Title	***SR beam loss monitor upgrade***			
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Date	02/22/2008			
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Category	Accelerator Improvement			
Content ID*	APS_XXXXXX	Rev.	ICMS_Revision	ICMS Document Date

*This row is filled in automatically on check in to ICMS. See Note [1]

Description:

Start Year (FY)	**2009**	**Duration (Yr)**	**4**

Objectives:

This project includes two parts, a loss monitor upgrade and test facilities for radiation damage and loss monitors.

Loss monitor upgrade goals: (1) Provide sufficient Cherenkov detectors and adequate electronics to cover every ID straight and narrow apertures in the storage ring, and implement dosimetry function for undulators. (2) Develop additional loss monitors for insertion device dosimetry and for bend magnet area to completely cover the storage ring enclosure.

Goals for the test and measurement facility for loss monitor and radiation effect on undulator magnet: (1) Construct a test platform in Booster beam dump area for studying radiation damage of magnets and other accelerator components, in collaboration with ID group. (2) Construct calibration stands for the SR Cherenkov detectors and processing electronics. (3) Study spatial distribution of the radiation near an ID chamber to quantify radiation dose received by undulators at different gap openings.

Benefit:

The APS Cherenkov detector is designed specifically to respond to multi-MEV to GeV electrons which are likely to be responsible for radiation damages of the undulator magnets. A functional dosimeter will help Insertion Device group to keep track of the radiation level each undulator receives and schedule its retuning accordingly. It will not only save valuable time for retuning the undulators, but also improve user x-ray beam quality since it is less likely that users will need to put up with a radiation-damaged undulator due to its delayed retune.

A shot-by-shot spatial-temporal map of beam losses over the entire storage ring enclosure provides a global view of beam losses which gives the storage ring manager valuable information for optimizing injection process.

Risks of Project: See Note [2]

None. The new system will be implemented in steps to supplement / replace the existing Cherenkov detectors.

Consequences of Not Doing Project: See Note [3]

Lack of radiation monitor / dosimeter forces the scheduling of insertion devices retuning to base purely on experience, which make is possible to leave more severely damaged undulators in the tunnel while retuning less damaged ones. As a result, user beam quality may be affected since their undulator was not retuned in time.

Having no reliable measurement of radiation in the accelerator tunnel also affects effective development new undulator / accelerator components which are susceptible to radiation damage.

Cost/Benefit Analysis: See Note [4]

Initial development will be based on existing Cherenkov detectors. Recent work on the detector's pulse counting electronics has shown that these detectors respond to Touschek scattered electrons at a level of several fC per count. But one to two orders of magnitude improvement in processing electronics S/N ratio is needed to take full advantage of the detectors. Hence the initial effort in developing adequate electronics will be most efficient ways of reaping the benefit of the existing detectors.

In the long term, with the goal of characterizing the spatial-temporal properties of the beam loss, and spectral properties of the radiation damaging the undulator magnets and other components, control experiments that facilitate the understanding of the radiation damage process will enable more smart undulator designs.

Description:

This project includes two parts, upgrade of loss monitors and construction of test facilities for radiation damage and loss monitors.

Loss monitor upgrades include the following tasks: (1) Purchase additional Cherenkov detector of current design to populate every ID straight and narrow apertures in the storage ring. (2) Enhance the functionality of Cherenkov detector with adequate analog front end and FPGA-based pulse processing electronics: to implement dosimetry functions to keep track of high-energy electron dose each undulator receives during accelerator operations, covering the full range of dose rate from Touschek scattered electrons to full beam dump. The complete system will also provide temporal and spatial information of beam losses during injections and stored beam operations. (3) Develop /

evaluate new, additional loss monitors for insertion device dosimetry such as miniature loss monitors to be mounted on the undulator magnet, and for beam losses in the bend magnet area, such as shielded optical fibers, to complete the coverage of loss monitors in the storage ring enclosure.

Goals for the test and measurement facility for loss monitor and radiation effect on undulator magnet: (1) Construct a test platform in Booster beam dump area for studying radiation damage of magnets and other accelerator components, in collaboration with ID group. (2) Construct one calibration stand for the SR Cherenkov detectors in storage ring tunnel and one bench-top calibration for the processing electronics. (3) Construct a measurement stand to quantify spatial distribution of the radiation near an ID chamber. The measured data are to be used to quantify radiation dose received by the undulators at different gap openings.

The two parts of this proposal form an integral program: The first part develops and builds necessary hardware to monitor the beam loss in the storage ring enclosure. The second part provides tools for checking and calibrating the hardware, for performing controlled experiments to facilitate the interpretations of the data obtained.

Funding Details

Cost: ($K)
Use FY08 dollars.

Year	AIP	Contingency
1	135	10%
2	135	10%
3	135	10%
4	135	10%
5		
6		
7		
8		
9		
Total	540	54

Contingency may be in dollars or percent. Enter figure for total project contingency.

Effort: (FTE)
The effort portion need not be filled out in detail by March 28

Year	Mechanical Engineer	Electrical Engineer	Physicist	Software Engineer	Tech	Designer	Post Doc	Total
1	0.25	0.125	0.25	0.2	0.25	0.5		1.575
2	0.25	0.125	0.25	0.5	0.5	0.5		2.125
3	0.25		0.25	0.25	0.5	0.125		1.375
4	0.25		0.25	0.125	0.5	0.125		1.25
5								0
6								0
7								0
8								0
9								0

[1] **Notes:**

ICMS. Check in first revision to ICMS as a *New Check In*. Subsequent revisions should be checked in as revisions to that document i.e. C*heck Out* the previous version and C*heck In* the new version. Be sure to complete the *Document Date* field on the check in screen.

[2] **Risk Assessment.** Advise of the potential impact to the facility or operations that may result as a consequence of performing the proposed activity. Example: If the proposed project is undertaken then other systems impacted by the work include ... (If no assessment is appropriate then enter NA.)

[3] **Consequence Assessment.** Advise of the potential consequences to the facility or to operations if the proposal is not executed. Example: If the proposed project is not undertaken then ____ may happen to the facility. (If no assessment is appropriate then enter NA.)

[4] **Cost Benefit Analysis.** Describe cost efficiencies or value of the risk mitigated by the expenditure.

Example: Failure to complete this maintenance project will result in increased total costs to the APS for emergency repairs and this investment of ___ will also result in improved reliability of ____. (If no assessment is appropriate then enter NA.)