Background and Forward Geometry

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Introduction

- Forward region design requires a coherent design from IP to LumiCal and to BeamCal
  - Acceptance
  - Clearance from pairs
  - Beam parameters

  - Solenoid field strength 5 Tesla vs. 4 Tesla
  - No-DID or Anti-DID
  - Beampipe
- Talk about forward geometry and background constraints

SiD Forward Region

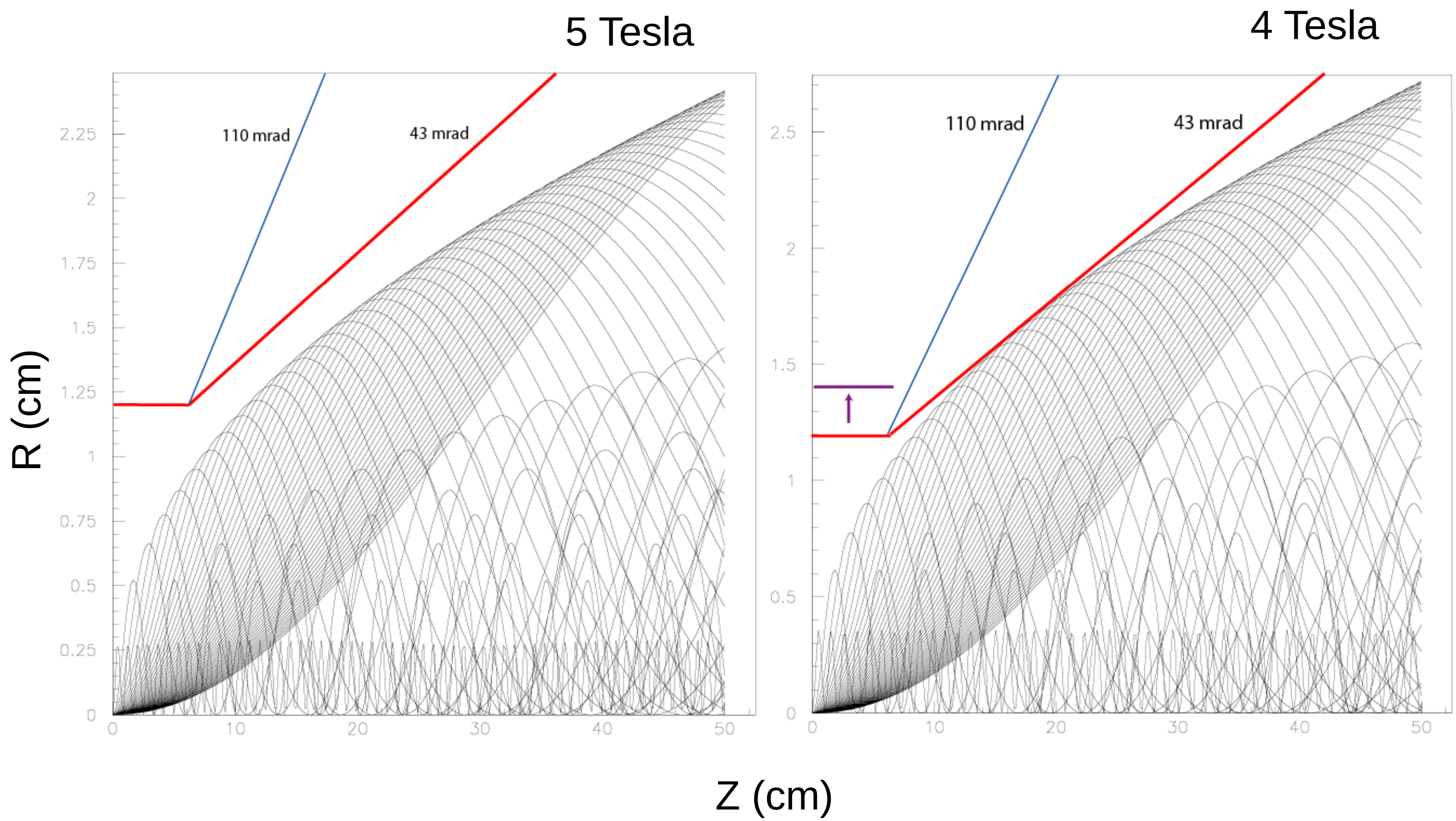
Cooper SiD Workshop

- Very useful discussions at SLAC during IRENG07
- The general layout of forward calorimetry follows parameters provided by Bill Morse and concepts suggested by Tom Markiewicz.

LumiCal inner edge	≈36mrad about outgoing
LumiCal outer edge	≈113mrad about 0mrad
LumiCal fiducial	≈46-86mrad about outgoing
BeamCal outer edge	≈46mrad about outgoing
LumiCal	$30X_0$ Si-W
BeamCal	$30X_0$ rad-hard Si,diamond....

Current Beam pipe is designed for

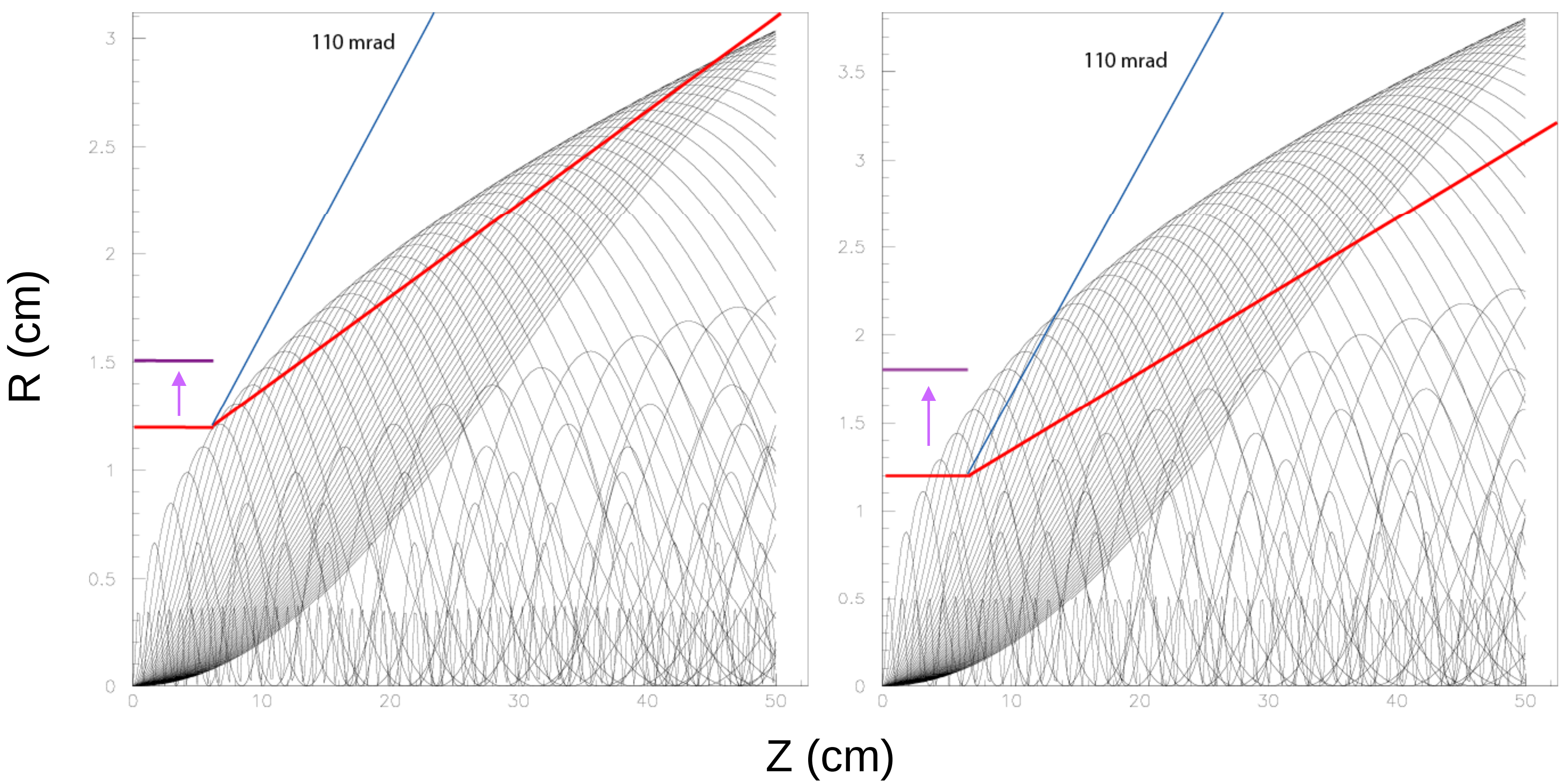
ILC 500 GeV Nominal + 5 Tesla



For 4 Tesla, R=1.2 cm is tight and 43 mrad is too small.
R=1.4 cm and 110 mrad beam-pipe would work.

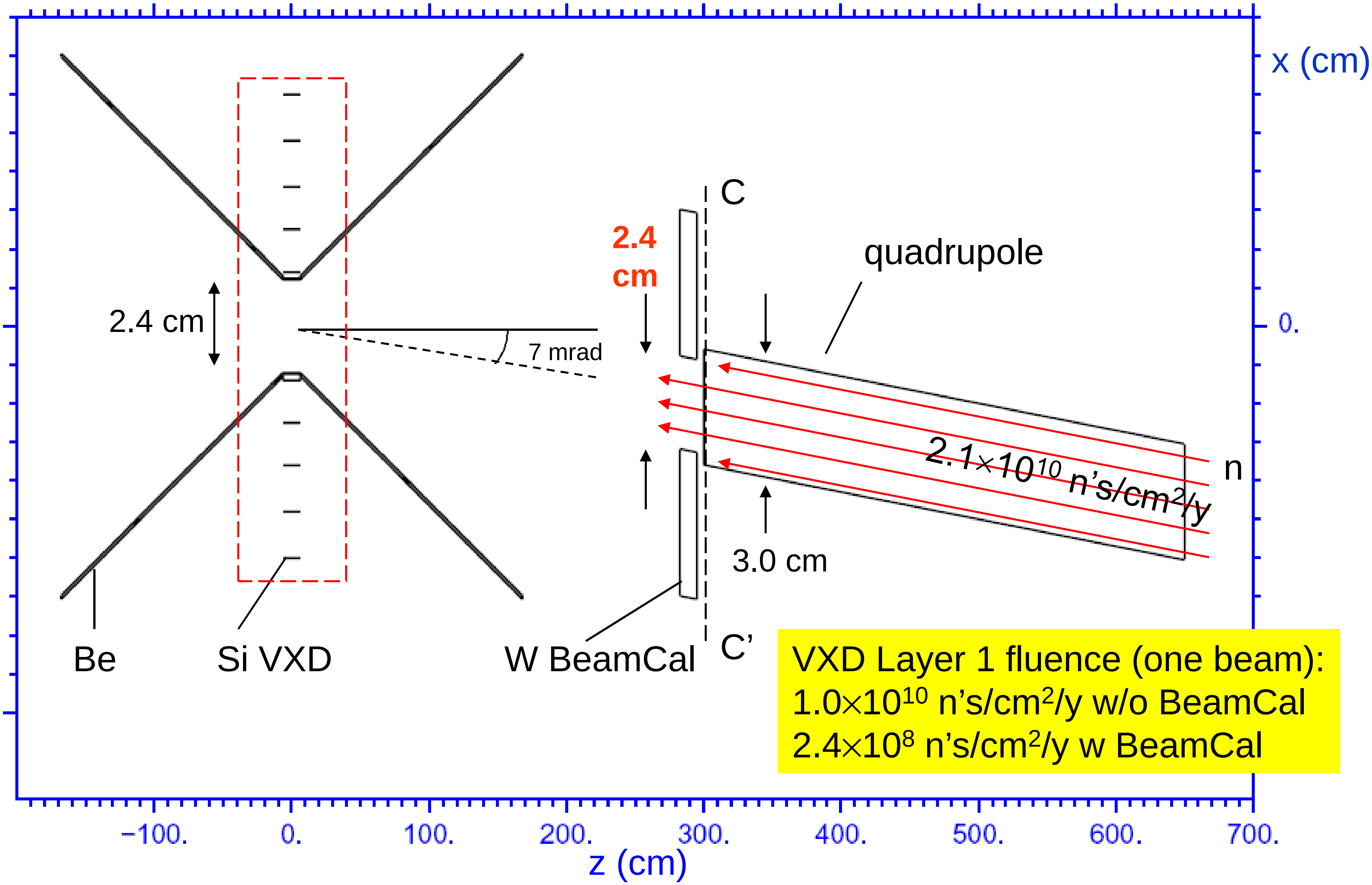
Current Beam pipe is not compatibe with the Low P or High Lumi options.

500 GeV Low P + 5 Tesla   500 GeV High Lum + 5 Tesla



110 mrad beam-pipe would work as long as
R= 1.2 cm → 1.5 cm (Low P), and R= 1.2 cm → 1.8 cm (High Lumi).

Neutrons from the dump



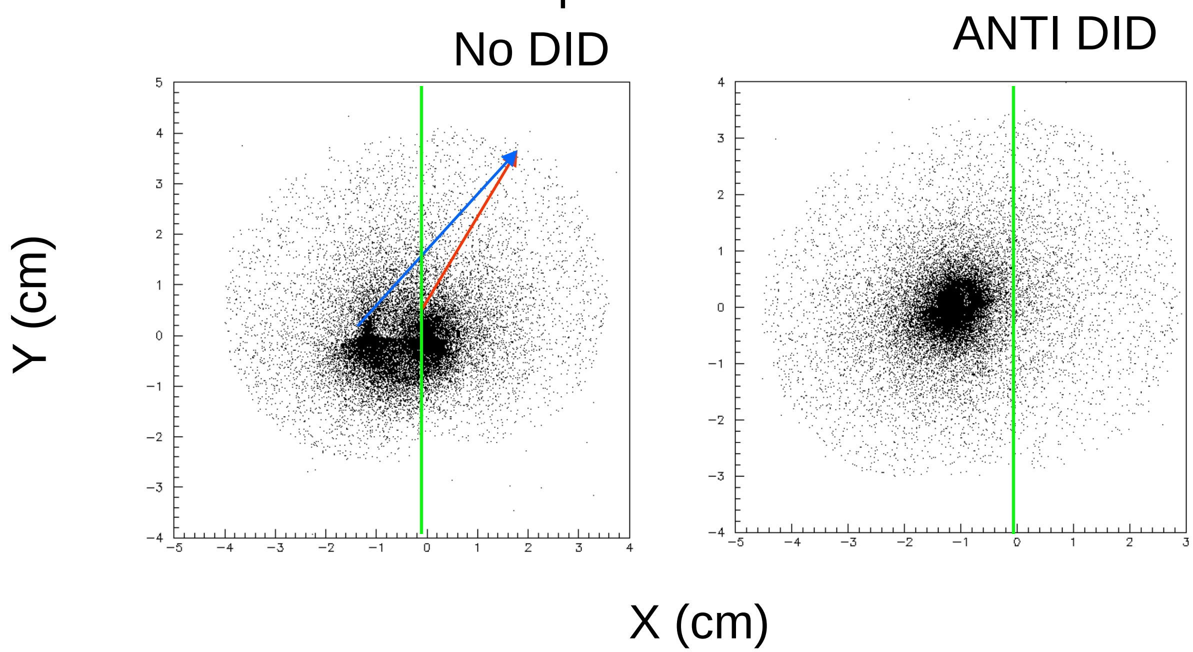
IP Beampipe radius and VXD layer 1

- R_{bp} = 1.2 cm and R_{vxd1}= 1.4 cm
  - OK for ILC 500 GeV Nominal + 5 Tesla
  - Intolerable neutron fluence if the Beamcal aperture is 1.5 cm
- Increase to R_{bp} = 1.4 cm and R_{vxd1}= 1.6 cm?
  - Will work for
    - ILC 500 GeV Nominal + 4 Tesla
    - ILC 500 GeV Low P + 5 Tesla
  - Neutron fluence is acceptable
- Keep R_{bp} = 1.2 cm and R_{vxd1}= 1.4 cm for LOI?

Pair distribution at Z = 168 cm

- Beam parameters – Nominal, Low Q, High Y, Low P, High Lumi
- Solenoid field strength – 5 Tesla vs. 4 Tesla
- Crossing angle (14 mrad) + DID/ANTI-DID

ILC 500 GeV Nominal beam parameters + 5 Tesla

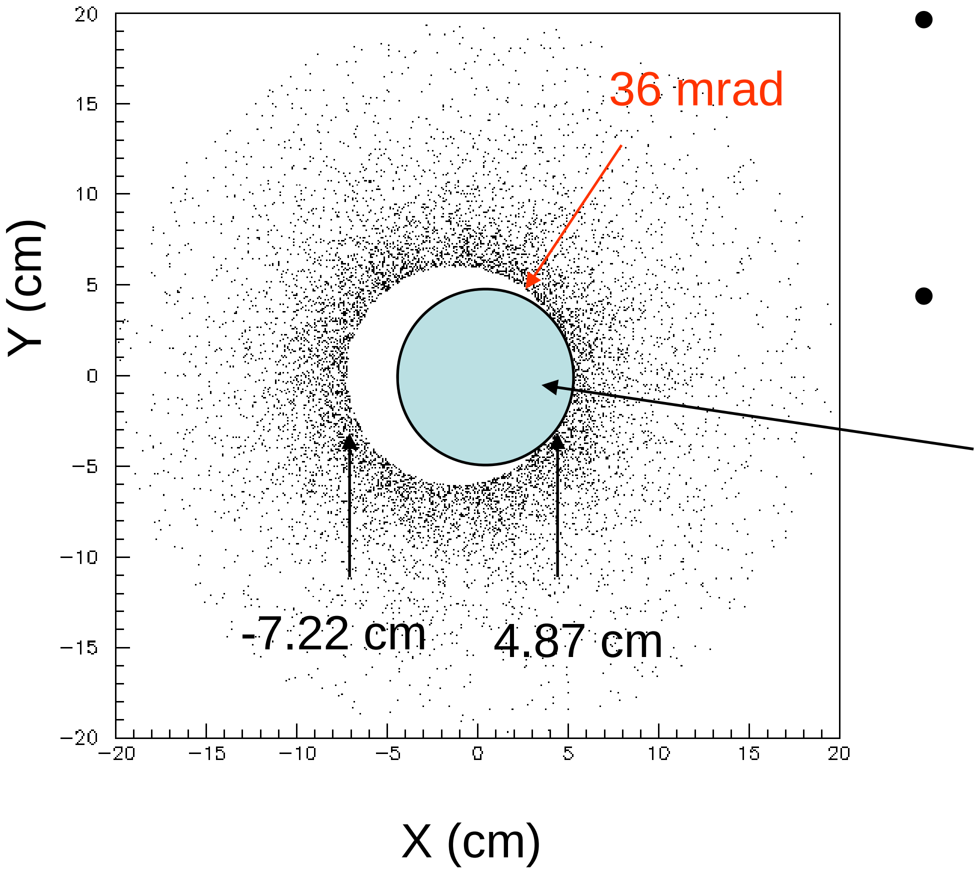


Pair Radius in cm at Z=168 cm

	4 Tesla			5 Tesla		
	ANTI-DID	NO DID	DID	ANTI-DID	NO DID	DID
Nominal	5.2 / 4.7	5.1 / 5.5	5.8 / 6.5	4.7 / 4.1	4.4 / 5.1	5.3 / 6.1
Low Q	4.7 / 4.2	4.4 / 5.1	5.3 / 6.0	4.2 / 3.8	3.8 / 4.6	4.8 / 5.6
High Y	4.6 / 4.2	4.6 / 5.1	5.5 / 6.0	4.3 / 3.9	4.1 / 4.6	4.9 / 5.7
Low P	6.3 / 6.0	6.2 / 6.8	6.8 / 7.6	5.7 / 5.3	5.5 / 6.1	6.4 / 7.0
High Lumi	7.0 / 6.6	6.8 / 7.3	7.4 / 8.2	6.2 / 5.9	6.1 / 6.7	6.7 / 7.5

Radius in black is measured from solenoid axis (x,y) = (0., 0.).
Radius in red is measured from extraction line (x,y) = (-1.176 cm, 0.)

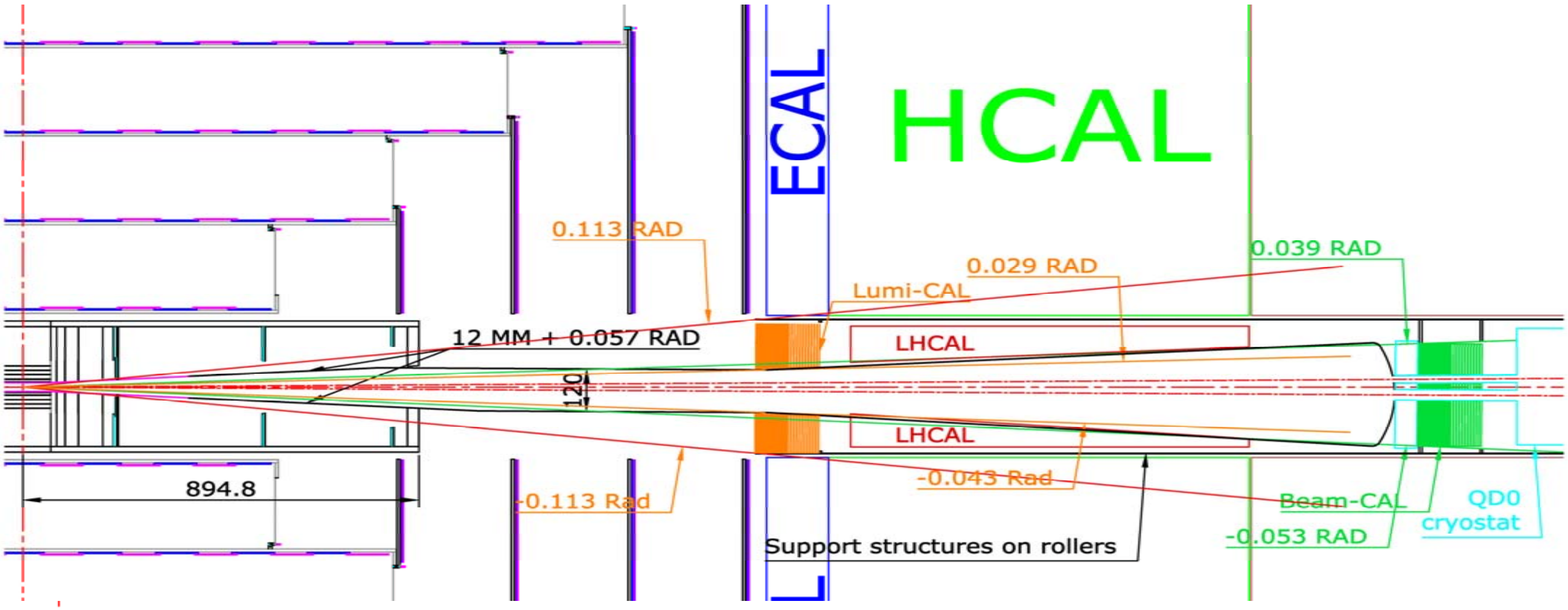
Bhabha and Pairs at Z=168 cm

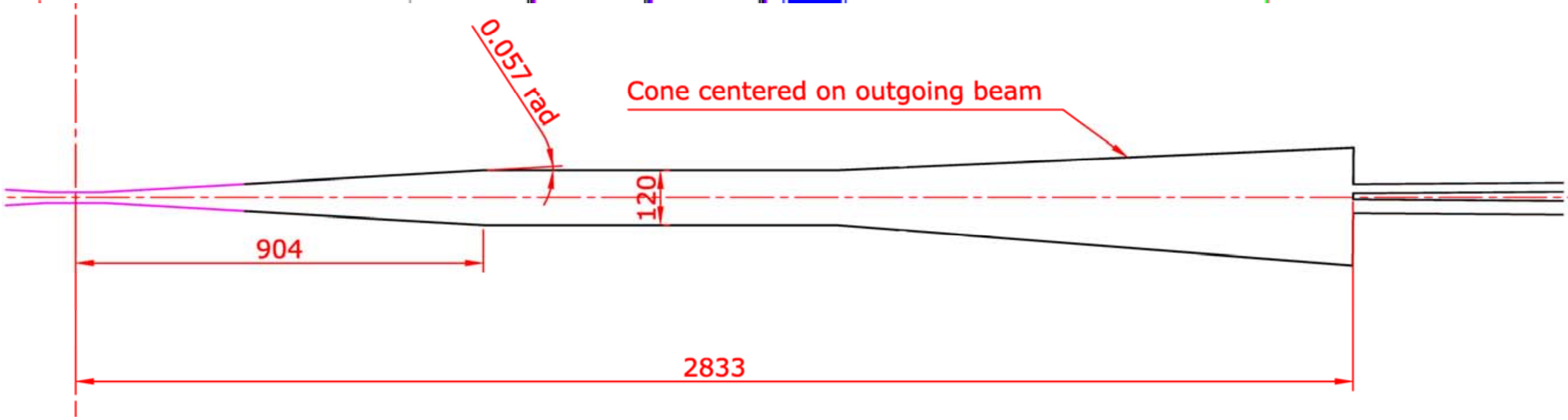


- Anti-DID
  - Nominal OK
  - Low P OK
- No DID
  - Nominal OK
  - Low P Not OK

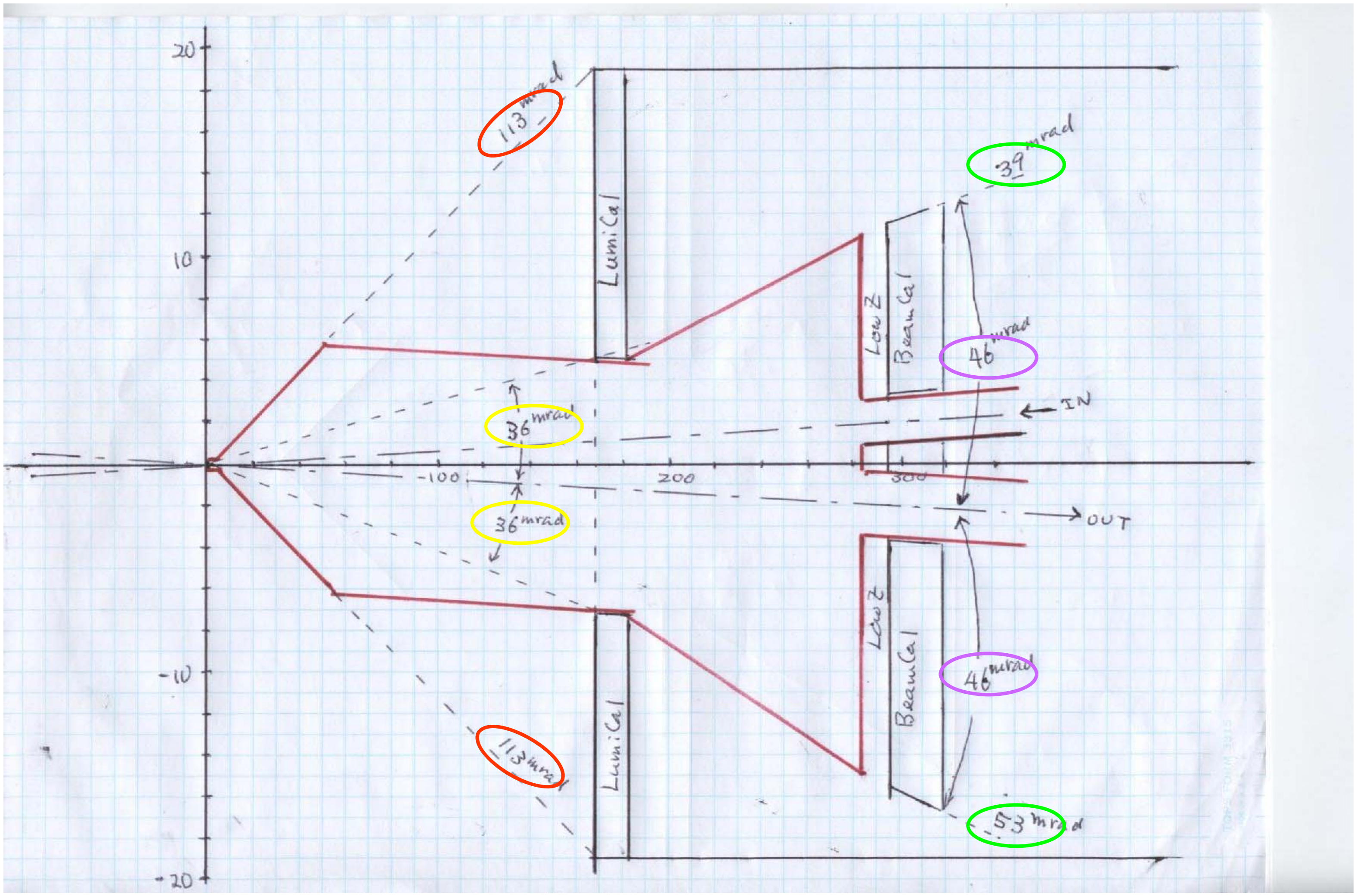
SiD Beam Pipe

Cooper/Krempetz





Beampipe

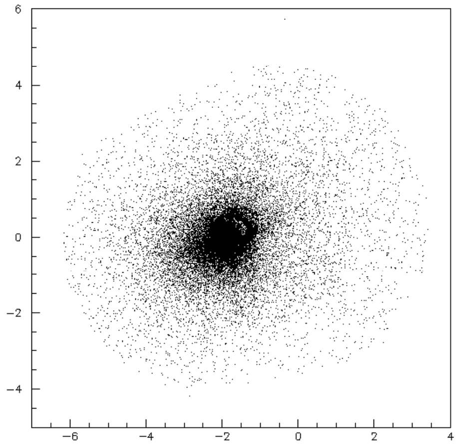


20
10
-10
-20
-100
200
300
113 mrad
113 mrad
36 mrad
36 mrad
39 mrad
53 mrad
46 mrad
46 mrad
LumiCal
LumiCal
Low Z
Low Z
BeamCal
BeamCal
IN
OUT

Pairs at Z = 295 cm

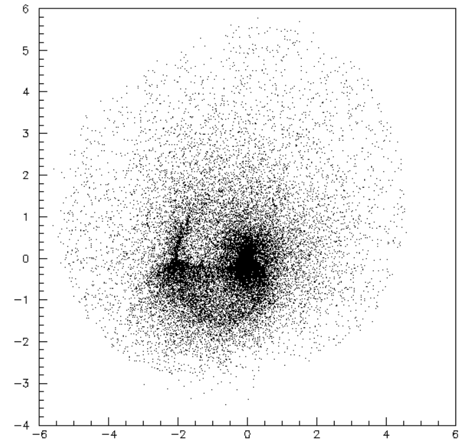
Anti-DID

No DID



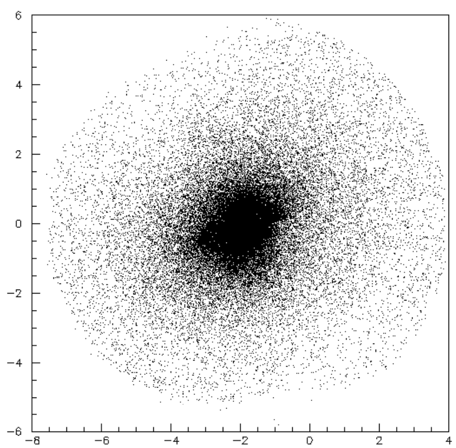
ILC 500 GeV
Nominal

R < 5 cm



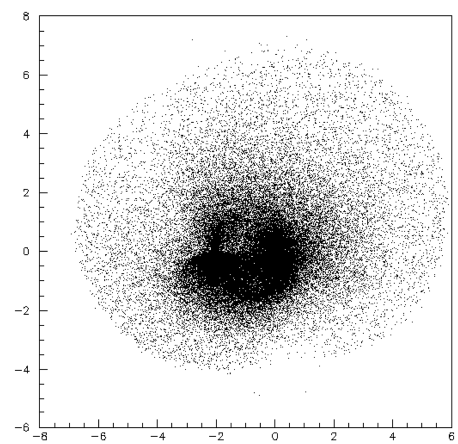
R < 6 cm

Y (cm)



ILC 500 GeV
Low P

R < 6 cm



R < 8 cm

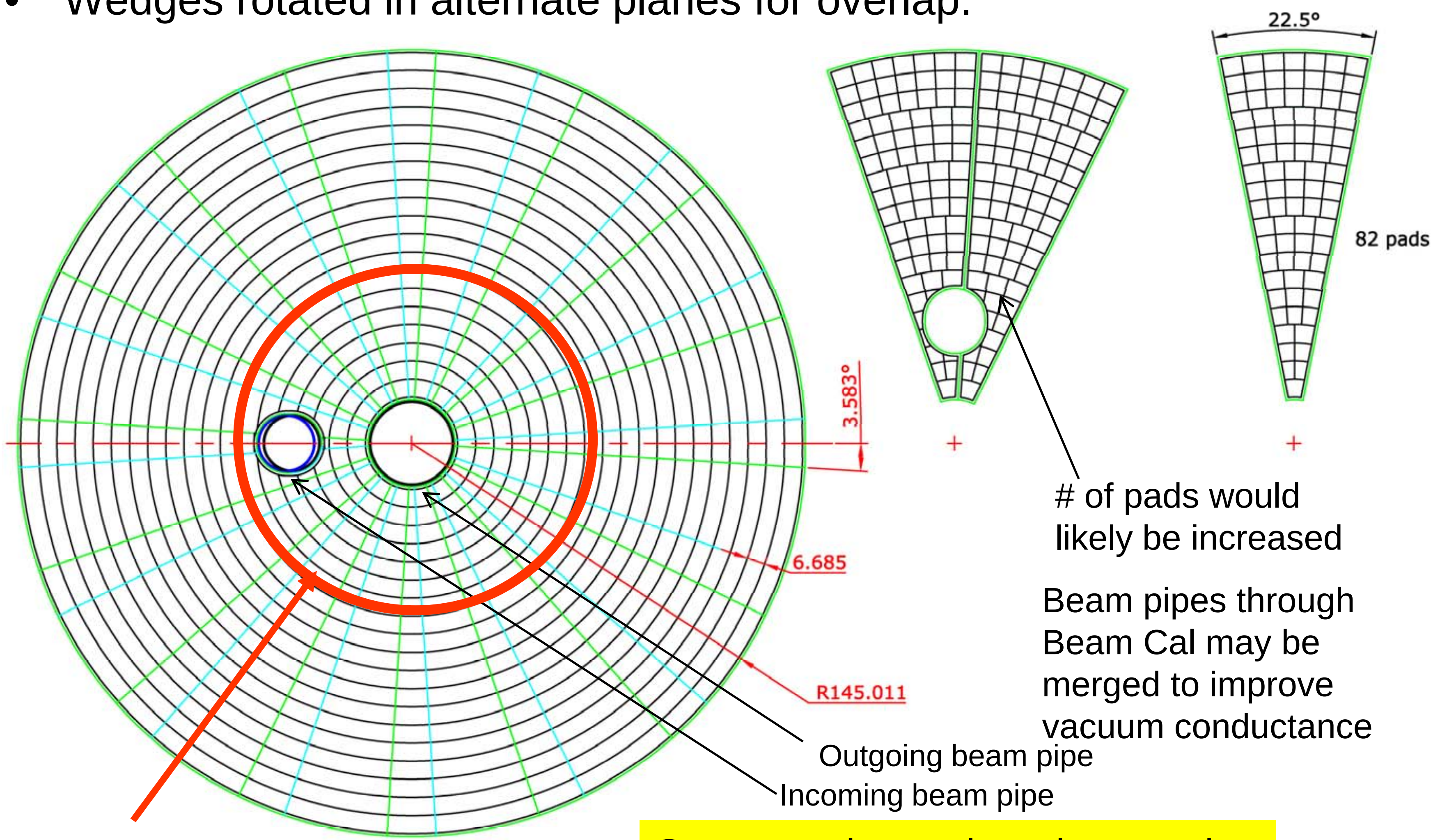
X (cm)

X (cm)

Preliminary BeamCal Sensor Layout

- Assumes 6” silicon sensor technology.
- Wedges rotated in alternate planes for overlap.

Cooper



Pairs are confined within r < 6 cm.

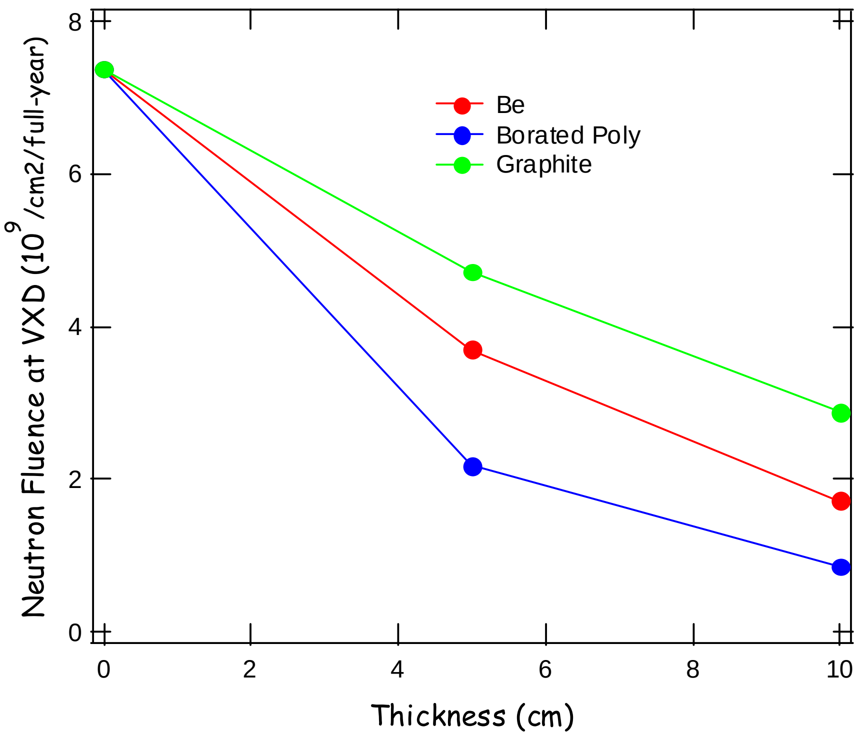
Segmentation and readout can be different for r< 7cm and r>7cm

Low Z material

- Low Z layer in front of BeamCal to absorb low energy e+/e- coming out of BeamCal
- 10 cm thick Be ($0.28X_0$)
- Other material to absorb neutrons as well

	Density (g/cm^3)	X_0 (cm)
Be	1.8	35.3
Graphite	2.0	18.8
Borated Poly	0.9	45.6

ILC 500 GeV Nominal + DID



Borated Poly is more effective in absorbing neutrons but X_0 is longer.