

# Detector Development at NSLS-II

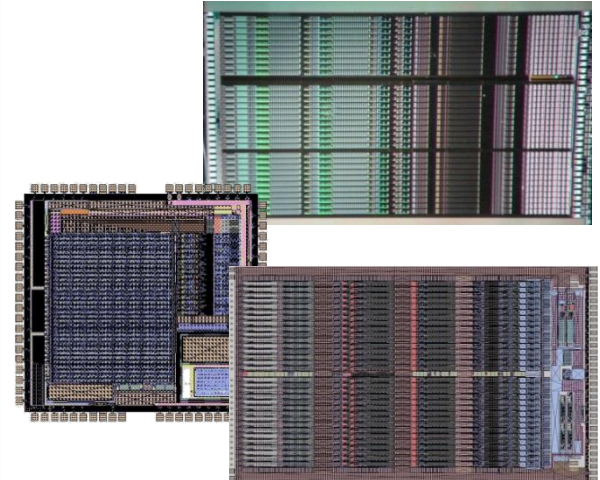
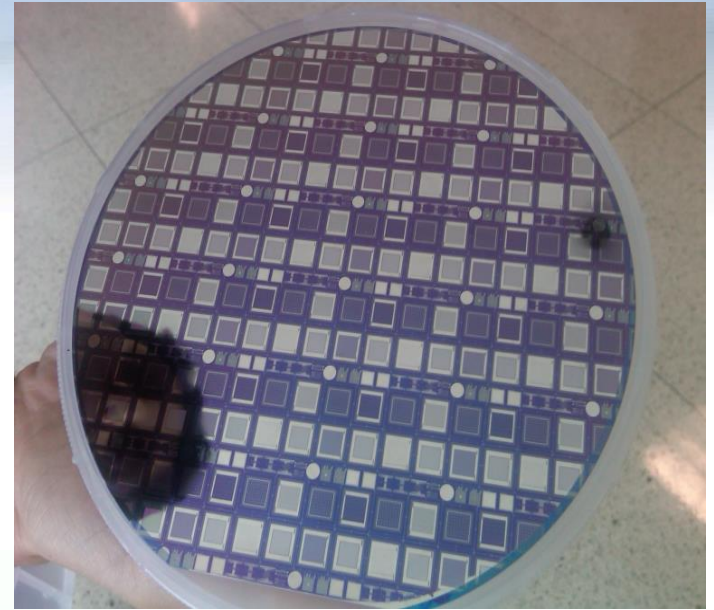
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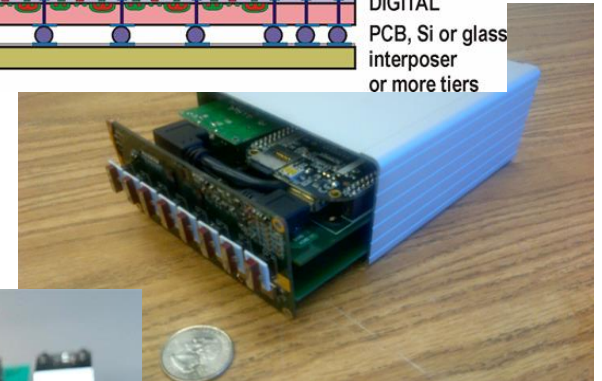
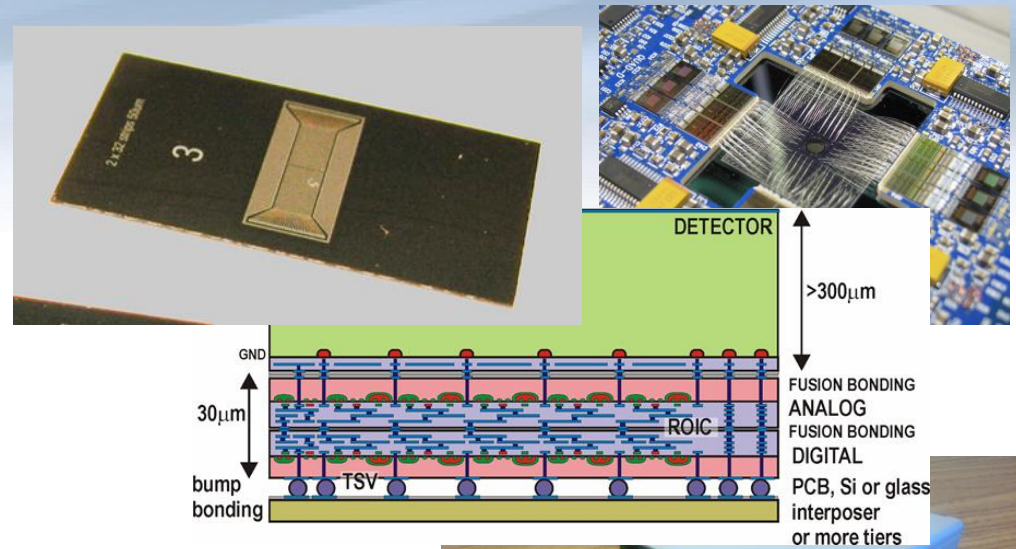
# Detector toolkit

- Given our limited resources we arrived at a small set of components which allow us to maximize our productivity:
  - A small foundry with a silicon diode process which produces high quality sensors
  - A few carefully-chosen ASIC designs
    - HERMES: a 32-channel amplifier with hardware discriminators and counters as well as individual analog outputs
    - SCEPTER: a 32-input analog peak-detector and de-randomizer, allowing the use of high-speed synchronous ADCs.
    - MARS: a new 32-channel chip which combines the amplifier and peak detector functions for purely spectroscopic applications.
  - A flexible FPGA-based readout system



# Products

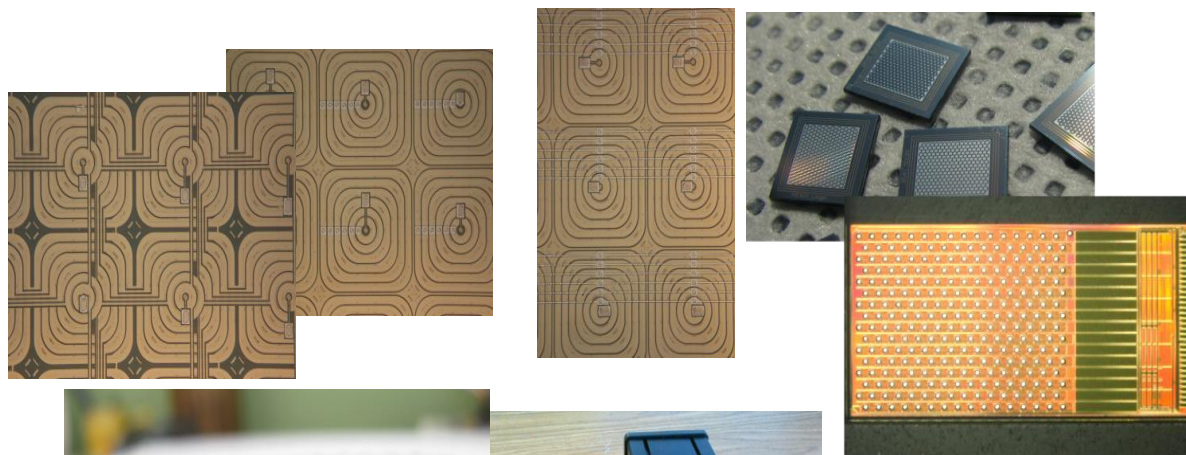
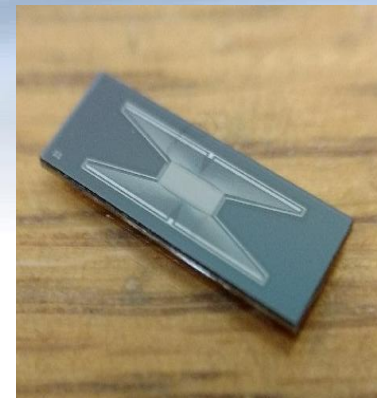
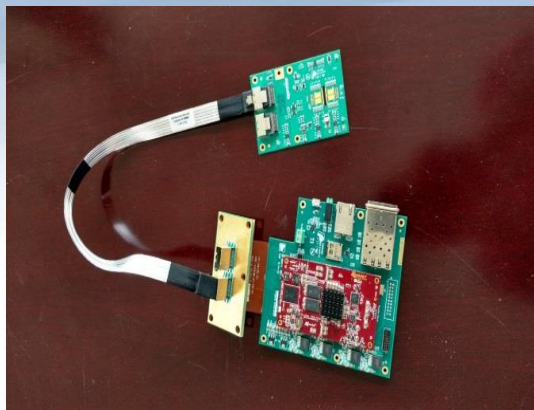
- **X-ray spectroscopy**
  - Maia: high-throughput elemental mapping: continuous evolution
- **XCS (x-ray 'speckle')**
  - VIPIC: 3D-integrated system
  - 3 layers: analog, digital and sensor. All oxide-bonded.
  - Sparsified readout system, microsecond timestamps.
- **Inelastic scattering:**
  - Custom quasi-2D silicon microstrip detector
  - Two units completed. One in use.
- **Powder diffraction**
  - CZT: 8 x 16 sensors. Beaglebone readout, local flash disk persistent store.
  - Scintillator array. 8 channels. Complete processing on a 50mm x 50mm PCB, including HV generator. ZynQ readout.
  - Germanium: Series of strip detectors (64, 192 and 384 strips, 8mm x 0.5, 0.25 and 0.125mm pitches).





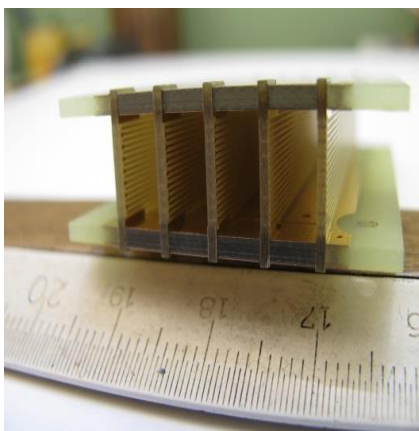
# Coming soon

- High-resolution photon-counting microstrip detector (1 $\mu$ m). As readout for Von Hamos spectrometer on ISS endstation. Testing in progress
- Large (384) SDD array for new Maia version.
- HEXID, a color x-ray camera



# Other stuff

- 4-channel ionization chamber
- 4-channel low-current readout: pA  $\rightarrow$   $\mu$ A (90 units deployed at NSLS-II)
- X-ray BPM readout: nA  $\rightarrow$  mA, DAC and Bias outputs. Embedded IOC (ZynQ COTS module)



# Acknowledgments

- **NSLS-II Detector group:**

- Anthony Kuczewski: Elec. Eng.
- Abdul Rumaiz: Semiconductor scientist
- Rich Michta: Elec. Eng.

- **Collaborators**

- CSIRO, Melbourne, Australia: Maia**

- BNL: ASICs, sensors, analog electronics

- CSIRO: Digital electronics, FPGA code and User Interface

- Fermi / ANL: VIPIC**

- Fermi: 3D ASIC design

- BNL: Sensors, front-end electronics

- ANL: Data acquisition

- ANL, FZ Julich : Germanium**

- BNL: electronics

- BNL, ANL: data acquisition

- FZ Julich: sensors BNL

- **Instrumentation Division:**

- **ASIC design**

- Gianluigi De Geronimo
    - Angelo Dragone
    - Emerson Vernon
    - Shaorui Li

- **Semiconductor lab Group leader**

- Gabriele Giacomini

- **Foundry technical staff**

- Don Elliott
    - Wei Chen

- **FPGA support:**

- Joe Mead

- **PCB layout:**

- Kevin Wolniewicz

- **PCB assembly:**

- Kenny Luong

- **Wire & bump bonding:**

- Don Pinelli