Update on the sweep magnet for the NPS experiments

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Kinematics of SI pion (E12-13-007)

#	θ_γ	θ_e	D_{mag}, m	Bdl, Tm	D_{mag}-Calo, m	angle range, degree
A **X**	10.57	10.27	1.57	0.3	3-1.57	
B **X**	16.20	11.70	1.57	0.3		
C	12.44	15.38	1.57	0.3		
D	7.93	24.15	1.57	0.3	1.43	4.7-11.1
E	16.57	15.65	1.57	0.3	1.43	
F	17.23	17.84	1.57	0.3	1.43	

X – SAM configuration is finalized. We checked 4(5) out of a total of 22 configurations.

Kinematics of DVCS (E12-13-10)

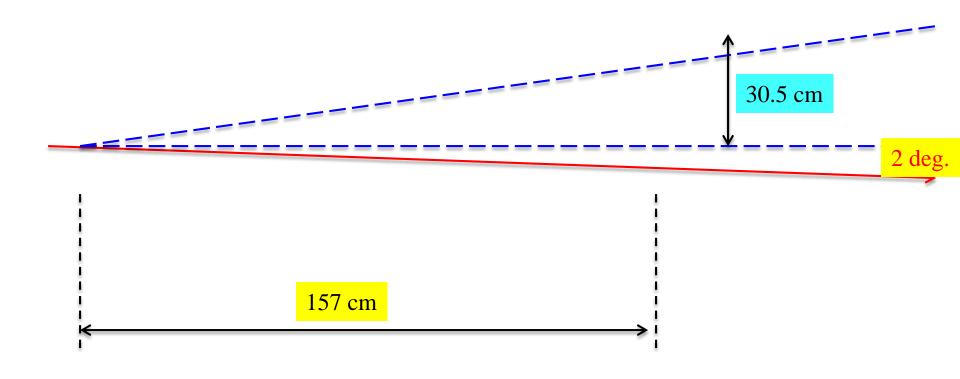| #	θ_γ	θ_e	D_{calo}, m	Bdl, Tm	D_{mag}-Calo, m	angle range, degree
3 (=B)	16.2	11.7	3	0.3	1.43	
5 (~C)	12.4	15.3	3	0.3	1.43	
7	21.7	11.7	3	0.3	1.43	
8 X	16.6	15.6	3	0.3	1.43	
13	6.3	27.9	6	0.3	4.43	3.1 - 9.6
16 X	6.3	17.3	6	0.3	4.43	

range of angles: 68 cm / 300 => 12.8 degrees
range of angles: 68 cm / 600 =>   6.5 degrees

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Kinematics of WACS (E12-14-003) /Pion

#	θ_γ	θ_p	D_{mag} ,m	Bdl, Tm	D_{det}, m	D_{magr}-Calo, m	Bdl, Tm / D_{mag}-Calo, m
4A	14.2	40.1	2.45+0.2	0.3	9.0	6.15	0.3 / (9-1.57)
4B	17.9	33.7	1.65+0.2	0.4	7.0		
4C	22.5	27.8	1.65+0.2	0.5	5.0		
4D	26.9	23.7	1.10+0.2	0.6	3.5		
4E	34.0	18.9	1.10+0.2	0.6	3.0	1.7	0.61 Tm / 1.68
5A	11.0	41.7	2.45+0.2	0.25	11.0		9.3-12.7 deg
5B	13.8	35.3	2.45+0.2	0.35	9.0		

Horizontal field dipole

30.5 cm

2 deg.

157 cm

Parameters

1. Field integral from the target to NPS ~ 0.58 Tm, for the main coil: 1050A, 140 kW
   corrector coils ~ 500 A, 20 kW

1. Field integral along the beam line from the target to magnet middle
      Goal is a low transverse BdL, below 1 milli Tm -> OK (see Rolf's)
      after tuning of the corrector, there is some field at the target and before it.

3. Field integral along the HMS central trajectory from the target to Q1
      Goal is to have BdL below 1 milli Tm - > could be hard to do even with
      the cone on the snout (t=5 mm). May need Q1 in the model.

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What are the requirements?

1. A low energy tail for the thin target case, $P_{loss} = P\_b \times 2t/3 \, (E_{cut}/E_b)^2$
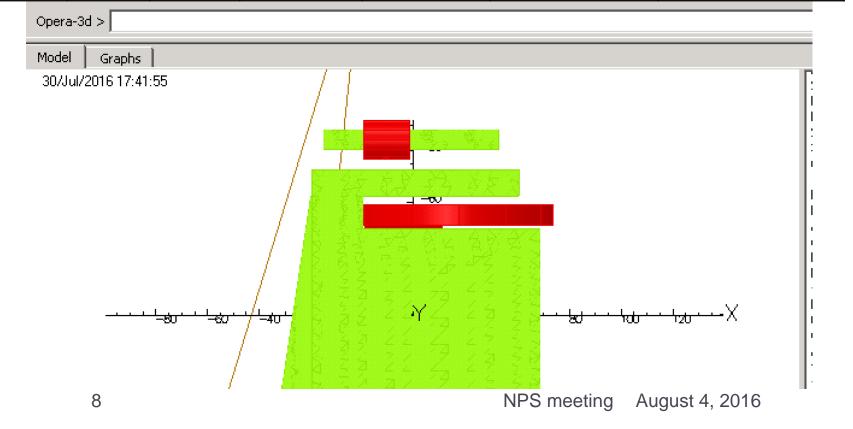
It would be great to have $E_{cut} = 300$ MeV => 0.05% of beam power
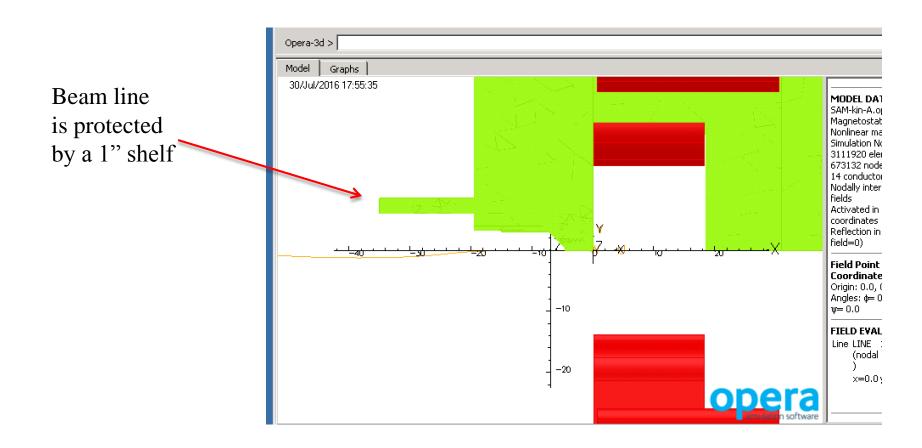
$BdL = 3$ cm $/ 30$ m $* [3 \times 10^8/300] = 10^3$ Gauss cm $= 1$ milli Tm (Rolf's)
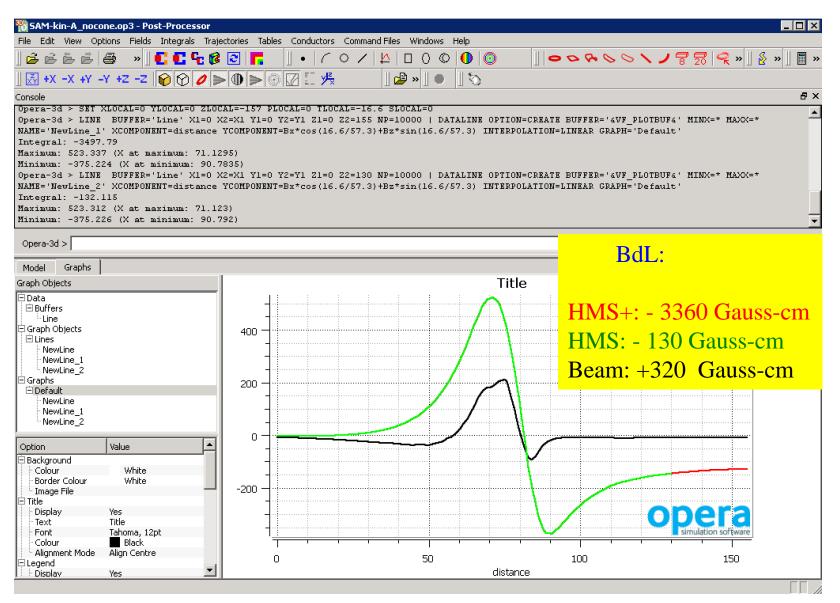
2. HMS optics aberration for 3 GeV/c and $BdL = 1 \times 10^3$ Gauss cm (Rolf's)

$\delta\theta \sim 300 \times BdL \,/3 \times 10^9 = 0.1$ mrad
vertex shift $\sim < 0.5$ mm?

Kinematics "A" for pion

FILE > yes
Track has current = 1.0

#	θ_γ	θ_e	D_{mag}, m	Bdl, Tm	D_{mag}-Calo, m	angle range, degree
A **X**	10.57	10.27	1.57	0.3	3-1.57	

Opera-3d >

Model | Graphs

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Kinematics "A" for pion

Beam line is protected by a 1" shelf

Kinematics "A" for pion

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Kinematics "A" for pion

```
Opera-3d > SET XLOCAL=0 YLOCAL=0 ZLOCAL=-157 PLOCAL=0 TLOCAL=-5.5 SLOCAL=0
Opera-3d > LINE  BUFFER='Line' X1=0 X2=X1 Y1=0 Y2=Y1 Z1=0 Z2=330 NP=10000 | DATALINE OPTION=CREATE
BUFFER='&VF_PLOTBUF&' MINX=* MAXX=* NAME='NewLine_9' XCOMPONENT=distance
YCOMPONENT=Bx*cos(5.5/57.3)+Bz*sin(5.5/57.3) INTERPOLATION=LINEAR GRAPH='Default'
Integral: 21456.1
Maximum: 358.148 (X at maximum: 229.482)
Minimum: -141.707 (X at minimum: 82.467)
```

Opera-3d >

| Model | Graphs |

Graph Objects

- NewLine_4
- NewLine_5
- NewLine_6
- NewLine_7
- NewLine_8
- NewLine_9
- Graphs
  - Default
    - NewLine
    - NewLine_1
    - NewLine_2
    - NewLine_3
    - NewLine_4
    - NewLine_5

Option	Value
Background	
Colour	W
Border Colour	W
Image File	
Title	
Display	Yes
Text	Title
Font	Tahom
Colour	■ Bla
Alignment Mode	Align (
Legend	11
Display	Yes

Title

Compensation after SAM needs to be designed

New
New
New
— New
— New
— New
— New
— New
— New
— New

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distance

BdL:
Beam: 21500 Gauss-cm

Kinematics "16" for DVCS
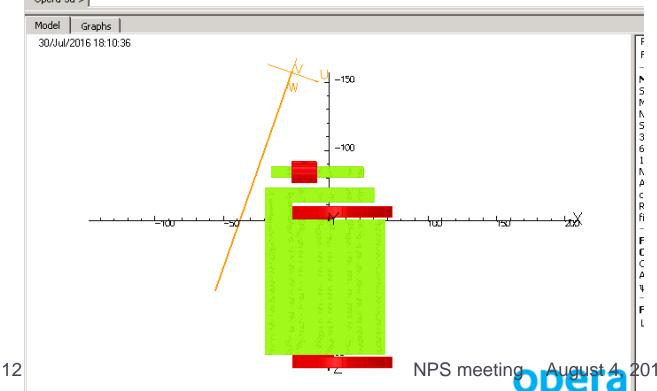
#	θ_γ	θ_e	D_{calo},m	Bdl, Tm	D_{mag}-Calo, m	angle range, degree
16 **X**	6.3	17.3	6	0.3	4.43	

```
Opera-3d > THREED OPTION=GETVIEW | THREED OPTION=SETVIEW ROTX=90 ROTY=0.0001 ROTZ=0.0001
Opera-3d > LINE  BUFFER='Line' X1=0 X2=X1 Y1=0 Y2=Y1 Z1=0 Z2=170 NP=10000 | DATALINE OPTION=CREATE
BUFFER='&VF_PLOTBUF&' MINX=* MAXX=* NAME='NewLine_2' XCOMPONENT=distance
YCOMPONENT=Bx*cos(19.3/57.3)+Bz*sin(19.3/57.3) INTERPOLATION=LINEAR GRAPH='Default'
Integral: -4374.62
Maximum: 323.246 (X at maximum: 71.315)
Minimum: -254.085 (X at minimum: 92.004)
```

Opera-3d >

Model   Graphs

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opera
simulation software

Kinematics "16" for DVCS
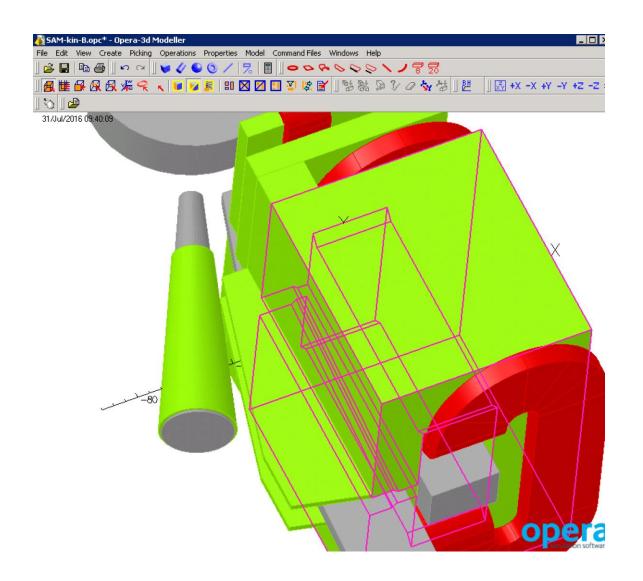

```
INTERPOLATION=LINEAR GRAPH='Default'
Integral: -209.065
Maximum: 369.974 (X at maximum: 76.211)
Minimum: -341.417 (X at minimum: 85.034)
Opera-3d > SET XLOCAL=0 YLOCAL=0 ZLOCAL=-157 PLOCAL=0 TLOCAL=-19.3 SLOCAL=0
Opera-3d > LINE  BUFFER='Line' X1=0 X2=X1 Y1=0 Y2=Y1 Z1=0 Z2=170 NP=10000 | DATALINE OPTION=CREATE
BUFFER='&VF_PLOTBUF&' MINX=* MAXX=* NAME='NewLine_1' XCOMPONENT=distance
YCOMPONENT=Bx*cos(19.3/57.3)+Bz*sin(19.3/57.3) INTERPOLATION=LINEAR GRAPH='Default'
Integral: -4374.62
Maximum: 323.246 (X at maximum: 71.315)
Minimum: -254.085 (X at minimum: 92.004)
```

BdL:

- - 4375 Gauss-cm
- - 209 Gauss-cm

Kinematics "B" for pion

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Kinematics "B" for pion

```
NAME='NewLine' XCOMPONENT=distance YCOMPONENT=Bx*cos(11.9/57.3)+Bz*sin(11.9/57.3) INTERPOLATION=LINEAR GRAPH='Default'
Integral: 691.459
Maximum: 131.026 (X at maximum: 44.733)
Minimum: -180.115 (X at minimum: 71.3465)
Opera-3d > SET XLOCAL=0 YLOCAL=0 ZLOCAL=-157 PLOCAL=0 TLOCAL=-23.6 SLOCAL=0
Opera-3d > LINE  BUFFER='Line' X1=0 X2=X1 Y1=0 Y2=Y1 Z1=0 Z2=155 NP=10000 | DATALINE OPTION=CREATE BUFFER='&VF_PLOTBUF&' MINX=* MAXX=*
NAME='NewLine_1' XCOMPONENT=distance YCOMPONENT=Bx*cos(23.6/57.3)+Bz*sin(23.6/57.3) INTERPOLATION=LINEAR GRAPH='Default'
Integral: 155.165
Maximum: 71.6425 (X at maximum: 24.3815)
Minimum: -124.908 (X at minimum: 71.362)
```

Opera-3d >

Model | Graphs

Graph Objects

- Data
  - Buffers
    - Line
- Graph Objects
  - Lines
    - NewLine
    - NewLine_1
- Graphs
  - Default
    - NewLine
    - NewLine_1

Option	Value
Background	
Colour	White
Border Colour	White
Image File	
Title	
Display	Yes
Text	Title
Font	Tahoma, 12pt
Colour	■ Black
Alignment Mode	Align Centre
Legend	
Display	Yes

BdL:

HMS: + 155 Gauss-cm
Beam:+ 691 Gauss-cm

Title

distance

Field on target is ~ 60 Gauss

opera
simulation software

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Kinematics "8" for DVCS

Kinematics "8" for DVCS

Field on target is
~ 60 Gauss

BdL:

HMS: - 664 Gauss-cm
Beam: + 662 Gauss-cm

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Kinematics "8" for DVCS

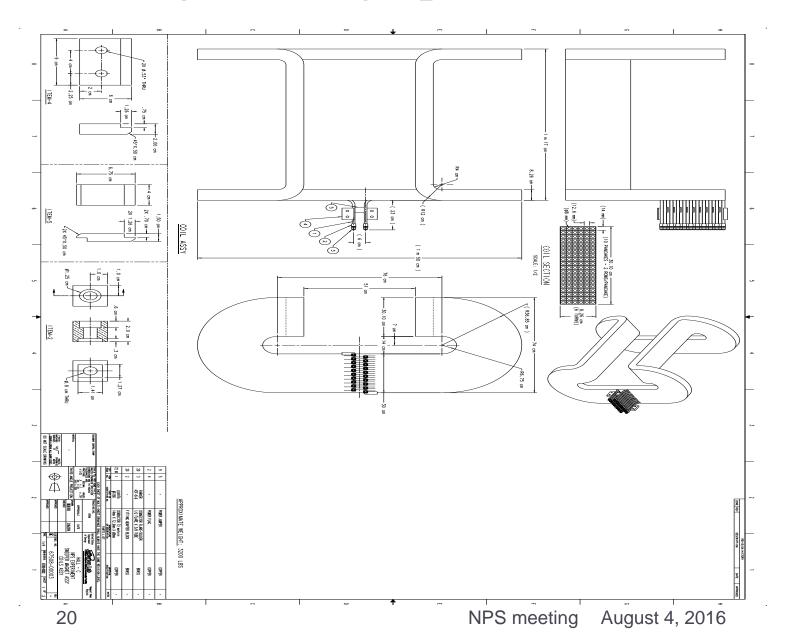   NPS meeting   August 4, 2016

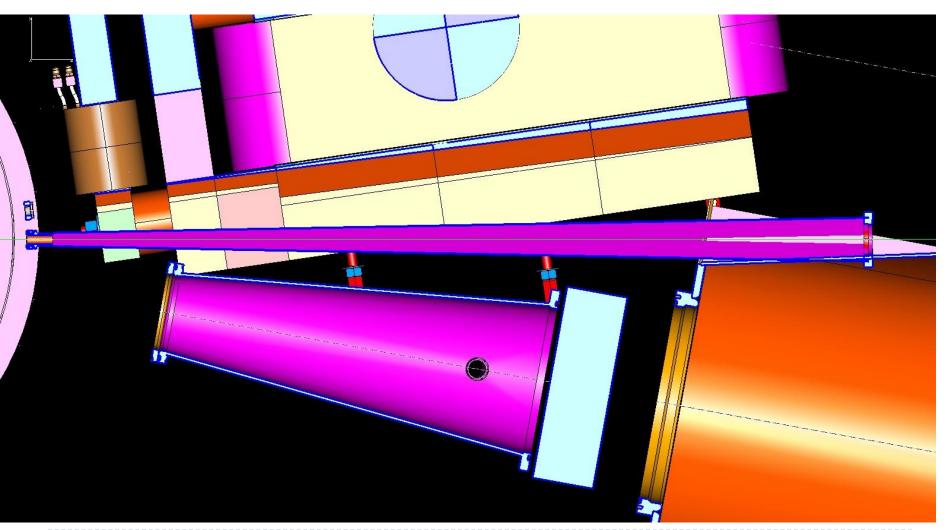# Kinematics "8" for DVCS

BdL variation for 0.5 degree

```
XCOMPONENT=distance YCOMPONENT=Bx*cos(12.3/57.3)+Bz*sin(12.3/57.3) INTERPOLATION=LINEAR GRAPH='Default'
Integral: 661.974
Maximum: 131.952 (X at maximum: 39.8815)
Minimum: -265.972 (X at minimum: 71.486)
Opera-3d > SET XLOCAL=0 YLOCAL=0 ZLOCAL=-157 PLOCAL=0 TLOCAL=-12.8 SLOCAL=0
Opera-3d > LINE  BUFFER='Line' X1=0 X2=X1 Y1=0 Y2=Y1 Z1=0 Z2=155 NP=10000 | DATALINE OPTION=CREATE BUFFER='&VF_PLOTBUF&' MINX=* MAXX=* NAME='NewLine_5'
XCOMPONENT=distance YCOMPONENT=Bx*cos(12.8/57.3)+Bz*sin(12.8/57.3) INTERPOLATION=LINEAR GRAPH='Default'
Integral: -240.411
Maximum: 127.971 (X at maximum: 39.308)
Minimum: -293.343 (X at minimum: 72.23)
```

Opera-3d >

BdL:

Beam: + 662 Gauss-cm
Beam+0.5°: - 240 Gauss-cm

Magnet design/procurement

HMS-beam line

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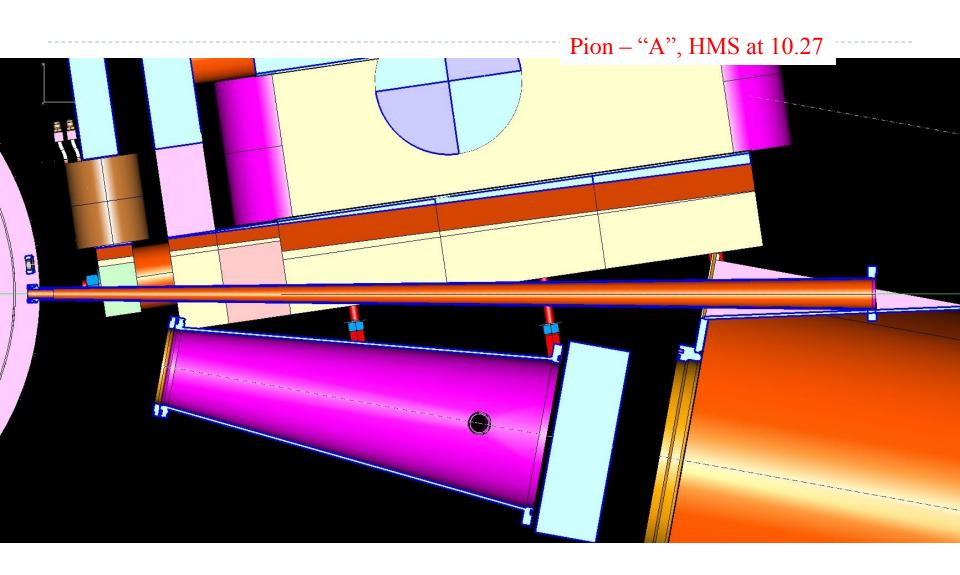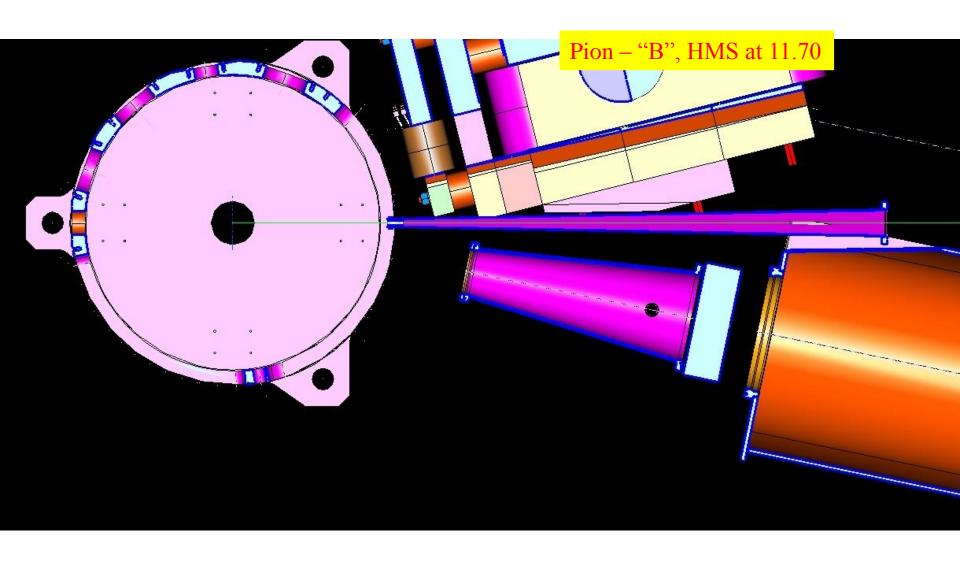
HMS-beam line

HMS-beam line

Pion – "B", HMS at 11.70

Magnet design plans

1. Large coil: a detailed drawing is competed (P. Medeiros)
2. The main yoke: magnetic design is finalized. Detailed design could start.

3. Option with an additional air-core corrector on the beam line could help reduction of the field on the target. Partial length cone in HMS?

4. A pipe problem at 10.27 angle of HMS – a low cost pipe is a bit too wide.

5. From Rolf: adjust cone length, keep field on the target as low as possible.

6. A post magnet beam line: a corrector + pipe requires some magnetic design.