National Synchrotron Light Source II

High-Z detectors for Photon Science

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IFDEPS workshop

April 8th 2021

U.S. DEPARTMENT OF ENERGY | Office of Science

BROOKHAVEN NATIONAL LABORATORY

Collaborations

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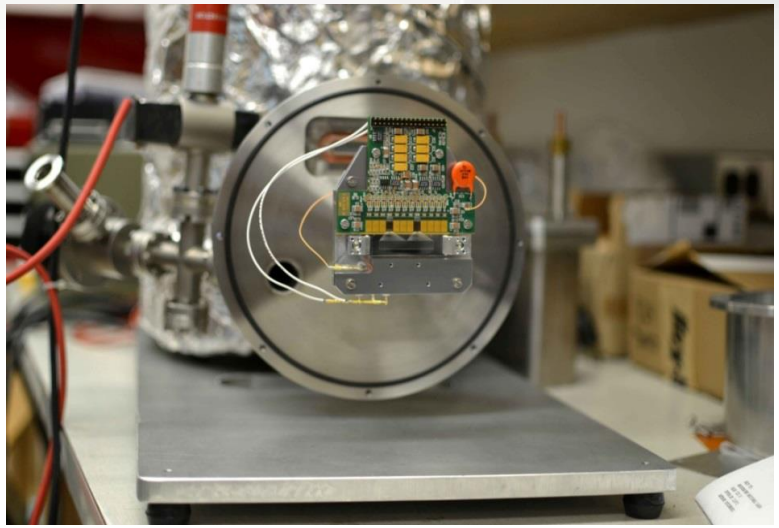
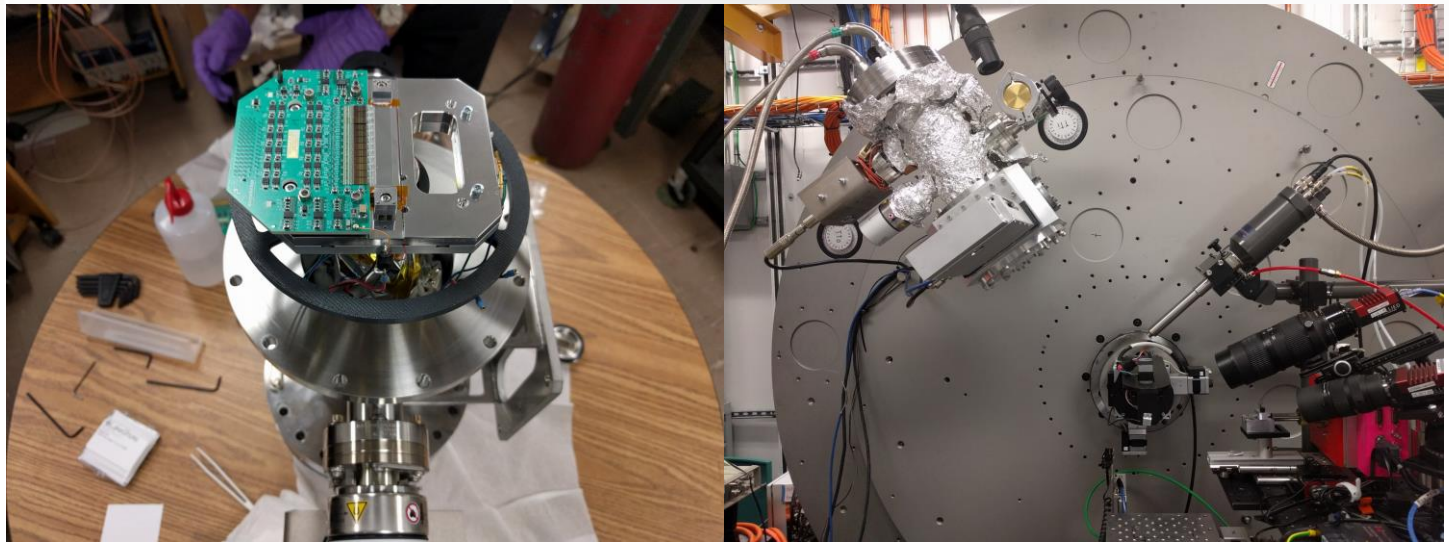
FZ-Julich: T. Krings

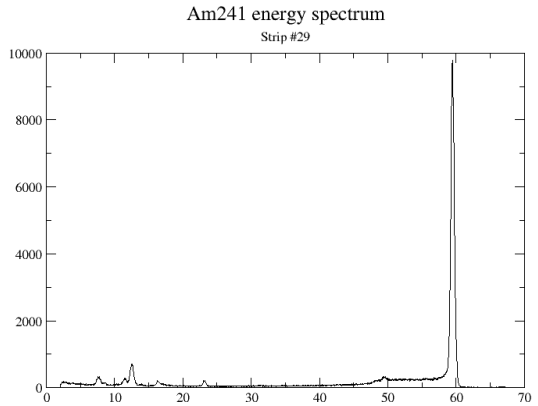
Multi-element Germanium detector

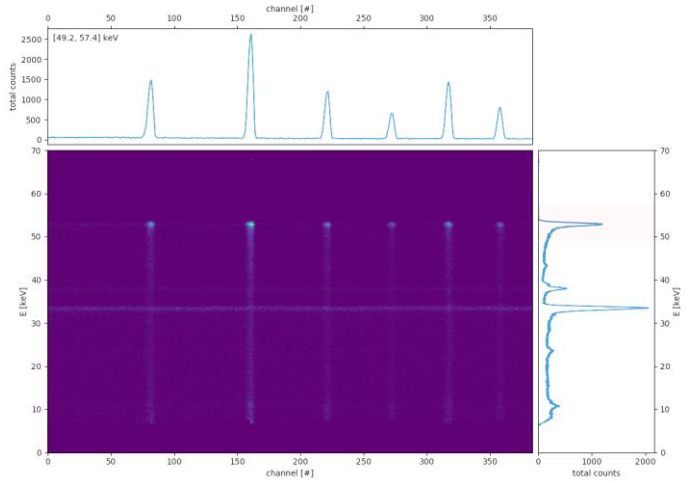
64- strip at XPD beamline at NSLS II



384- strip at XPD beamline at NSLS II



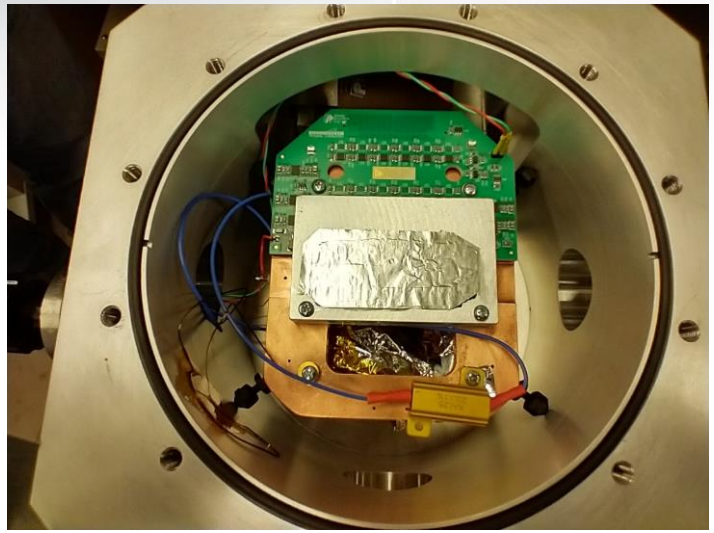




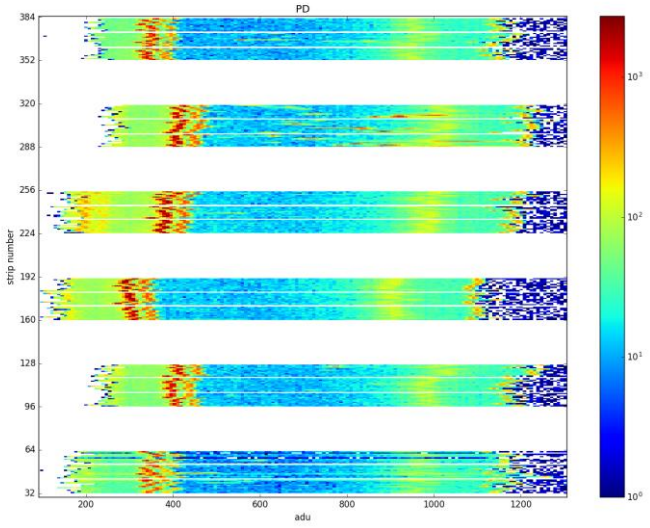
First data on LaB_6 at XPD

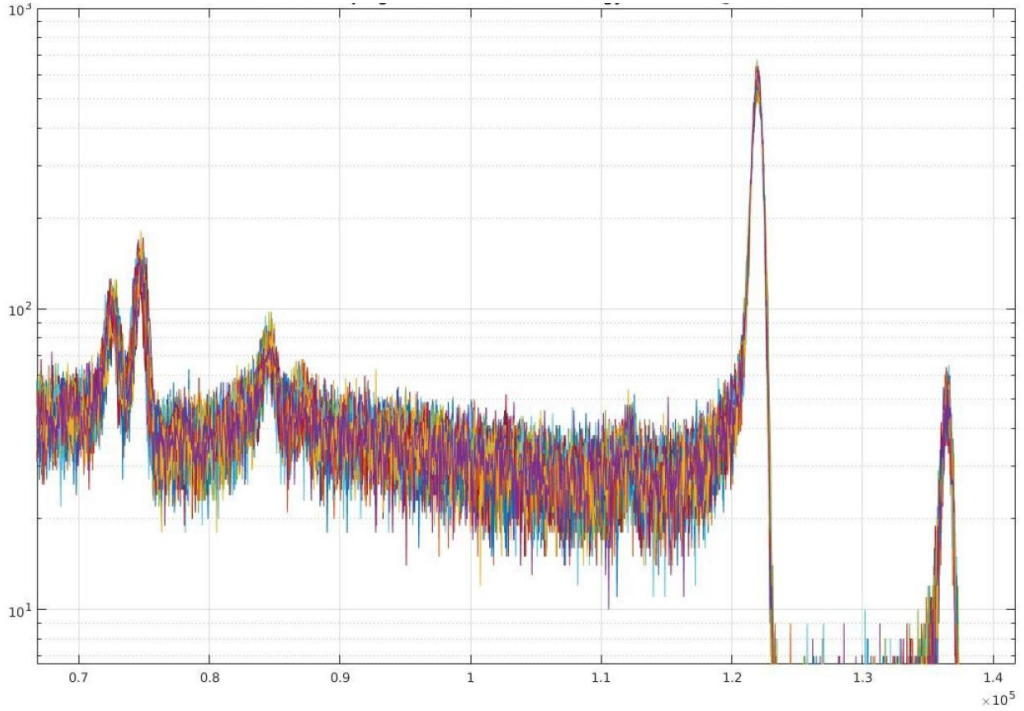
Multi-element Germanium detector

- 192-strip detector for HEX beamline at NSLS II
- Up to 200 KeV with 1% energy resolution
- New chip HE-MARS with lower gain



Initial test with Am source with Mo foil





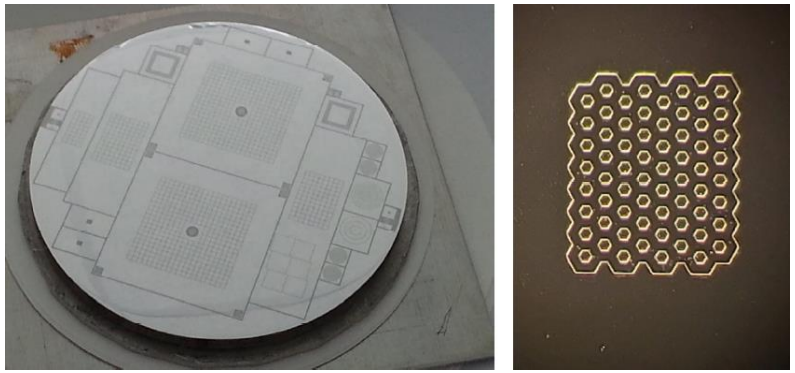
Co-57 source

Resolution~ 850 eV

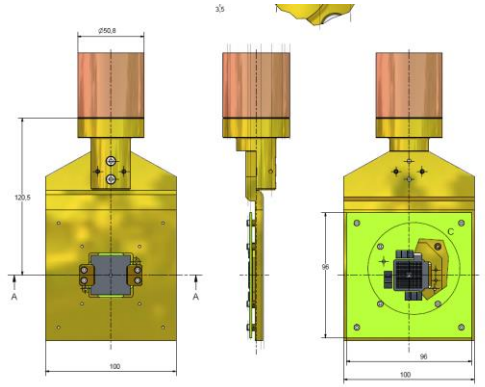
GALAHAD: Germanium Array for Low And High energy Area Detector

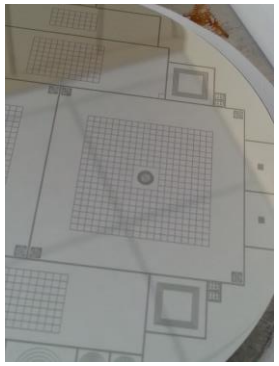
- Develop Ge based spectroscopic imaging detector
- Cold ASIC bump bonded to Ge (Tapeout 2021)

Fully processed Ge sensor



384-pin diode array: This will be used to fabricate a 384 multi-element Germanium fluorescence detector (GAIA)

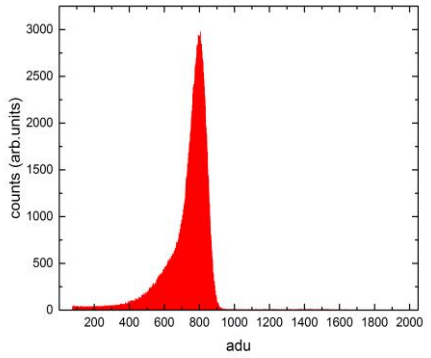




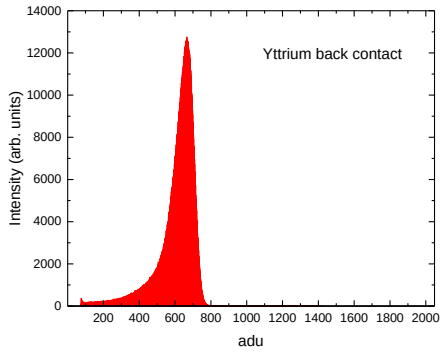
Alternate n+ contact in Ge

- Lithium diffusion is quite thick
- Ok for uniform back contact but cannot be masked
- Thick dead layer in the order of 100s of microns, undesirable for certain application

Phosphor doped and laser annealed



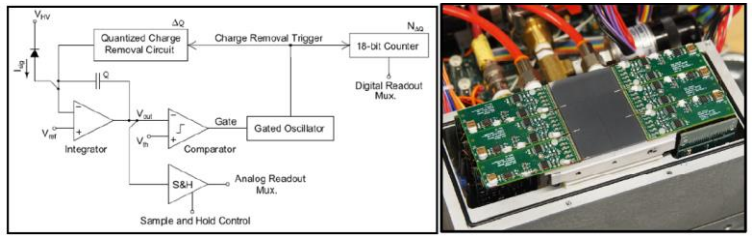
Yttrium n+ contact



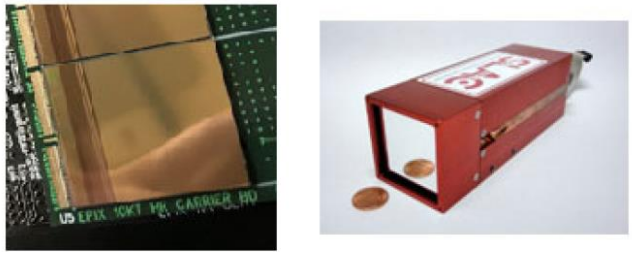
Evaluation of high-Z detector materials for X-ray Science

- The project was to use some well established high-Z sensor (Ge, CZT and perovskites) in a hybrid pixel array detector Prototypes
- Collaboration between BNL, Cornell, SLAC, ANL, and Northwestern U
- Bonding the three candidates to three ASICs used in synchrotron facilities and FEL: MM-Pad, e-Pix and UFXC
- Collaborative tests involving members of the team: LCLS-II, APS (Northwestern U), NSLS-II and CHESS

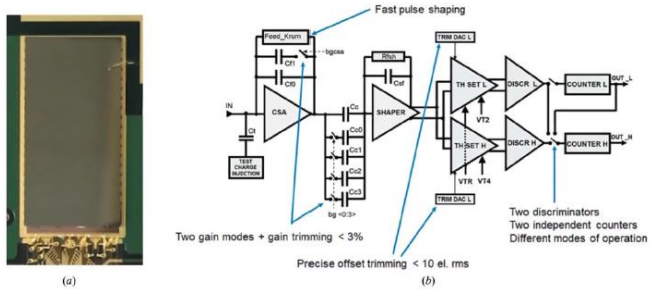
MM-Pad (Cornell)



e-Pix (SLAC)

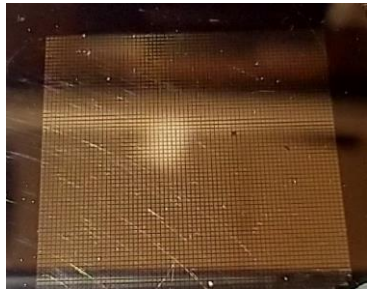


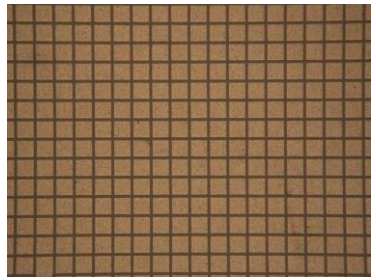
UFXC (Krakow)



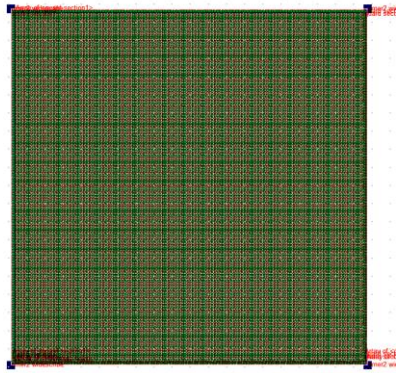
Pixelated high-flux CZT (BNL)

High flux CZT from Redlen. Pixelation (130 um) done at BNL

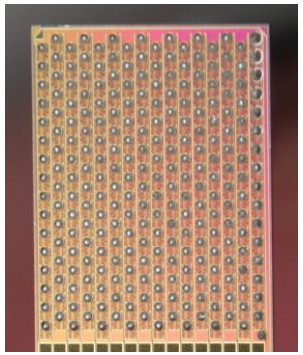




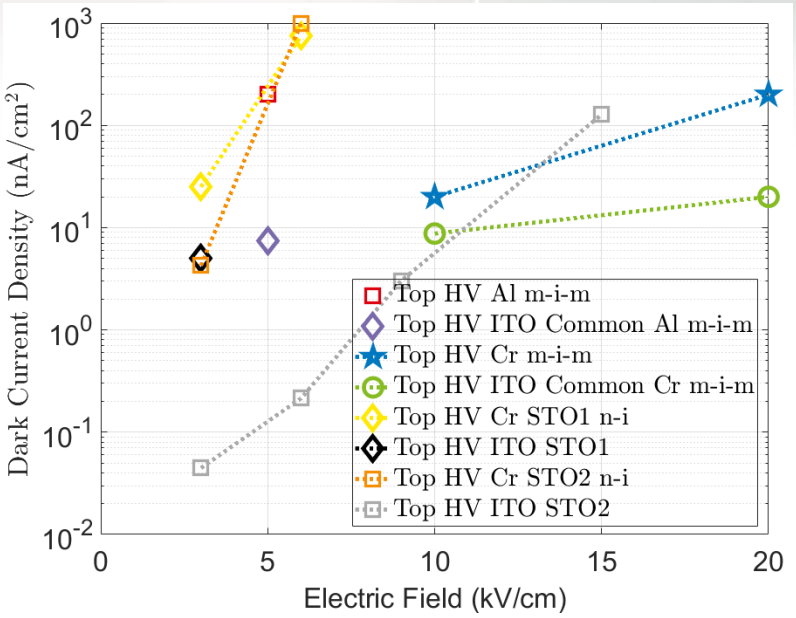
Ge sensor layout for MM-pad (BNL)
128X128 pixels



Bonding (BNL and SLAC)

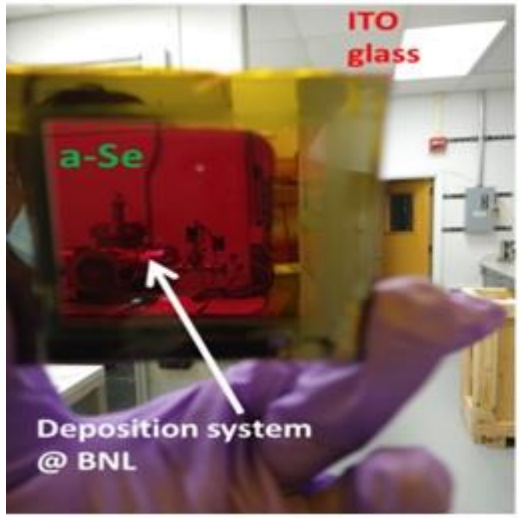


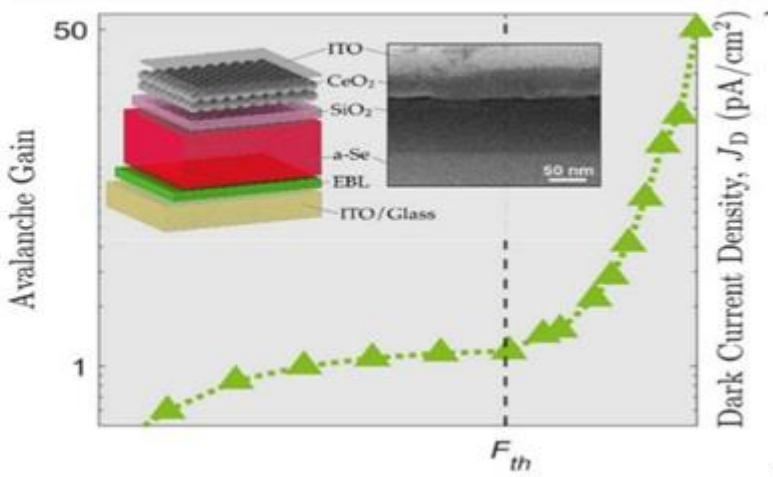
Amorphous Selenium for Hard X-rays



- Amorphous selenium is used in Medical imaging.
- High spatial resolution (below 10 microns) can be achieved for hard X-rays.
- Direct deposition of the active layer on readout electronics.
- Size not limited by crystal quality issues. Can be evaporated over large area.

On going project with Stony Brook Medicine. We have developed deposition tools to grow thick Se in house. Work on developing robust hole blocking layer.

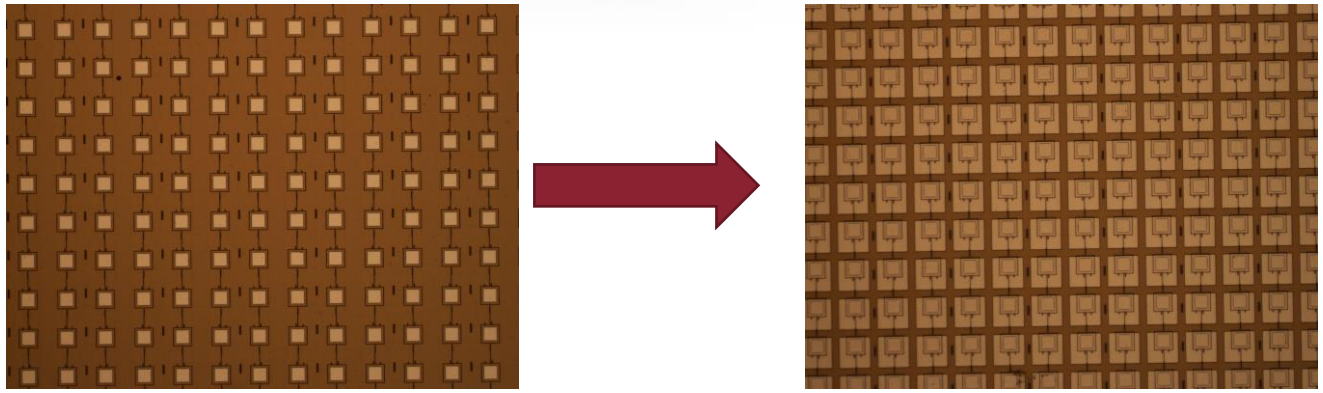




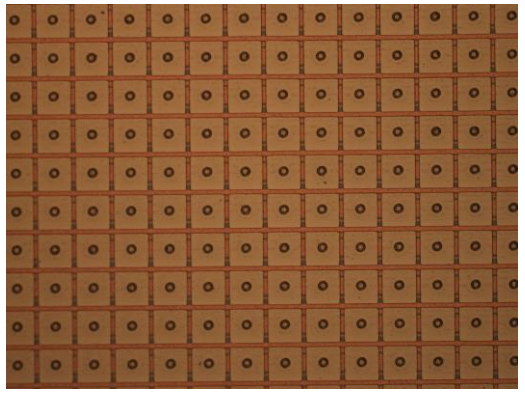
Amorphous Selenium for Hard X-rays

Direct deposition on CMOS chips

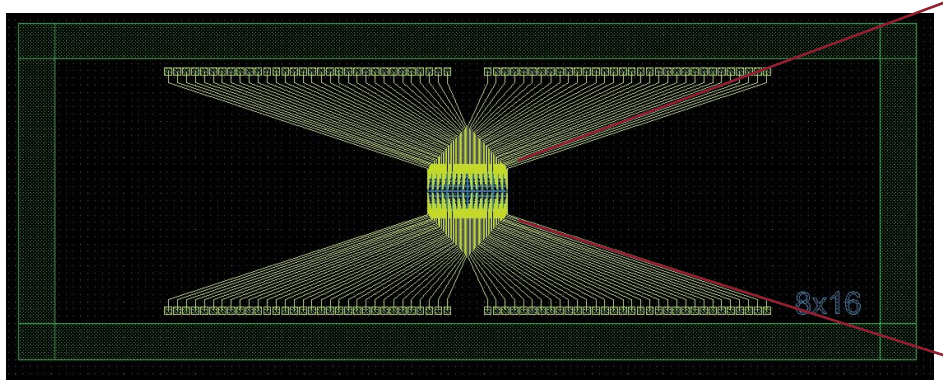
MM Pad: Top metal pad extension for improved fill factor

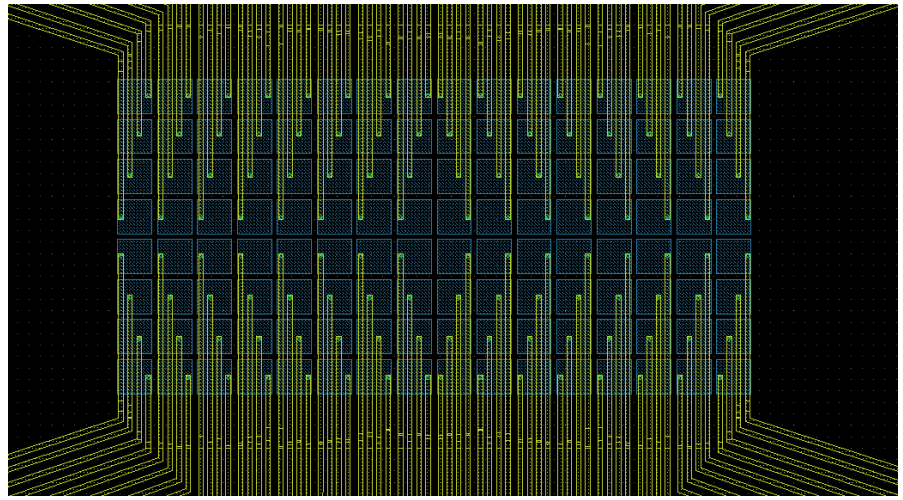


UFXC



Spectroscopy with MARS ASIC





Questions?