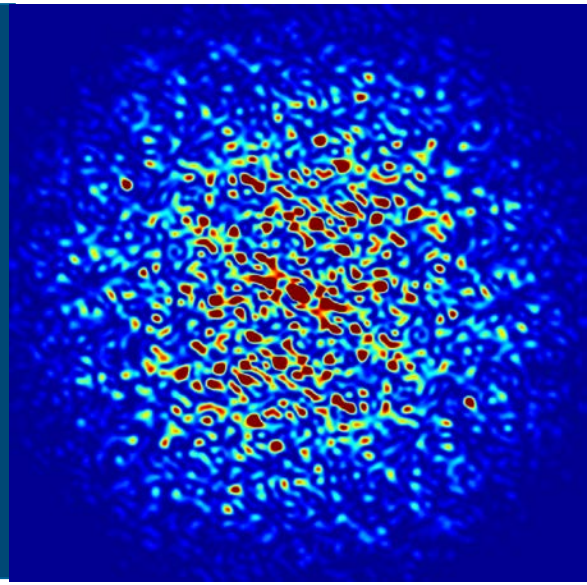
Bending Magnet Beamline Source



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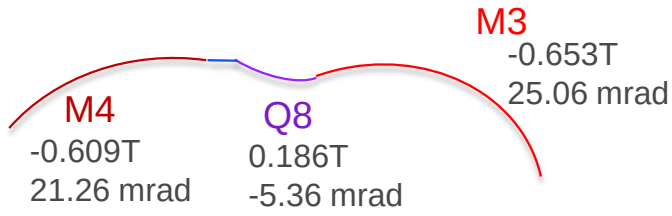
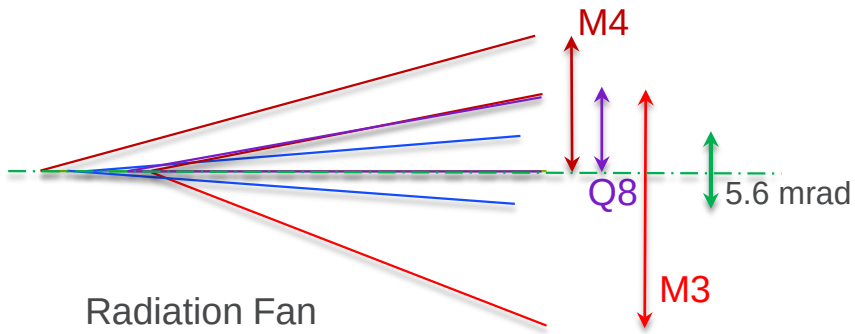
Bending Magnet Beamline Source

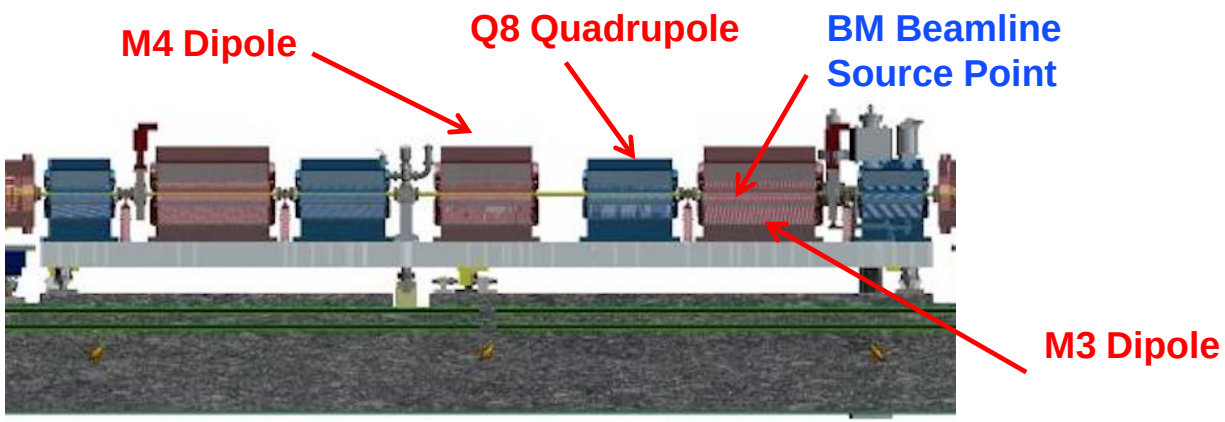
- The APS-U BM beamline source is complex due to the MBA lattice and the reverse bend makes it even more complex
- Angle between center of BM fan and the ID centerline has been kept the same from APS to APS-U
- APS-U BM beamline centerline will be displaced laterally inboard by 36.1 mm while keeping the angle the same (M3 magnet source point)
- The reverse bend lattice overlays the two dipole sources (M4 and M3) and the Q8 (weak dipole) on top of each other
- Beamlines will see a combination of three sources (M4+Q8+M3) on the outboard half and a clean M3 source on the inboard



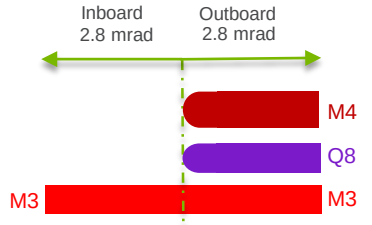
Schematic of radiation sources



Radiation Fan



FODO Section



View from beamline

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Bending Magnet Beamline Source

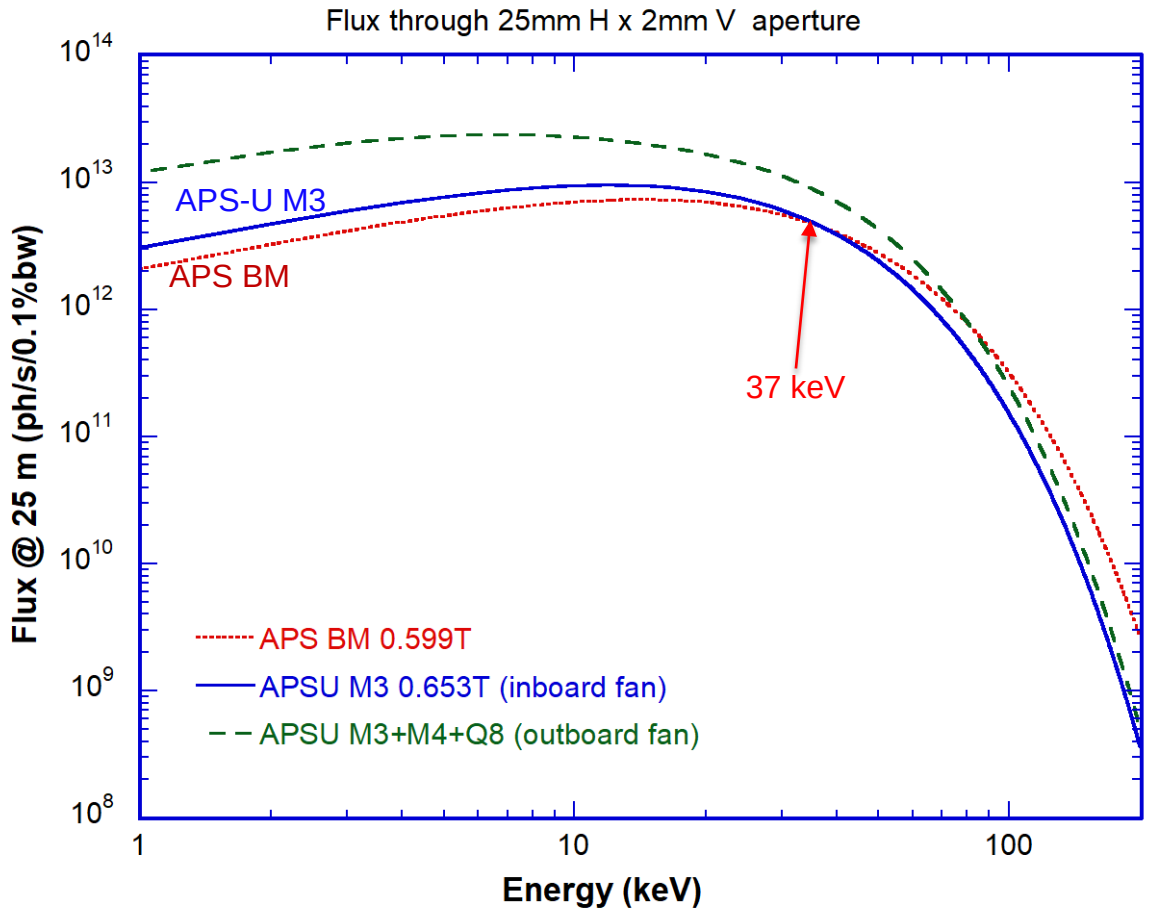
Source Magnet	Max Field (T)	Critical Energy (keV)	Horizontal Fan (mrad)	Ave Power/mrad (W)	Max Power Density (W/mm^2)
APS BM (current)	0.599	19.519	78.54	87	1.24
M3 Magnet Downstream	0.653	15.633	25.06	119	1.27
Q8	0.186	4.453	-5.36	34	0.34
M4 Magnet Upstream	0.609	14.580	21.26	111	1.09
Inboard (M3)			2.8*	119	1.27
Outboard (M4+M3+Q8)			2.8*	257	2.7

Power density is at current 25 m point from the source (Current APS BM source)
All APS-U sources have been adjusted to reflect the distance from sources (1.822 m upstream for M3, 3.071 m upstream for M4, 2.709 m upstream for Q8)
Magnets above are for APS-U 6 GeV 200 mA except APS BM which is 7 GeV 100 mA
* Amount of radiation accepted by BM front end as determined by the fixed mask 3

Existing BM front ends were designed for (300 mA 7 GeV) 261 W/mrad and can handle the combined power loads

Bending Magnet Beamline Source

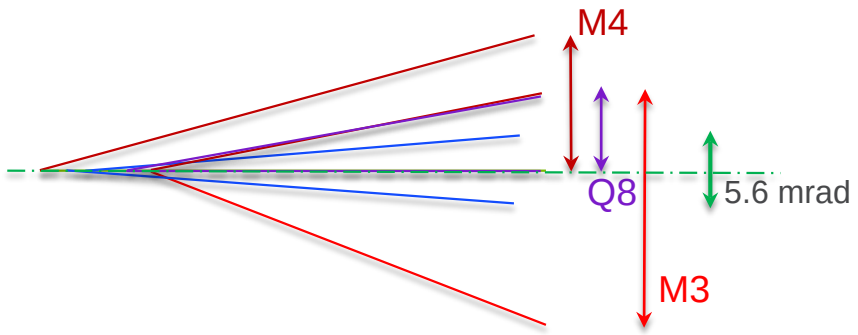
- The radiation fan for the new BM source will be different between the inboard and outboard fans (outboard has multiple magnet sources)
- M3 and M4 serve as two individual sources. The longitudinal distance between the two sources are about 1.24 m
- The inboard fan is a clean source from M3
- The outboard fan may cause problems for some experiments, but when focused, the beams can be separated specifically between M3 and the other magnets
- Most BM beamlines can be aligned to use the clean M3 radiation (inboard 2.8 mrad fan)



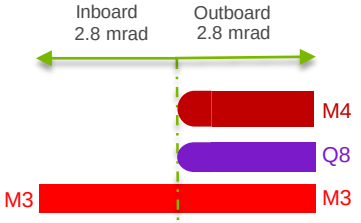
Flux on BM beamlines is higher than existing BM source for all energies up to 37 keV with very little increase in power and power density

Bending Magnet Beamline Path Forward

- Beamlines using 1mrad of BM radiation can align the beamline to the clean M3 source :
  - Will involve in addition to a lateral shift of 36.1 mm inboard a 0.5 mrad angle shift as well
- Beamlines using more than 1 mrad of BM radiation:
  - Use the center of the fan as one edge (no soft BM radiation edge) and rotate the beamline inboard by half the amount of fan accepted for a clean M3 source
- Beamlines splitting the beam for multiple branches:
  - Use the center of the fan as center of split.
  - Inboard beam will be a clean M3 source
  - Outboard branch will be a combination of 3 sources separated by ~1.25 m resulting in different focus spots (if focused)



Radiation Fan



View from beamline

Bending Magnet Beamline Path Forward

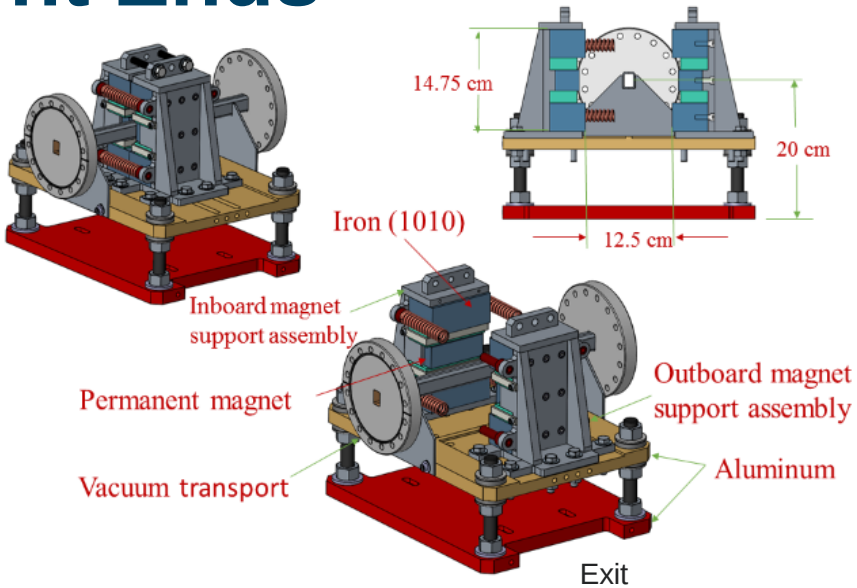
- APS-U project will provide resources to move all the BM beamlines as needed
- A plan for each beamline will be developed in collaboration with the beamline staff
- ICD similar to ID beamlines will be developed.

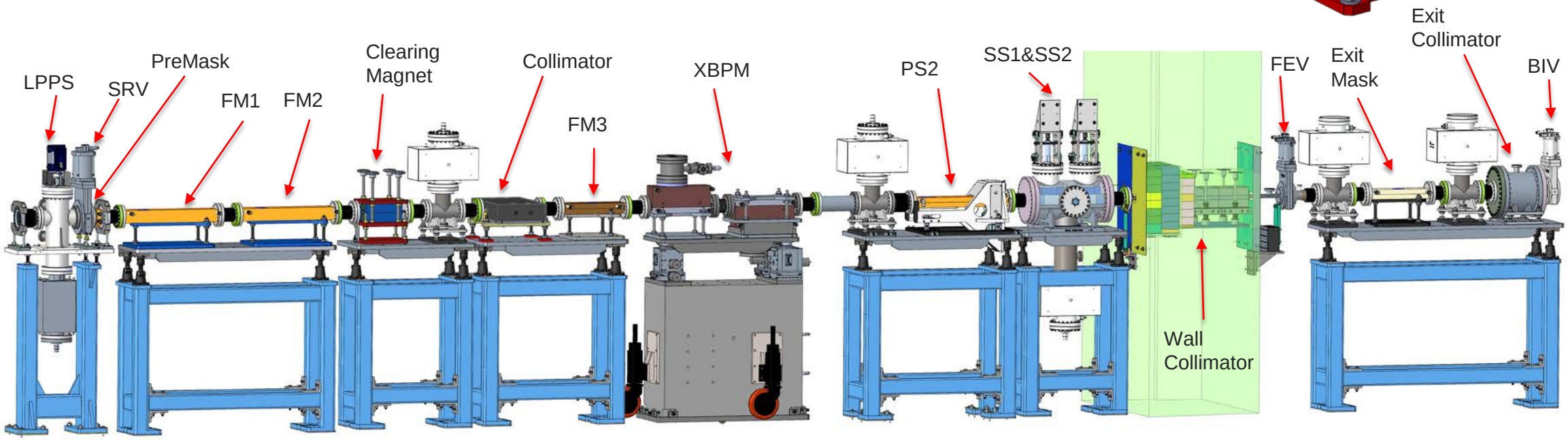
- A few outstanding issues still exist:
  - Anticipate a larger bremsstrahlung doses on backwall of all BM FOE due to the a combination of multiple factors in the storage ring
  - May require some additional local shielding on back wall

- Evaluation underway to see if the amount of BM radiation accepted by the front end can be restricted to only the clean M3 source
  - Makes the clearing magnet in the front end easier to make
  - Possible bremsstrahlung doses on the FOE backwall be reduced by an order of magnitude

Clearing Magnets in Front Ends

- Every front end for APS-U requires a clearing magnet for swap-out injection with shutters open
- Clearing magnet is a permanent magnet device located in the front end
  - Provided to deflect unintentional electrons of 6 GeV ever travelling outside the ratchet wall when the shutters are open
  - Deflect down for HHL FE and inboard for Canted and BM FEs





Insertion Devices and FE status

- We are starting the procurement of components for the front end
- Final decision on choice of HHL /CU front end has to be completed by June 30, 2018
- Few ID beamline ICD still in draft format – Have to to be completed by June 30, 2018

- Insertion Devices selection plans are finalized – need completed ICD by June 30, 2018
- Procurement of undulator assemblies for 28mm period will start in July 2018