Implementing an "Anti-Solenoid" to Correct Beam Line Distortion
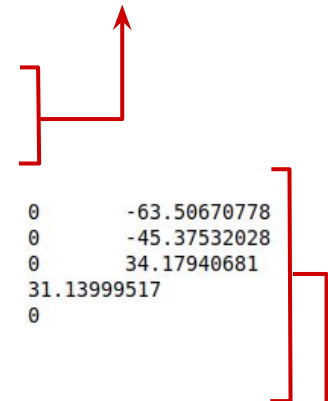
Ruthie Gu

Collaborators: Wenliang (Bill) Li, Abhay Deshpande, Paul Brindza, Charles Hyde, Pawel Nadel-Turonski, Vasiliy Morozov

Current Configuration

rear elements

forward elements

## name	center_x [m]	center_y [m]	center_z [m]	rin(z-in) [m]	rin(z-out) [m]	dout [m]	length [m]	angle [mrad]	B [T]	gradient [T/m]	
BXUS01	0.40249228105	0	-17.73979064	0.04	0.04	0.28	4.49991731158	24.5	-4.28073928333	0	
QFFUS03	0.5538411038	0	-12.742191425	0.04	0.04	0.28	4.5	35	0	55.5399548174	
QFFUS02	0.7095593068	0	-8.294916769	0.04	0.04	0.28	1.4	35	0	-76.5683196946	
QFFUS01	0.78304430145	0	-6.1962028875	0.04	0.04	0.28	1.8	35	0	-103.781316558	
BXSP01	0.212097365102	0	6.09600210598	0.245	0.245	0.69	1.19999819965	0	4.586506375	0	
QFFDS01A	0.260495441074	0	8.19569108373	0.0613866516955	0.0613866516955	0.28783220848	2	42.81707533	0	-63.50670778	
QFFDS01B	0.347217216172	0	10.7942654355	0.08597677172	0.08597677172	0.38779016144	2.2	42.42649039	0	-45.37532028	
QFFDS02A	0.482534996502	0	14.1918489261	0.11198630354	0.11198630354	0.5157363412	2.6	23.37358572	0	34.17940681	
QFFDS02B	0.573577466652	0	17.1904505591	0.12511851896	0.12511851896	0.6236	2.4	37.155013241	0	31.13999517	
BXDS01A	0.737879152469	0	21.2880193505	0.19	0.19	0.58	4.79995499686	30.752237898	4.443442343	0	
BXDS01B	0.905112088983	0	38.4880970566	0.055	0.055	0.31	3.59996625015	21.5	-4.59686275	0	
QDS01	0.9834278683	0	41.537066035	0.04	0.04	0.28	1.5	29	0	2.526510576	

Configuration with Anti-Solenoid

rear elements

forward elements

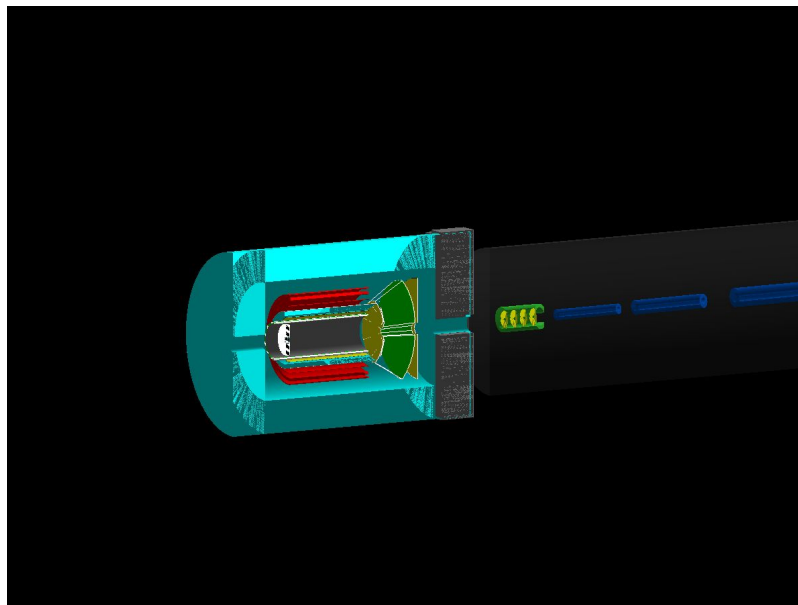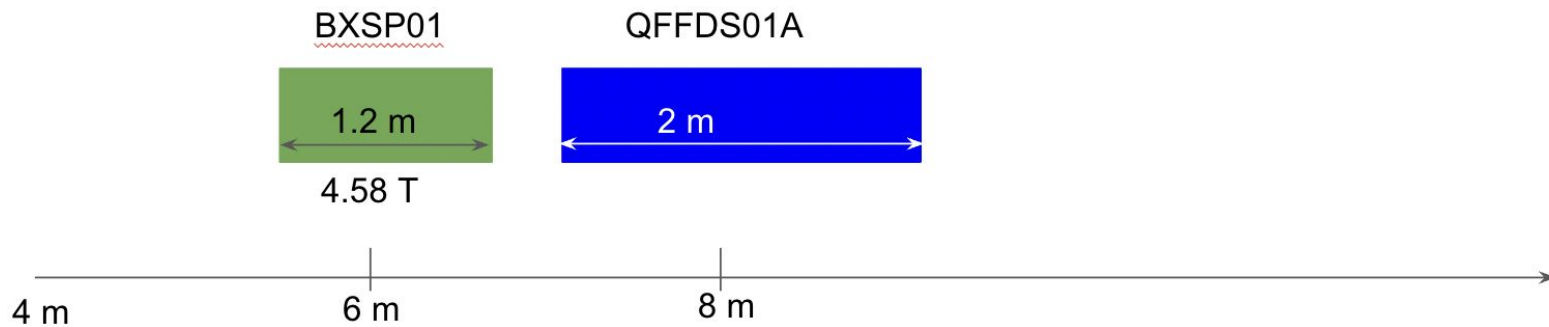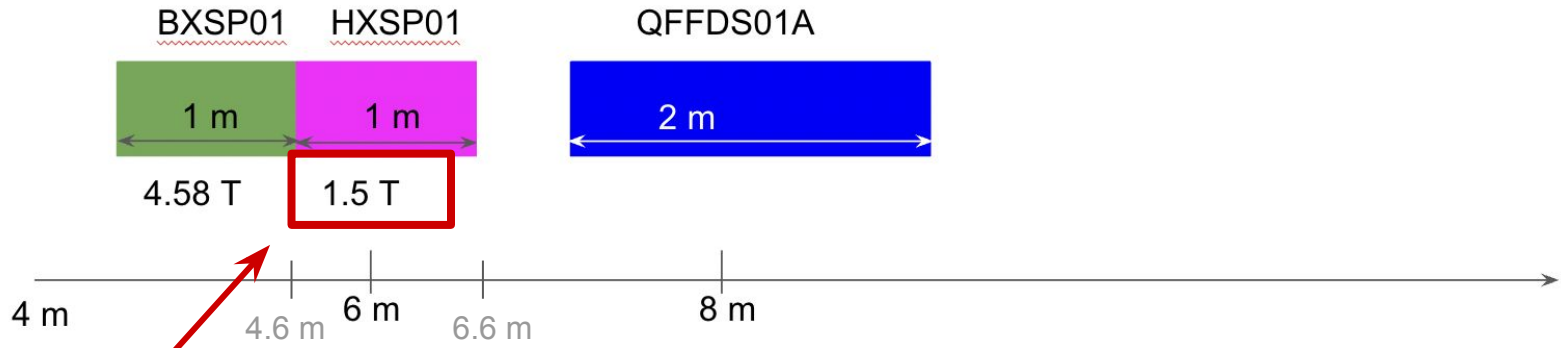| ## name	center_x [m]	center_y [m]	center_z [m]	rin(z-in) [m]	rin(z-out) [m]	dout [m]	length [m]	angle [mrad]	B [T]	gradient [T/m]		
BXUS01	0.40249228105	0	-17.73979064	0.04	0.04	0.28	4.49991731158	24.5	-4.28073928333	0		
QFFUS03	0.5538411038	0	-12.742191425	0.04	0.04	0.28	4.5	35	0	55.5399548174		
QFFUS02	0.7095593068	0	-8.294916769	0.04	0.04	0.28	1.4	35	0	-76.5683196946		
QFFUS01	0.78304430145	0	-6.1962028875	0.04	0.04	0.28	1.8	35	0	-103.781316558		
BXSP01	0.212097365102	0	5.09600210598	0.245	0.245	0.69	1.0	0	4.586506375	0		
HXSP01	0.212097365102	0	6.09600210598	0.245	0.245	0.69	1.0	0	1.5	0		
QFFDS01A	0.260495441074	0	8.19569108373	0.0613866516955	0.0613866516955	0.28783220848	2	42.81707533	0	-63.50670778		
QFFDS01B	0.347217216172	0	10.7942654355	0.08597677172	0.08597677172	0.38779016144	2.2	42.42649039	0	-45.37532028		
QFFDS02A	0.482534996502	0	14.1918489261	0.11198630354	0.11198630354	0.5157363412	2.6	23.37358572	0	34.17940681		
QFFDS02B	0.573577466652	0	17.1904505591	0.12511851896	0.12511851896	0.6236	2.4	37.155013241	0	31.13999517		
BXDS01A	0.737879152469	0	21.2880193505	0.19	0.19	0.58	4.79995499686	30.752237898	4.443442343	0		
BXDS01B	0.905112088983	0	38.4880970566	0.055	0.055	0.31	3.59996625015	21.5	-4.59686275	0		
QDS01	0.9834278683	0	41.537066035	0.04	0.04	0.28	1.5	29	0	2.526510576		

Fun4All Simulation

Benefits of Anti-Solenoid (vs. Skewed Quadripoles) for IP8

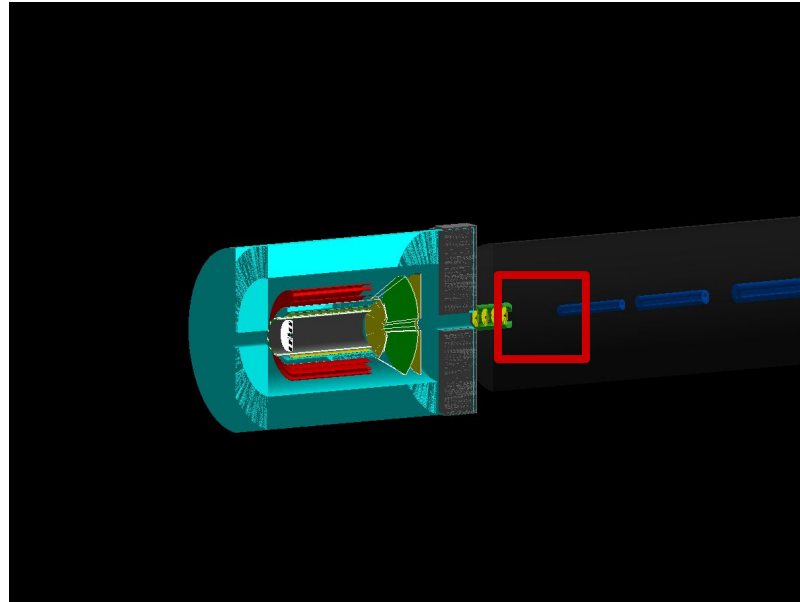→ larger acceptance for physics in the far-forward region

→ simpler, more straightforward engineering solution

Note: This solution can only be implemented with CORE due to the detector's shorter length; would not work for IP6.

BXSP01

QFFDS01A

1.2 m

2 m

4.58 T

4 m

6 m

8 m

BXSP01   HXSP01   QFFDS01A

1 m   1 m   2 m

4.58 T   1.5 T

4 m   4.6 m   6 m   6.6 m   8 m

subject to change

Scaling down CORE solenoid field map as B for the anti-solenoid

CORE Field Map

B-field magnitude (Gauss)

CORE Field Map

z (cm)

r (cm)

r (cm)

z (cm)