ARGONNE NATIONAL LABORATORY

INTRA-LABORATORY MEMO

Advanced Photon Source

February 18, 2005

To: W. G. Ruzicka Division Director, AOD

From: M. Ramanathan Chair, Design Review Committee

Subject: Report on the Hard X-ray beam Position Monitor Design Review

Summary:

A design review committee consisting of M. Beno (XFD), M. Capel (NE-CAT), L. Emery (AOD), M. Ramanathan (Chair, AOD) and D. Shu (XFD) met on February 3, 2005 to review the proposal for Hard X-ray Beam Position Monitors (HXBPM) to enhance the beam stability. The committee was charged with evaluating the proposed beam stability specifications and whether the proposed design will meet the criterion.

G. Decker (AOD) presented an overview of the current performance and the limitations for Storage ring beam stability. He also provided a strategy to achieve 200 nrad per week stability. Following his presentation G. Rosebaum (SBC/SER CAT) made a presentation on his proposal for a Hard X-ray Beam Power and HXBPM.

The committee strongly remommands the APS management to fund the proposed feasibility study of this HXBPM for white beam as it is the first step towards a future true prototype prior to real use in at ID beamlines.

Findings:

The committee was presented with a justification for 200 nrad as the target angular stability for ID beamlines. The justification of 5% of vertical angular divergence was reasonable. The present drift in ID photon angle is about 1 microradian, as measured by a straight fit of RF BPMs and XBPMs. The stability target is one fifth of this value, which is a reasonable and desirable improvement. The limitations of the current BPM systems were presented. The proposed HXBPM will be insensitive to the distribution of low-energy photons, and thus be a better measure of centroid position of the photons.

The ability for orbit correction to stabilize the position and angle of the beam down to a certain level depends on the signal-to-ratio of the readback devices in general. There was no modeling done to estimate of the signal-to-ratio of the proposed HXBPM, which is difficult to do. Nevertheless the success of this device was argued by the presenters on the basis of a previous hard-x-ray device designed for a monochromatic beam. The signal-to-ratio of that device was more than enough to produce 200 nrad stability.

Data as presented from the monochromatic beam hard x-ray beam was not adequate to judge the requirement of 200 nrad over a period of a week. In addition moving from a monochromatic beam to a white beam has its own challenges. For example, the PIN diode is most case will not survive the white beam radiation environment. The proposal feasibility was designed for low power density condition (can only be located at 45 or 50 meters away from the ID source). There are big technical gaps between this version and real prototype for majority of the APS beamline applications where the device has to reside either in the front end or in the FOE. . The major technical challenges will be: the high beam power densities, radiation damage to the detector, and different background beam intensities due to bending magnet sources.

It is clear that the proposed device is only applicable to testing the concept of the design in the 19ID SOE and that the proposed design cannot be considered a prototype for a future APS white-beam position monitor. Parts of the proposed design would be very difficult to model and the flexibility of what was proposed will allow the testing of components such as filters and targets without the requirements which would be involved with a true UHV design installed in an FOE. The project will provide valuable data that could be very useful in setting specifications for a future prototype BPM.

Beam stability is an important aspect for APS. Any scheme which will help enhance the beam stability is worth pursuing. Improved positional stability of the x-ray beam is mandated by the progressive move towards small sample size that is having experienced at all APS crystallography beamlines. A capability to accurately monitor x-ray beam location at a position reasonably close to the sample goniometer, but upstream of perturbing beamline optics seems necessary for improved beam steering.

Recommandations:

The proposed feasibility study of this HXBPM for white beam is a first step in providing the real data needed to further enhance the HXBPM system for real application in all the beamlines at a later date once a complete prototype is designed and reviewed. At the minimum the feasibility version of the HXBPM will greatly enhance the efficiency and reliability of at least four bio-crystallography beamlines at the APS. On this basis alone the committee feels that the proposal should be funded by the APS management.

CC:
M. Beno
M. Capel
L. Emery
D. Shu
O. Singh
G. Decker
G. Rosenbaum