TWG meeting 1/20/2005: Detector Pool purchases, FY'05

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Purposes of this presentation are (1) inform you of requests for detectors and (2) ask (last time) for feedback – via email

- Steps we are following to spend about $200K on detectors
- List of existing detectors in pool
- List of specific requests
- List of more general requests, semi-commercial, some development

Miscellaneous about Detector Pool

- Web site: www.aps.anl.gov
- Go to “Quick links for Users”
- See the link to “Detector Pool”
  - http://www.aps.anl.gov/Users/General_reference/Database_System
- We know the reservation computer system has flaws.
- Will eventually get more info onto www

Timeline for purchases

- 12/2004 requested (again) input from beamline scientists for what to buy. About $200K to spend in 2005.
- 1/20/05 TWG meeting list all the suggestions, without attaching priorities. Also last open invitation, because we only have so much time to research the options. Please email us with suggestions, and rationales, reasons why something is important etc. Please email also why something is NOT a good idea.
- Early 3/05 we send out to detector pool mailing list our choices, our priorities. We set up meeting.
- 3/05 meeting to discuss priorities – our “list”. You can come and argue, but much will be somewhat decided.
- 4/05 onwards, we start purchasing

Existing Detector Pool equipment

- MAR165 CCD, 80 um pixels, 2048x2048, 165 mm, taper 2.7:1, FWHM ~ 100 um, readout in a few seconds. Qty 2
- MAR345 Image plate, 345 mm area, 2300x2300 150 um, or 3450x3450 100um pixels, readout ~60 sec. 16 bit DR, Qty 2.
- Vortex, Vortex EX Silicon multicathode detector (SMCD). ~200 eV energy resolution, (5.9 keV, 1.e5 CPS, 1us). Qty 3
- Coolsnap HQ CCD camera. 1392 x 1040, 6.5um pixels, 12 bit, 10 frames/sec, full frame (0 sec exposure). A collection of microscope objective lenses, and scintillators.
- Canberra 2016 Germanium, single element, and “13” element.
- Ketek Silicon Drift Diode. 1.e5 count rate, 147 eV at 6keV, 1us. Active areas 5 mm, 10 mm, low energy model
- Oxford Head NaI, / YAP CyberStar shaping amp , Qty 4, 150mmIon chambers
- Electronics modules (AMP TCA, BNC Pulse gen, Canberra AIM556,, HVDC supplies).
- MAR DTB base, Qty ~1.

#1 General Electric Amorphous silicon detector – coming this spring

- 400 x 400 mm image size
- 500 um thick CsI scintillator
- 200 um pixel size
- Dynamic range 14 bits
- Readout rate, 2x2 binning, 1K x 1K, typical 10ms exposure, 23 ms readout, thus 30 fps.
- PSF 1-2 pixels (see Jon Almer 1id)
- $$ separate from Detector pool capital.
- Questions see Patricia, Jon Almer, sector 1 people etc

#2 Miniature ion chamber (ESRF)

- See M. Kocsis, A. Somogyi, J.Sync Rad (2003) 10, p. 187, or ask Julie Cross 20ID
- 10 mm size along beam, 5mm perpendicular to beam
- ~$6K

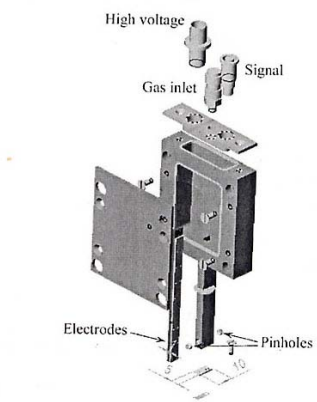


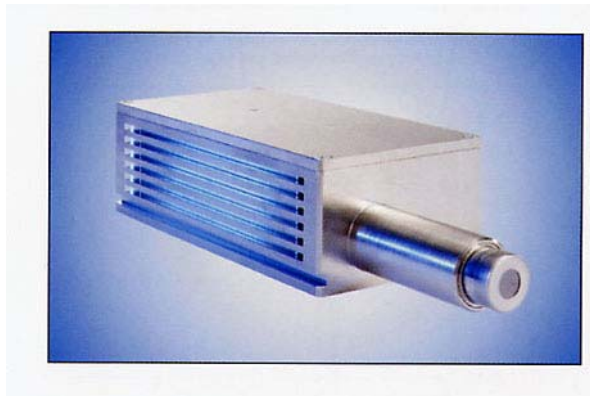
Figure 1
Technical drawing of the small ionization chamber detector. The dimensions are given in millimeters. See text for details.

#3 1:1 CCD camera (several options)

- A possible development effort, to get existing hardware working again.
- 1024 x 1024, 24 um pixels, readout a few seconds, 1:1 fiber, phosphor, sensitive to a few x-rays/pixel.
- Fits needs, for example of sector 6
- Also various commercial choices

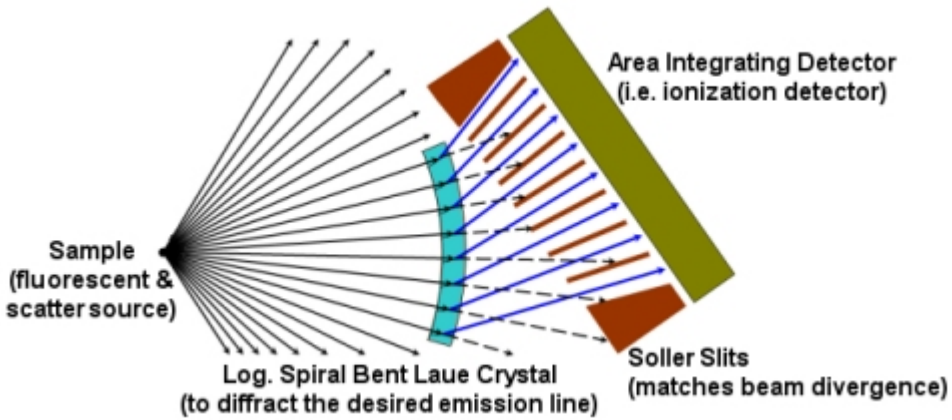
#4 Canberra Si X-PIPS detector

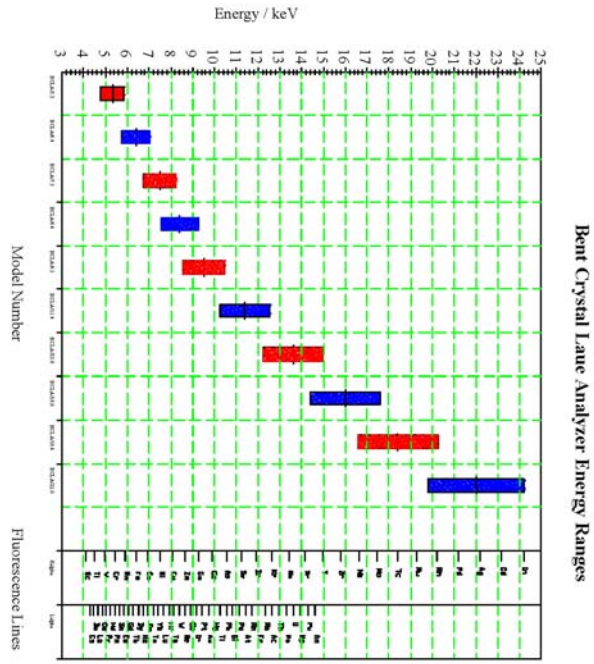
- Energy range 1-30 keV
- Active area 8 mm^2 (5 mm^2 with collimator)
- Energy resolution <190 eV(FWHM)
- Count rate 100,000 cps (210 eV FWHM, 5.9keV)
- $6K



#5 Bent Laue Crystal analyzer

- See www.gmw.com (Oxford-Danfysik)
- $6k/energy * 5 energies ??
- See Barry Lai, or sector 5





#6 Cool Snap Micromax visible light CCD camera- higher resolution

- www.photomet.com/micromax.html
- Small pixels –6 um, few frames/sec readout
- Microscope objective optics
- Similar to existing CoolSnaps

#7 High Frame rate visible light CCD camera – several options, and several ways to become x-ray sensitive.

- Sarnoff 1024 ~$65K
  - 1024 x 1024, 16 um pixels, 1.6cm x 1.6 cm
  - >100 fps
  - 12 bit, dynamic range 4096, TEC
  - Visible QE @ 550 nm = 0.68 (for phosphors)
- Sarnoff 512 $40K
  - 512 x 512, 18 um pixels, 0.92cm x 0.92 cm area
  - 400 fps (800 fps binned by 2)
  - 12 bit, dynamic range 3200:1, no TEC
  - Visible QE @ 550 nm = 0.62 (for phosphors)
- Cooke, other companies etc.

#8 XIA Inc. Saturn Processor

- $6K / 1 channel flexible electronic stand alone DAQ
- Takes counts from detectors such as Canberra Ge, Si, performs pulse shaping, and MCA functions.
- 10^6 input count, $.5x10^6$ output count
- MCA 8K spectrum, or energy ROI, 24 bit deep
- Output parallel port, USB port, on into EPIC's (Mark Rivers et.al.)

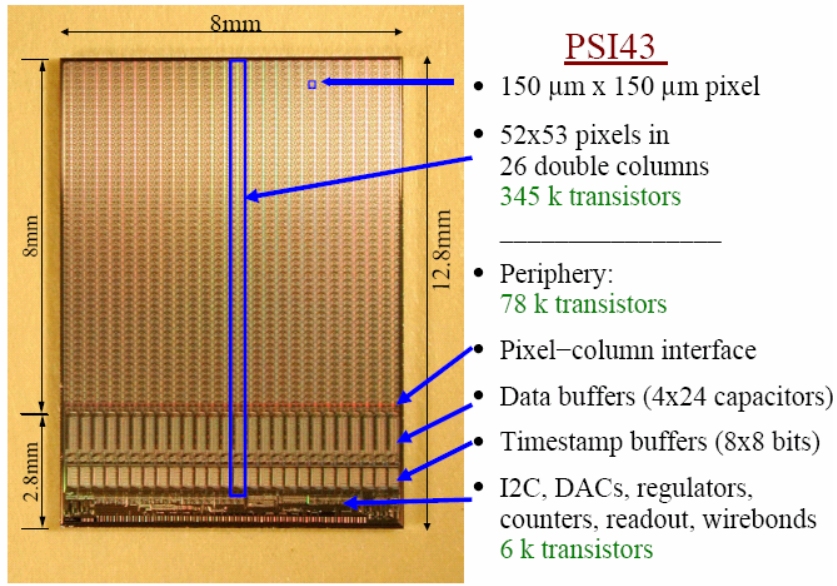
#9 XIA Inc. DXP Signal Processor

- Similar to Saturn, but now multi channel in crate, with PCI interface card.
- 8 channel DXP-PX4 system: $44K
  - 2 cards, 4 channels each DXP-PX4
  - 8 slot PXI crate
  - HV module
  - PCI-PXI interface card for the PC
  - Training, software
- Ref: Peter Grudberg XIA

#10 Possible Collaboration with Fermi/PSI (Ref:

U. Joshi FNL, W. Erdmann, PSI, and many of their presentations, initial contacts via Denny Mills, and Patricia Fernandez).

- A 52 x 53 “array” of 150 um pixels, covering about 8 mm x 12 mm area.
- 250 um thick silicon stopping layer
- average count rate is about
  1.6 x 10^6 / sec per “array”.
  (a somewhat complicated discussion, given various pipeline spots to “saturate”) TBD
- Electronic read noise (measured)
  ~200 e- (RMS) ➔
  200/3.65*2.4 =
  130eV (FWHM)



#11 FReLoN CCD camera (ESRF)

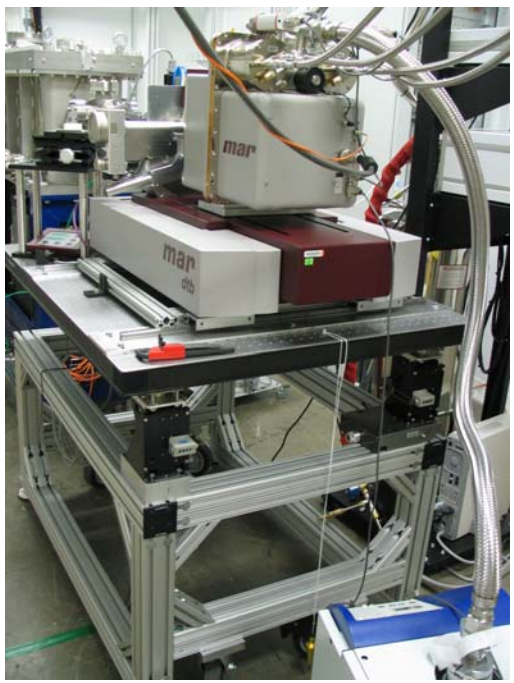
- This camera is becoming available from ESRF, and our APS management is suggesting that we purchase it.
- 14 x 14 um pixel, 2048 x 2048, for active area of 2.9 cm
- 4-8 Full frames/ sec (up to 16 fps, if binned 2x2)
- TE cooled to –20 C
- 14 (16 if read slower) bit dynamic range
- Image-Pro software and controls
- This is a bare CCD camera, no x-ray taper, phosphor, lens etc.
- Approx 75-100K euros, reference: labiche@esrf.fr, delay of 1.5 years ARO

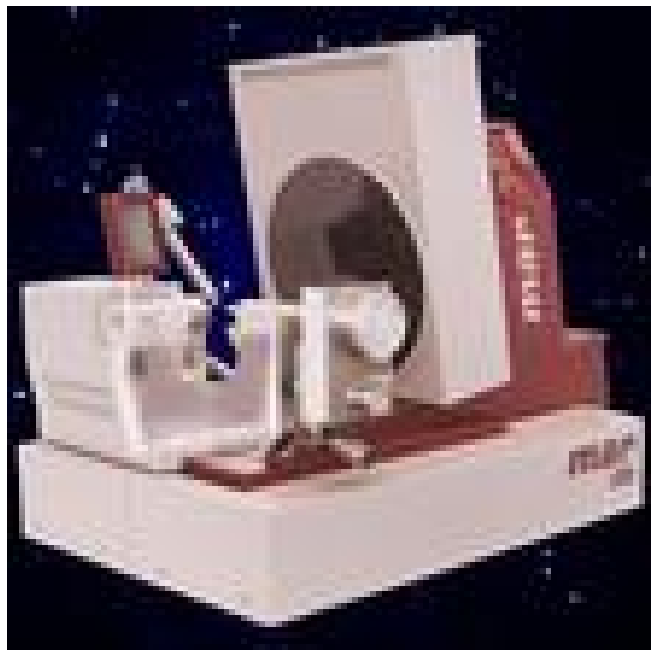
#12 CMOS camera (several options, including develop)

- (referred by Tom Irving 18id)
- 1024 x 1024, 2000 fps (up to 120,000 fps, reduced resolution)
- 10 bit, 17 um pixel
- Typically dynamic range less than CCD
- www.photron.com, Hamamatsu designs also

#13 Another DTB stand for MAR's

- We have one unit, shared with sector 23
- Requests from sectors 22,7,23





#14 APD, PIN arrays

- Investigations in progress
- We are basically trying to work with industry, and possibly ESRF, to create a fast APD array detector.
- Few centimeter linear dimension, cut into approx 1mm pixels
- Thick silicon for higher energy (~200-300um ?)
- Readout rates compatible with 324 bunch mode? (12 ns)
- Note: “standard package” for single detector EG&G APD is being developed now.

#15 Superconducting Tunnel Junction (STJ)

- Not being pursued at this time. We are curious as to level of interest.
- Tests at ALS, 100 um x 100 um detectors, soft x-ray 277-850 eV, energy resolution of 11 to 25 eV, count rate 100kHz

Ref: Friedrich/Robinson, SRN 14,2, (2001) p. 36

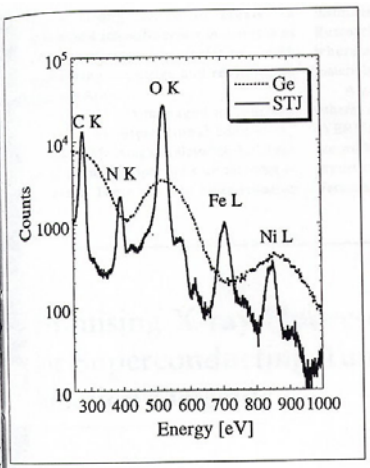


Figure 2. Soft X-ray emission spectra at ALS Beamline 4.1-2 of the metalloprotein hydrogenase containing about 480 ppm nickel and about 5800 ppm iron taken with the superconducting tunnel junction (STJ) detector (red curve) and, for comparison, a commercial 30-element germanium detector (blue curve). The nickel fluorescence is enhanced in the case of germanium because of resonant excitation at the nickel L edge, whereas the spectrum recorded by the STJ was excited well above the nickel edge.