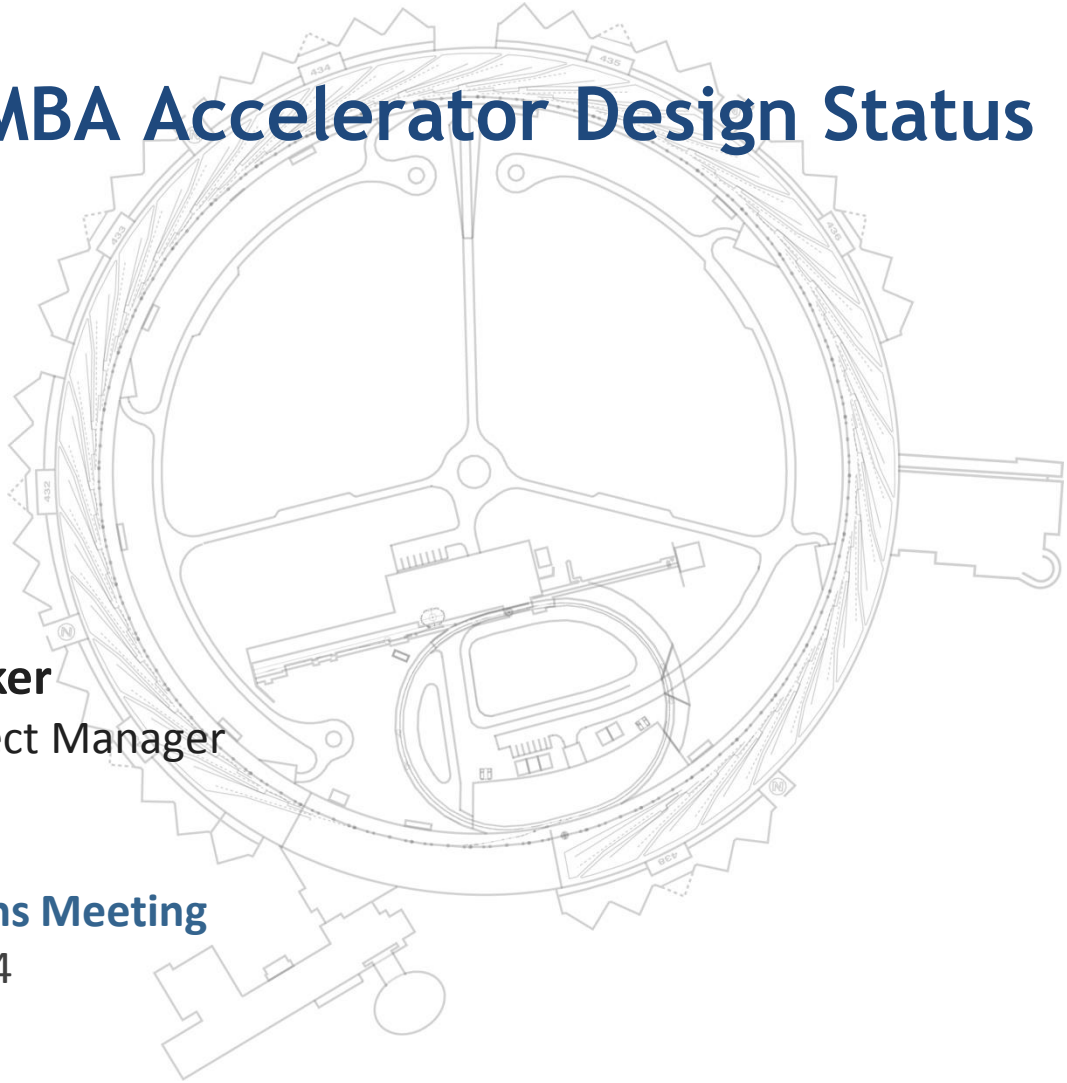
MBA Accelerator Design Status



Glenn Decker
Associate Project Manager
MBA@APS

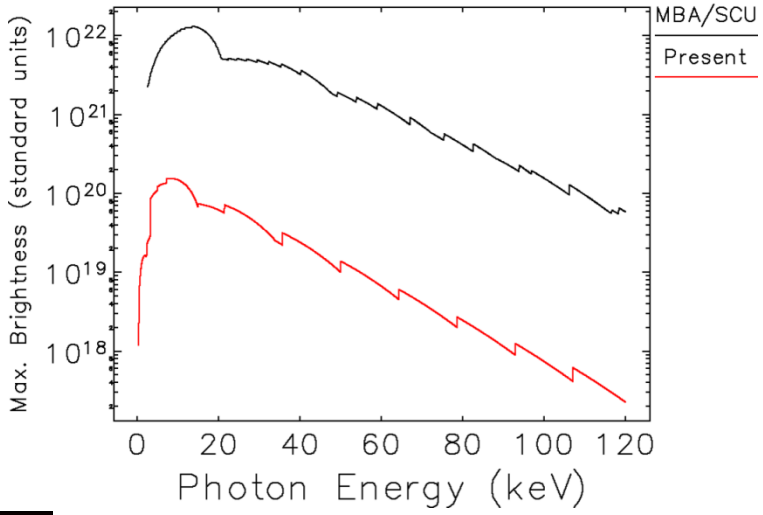
User Operations Meeting
March 26, 2014

Outline

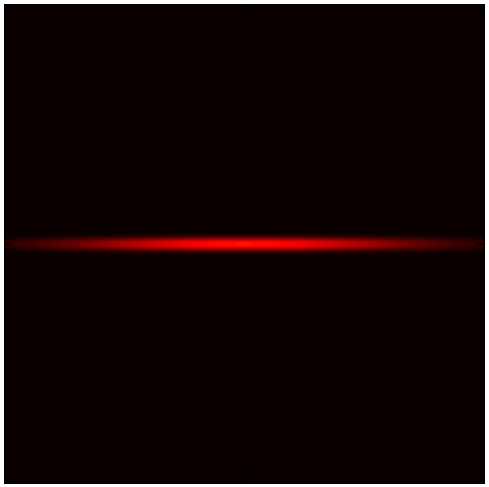
- MBA Overview
- Three-pole wiggler concept
- Technical reviews
- Outlook

APS MBA improvement

Dramatically enhance the performance of the APS as a hard x-ray source

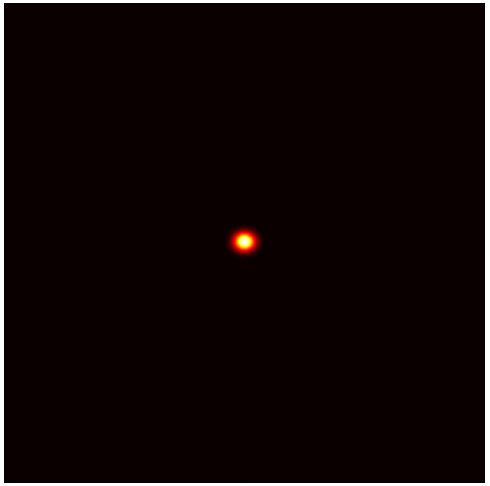


APS Now



Particle Beam Profiles

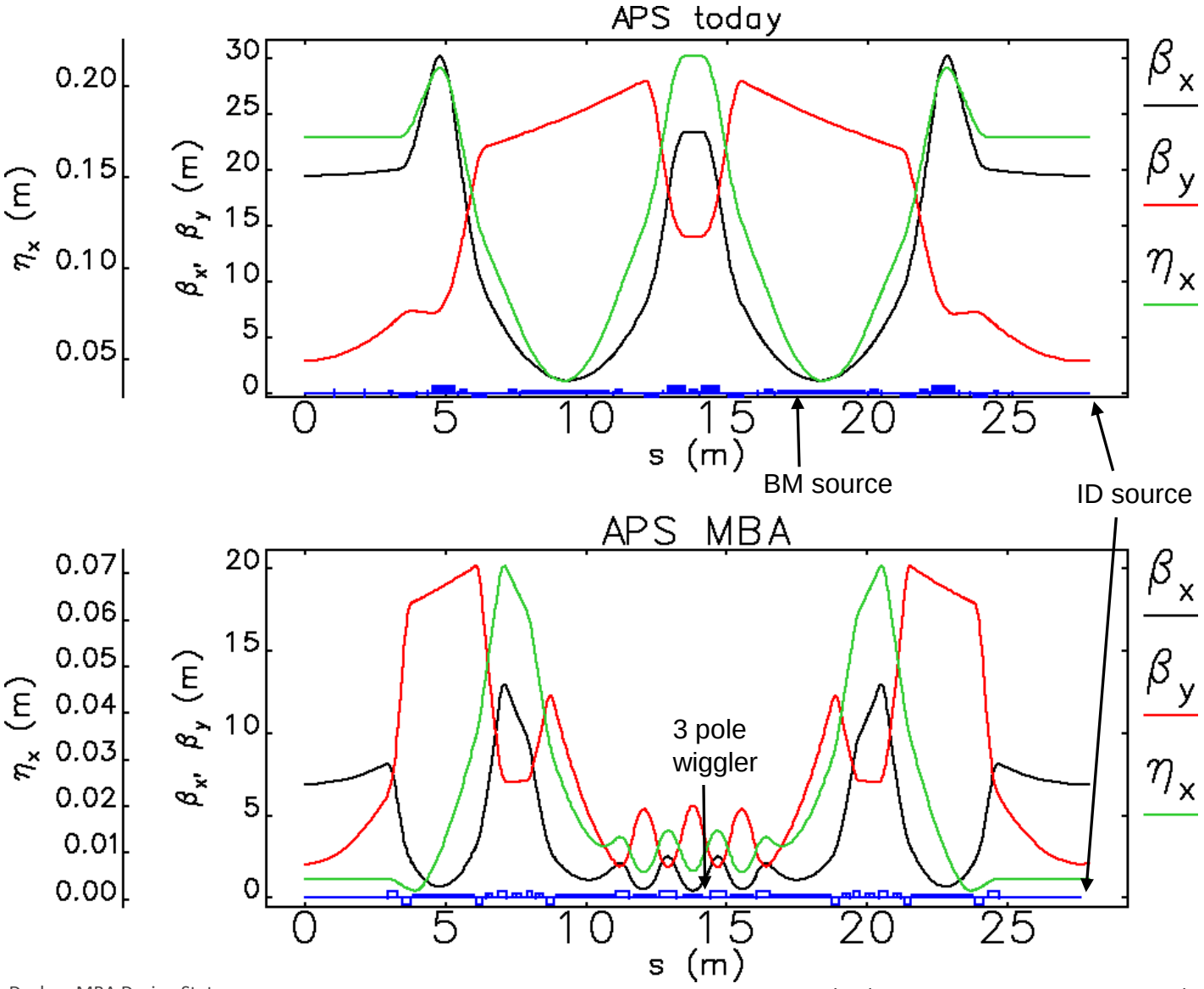
MBA



1 mm

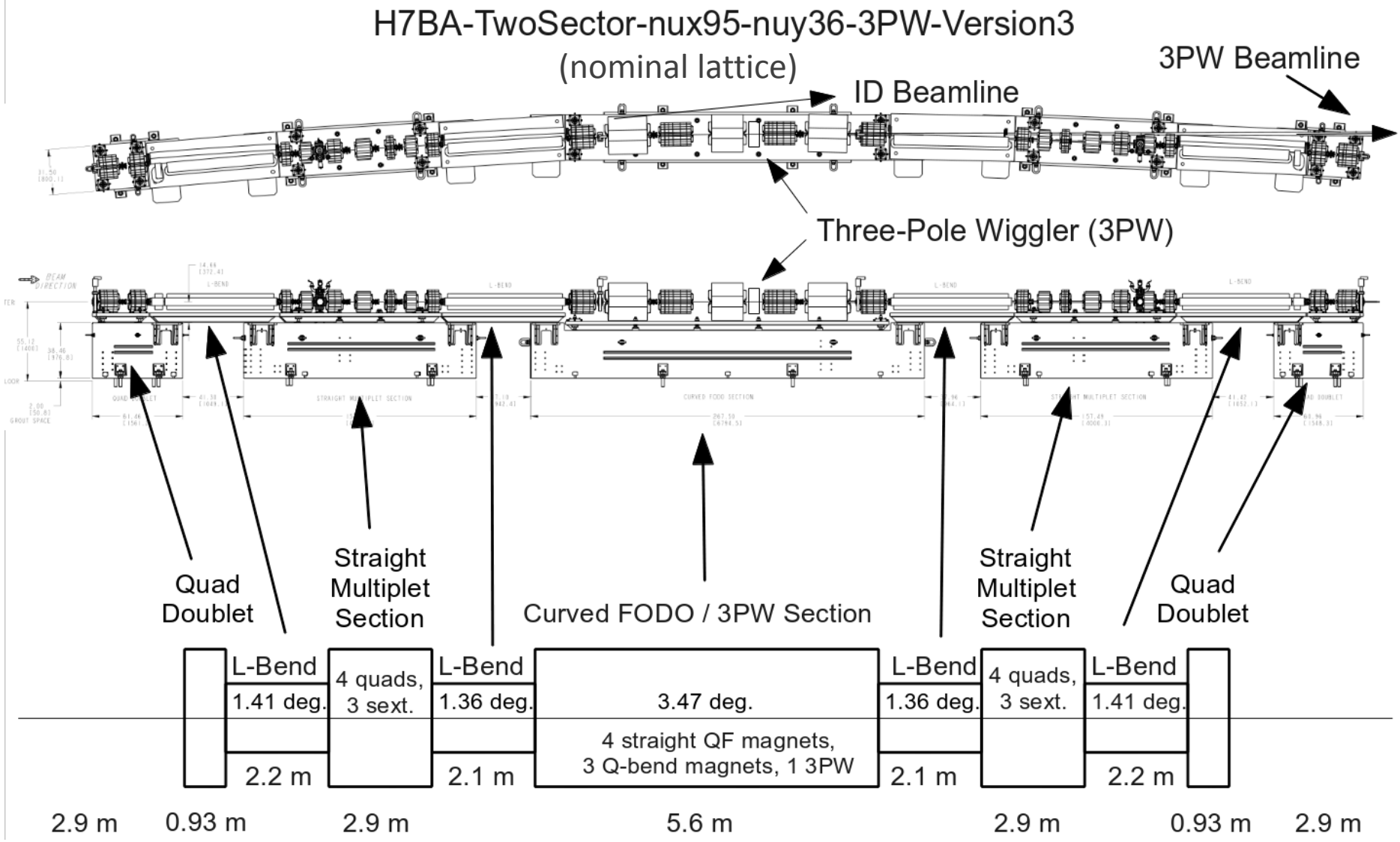
Comparison inspired by C. Steier, LBNL

MBA Lattice for the APS Tunnel



Hybrid 7BA Concept From P. Raimondi, ESRF

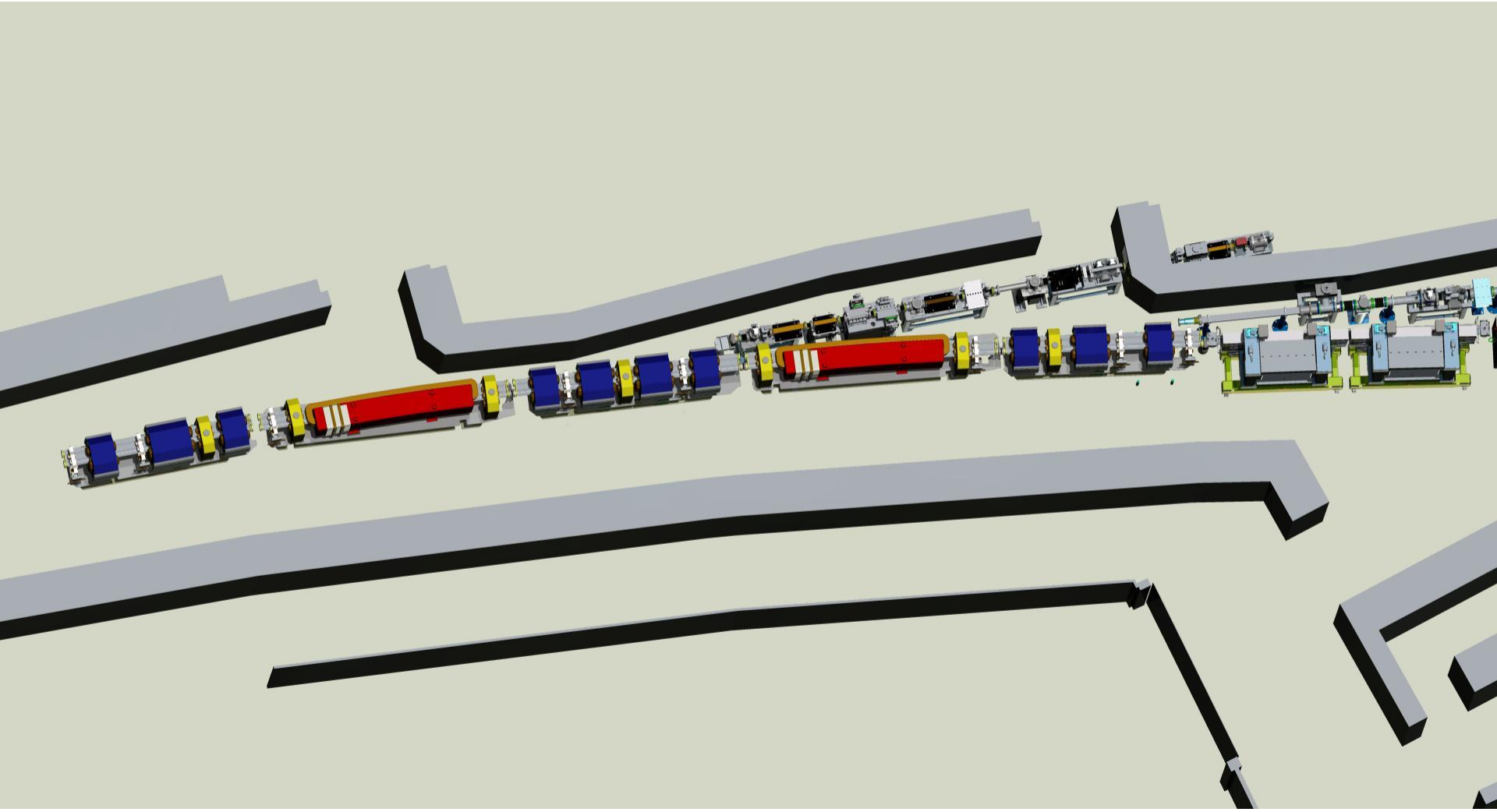
APS MBA Accelerator Implementation



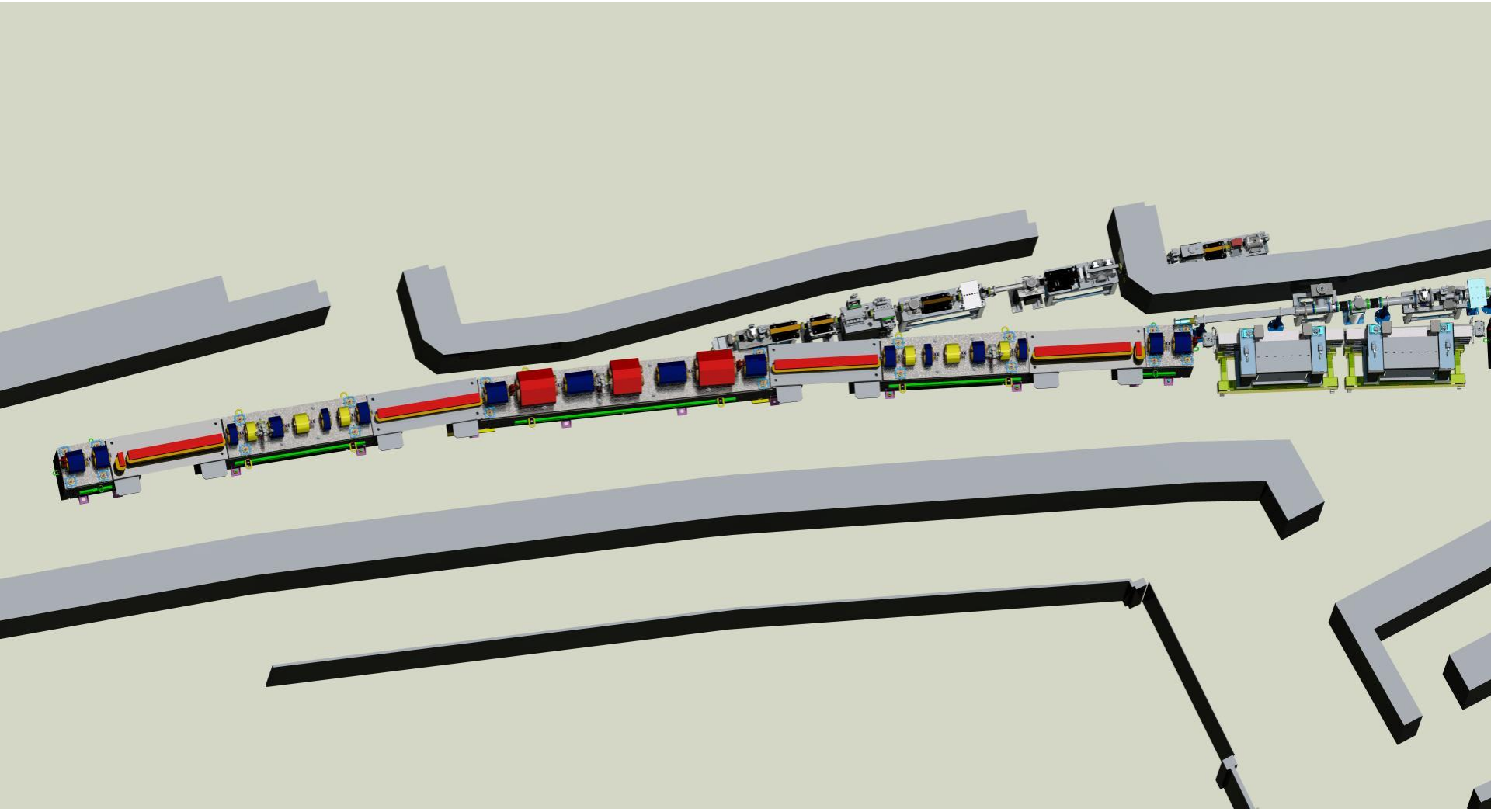
High-Level Machine Properties

	APS Now	MBA
Beam Energy	7 GeV	6 GeV
Beam Current	100 mA	200 mA
Effective Emittance	3100 pm-rad	65 pm-rad
Sectors	40	40
Circumference	1104 m	1104 m
RF Frequency	352 MHz	352 MHz
Minimum Bunch Spacing	11.4 ns	11.4 ns
Energy Spread	0.096%	0.095%
Dipoles / Sector	2	7
Quads / Sector	10	16
Sext. / Sector	7	6
Fast Correctors / Sector	1 to 2 / plane	4 / plane

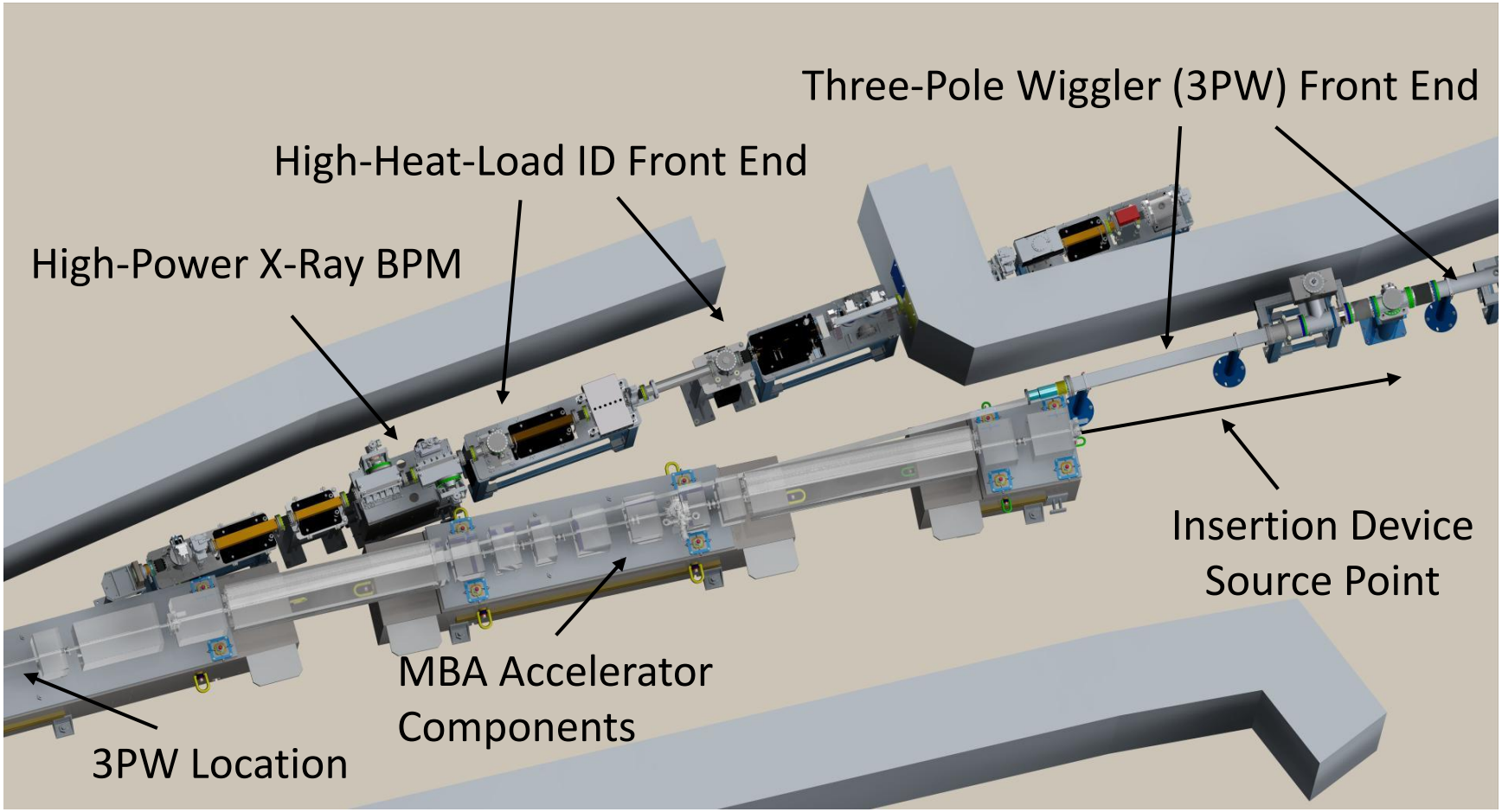
Current APS Storage Ring



APS MBA Storage Ring



In-Tunnel Arrangement of Components



APS-MBA High-Level Performance Goals

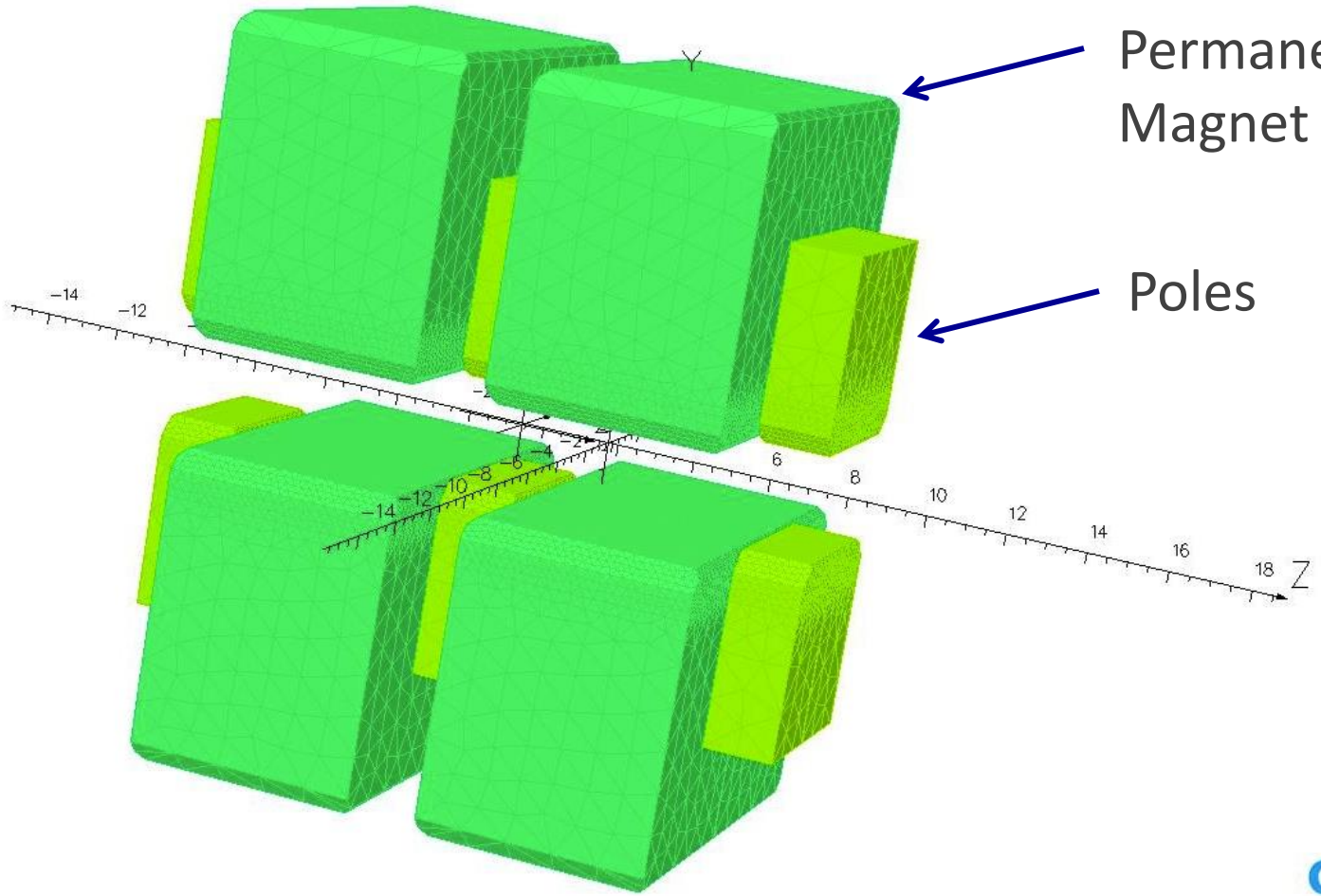
- More than two orders of magnitude increase in brightness at ID sources over a wide range of hard x-ray energies
- Significant improvement of coherent flux
- All insertion device beamlines including canted lines supported
- All BM beamlines supported, with greater flux and harder x-rays using three-pole wiggler source
- At least a factor of 2 increase in hard x-ray flux (BM and ID)
- 48 to 324 uniformly-spaced bunches supported

MBA ID Source Characteristics

Table 2.4: Parameters for ID source points for H7BA-TwoSector-nux95-nuy36-3PW-Version3

κ	σ_t ps	ϵ_x pm	ϵ_y pm	β_x m	β_y m	σ_x μm	σ'_x μrad	σ_y μm	σ'_y μrad	σ_δ 10^{-4}	$\tau_{10^{th}}$ h	$\Delta T_{\rm inj}$ s
$N_b = 48$		$f_b = 13.0$**MHz**				$Q_b = 15.3$**nC**						
1.00	53	47.9	47.9	6.8	2.2	18.2	2.7	10.2	4.7	1.02×10^{1}	1.92	14.4
$N_b = 81$		$f_b = 22.0$**MHz**				$Q_b = 9.1$**nC**						
1.00	53	45.0	45.0	6.8	2.2	17.7	2.6	9.9	4.5	9.93	3.01	13.4
$N_b = 162$		$f_b = 44.0$**MHz**				$Q_b = 4.5$**nC**						
1.00	50	42.9	42.9	6.8	2.2	17.3	2.5	9.7	4.4	9.75	5.20	11.6
$N_b = 216$		$f_b = 58.7$**MHz**				$Q_b = 3.4$**nC**						
0.40	51	55.7	22.1	6.8	2.2	19.6	2.9	6.9	3.2	9.74	5.70	9.5
$N_b = 324$		$f_b = 88.0$**MHz**				$Q_b = 2.3$**nC**						
0.11	53	66.1	7.1	6.8	2.2	21.4	3.1	3.9	1.8	9.79	5.70	6.3

Concept for the 3-pole wiggler



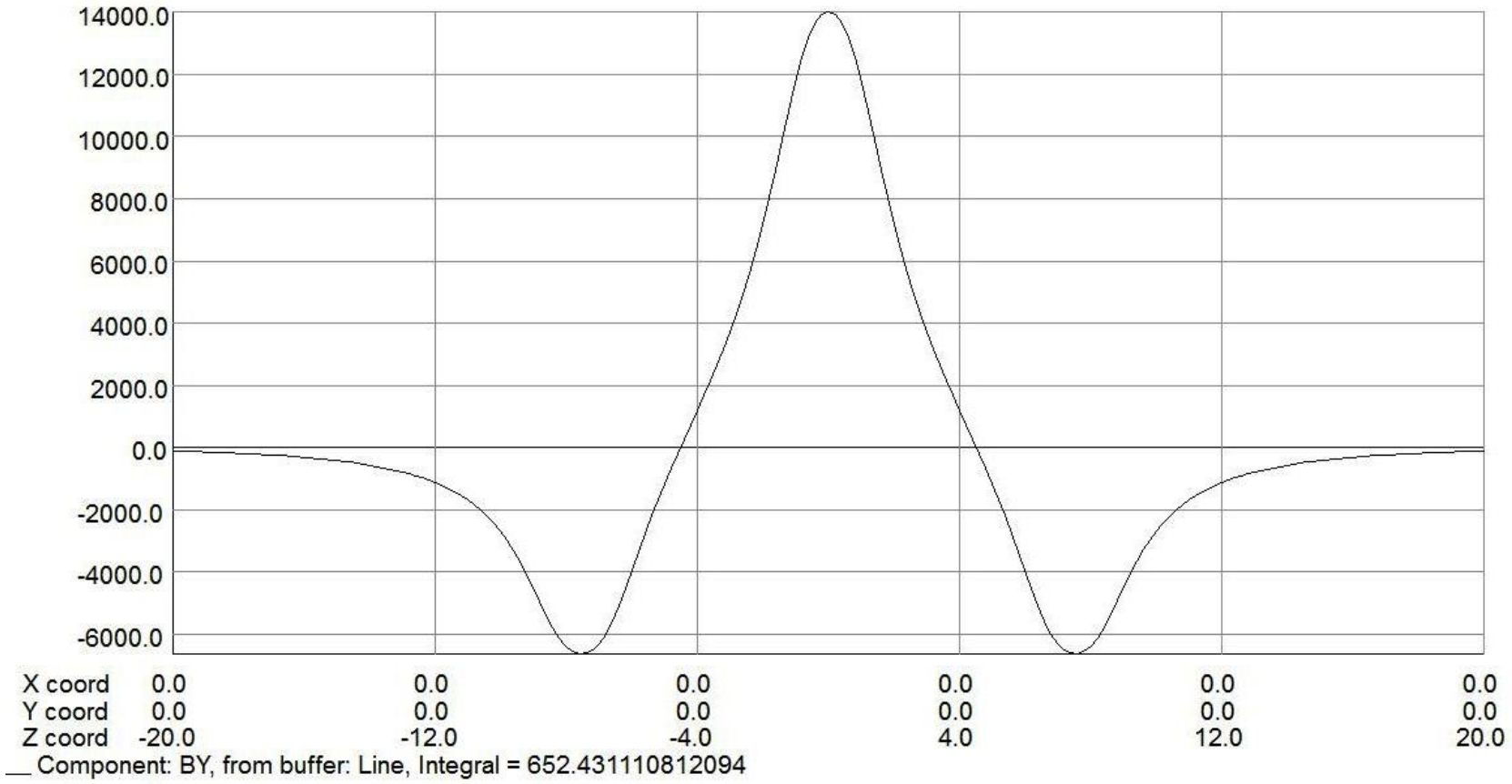
opera simulation software

- Design uses 4 permanent magnets and 6 vanadium permendur poles

By E. Moog

3 Pole Wiggler

Field on beam axis



Field under center pole = 14029 G; field under side pole = -6624 G

Wiggler period ~ 12 cm, K > 15, ε_c > 30 keV, K/γ ~ 1.3 mrad

Ongoing Technical Reviews

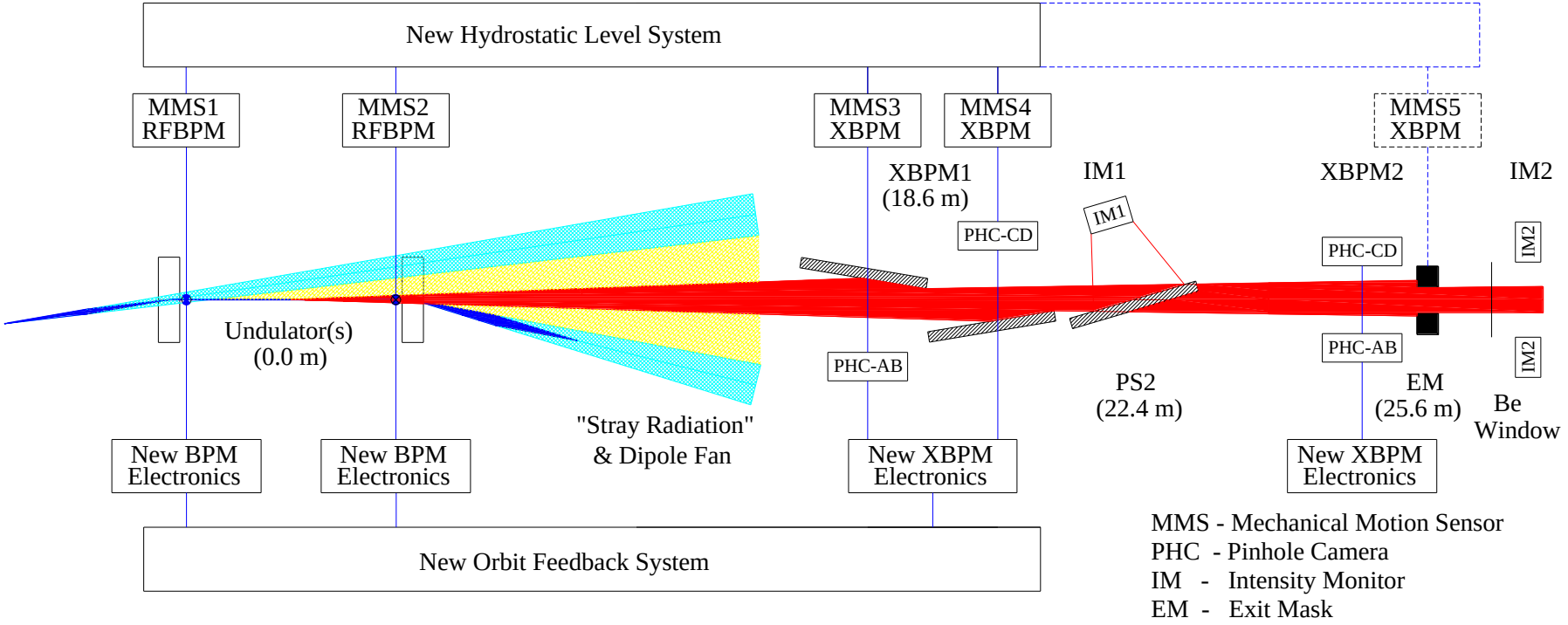
APS-U Upcoming Project Reviews

MBA Vacuum System Review	March 25, 2014
MBA Storage Ring Removal and New Storage Ring Installation Plan Review	March 27-28, 2014
MBA Magnet and Mechanical Support Review	April 1-2, 2014
MBA Power Supplies Review	April 3-4, 2014
MBA Pulsed Injection Systems Conceptual Design Review	April 8, 2014

Previous APS-U Project Reviews

MBA Diagnostics and Controls Review	March 20-21, 2014
MBA Beam Physics Design Review	February 13-14, 2014
MBA Magnet Measurement Workshop	January 28-29, 2014
Working Assumptions Document Review	December 16-18, 2013
MBA M1 Pre-Prototype Magnet Design Review	November 26, 2013

Orbit Stabilization Diagnostics – Undulator Source



Orbit Stabilization System for the APS-U includes a new orbit feedback system and improved electron and x-ray beam position monitors. R&D program at sector 27 will test many of these new diagnostic systems this summer.

MBA Diagnostics / Controls Conceptual Design Review* Recommendations - March 20-21, 2014

- The new diagnostics installation in BL27 is an excellent idea. It will be used for the new RF bpm system, GRID-XBPM, etc. It would also be beneficial to install good x-ray diagnostics further down the beamline so that the measurements of these diagnostics can be used to cross-correlate with the storage ring diagnostics.

Committee members:

Jim Sebek – SLAC / SSRL
Mark Rivers – University of Chicago
Barry Lai - ANL
Dave Gurd – SNS (retired)

Outlook

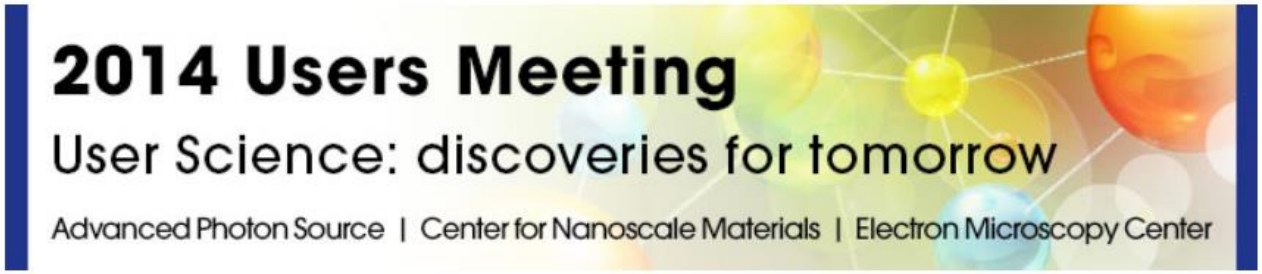
- Technical reviews complete April, 2014
- Prototype activities for magnets, vacuum, etc. ongoing
- Conceptual Design Report preparation April-May
- Cost estimates now starting in earnest
- Director's review late summer
- Ready for CD-1 review September, 2014

Home
Registration
Program/Agendas
Deadlines
Poster Submission
Travel and Lodging

Awards
Social Events
Exhibitors List
Download poster

Guidelines
- Registration FAQ
- Exhibitors
- Workshop organizers

Facilities
- APS
- CNM
- EMC



Cross-Facility Workshop B—The APS MBA Upgrade: Introduction and Scientific Opportunities

Tuesday, May 13, 2014
Location TBD

Organizers: Dean Haeffner and Jonathan Lang (APS)

jump to agenda »

OVERVIEW

Session I: Introduction to the APS MBA Upgrade (morning)

This workshop is a series of tutorial lectures designed to educate the participant on technical subjects related to the APS MBA Upgrade proposal. Talks will cover accelerator design (from a user's point of view), optics, detectors, and X-ray theory that are relevant to understanding and fully utilizing the extremely high brilliance provided by the low-emittance storage beam after the MBA upgrade.

Session II: APS MBA Upgrade Science Opportunities (afternoon)

This session will feature talks highlighting the science opportunities provided by a storage ring approaching the diffraction limit. Subjects would include CDI/ptychography, XPCS, wide-field imaging, nanoprobe imaging, and other subjects that particularly benefit from low emittance. Speakers would be instructed to be speculative and forward thinking. The goal of the session is to inspire the audience to project their own needs onto the capabilities of an MBA based APS by showing exciting examples and, consequently, to further enhance the science case for the APS MBA Upgrade.