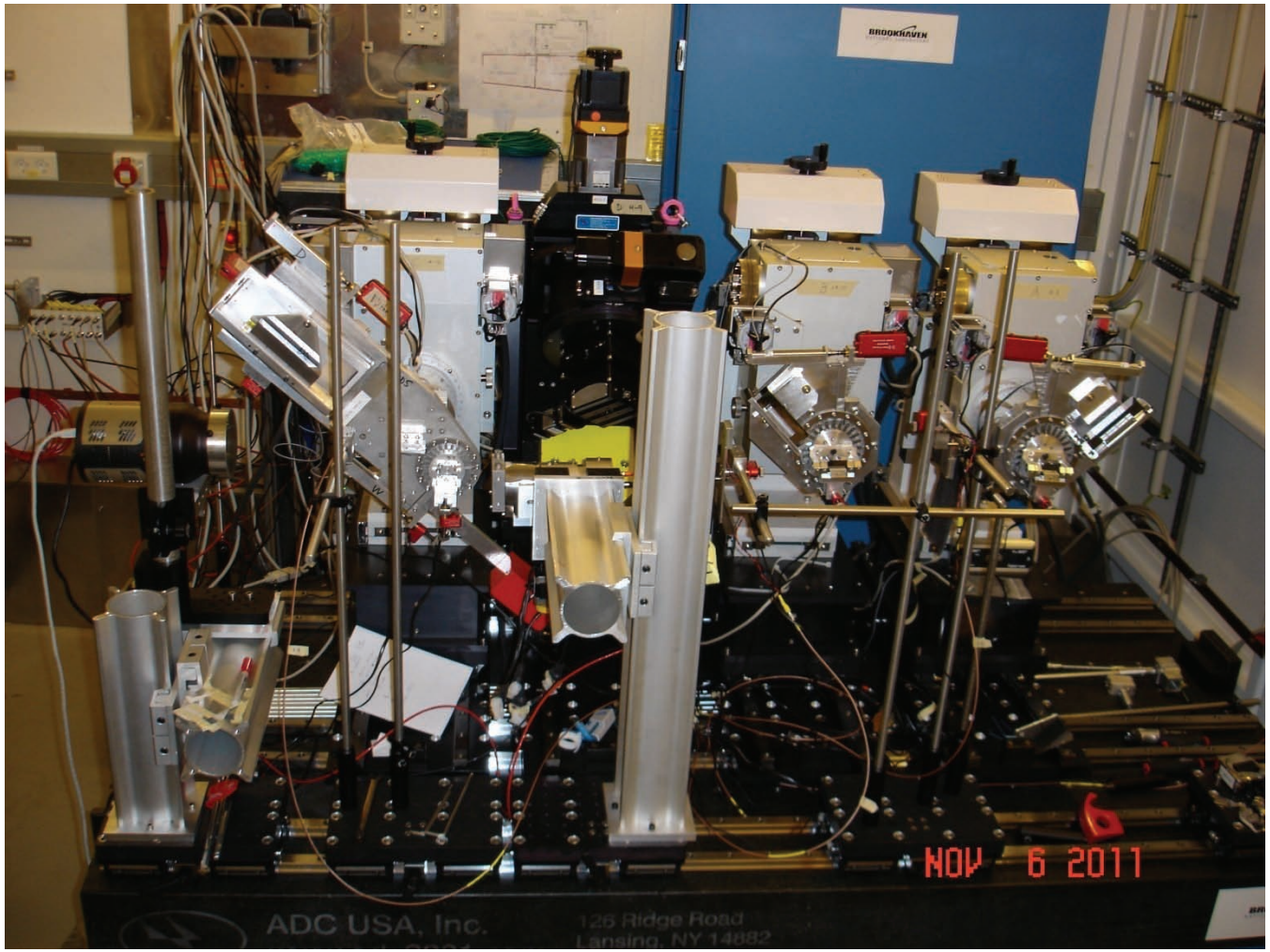
IXS R&D @ PETRA-III Oct/Nov 2011



debrief 2011.11.17

J. Keister

A work with many contributions

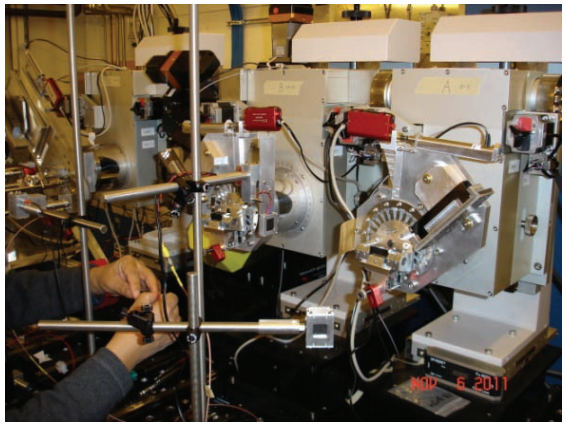
- Yong Cai – group POC
- Scott Coburn – CDW base design, flexure characterization, temperature controls, prototype requestor
- Alexey Suvorov – 4B crystal design, imaging and diffractometry methods
- Nalaka Kodituwakku – crystal processing and metrology
- Alessandro Cunsolo – experimental design
- Jeff Keister – system integration, detectors, controls, methods, logistics
- Leo Reffi – designer (all parts)
- David Levy – fabrication (all parts)
- Dennis Poshka – electrical tech support
- Tony Kuczewski – APD system design and setup
- Yuriy Stetsko – crystal methods and optics simulation
- Michelle Scaduto – shipping and travel support
- Kaz Gofron, Daron Chabot, Wayne Lewis – epics controls support
- Zhijian Yin – PC configuration and spec support
- Alex Scholl – SAE fabrication and tech support at P01
- Hans-Christian Wille – P01 POC and beamline scientist / chief technical lead
- Frank-Uwe Dill – P01 engineering support
- Thorsten Kracht, Marcus Fleck, P01 controls/tango support

R&D on the go

- We are prepared to ship nearly everything
- Integration with local machine / beamline useful if not required (well-defined interface needed.. So far we have used EM and Tango with “mostly good” results)
- Less bright local test beamline useful for proof of principle tests, alignments, detector calibrations etc. but not capable of yielding ultimate results… use a bright source if you can

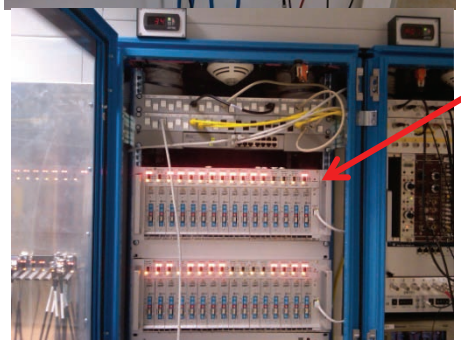
Run Timeline

- Oct 24 Arrive and start install granite table, rack, and goniometers to beamline
- Oct 31 Start tests with x-ray beam
- Nov 2 complete 1st CDW
- Nov 4 complete CDW-CDW alignment
- Nov 4 change to <311> DCM
- Nov 5 complete CDW testing, start 4Bounce
- Nov 6 complete 4B-CDW alignment
- Nov 8 complete testing and begin packup

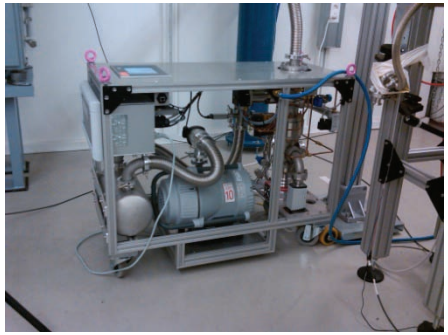


Petra-III

Removable concrete block hutch roofs



Low-noise / high-noise mains outlets
Internet and “patch only” ethernet jacks in EH and CH
BNC and stepper motor feedthroughs (custom phytron 16-channel driver packs)



House/kit pump stations with PLC / touchscreen / ballast -scroll pump not running continuously

Overhead crane, light, cabling and air handling

Notes from P01

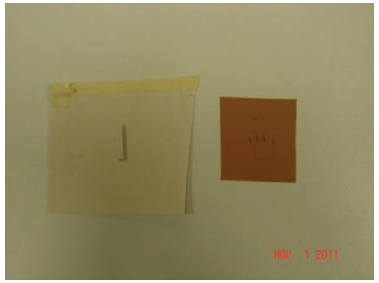
- Slit convention
  - L left outboard (what we would call +x)
    - + motion is outboard (opening)
  - R right inboard (what we would call –x)
    - + motion is outboard (closing)
  - T top
    - + motion is upward (opening)
  - B bottom
    - + motion is upward (closing)
- DCM energy available thru tango controller (3 axis)

Issues

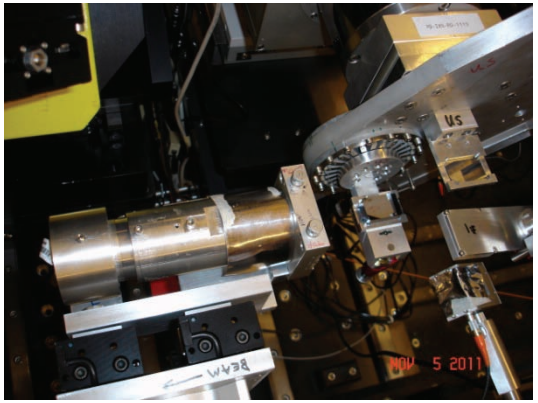
- DCM Encoder fail
- Offset (V) & chi/roll (H) adjustment needed in order to pass existing pipe
- Beam dump 3x during run
- DCM closed loop operation not reliable (yet)
- Machine day Wednesdays

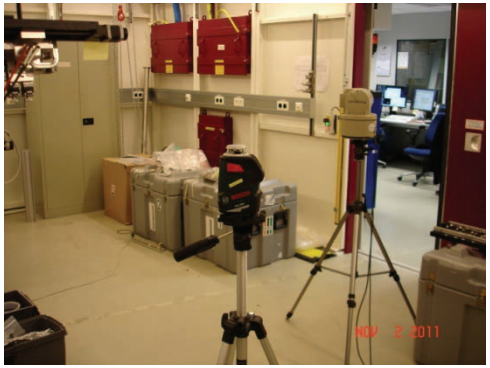
Power tools

- “super paper” (gafchromic XR-QA) can catch meV beam on 3rd gen SRs



- Cross line laser level
- Xray Imaging camera
- Remote visible cameras
- Digital level (~0.05 degree accuracy), unfortunately somewhat bulky
- NSLS-built APD





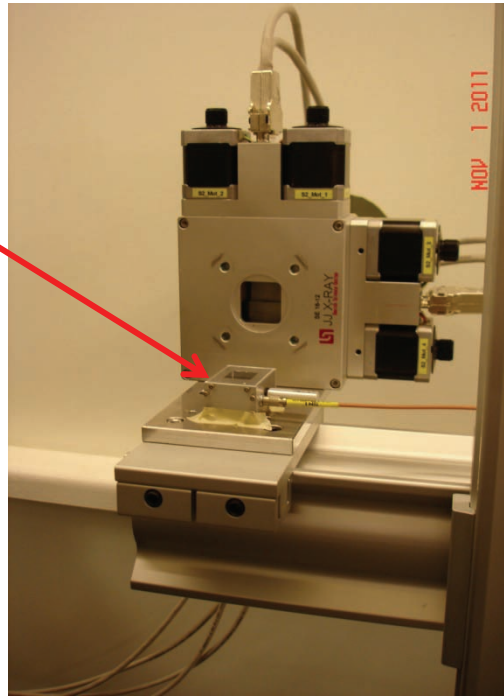
Actuators

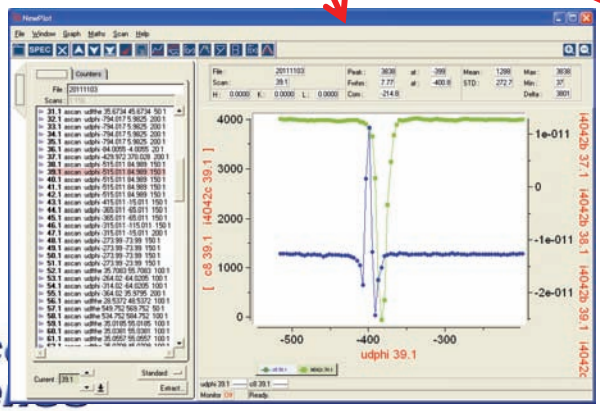
- Picomotors
  - open loop has different size + and – steps
  - Ethernet controller doesn't renew its IP in DHCP environment
  - Jumpiness can cause nearby movement, non-repeatability for small moves
- Piezo
  - Requires power
- Stepper
  - Limited resolution & speed

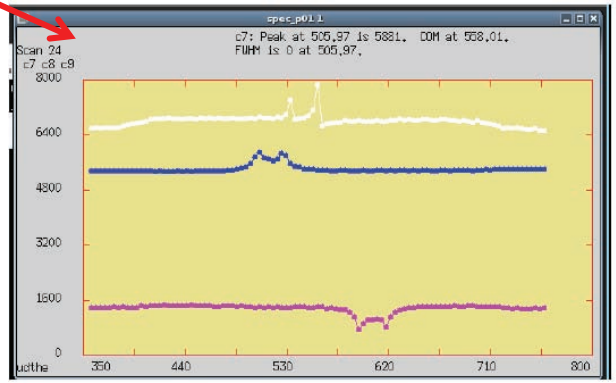
- Piezo issues:
  - driver m40 shows overflow no matter what
  - "enable" needed set manually?
  - Analyzer W & D theta drivers limited to 50 µm?
- Motion issues
  - One bad OMS card? A_o axis hangs daq, requires VME reset
  - Moved to another axis (m24), driver still jumpy with caps installed; finally m30 driver was used with success
  - "singing" of kohzu goniometer axes (removing covers helps)

Detectors

- Air scatter monitor more robust than direct silicon photodiode (less sensitive to higher harmonics in direct DCM beam)
- Finding the two <440> reflections atop D crystal is tricky (time consuming) without some alignment key; “dual diode box” design could help with this; camera is useful for alignment (this particular camera could be overkill however)
- Photodiodes in this environment often have a small (possibly negative!) offset current which gives strange counter data (i404 needs current offset and/or new frequency monitor mapping mode)





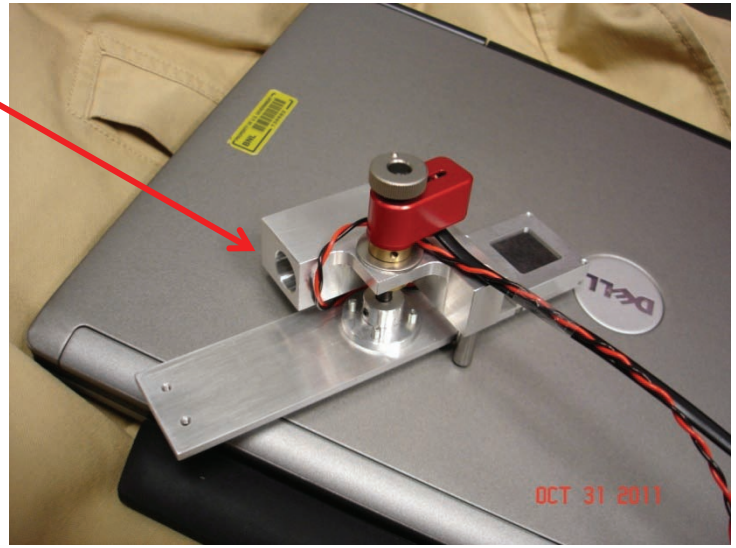


Spec

- Max counters default 10 too small
- Intermittent fail of macro controls for slits, i404
- Continuous slowdown of plot drawing thru NX (may or may not be spec related)

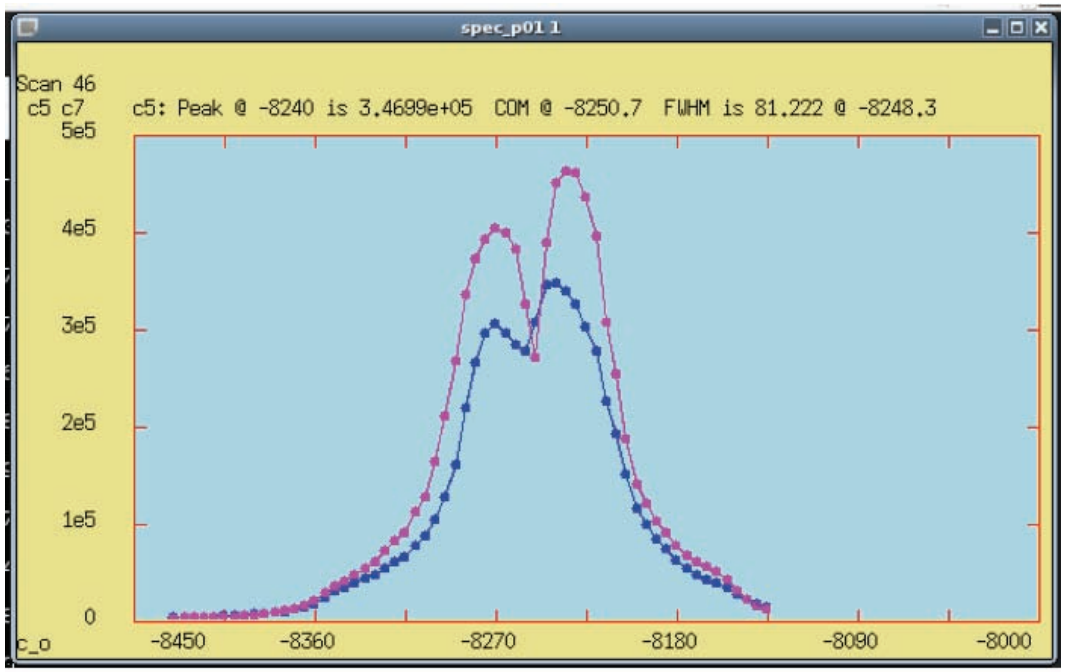
New this run

- Electronic logbook (MSWord).. Captures 90% (some notes on paper)… screenshots could be easier?
- NX -- too slow? Even hanging! Restart controls PC 1x
- Removed C chi swivels from CDW plates
- Photodiode actuators



- <u>All new</u> 4Bounce

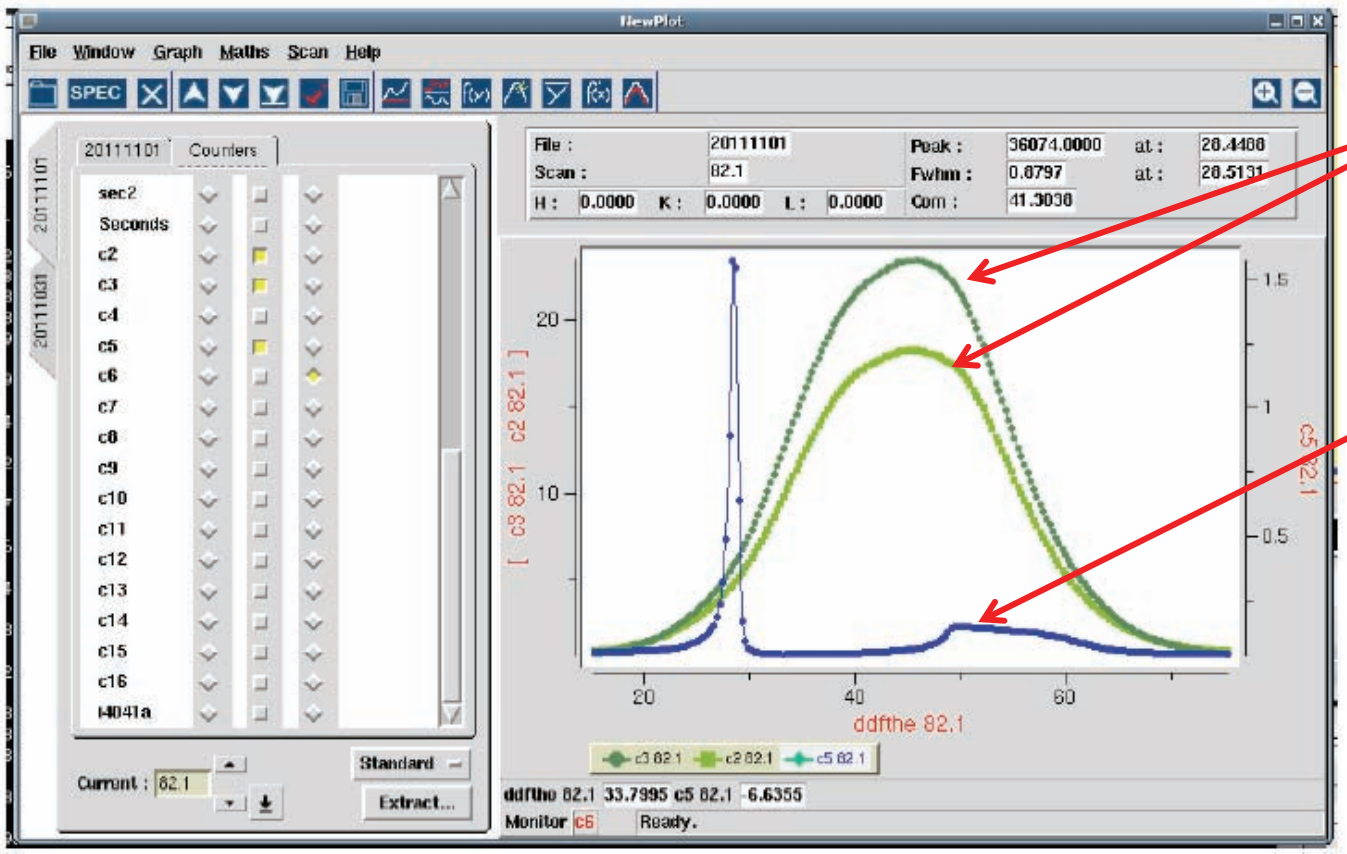
Energy setting



Simultaneous 440 reflections (Bragg, Laue) confirm energy selection

Central dip due to multiple wave effects

D theta set using 440 peaks



Inboard & outboard 440 peaks

800 reflection after anomalous transmission thru C crystal of CDW mono

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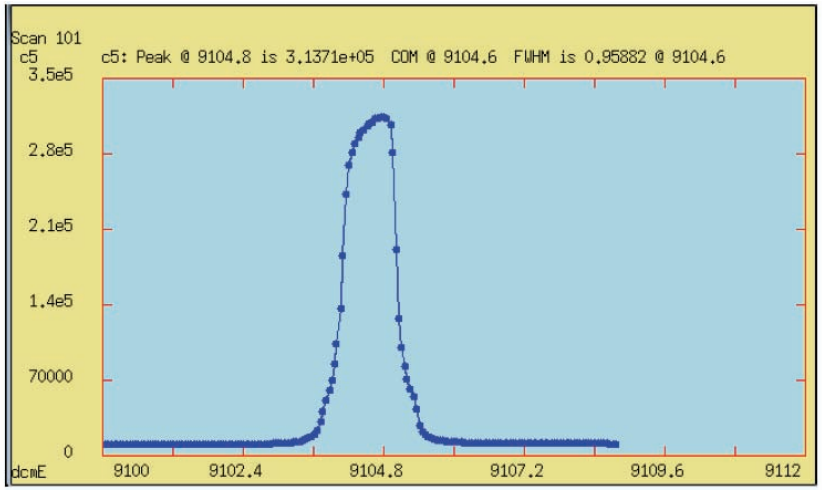
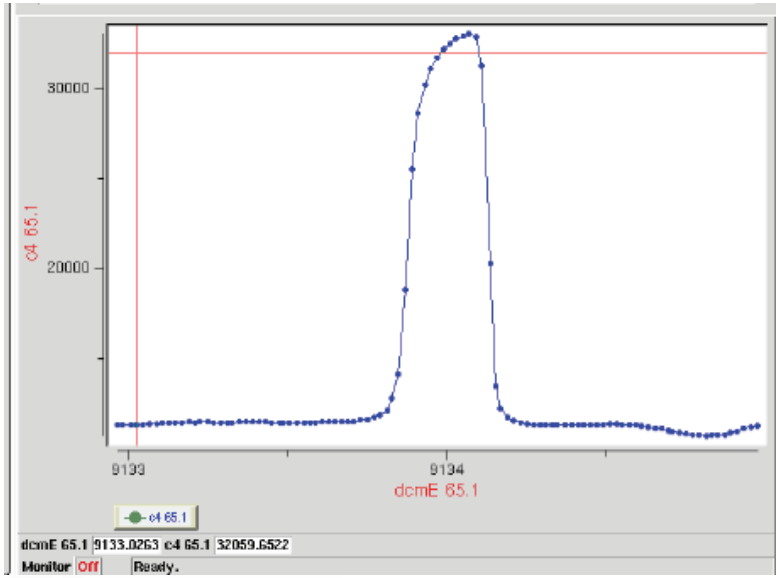
CDW to measure DCM BW

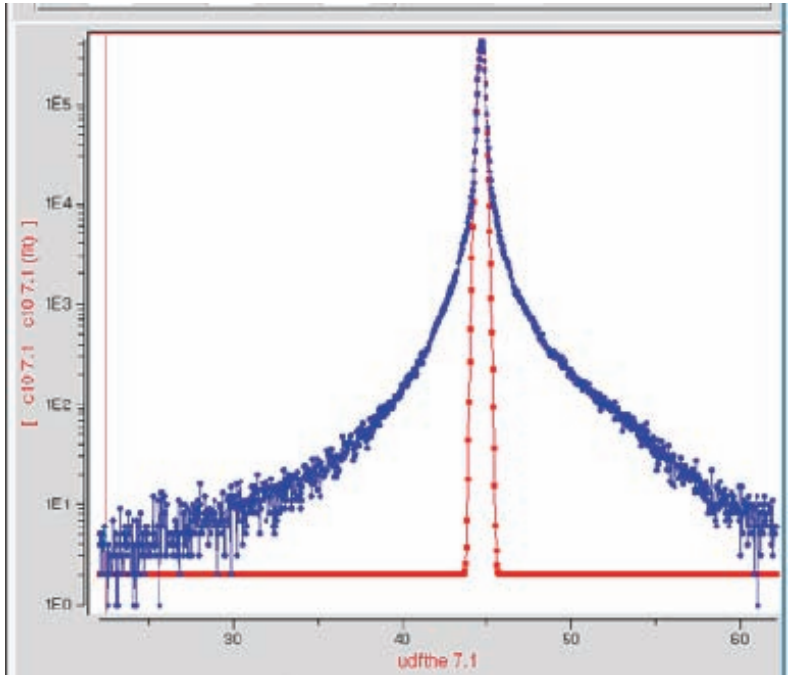


Si(111): 0.95 eV



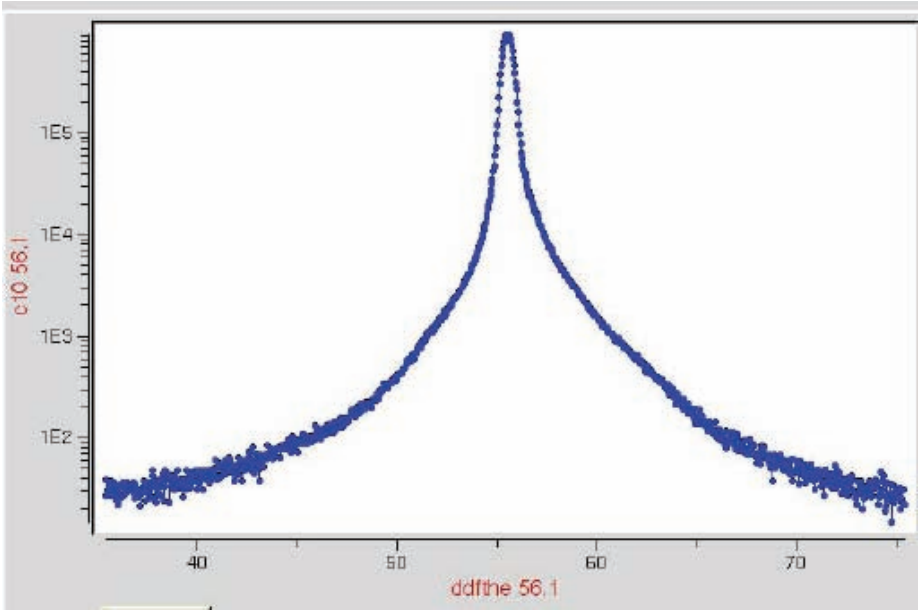
Si(311): 0.25 eV

Nice results



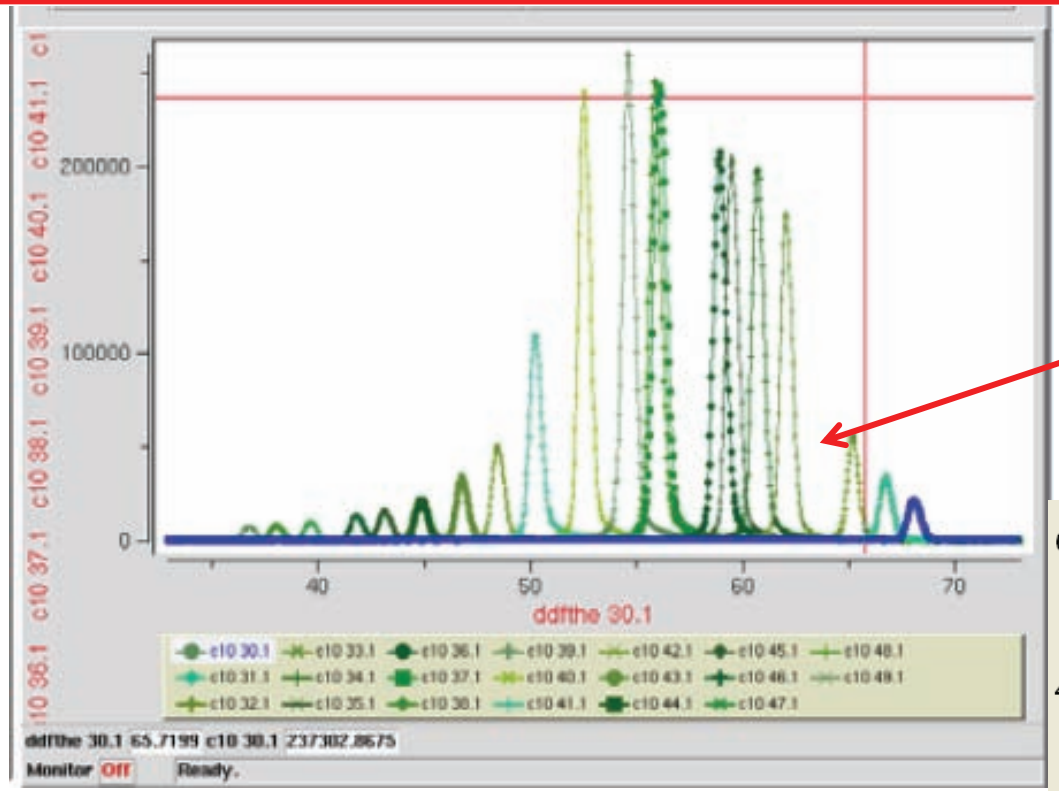
CDW-CDW performance:
Resolution 0.9 meV total
Gaussian to 1.5 OM
Efficiency 18-20%

Nice results



4B-CDW performance:
Resolution 1.3 meV total
Gaussian to 1-1.5 OM
Efficiency 18%

4B mono tests

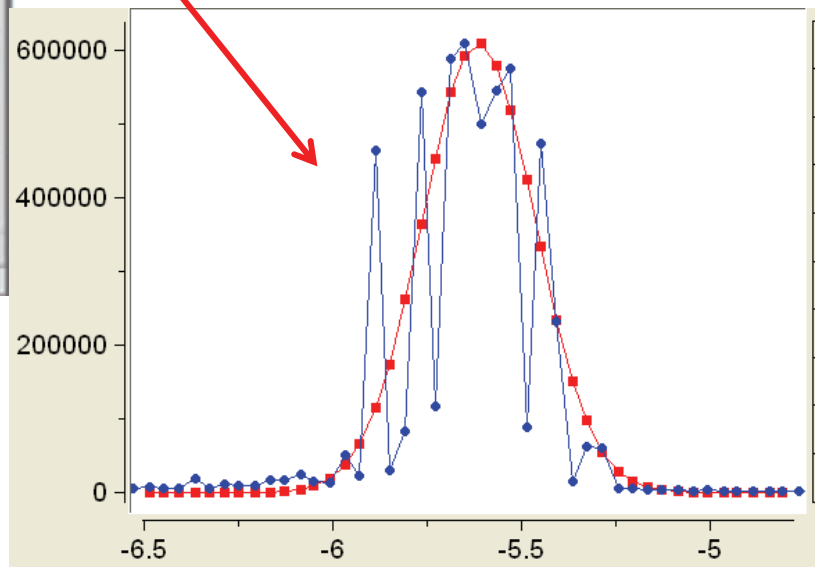


Scanning / stepping 4B using CDW as analyzer

Positioning error

Up to ~ 1 urad (3 meV)

~ 0.16 urad (0.5 meV)



Repeatability improvements on the way

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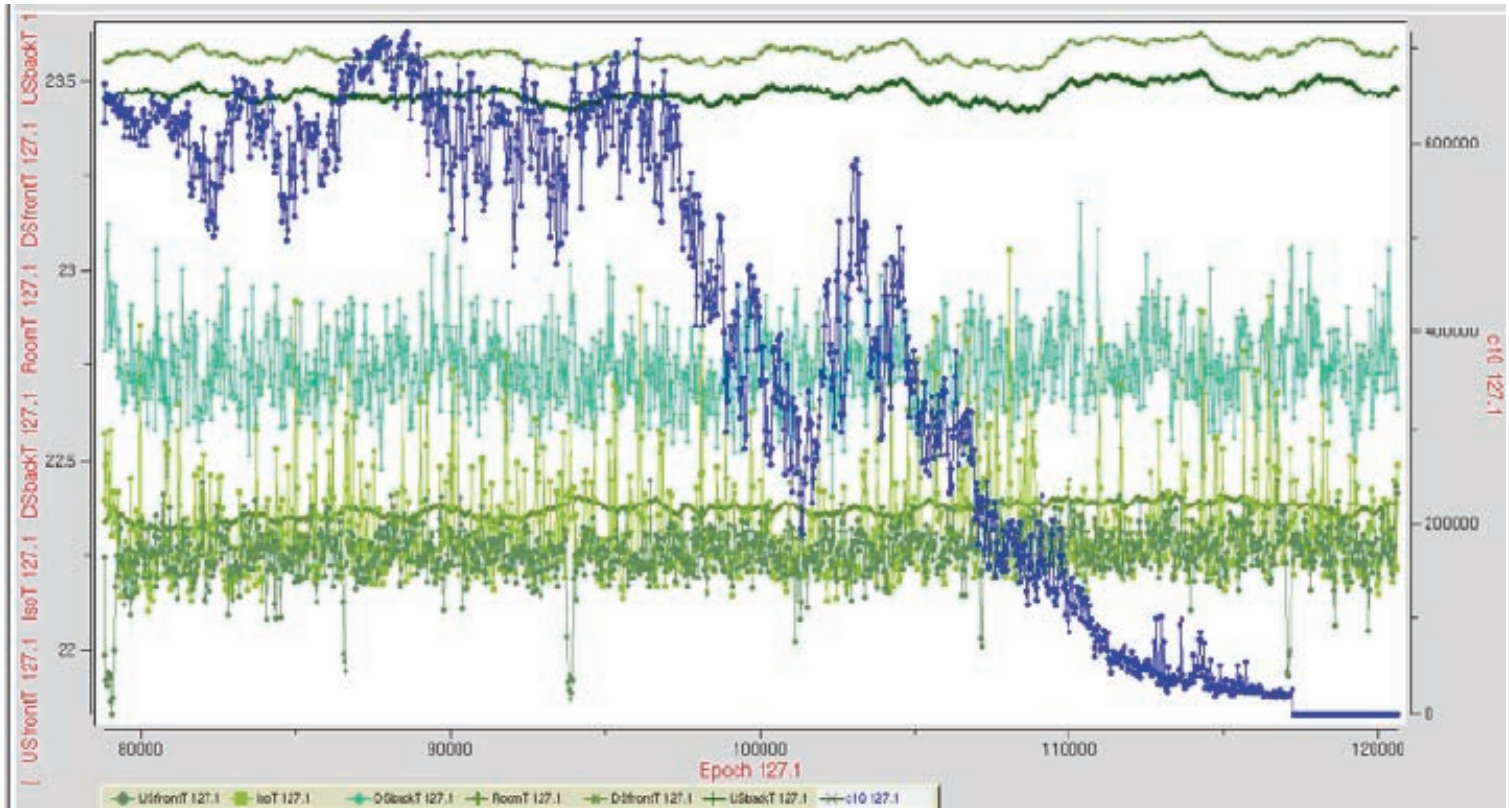
results

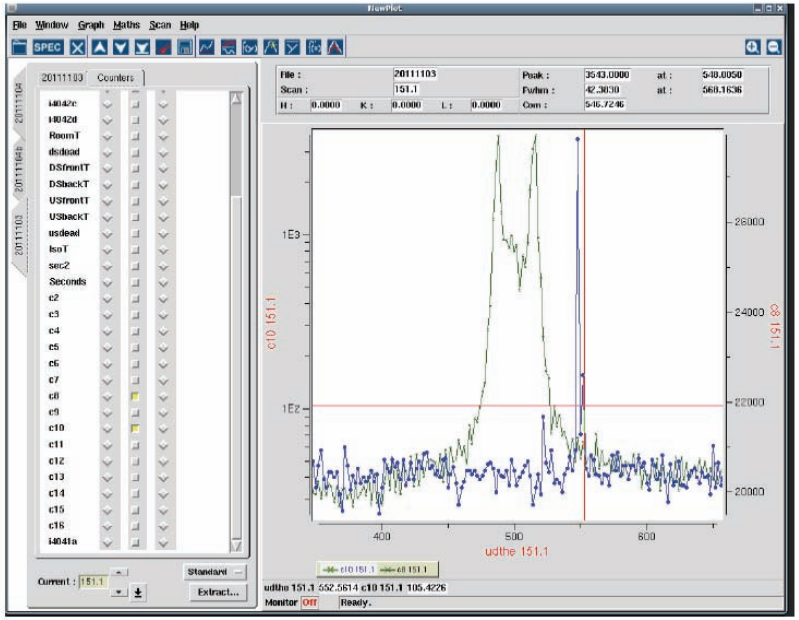
4B-CDW stability: ~ 5 hours

Temperature drifts ~ 4 mK /hour (more analysis to come)



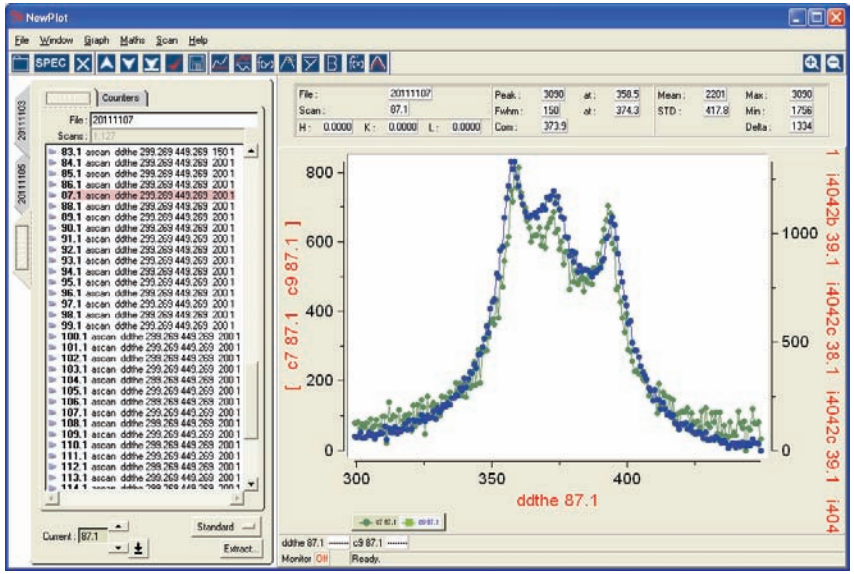
440 investigation

440 offset from 800 in D theta by 50 urad



D crystal lattice uniformity measured from 440 peaks
Different peak position / shape / width depending on energy (lattice) (several detectors atop D at different positions)

(more analysis to come)



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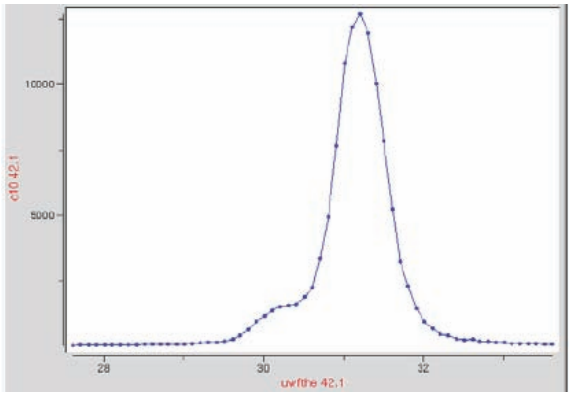
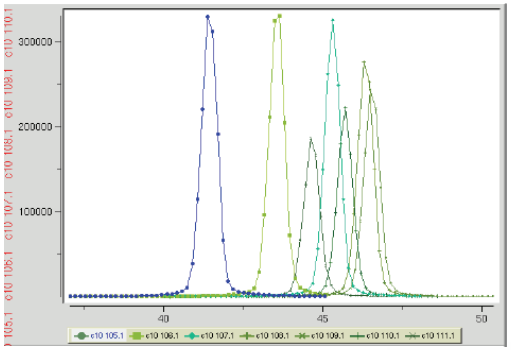
Mysteries

- Double peak in W scan: detector slit?
- 440 offset from 800 in theta by 80 urad = normal?
- Analyzer phi/theta mapping of 800 intensity shows asymmetric parabola (stronger on one side)
- D chi important?
- PD frequency mapping mode / detector polarity question





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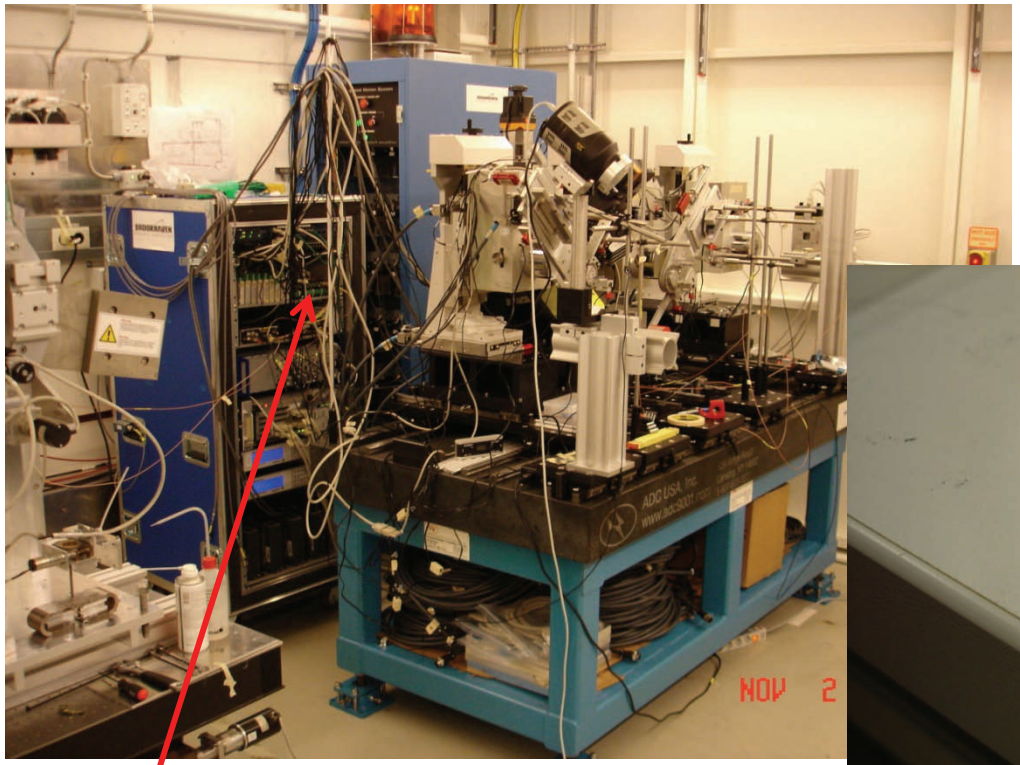
A few wrinkles



cables

Successful PETRA-III run, warts and all

Work for next run (SPring-8)

- New 4B base (trapezoids)
- Heater tapes
- Temp sensor holes
- Dual diode boxes