Emittance Exchange in MICE

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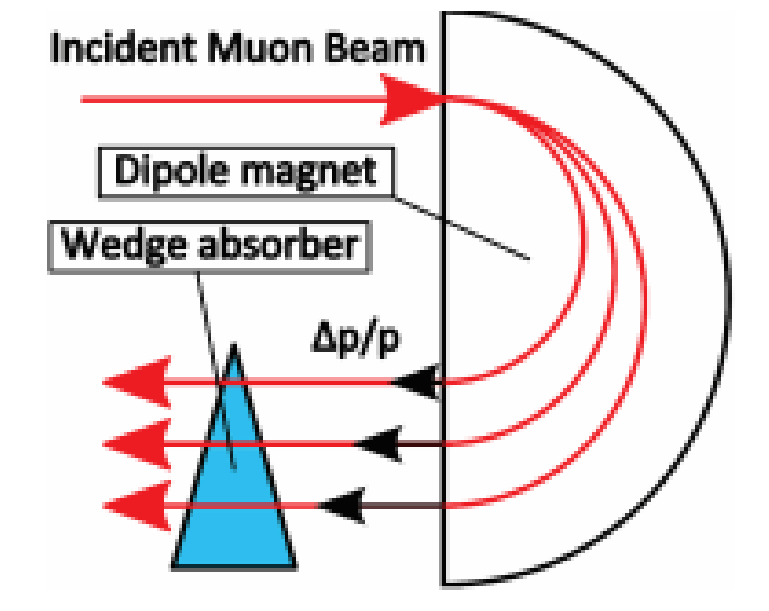
Aims

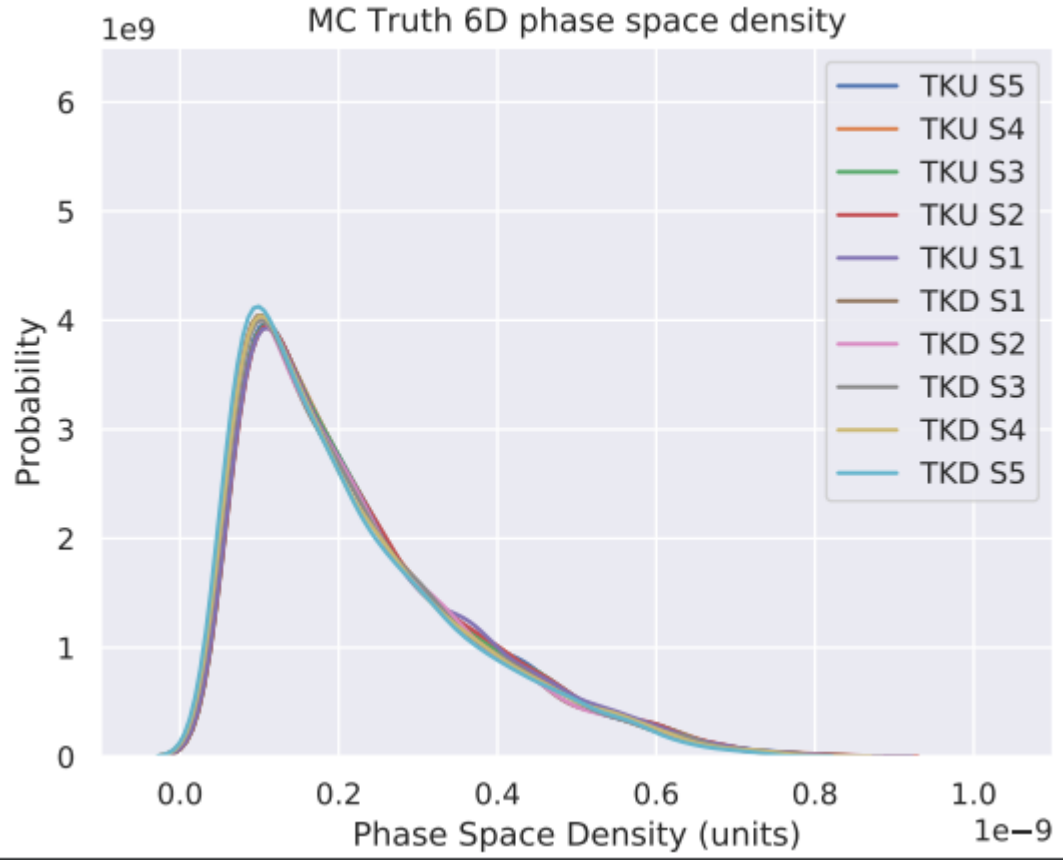


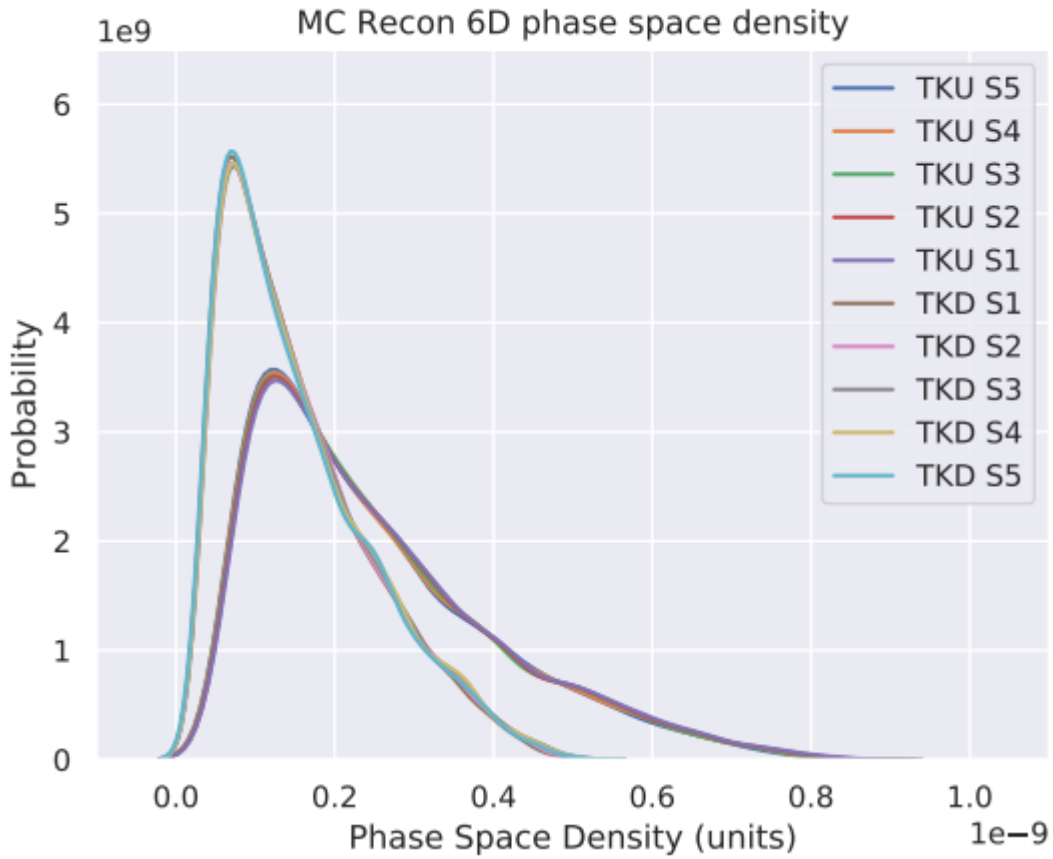
- Demonstrate Emittance Exchange and Reverse Emittance Exchange in the Wedge using MICE data
- Emittance Exchange can be demonstrated by looking at the change in phase space density of the particle selection before and after having passed through a Wedge absorber
- Emittance Exchange is shown by a decreased transverse phase space density (x, px, y, py) and increased longitudinal phase space density (z, pz), (and vice versa for Reverse Emittance Exchange)
- Can use a number of techniques to calculate phase space density: KDE, KNN, Voronoi Tessellations, etc.
- MICE beam only has a small natural dispersion → Use beam reweighing techniques to select beams with desired dispersion

Previously

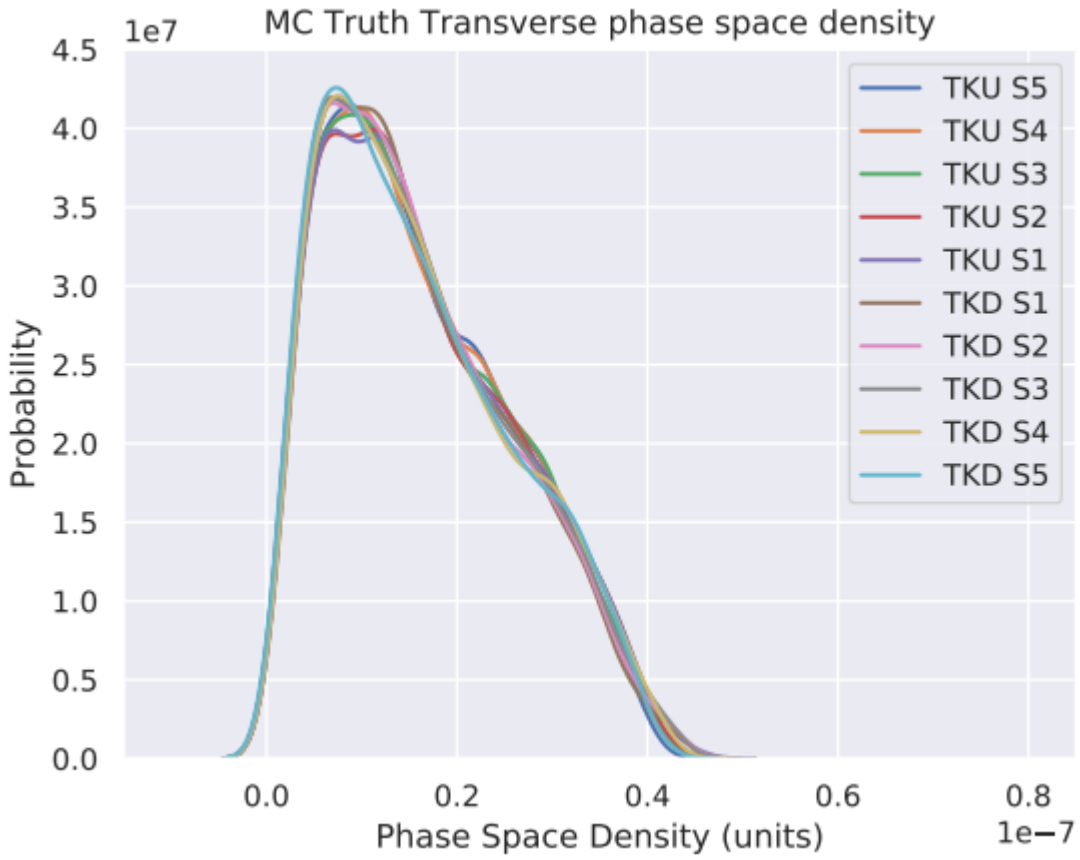
- For No Absorber case:
  - MC Truth: Showed conservation of 6D phase-space density
  - Still largely conserved when separated into Transverse and longitudinal components
  - MC Recon: Transverse density shows some agreement with MC Truth
  - MC Recon: Longitudinal shows large disagreement
- Note: TKU and TKD are slightly different (different misalignments), separation into components will be slightly different
- We know of Pz discrepancy between Truth and Recon
- The Reconstruction also appears to work differently for upstream and downstream

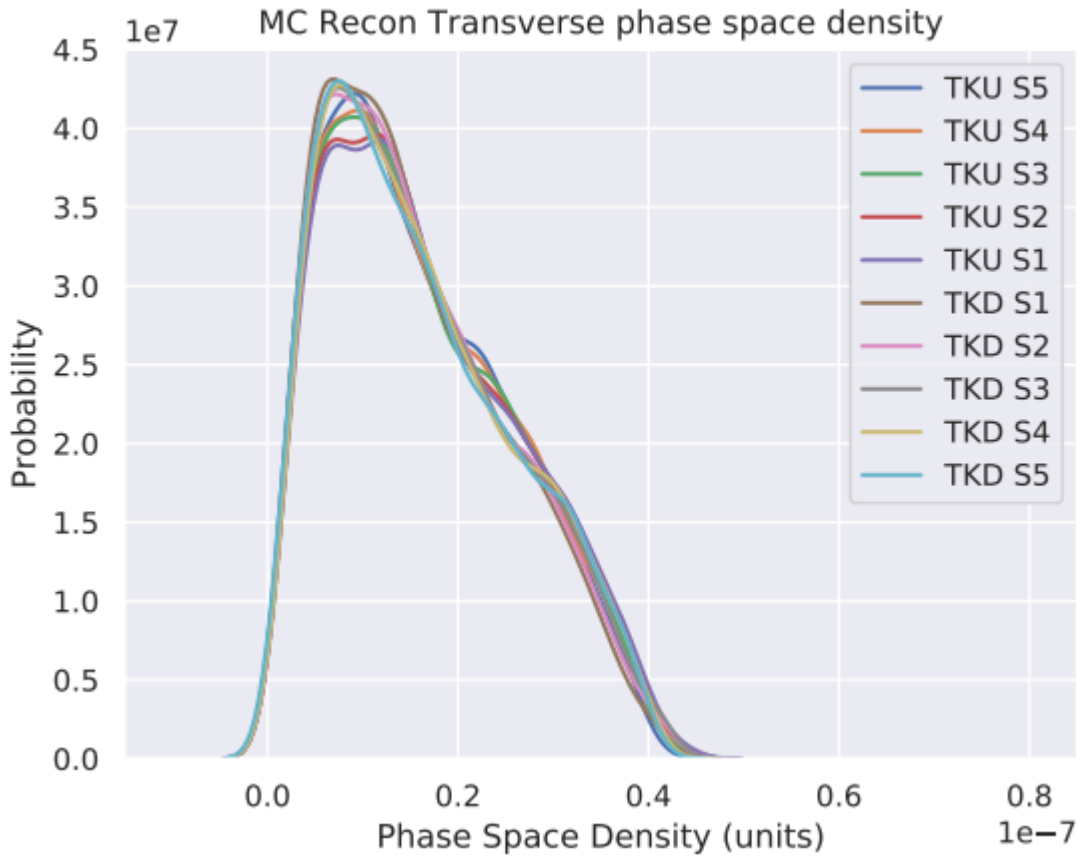
No Absorber 6D density



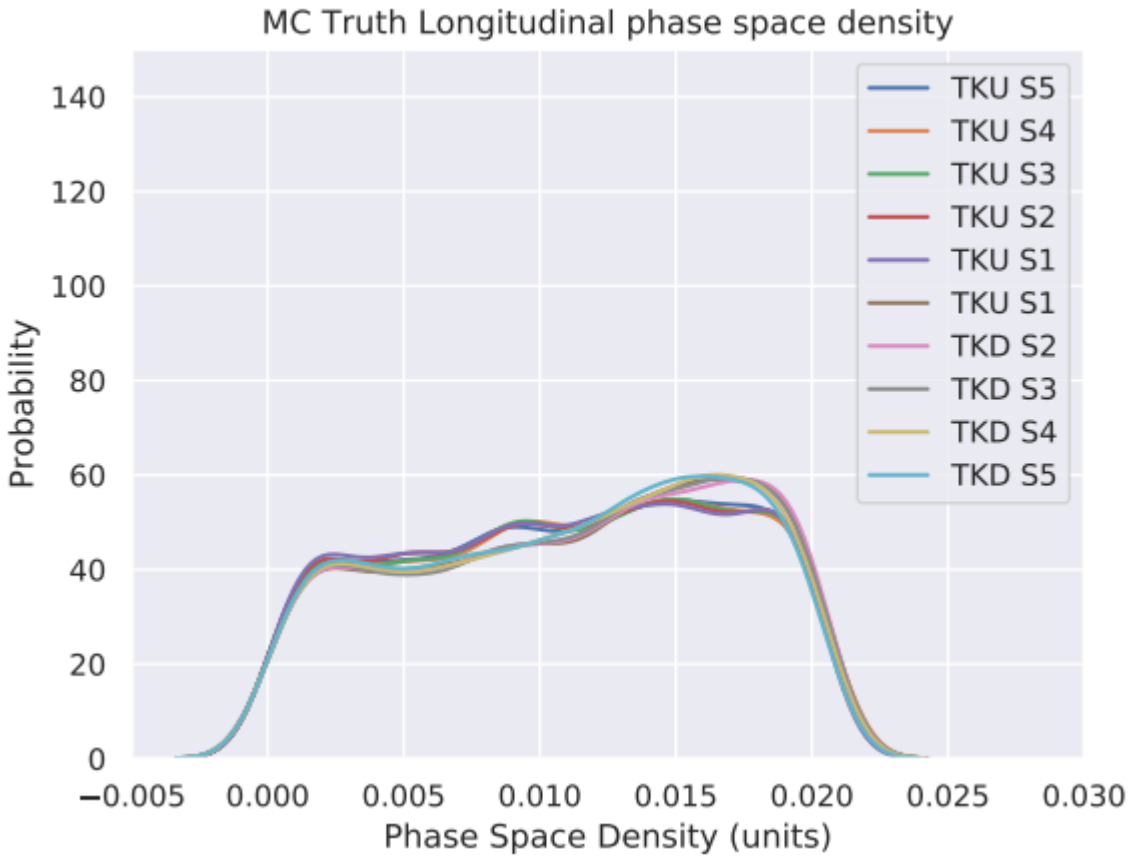


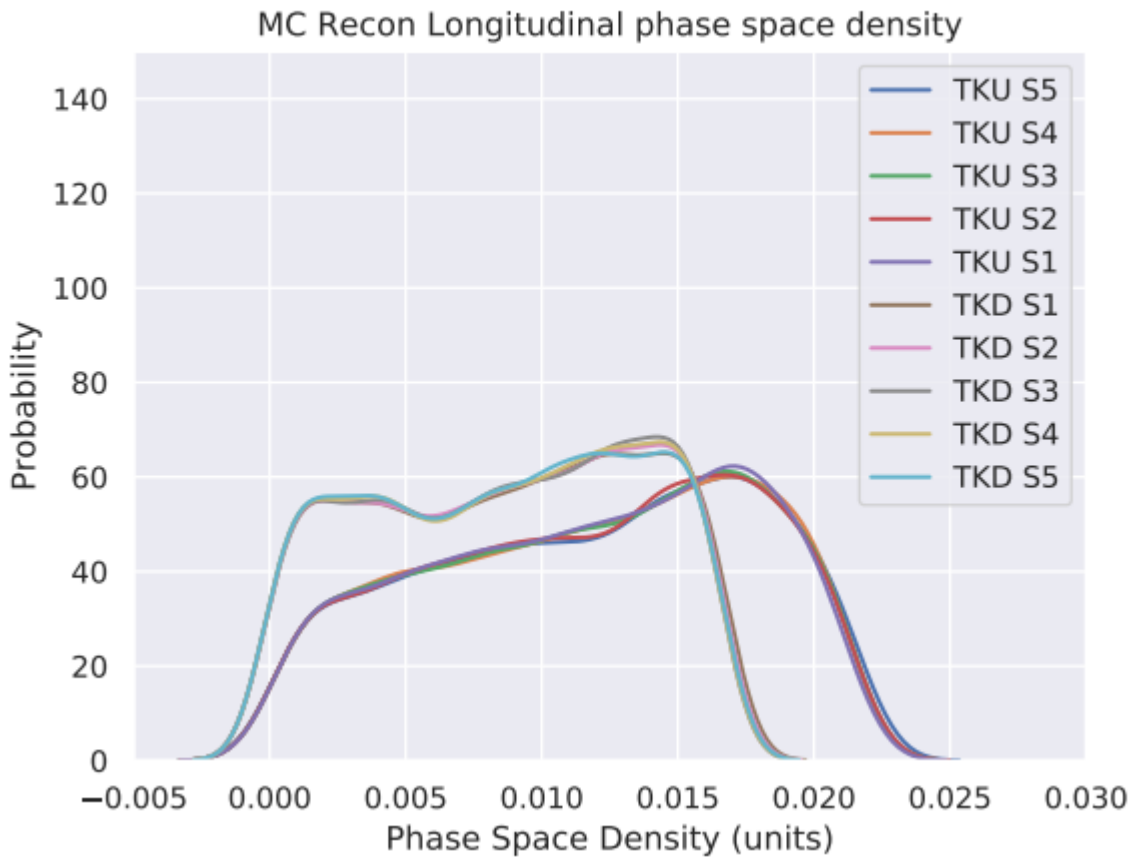
No Absorber Transverse density





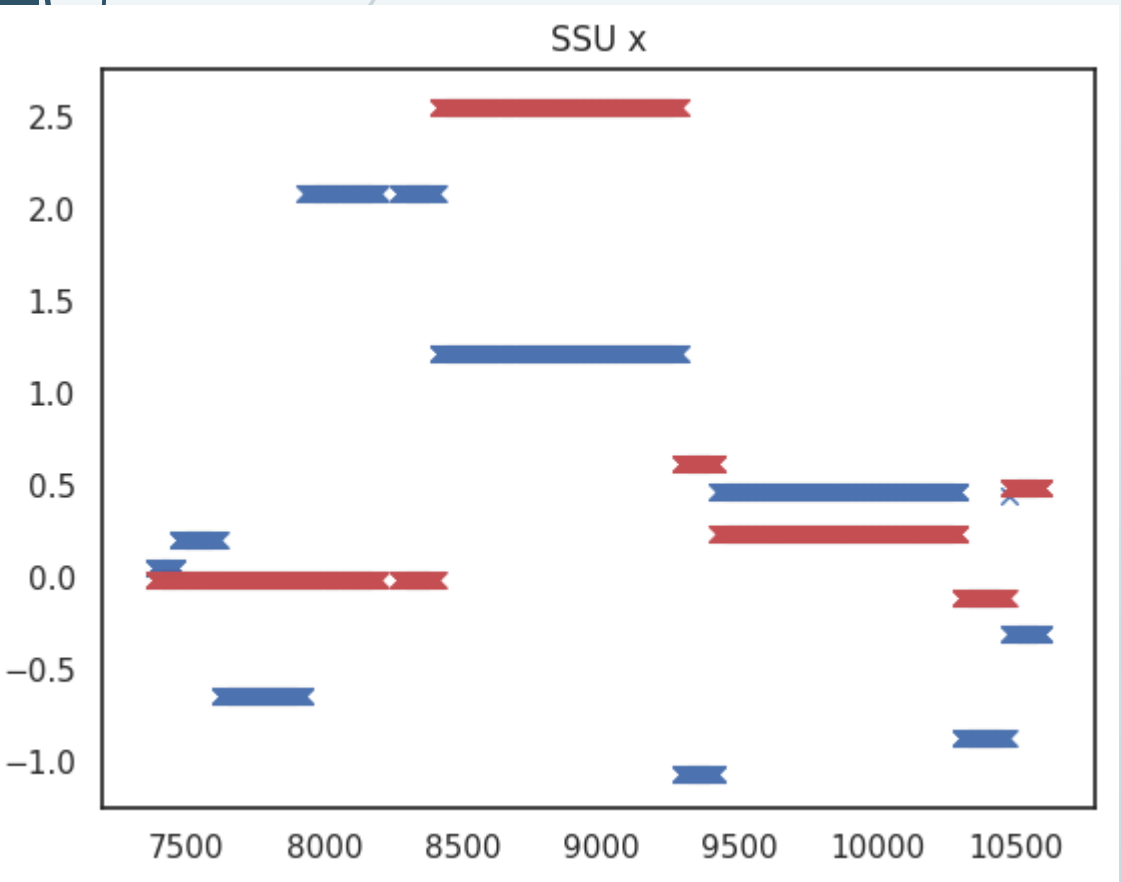
No Absorber Longitudinal density

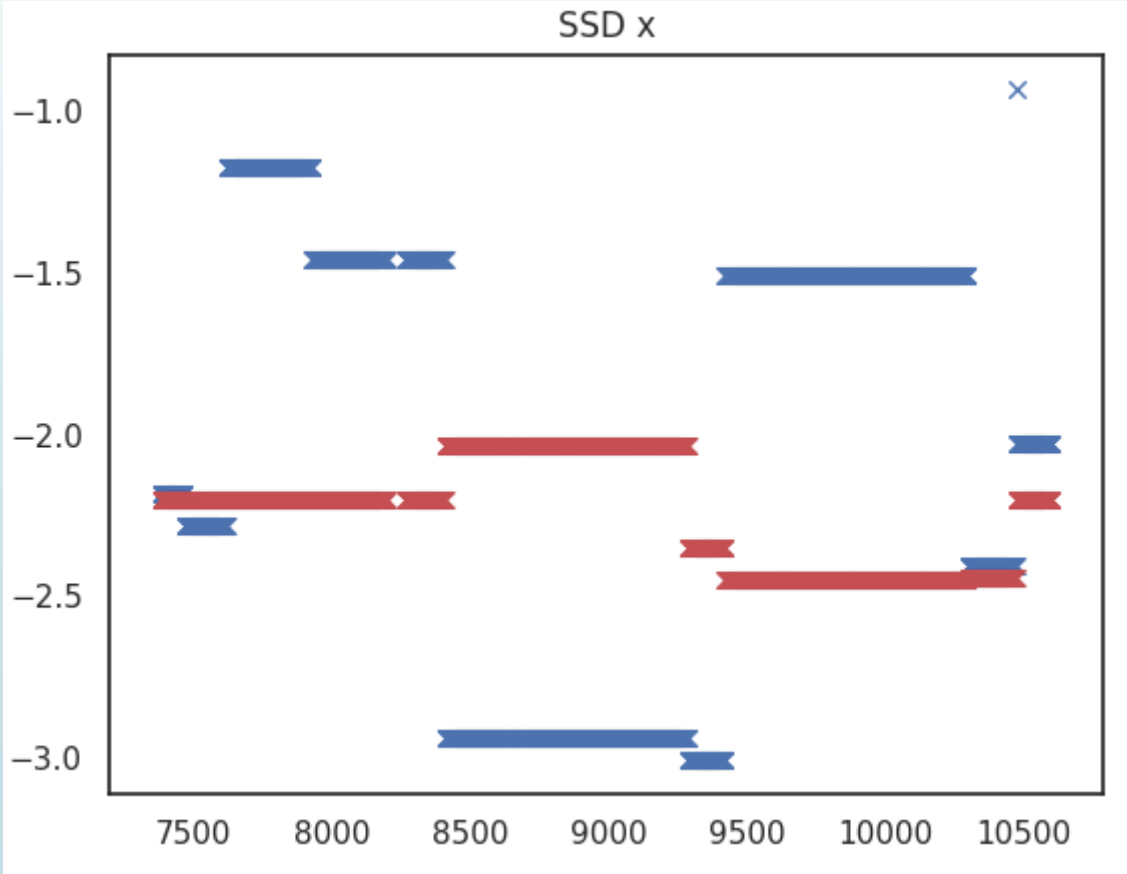




Misalignments

- Blue: tracker position (mm)
- Red: Centre coil Position (mm)
- As a function of run number





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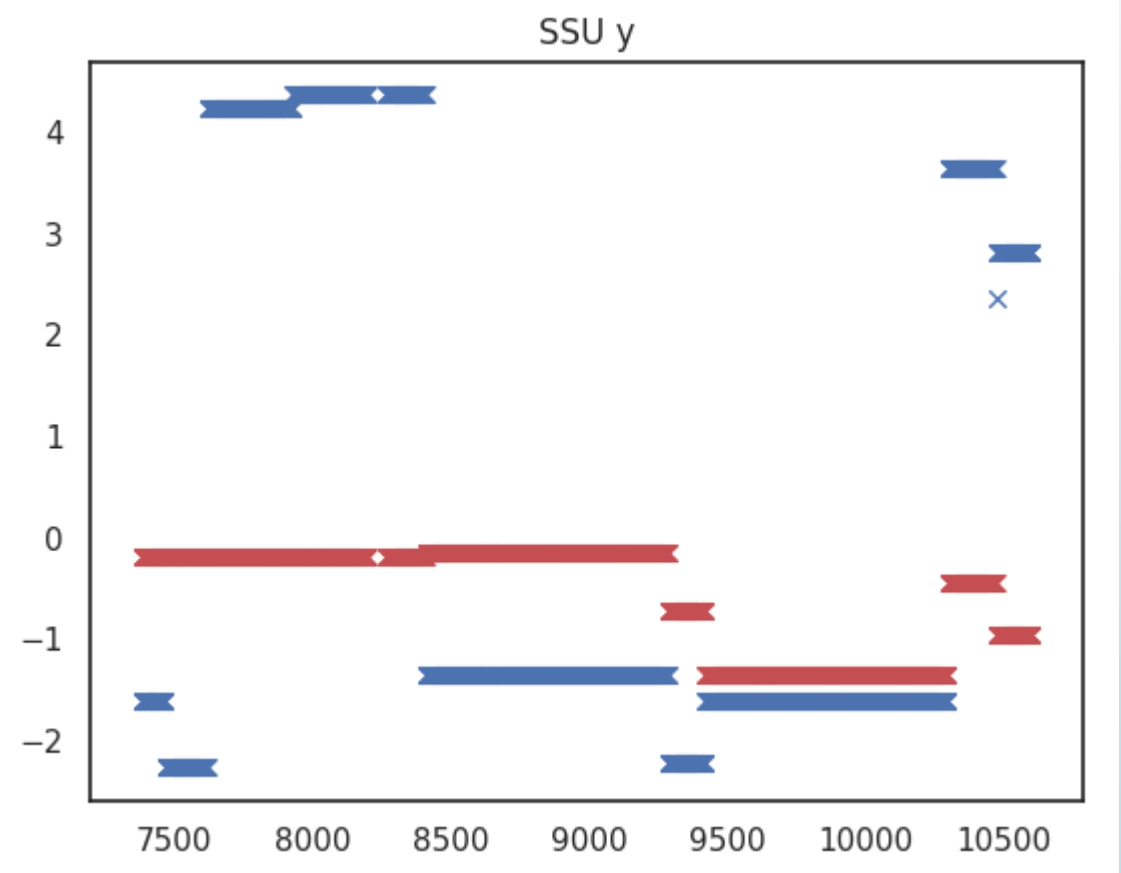
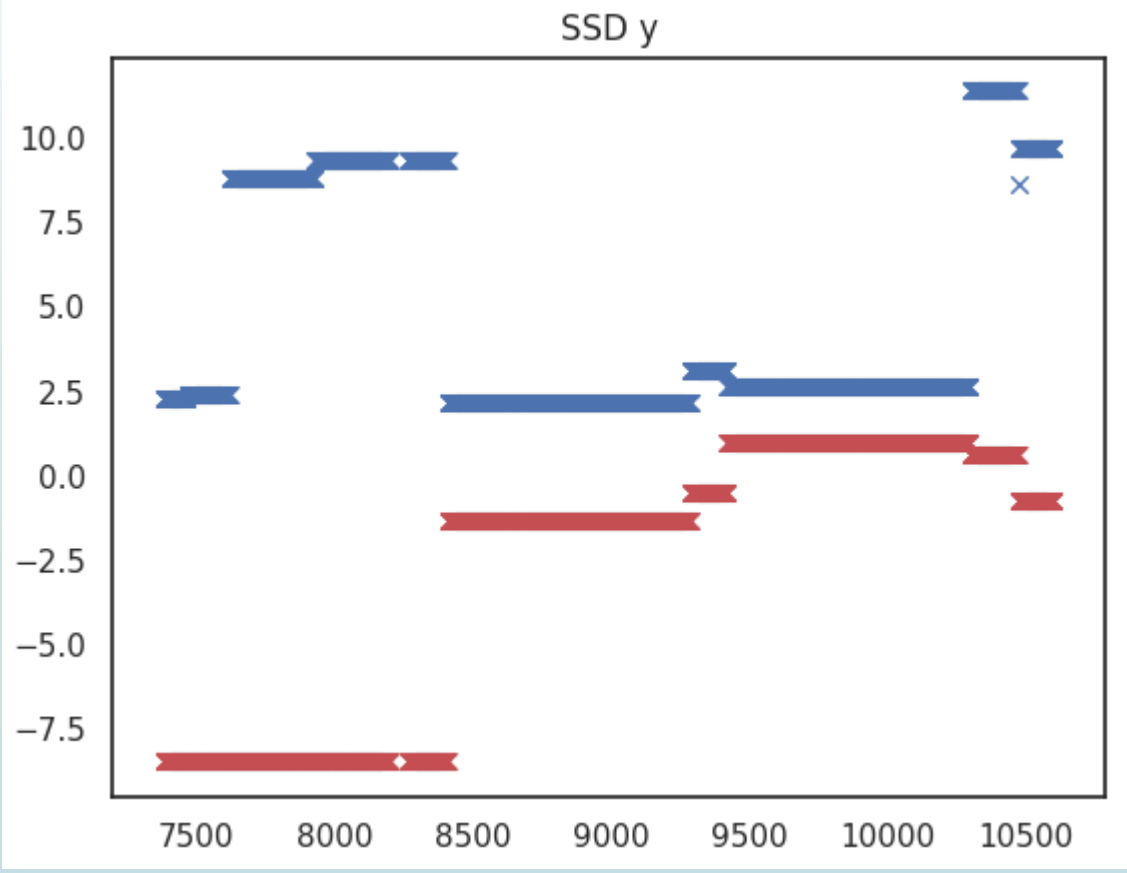
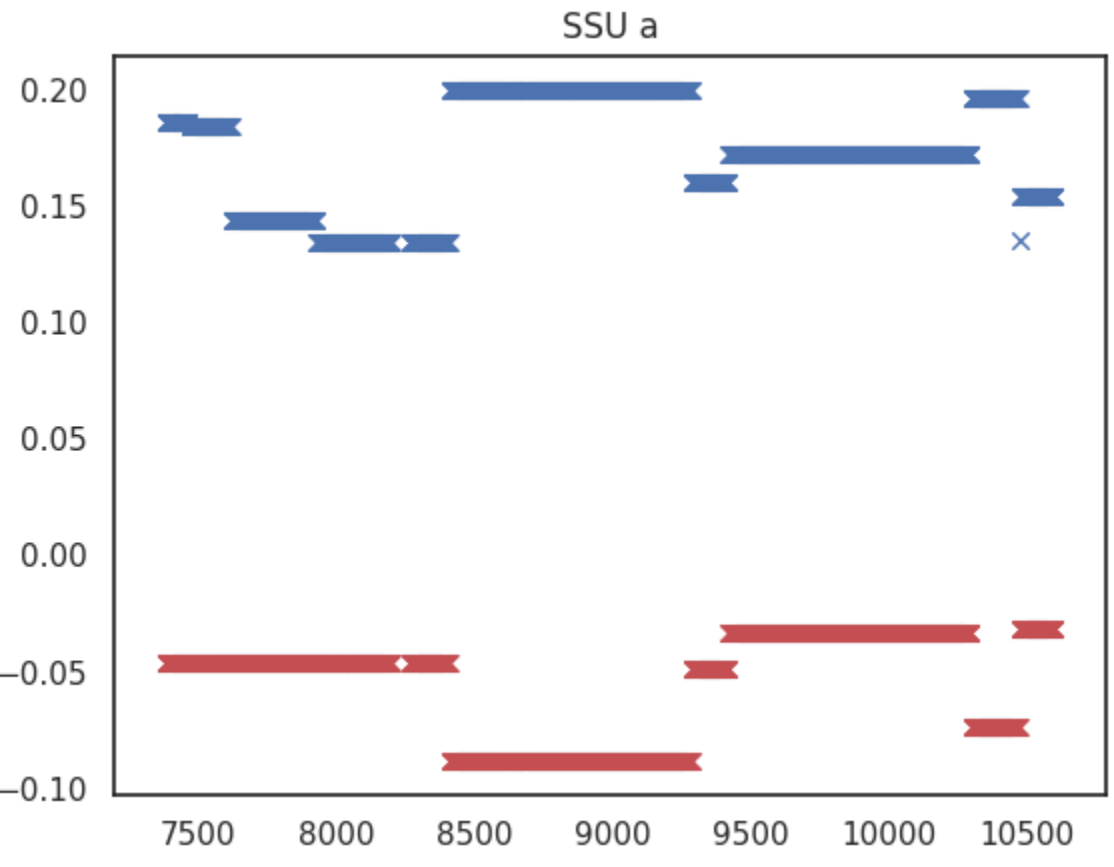
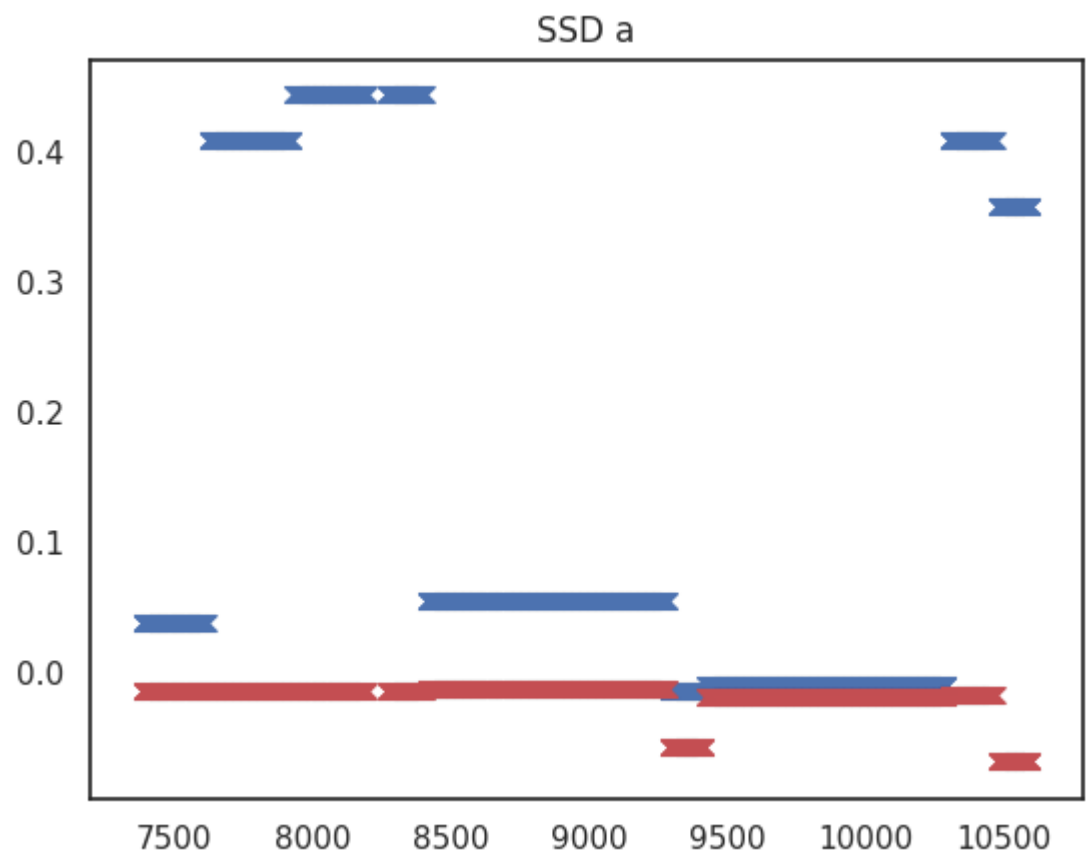




Misalignments

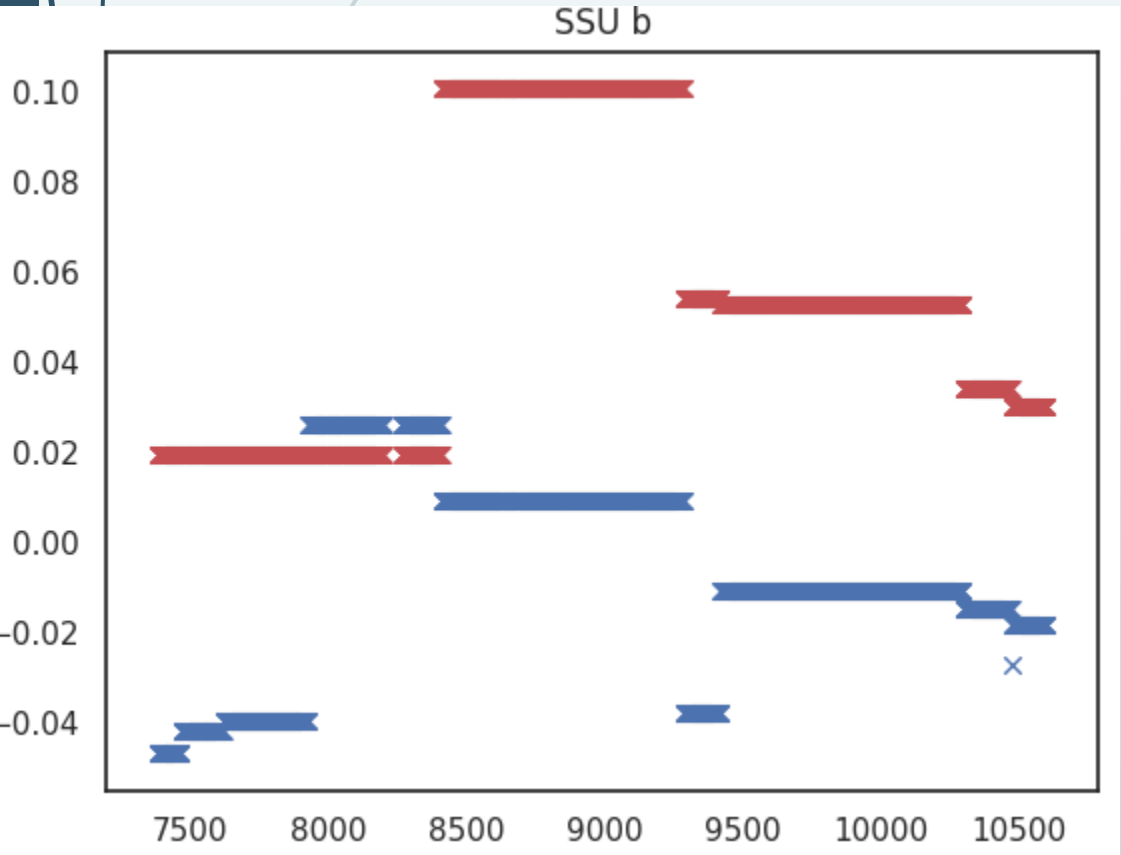
- Blue: tracker alpha rotation (degrees)
- Red: Centre coil alpha rotation (degrees)
- As a function of run number

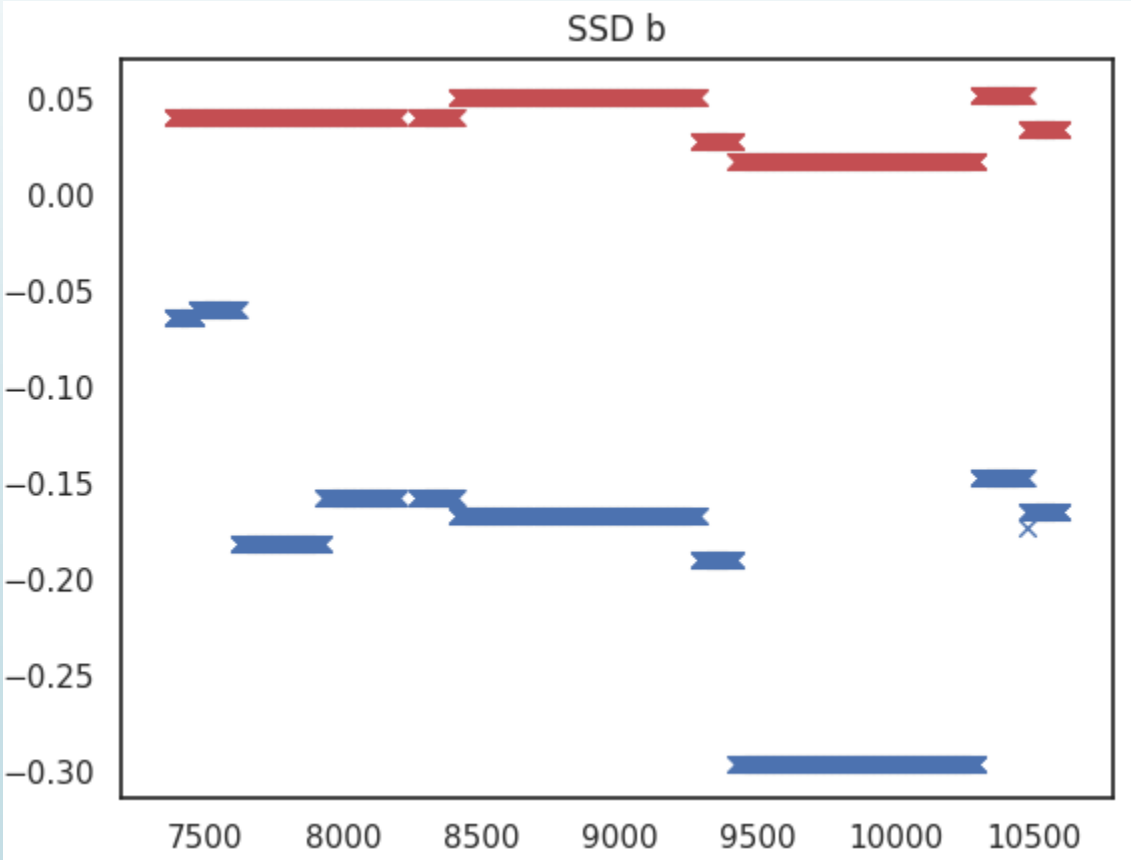




Misalignments

- Blue: tracker beta rotation (degrees)
- Red: Centre coil alpha rotation (degrees)
- As a function of run number





Fiducials						Magnetic Axis					
Original Survey System						Mapper System			Original Survey System		
Point	X Beam	Y	Z Up			Zm	Xm	Ym	X Beam	Y	Z Up
PT-1	7.472	-750.34	224.847	On SS-FC flange			(Horiz)	(Vert)			
PT-2	12.982	-249.41	743.267	Average X	9.93	872.23	0.775	-3.901	9.93	0.78	-3.90
PT-3	11.078	251.818	742.691								
PT-4	8.171	750.239	227.003								
PT-5	714.878	659.29	404.669								
PT-6	1038.76	725.813	-24.125								
PT-7	1279.48	584.487	426.871								
PT-8	1679.37	723.666	-31.611								
PT-9	2052.98	586.738	428.243	On d/s semi-flange							
PT-10	2360.28	775.057	-38.248	Average X	2906.58	3767.74	0.550	-10.949	2906.58	0.55	-10.95
PT-11	2903.25	775.416	0.482								
PT-12	2906.52	267.601	740.3								
PT-13	2910.04	-257.01	741.328								
PT-14	2906.5	-771.08	23.002								
PT-15	2368.62	-750.14	192.024								
PT-16	722.228	-655.63	420.965								

Table 2: Fiducials and magnetic axis of SS1 (SSD).

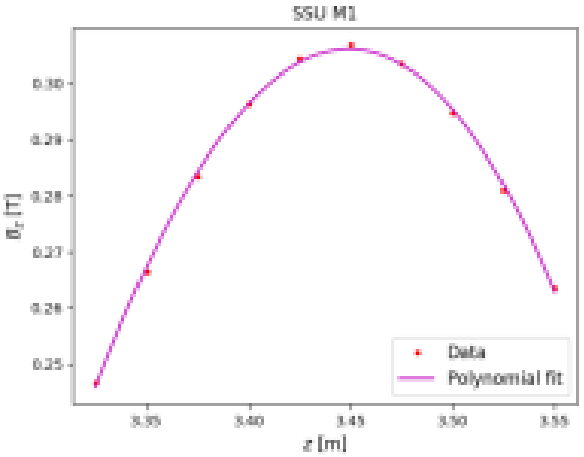
Fiducials						Magnetic Axis					
Original Survey System						Mapper System			Original Survey System		
Point	X Beam	Y	Z Up			Zm	Xm	Ym	X Beam	Y	Z Up
A	246.751	758.26	197.409	SS-FC flange							
B	247.19	328.459	710.927	Average X	247.22	541.36	0.401	-1.597	247.22	-0.40	-1.60
C	247.776	-330.01	710.688								
D	247.144	-757.66	199.688								
E	-465.34	-668.84	399.861								
G	-971.13	-573.24	449.322								
J	-1587.4	-562.72	458.052								
M	-2105	-751.02	208.858								
N	-2643.9	-783.58	35.738	Upstream semi-flange							
P	-2642.6	-304.69	727.444	Average X	-2643.89	3431.87	-0.120	-0.343	-2643.89	0.12	-0.34
R	-2644.4	227.345	753.017								
S	-2644.6	785.353	21.92								
K	-1891.5	-729.93	-40.962								
H	-1260.5	-728.6	-31.893								
F	-653.67	-729.68	-19.5								

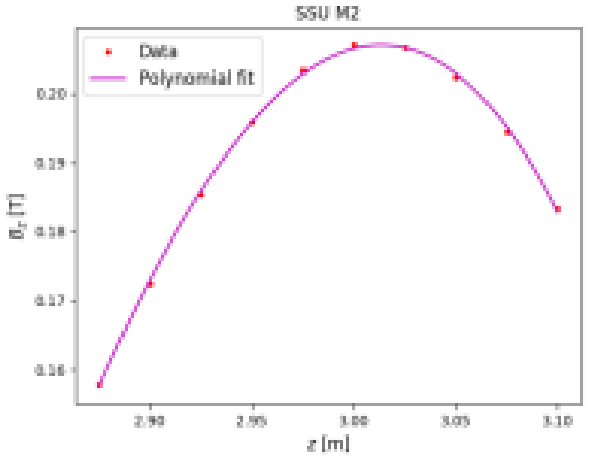
Table 3: Fiducials and magnetic axis of SS2 (SSU).

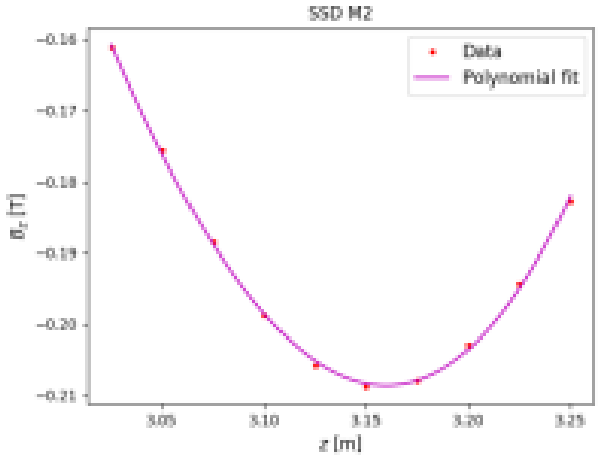
Blackmore & Cobb

- Survey Axis and magnetic axis virtually aligned (parallel) for SSU and SSD
- Survey Axis and magnetic axis misalign for Focus coils
- MICE notes 481 and 496

	dy	*dz*	dist
FC1 upstream	-0.47	1.72	1.78
FC1 downstream	-0.10	-0.79	0.79
FC2 upstream	0.11	-0.28	0.30
FC2 downstream	-0.09	0.54	0.54







SSU	M1 [mm]	M2 [mm]	E1 [mm]	CC [mm]	E2 [mm]
z	3449.22	3013.39	2613.39	1863.39	1113.39
z'	16106.55	15670.49	15270.29	14519.90	13769.50

Table 3.7 Table of centre positions in z and z' for all of SSU's coils. Coloured cells are those that are calculated from the method described above.

SSD	M1 [mm]	M2 [mm]	E1 [mm]	CC [mm]	E2 [mm]
z	3599.65	3159.65	2759.65	2409.65	1259.65
z'	17797.05	18237.34	18637.59	18987.81	20138.54

Table 3.8 Table of centre positions for all of SSD's coils.

Langlands thesis

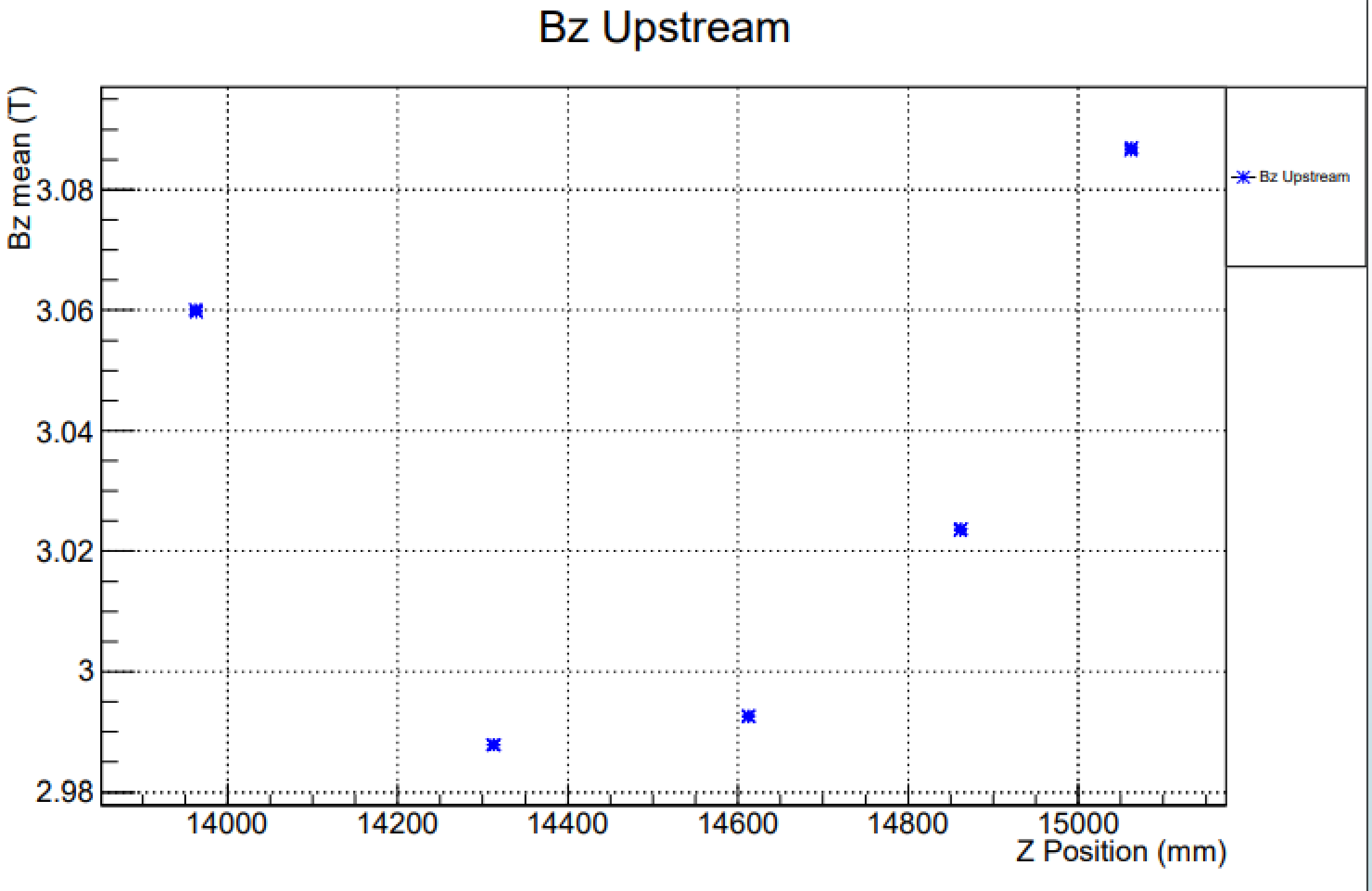
- Used Max of magnetic field to find centre of each coil, when only that coil was powered.
- Last Survey placed at:
- M1 SSU z = 16095.369 mm
- M2 SSU z = 15655.724 mm
- M2 SSD z = 18253.2598 mm

- Disagreements of up to 12 mm
- Also shows M1 and M2 coils are 4 mm closer to one another (~1%)

Next time

- Show residual variation through cooling channel

The End


Bz Upstream
Bz mean (T)
3.08
3.06
3.04
3.02
3
2.98
14000
14200
14400
14600
14800
15000
Z Position (mm)
Bz Upstream

Bz Downstream