

Final transport to Storage Ring

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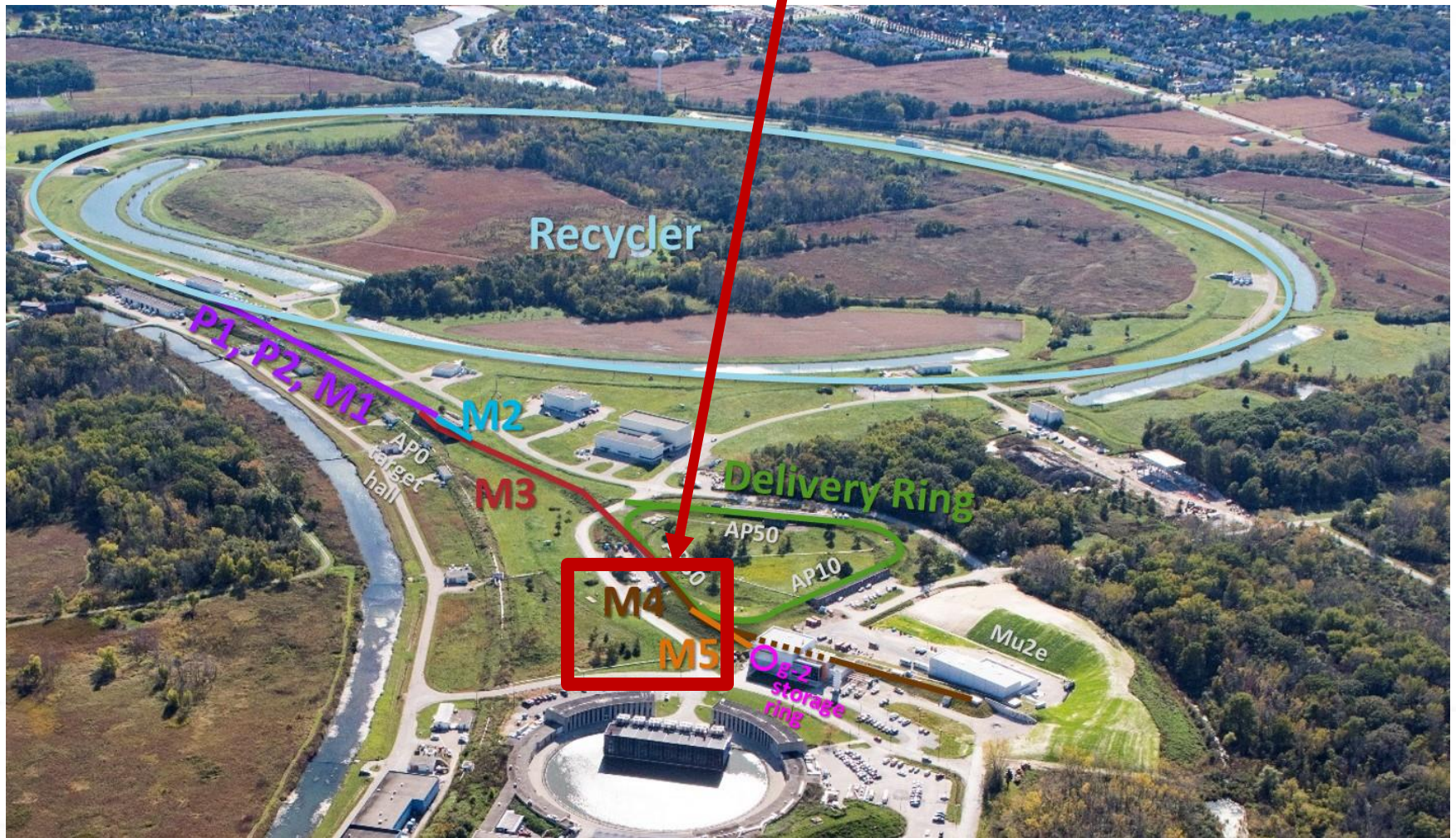
Fermi National Accelerator Laboratory

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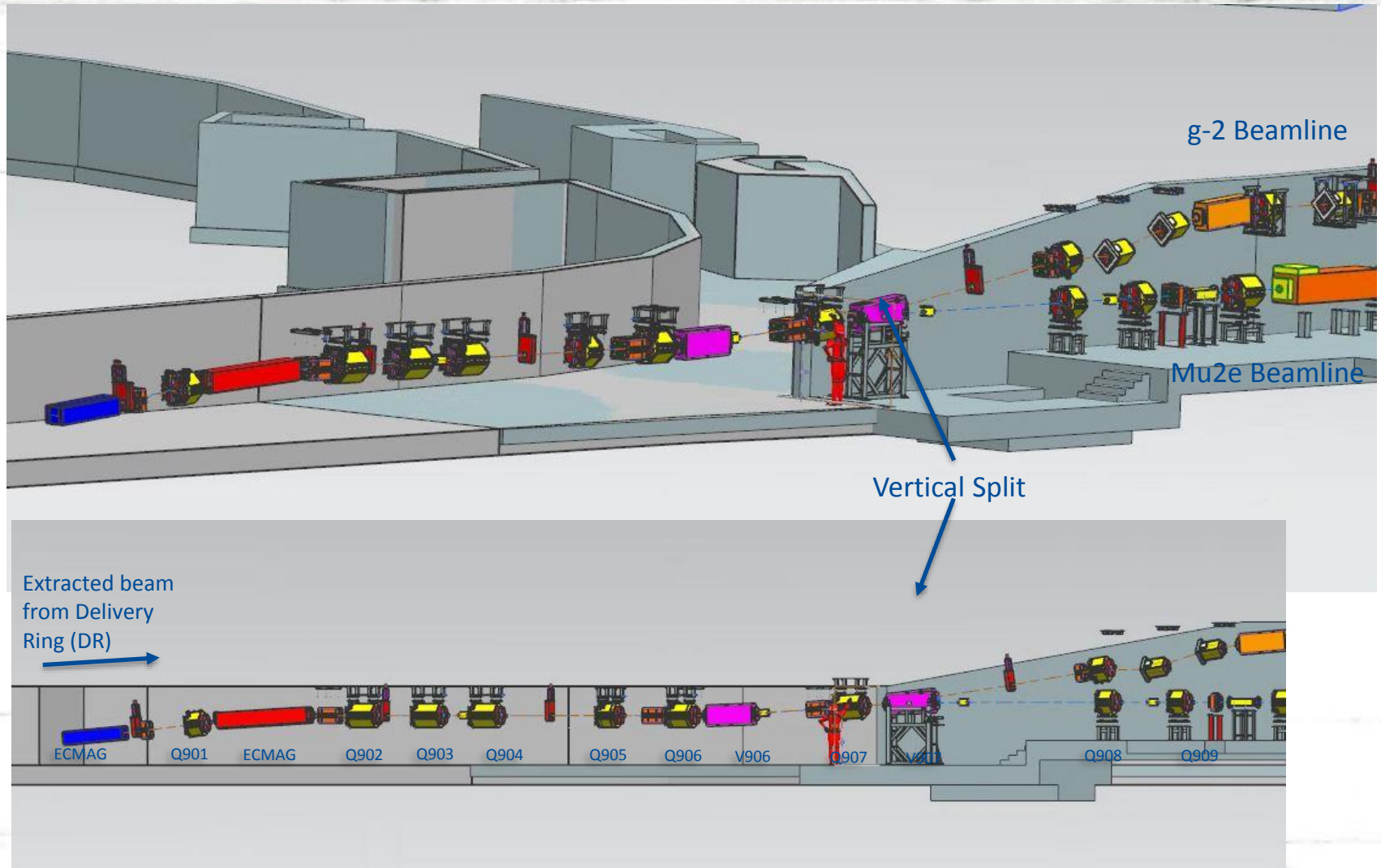
Outline

- Beam delivery lines (M4-M5 lines)
- Design optics
- Final focus into the storage ring
- Injection to the storage ring

Beam to g-2 storage ring (M4-M5)



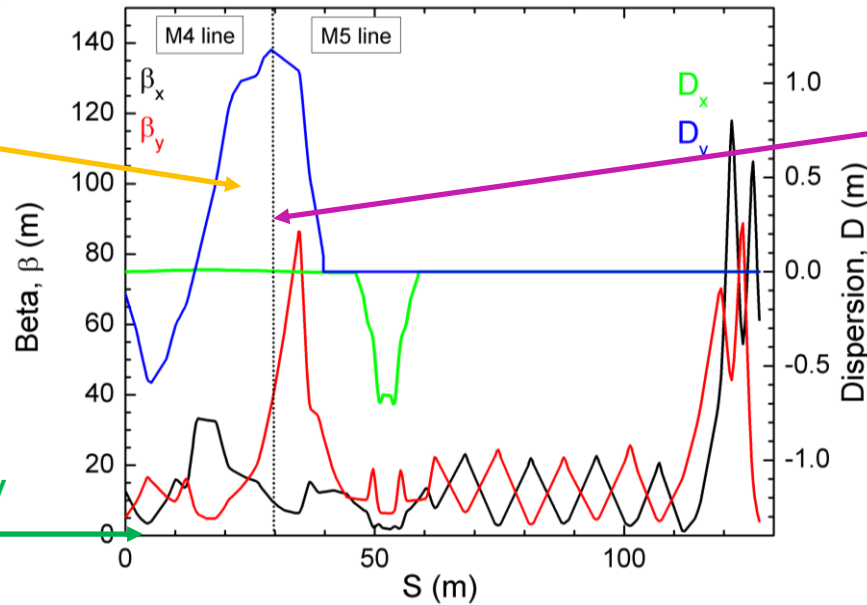
M4-M5 lines separation (side view)



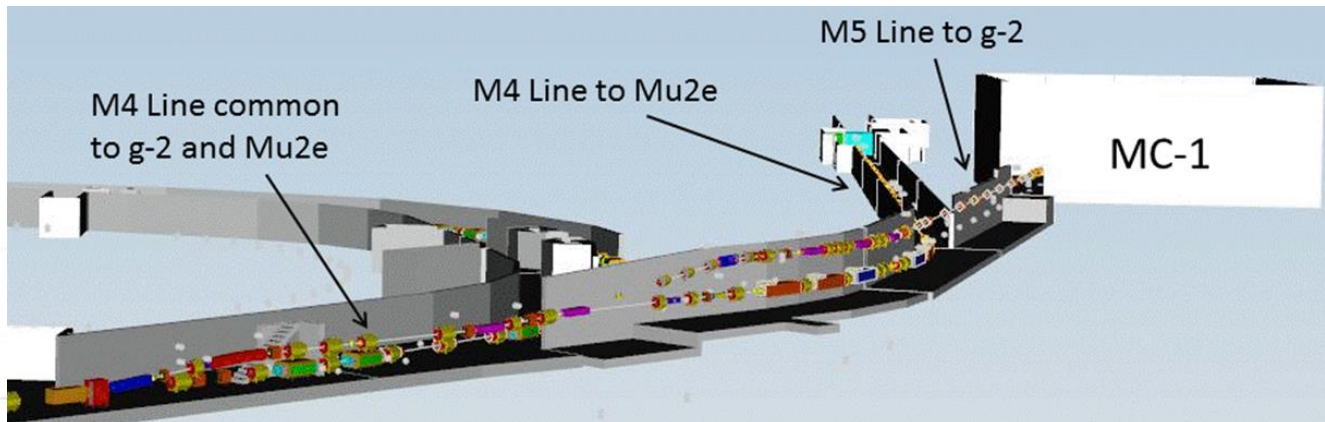
M4 beam optics

Three vertical bends, bend the beam upward out of the DR

First 20 m are directly over the DR



Switch vertical magnet reverses polarity for g-2 and Mu2e operation



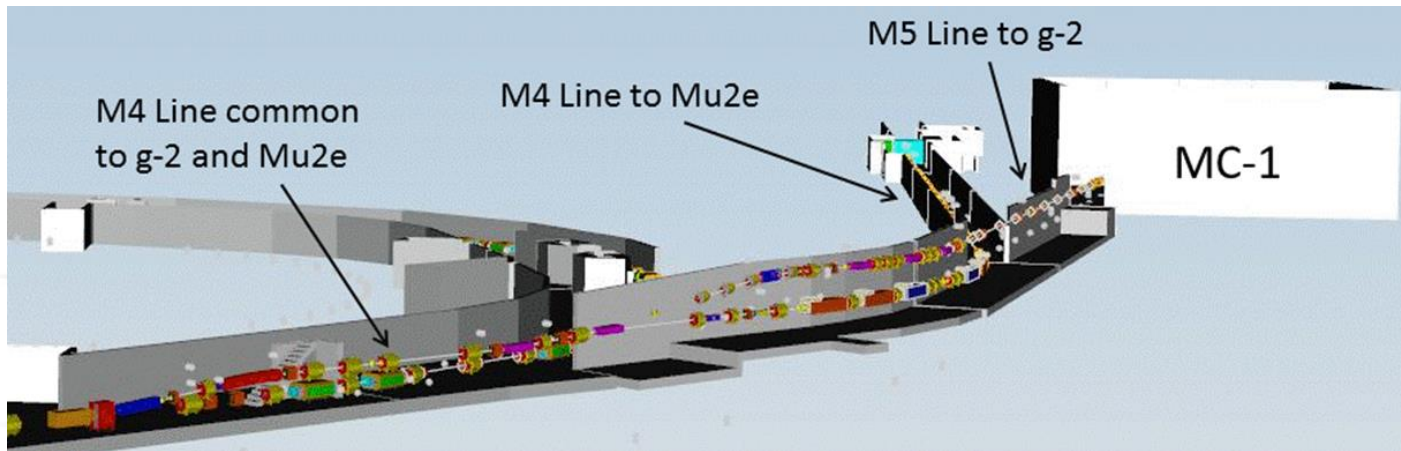
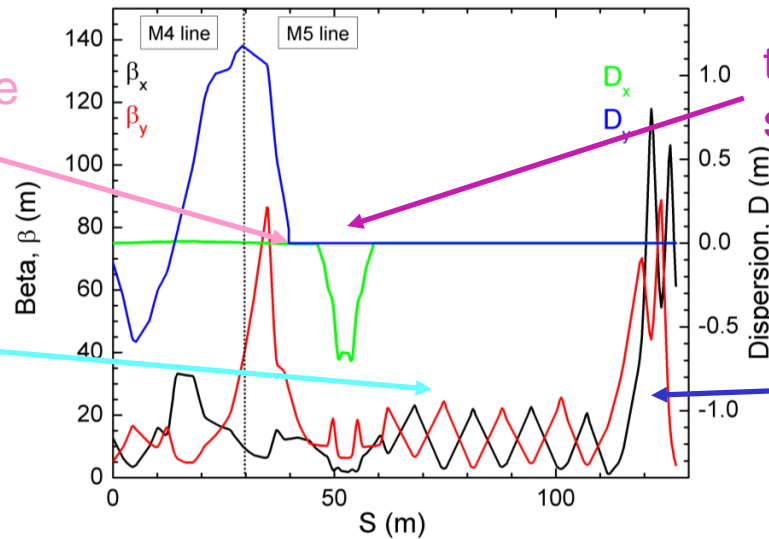
M5 beam optics

Vertical dispersion is cancelled at V003 in the M5

Three horizontal bends, to align trajectory with the storage ring

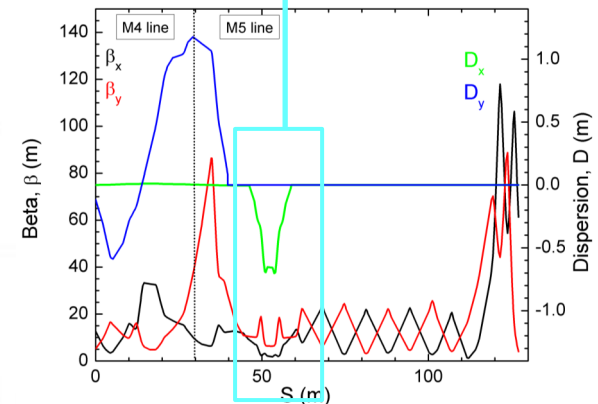
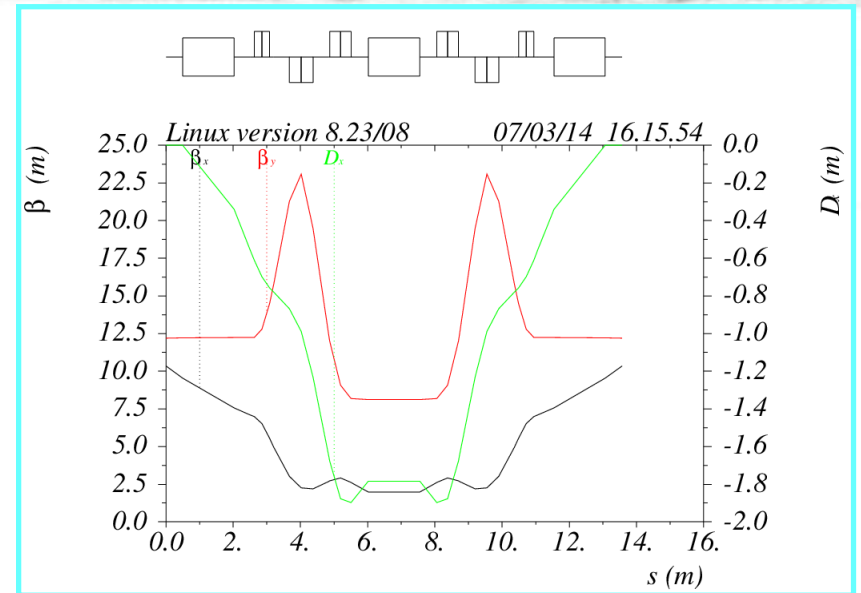
FODO

Final Focus



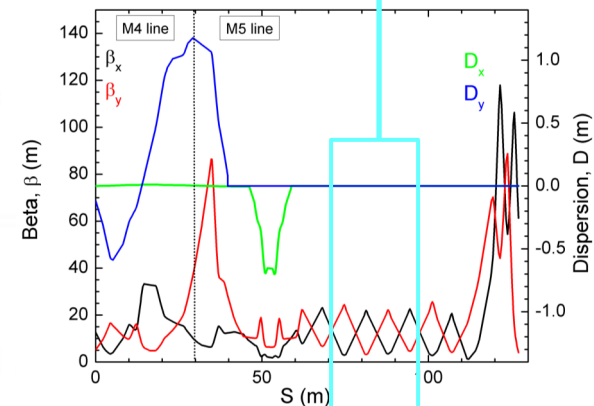
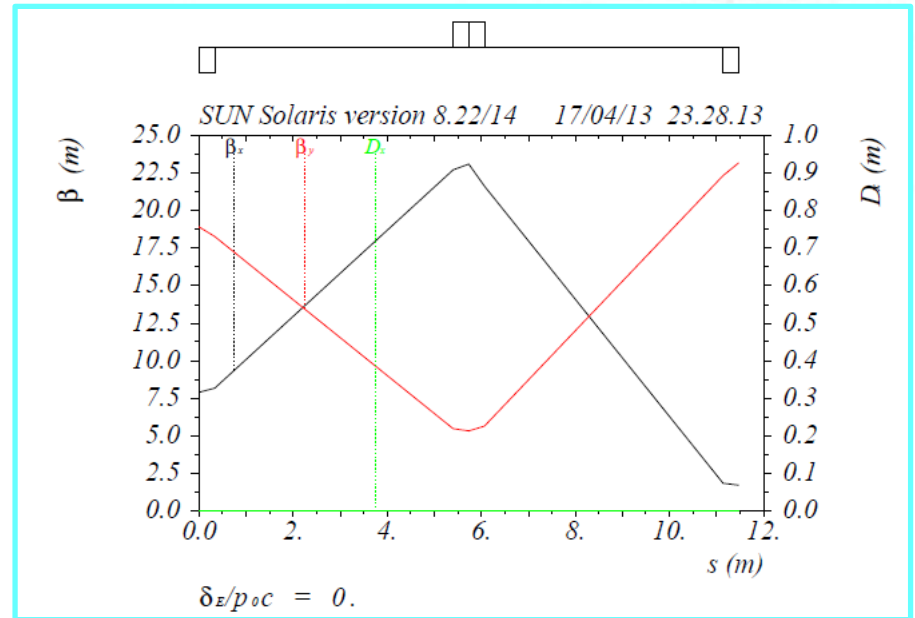
M5 left bends

- Left bend of 27.1° made up of three dipoles bused in series
- Dispersion contained within the module only
- BUT lattice can be intentionally distorted to propagate a dispersion wave further downstream
- Very useful section for muon cooling experiments (Thursday lecture)

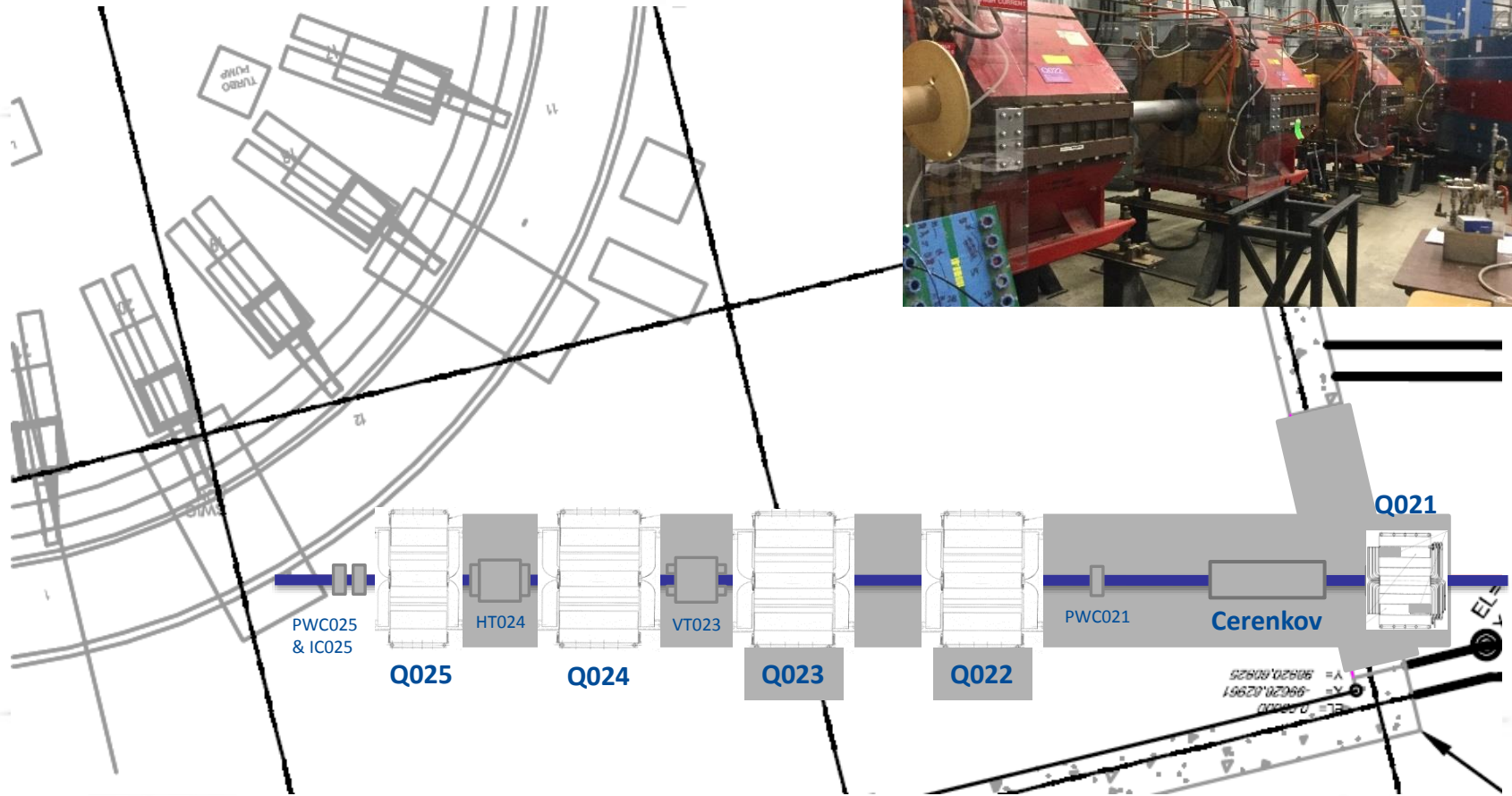


FODO cells

- Two FODO cells connect the left bends with the final focus module

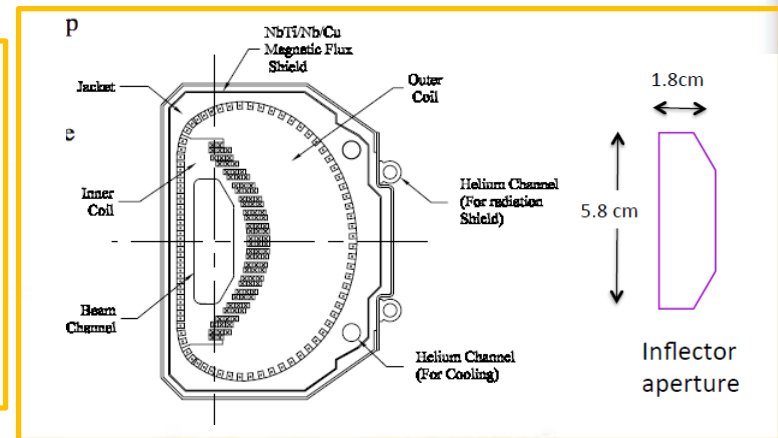
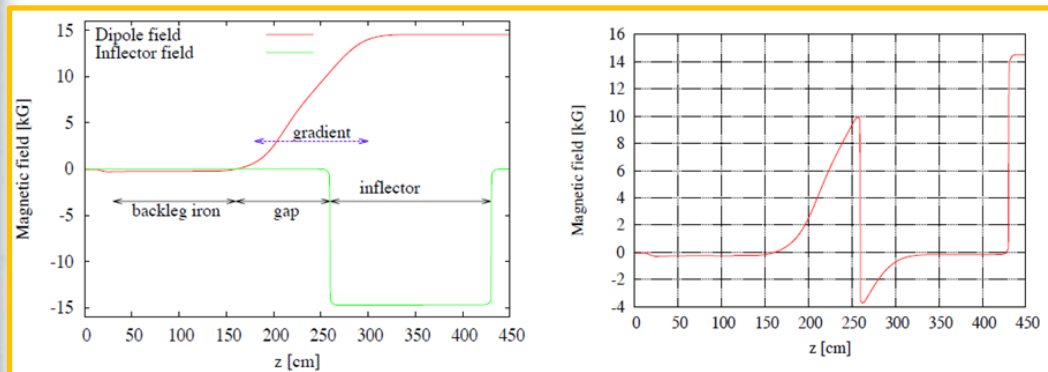


M5 final focus



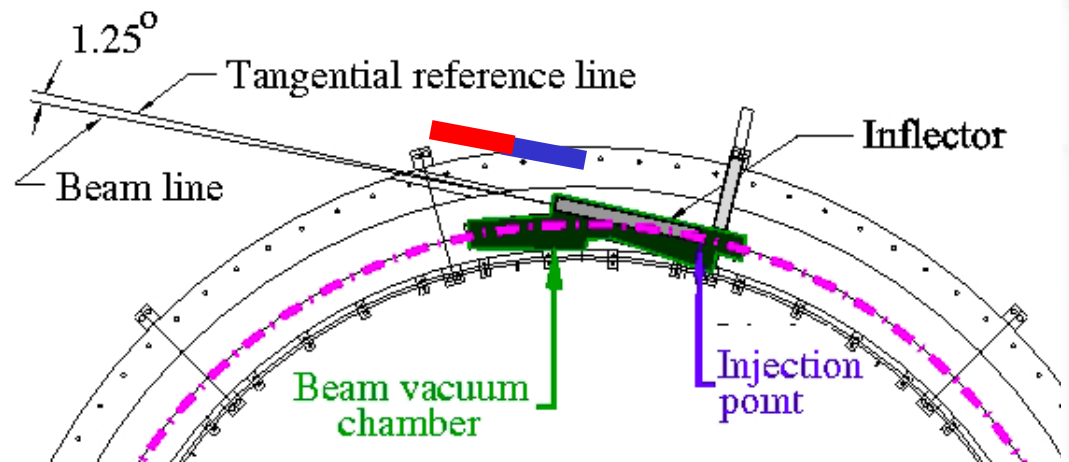
Inflector

- Injection into g-2 storage ring occurs through an inflector
- An inflector is a septum like cryogenic magnet which cancels the storage ring dipole field to allow tangential injection into the ring
- Is 1.7 m long and with only 18 mm horizontal aperture opening, is the limiting aperture for injection

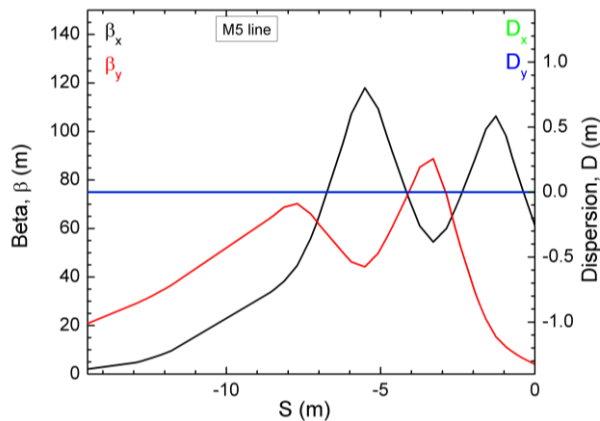
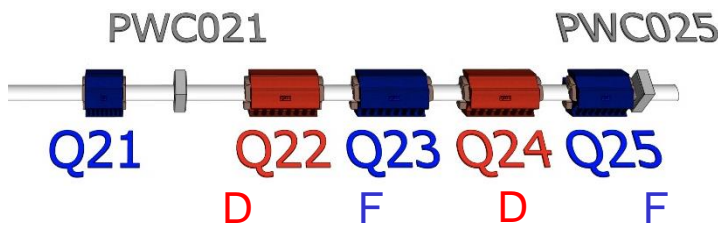


Injection

- Muons come to the end of the M5 line and then propagate through:
 - Hole in the magnet yoke
 - Dipole fringe field
 - Inflector
- Exit the inflector 77 mm from the center of the dipole aperture of the ring

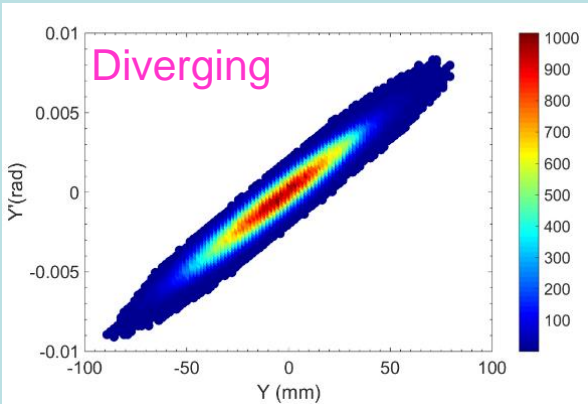
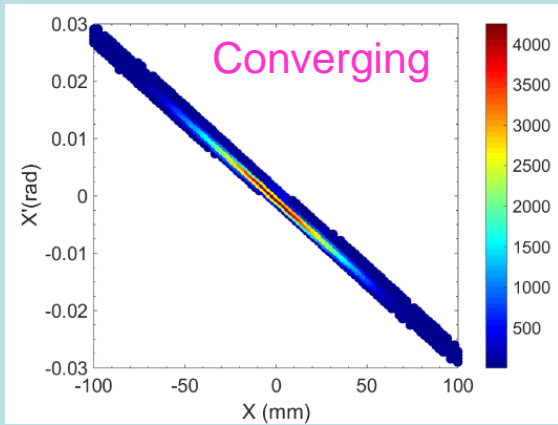


M5 final focus

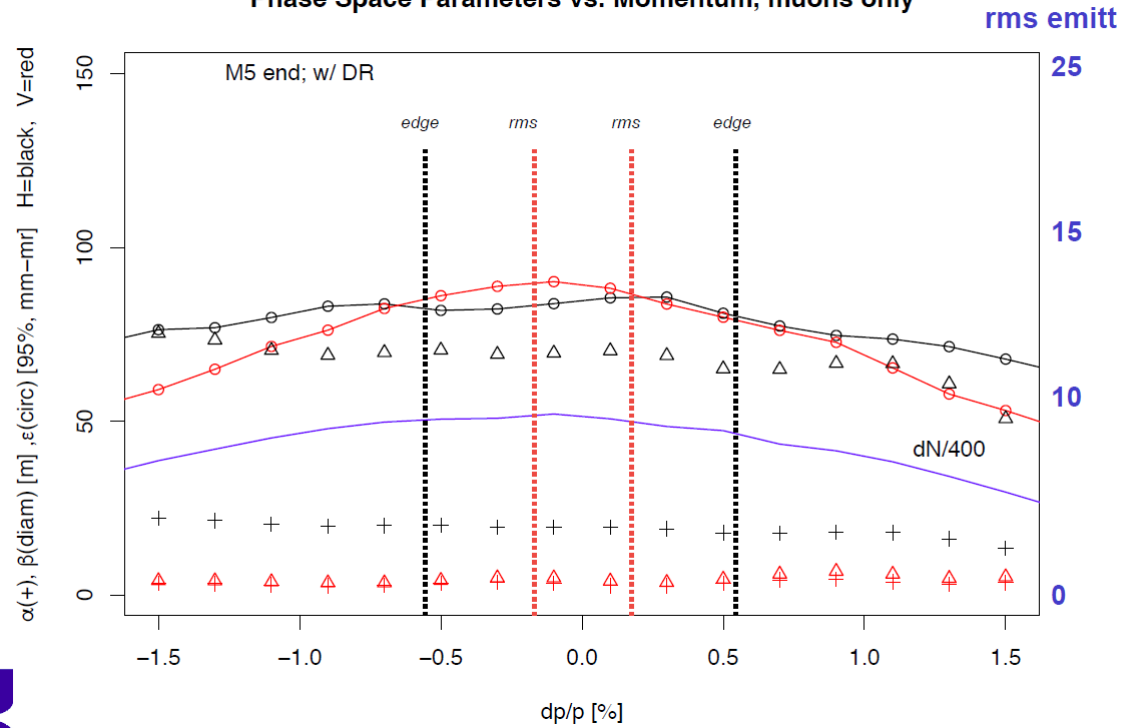


- A strong-focusing and tunable final focus area is designed to optimize parameters for injection into the ring
- But $\beta(s) = \beta_0 + \frac{s^2}{\beta_0}$ ($\alpha = 0$)
- Place a focusing quad as close as possible to the inflector

Beam distribution at the of M5



Phase Space Parameters vs. Momentum, muons only



Final focus tuning

- But the # of stored muons is highly depended on the Twiss parameters of the final distribution
- Can we measure them?

