

3D Pixels for Protein Structure Studies

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Pixel 2002
Carmel, California
September 12, 2002

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Project Members

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- J. Hasi, A. Kok, C. da Via - **Brunel University**
- S. Beckwith, N. Latta - **Stanford University**
- E. Perozziello - **Consultant**

Current Systems

- Absorbed in a scintillator
- Visible photons guided by tapered fibers
- O-E conversion in CCD

- Expensive - \$1,000/cm²
- Defects
- Slow
- Dynamic Range

Requirements

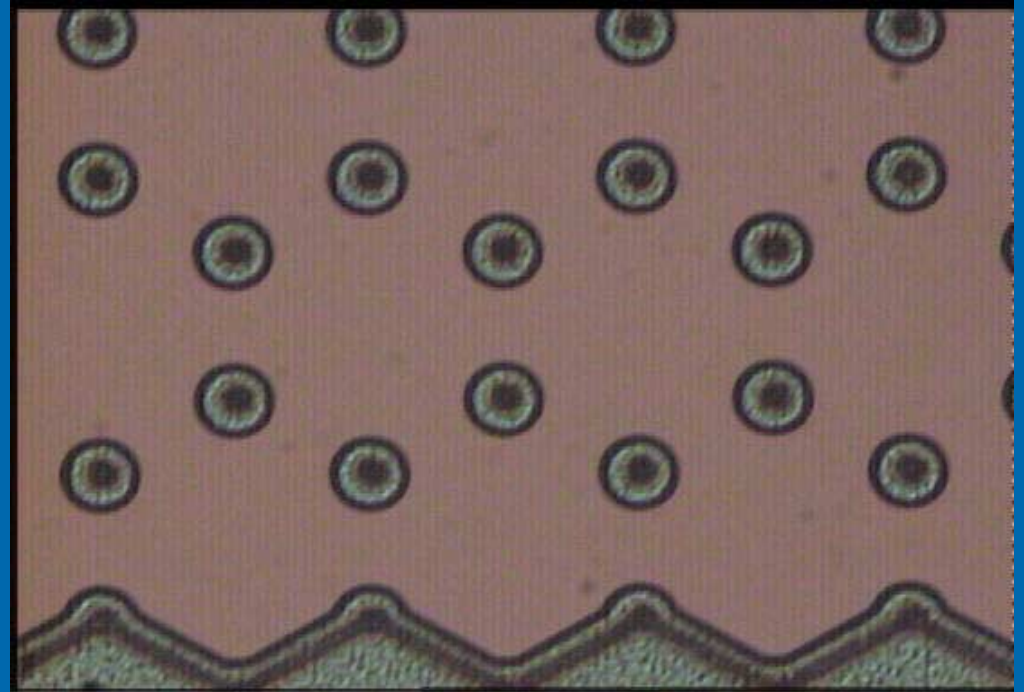
- 12,000 eV Photons
- Large Area - 30 x 30 cm²
- No Dead Areas
- Large Dynamic Range
- High Efficiency

3DX System

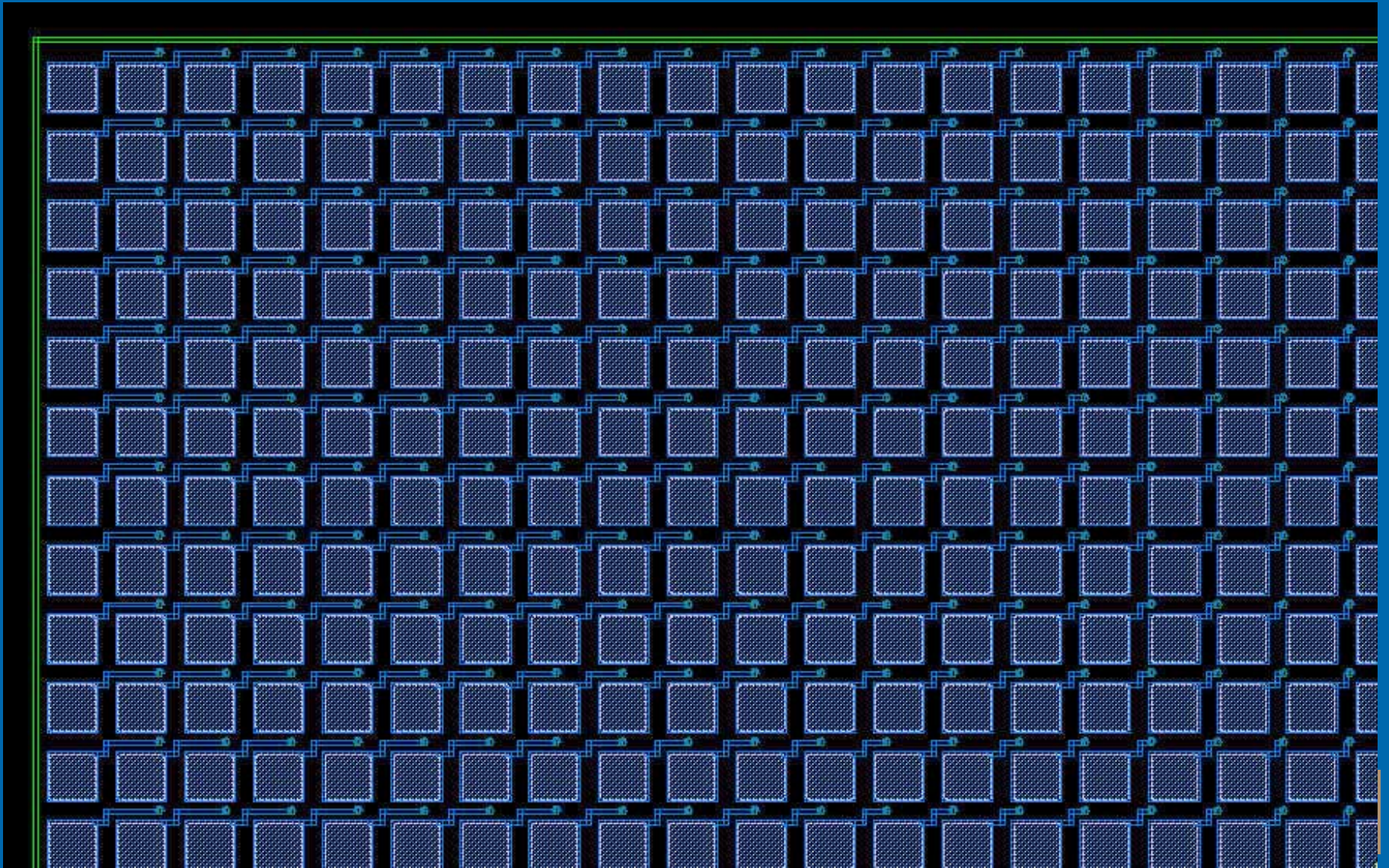
- Direct Conversion
- Photon Counting
- Active Edges
- Less Expensive
- Fast < 100 microseconds

Sensors

- 3D Architecture
- Active Edges
- Make at Stanford
- 150 x 150 μm^2 Pixels



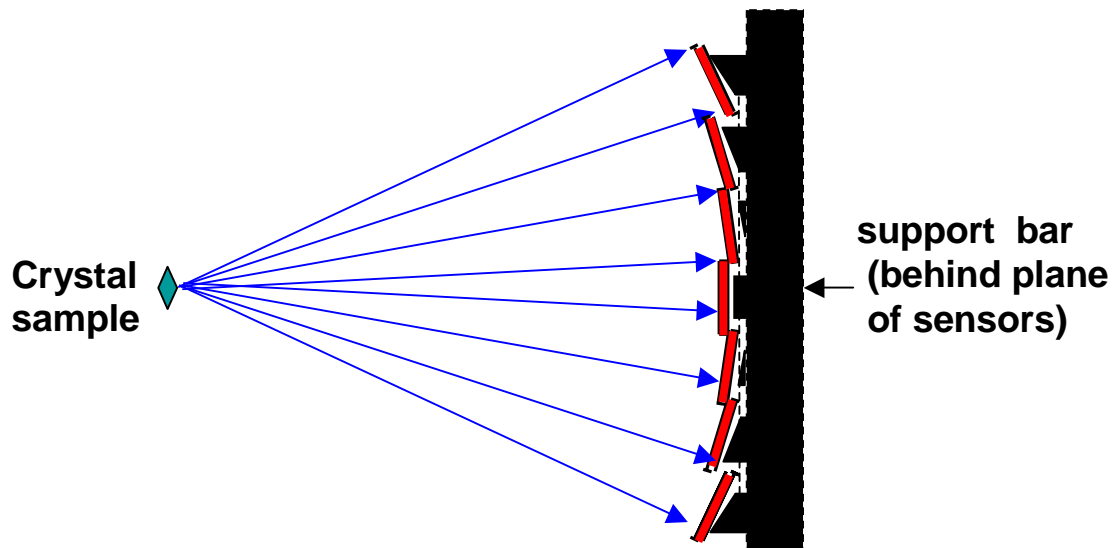
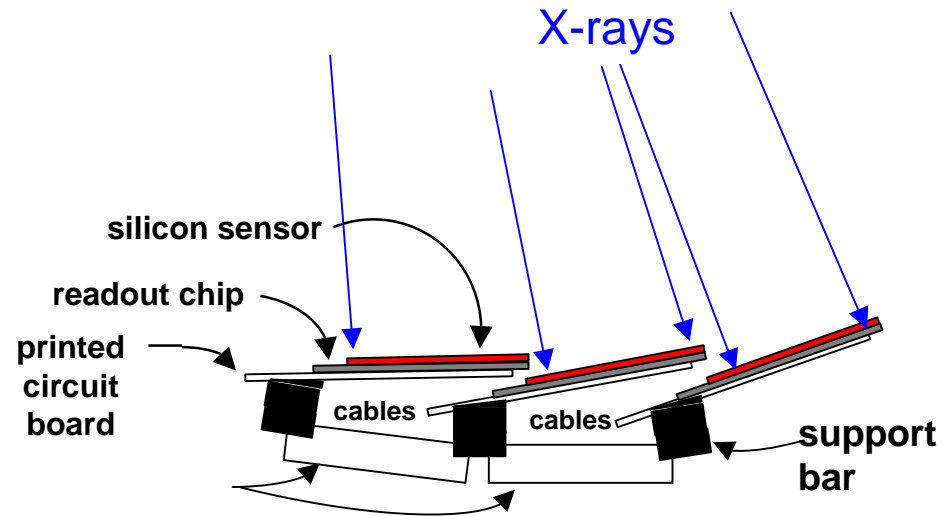
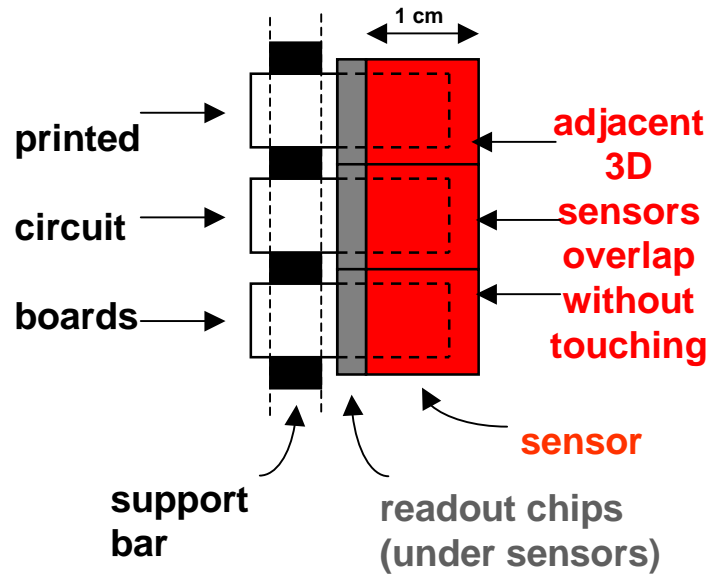
Offset Read-out Pitch



Read Out Circuit

- All Cells Readout
- On-Chip ADC
- 144 x 150 μm^2 Pixels
- 0.25 micron CMOS
- Designed at LBL

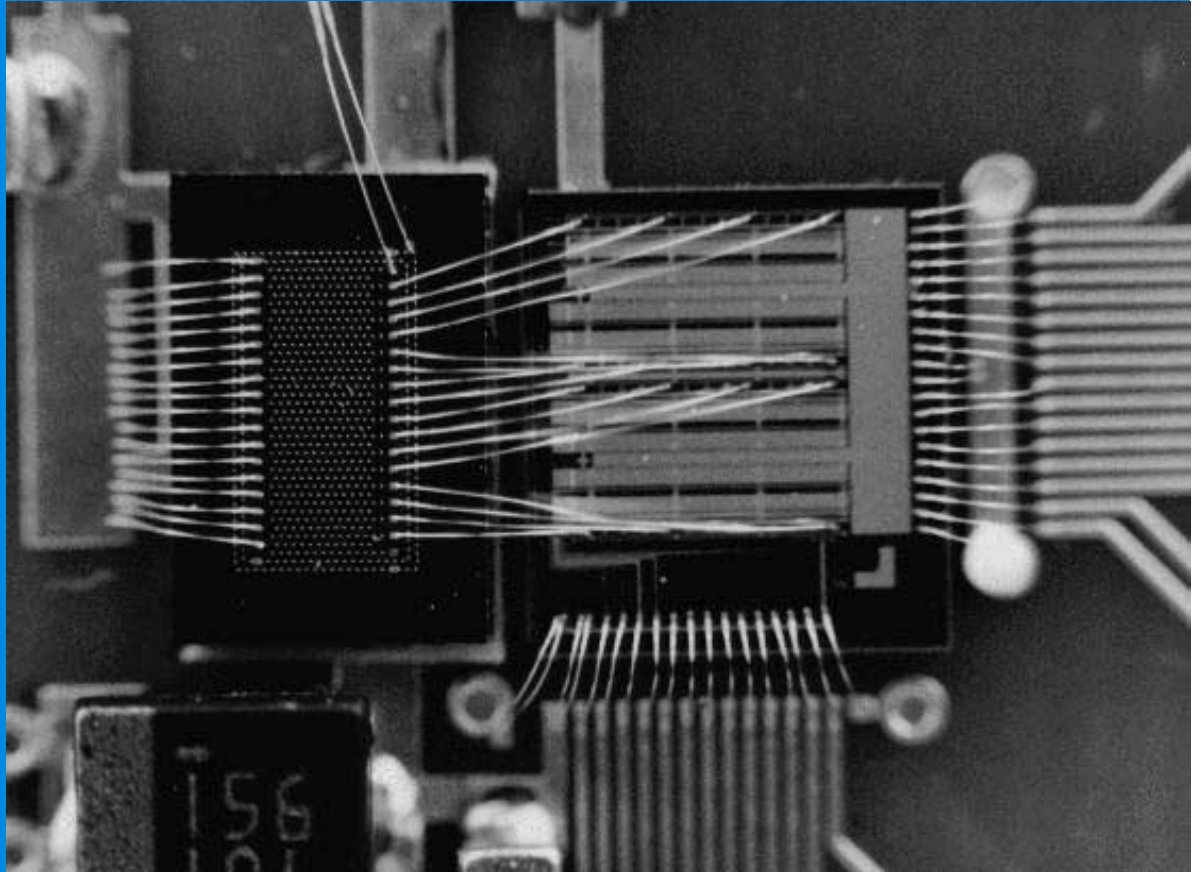
System Geometry



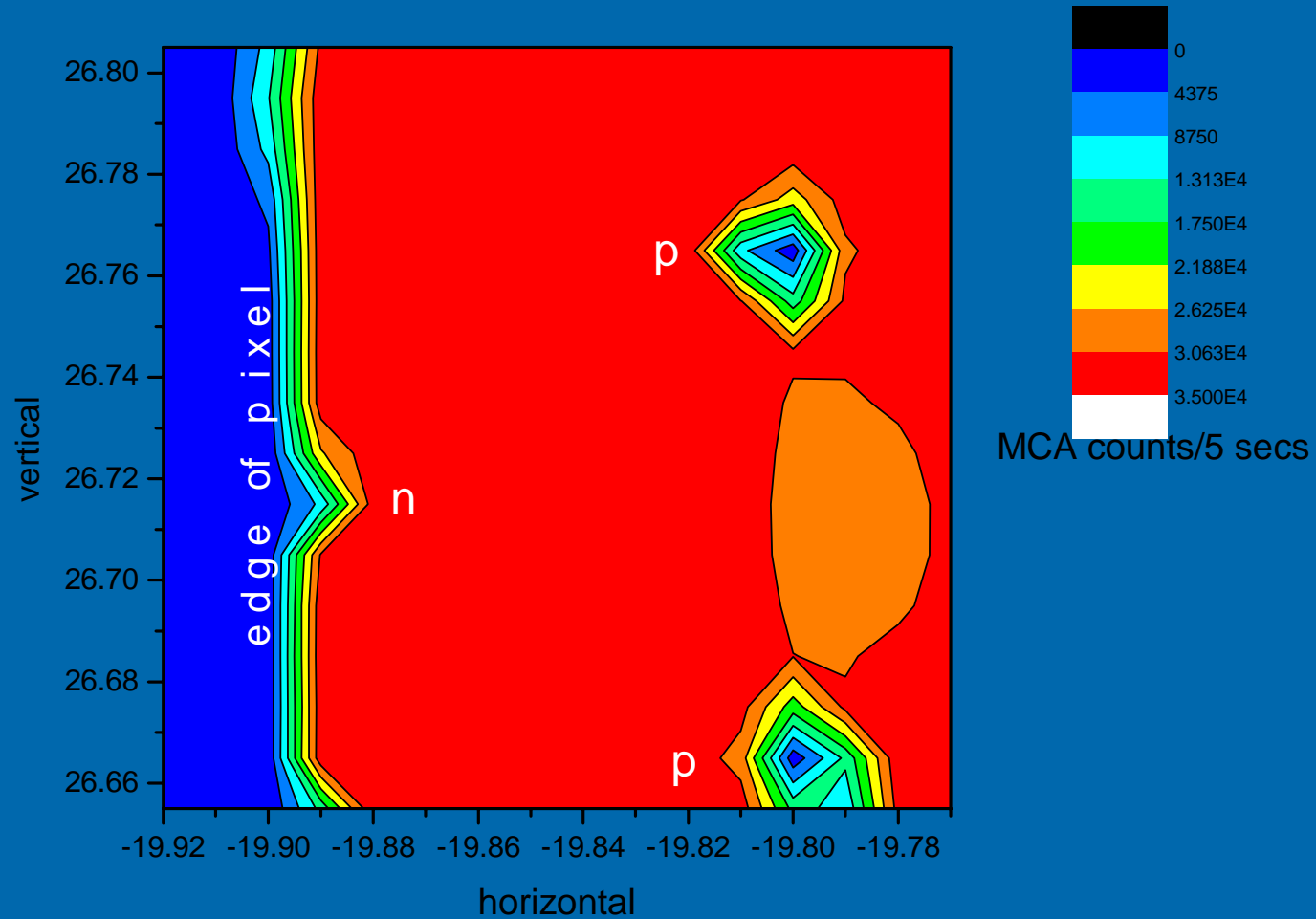
All X Rays are within 3 Degrees of Normal to the Sensors

Synchrotron Beam Setup

- 12.66 KeV
- Integral Counts
- Energy Window
- Beam FWHM = 4 μm
- 16 Channel Charge Preamp and Shaper



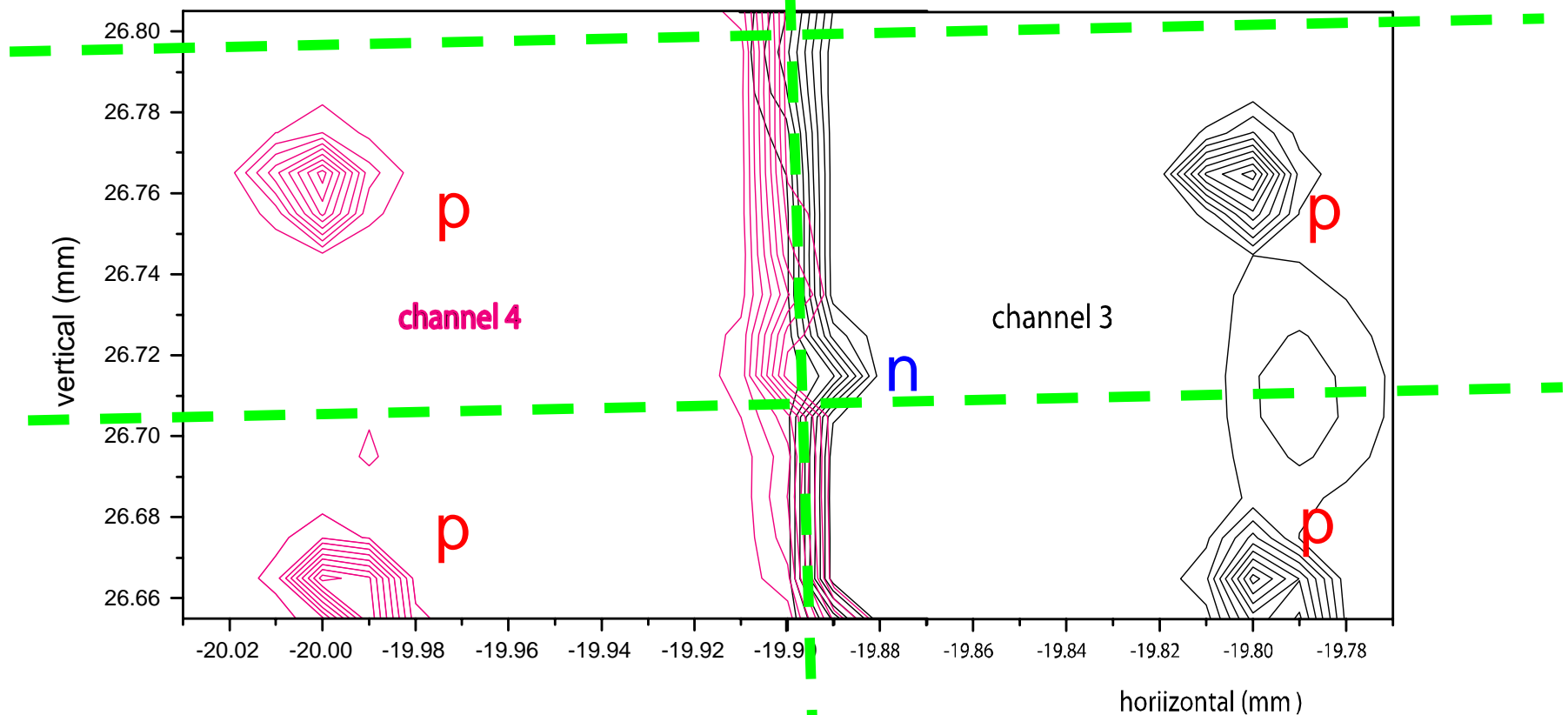
Synchrotron Intensity Map



Beam x, y raster scan 10 μ m
steps over Channel #3
(20V bias)

Pixel-to-Pixel Transistion

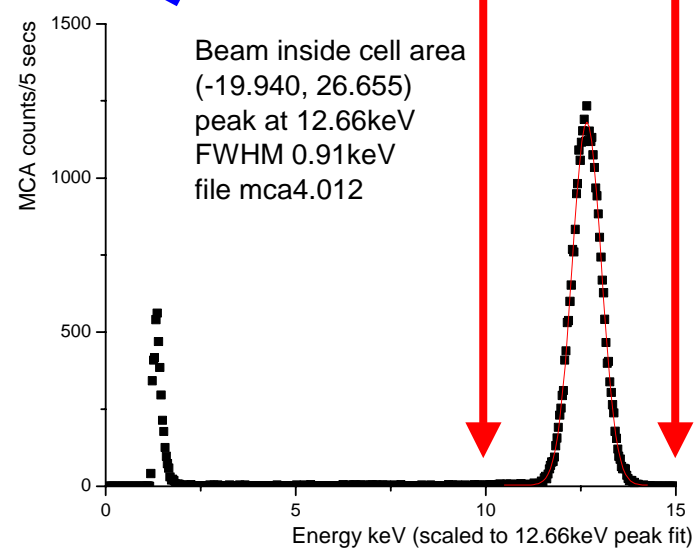
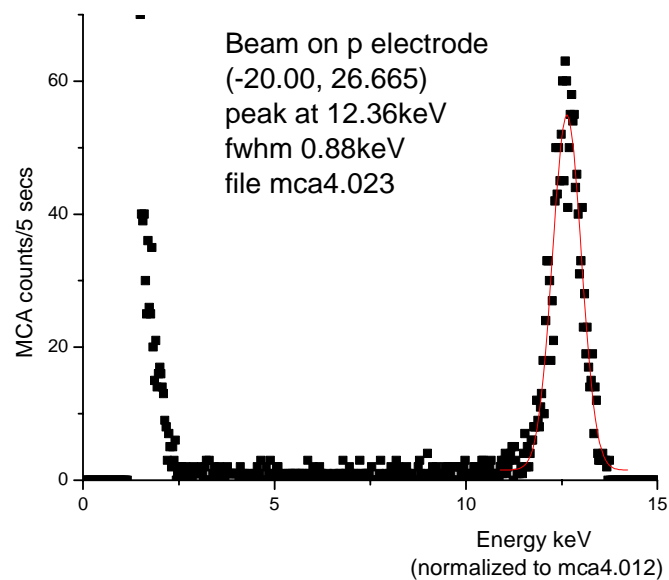
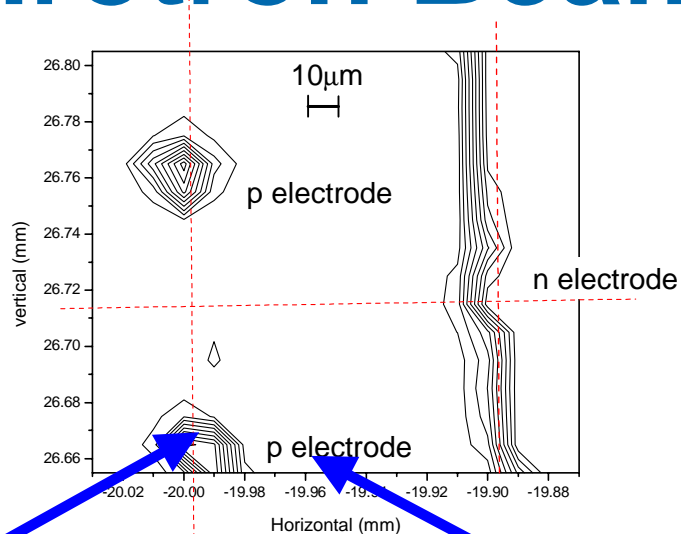
contours at: 3.5; 3.2; 2.8; 2.5; 2.1; 1.8; 1.4; 1.1; 0.7; 0.35 x 10E4



Mesh scan, 10 μ m steps, x-y raster, channels 3 and 4 (20V bias). Superposed data from each channel.

Synchrotron Beam Scan

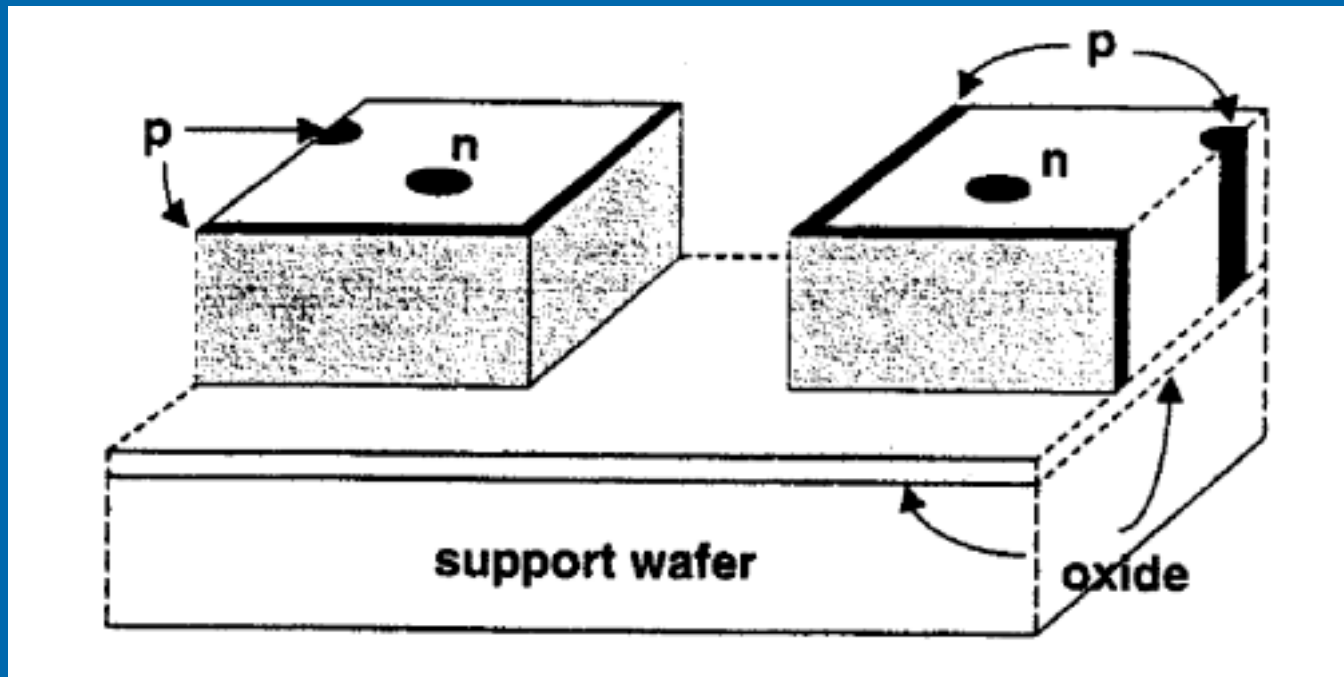
Beam has
FWHM = 4 μm



Integral
window for
contour plots

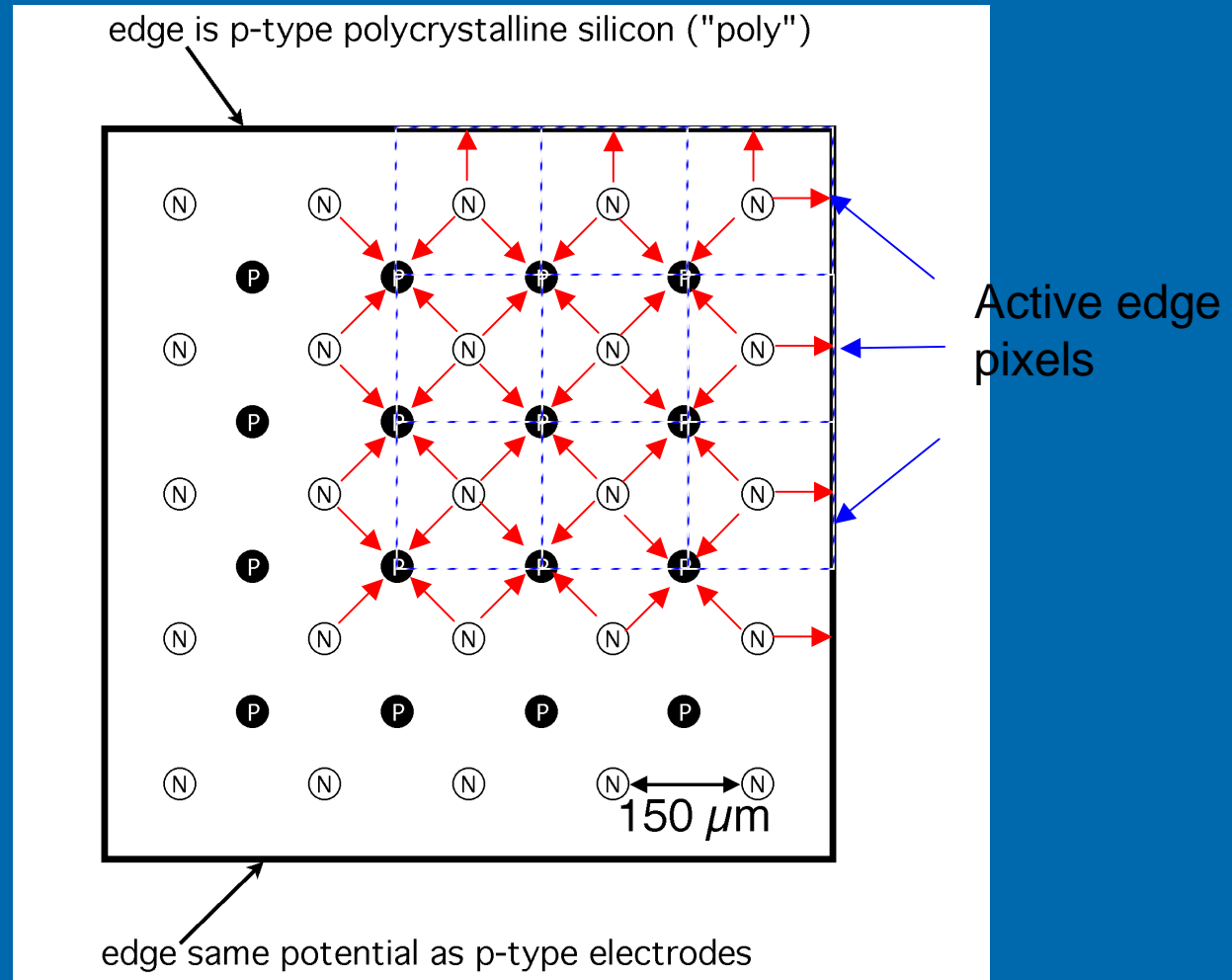
Active Edges

Fabrication scheme for 'active edge' detectors



Corners of the two sensors after dicing by etching large trench, showing doped polysilicon sidewalls (sensors still on support wafer)

AE Schematic



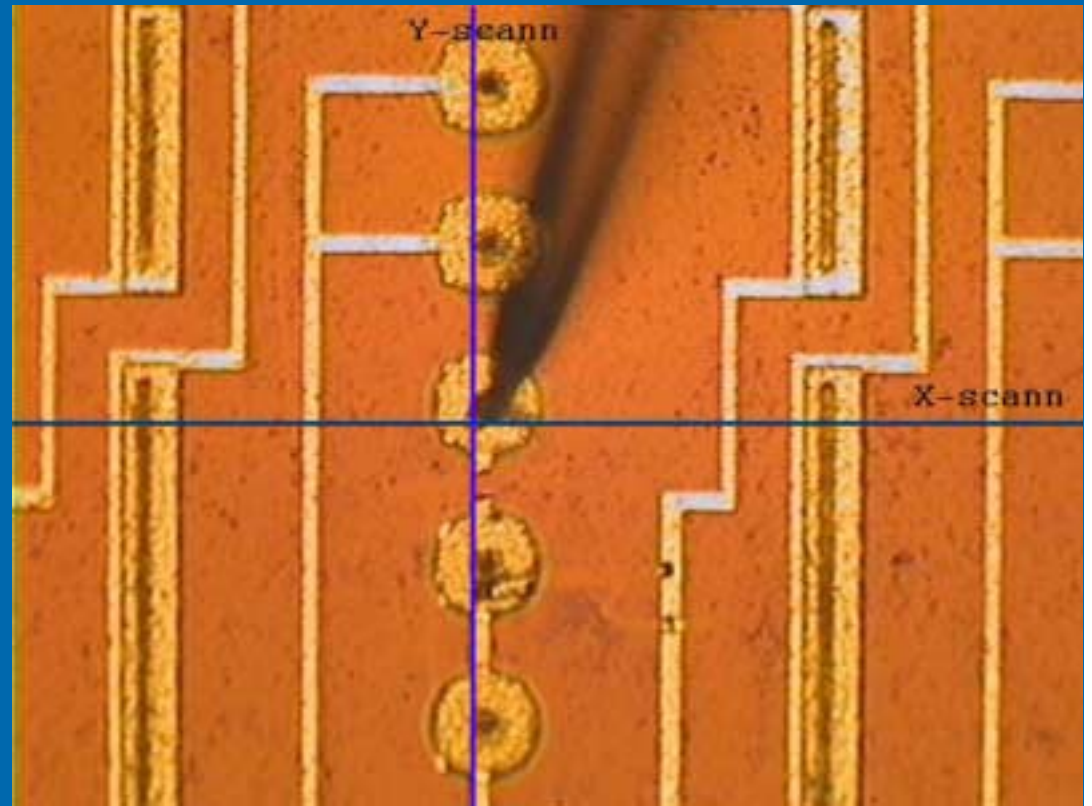
Trench Sensors

Ganged Strip of 14
Electrodes

290 microns
between aluminum
traces

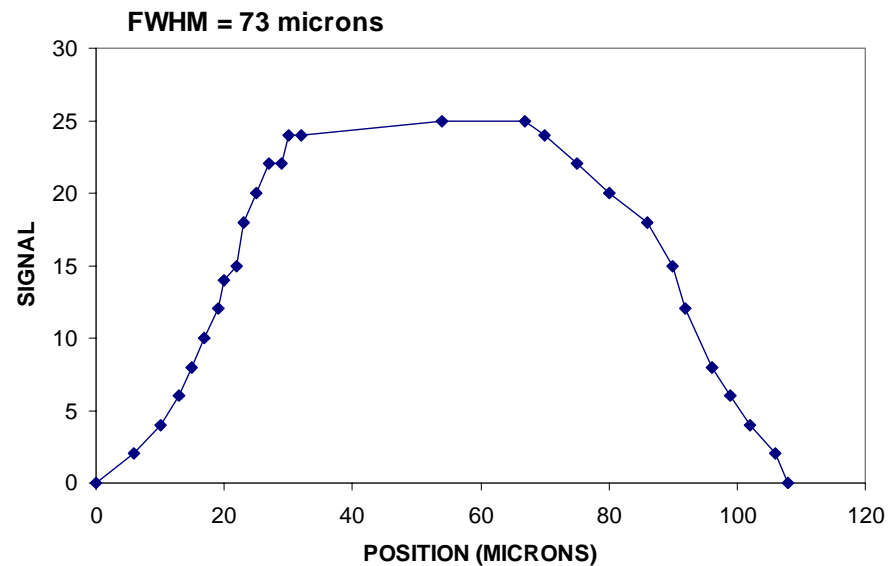
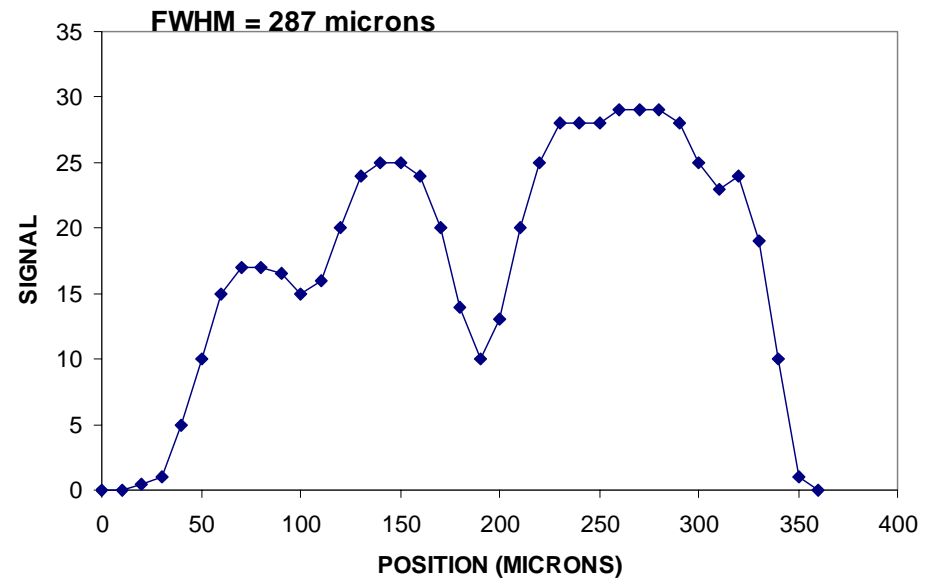
75 microns vertical

Infrared Beam, 30 microns diameter



Trench Sensors

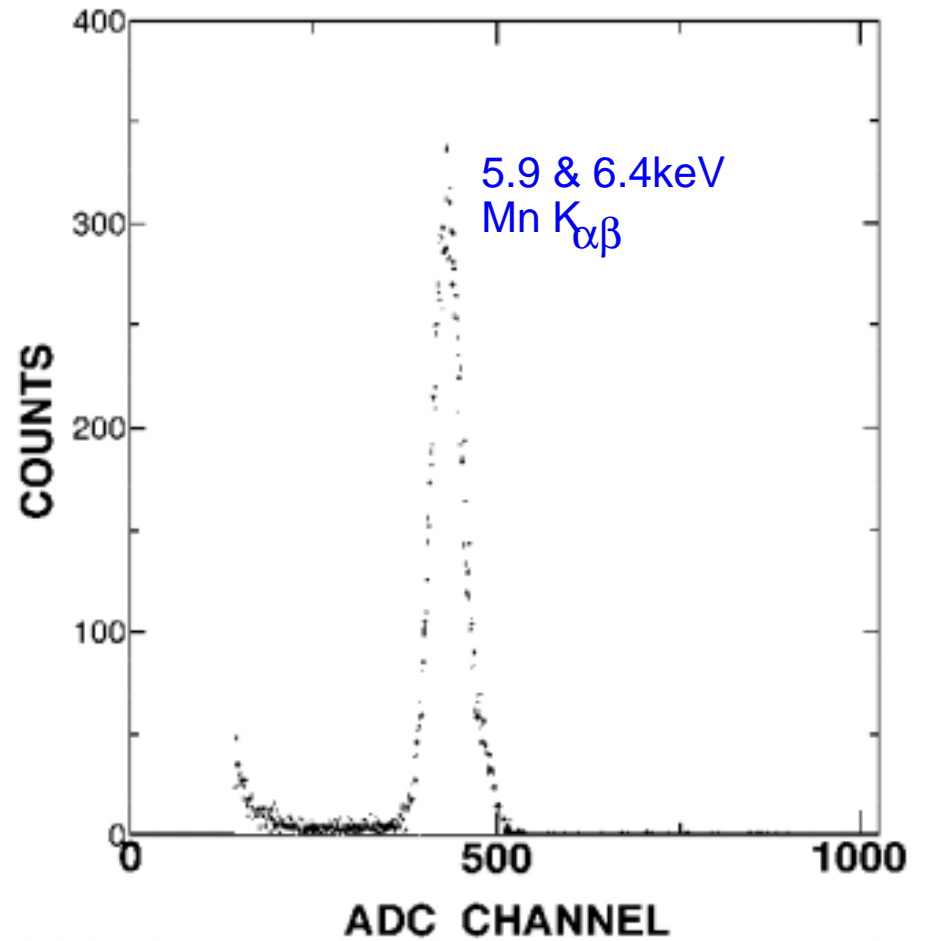
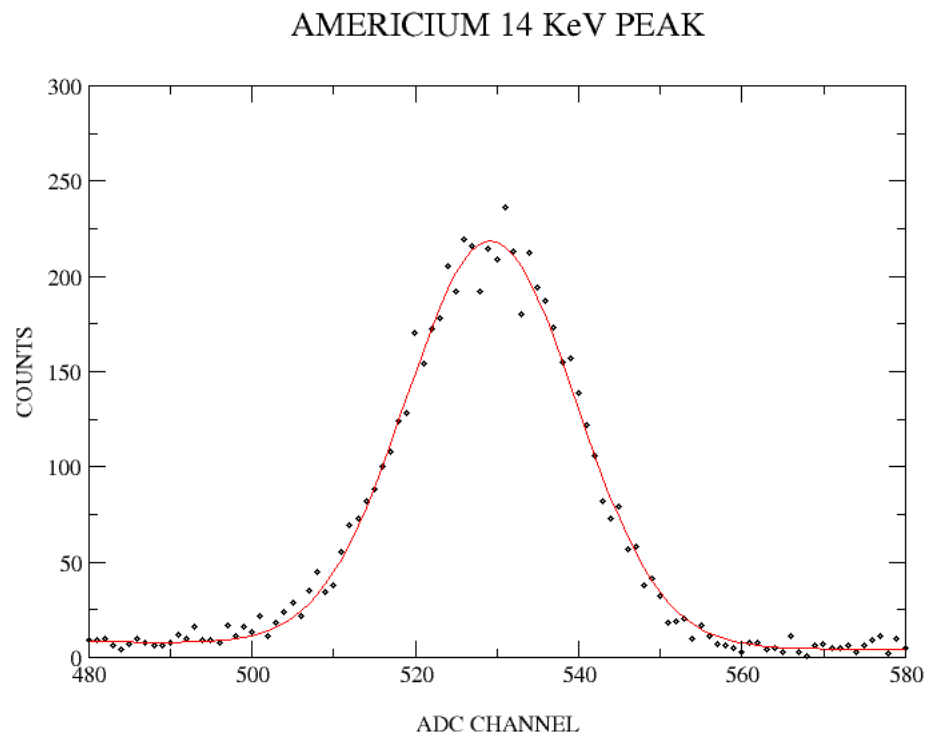
Metal-to-Metal
Expect 290 μm
Find 287 μm



Electrode-to-Electrode
Expect 75 - Find 73 μm

Charge Sharing

Small Excess
below Peak



Future Plans

Test Readout ASIC – Winter 2003

Finish 3D AE Sensors – Fall 2002

Construct Hybrid Components - 2003

Assemble Small System - 2003

Acknowledgements

Fabrication of sensors:

Center for Integrated Systems,
Stanford Nanofabrication Facility

Beamline Tests:

GSECARS 13-BMD,
Advanced Photon Source
(*Mark Rivers, Matt Newville*)

Present work is supported by NIH, grant 1 R01 RR1 6230-01

