1. Are you satisfied with the stability of the x-ray beam arriving at your sample?

Insertion Device beamlines: (No: 16 | Yes: 2 | Undecided: 1)

6ID (D. Robinson)
Yes and no. For resonant magnetic scattering experiments, the stability seems adequate. For surface reflectivity / scattering, especially with a vertically focused beam incident at or below the critical angle, we are very sensitive to, and we definitely see the effects of, vertical beam movement

7ID E. Dufresne
In terms of satisfaction with beam stability on 7ID, we are satisfied. In low emmittance top up mode, the beam centroid is stable to within a few microns to say 10 um over days. In non-top up mode, heating effects cause beam motion that are more substantial but this only represents 25% of the beam time, and some improvements can be made to stabilize further our monochromator (Improved Compton shield). Furthermore using feedback could improve the stability as well even further, but we have not used it yet. We could use help from the APS in further stabilization of these heating effects.

9ID (T. Gog)
Not really

11ID-B (M. Beno)
NO

11ID-C (M. Beno)
NO

11ID-D (M. Beno)
NO

12ID (M. Beno)
NO

12ID-C (J. Hessler)
This depends upon the experiment. Recently I have been monitoring the incident and transmitted intensity during my SAXS experiments. I can detect changes in both the incident intensity and the ratio of transmitted-to-incident intensity. This gives me a document of beam stability, allows me to correct for small fluctuations, and identifies situations that are not acceptable. I can give you more detailed statistics, but this must wait until I complete other tasks.

13ID (M. Rivers)
For the undulator beamline in some cases no.

17ID (A. Howard)
No. We would be happy with improvements in geometrical stability.

18ID (T. Irving)
Not entirely - there are classes of experiments that are important to our mission that require greater stability and/or better mitigation of instabilities.

19ID (R. Alkire)
A qualified yes. We are monitoring beam stability in an instantaneous mode, but we do not have software in place to show variations over time. When the ring works well, we have no complaints. In the past when there were problems discovered by the APS we were not informed about them in a timely fashion i.e., several days later if at all. By that time it's too late to do anything about it.

22ID J. Chrzas
This is an interesting question. We are never satisfied. We have a new desing in the mono that we are debugging. Once we have addressed the issues I am confident that the system will be stable.

22ID (G. Rosenbaum)
No.

31ID (K. D'Amico)
Not really.

33ID (P. Zschack)
No. We have clear instability issues.

33ID-D(G. Long)
We are not satisfied with the stability of the x-ray beam arriving at our sample. There is a fair amount of high frequency flutter in our beam, which we anticipated would not cause problems with millisecond exposures. However, we currently take sequential exposures 5 seconds long, and we see varying intensity distributions as frequently as from one exposure to the next. This makes it impossible to "flat field" our detector.

34ID (I. Robinson)
No

34ID (G. Ice)
No-but it is better than anticipated.

Bending Magnet beamlines: (No: 1 | Yes: 3 | Undecided: 0)

12BM (M. Beno)
YES

13BM (M. Rivers)
For the bending magnet beamline in general yes.

17BM (A. Howard)
No. We would be happy with improvements in geometrical stability.

19BM (R. Alkire)
A qualified yes. We are monitoring beam stability in an instantaneous mode, but we do not have software in place to show variations over time. When the ring works well, we have no complaints. In the past when there were problems discovered by the APS we were not informed about them in a timely fashion i.e., several days later if at all. By that time it's too late to do anything about it.

2. Do you use any feedback to stabilize your beam?

Insertion Device beamlines: (No: 9 | Yes: 10 | Undecided: 0)

6ID
Yes. The second crystal "theta" axis of the monochromator has a piezo drive coupled with the motor drive.

7ID
No feedback at the moment, but I may use it in the future.

9ID
Sometimes. It measures the incident intensity and corrects the second mono x-tal. This improves long-term stability but often leads to short-term oscillations.

11ID-B
No, not at present. We will use split photodiode for feedback in future as in 11ID-C

11ID-C
Yes, Computer controlled slow feedback on a split photodiode signal.

11ID-D
Yes Struck D-MOSTAB

12ID
Yes MOSTAB

12ID-C

A MOSTAB is in the system, however I do not change its settings. I only make sure it is working.

13ID

Yes, we use the EPICS EPID record that I wrote to stabilize the second crystal of our monochromators on both the bending magnet and ID beamlines.

17ID

Not yet. We have plans to implement internal feedback using a piezo stack associated with the omega (relative theta of the second crystal) motion of our monochromator. Feedback based on information from APS Xray BPMs could certainly be incorporated as well if we were confident of its accuracy.

18ID

We have an analog intensity feedback system for use during EXAFS scans and are implementing Mark River's software feedback system. Neither quite do the job we need. Better solutions would be welcome.

19ID

Not at the present time.

22ID

Yes, we use two monochromatic BPMs.

22ID

Not yet, is in the making.

31ID

NO

33ID

Yes. But the fluctuations are in the 10 - 40 Hz range, and are intermittent.

33ID-D

Yes, there is feedback on the monochromator, and, thanks to considerable efforts on the part of the beam line staff, the appearance of the x-ray beam at the sample position is very much improved from early days. Nevertheless it is not yet good enough for our maging application.

34ID

No

34ID

No

Bending Magnet beamlines: (No: 2 | Yes: 2 | Undecided: 0)

12BM

Yes MOSTAB

13BM

Yes, we use the EPICS EPID record that I wrote to stabilize the second crystal of our monochromators on both the bending magnet and ID beamlines.

17BM

Not yet. We have plans to implement internal feedback using a piezo stack associated with the omega (relative theta of the second crystal) motion of our monochromator. Feedback based on information from APS Xray BPMs could certainly be incorporated as well if we were confident of its accuracy.

19BM

Not at the present time

3. Have you determined at your beamline the relative contributions to the beam instability from the source and from the beamline optics?

Insertion Device beamlines: (No: 11 | Yes: 8 | Undecided: 0)

6ID

Although we have no direct data yet, we suspect that the vertical beam motion is dominated by vibration inside the monochromator associated with the liquid nitrogen cooling flow turbulence telegraphing through the mechanics to the second crystal. Based on crude beam-image video observations and estimates, plus some hand-waving, the relative proportion of contribution may be ca. three parts beamline optics to one part source. We would very much like to try some "correlation" spectroscopy to help sort this out.

7ID

I've mostly focussed on the high heat load monochromator stability. In the past our monochromator was quite sensitive to pressure fluctuations in the cooling lines. We have stabilized this drawback in 2001 and this work was reported in the Proceedings of the SRI 2001 in Madison WI. We've noticed sharp source motion at times with our X-Ray BPM (SBC design) but we've ignored them for now although we can easily measure slow sub-micron motion at the 49 m point.

9ID

No. To do this we, URGENTLY need the PROMISED beam position information

11ID-B

NO

11ID-C

NO

11ID-D

NO The extreme heat load on the double crystal mono has led us to assume that most of the beamline stability problems are caused by mono thermal stability issues. Clearly if time becomes available tests at more open gaps with a lower critical energy may clear up some of these problems.

12ID

NO

12ID-C

No

13ID

The main instability appears to be vibration of the monochromator from the liquid nitrogen cooling system. We have not done detailed spectral analysis.

17ID

To some degree, yes. We have had numerous instances in which we could convince ourselves (although not necessarily Tony) that our optics were rock-solid, but the beam was moving from the source point either translationally or rotationally. In other instances we could recognize a contribution to beam motion from thermal motions within our own systems. So it would be bootless to quote a single number for the relative contributions of the beamline and the source, because it has varied substantially from circumstance to circumstance. The number of instances in which we could document source-related instabilities has diminished substantially since Top-Up became routine. When we do notice instabilities, they tend to come in clusters, perhaps owing to steering efforts on other sectors.

18ID

Not really - about a year a go we finished an aggressive effort to improve the thermal stability of our monos with good results. Better diagnostic tools are needed to find the residual instabilities in the optics and/or source.

19ID

Qualitatively yes. Most of our instability occurs at third order undulator radiation due to Compton heating. We have replaced our monochromator design with a new one, with some modifications still to go. We anticipate this reducing our drift considerably when they are completed. At present this limits our useable energy range.

22ID

Yes, currently, the majority of the constant problems come from the optics. We have a new cryo crystal design that we are working the bugs out of. There are times though that the storage ring is the problem, and at those times it is the major issue.

22ID

Yes, roughly

31ID

No. We do see some variation of intensity with time that may have both as contributors but haven't sorted it out yet. It has not resulted in our inability to carry on our work so we are testing these things over time along with performing other experiments and tests on the beamline.

33ID

We are not able to separate the beamline vibrations from the source. I suspect most are due to problems with our DCM.

33ID-D

To a limited extent.

34ID

Mostly the optics, but some from the diffractometer. Probably not the source.

34ID

We believe we have but this could use additional work.

Bending Magnet beamlines: (No: 1 | Yes: 3 | Undecided: 0)

12BM

NO

13BM

The main instability appears to be vibration of the monochromator from the liquid nitrogen cooling system. We have not done detailed spectral analysis.

17BM

To some degree, yes. We have had numerous instances in which we could convince ourselves (although not necessarily Tony) that our optics were rock-solid, but the beam was moving from the source point either translationally or rotationally. In other instances we could recognize a contribution to beam motion from thermal motions within our own systems. So it would be bootless to quote a single number for the relative contributions of the beamline and the source, because it has varied substantially from circumstance to circumstance. The number of instances in which we could document source-related instabilities has diminished substantially since Top-Up became routine. When we do notice instabilities, they tend to come in clusters, perhaps owing to steering efforts on other sectors.

19BM

Qualitatively yes. Most of our instability occurs at third order undulator radiation due to Compton heating. We have replaced our monochromator design with a new one, with some modifications still to go. We anticipate this reducing our drift considerably when they are completed. At present this limits our useable energy range.

4. Is there a class of existing or proposed experiments that is made difficult by the .present level of stability on your beamline?

Insertion Device beamlines: (No: 2 | Yes: 15 | Undecided: 2)

6ID

Yes. Surface scattering with a focused beam.

7ID

At this point, the stability is adequate for nearly all our experiments.

9ID

Yes. All experiments far from the source (70 m in our C-Hutch). All experiments involving small samples, micro-probe and grazing incidence experiments

11ID-B

YES Magnetic Compton Scattering

11ID-C

YES Since horizontal beam position changes the Energy in this station highly accurate triple axis experiments require higher stability than is presently observed.

11ID-D

YES, Users have reported a number of stability problems affecting the accuracy of scattering experiments. XMCD experiments are critically affected by beam stability.

12ID

YES ASAX is one example, Stability also impacts XSW experiments and MOCVD experiments in 12ID-D.

12ID-C

Changes in beam shape can not be tolerated. Therefore, I can not take data during the injection. This is especially true when TopUp is on. We are currently changing our control program to test for TopUp and will simply wait until the injection is complete. Beam wander is also bad, but we need more data on this. Finally, intensity fluctuation should be less than 1%.

13ID

The vibration causes an effective increase in the size of the focal spot when we use both our small and large K/B mirrors. We could do better science with a smaller beam.

17ID

Yes. We are unable to collimate 17-ID down to the desired level of ~50x50 microns without risking missing our sample.

18ID

In macromolecular SAXS experiments, stability is everything. Routine SAXS is possible by quickly acquiring several patterns and rejecting the bad ones. This is not always possible. This is an inconvenience for static SAXS but is crippling for time resolved when one is adding up many weak scans and cannot tell easily which are the bad ones.

19ID

Besides the heating issues, no

22ID

Yes, if users want to do "microcrystallography" we would have a problem. Microcrystallography is defined as keeping a 5-10 micron size beam on a 5-10 micron sample.

22ID

All experiments/measurements after a large energy change require experimenter's vigilance.

31ID

We have not focused the vertical direction yet. We anticipate working with both vertical and horizontal focusing of about 200 microns (we currently have a 200 micron spot in the horizontal direction) and will need to carefully examine beam stability in both directions when we have that tight a focus..

33ID

The use of our x-ray microscope will be compromised when it arrives. For other experiments, it is an inconvenience, but has not compromised data collection.

33ID-D

Yes. Imaging applications.

34ID

Fluctuation experiments are hard.

34ID

Our differential aperture microscopy experiments are very sensitive to beam stability.

Bending Magnet beamlines: (No: 2 | Yes: 2 | Undecided: 0)

12BM

NO

13BM

The vibration causes an effective increase in the size of the focal spot when we use both our small and large K/B mirrors. We could do better science with a smaller beam.

17BM

Yes. We are unable to collimate 17-ID down to the desired level of ~50x50 microns without risking missing our sample.

19BM

Besides the heating issues, no

5. If APS will help with diagnostic of beam stability, will you use such service?

Insertion Device beamlines: (No: 0 | Yes: 16 | Undecided: 3)

6ID

That depends on the results of our own cost / benefit analysis and schedule demands. Most of our surface scattering customers don't complain, although I suspect they will when they get to the point of trying to measure the time dependence of the surface scattering during layer-by-layer growth experiments. There is little internal support for improving beam stability until a specific class of experiments actually fails.

7ID

I would be interested in using APS expertise with diagnostics of course. I think it would be very helpful to have a pool of diagnostic equipment for troubleshooting beamlines. For example, electronic dial gauges with analog outputs would be useful at time. Several sets of tilt sensors, one with sub-microradian sensitivity over one degree and one with microradian sensitivity over a few degrees have been found essential in debugging our monochromator. A set of accelerometer for vibration measurement with all the associated electronics would be useful. Finally, one could provide X-ray BPM systems that could be brought on a beamline for testing. I've found SBC's X-ray BPM very powerful and sensitive, coupled with Steve Ross' electronics. Also we've imaged the fluorescence from a YAG single crystal with a CCD. If coupled to a fast CCD (30 Hz), this could provide extremely useful data for the stability of a beamline.

9ID

Yes, definitely.

11ID-B

Yes, but in this case we must measure the stability in the polarization as well as source position.

11ID-C

Yes, if the beamtime required isn't too large.

11ID-D

YES, depending on how much beamtime would be necessary and how many changes would be required to the beamline to put the diagnostics in place. Since three stations are affected by down time of the A-station these concerns are critical here.

12ID

YES, But how much beamtime would be necessary for tests and how many changes would be required to the beamline to put the diagnostics in place are critical given the continuous use of the beamline and limited CAT staff.

12ID-C

Yes, if they are easy to use and meet my requirements.

13ID

Yes, a good position monitor and spectrum analyser, along with the expertise from looking at a number of beamlines would be very useful. We would like to know quantitatively how our beamline compares to others.

17ID

Certainly.

18ID

Most assuredly

19ID

We would be happy to work with the APS in monitoring beam stability if it proves feasible.

22ID

This is another interesting question. What type of services? In general, we would be open to discussions.

22ID

Not sure. We have developed our own tools.

31ID

Yes, but I would like to understand what form the help takes. For example, if there are specialized instruments such as accelerometers, sensors, or electronics that we could get access to that would be an advantage.

33ID

I'm not sure what service is being offered. Deming has been regularly consulted, and he has provided us with equipment and offered guidance throughout the years. Much of what we have already learned is in no small part due to Deming.

33ID-D

Yes.

34ID

Definitely yes. What tools/method do you have available?

34ID

yes!

Bending Magnet beamlines: (No: 0 | Yes: 4 | Undecided: 0)

12BM

YES, The answer however depends on how much beamtime would be necessary for tests and how many changes would be required to the beamline to put the diagnostics in place. Since the beamline users and CAT staff don't perceive a problem with this beamline such tests are certainly a much lower priority than tests of the ID beamlines.

13BM

Yes, a good position monitor and spectrum analyser, along with the expertise from looking at a number of beamlines would be very useful. We would like to know quantitatively how our beamline compares to others.

17BM

Certainly.

19BM

We would be happy to work with the APS in monitoring beam stability if it proves feasible.

Misc.

From:
Daniel Hausermann <dhausermann@hpcat.aps.anl.gov>

Barry,

As you know we are not quite operational as yet (planning to take beam in 2 stations by mi-July) and hence we certainly have no beam stability data to input in the discussion...

However I would like to put the following request:

Could (i) the machine output to us live data on positron beam and XBPM stability position and angle) data in a graphic form (all parameters 'live plotted' as a function of time) which could be directly displayed on the beamline. Also (ii), and I presume that these data are stored, could we have a 'look back' access to a user-friendly table at anytime. (i) will enable us to correlated 'intensity changes at the sample' with beam movement, and (ii) look back at beam behavior when beam stability is suspected when looking at overnight data, say.

Thank you for your attention.

Daniel.
Sector 16.