Overview of the Detector Pool

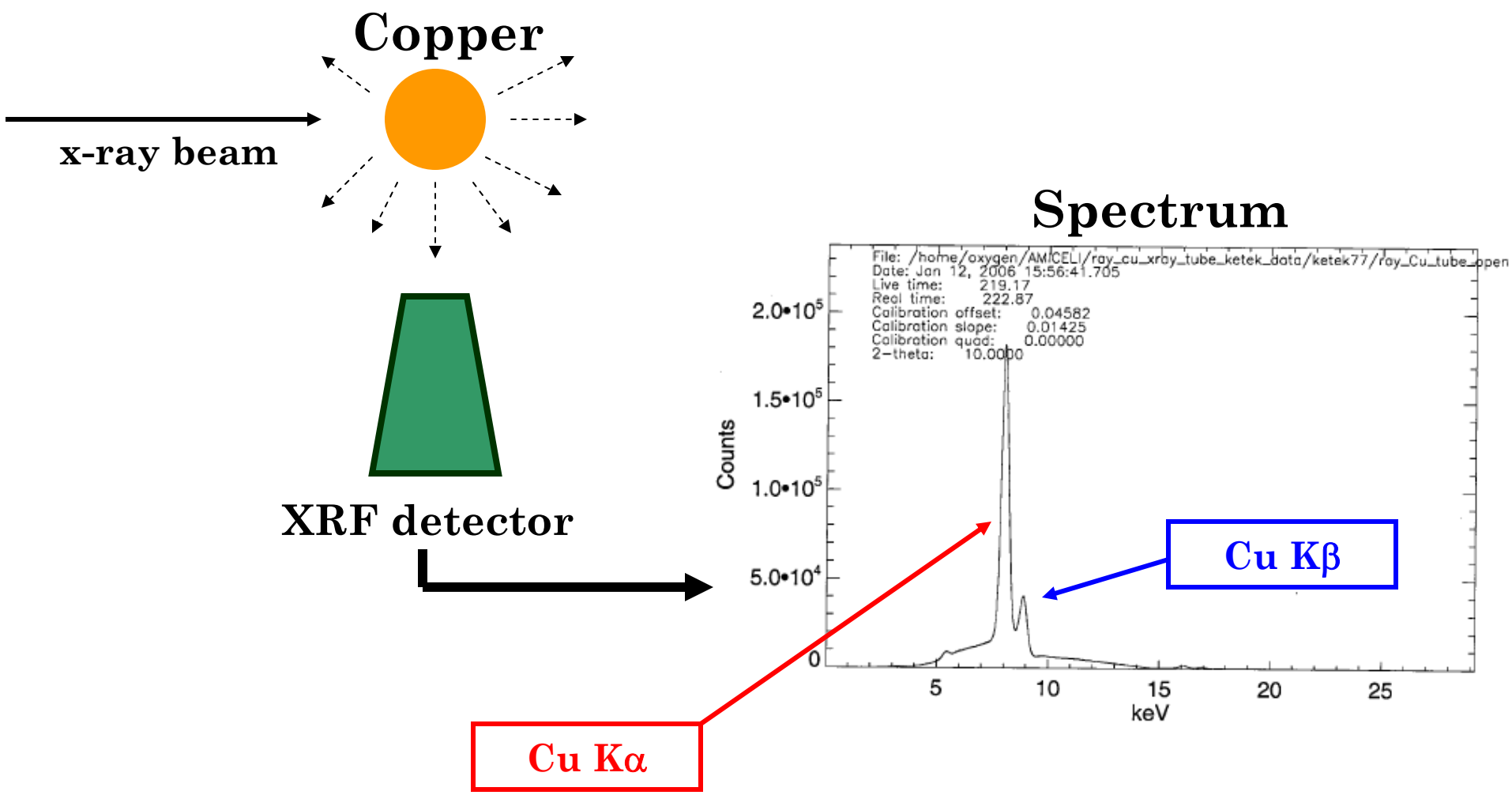
Outline

- What's in the DP?
  - Detector types and basic theory
- Other Projects in our group
  - Detector Test Facilities
  - Development Projects
- DP Operations

May 23, 2006

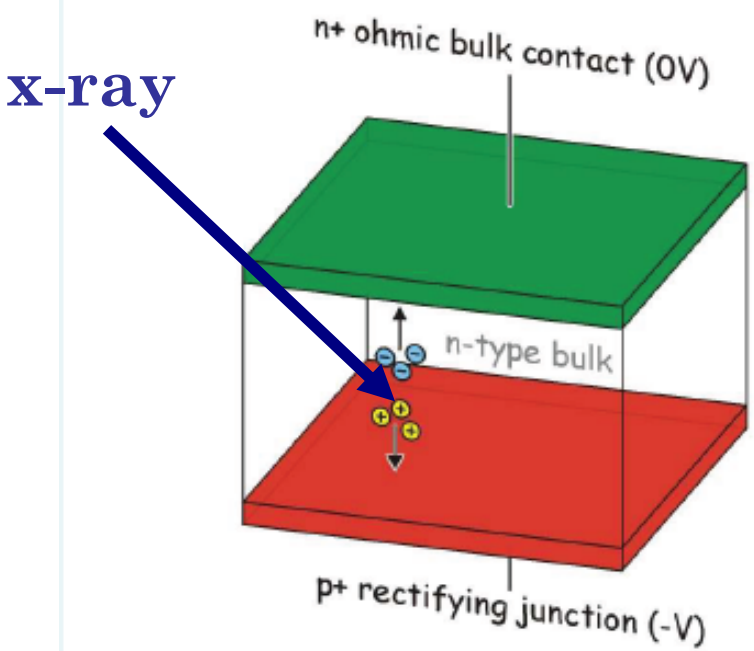
Spectroscopy Detectors

(aka Energy Dispersive Detectors)
(aka XRF detector)

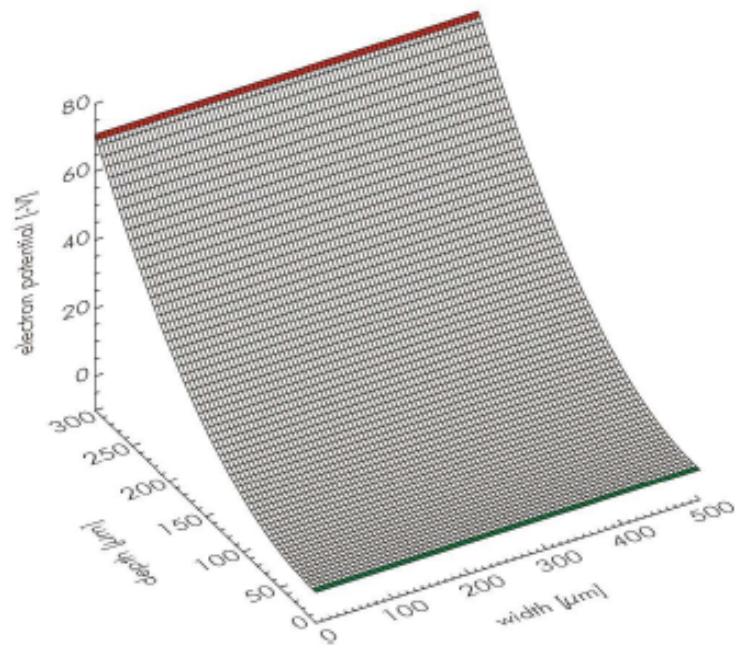


XRF Detector

- **Diode** (Silicon or Germanium)



Electric Potential



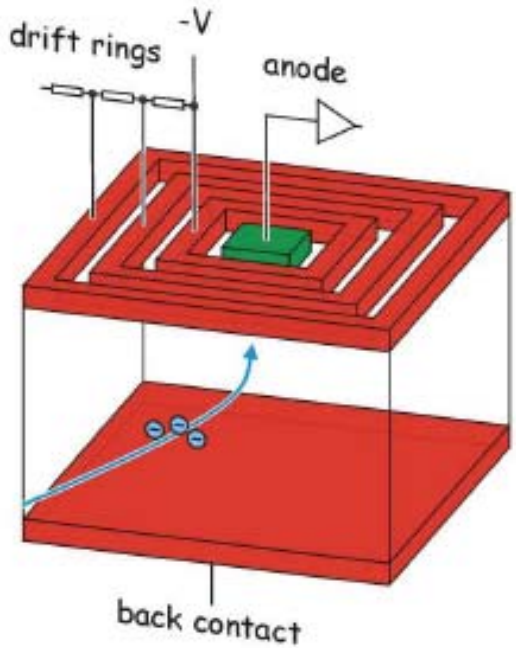
X-Ray Energy ~ # of e-h pair

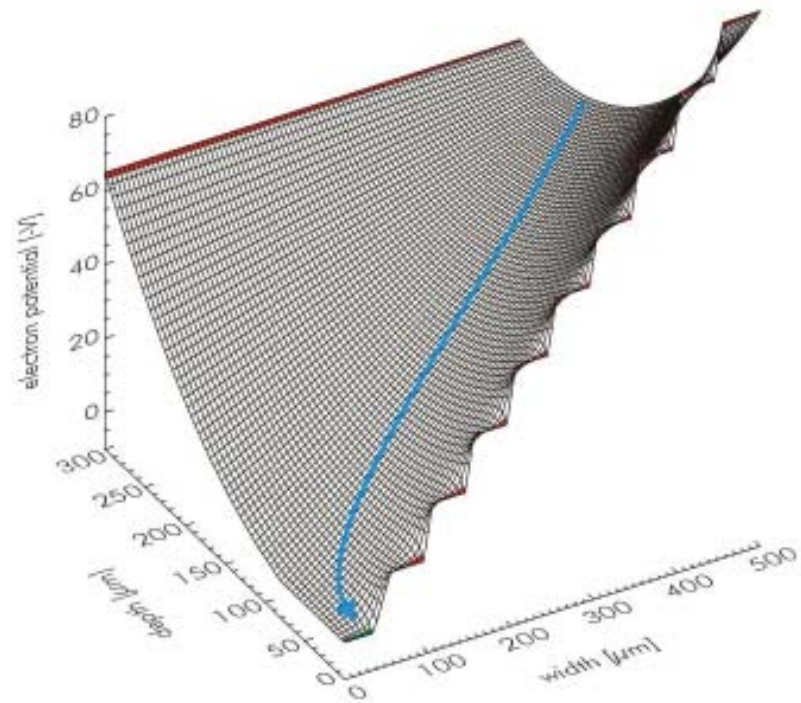
(typically ~ 2 mV/keV)

In reality, we use *Silicon Drift* Diodes ...

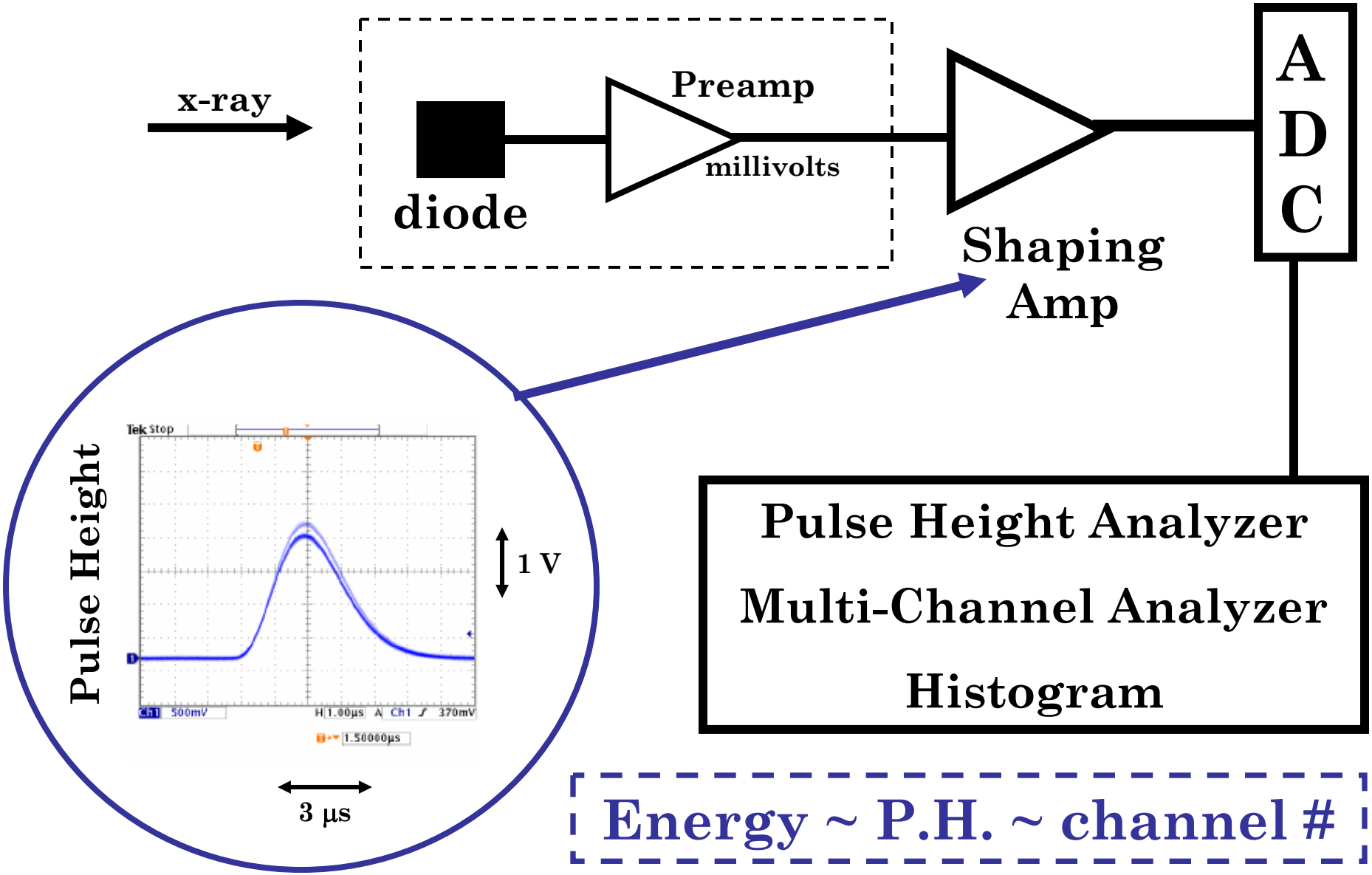
- **Spectroscopy SDD**

Josef Kemmer & Gerhard Lutz, 1987

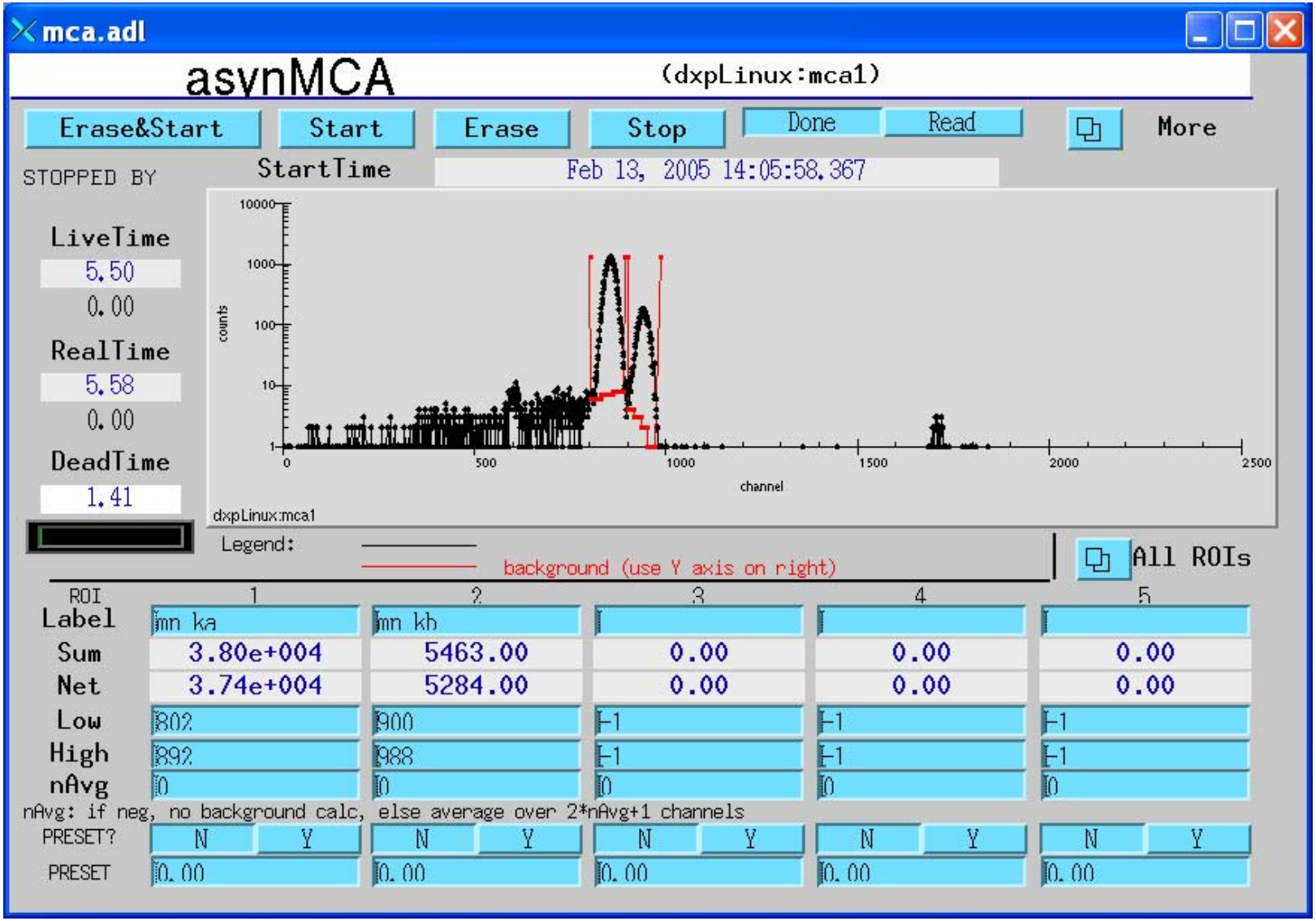




Signal Chain



Energy ~ P.H. ~ channel #



MCA = histogram (e.g., 2048 channels)

SCA = Single Channels (i.e., ROIs)

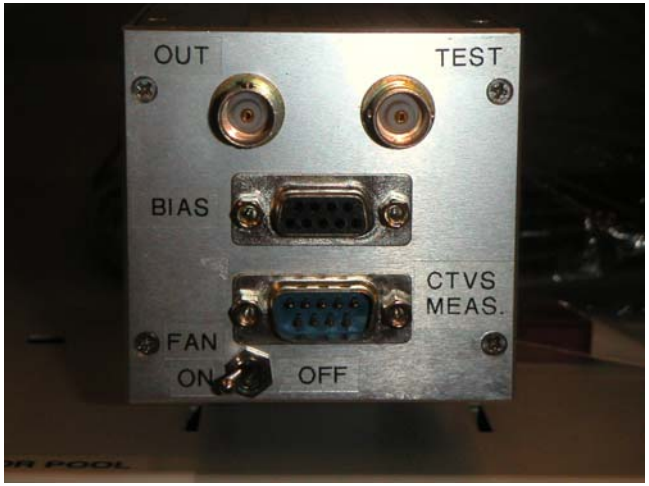
Vortex 1001

Vortex 1004

Vortex EX 115

Vortex EX 3063

Vortex EX 3070



Blue Box

- **Preamp power**
- **Amp**
- **MCA**

Ketek 40

Ketek 41

Ketek 77

Ketek 121 (LE)

Ketek 150

Ketek 151 (LE)

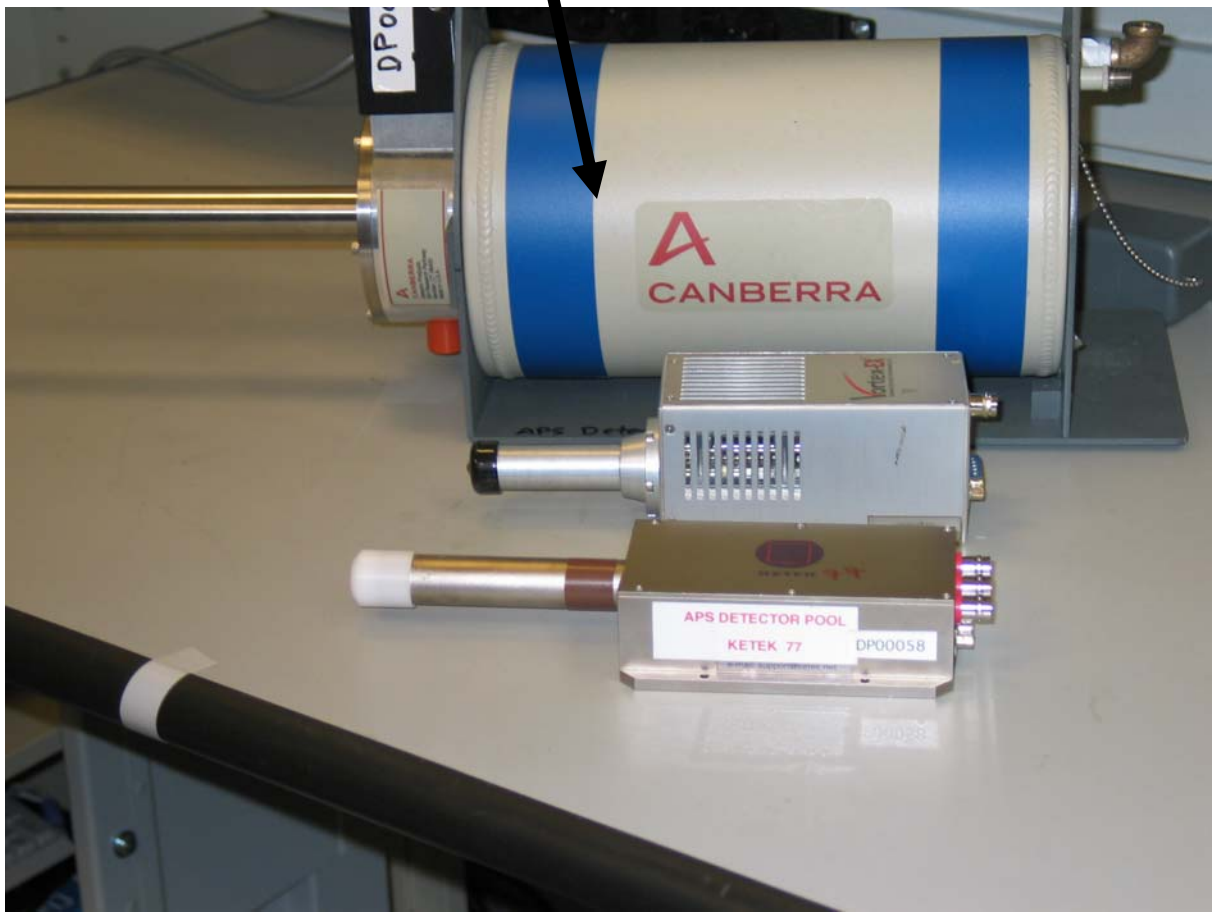
LE = Low Energy (> 1 keV) (mostly 2-ID-B)

- **Polymer Window (not Be) (not light-tight!!)**

Ketek come with pre-amp and amp-ed output

- **Most people use external amplifiers**

Canberra Germanium detector (LN2 cooled)



Energy Resolution

- SDD ~ 150 eV
- Ge ~ 190 eV

Count Rate

- < 100 kHz

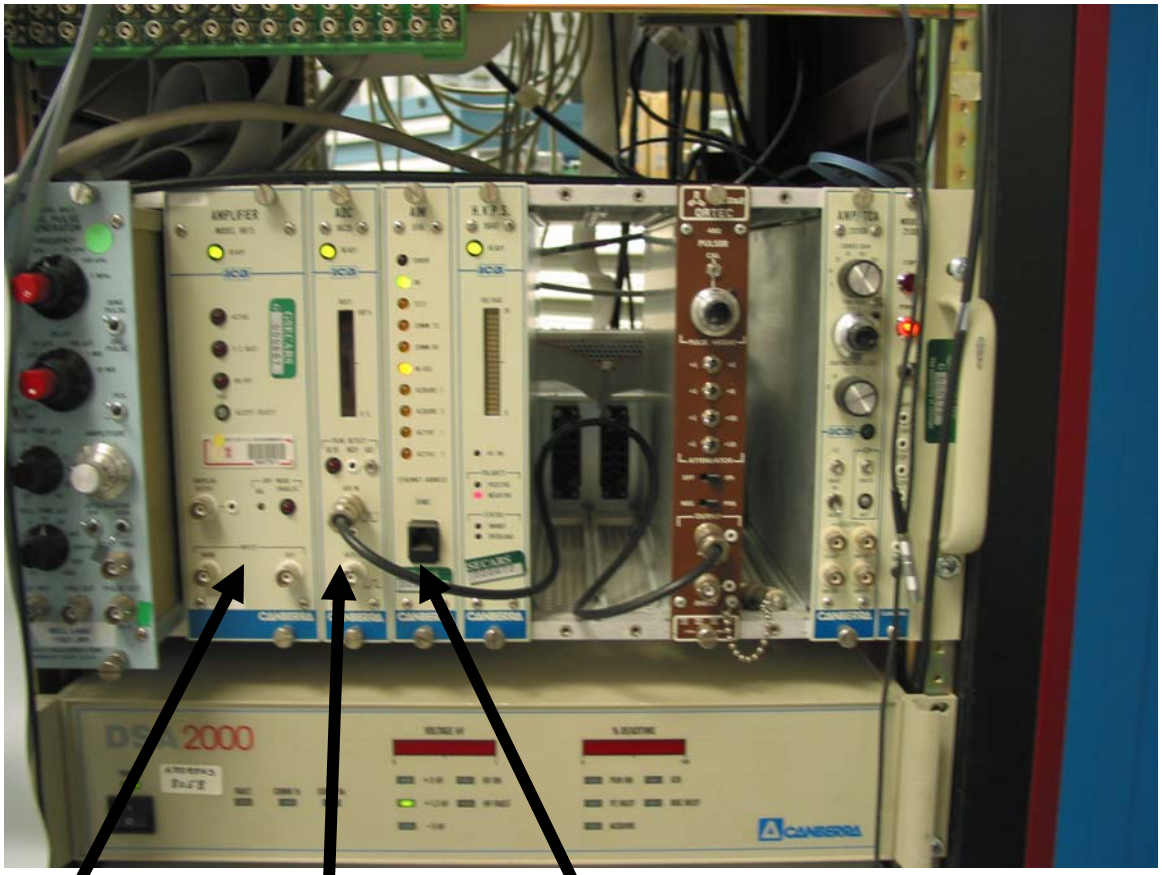
Stopping Power

- Ge for higher energies

Etc????

Canberra NIM Readout Electronics

(at most beamlines)



Amp **ADC** **MCA** **(i.e. AIM module)**

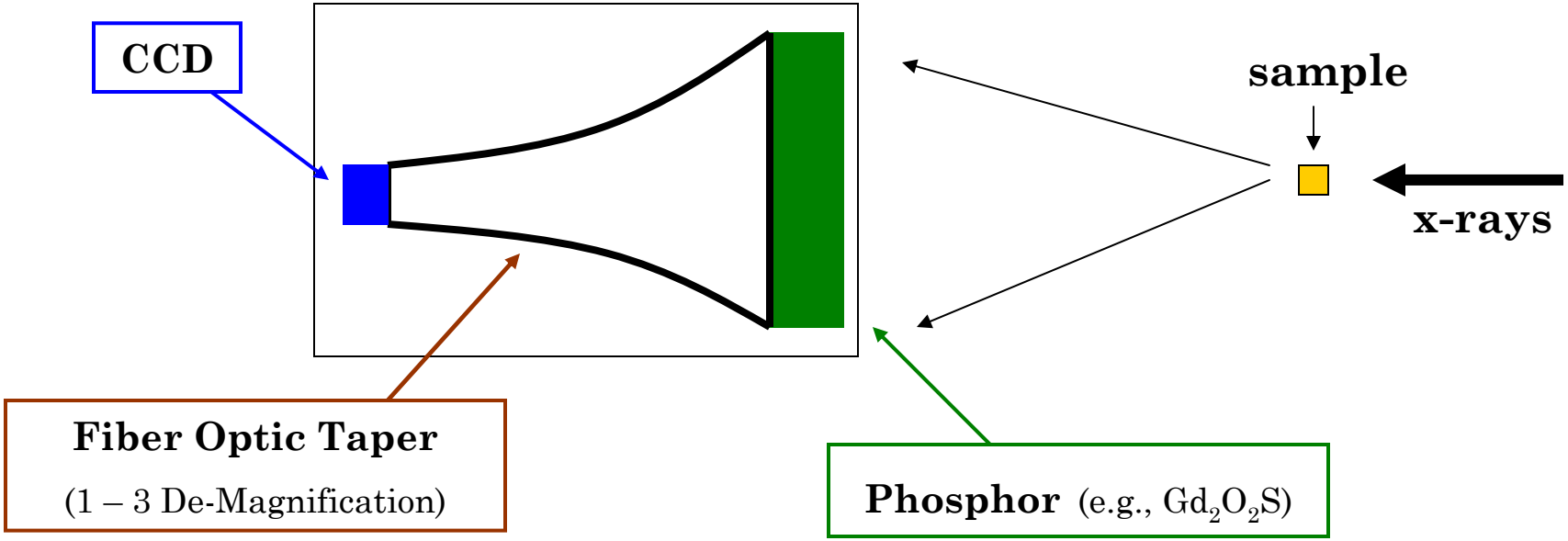
There are other form-factors:

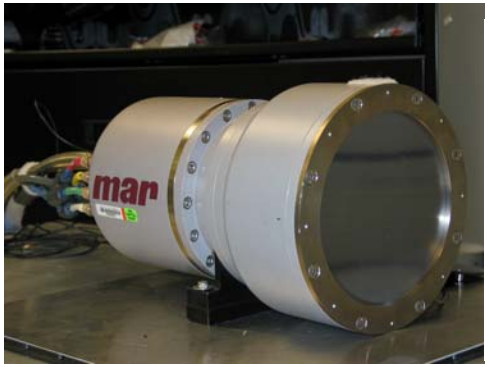
e.g., XIA's DXP Saturn Box

Includes: Amp, MCA, HV, pre-amp power, etc.

We own 3 of them.

Small-Angle X-ray Scattering (SAXS) or Area Detectors





Mar 165

Bruker 6500

- **Readout: 1-5 seconds**
- **Larger De-Mag → Lower Sensitivity (light loss in the taper)**
- **Pixel Size ~ 150μm (at phosphor)**

Other Large Area Scattering Detectors …

Mar 345 Image Plate

- **Storage phosphor**
- **> 10 second readout**
- **High dynamic range**

GE Amorphous Silicon Flat Panel Detector

- Leased from GE Medical
- CsI Scintillator (x-ray converter)
- a-Si array of photodiodes
  - 2048 x 2048 (200 μm pixels)
- Frame Rates:
  - 8 Hz (2k x 2k)
  - 30 Hz (1k x 1k binned)
- Useful for > 60 keV
  - e.g., powder diffraction
  - 1-id, 6-id, 11-id

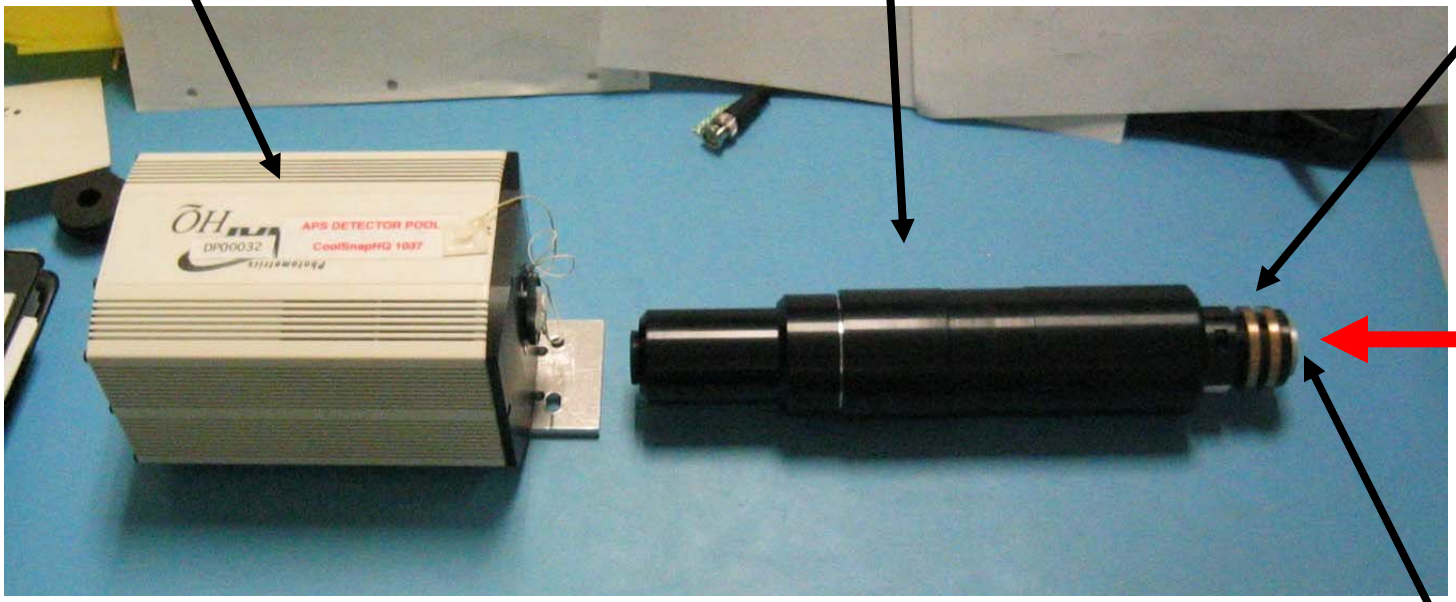
X-Ray Microscope – "CoolSnap"

CCD Head

Tube Lens

Objective Lens (e.g., 10x)

" Infinite " optics



x-rays

Scintillator Crystal (e.g., YAG:Ce)

High resolution imaging (> 1 μm)

- Tomography
- Phase Contrast Imaging
- Beam Diagnostics

- Delicate System
- Needs Auto-Focus

Most of our detectors …

Area Detectors

- **Mar165 (2), Bruker (1), Mar 345 (2), GE a-Si (1)**

XRF **(Energy dispersive/spectroscopy)**

- **SDD: Ketek (6), Vortex (5)**
- **Canberra Ge 1-element (2) & 13-element (1)**
- **Canberra Si X-PIPS (1)**
- **Oxford NaI & Yap + PMT (mostly for counting photons (~ 100% efficient), but poor energy resolution)**

Microscopy

- **CoolSnap (2) (and "Sarnoff" in the future)**
  - **2 Lens Tubes & 2 objective sets (1.25x, 2.5x, 5x, 10x, 20x)**
  - **Yag:Ce Scintillator Crystals**

Other Projects

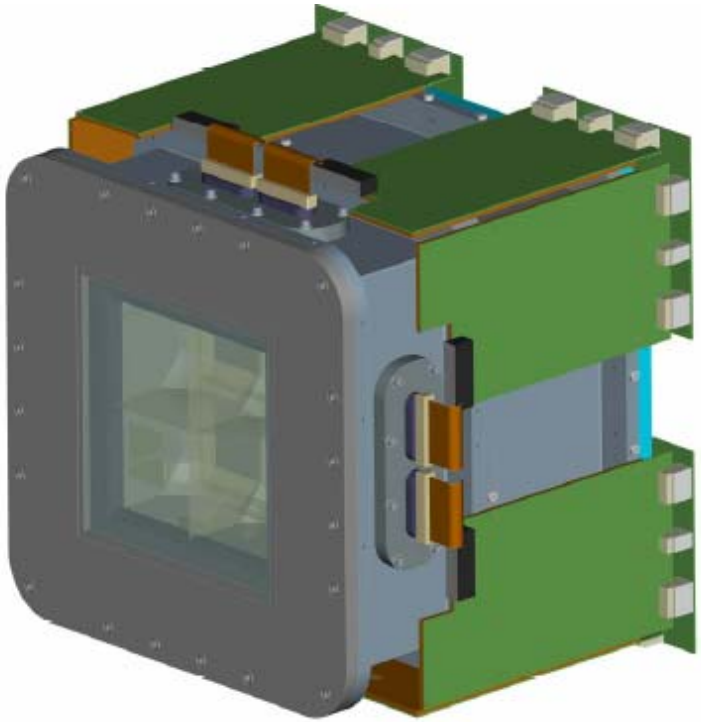
Detector Test Facilities

- **Testing & Characterizing Detectors**
  - **Optical box (L3120) → Opto-electro equipment**
  - **Beamline-like setups (e.g., MCAs, EPICS, etc)**
  - **X - Ray tube ("enclosure") (next door to L0119 lab)**
  - **1-BM-C Beamline access**

There's lots to do …

Development Projects

Lens SAXS Camera

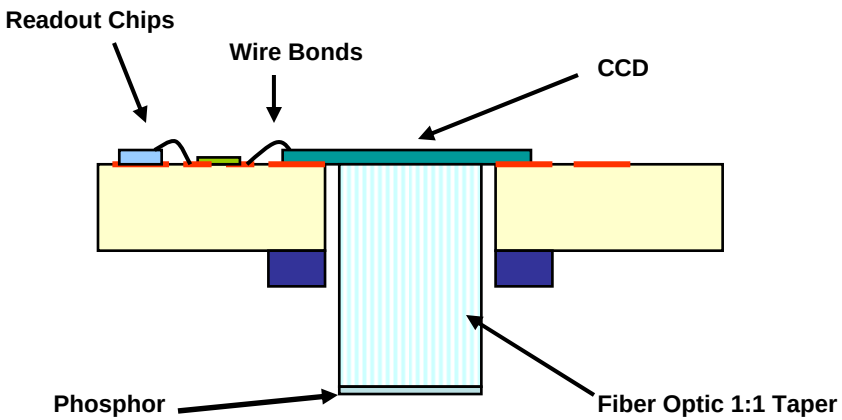


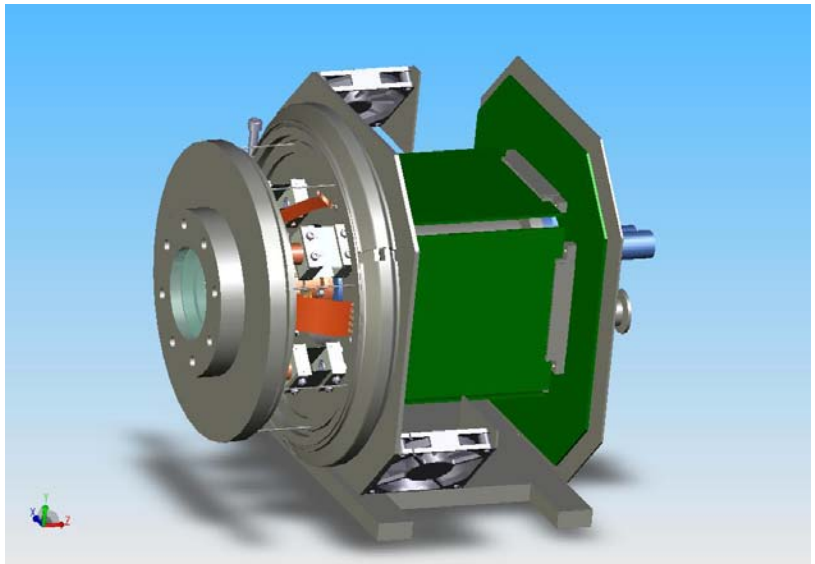
BESSRC Quad Detector

- **Fast (5 Hz) & Sensitive (1.7 demag)**

Fast CCD Project (with ALS/LBL)

CCD with lots of readout ports





LBNL Contributions

- Custom CCD
- Custom Fast Readout IC
- Mechanical, Optics and Cooling
- Testing

ANL Contributions

- DAQ Readout Electronics
- User Interface
- Image Processing
- Testing

DP Operations

- **Requests For Detectors (via web db)**
  - Most before the run, but requests do arrive during the run as well!!!
  - States in the db (i.e., "**Actions**") for each **transaction**:
    - ***Confirm Reservation***
    - ***Process Loan***
    - ***Process Return***
    - Paper **logbook** of all transactions in DP Lab (431-Z)
  - Person on-call fills reservations and processes any new requests for that week.
  - Each detector has a "**maintenance.log**" file on the shared disk (e.g., aa_Detector Pool Equipment\Mar_165_CCD_Camera\Mar_165_B_DP00051\ )

The “Shared Disk”

On Windows, map a Network drive:

\\nickel\detector_share$

(you can create your own folder!)

aa_Detector Pool\ → Detector Pool Info & Manuals

aa_Detector Pool Equipment\aaa-inventory

aa_Dectector Development\ → Development Info

Articles\ → Papers on CCDs, APDs, etc…