Beam Stabilization Proposals Supporting the APS Renewal

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Table 1: RMS Beam Motion, 0.1-200 Hz

	APS 2008	ESRF c. 2005	SPring-8 c. 2004
Horizontal (μm)	4.8	1.2 - 2.2	3 - 4
Vertical (μm)	1.6	0.8 - 1.2	1

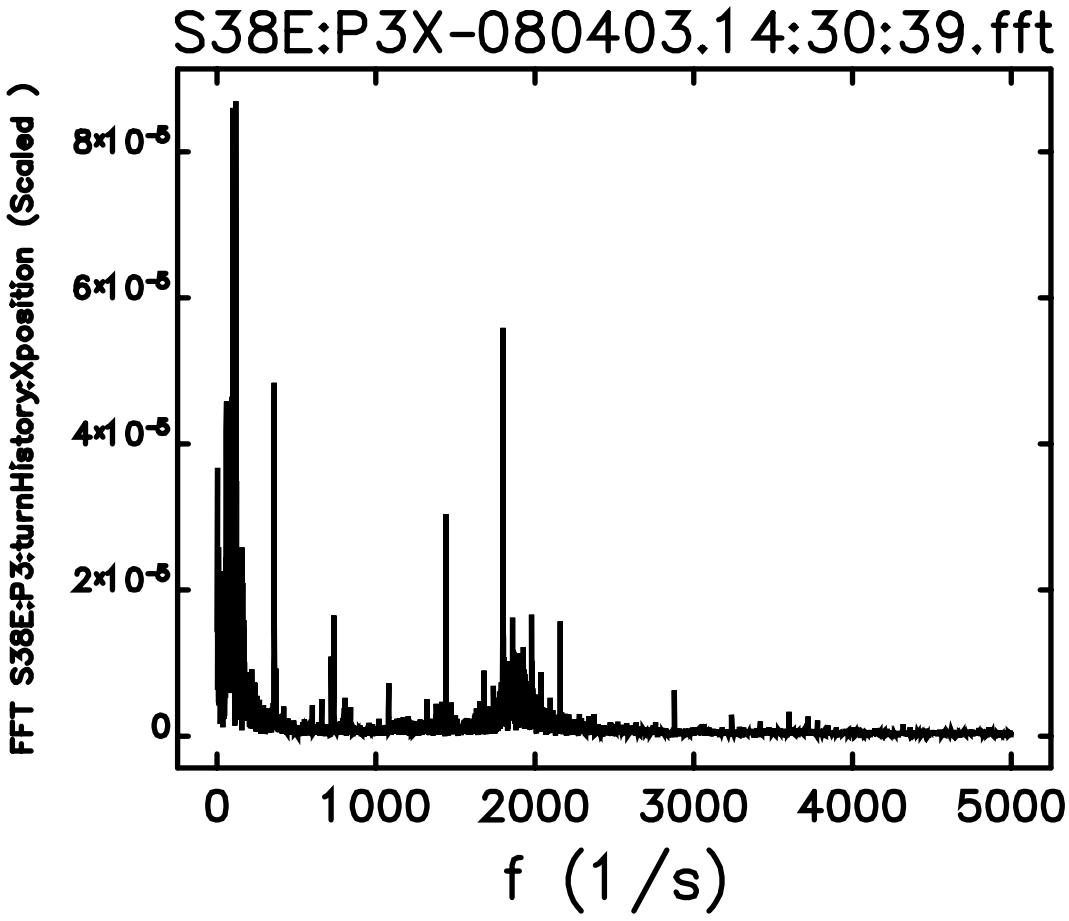


Table 1: APS Beam Stability Goals

	AC Motion, 0.1 - 200 Hz		Long-term Drift, (One week)	
	microns rms	μrad rms	microns p--p	μrad p-p
Horizontal	3.0	0.53	5.0	1.0
Vertical	0.42	0.22	1.0	0.5

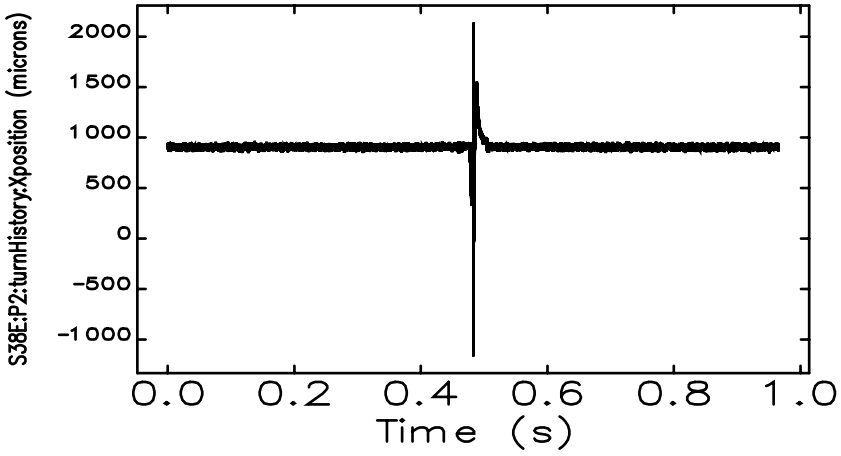
Five Year Strategic Plan for APS Beam Stability

Glenn Decker, Bingxin Yang, Frank Lenkszus etal. (Feb. 2008)

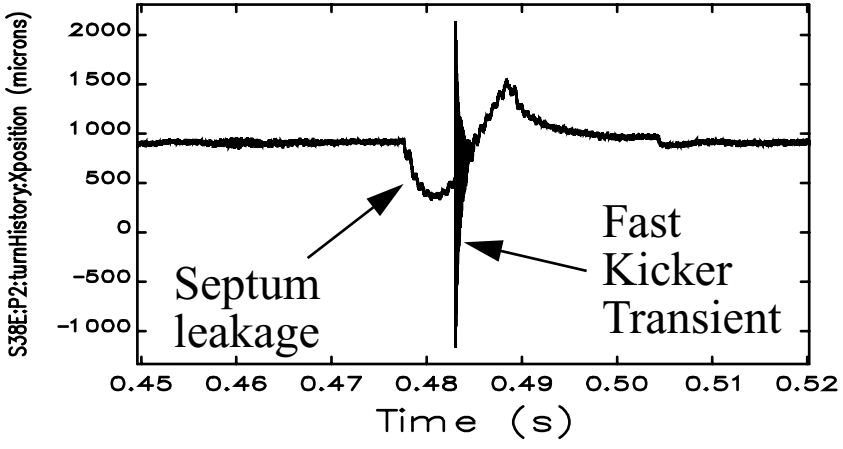
Project	Sub-Project (ICMS content ID)	Proposer	Objectives / Tasks	Duration	Budget
RF Beam Position Monitoring and Feedback (APS_1258136)	Monopulse rf Beam Position Monitor Upgrade (APS_1255203)	Glenn Decker	Deploy new FPGA-based monopulse rf bpm data acquisition system. For improved resolution, diagnostic capability, and to alleviate obsolescence issues.	3 years	$585 K
	Storage Ring Real-Time Feedback System Upgrade (APS_1255207)	Frank Lenkszus	Increase sampling rate of storage ring real-time feedback system from 1.5 kHz to 20 kHz. Suppress noise out to 200 Hz closed-loop bandwidth.	4 years	$600 K
	Fast Steering Corrector Relocation (APS_1255209)	Mark Jaski	Relocate BH4 storage ring corrector magnets to increase their frequency response.	3 years	$181 K
	Spurious Storage Ring Vacuum Chamber Microwave Mode Dampers (APS_1255205)	Glenn Decker	Eliminate spurious microwave modes from the storage ring large-aperture vacuum chambers which affect vertical rf beam position monitor readings.	5 years	$440 K
X-ray Beam Position and Flux Monitoring (APS_1258137)	X-ray bpm System Enhancement (APS_1255209)	Glenn Decker	Design, fabricate, install and commission hard x-ray beam position monitor system.	4 years	$1,500 K
	SR Portable detector upgrade (APS_1255145)	Bingxin Yang	Enhancement of portable detector capabilities: Absolute flux measurements: better than 25% Beam motion measurements: > 10 kHz Flux density stability (size fluctuation): < 0.5% Digital video: beam size measurement > 1 kHz	3 years	$182 K
	Microminiature XBPM and Flux Monitor for High-Flux Micro-focused Hard X-ray Beams (APS_1256819)	Deming Shu	Construct diamond-based photoconductive beam position and flux monitor for high-flux micro-focused hard x-ray beams.	5 years	$165 K
Storage Ring Tunnel Temperature Regulation Upgrade (APS_1255208)	NA	Glenn Decker	Improve APS storage ring tunnel temperature regulation to within + / - 0.1 degrees C.	4 years	$4,000 K

Monopulse rf beam position monitor upgrade

- Presently provides broadband beam position monitoring (turn-by-turn)
- Most useful for monitoring / correction of AC beam motion
- Important for post-mortem analysis of beam loss events
- Spare parts are dangerously low for existing hardware



262144 turns (1 second) of data using first production model of fpga-based monopulse rf bpm data acquisition



Storage Ring Real-Time Feedback System Upgrade

- Originally commissioned in 1997
- Limited to 1.5 kHz sample rate / 50 Hz closed-loop bandwidth
- Modern commercially available hardware should allow closed-loop BW up to 200 Hz
- Relocation of “B:H4” correctors will double the coverage of fast steering correctors, improving ac stability by factor of 2.

X-ray Beam Position Monitor System Enhancement

- R&D on hard x-ray white beam position monitors is nearing completion in collaboration with G. Rosenbaum at 19-ID
- First production flux monitor being fabricated for testing at 35-ID
  - Use for absolute fiducialization of white beam in relation to beam defining aperture
  - Destructive, retractable
- Design work beginning on non-destructive high-power hard x-ray beam position monitor to replace one of the two in-tunnel UV photon bpms.
- Wide spread deployment should provide long-term stability at the level of a few hundred nanoradians.

Portable Detector Upgrade

- Existing system under test at 35-ID
- For use to quantify beamline performance
- Enhanced capabilities include beam motion measurements up to 10 kHz, beam size measurements up to 1 kHz.

Storage Ring Tunnel Temperature Regulation Upgrade

- Latest upgrade provides + /– 0.6 deg. F temperature stability.
- Methods for improving upon this are under investigation, with a long-term goal of + /– 0.1 deg. F
- A detailed cost / benefit analysis will be required to justify major modifications to tunnel air-handling systems.

Summary

- The APS renewal provides an opportunity for significant improvements in beam stability at the APS
- A number of R&D projects can be brought into production to provide 100-nanoradian-scale beam stabilization
- The APS renewal web site provides additional details on proposed improvements to accelerator systems:

http://www.aps.anl.gov/Renewal/mt_accelerator.html