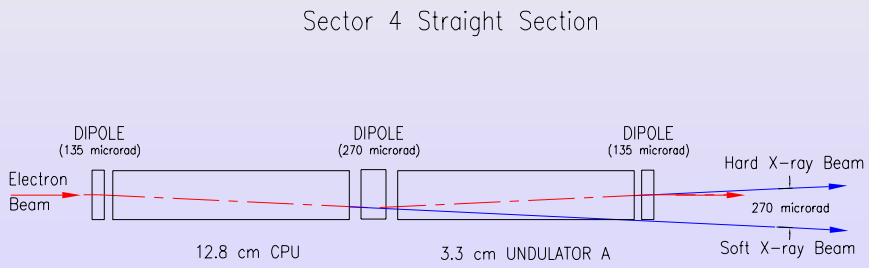
Canted Undulator FE Installations at the APS

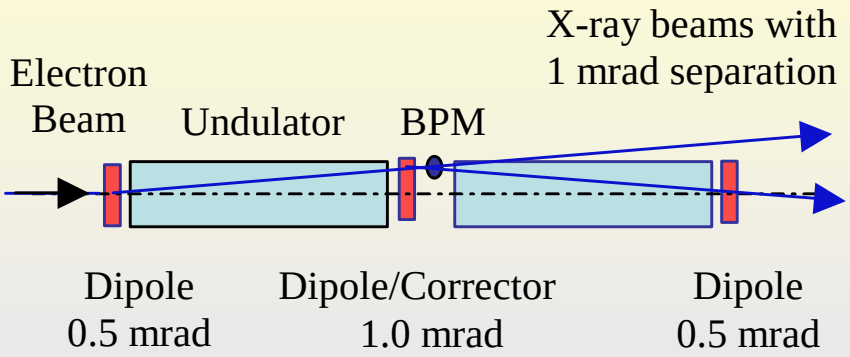
Patric Den Hartog
XF Engineering Group
Experimental Facilities Division

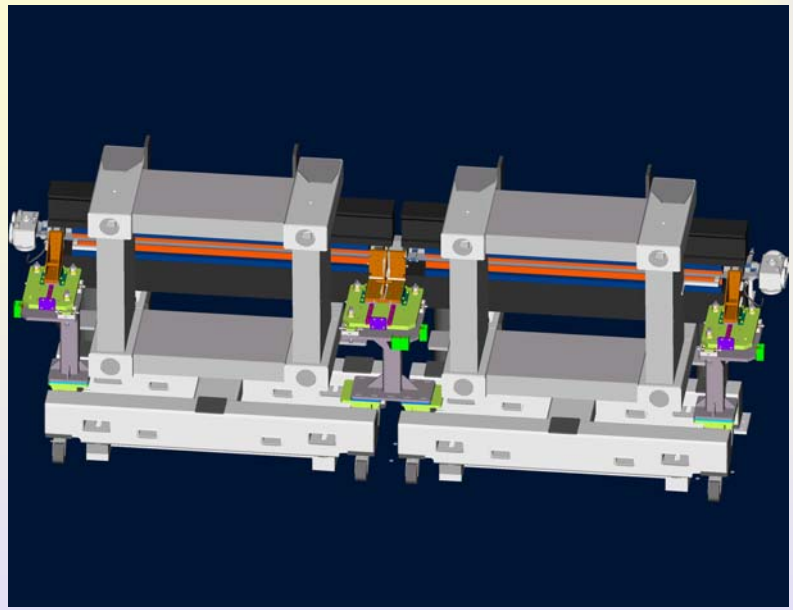
Canted Undulator Concept

- **Canted Undulator at APS**
  - First application in sector 4
    - Hard and soft x-ray branches
    - CPU and UA
  - PM dipoles
  - 270μ rad offset augmented with pair of horizontally deflecting mirrors



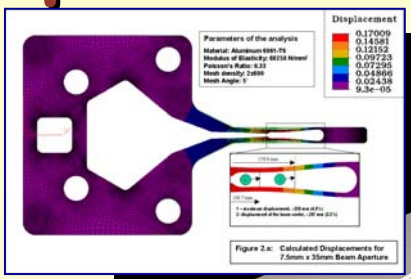
New Canted Undulator Layout

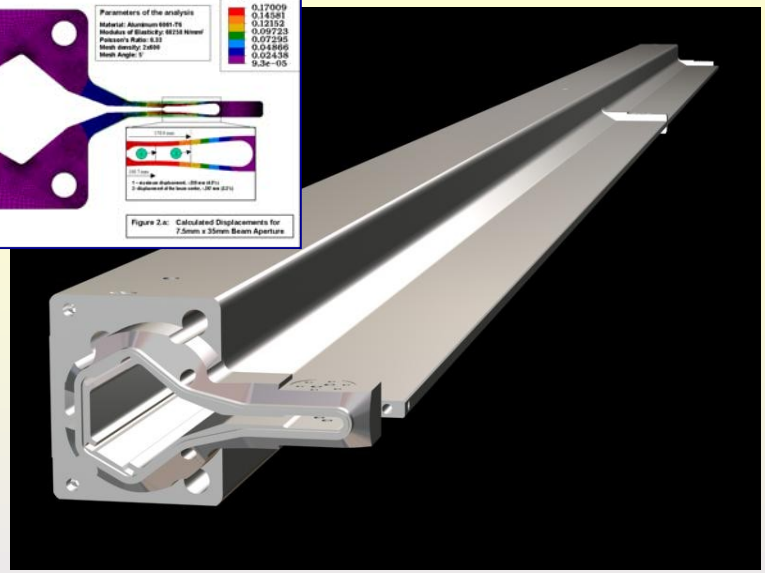


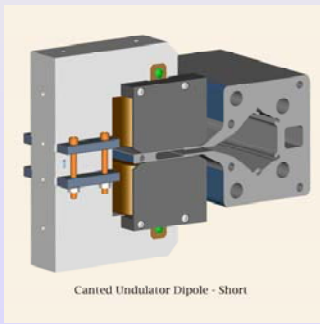


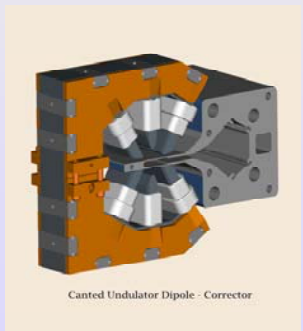
ID VC and Dipoles for CU

- ID VC
  - New extrusion
    - Oval instead of ellipse
  - Chamber design includes central BPM
- Dipoles
  - Electromagnet
  - Matched for single PS
  - Fit over ID VC



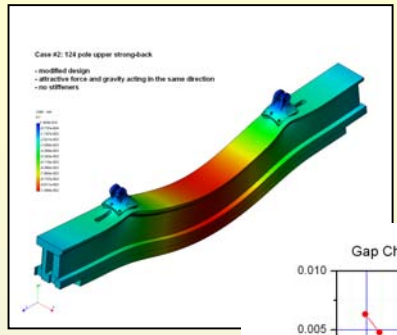


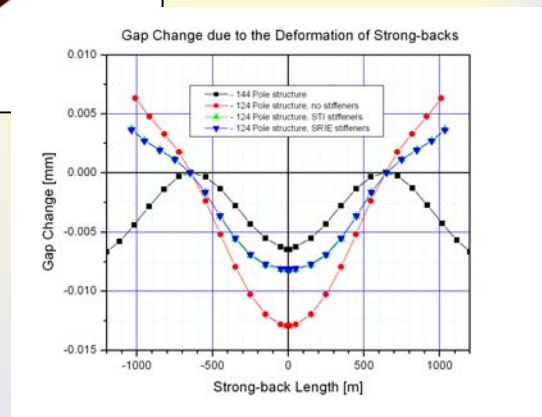


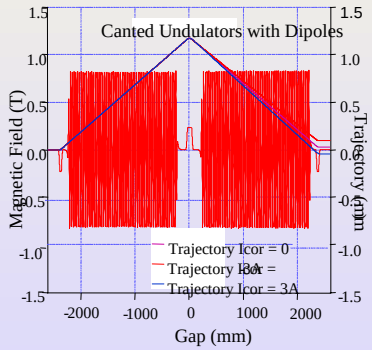


Modification of UA Strongback

- Created space for dipoles and corrector by removing 10 periods
  - Changes deflection of strongback

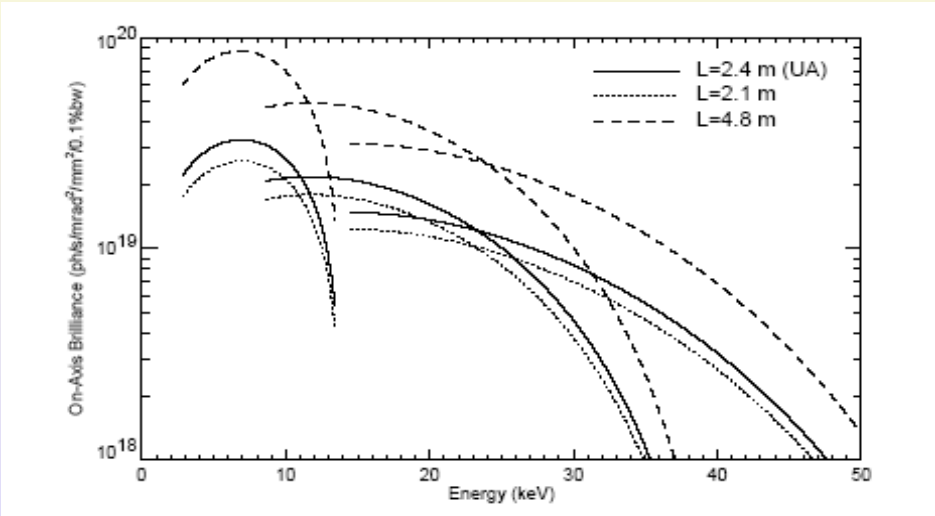






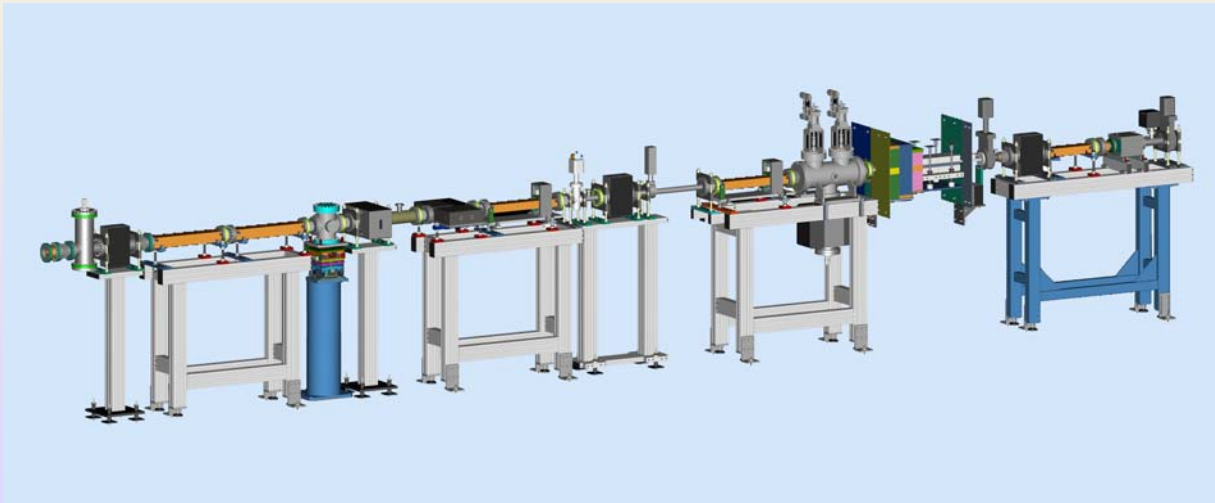
Tuning Curves

Energy (keV)		L=2.4 m; N=70 (Undulator A)	L=2.1 m; N=60 (Canted)	L=4.8 m; N=142 (Tandem)
7	(1^{st})	3.29×10^{19}	2.61×10^{19} (1.50)	8.69×10^{19} (1.37)
10	(1^{st})	2.60×10^{19}	2.07×10^{19} (1.48)	6.76×10^{19} (1.35)
20	(3^{rd})	1.62×10^{19}	1.33×10^{19} (1.28)	3.61×10^{19} (1.13)
30	(5^{th})	8.71×10^{18}	7.27×10^{18} (1.17)	1.86×10^{19} (1.07)



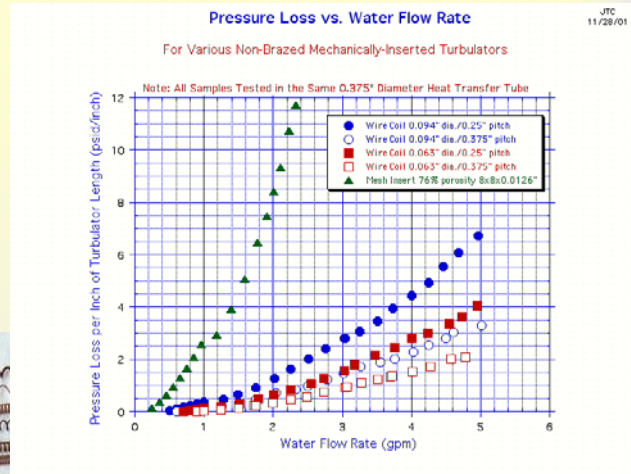
CU FE

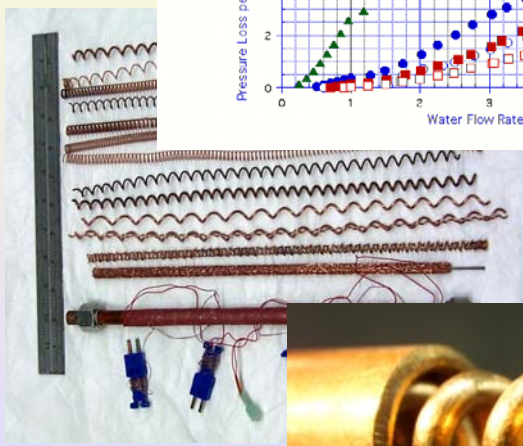
- **200 mA operation at K=2.78 (10.5 mm)**
  - **Total power from two undulators = 20.4 kW**
  - **Power density at normal incidence = 281 kW/mrad^2**

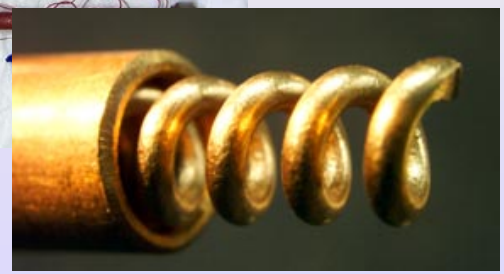


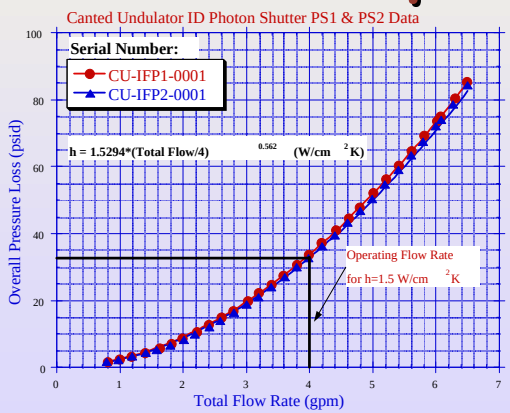
Wire coil enhancement of Heat Transfer Coefficient

- Replaces copper mesh
- Resists corrosion and clogging
- Lower pressure drop



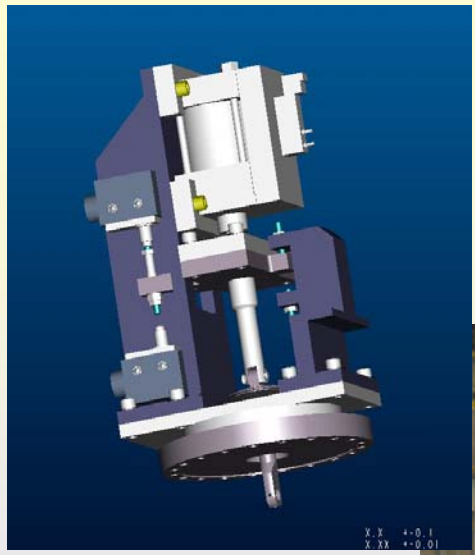






New Actuator Assembly

- **Improves maintainability**
  - Design concept can be applied to Safety Shutters and Photon Shutters
    - Common air cylinder usage
    - Integrated air solenoid and manifold
    - Replace without breaking vacuum or losing alignment
  - Currently have designs for CU SS, Vs. 1.2 PS and BM PS



CU Installation Status

- S23 FE installed in SR
  - Exit Mask & BeW to be installed
    - FOE under construction
  - ID VC and IDs installed
- S24 and S21
  - Wall collimators installed
  - Utilities installed
  - S24 ID VC installed
  - S24 Undulators being assembled

Canted Undulator (Sector 23) Commissioning

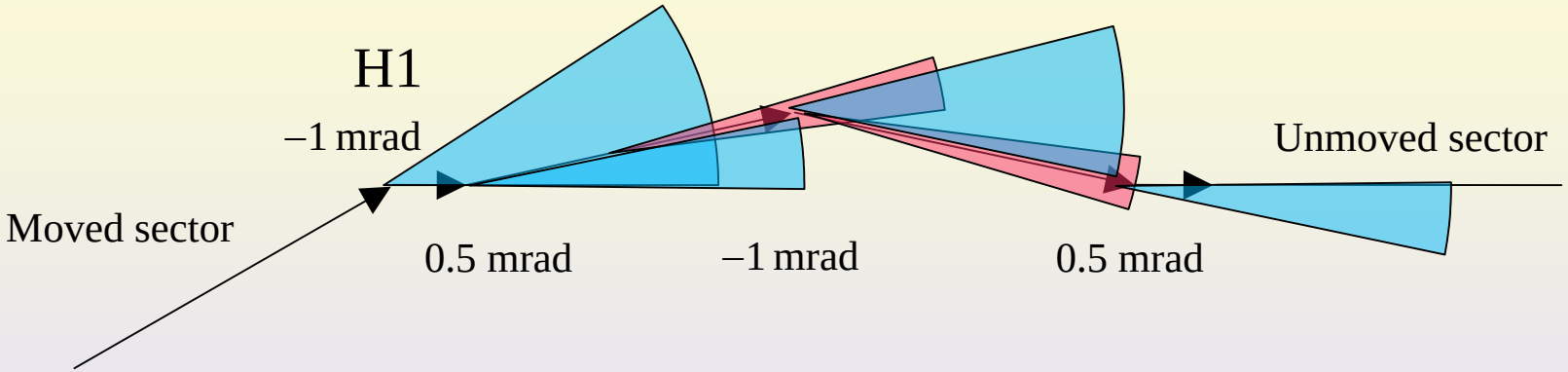
- **Photon beam stays inside tunnel**
  - Front-end (FE) installed but no First-Optics Enclosure (FOE)
- **Steered beam to the center of FE components**
  - Used rf BPMs offsets, quadrupole and girder alignment for dead-reckoning steering
  - X-ray BPMs available. ID P1 and P2 side-by-side
- **Turned on dipole magnets**
  - Checked amplitude and closure condition

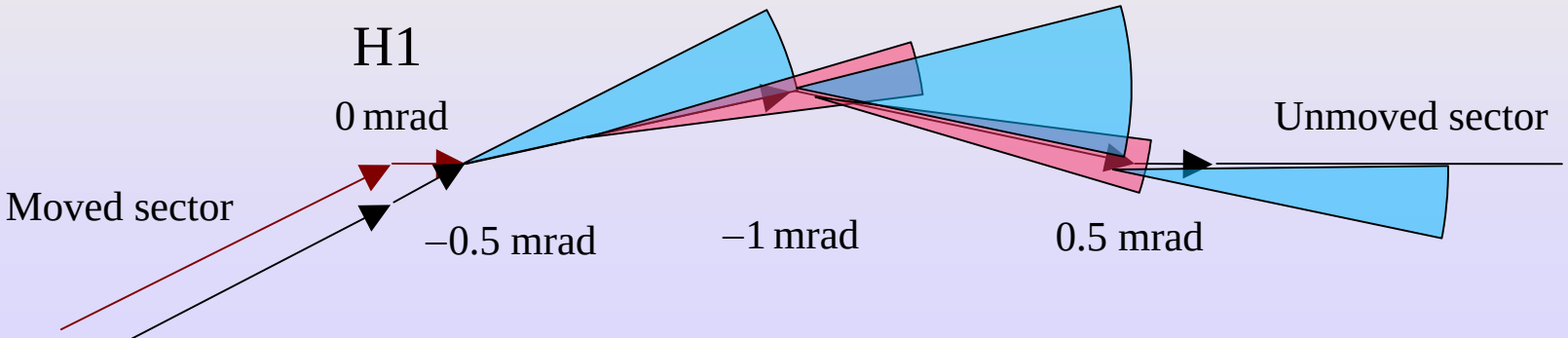
Canted Undulator (Sector 23) Commissioning

- Turned on H/V corrector magnets
  - Checked response
- Measured ID perturbation on orbit
- Scanned beam to outgas PS1
- Checked new BPLDs
- Commissioning into FOE scheduled for July

Canted Undulator (Sector 23) Commissioning

- **Measure dipole fan background on Xbpms with two dipole magnet configurations**





FE Installation Schedule

Activity Name	Start Date	ID VC Type	Finish Date	2002	2003				2004				2005			
				Fourth	First	Second	Third	Fourth	First	Second	Third	Fourth	First	Second	Third	Fourth
GM/CA ID VC	12/26/02	CU 7.5mm	1/20/03													
GM/CA CU FE Sector 23	5/1/03		6/2/03													
NE ID VC	5/1/03	CU 7.5 mm	6/2/03													
NE CU FE sector 24	9/1/03		10/1/03													
LS ID VC	9/1/03	CU 7.5 mm	10/1/03													
LS CU FE Sector 21	12/27/03		1/22/04													
GM/CA BM FE Sector 23	5/1/04		6/3/04													
IXS ID VC (5 m)	5/3/04	7.5 mm	6/2/04													
IXS FE	9/1/04		10/1/04													
Nano ID VC	8/27/04	7.5 mm	9/28/04													
Nano FE	1/3/05		2/2/05													
NE BM FE Sector 24	9/2/05		10/4/05													
				Fourth	First	Second	Third	Fourth	First	Second	Third	Fourth	First	Second	Third	Fourth