15 May 2019

NPS Sweep Magnet Status and Test Plan

CHARLES HYDE

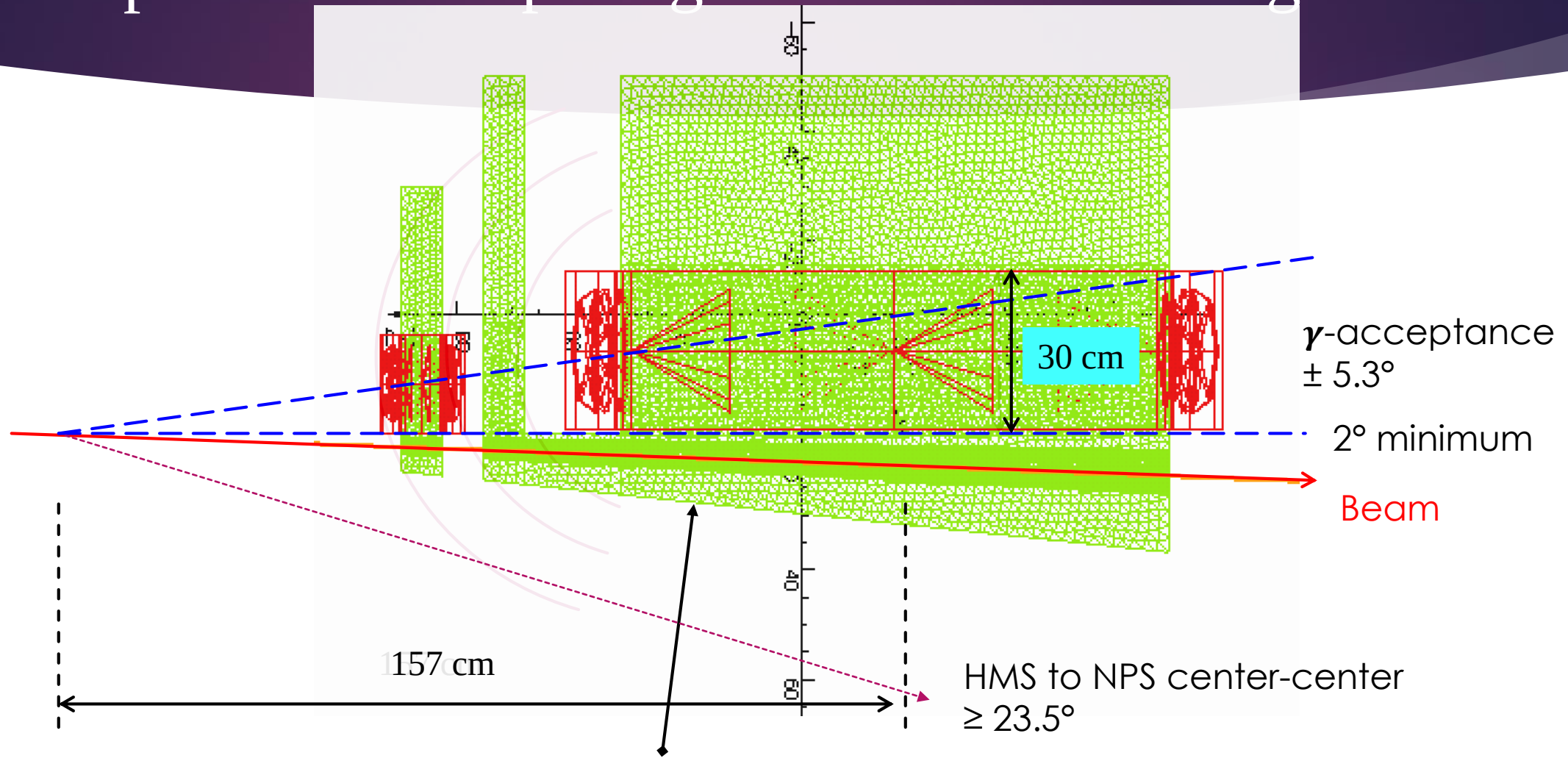
OLD DOMINION UNIVERSITY

Magnet assembled in Test Lab

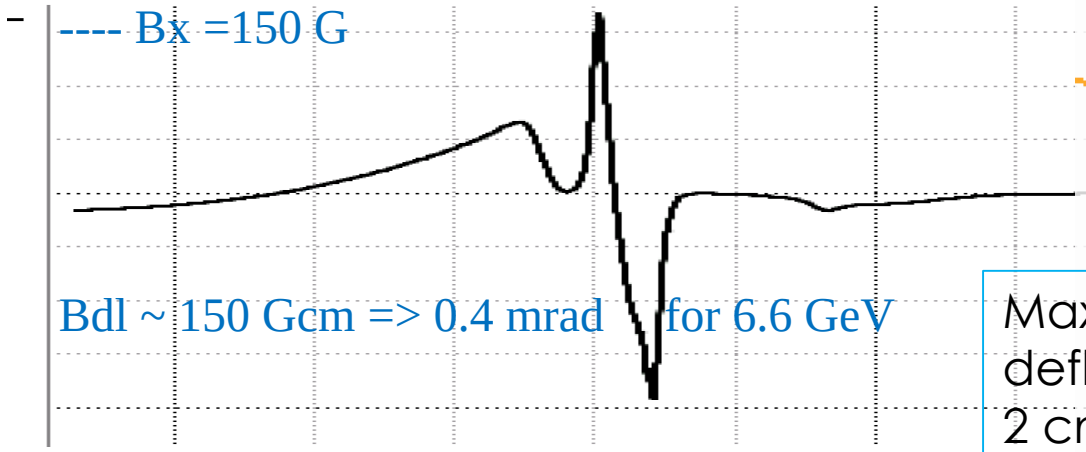
- Normal resistive, iron dominated magnet

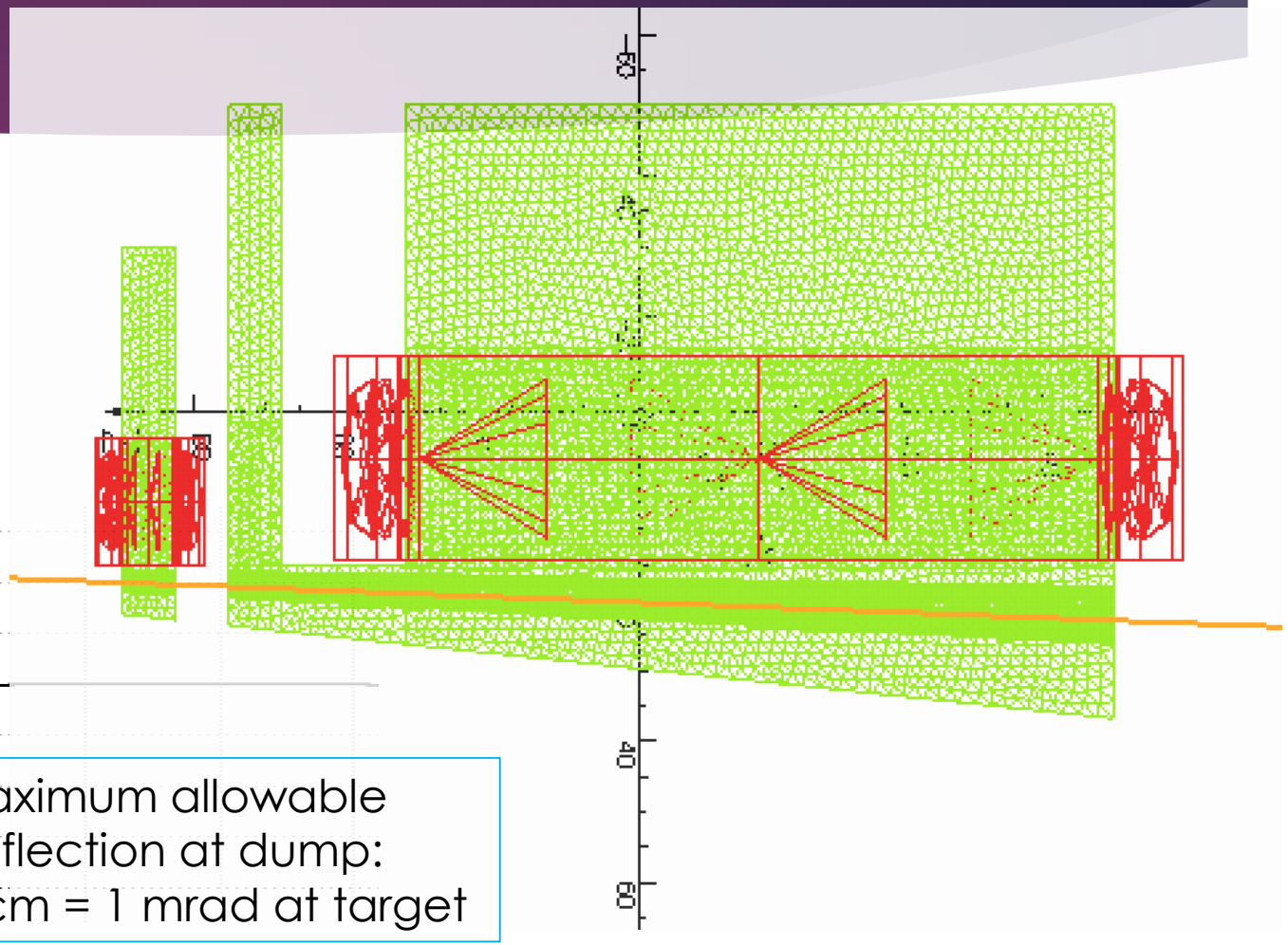
Magnet Parameters	
Max Current (Amp)	990
R @20C (Ohm)	0.1
ΔV Max (V)	110
Cooling Medium	LCW
ΔP (psi)	130
ΔT (°C)	30
Corrector Max Amps	520

Top view: Sweep Magnet on SHMS carriage



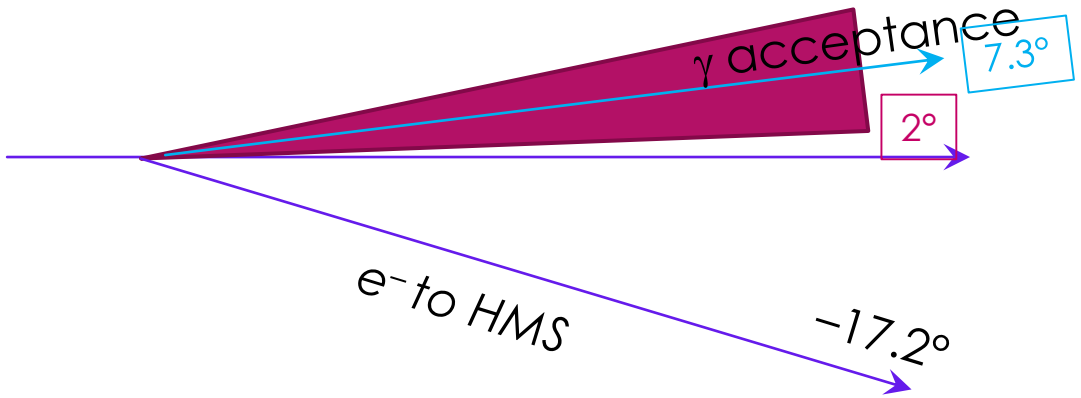
Calculated Fringe Field on Beam Line

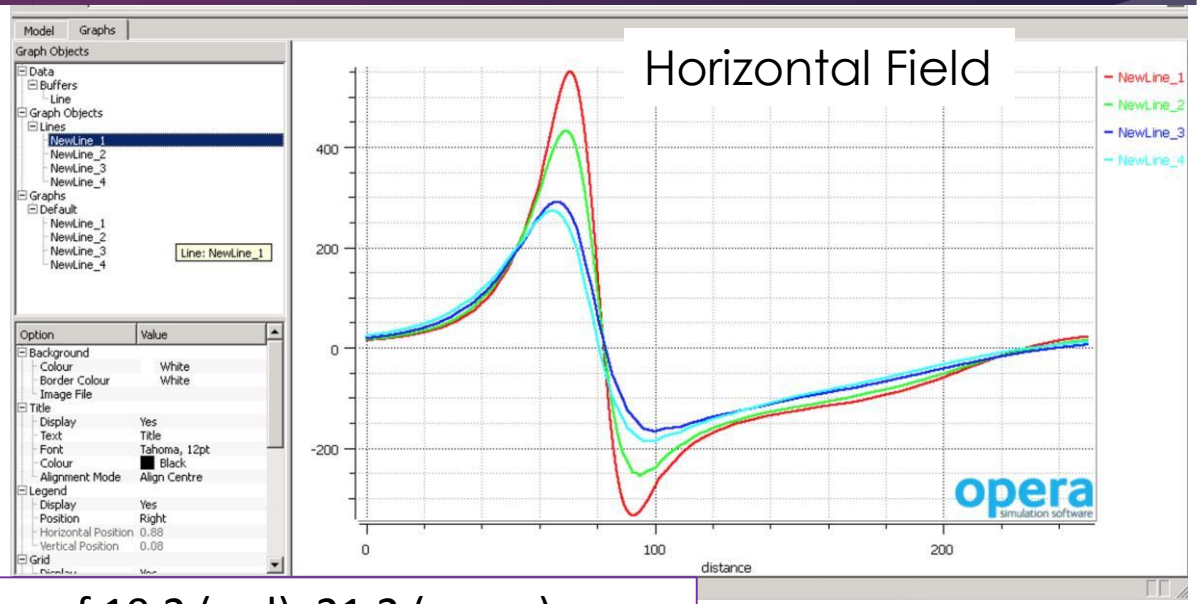




Maximum allowable deflection at dump:
2 cm = 1 mrad at target

Estimated fringe field integrals at center of HMS acceptance





The field perpendicular to the central trajectories at angles of 19.2 (red), 21.2 (green), 25.2 and 33.2 degrees versus the distance from the target. The beam angle is 2 degrees. These settings correspond to the angle separation of NPS and HMS of 23.5, 25.5, 29.5 and 37.5 degrees, respectively, with HMS initially at 17.2 degrees with beam and then rotating outward.

Field integral ~ -4650 Gauss-cm for 23.5° (red);

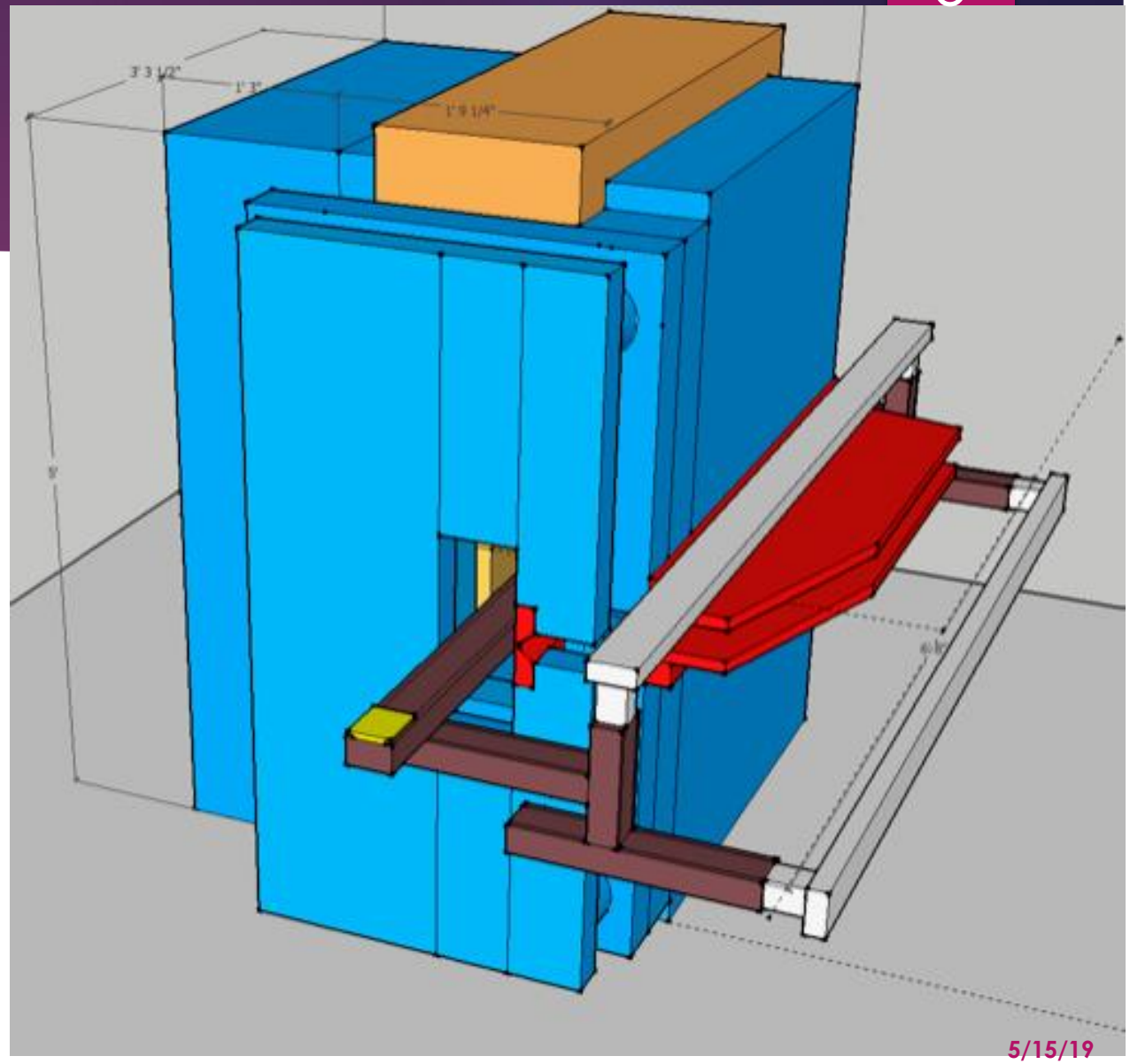
Field integral ~ -3960 Gauss-cm for 25.5° (green);

Field integral ~ -2720 Gauss-cm for 29.5° (blue) (near-identical for 37.5° (light-blue).

Maximum HMS effective momentum offset < 0.3%

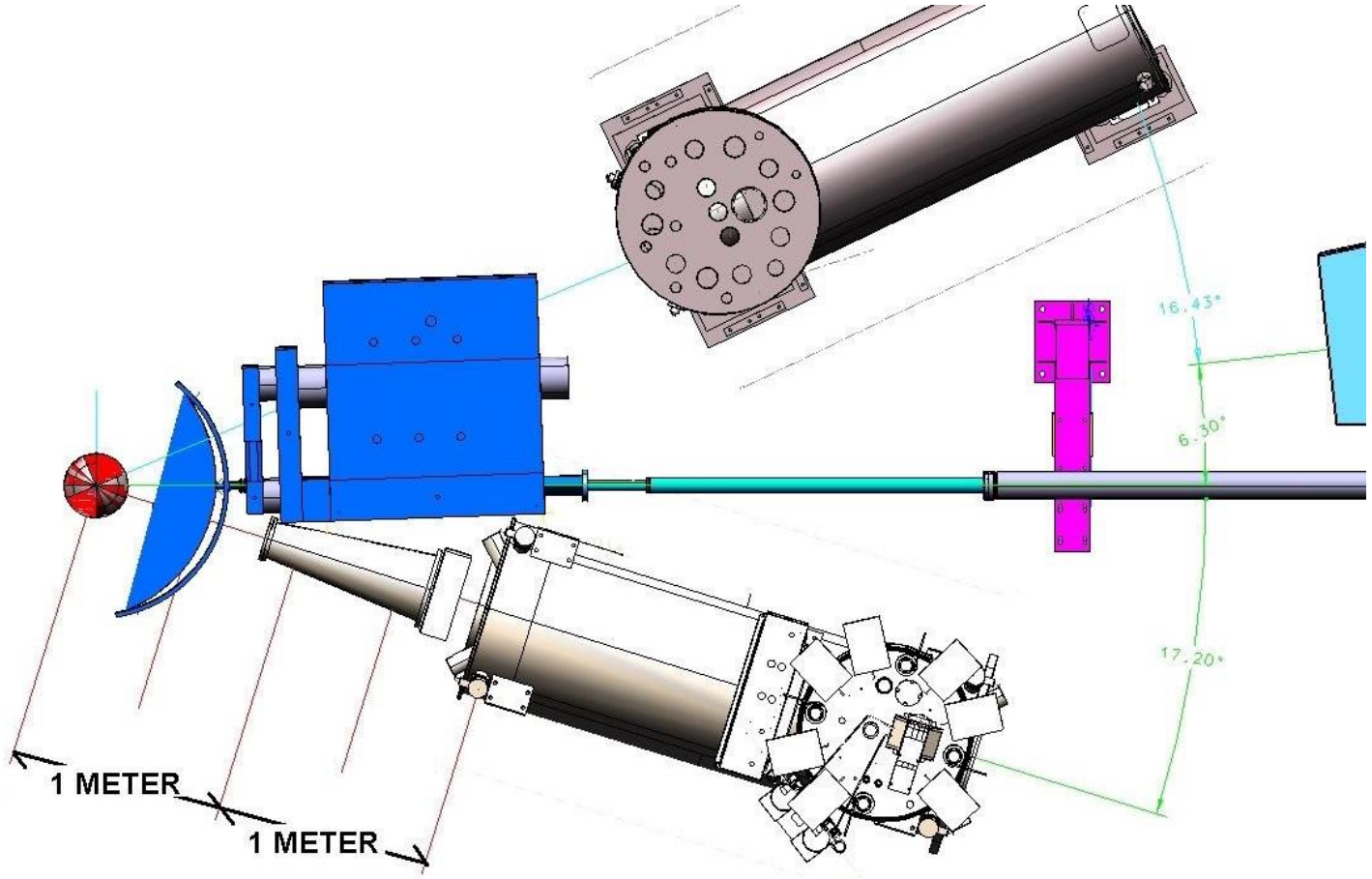
Test / Mapping plan

- Map in Test Lab @ 100 A
  - TOSP in preparation
  - Full test (0 current) completed LabView controlled
    - 1 cm steps 3D, 3 axis, 2 m longitudinal in main gap ~1 hour x 3 probe geometries x 3 axes
    - 2D in beam gap
    - Complete June-July 2019
- Map again on Hall C floor at full current ~ 730 A
  - Critical for beam-line fringe field
  - Fringe field in acceptance of HMS



Impact of Sweep on HMS Optics

- Basic geometry of NPS and HMS at small angles
- Minimum separation angle = 23.5 degrees
- •Effect of the NPS fringe field is around the location of the HMS vacuum snout, before Q1
- *Image courtesy Paulo Medeiros*



Questions?

Impact on HMS Optics

As can be seen, the impact of the NPS fringe field corresponds to a small vertical deflection of the rays entering the HMS spectrometer optics, and parallel to the axis.

HMS is a vertical bending spectrometer, so such a vertical offset has an optics effect similar as a vertical beam position offset would have. This is minor.

For HMS, a 1 mm vertical offset corresponds to a 0.08% apparent momentum offset. The momentum offset of such particles is taken into account by using the special aberration matrix elements that also take into account a vertical beam offset by the target.

So all one would need to do is calculate the minor vertical deflection imposed by the NPS fringe field, as calculated for the HMS central momentum setting, and treat it as a vertical beam offset, and this NPS fringe field effect automatically gets taken into account in the particle optics reconstruction.

Coil Specs

SAM Magnet main Coil	
Maximum current , A	990
Resistance @20C, ohm	0.11
Voltage drop at max current, Volt	110
Total water flow, gallon per minute	14
Max. operational pressure, psi	130
Cooling medium	LCW
Max Temperature Rise, C	30

SAM Magnet corrector Coils	2 each
Maximum current, A	520
Resistance @20C, ohm	0.04
Voltage drop at max current, Volt	20
Total water flow, gallon per minute	3
Max. operational pressure, psi	130
Cooling medium	LCW
Max Temperature Rise, C	15