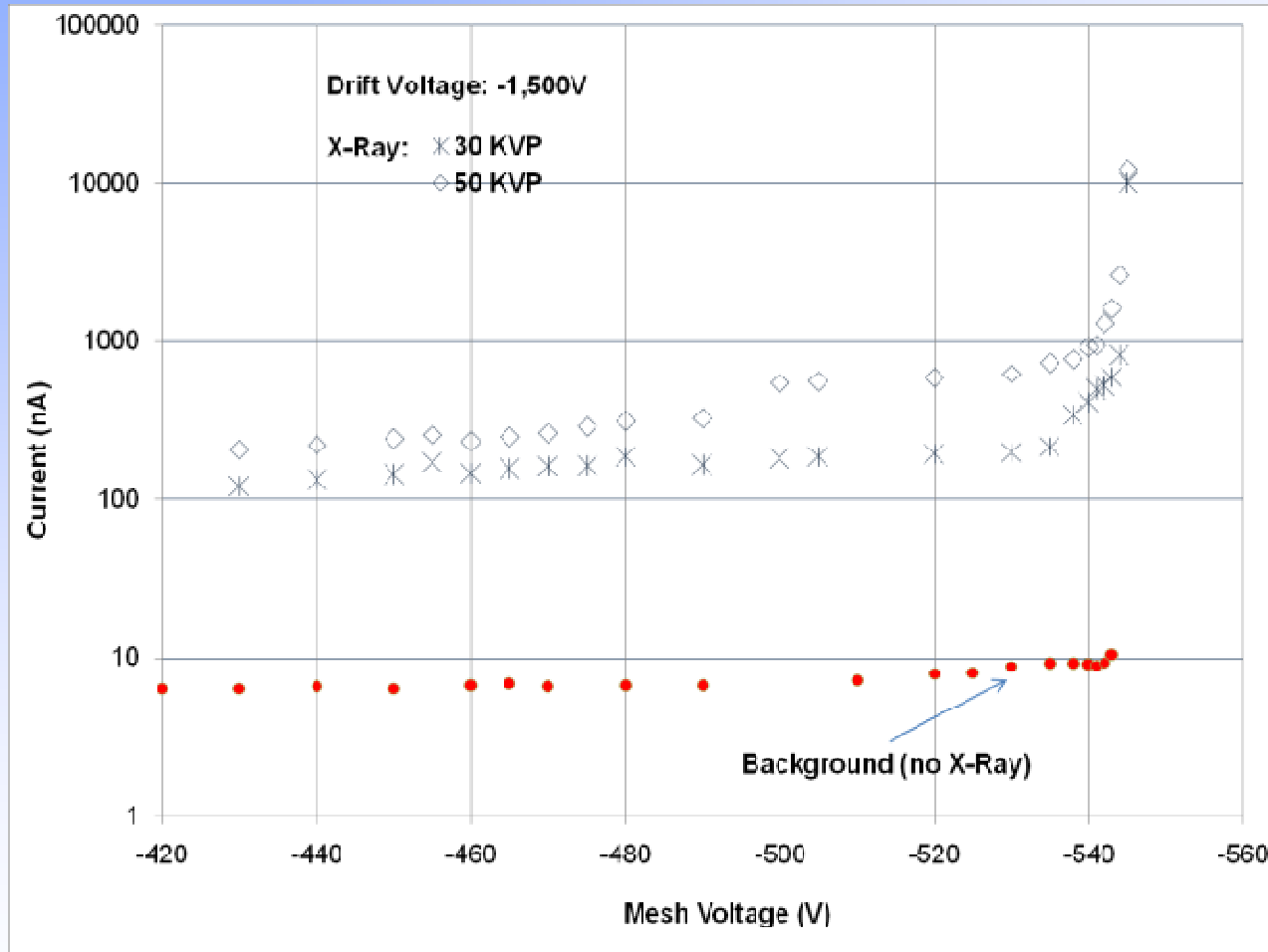
- 50 μm Mesh Gap
- P-10 gas at ambient pressure

Excellent Pixel Uniformity and Extremely Low Leakage Current



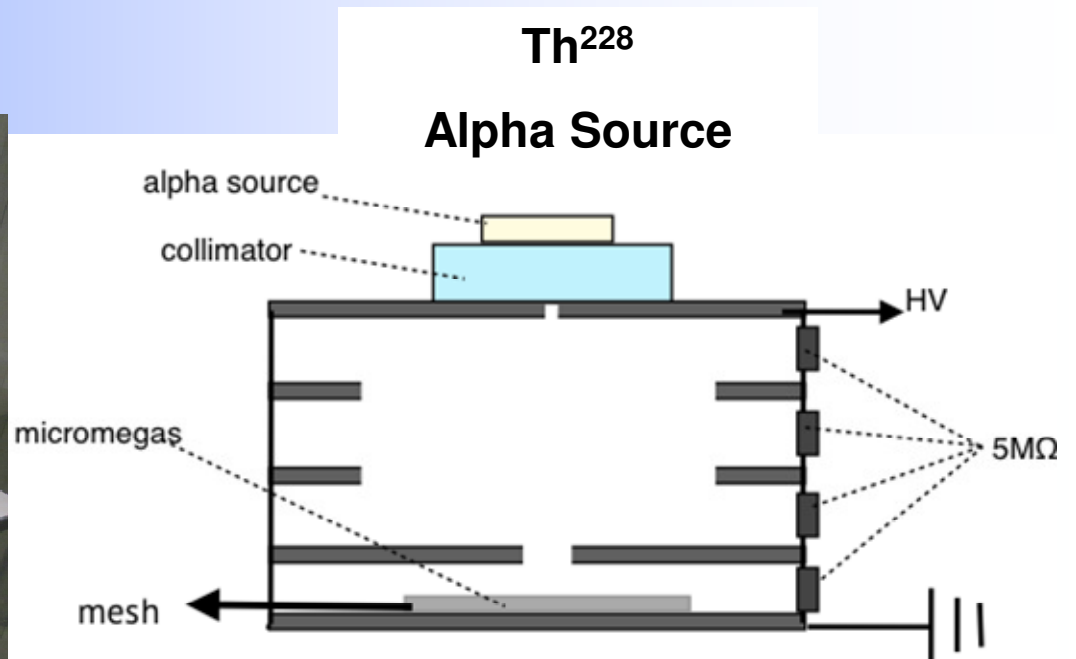
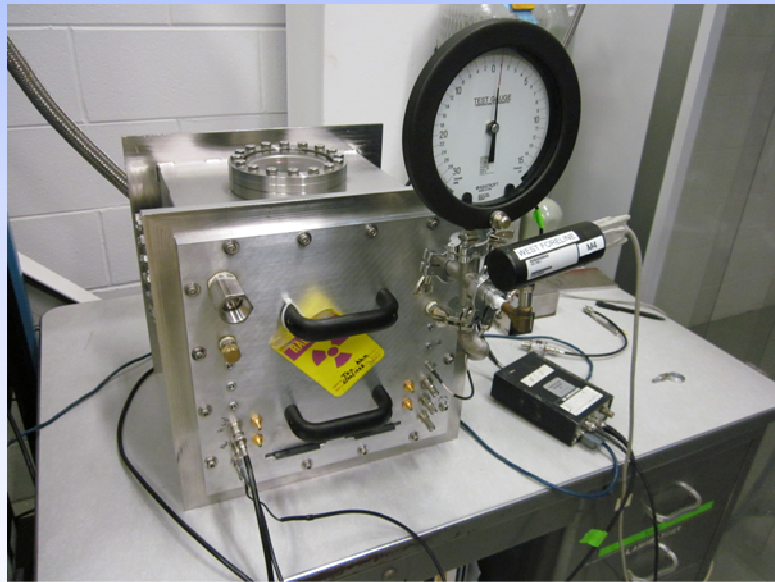
- 75 μm Mesh Gap
- Pixelated Anode Strip
- P-10 gas at ambient pressure

Excellent Linearity

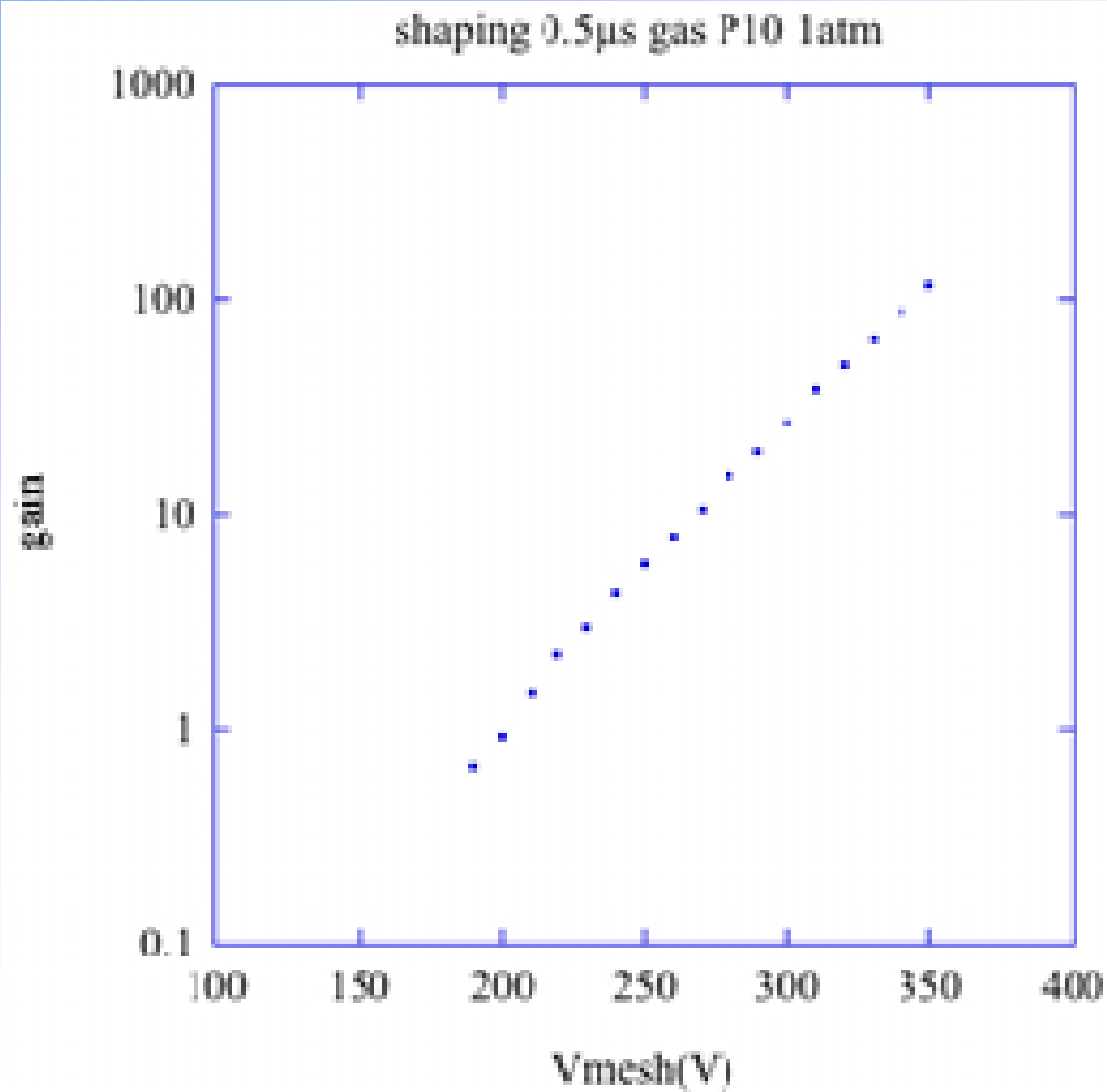


- 75 μm Mesh Gap
- Pixelated Anode Strip
- P-10 gas at ambient pressure

Alpha Radiation (NSCL) (Dr. Wolfgang Mittig)

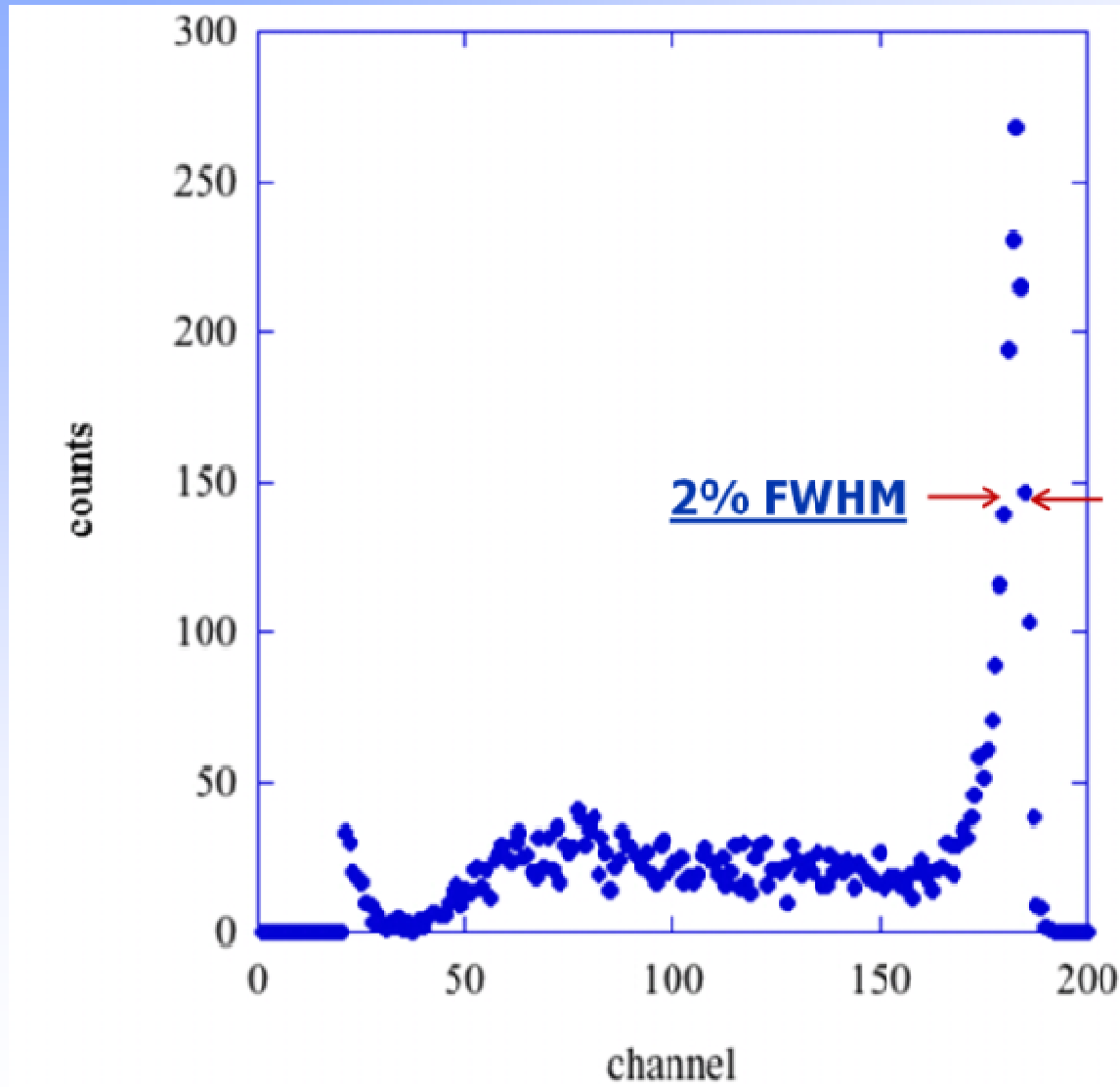


Alpha Source (NSCL)



- 50 μ m Mesh Gap
- P-10 gas at ambient pressure

Excellent Energy Resolution



- 50 μm Mesh Gap
- Pixelated Anode Strip
- P-10 gas at ambient pressure

Summary

- ❖ Designed, optimized, fabricated, assembled and tested a large area micromegas with pixelated anode.
- ❖ Achieved exceptional energy resolution of $\sim 2\%$ FWHM.
- ❖ Gain over 1,000 under P-10 gas at ambient pressure and at operating electric field greater than 80kV/cm.
- ❖ Excellent pixel uniformity, reproducibility, and high yield, greater than 95%.