

New SoLID Setup

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- Detector Layout
 - Magnet dimension
 - EC size
 - Cables
-
- Zhiwen Zhao
 - ❑ 2017/02/22 (initial discussion)
 - ❑ 2017/03/37 (1st round)
 - ❑ 2017/04/10 (2nd round)

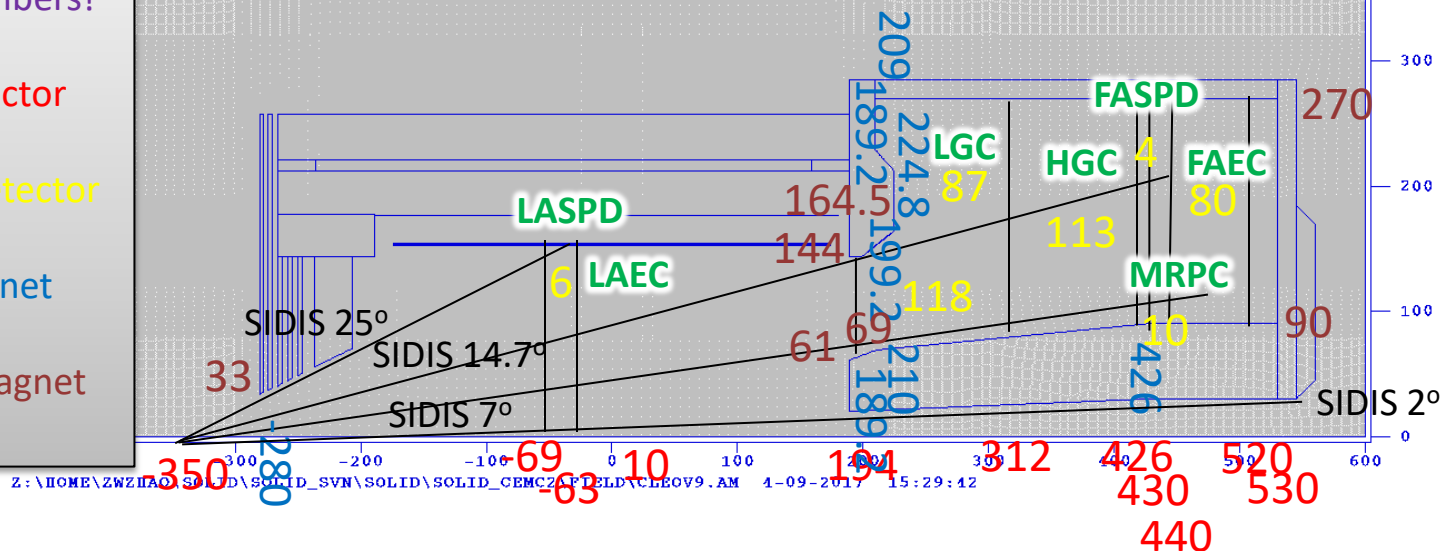
Proposed Layout and Magnet

enlarge endcap space in Z by 45cm=(530-485)
Change endcap nose with two slopes

SIDIS and JPsi

Read the Color numbers!

- Red number, detector boundary in Z
- Yellow number, detector space in Z
- Blue number, magnet boundary in Z
- Brown number, magnet boundary in R



144cm	Cryo Rin
R=144cm , Z=199.2	Collar tip1
R=164.5cm , Z=224.8	Collar tip2
$\text{atan}((164.5-144)/(224.8-199.2))/3.1416*180=38.7^\circ$	Collar slope
R=61cm , Z=189.2	Endcap Nose tip1
R=69cm , Z=210	Endcap Nose tip2
R=90cm , Z=426	Endcap Nose flat
$\text{atan}((69-61)/(210-189.2))/3.1416*180=21.0^\circ$	Endcap nose slope1
$\text{atan}((90-69)/(426-210))/3.1416*180=5.6^\circ$	Endcap nose slope2
$(350-280)*\tan(25/180*3.1416) =33\text{cm}$	front plug Rin

$\text{atan}(135/(350-63))/3.1416*180=25.2^\circ$	SIDIS Max angle
$\text{atan}(144/(350+199.2))/3.1416*180=14.7^\circ$	SIDIS Middle angle, collar tip1
$\text{atan}(69/(350+210))/3.1416*180=7^\circ$	SIDIS Min angle, nose tip2
$\text{atan}(95/(350+426))/3.1416*180=7^\circ$	SIDIS Min angle, nose flat
$\text{atan}(135/(315-63))/3.1416*180=28.2^\circ$	JPsi Max angle
$\text{atan}(144/(315+199.2))/3.1416*180=15.7^\circ$	JPsi Middle angle, collar tip1
$\text{atan}(69/(315+210))/3.1416*180=7.5^\circ$	JPsi Min angle, nose tip2
$\text{atan}(95/(315+426))/3.1416*180=7.3^\circ$	JPsi Min angle, nose flat

Proposed Layout and Magnet

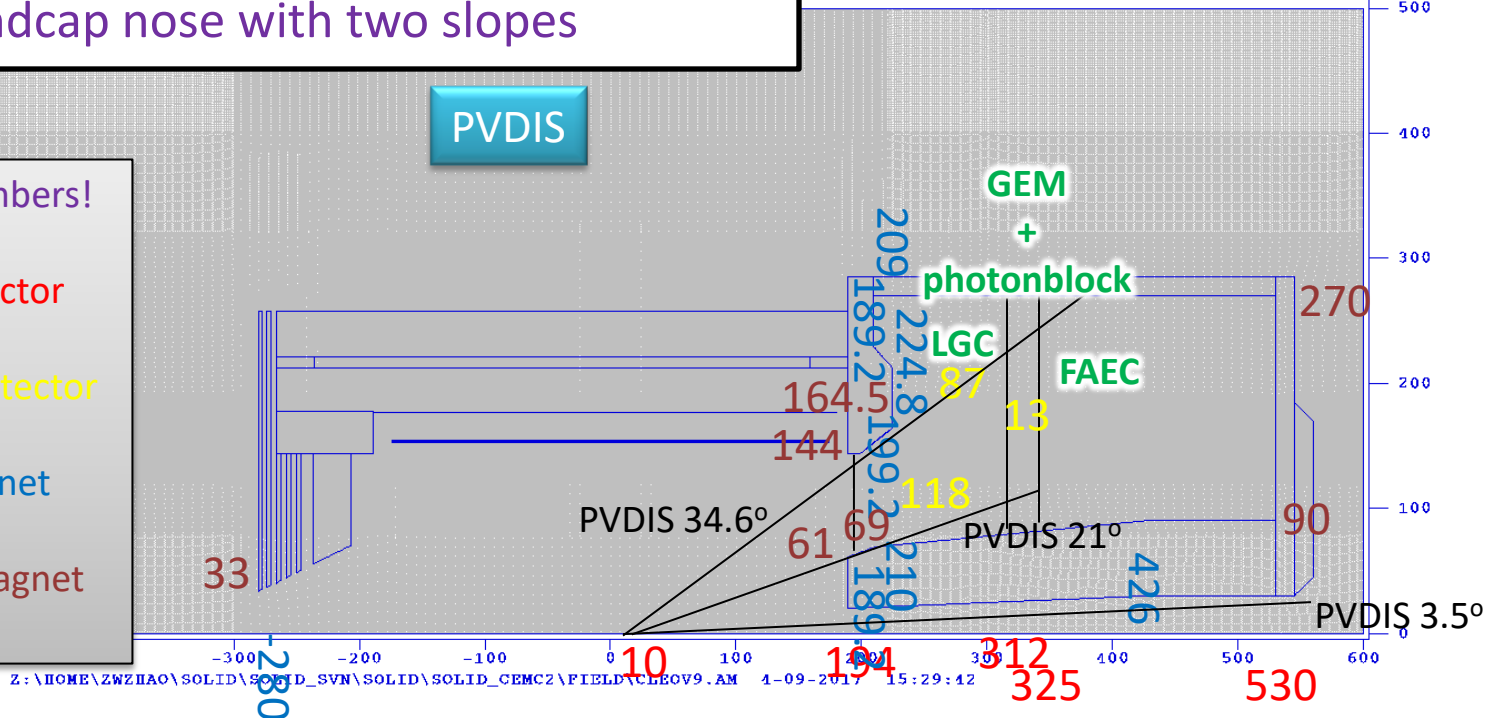
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enlarge endcap space in Z by 45cm=(530-485)
Change endcap nose with two slopes

PVDIS

Read the Color numbers!

- Red number, detector boundary in Z
- Yellow number, detector space in Z
- Blue number, magnet boundary in Z
- Brown number, magnet boundary in R



144cm	Cryo Rin
R=144cm , Z=199.2	Collar tip1
R=164.5cm , Z=224.8	Collar tip2
$\text{atan}((164.5-144)/(224.8-199.2))/3.1416*180=38.7^\circ$	Collar slope
R=61cm , Z=189.2	Endcap Nose tip1
R=69cm , Z=210	Endcap Nose tip2
R=90cm , Z=426	Endcap Nose flat
$\text{atan}((69-61)/(210-189.2))/3.1416*180=21.0^\circ$	Endcap nose slope1
$\text{atan}((90-69)/(426-210))/3.1416*180=5.6^\circ$	Endcap nose slope2
$(350-280)*\text{tan}(25/180*3.1416) =33\text{cm}$	front plug Rin

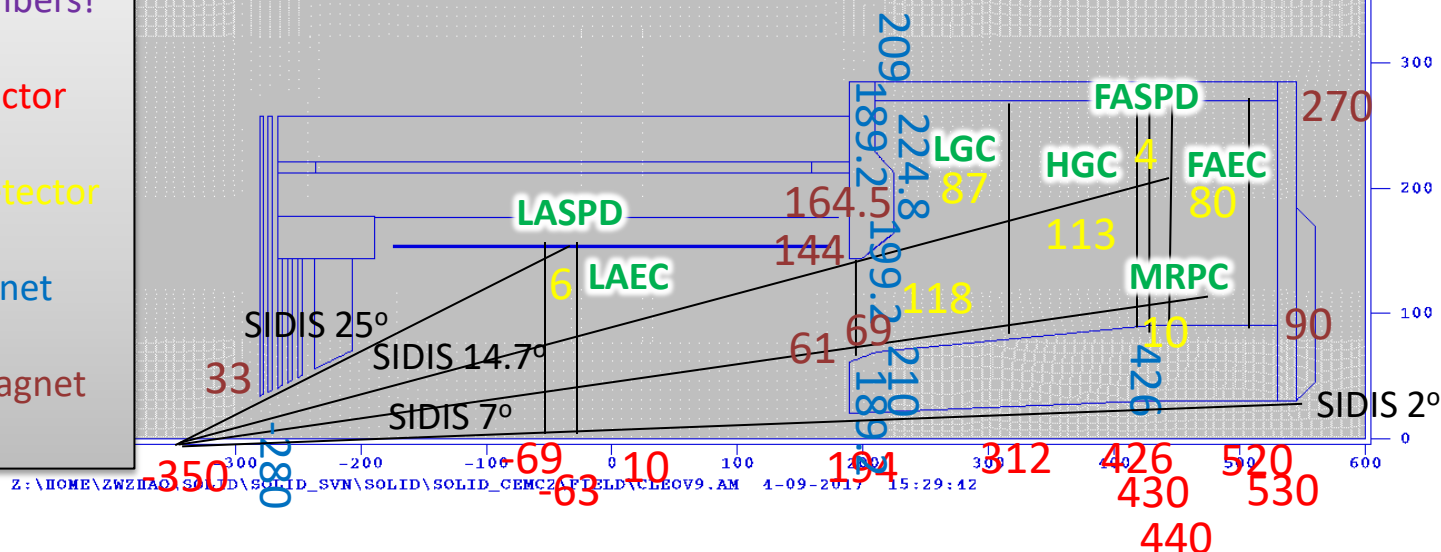
$\text{atan}(144/(199.2-10+20))/3.1416*180 =34.6^\circ$	PVDIS Max angle, up, collar tip1
$\text{atan}(144/(199.2-10))/3.1416*180 =37.3^\circ$	PVDIS Max angle, middle, collar tip1
$\text{atan}(144/(199.2-10-20))/3.1416*180 =40.4^\circ$	PVDIS Max angle, down, collar tip1
$\text{atan}(164.5/(224.8-10+20))/3.1416*180 =35.0^\circ$	PVDIS Max angle, up, collar tip2
$\text{atan}(164.5/(224.8-10))/3.1416*180 =37.4^\circ$	PVDIS Max angle, middle, collar tip2
$\text{atan}(164.5/(224.8-10-20))/3.1416*180 =40.2^\circ$	PVDIS Max angle, down, collar tip2
$\text{atan}(61/(189.2-10+20))/3.1416*180 =17.0^\circ$	PVDIS Min angle, up, nose tip1
$\text{atan}(61/(189.2-10))/3.1416*180 =18.8^\circ$	PVDIS Min angle, middle, nose tip1
$\text{atan}(61/(189.2-10-20))/3.1416*180 =21.0^\circ$	PVDIS Min angle, down, nose tip1
$\text{atan}(69/(210-10+20))/3.1416*180 =17.4^\circ$	PVDIS Min angle, up, nose tip2
$\text{atan}(69/(210-10))/3.1416*180 =19.0^\circ$	PVDIS Min angle, middle, nose tip2
$\text{atan}(69/(210-10-20))/3.1416*180 =21.0^\circ$	PVDIS Min angle, down, nose tip2

enlarge endcap space in Z by 45cm=(530-485)
Change endcap nose with two slopes

SIDIS and JPsi

Read the Color numbers!

- Red number, detector boundary in Z
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- Blue number, magnet boundary in Z
- Brown number, magnet boundary in R



$$(315+440)*\tan(7.3/180*3.1416) = 97\text{cm}$$

FAEC JPsi Rin(phys)

$$(350+440)*\tan(7/180*3.1416) = 97\text{cm}$$

FAEC SIDIS Rin(phys)

= 90cm

FAEC Rin(eng)

$$(315+490)*\tan(15.7/180*3.1416)=226\text{cm}$$

FAEC JPsi Rout(phy)

$$(350+490)*\tan(14.7/180*3.1416)=220\text{cm}$$

FAEC SIDIS Rout(phv)

240cm

FAEC Rout(eng)

$$3.1416 \cdot (240^2 - 90^2) / 10^4 = 15.6 \text{ m}^2$$

area FAEC SIDIS

$$(350-63)*\tan(14.7/180*3.1416) = 76\text{cm}$$

LAEC SIDIS front Rin(eng)

$$(350-13)*\tan(14.7/180*3.1416) = 88\text{cm}$$

LAEC SIDIS rear Rin(eng)

144cm LAEC Rout (eng)

$$(350-63)*\tan(25/180*3.1416) = 134\text{cm}$$

LAEC SIDIS front Rout (phv)

$$(350-38)*\tan(25/180*3.1416) = 146\text{cm}$$

LAEC SIDIS middle Rout (phv)

$$(350-13)*\tan(25/180*3.1416) = 157\text{cm}$$

LAEC SIDIS rear Rout (phy)

$$3.1416 \cdot (144 \cdot 144 - 76 \cdot 76) / 1e4 = 4.7 \text{ m}^2 \quad \text{area LAEC SIDIS}$$

Total EC area 20.3 m²

Proposed EC Size

Assume EC module 50cm long

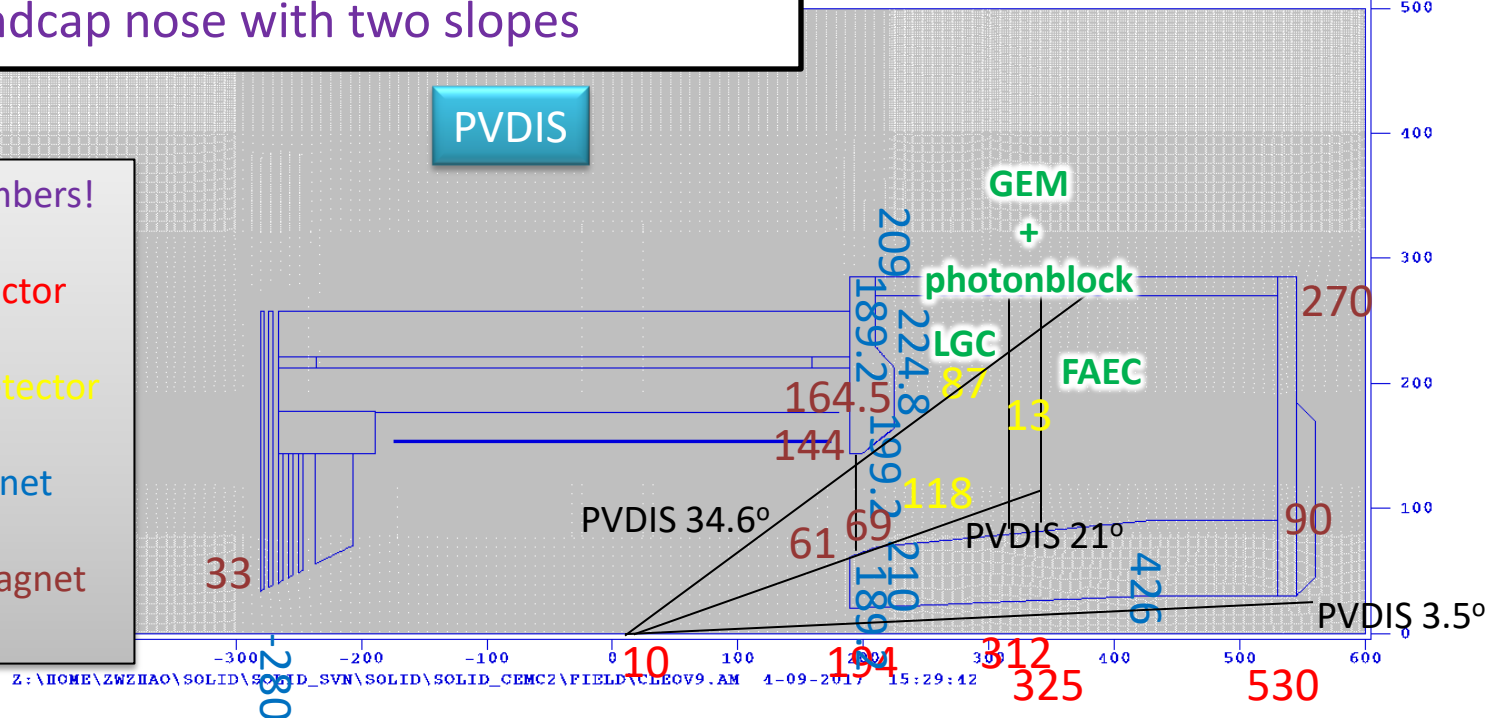
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enlarge endcap space in Z by 45cm=(530-485)
Change endcap nose with two slopes

PVDIS

Read the Color numbers!

- Red number, detector boundary in Z
- Yellow number, detector space in Z
- Blue number, magnet boundary in Z
- Brown number, magnet boundary in R



$$(325-10-20)*\tan(21/180*3.1416) = 113\text{cm} \quad \text{FAEC PVDIS Rin from up (phys)}$$

$$90\text{cm} \quad \text{FAEC PVDIS Rin from up (eng)}$$

$$(375-10+20)*\tan(35/180*3.1416) = 270\text{cm} \quad \text{FAEC PVDIS Rout(phy)}$$

$$270\text{cm} \quad \text{FAEC PVDIS Rout(eng)}$$

$$3.1416*(270*270-90*90)/1e4 = 20.4 \text{ m}^2 \quad \text{area FAEC PVDIS}$$

Total EC area 20.4 m²

Cables

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	Total area(cm2)	Location to go out	comment
FAEC (PVDIS)	1800	Endcap Back plate	1800 1.1cmD fiber bundle, 1800 0.3cmD fiber bundle
LAEC (SIDIS)	500	near downstream collar?	500 1.1cmD fiber bundle, 500 0.3cmD fiber bundle
FASPD	tiny	endcap side	240 1mmD fiber
LASPD	40	near downstream collar or solenoid front?	60 HV, 60 BNC
LGC	170	Near downstream collar or endcap side?	270 5mmD HV, 270 3mmD BNC
HGC	300	Endcap side	480 HV, 480 BNC 2 gas line at top, 2 gas line at bottom
GEM (PVDIS)	650	Near downstream collar or endcap side?	1,2,3 GEM planes, total cable 540 HDMI, 90 SHV, 180 Gas, 6mmD each, use 10mmD for safety, $3.1416 \cdot (10/2)^2 / 100 \cdot (540 + 90 + 180) = 636 \text{cm}^2$
	730	endcap side	4,5 GEM planes, total cable 720 HDMI, 60 SHV 120 Gas, 6mmD each, use 10mmD for safety, $3.1416 \cdot (10/2)^2 / 100 \cdot (720 + 60 + 120) = 707 \text{cm}^2$
GEM (SIDIS)	1380	Near downstream collar or solenoid front?	Assume same like PVDIS
MRPC	1650	endcap side	3300 channels, assume 0.5cm2 each

2017/3/27

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- 1st round proposed layout and magnet

Proposed New Layout and Magnet

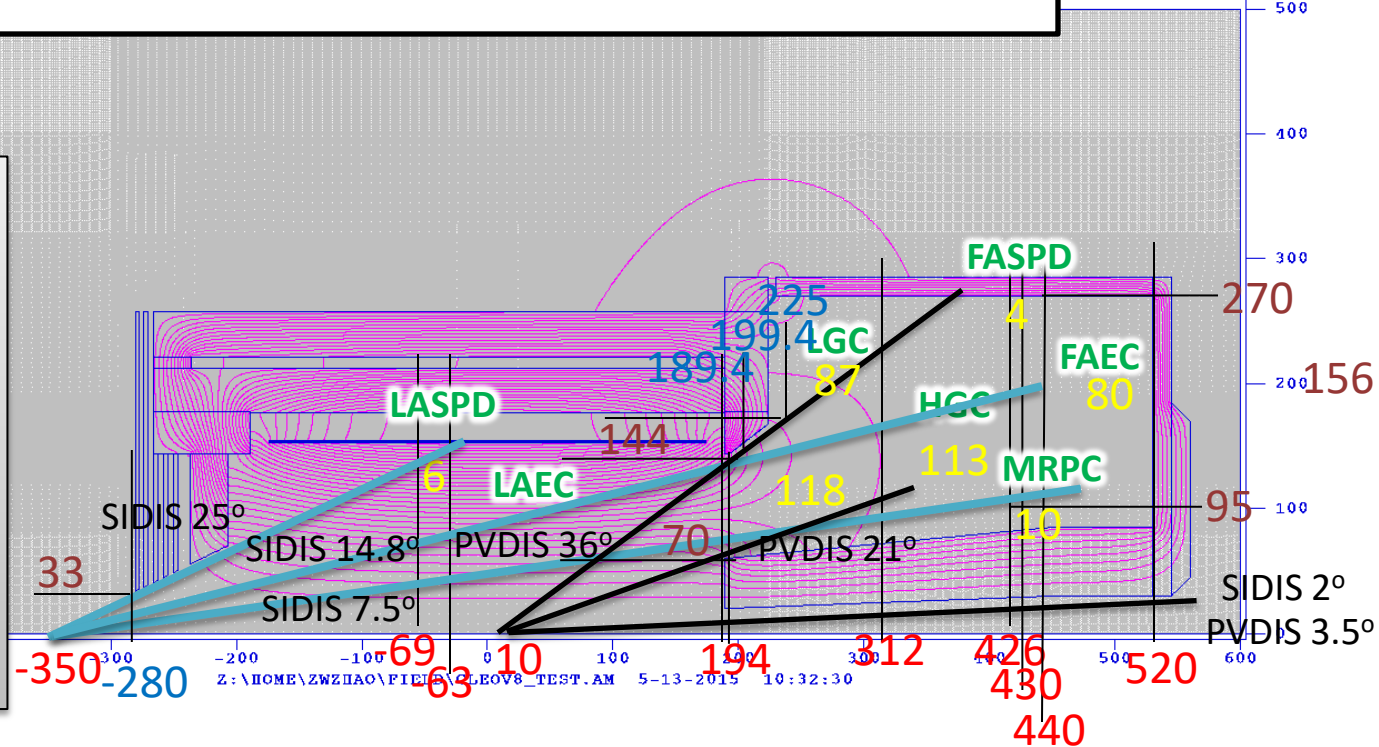
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enlarge endcap space in Z by 35cm=(520-485)

increase endcap nose size in R from 60 to 70cm and from 90 to 95cm

The picture is NOT accurate,
Read the Color numbers!

- Red number, detector boundary in Z
- Yellow number, detector space in Z
- Blue number, magnet boundary in Z
- Brown number, magnet boundary in R



144cm Cryo Rin
70cm Endcap Nose tip Rout
95 cm Endcap Nose flat Rout
426cm Endcap Nose flat front Z

$\text{atan}((95-70)/(426-189))/3.1416 \times 180 = 6^\circ$
Endcap Nose slope

$(350-280) \times \tan(25/180 \times 3.1416) = 33\text{cm}$ front plug Rin

$(350+440) \times \tan(7.5/180 \times 3.1416) = 104\text{cm}$ FAEC Rin(phys)
 $104 - 9 = 95\text{cm}$ FAEC Rin(eng)
 $(315+500) \times \tan(15.8/180 \times 3.1416) = 231\text{cm}$ FAEC SIDIS Rout(phy)
 $231 + 9 = 240\text{cm}$ FAEC SIDIS Rout(eng)
265cm FAEC PVDIS Rout
 $(350-63) \times \tan(14.8/180 \times 3.1416) = 76\text{cm}$ LAEC front Rin(eng)
 $(350-13) \times \tan(14.8/180 \times 3.1416) = 89\text{cm}$ LAEC rear Rin(eng)
 $3.1416 \times (265 \times 265 - 95 \times 95) / 1e4 = 19.2 \text{ m}^2$ area FAEC PVDIS
 $3.1416 \times (240 \times 240 - 95 \times 95) / 1e4 = 15.3 \text{ m}^2$ area FAEC SIDIS
 $3.1416 \times (140 \times 140 - 80 \times 80) / 1e4 = 4.1 \text{ m}^2$ area LAEC SIDIS

$\text{atan}(144/(195-10))/3.1416 \times 180 = 35.8^\circ$ PVDIS Max angle
 $\text{atan}(70/(189-10))/3.1416 \times 180 = 21.4^\circ$ PVDIS Min angle
 $\text{atan}(135/(350-63))/3.1416 \times 180 = 25.2^\circ$ SIDIS Max angle
 $\text{atan}(144/(350+195))/3.1416 \times 180 = 14.8^\circ$ SIDIS Middle angle
 $\text{atan}(70/(350+189))/3.1416 \times 180 = 7.4^\circ$ SIDIS Min angle
 $\text{atan}(135/(315-63))/3.1416 \times 180 = 28.2^\circ$ JPis Max angle
 $\text{atan}(144/(315+195))/3.1416 \times 180 = 15.8^\circ$ JPis Middle angle
 $\text{atan}(70/(315+189))/3.1416 \times 180 = 7.9^\circ$ JPis Min angle

2017/2/22

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➤ Initial discussion

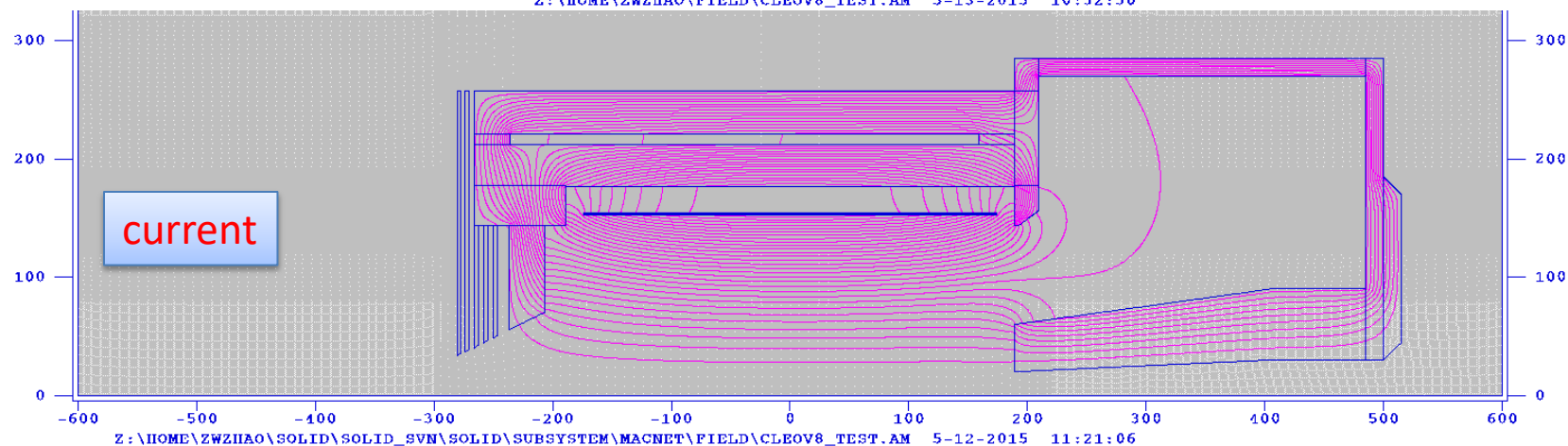
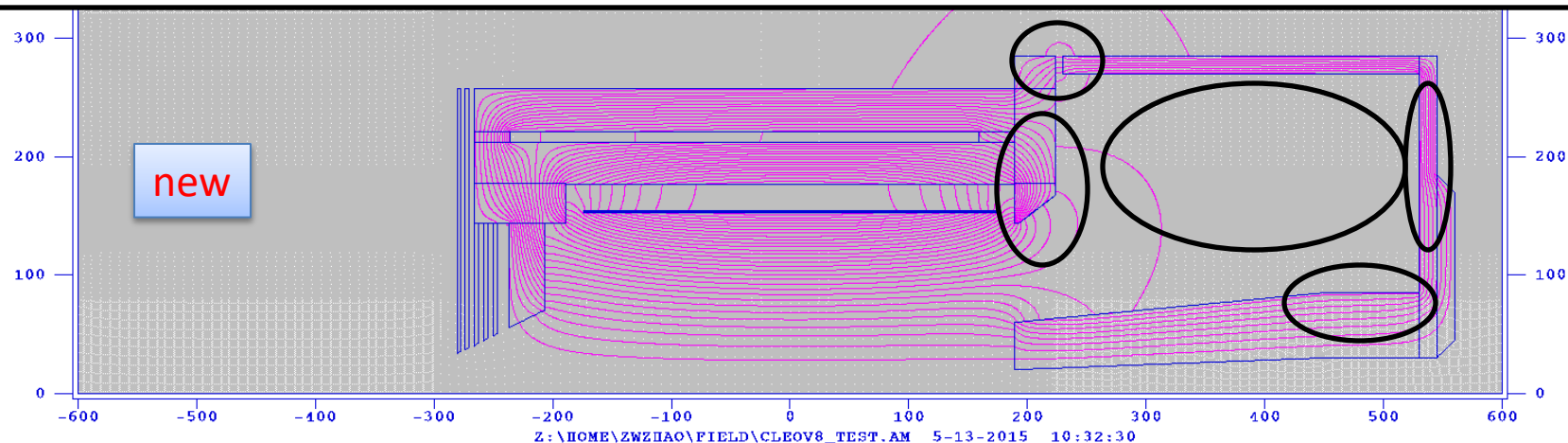
Just ideas here, but changes are clearly needed

- Downstream collar enlarge by 15cm in z (needed for engineering)
- Endcap enlarge 30cm (SIDIS setup needs room)
- Endcap nose back reduce 5cm in r (EC hexagon module needs room)
- 6cm gap between downstream collar and endcap (let cable out, more cable out at back needed)
- possible impact, PVDIS EC large angle performance

Zhiwen's old slide

Need design with full 3D model and satisfy both physics and engineering requirement needed by all subsystems to fix their design, must be a coherent effort

More realistic design now, More saving of man power, effort, cost, maybe even physics



Jay's new model

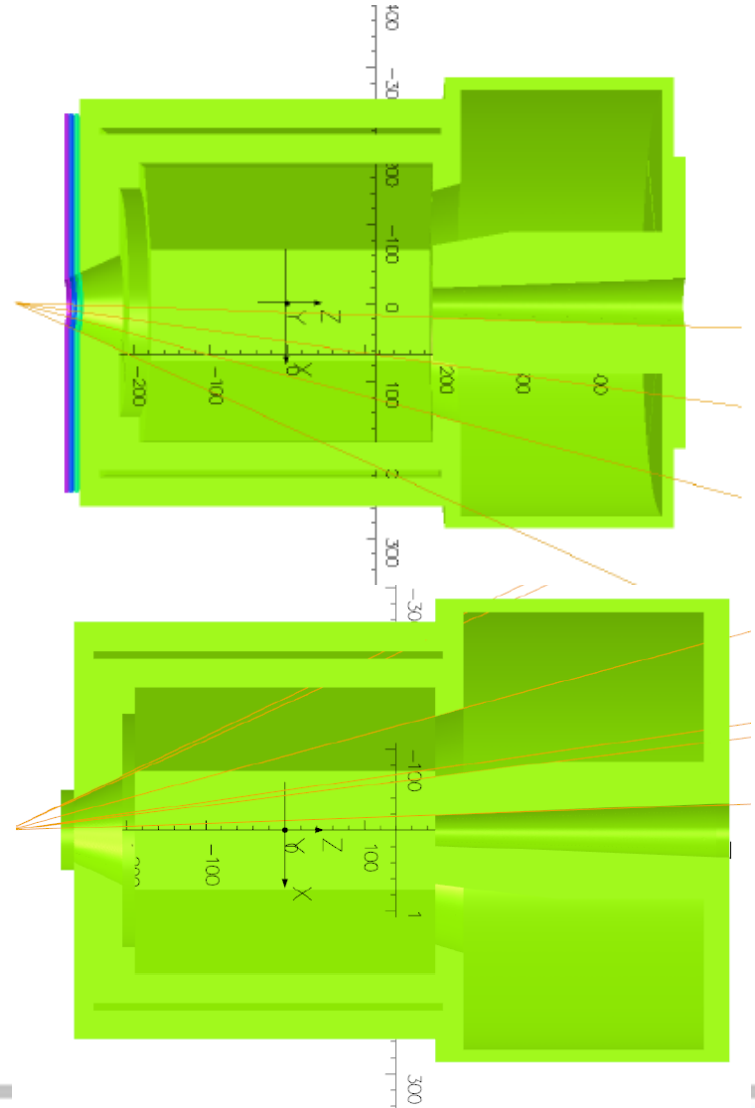
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➤ Model 1

- ❑ SIDIS Opening 8-24 deg
- ❑ Endcap nose outer_r=90cm
- ❑ Endcap length_z=261cm
- ❑ Downstream collar 15cm thicker than current

➤ Model 2

- ❑ SIDIS Opening 7-25 deg
- ❑ Endcap nose outer_r=85cm
- ❑ Endcap length_z=304.8cm (10ft)
- ❑ Downstream collar 15cm thicker than current



Jay's questions

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- 1. how long should endcap interior be, including contingency for detector changes? The one shown is 304.8 cm. Zhiwen's model has 261 cm.
- 2. what should OD of endcap central cylinder be? Range 85-90 cm. One could slot a 90 cm cylinder and recess Thomson rails: intermediate steel case.
- 3. what size radial holes are needed at what endcap Z locations for cables? 24 2" diameter with external compensatory steel?
- 4. how much will ~ 2 G excursion in Bz over 60 cm He3 target affect it?

Zhiwen's thoughts

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- 1. “Downstream collar enlarge by 15cm”, will LGC can redesign tank and keep PMT at same location, thus preserve same performance?
- 2. HGC wants 10cm in Z to allow tolerance with pressured thin windows.
- 3. Is the current space good in Z and R for SPD, GEM, MRPC, baffle, EC at engineering level? If not, what change do you want?
- 4. What is the size of the crosssection area of cables of your detector going out? Where is the preferred location you want them to go out?