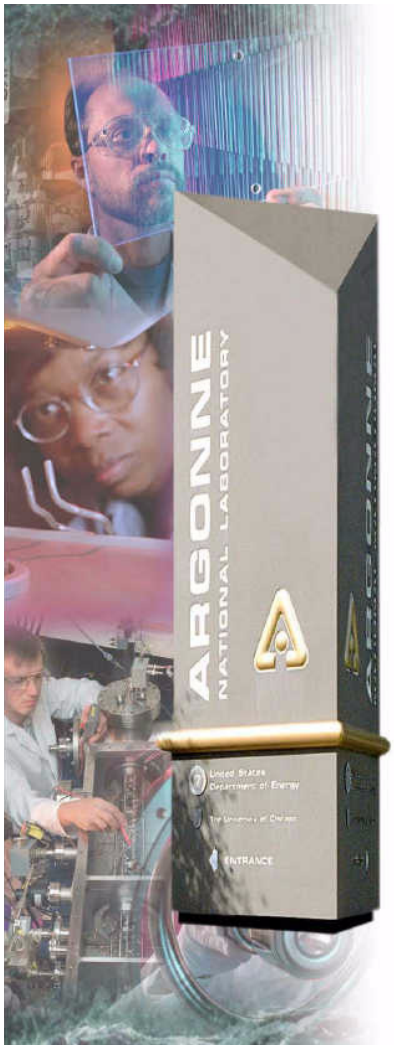


ADVANCED PHOTON SOURCE
APS OPERATIONS DIVISION

Experience with Insertion Device Photon Beam Position Monitors at the APS

Glenn Decker

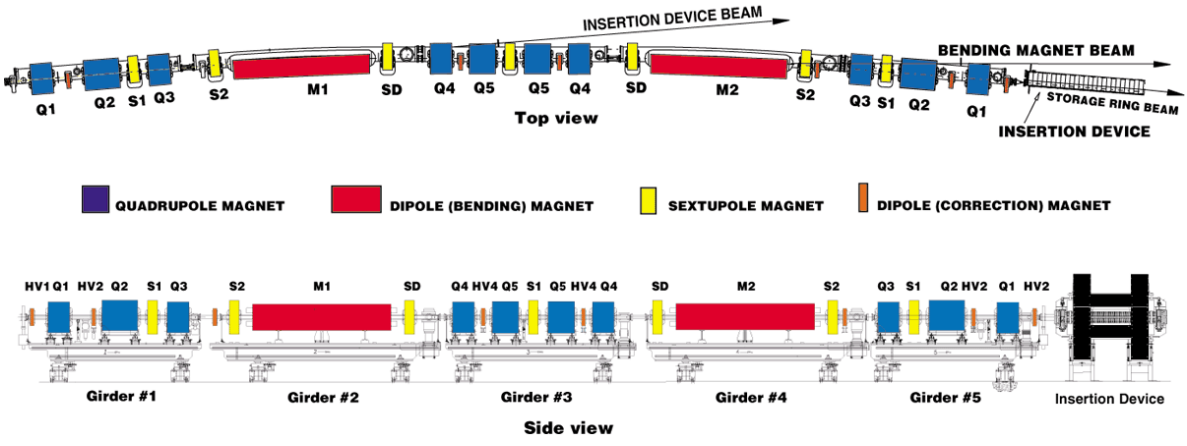
IWBS 2004
December 10, 2004

Argonne National Laboratory

Office of Science
U.S. Department of Energy

A U.S. Department of Energy
Office of Science Laboratory
Operated by The University of Chicago

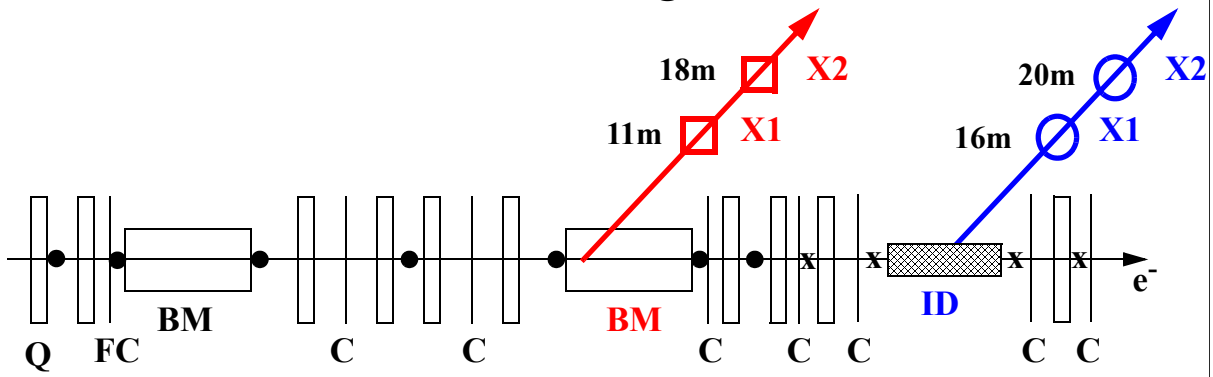
One Sector of the Advanced Photon Source Storage Ring



27.6 meters

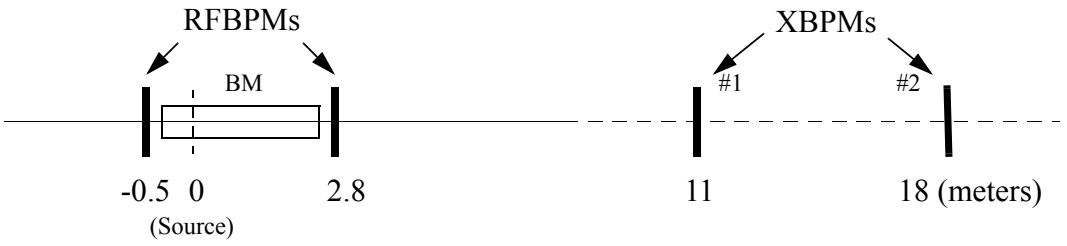
(The APS has forty sectors - 1104 meters total circumference)

Beam Position Monitors and Magnets in One Sector

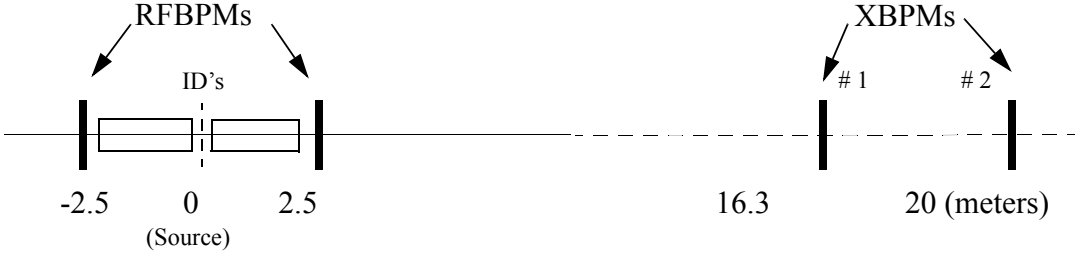


- ● : Broad-band RF Beam Position Monitors (7) (Turn-by-Turn)
- x : Narrow-band RF Beam Position Monitors (4) (~ 300 Hz)
- □ : BM X-ray Beam Position Monitors (2 - Vertical Only) (~165 Hz)
- ○ : ID X-ray Beam Position Monitors (2) (~165 Hz)
- FC : "Fast" Corrector Magnet (1) (~ 1000 Hz)
- C : "Slow" Corrector Magnets (7) (few Hz)
- Q : Quadrupole Magnets

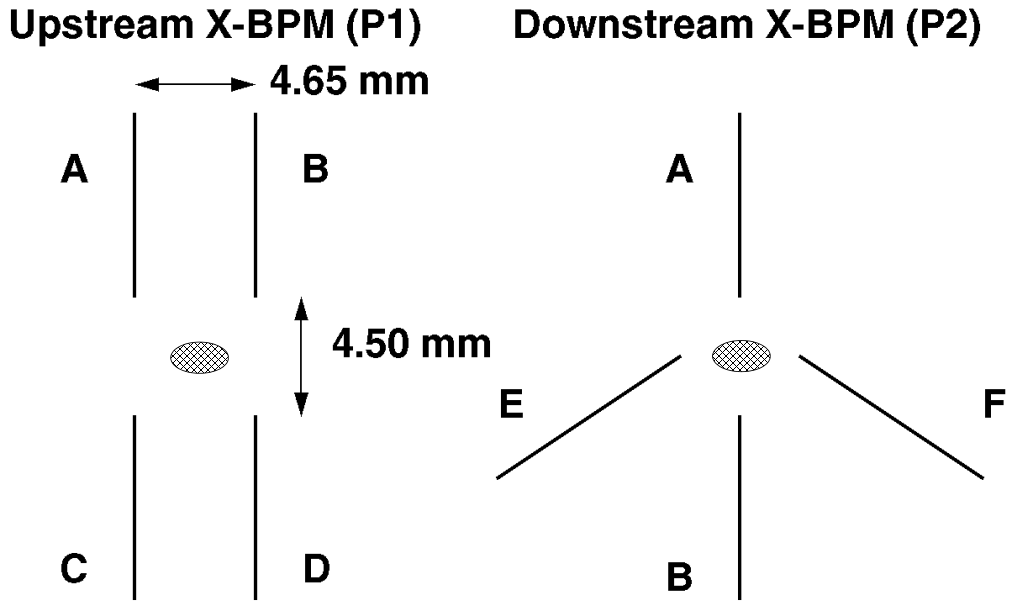
Bending Magnet and BPM Arrangement



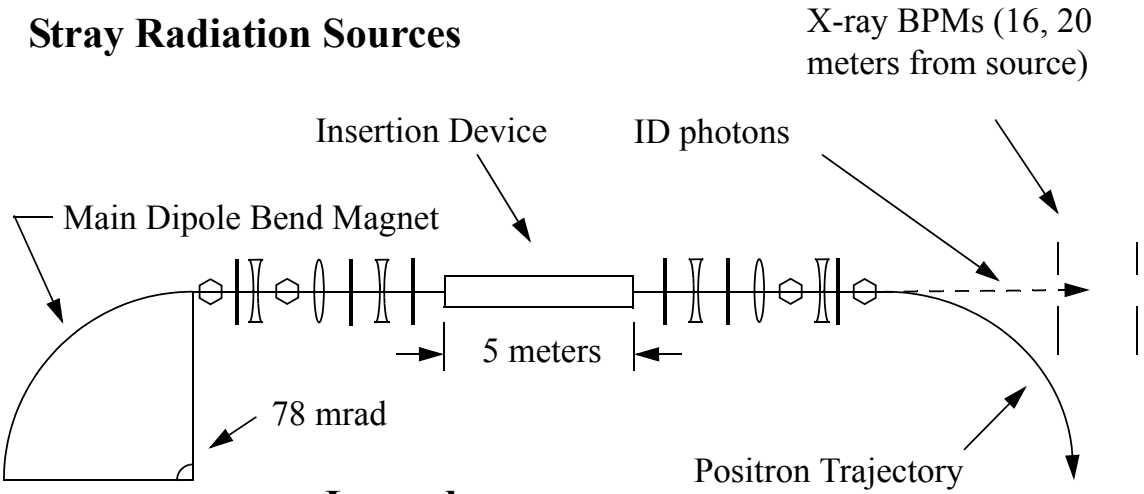
Insertion Device and BPM Layout



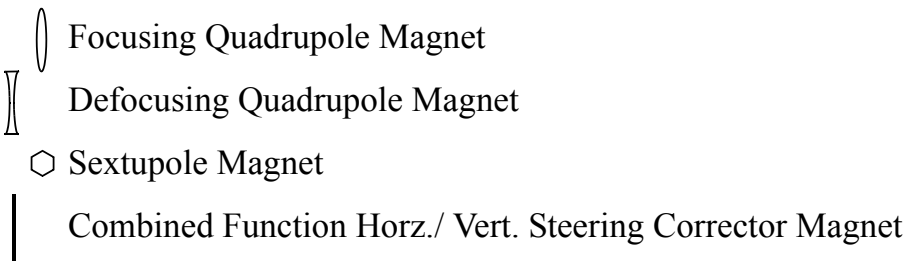
Insertion Device
Photon Beam Position Monitor
Blade Geometry



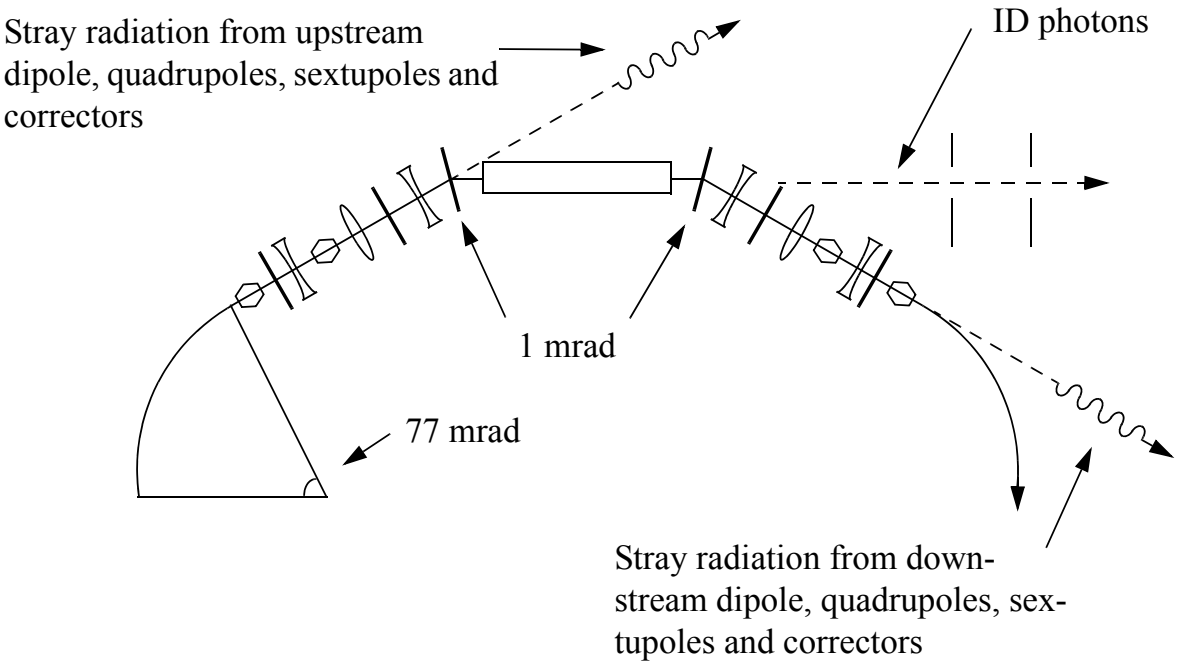
Stray Radiation Sources



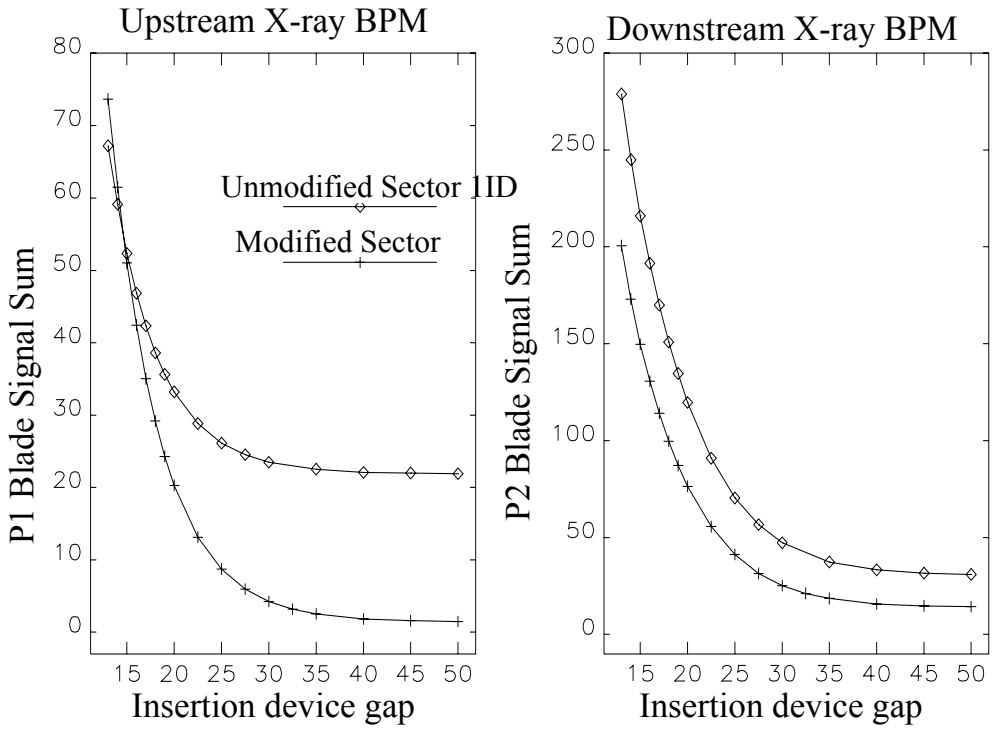
Legend



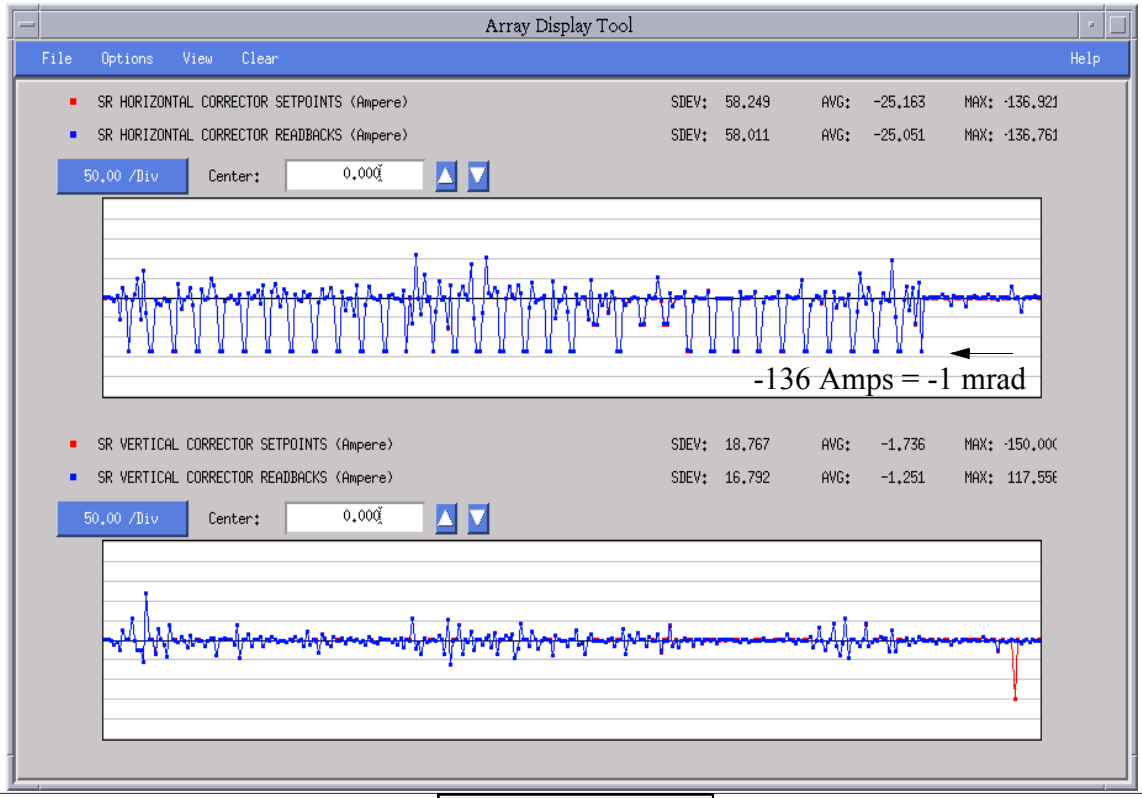
Re-direction of Stray Photons by Girder Alignment*



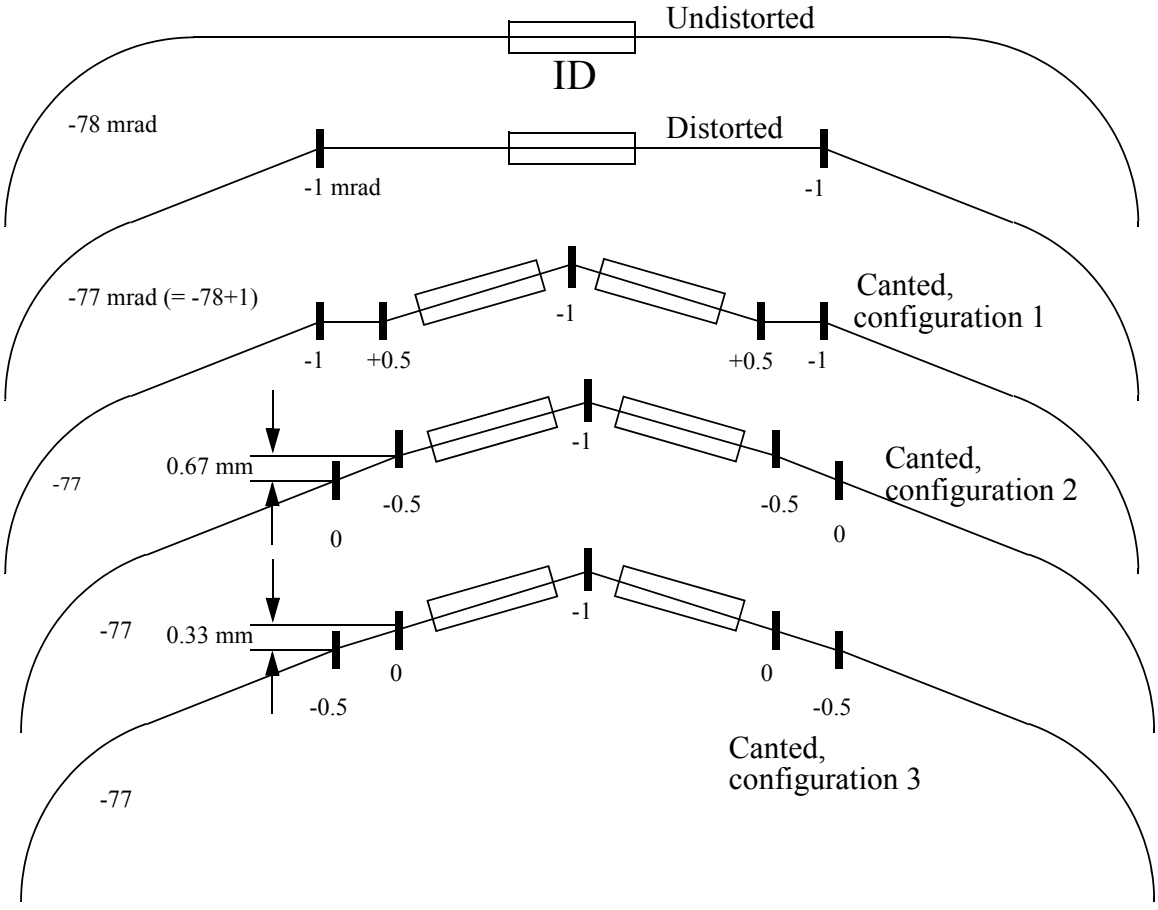
*Phys. Rev. ST Accel. Beams 2, 112801 (1999)



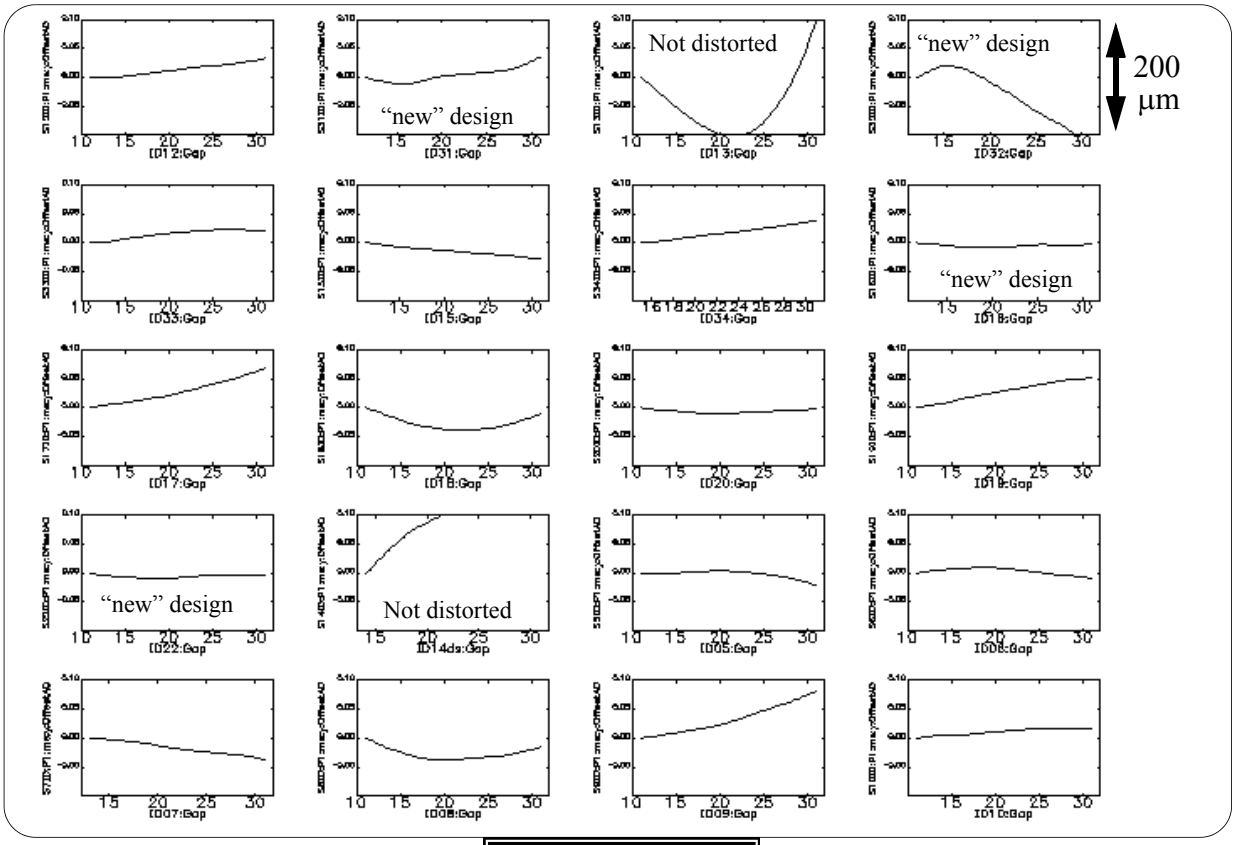
Raw Corrector Settings



Geometries of Canted Undulators and decker Distortions



BPM Offset vs. Gap Lookup Tables (Vertical)



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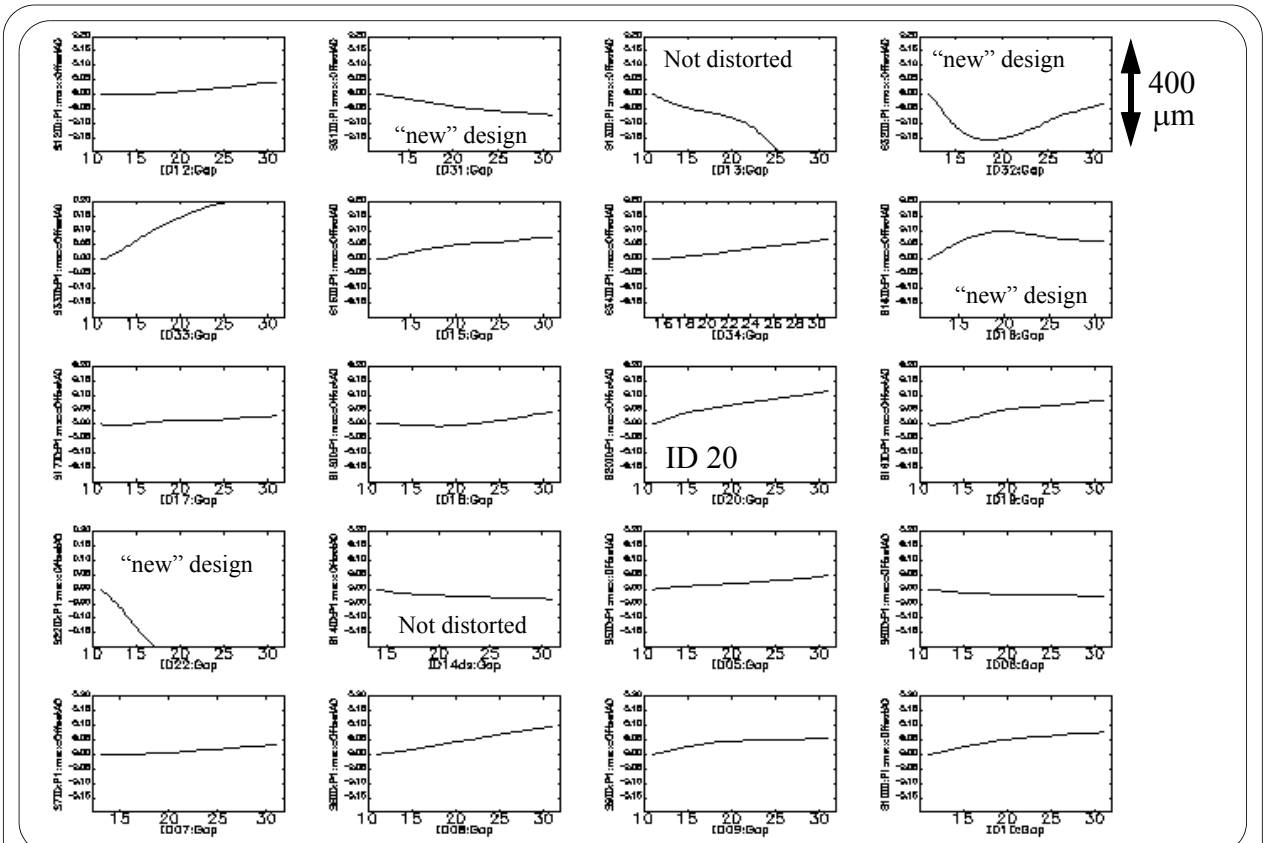
BPM Offset vs. Gap Lookup Tables (Horizontal)



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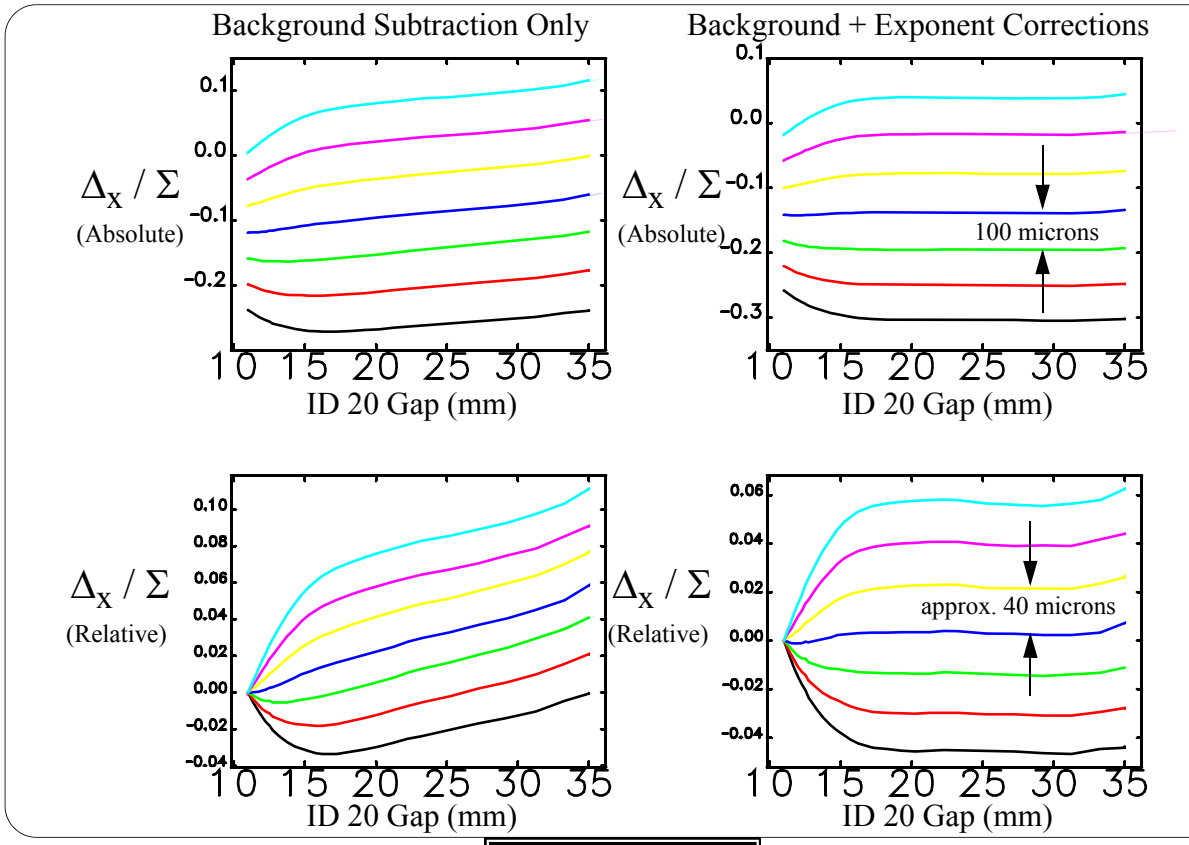
Correction of Residual ID Photon BPM Gap-dependent Systematic Errors



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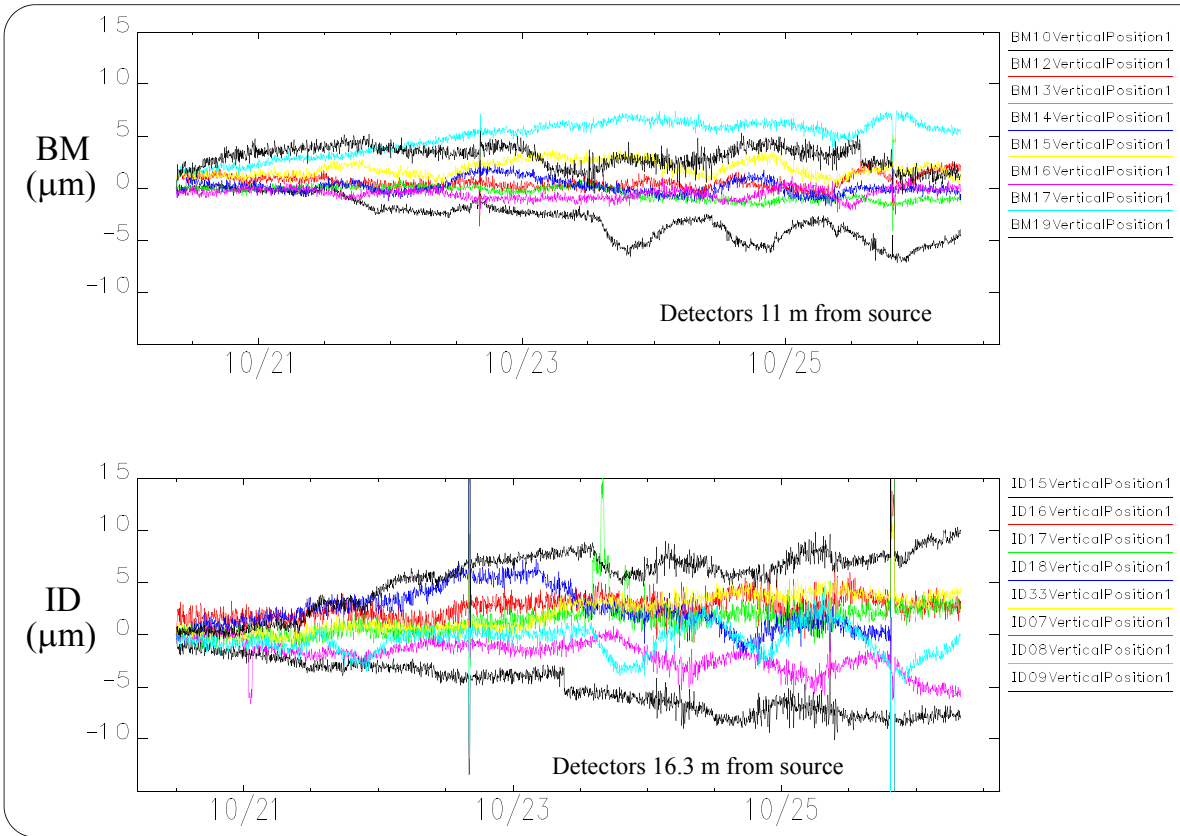
Long Term Drift of BM and ID Photon BPM Readbacks



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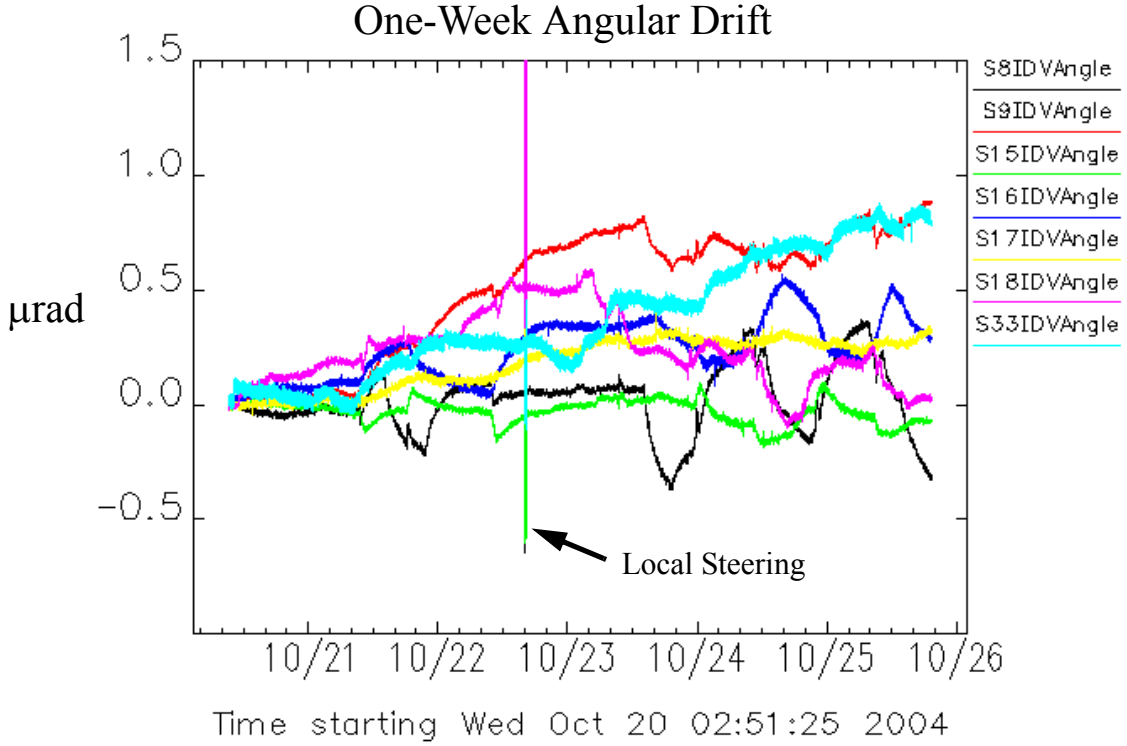
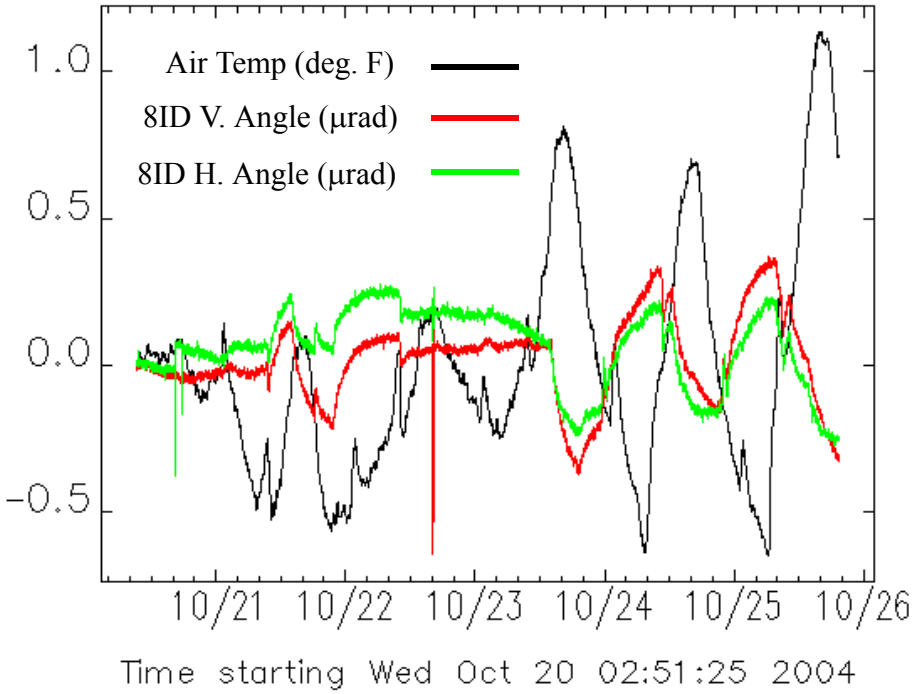
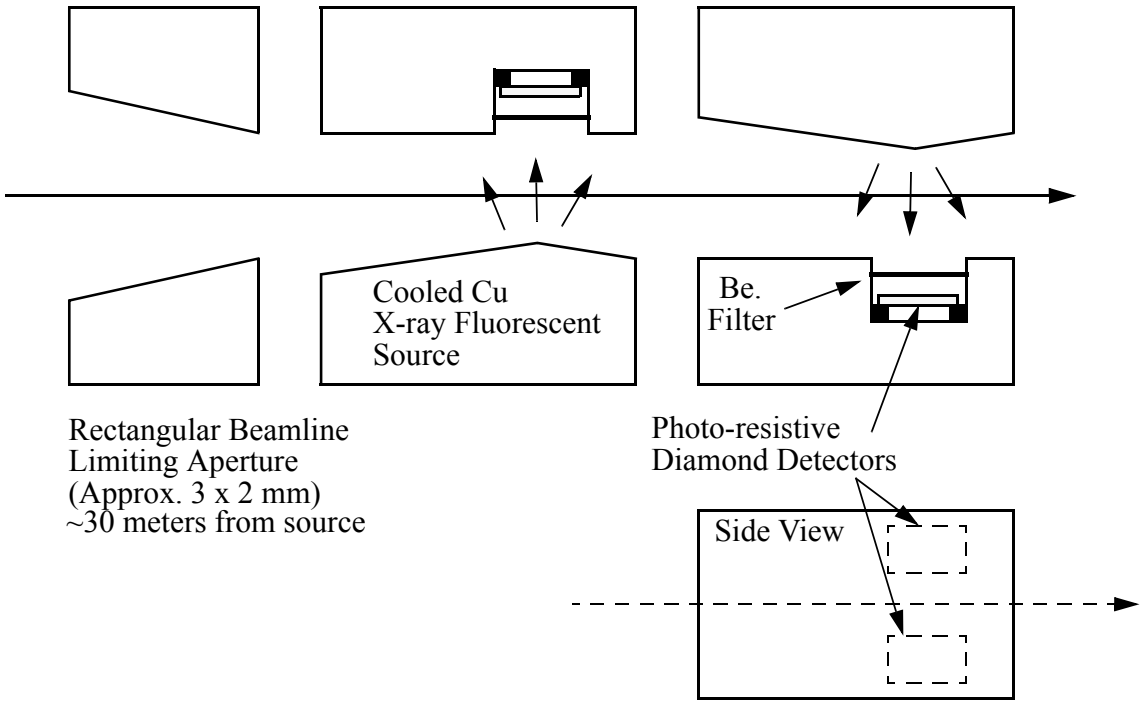
One-Week Angular Drift

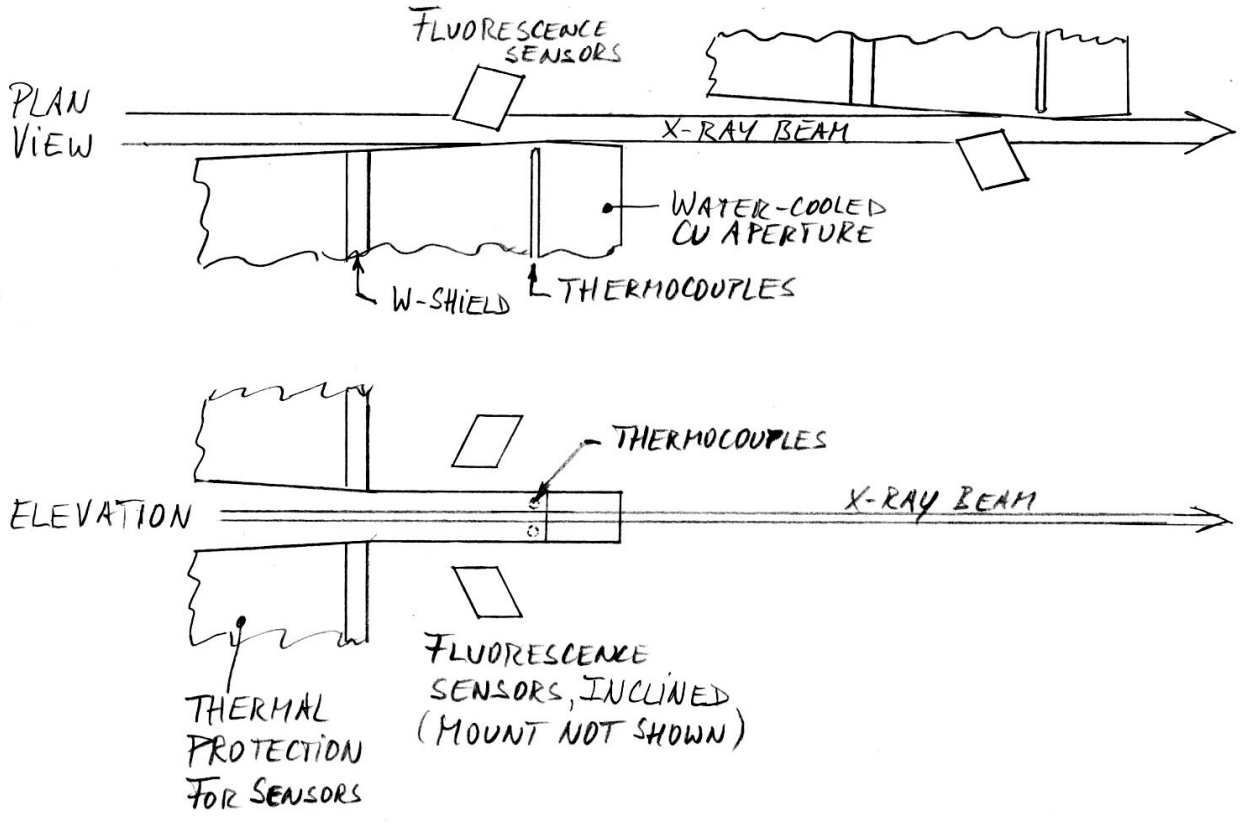


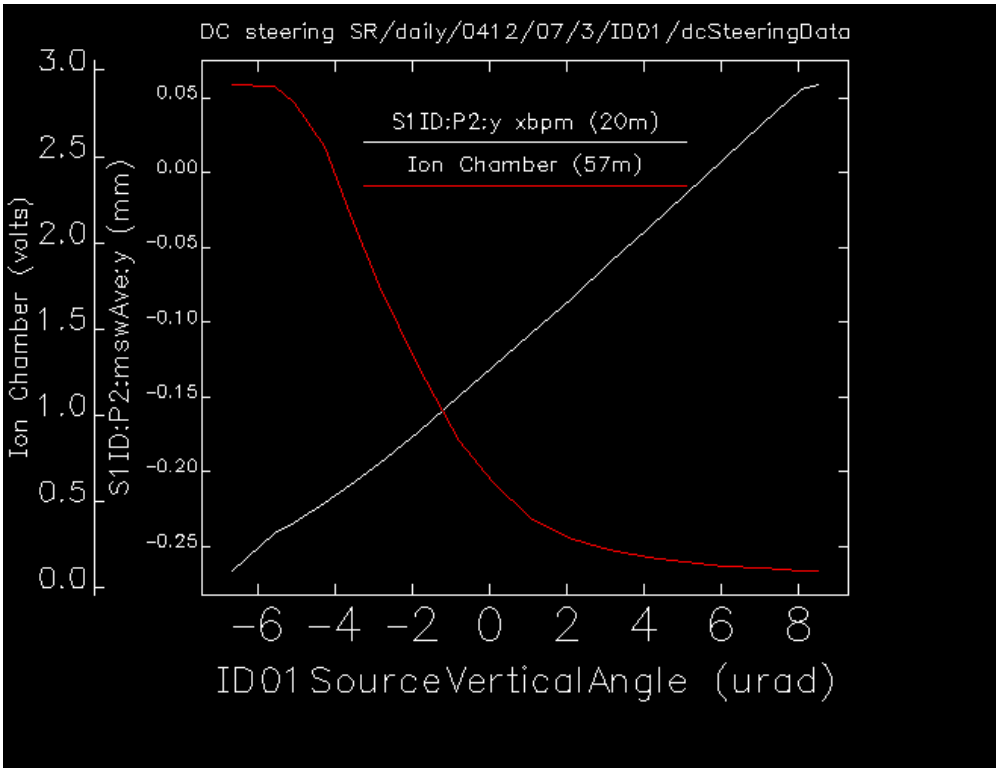
Local Tunnel Air Temperature Impacts Pointing Stability



Conceptual Design of Hard X-ray Beam Position Monitor (Top View)







Summary

- An extensive accelerator re-alignment is near completion after a 6-year effort, resulting in reduced insertion device photon bpm stray radiation background signals.
- Correction of residual gap-dependent systematic errors is presently performed using lookup tables.
- Careful alignment, background subtraction, and algorithm refinement should further reduce systematic errors to the +- 10 to 20 micron level (~0.5 - 1 μrad). (but depend critically on assumptions / constraints)
- Development of a “gold standard” hard x-ray bpm located 30 meters from the source should allow achieving +- 100 nrad-scale long-term pointing stability (perhaps the only way).