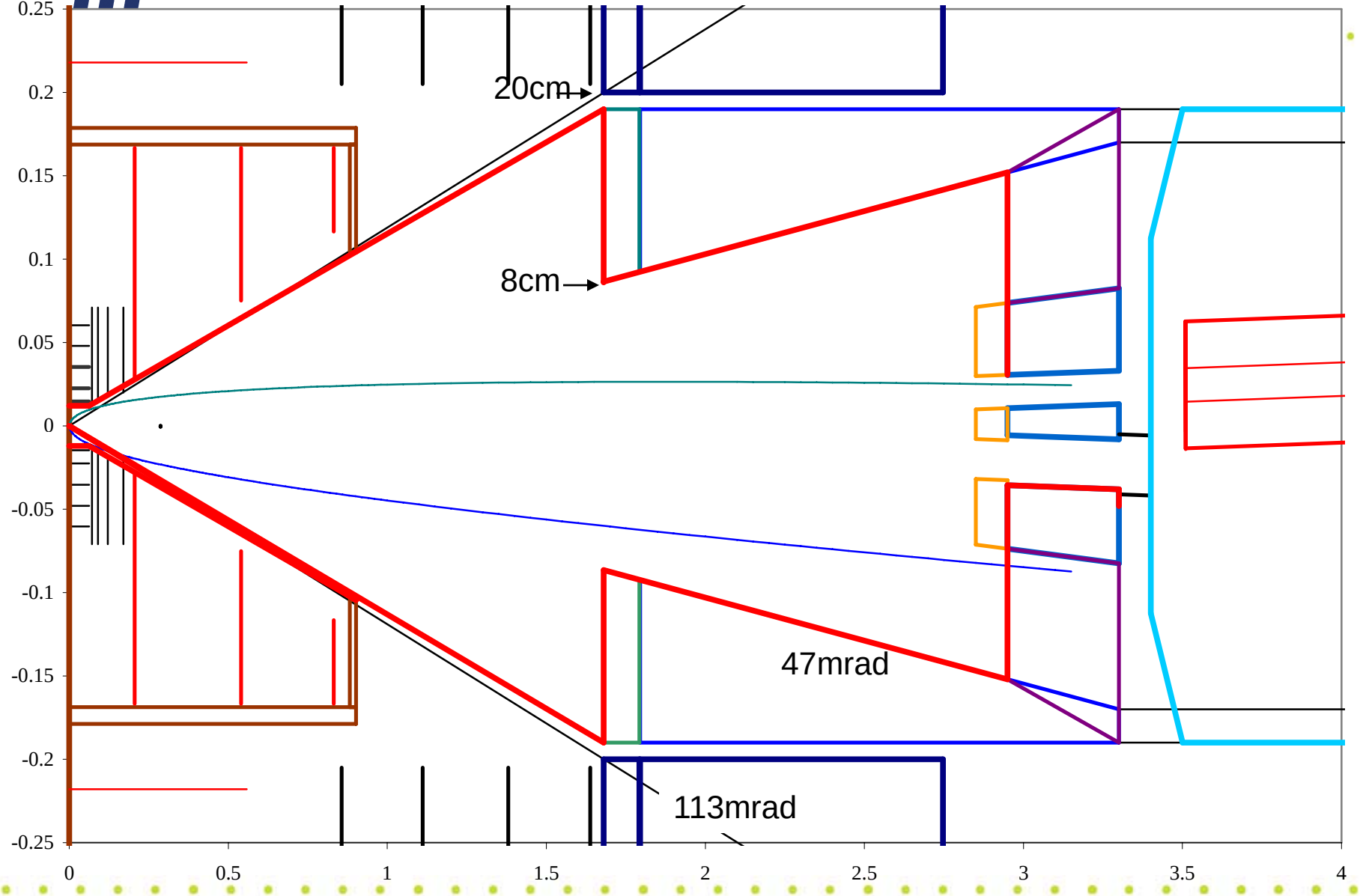
SiD MDI and the VXD

Tom Markiewicz/SLAC

VTX Mechanics Meeting

12 June 2007

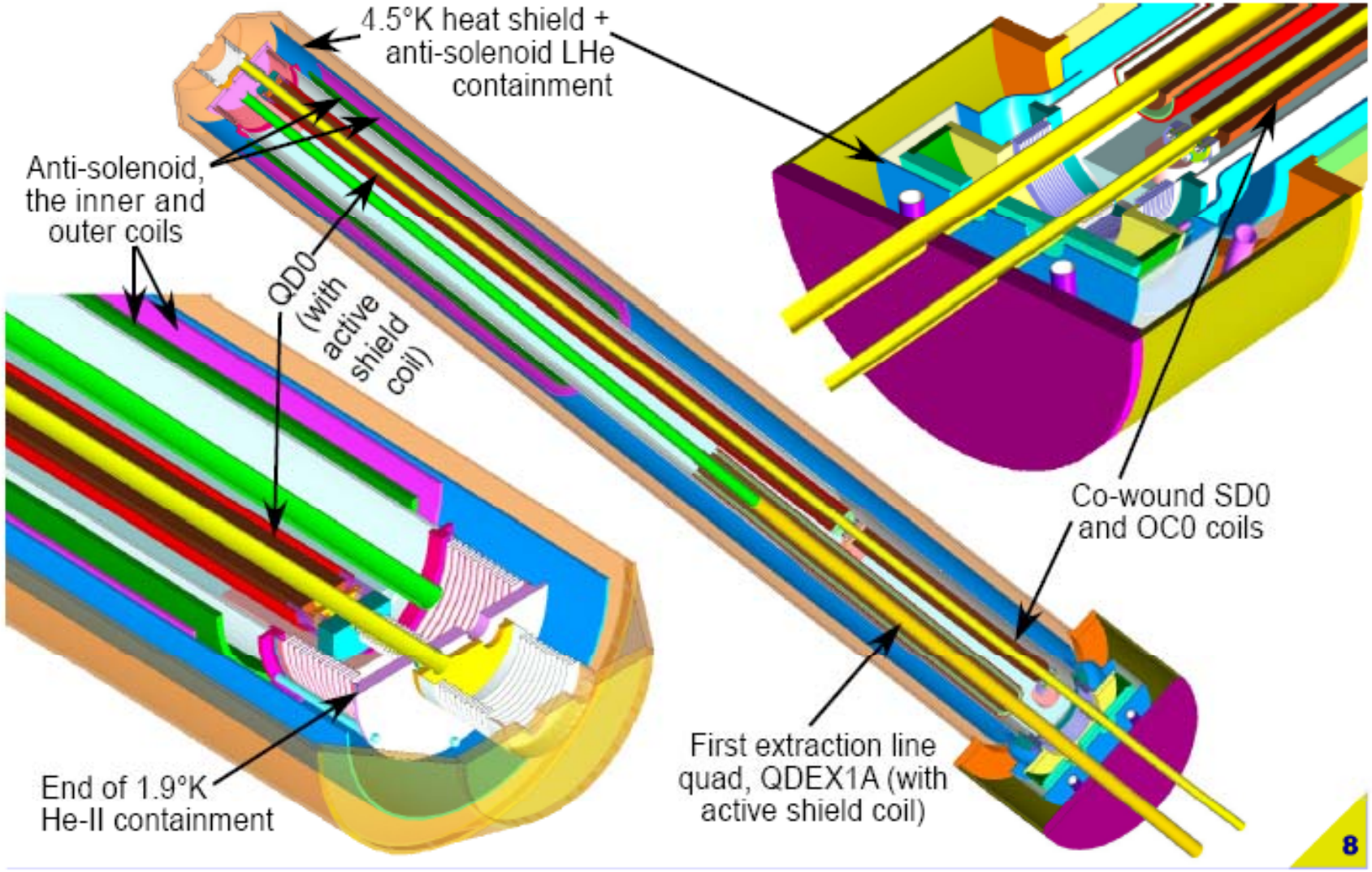
SiD at 2007-04-09 Collaboration Meeting



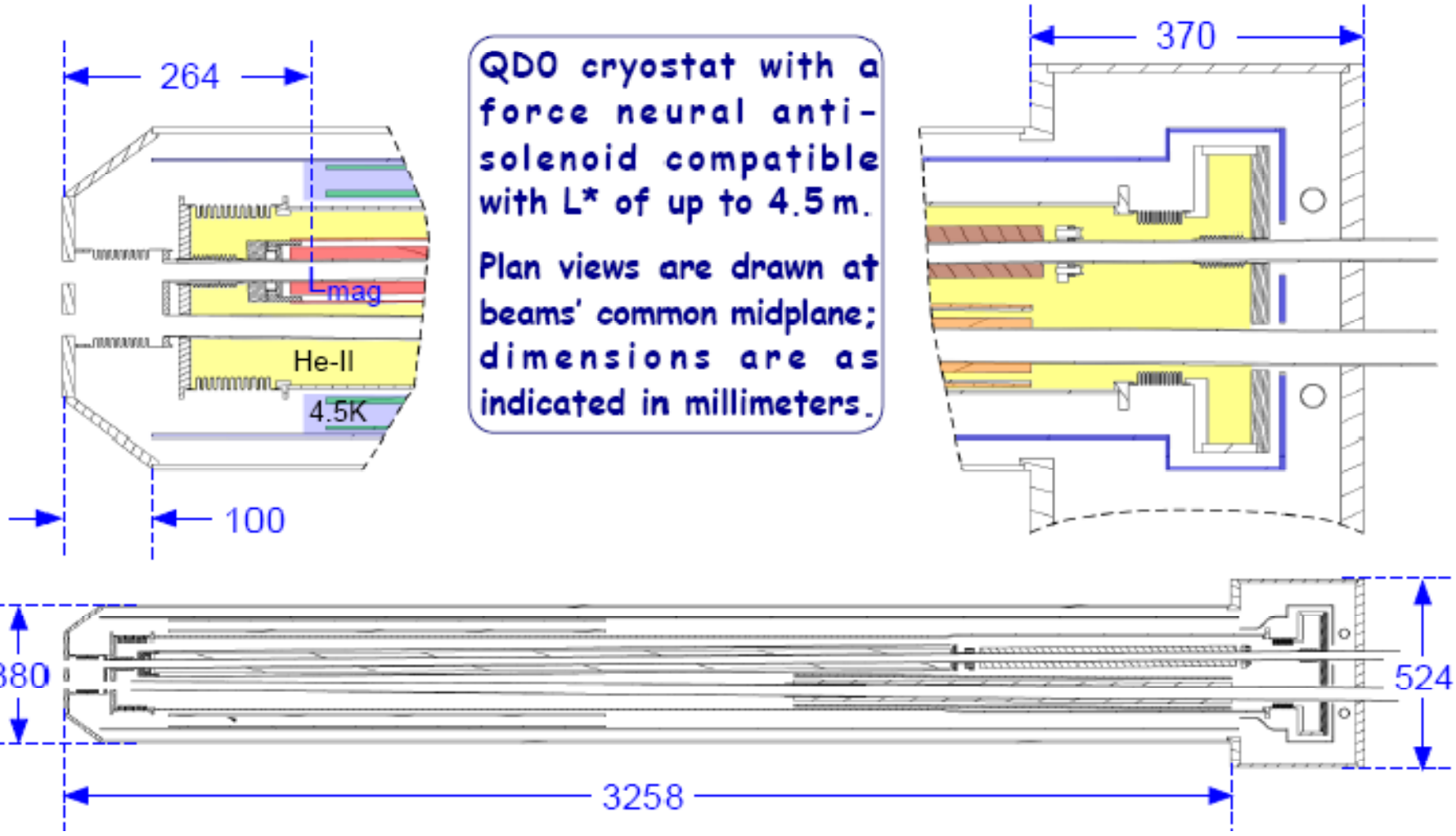
Semi-recent developments affecting SiD MDI Design

- Push-Pull
  - **Separate cryostats for QD and QF magnets**
  - **QD0 carried by detector at optimized L***
    - Cantilevered support tube concept dead
  - **QF never moves & z of QF = 9.5m same for all detectors**
  - **Assume cryo supply of QD0 must move with SiD**
- BNL magnet engineering
  - **Well developed design for 380mm Ø QD0 magnet cryostat (L*=4.5m) with integrated anti-solenoid**
  - **Discussions & early estimates of required size & location of QD0 service cryostats**
- SiD Detector changes
  - **VXD in 1.6m long cryostat with integrated forward tracking**
  - **Higher angle FWD tracking begins at r>r(QD0,FCAL)**
  - **Update of FCAL (=Lumical+Beamcal) to provide increased coverage & overlap**
  - **Beampipe size/shape between VXD and Lumical subject of intense debate**
- Integration & support issue cartoons for discussion
  - **Space for FCAL readout and access for VXD services (power, fiber,..)**
  - **FCAL+QD0 cryostat support**
  - **On/off beamline access**
  - **Assembly feasibility (flange location & space requirements)**
- Background Updates
  - **Minimum radius of VXD and Lumical due to pairs considering DID/Anti-DID and IP parameters**

QD0 + QDEX1A + Anti-Solenoid in Cryostat



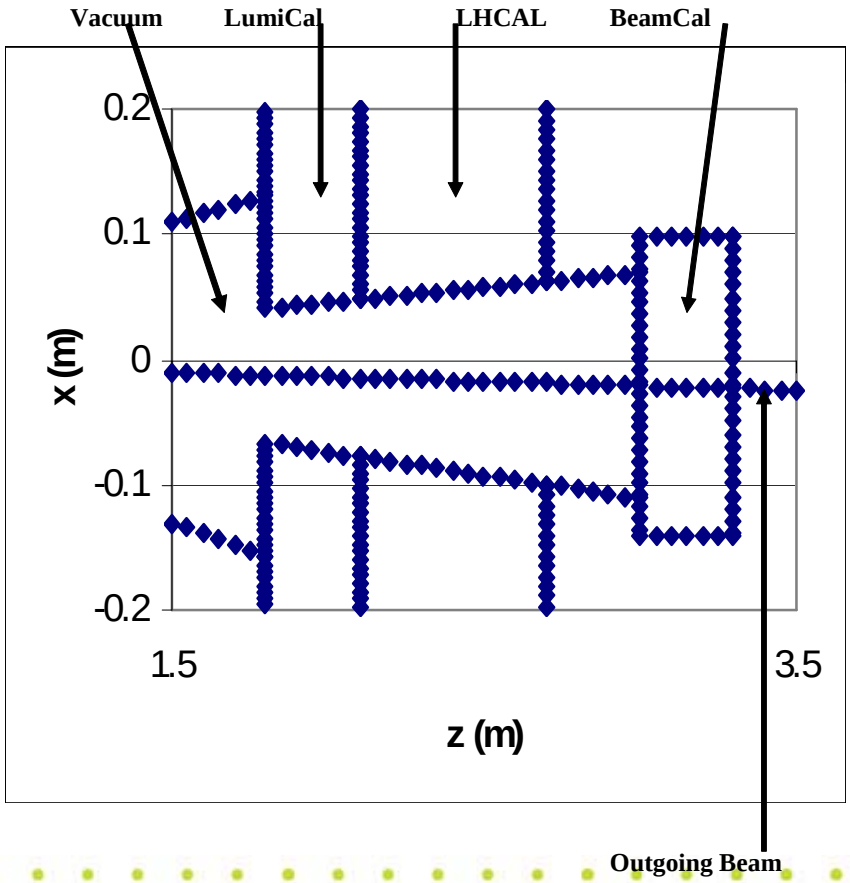
Plan View - Details



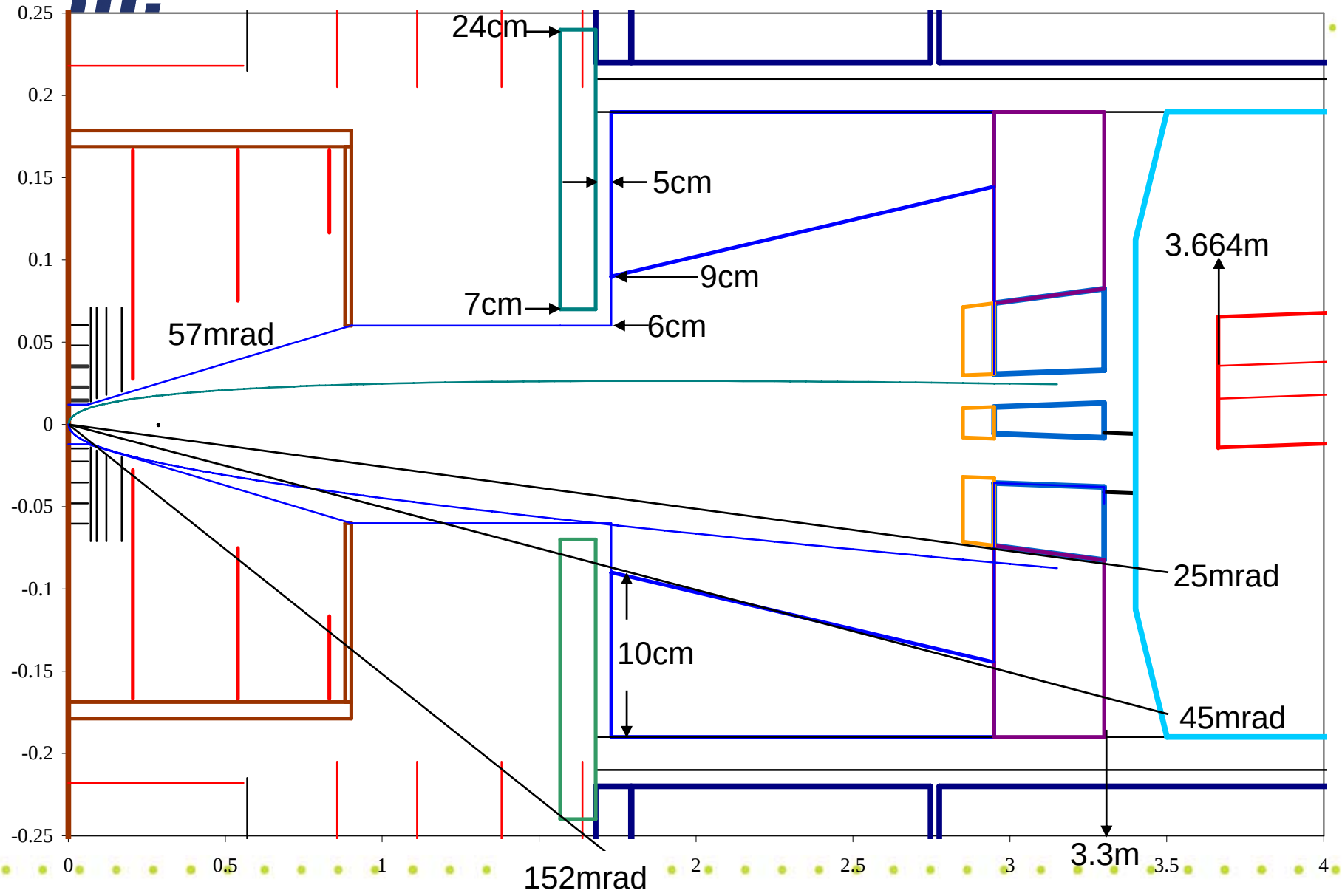
FCAL Beam Pipe Discussions
Bill Morse, BNL

- SiD FCAL group focused on ONE Device which covers 30-80mrad and to a first approximation ignores LUMI aspects of BEAMCAL (inspired by LCD Design)

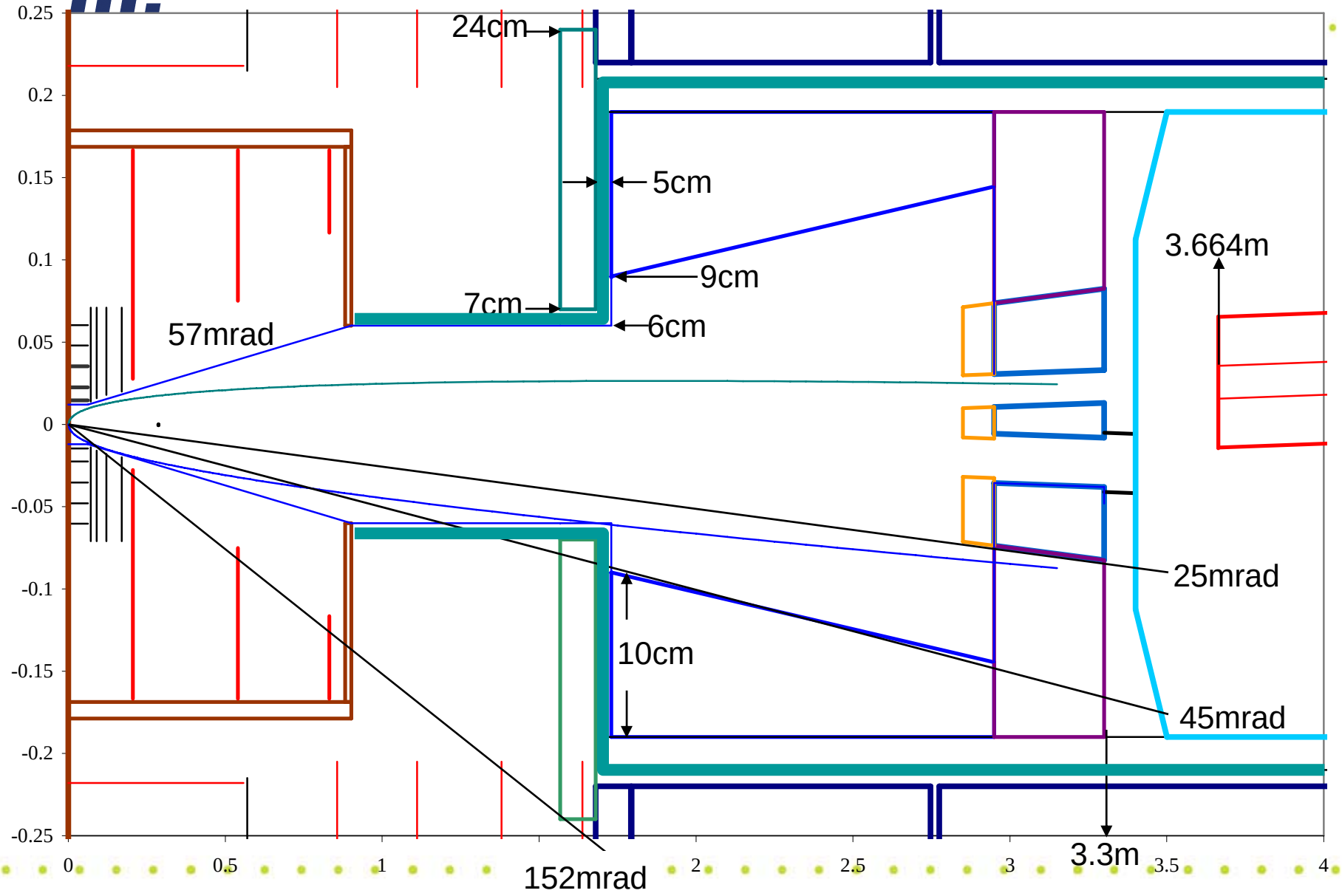
LumiCal Inner Edge	≈30mrad about outgoing beam
LumiCal Outer Edge	≈113mrad about 0mrad (ECAL)
LumiCal Fiducial Region	≈40-80mrad about outgoing beam
BeamCal Outer Edge	≈40mrad about outgoing beam
LumiCal	≈25 X_0 Silicon - Tungsten
BeamCal	≈25 X_0 Rad-hard Silicon or Diamond - Tungsten



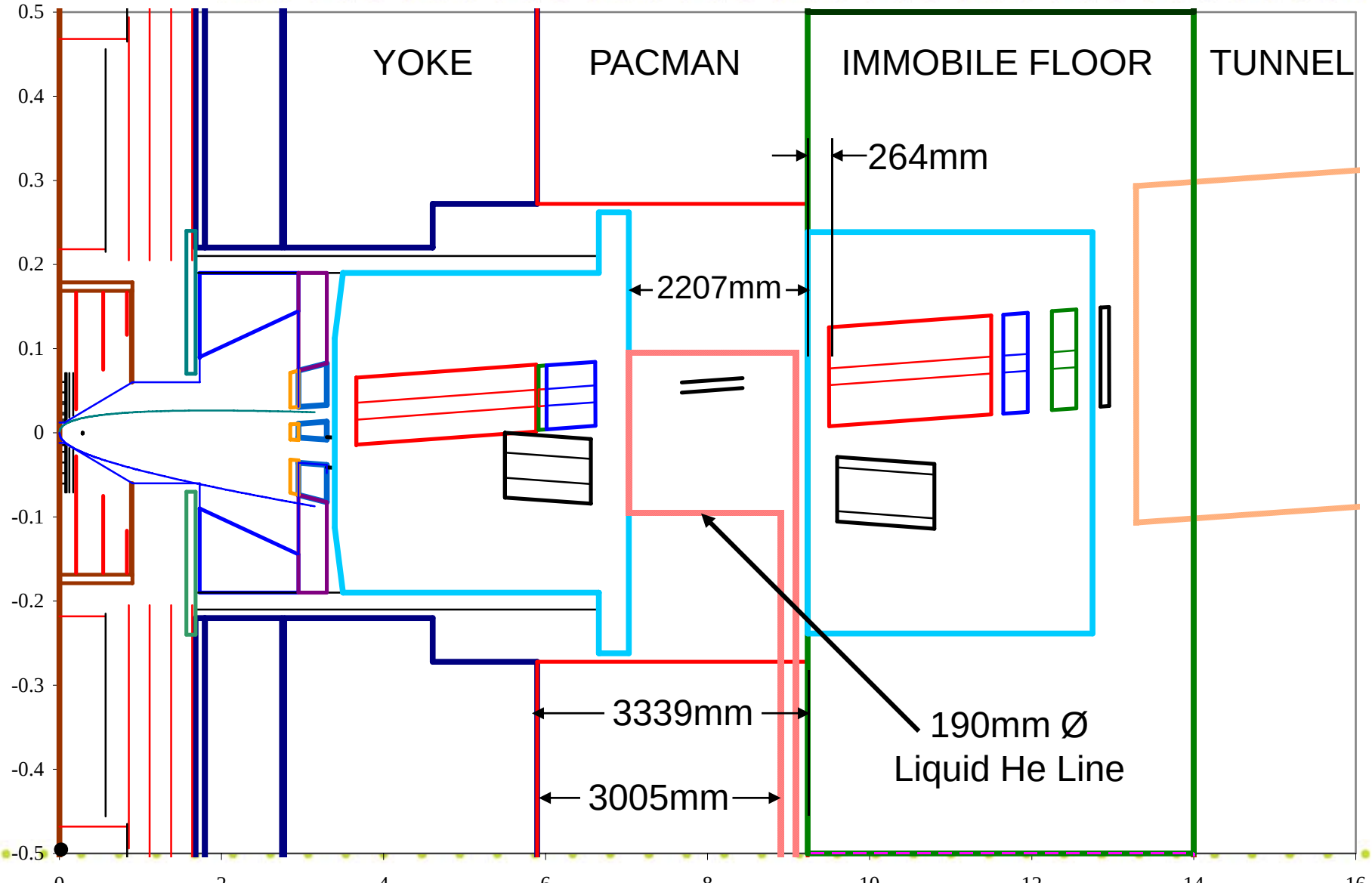
Suggested FCAL Layout for Discussion



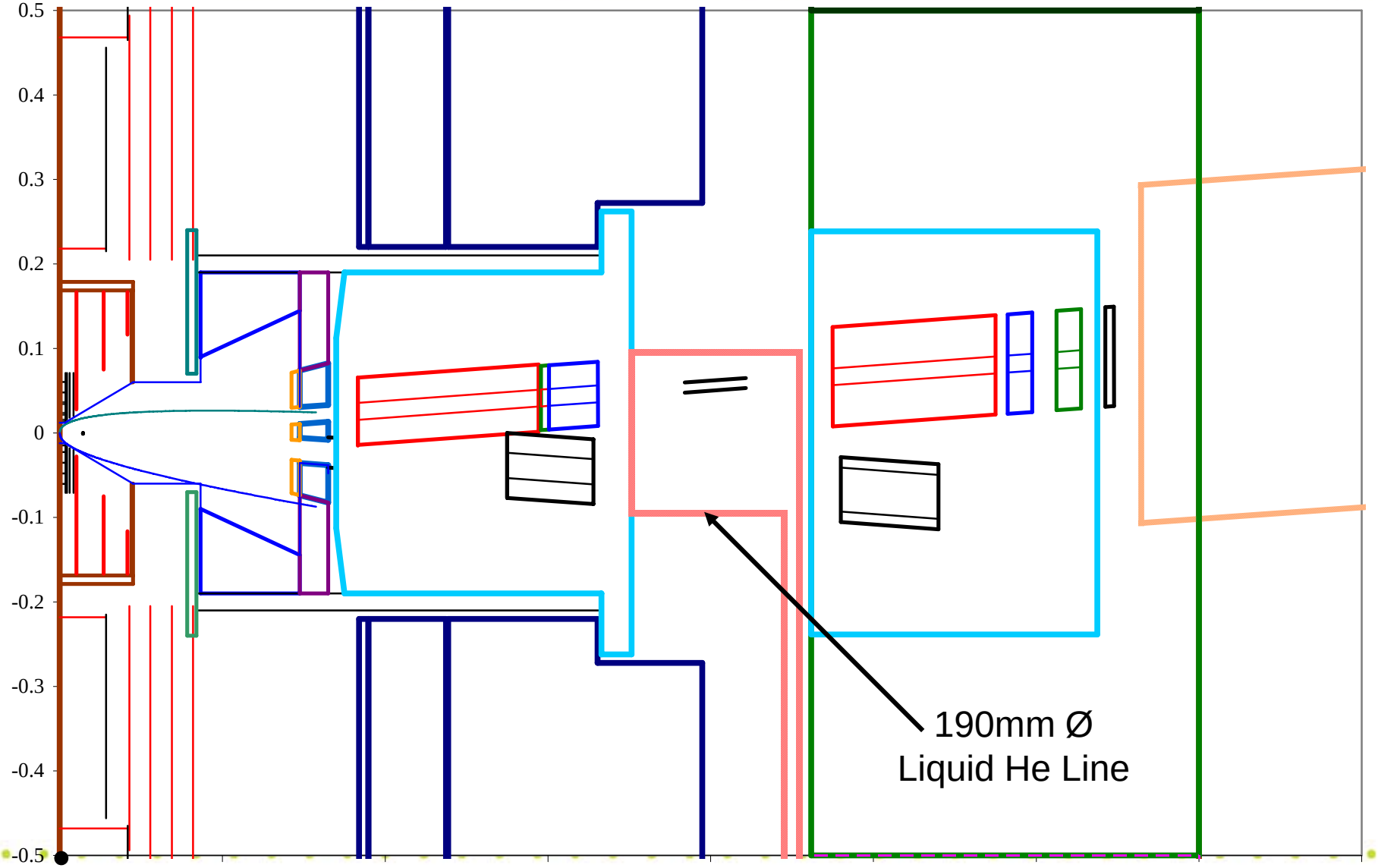
Proposed Cable/Gas Path



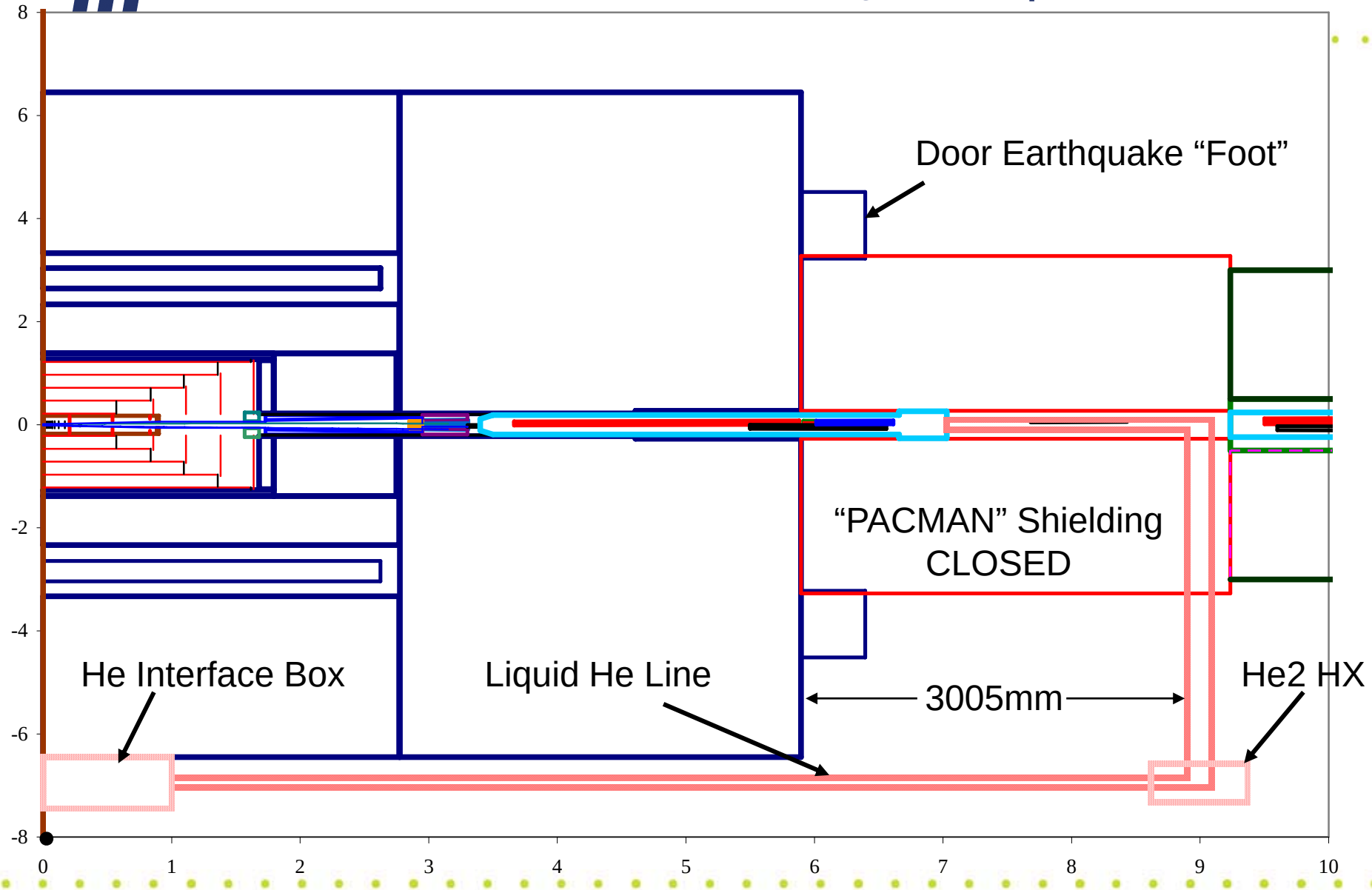
SiD r<50cm, L*=3.664m, 14mrad, Push-Pull, QF@9.5m, Door Closed



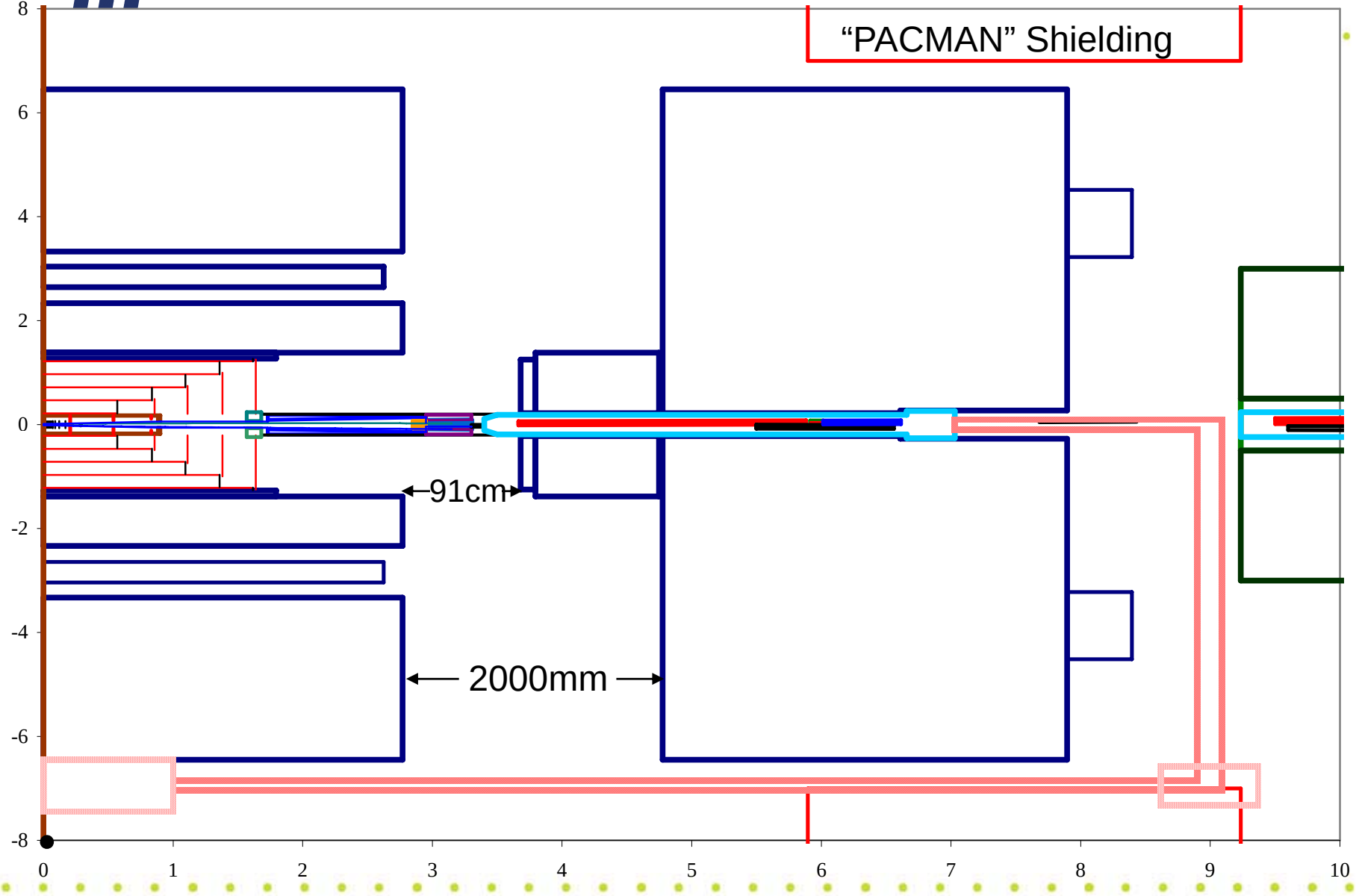
SiD r<50cm, L*=3.664, 14mrad Crossing Angle, Push-Pull, Door **Open 2m**



Door Closed, Permanent QD0 Liquid He Line

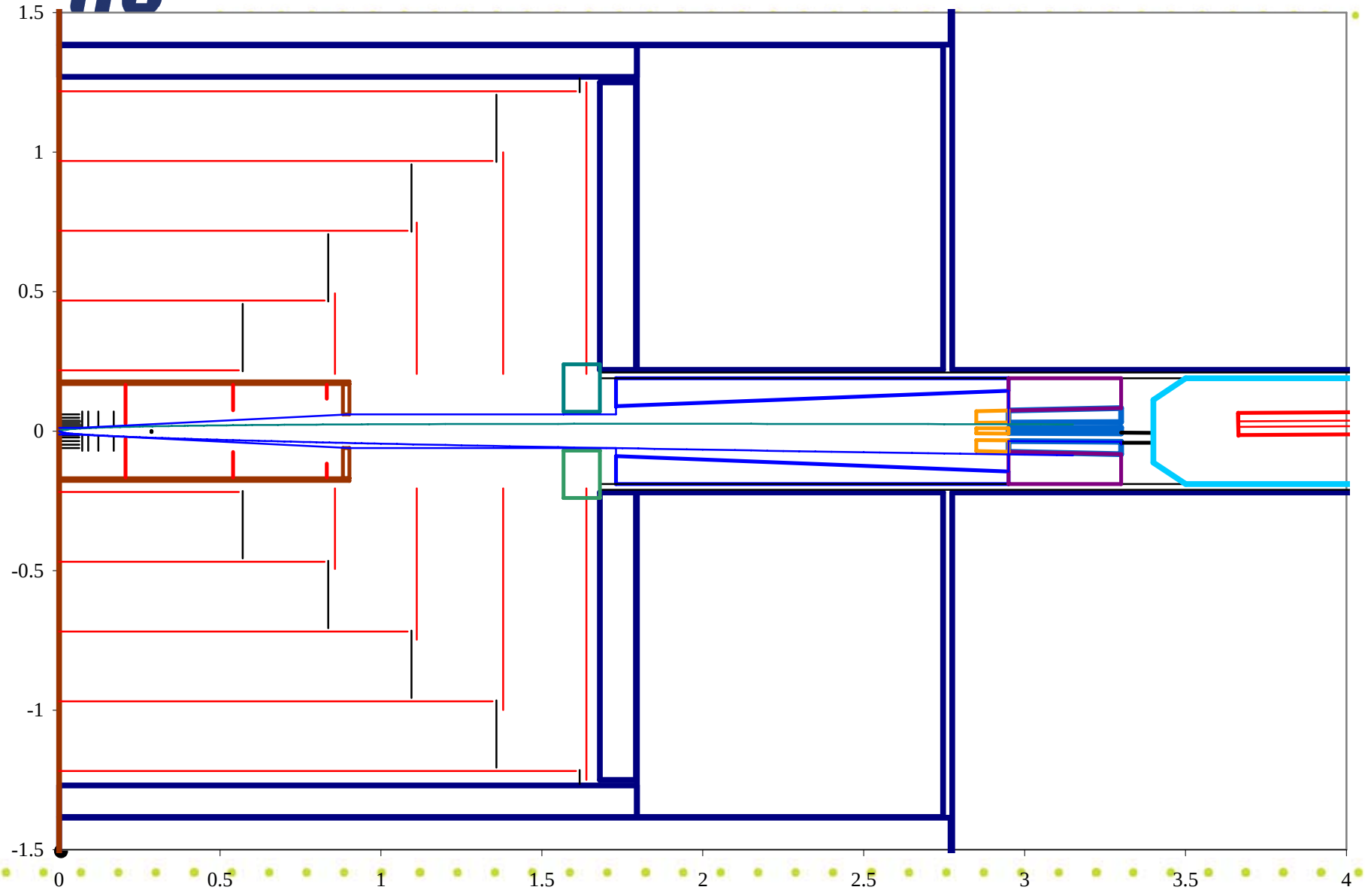


Door Open, Permanent QD0 Liquid He Line

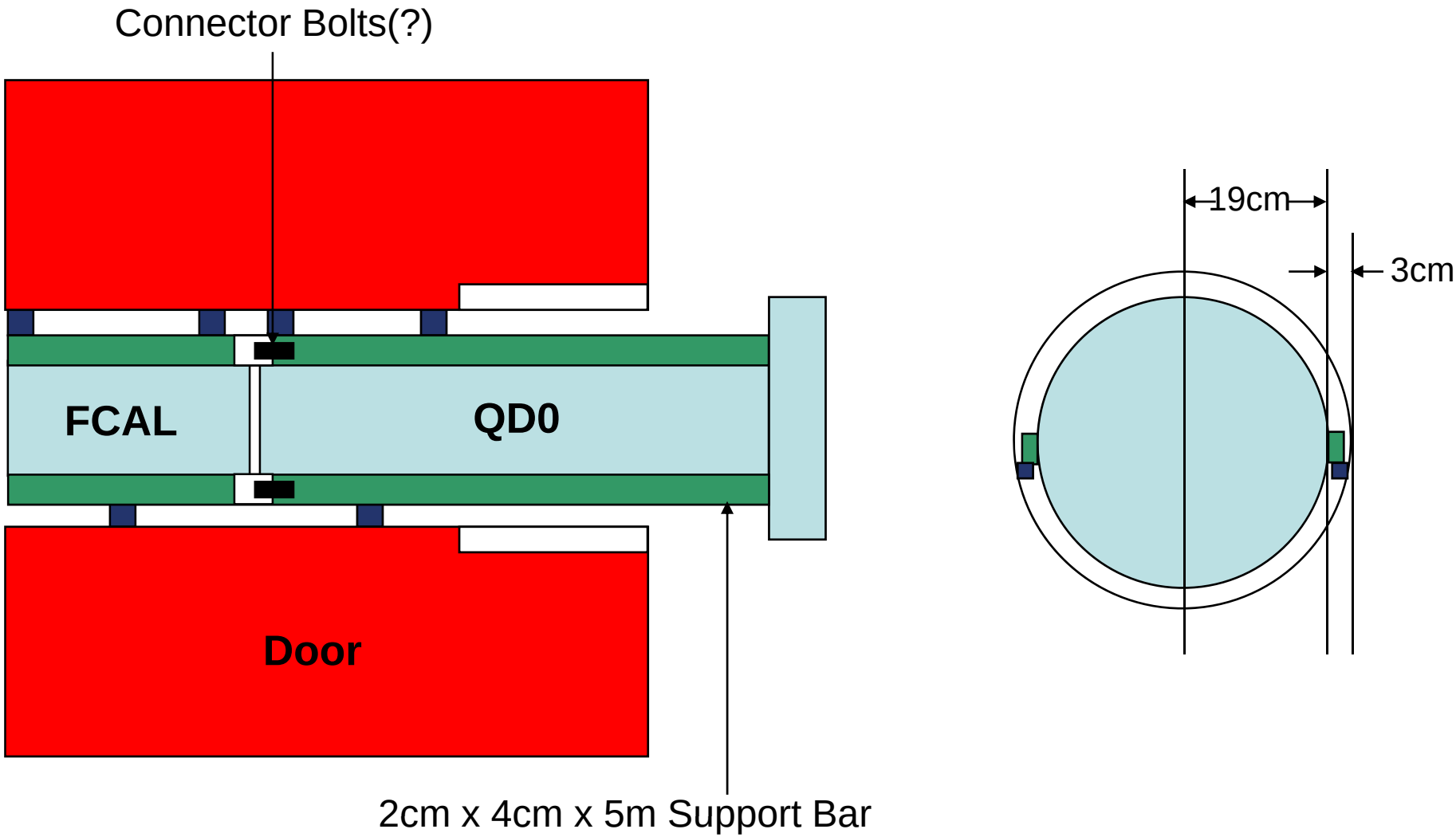


Tracker CANNOT Be used to Support FCAL+Mask Package

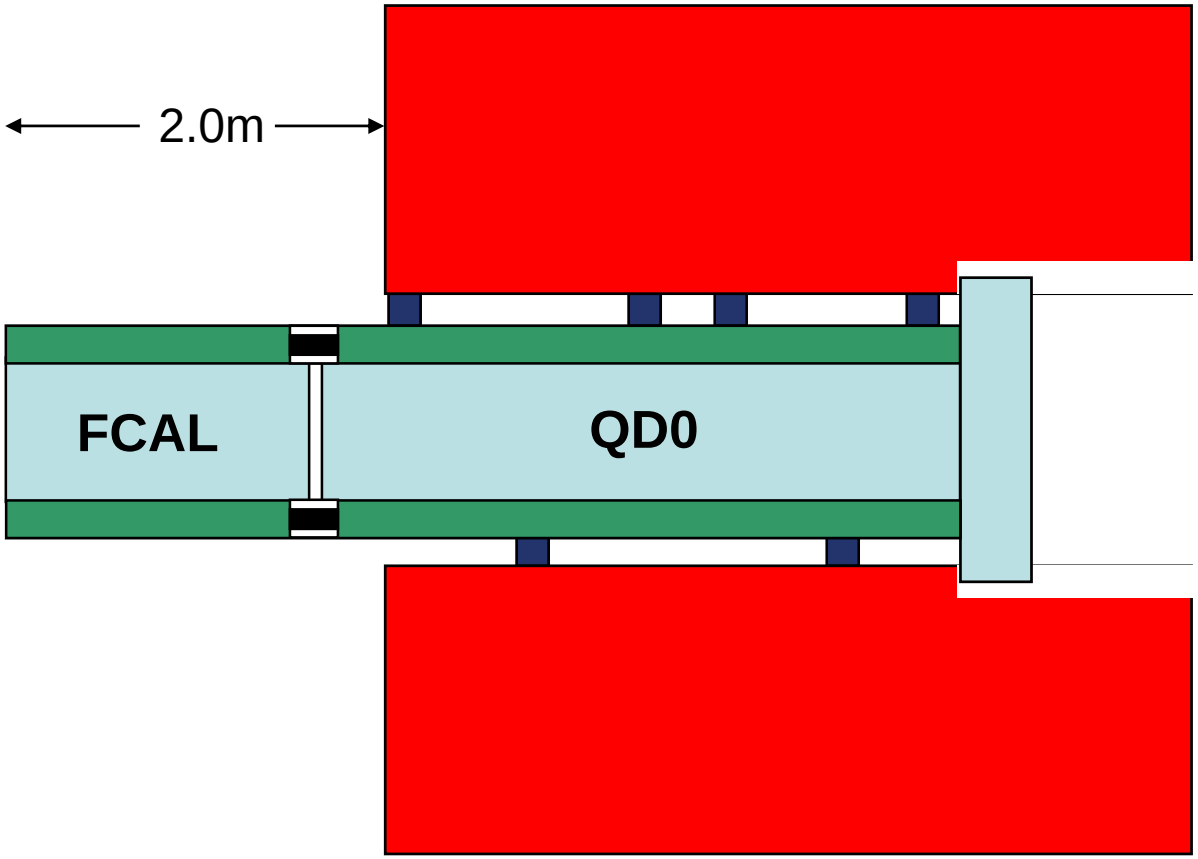
→ **MUST HANG OFF QD0 (at least when door open)**



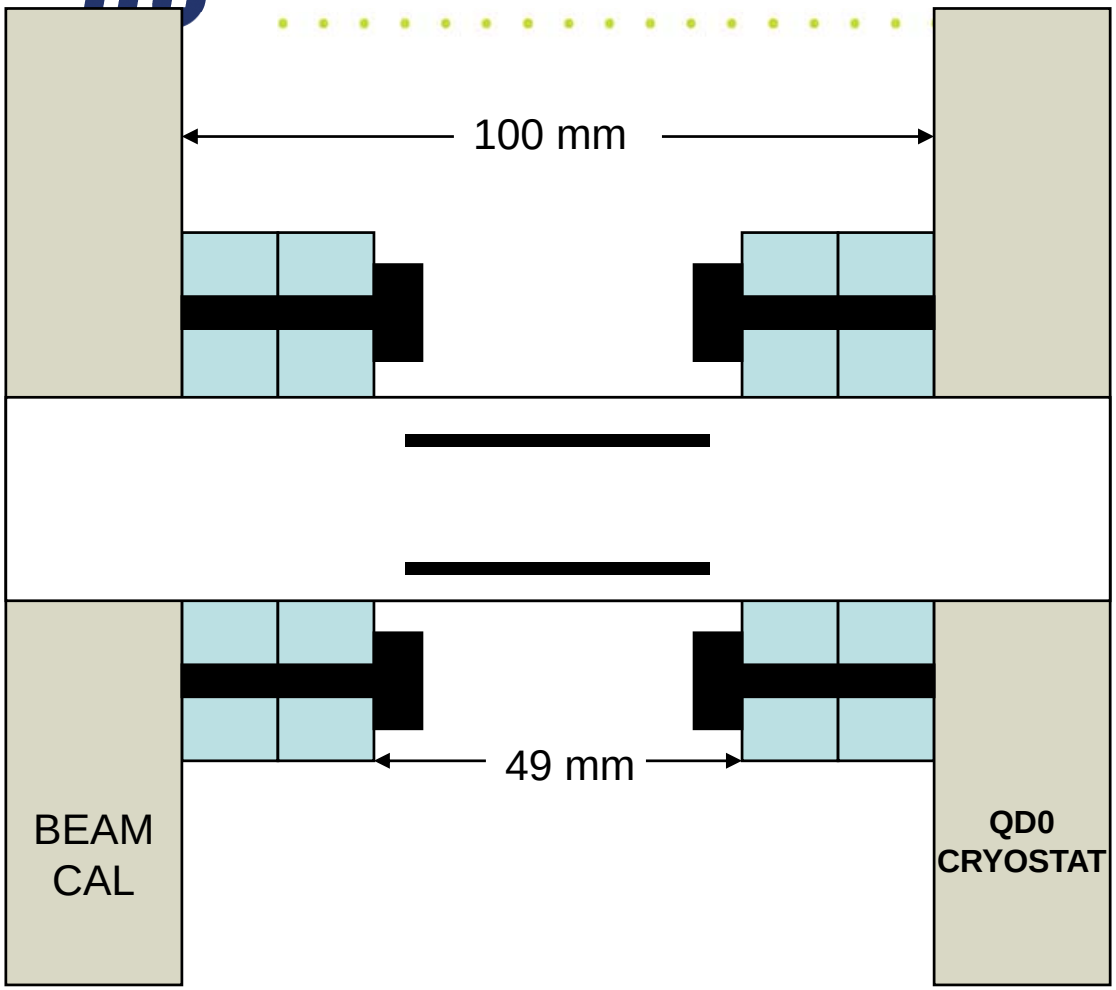
FCAL/QD0 Supported with Door Closed



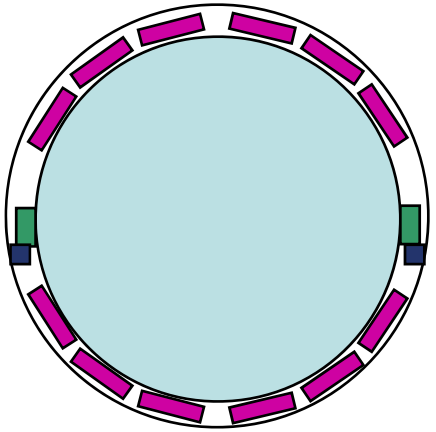
FCAL/QD0 Supported with Door Open



Practical Details: Flange/Bellows



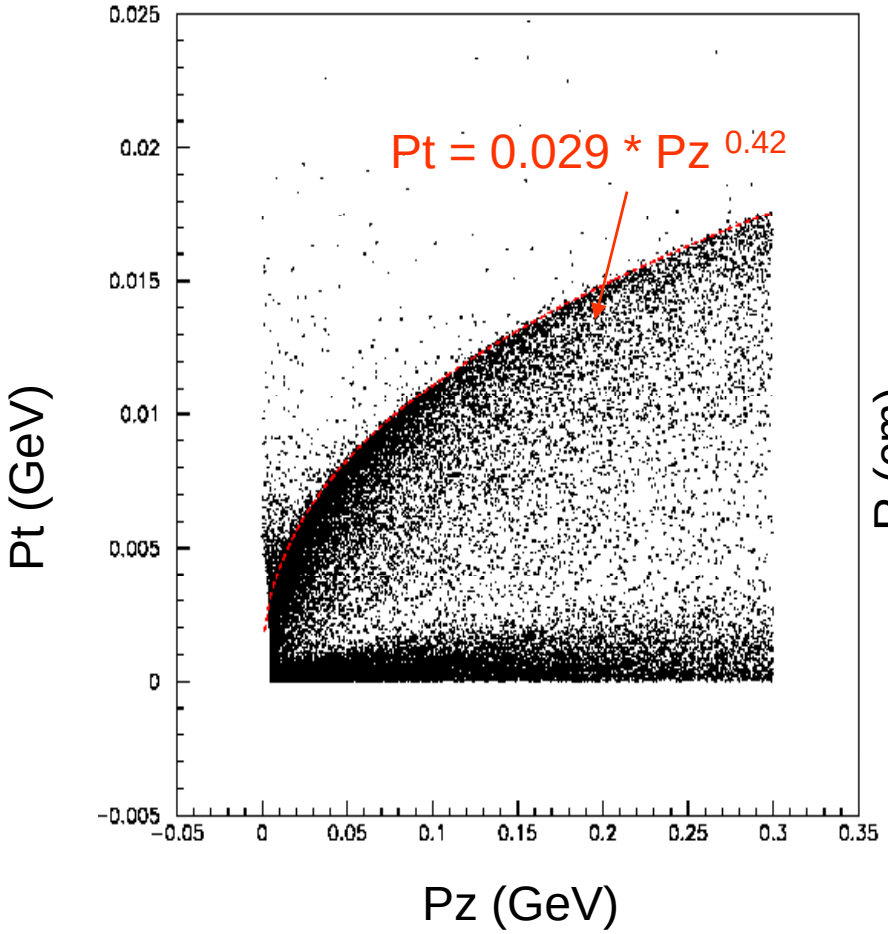
Space for Readout Services?

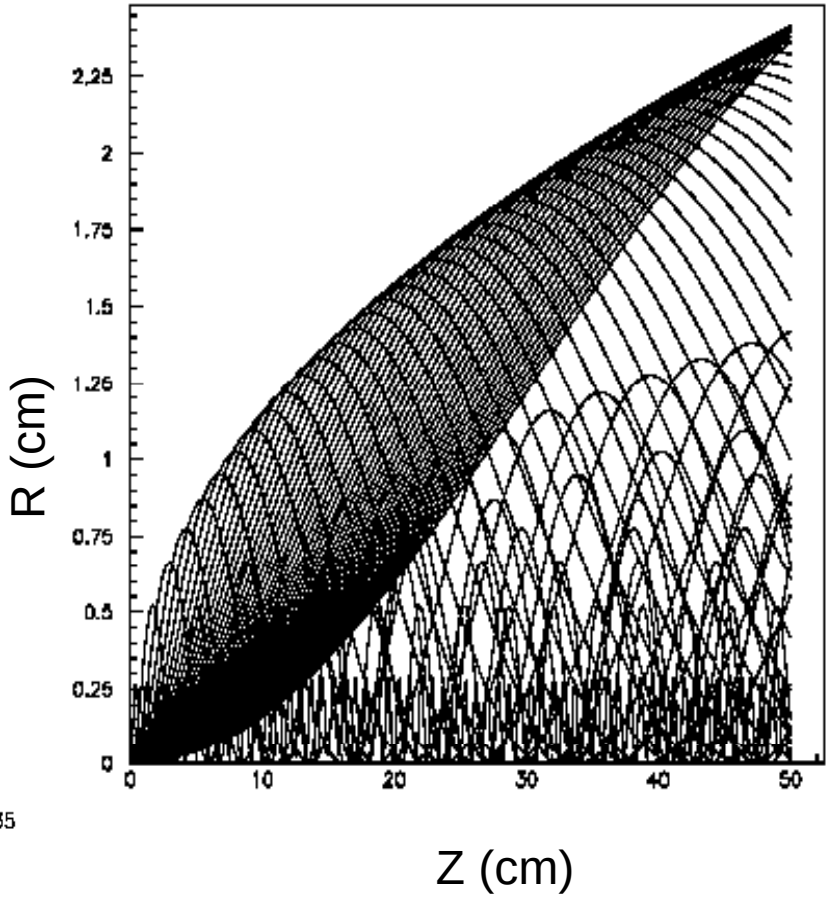


2 x 13.5mm Ø Beampipe (bellows?) with BPM
using 2.75” x 0.5” standard conflat flanges
1:1 scale

Finding the pair edge

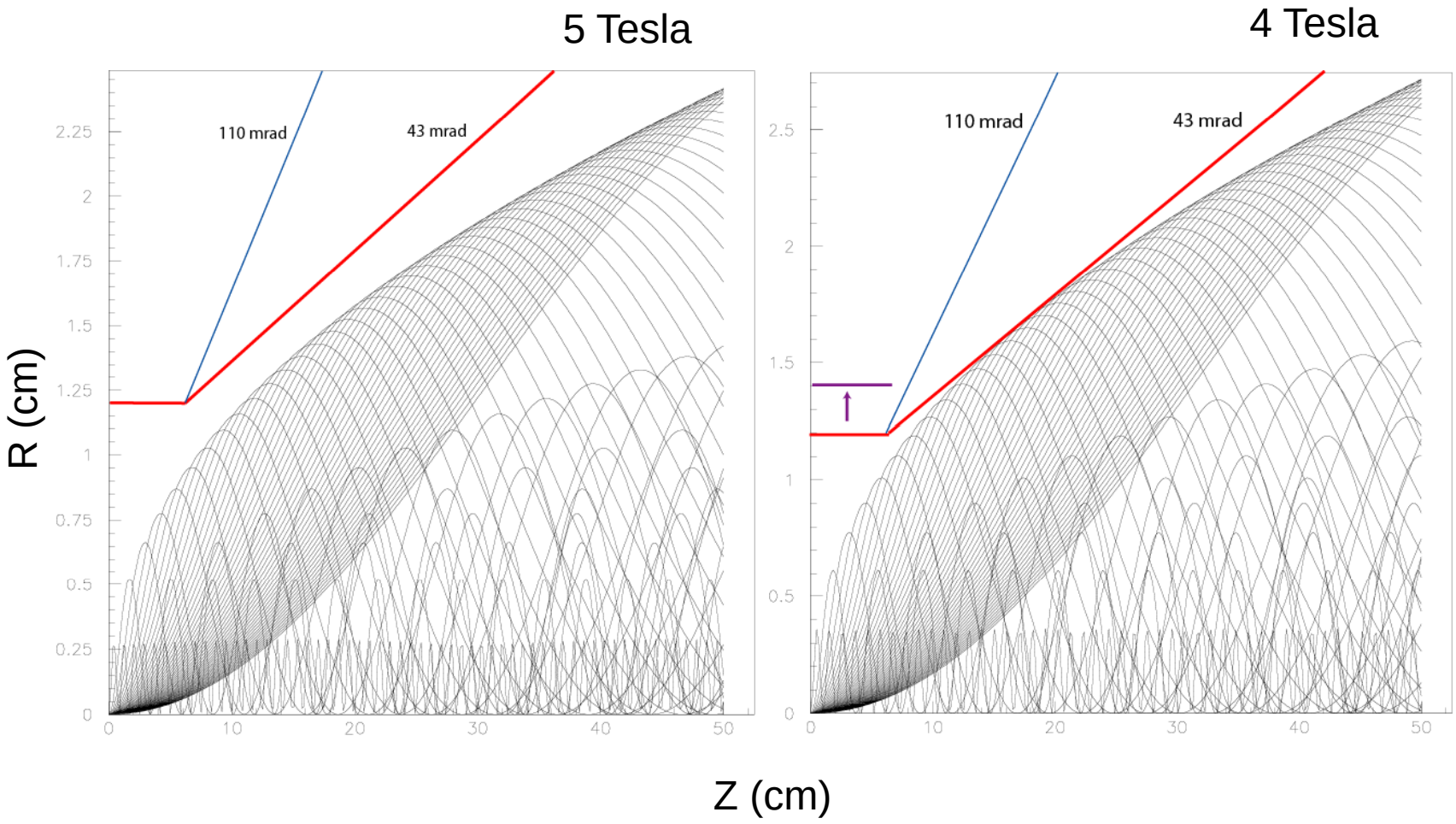
ILC 500 GeV Nominal Beam Parameters 5 Tesla + 14 mrad NO DID





Current Beam pipe is designed for

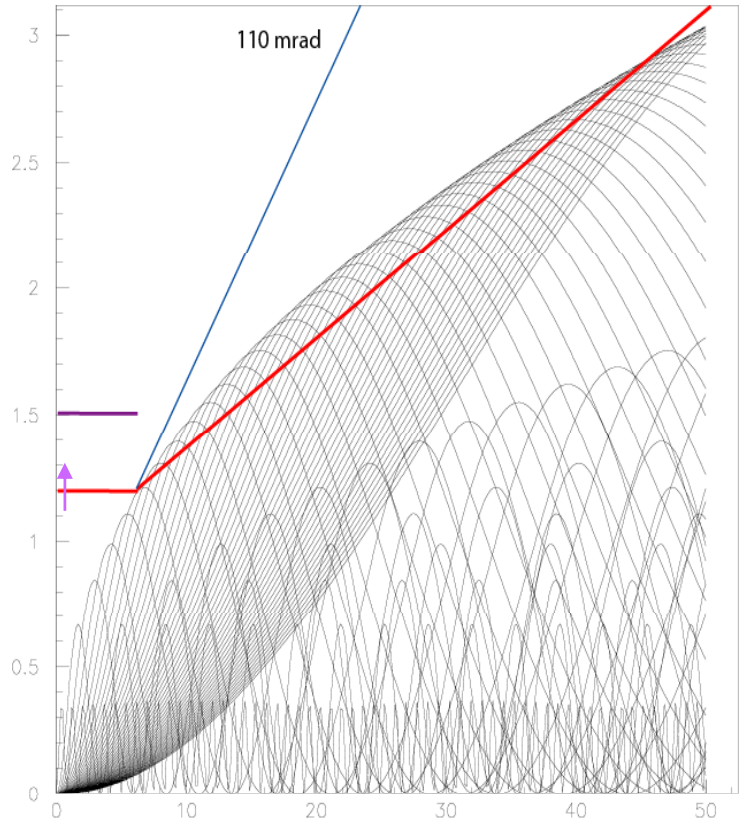
ILC 500 GeV Nominal + 5 Tesla



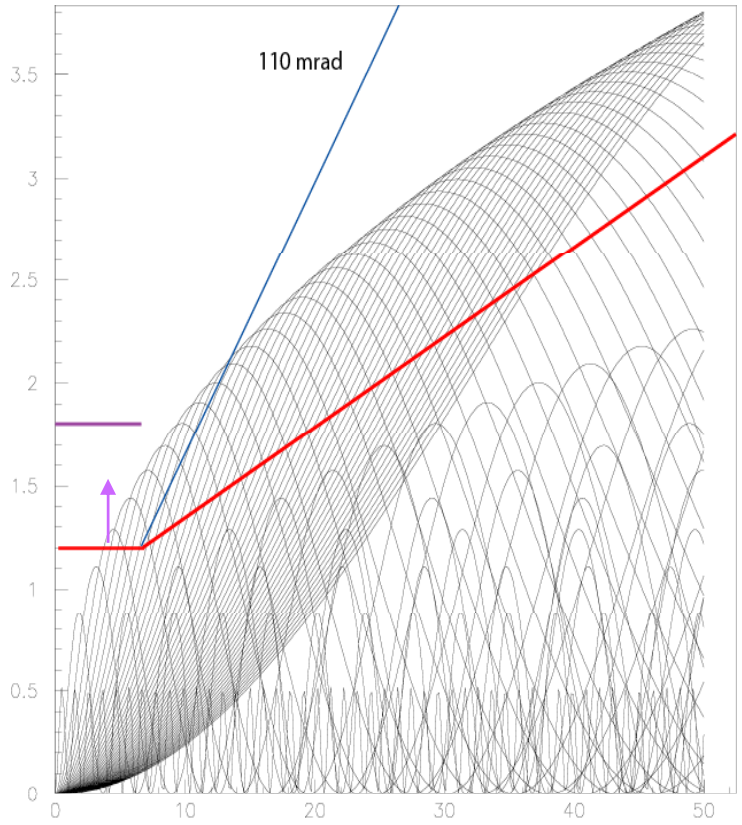
For 4 Tesla, R=1.2 cm is tight and 43 mrad is too small.
R=1.4 cm and 110 mrad beam-pipe would work.

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

500 GeV Low P + 5 Tesla



500 GeV High Lum + 5 Tesla



R (cm)

Z (cm)

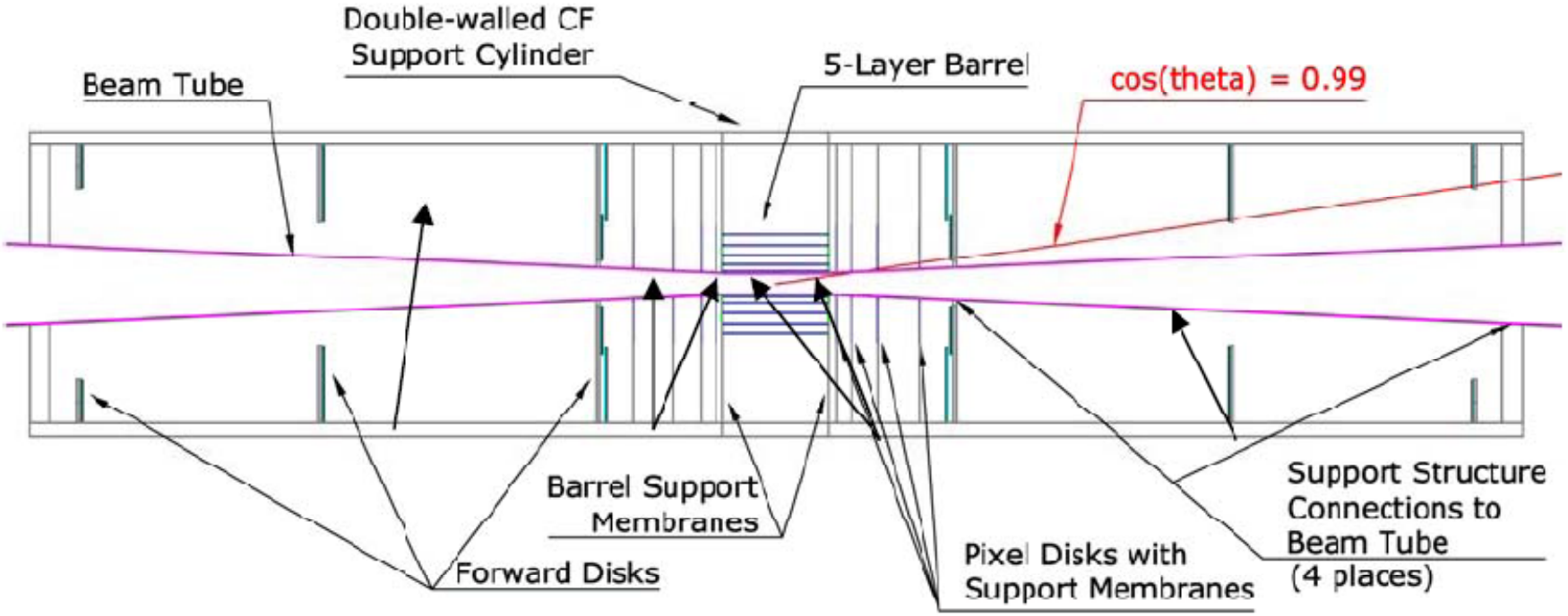
110 mrad beam-pipe would work as long as
R= 1.2 cm → 1.5 cm (Low P), and R= 1.2 cm → 1.8 cm (High Lumi).

Conclusions

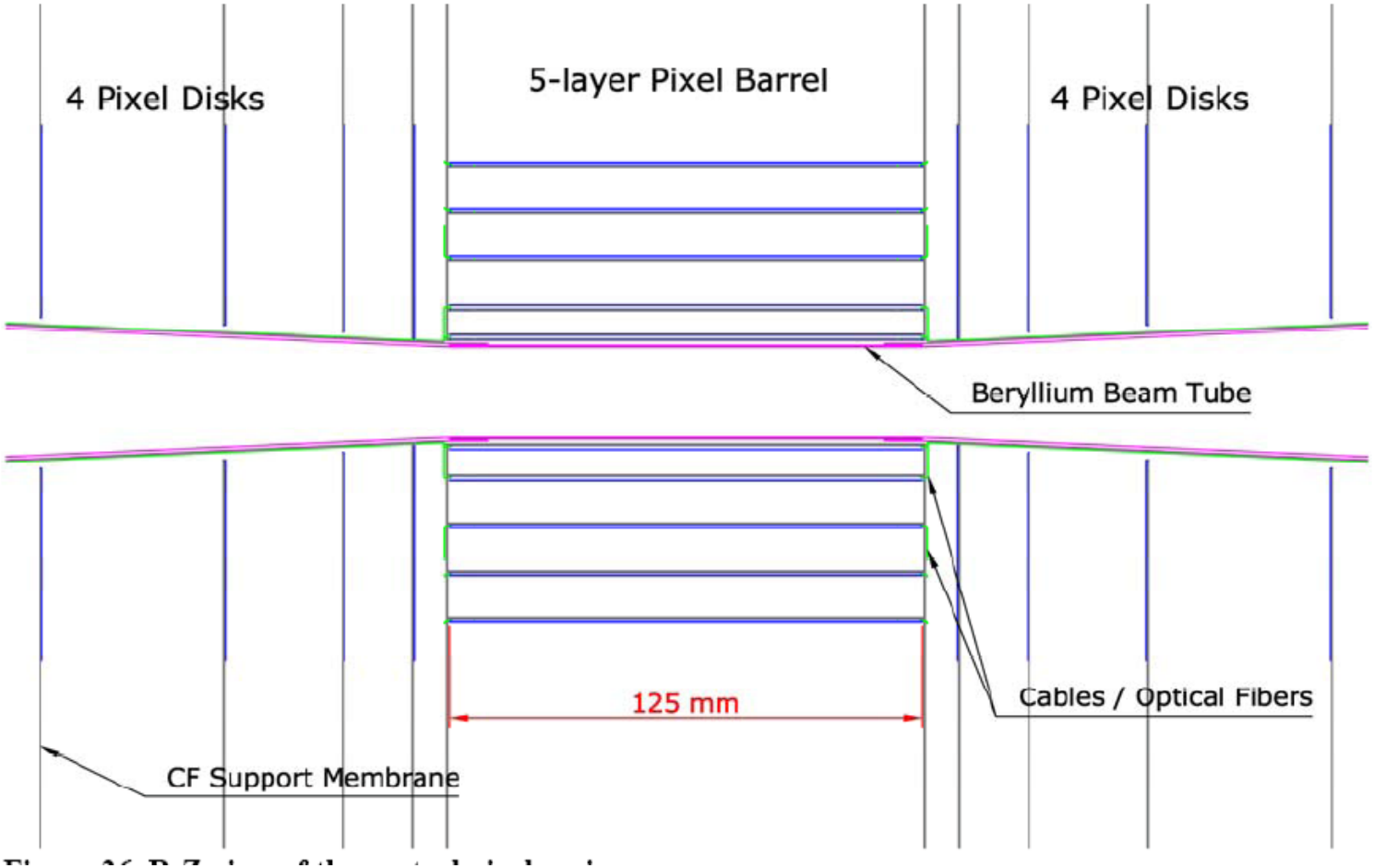
- Current QD0 cryostat requires ECAL to start at r=22cm (was 20cm)
- Lumical @ ~1.68m pushed toward IP and out in radius to overlap ECAL
  - **affects r_{min} of tracker if hermeticity here required**
- It is assumed that for most physics (but not Giga-Z) better to keep large angles as free of service material as possible. Service path at 6<r<7cm proposed
- Group reminded that $r_{min}(z=0)$=1.2cm ONLY valid for nominal IP parameter set & $B_{solenoid}$=5 Tesla
  - **r=1.5cm to satisfy low P parmeters**

Bonus Material Follows

VXD and Support Structures

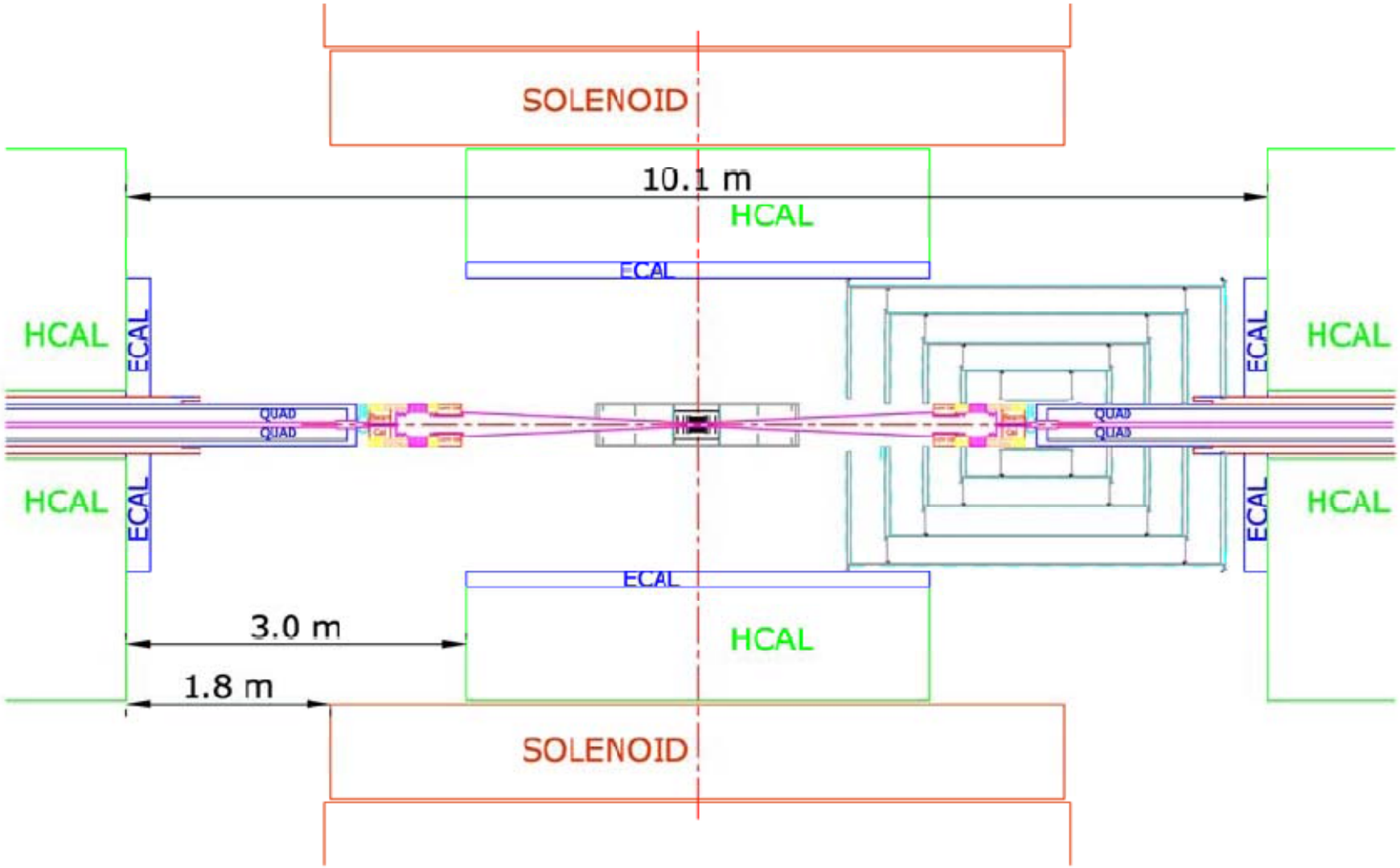


R-Z View of the Pixel VXD



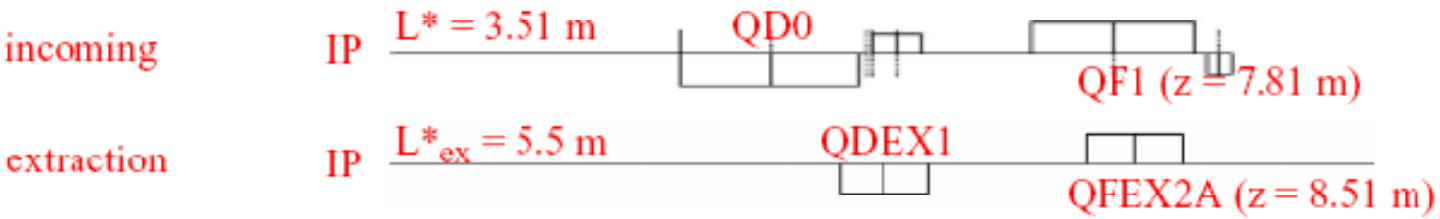
SiD Open for Access to the VXD Region

What Opening is Required for Access ON Beamline?

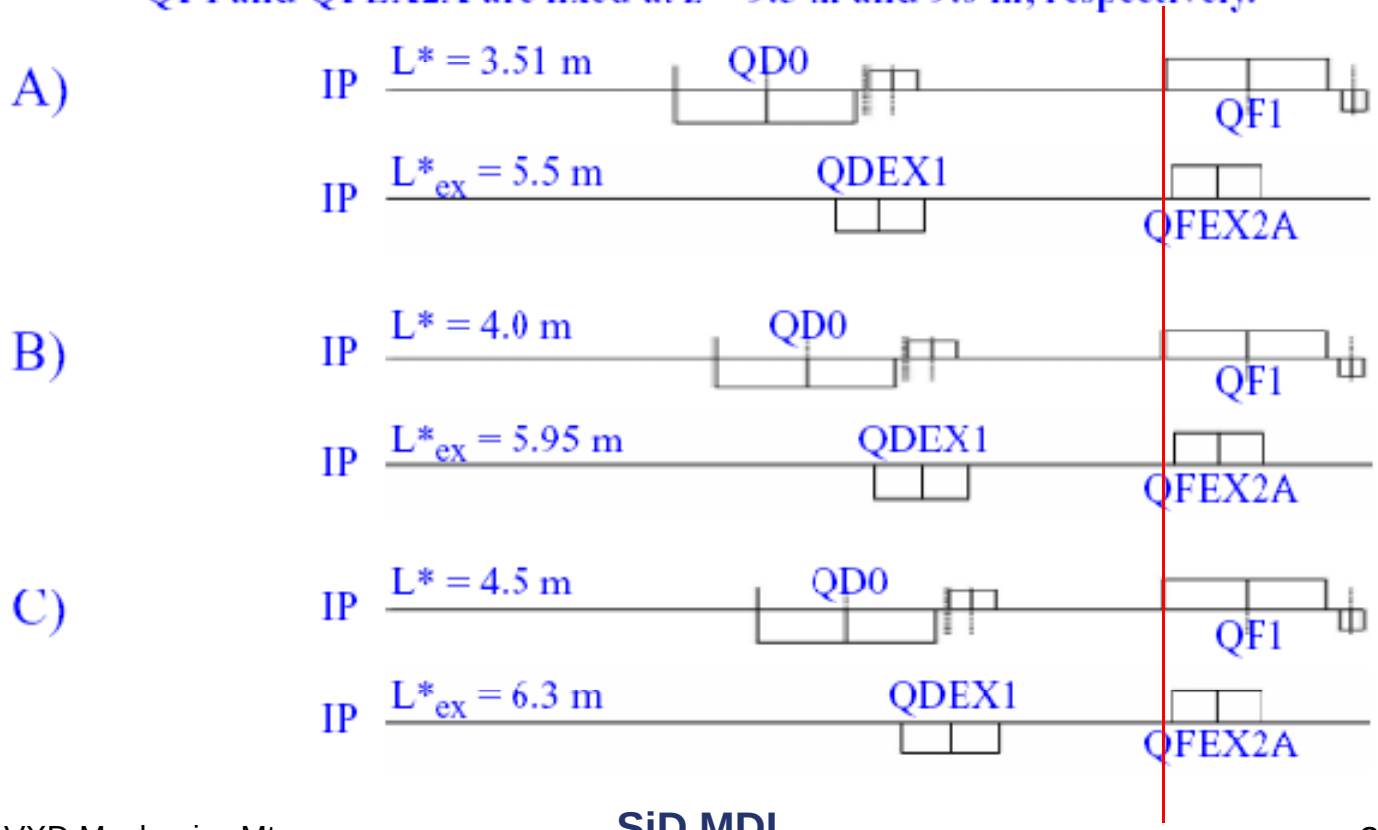


Nosochkov Study: Fix QF1 @ 9.5m, L* chosen by Detector Concept: Study Extraction Losses, Collimation & Optics Sensitivity

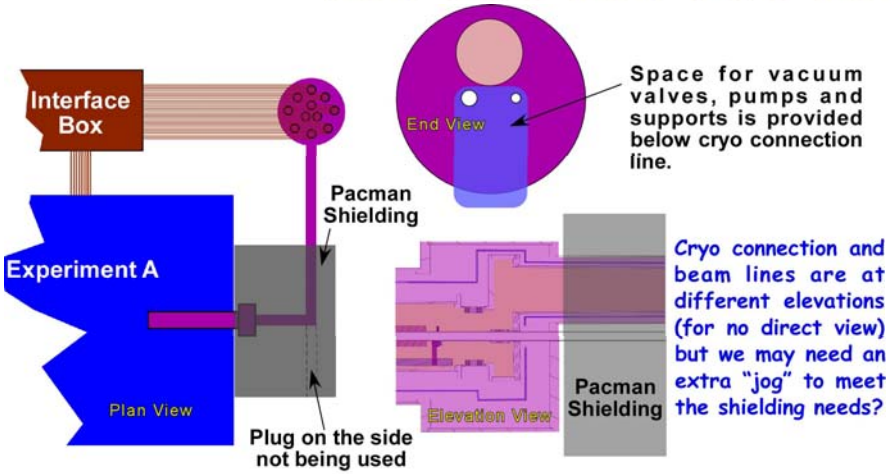
Nominal positions near IP for push-pull

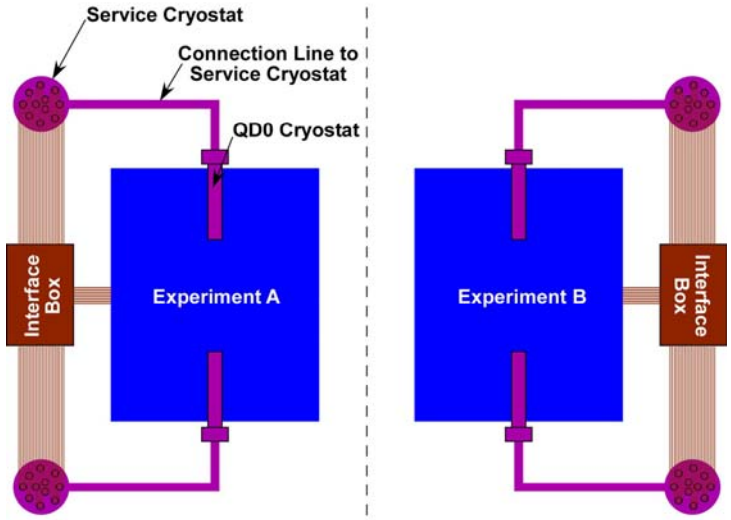


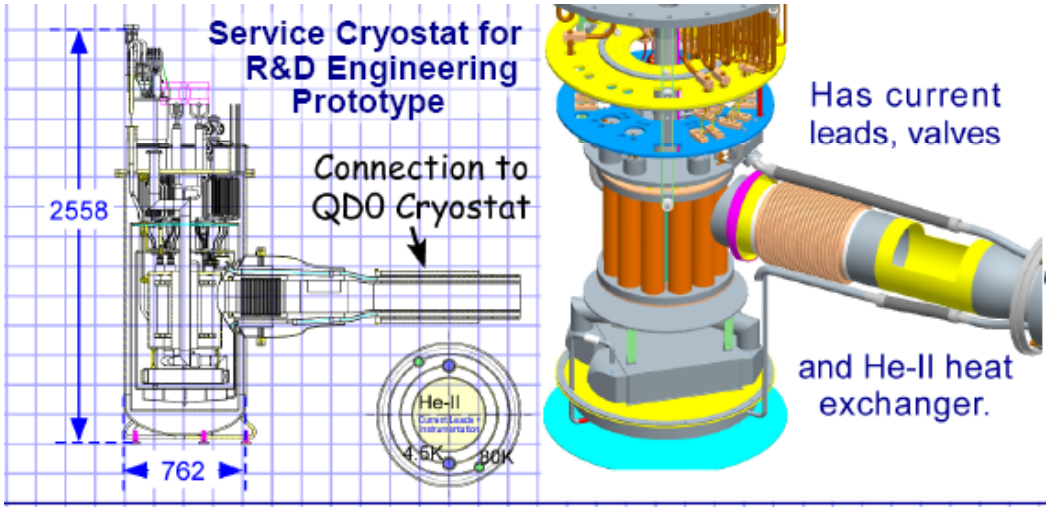
Modified positions near IP: QDEX1 moves along with QD0, QF1 and QFEX2A are fixed at z = 9.5 m and 9.6 m, respectively.



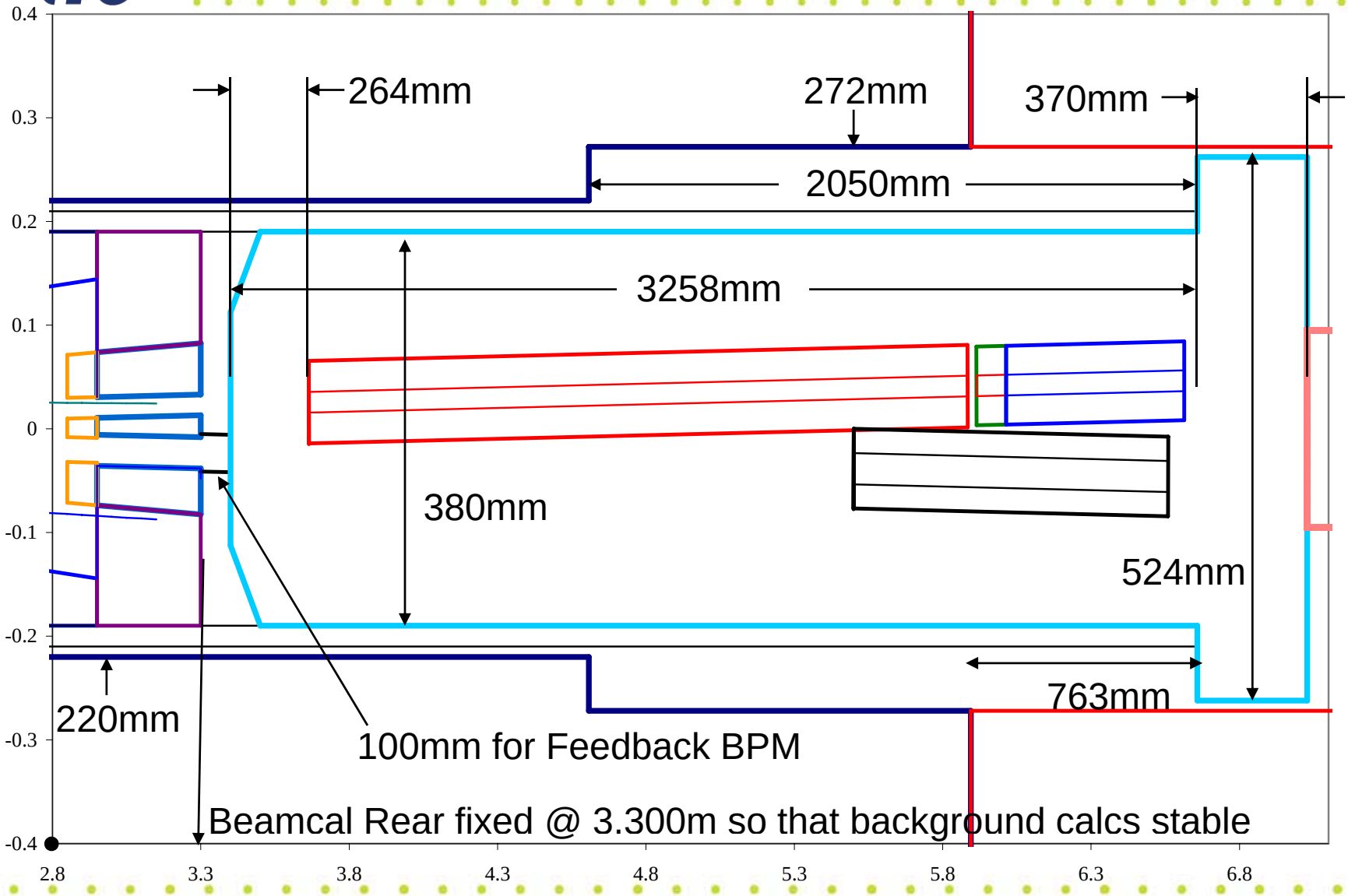
Brett Parker's Schematics







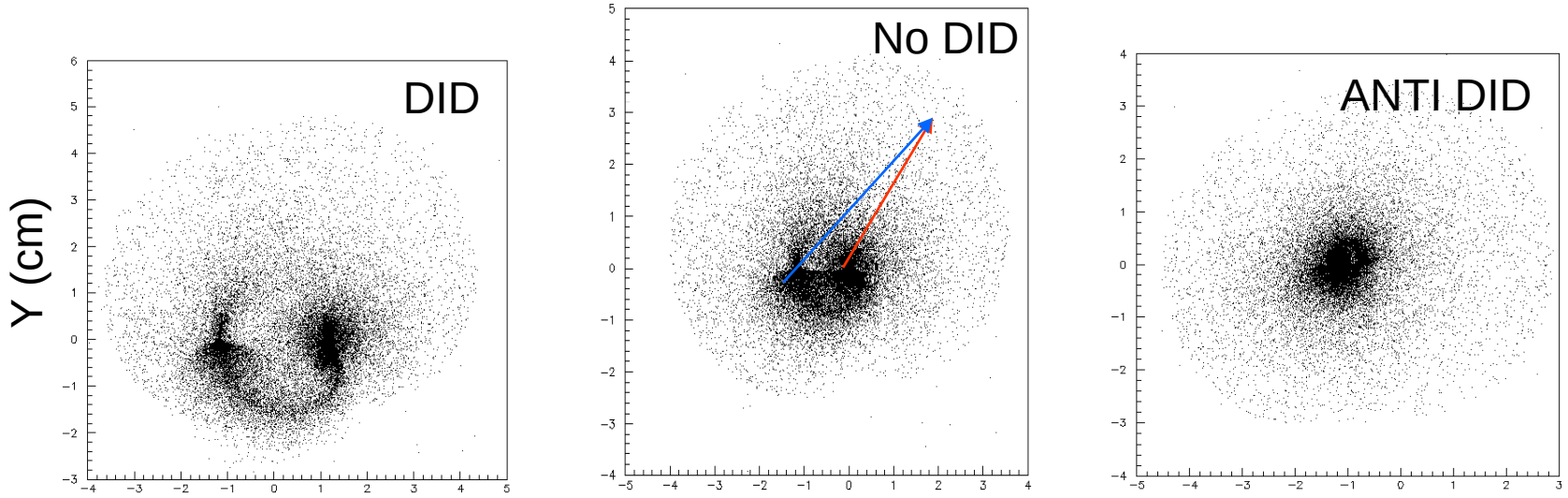
QD0 Cryostat in SiD @ L*=3.664m



Study Pair distribution at Z = 168 cm to find minimum radius of beampipe and acceptance gain if LumiCal centered on Extraction Line

- 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

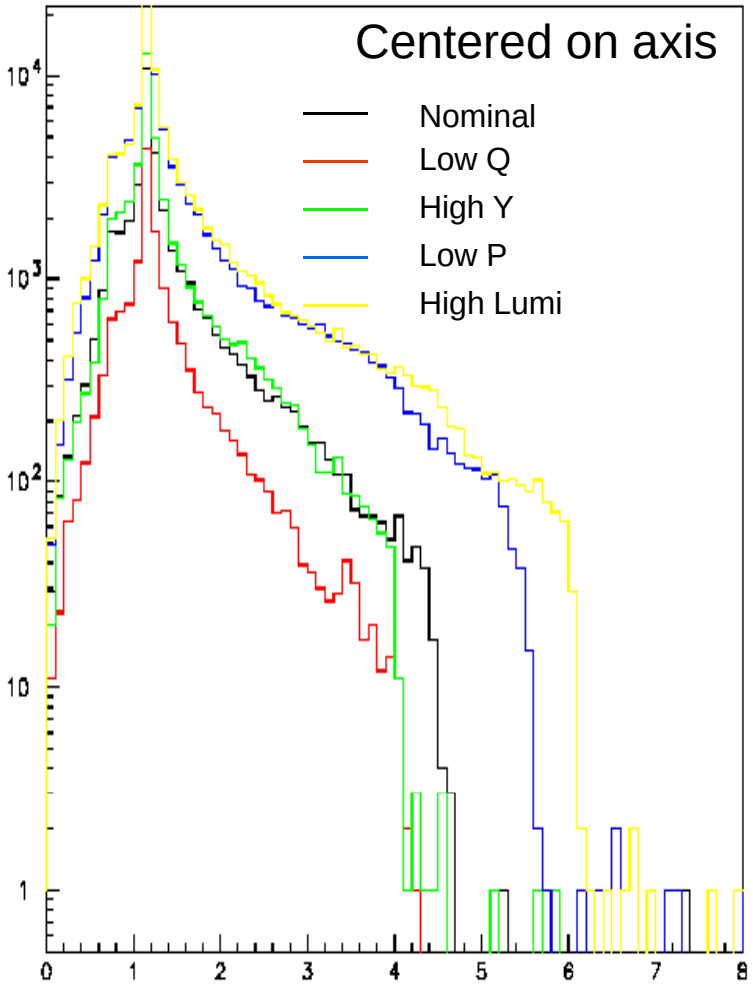


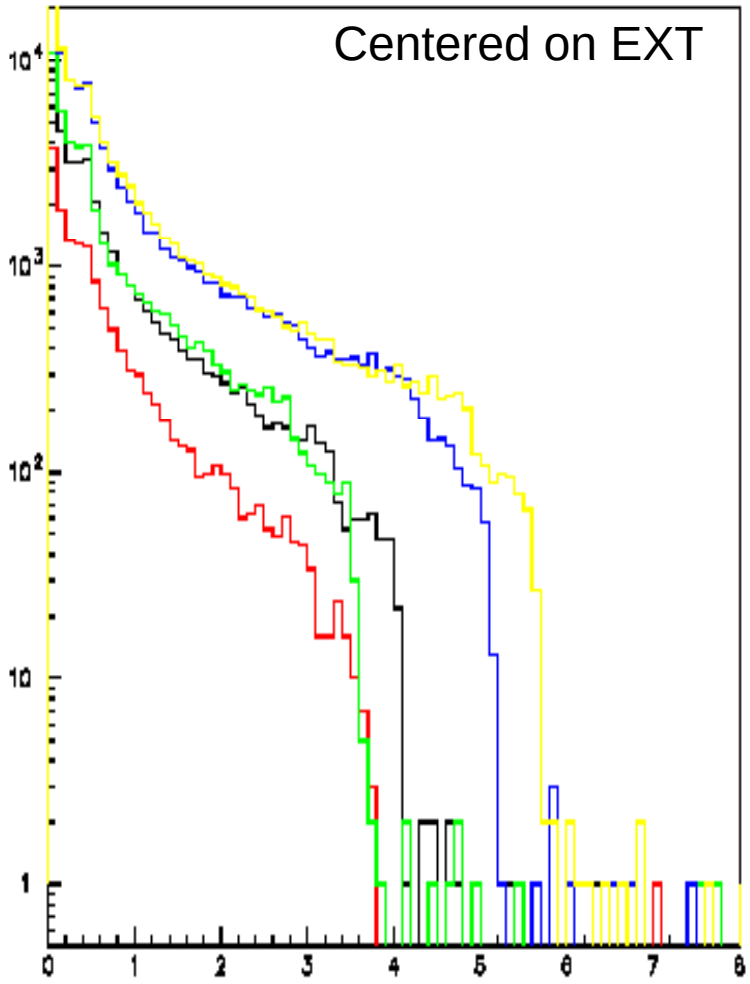
T. Maruyama, SLAC

Pair Radius at Z = 168 cm

T. Maruyama, SLAC

ILC 500 GeV





Pair Radius in cm at Z=168 cm

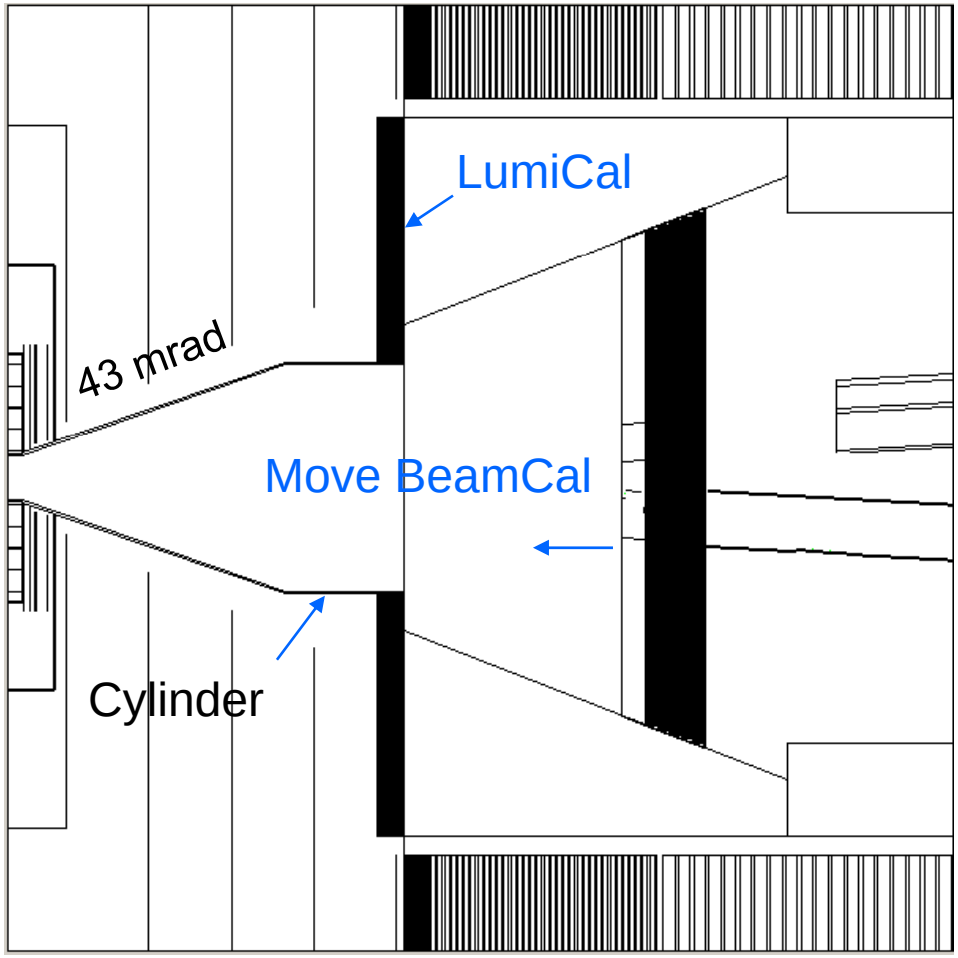
	4 Tesla			5 Tesla		
	ANTI-DID	NO DID	DID	ANTI-DID	NO DID	DID
Nominal	5.2 / 4.7	5.1 / 5.5	5.8 / 6.5	4.7 / 4.1	4.4 / 5.1	5.3 / 6.1
Low Q	4.7 / 4.2	4.4 / 5.1	5.3 / 6.0	4.2 / 3.8	3.8 / 4.6	4.8 / 5.6
High Y	4.6 / 4.2	4.6 / 5.1	5.5 / 6.0	4.3 / 3.9	4.1 / 4.6	4.9 / 5.7
Low P	6.3 / 6.0	6.2 / 6.8	6.8 / 7.6	5.7 / 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.)

LUMON acceptance

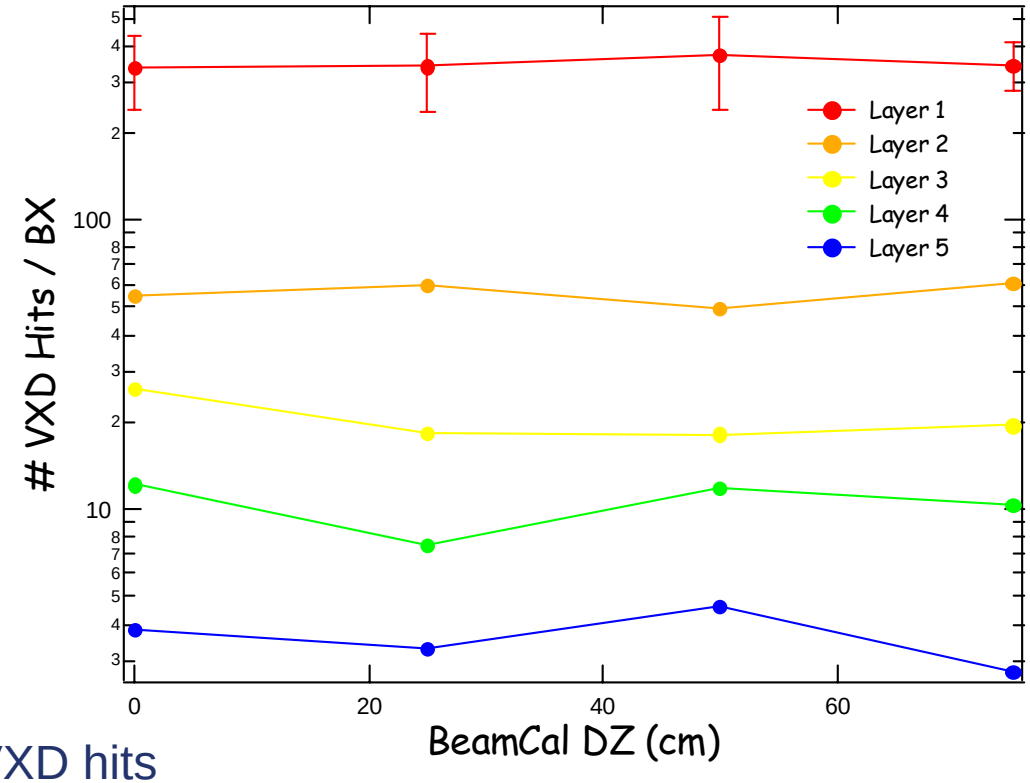
- Inner radius of LUMON can be smaller than 8.1 cm used previously
  - **Nominal + 5 Tesla: 8.1 cm → 5.0 cm (30 mrad)**
  - **4 Tesla → +3 mrad → 5.5 cm (33mrad)**
  - **Low P → +6 mrad → 6.0 cm (36mrad)**
  - **High Lumi → +9 mrad → 6.5 cm (39mrad)**
- Centering LUMON on the extraction line has an advantage only when ANTI-DID is used.

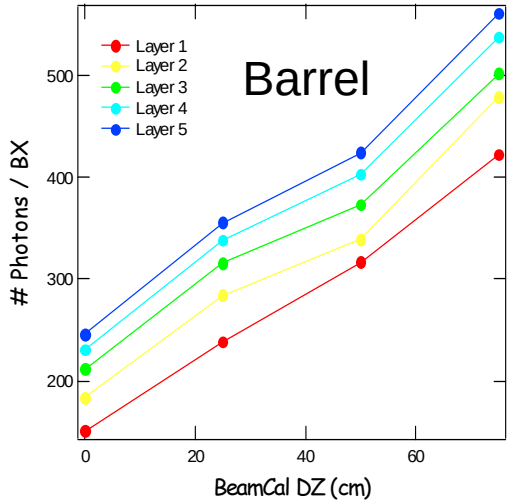
Study Background as Function of BeamCal z

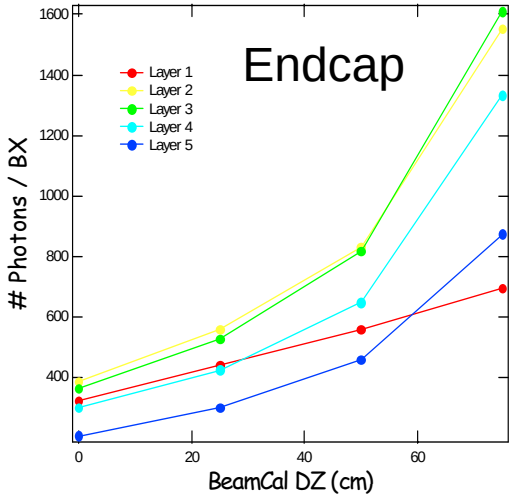


- LumiCal
  - **Z=156.75 – 168 cm**
  - **R_{inside}=6cm**
- Beampipe
  - **Original 43 mrad cone + cylinder**
- M1 geometry is the same.

Si Tracker Photons vs. BeamCal DZ







VXD hits

No effects from LumiCal/BeamCal changes

Si Tracker hits

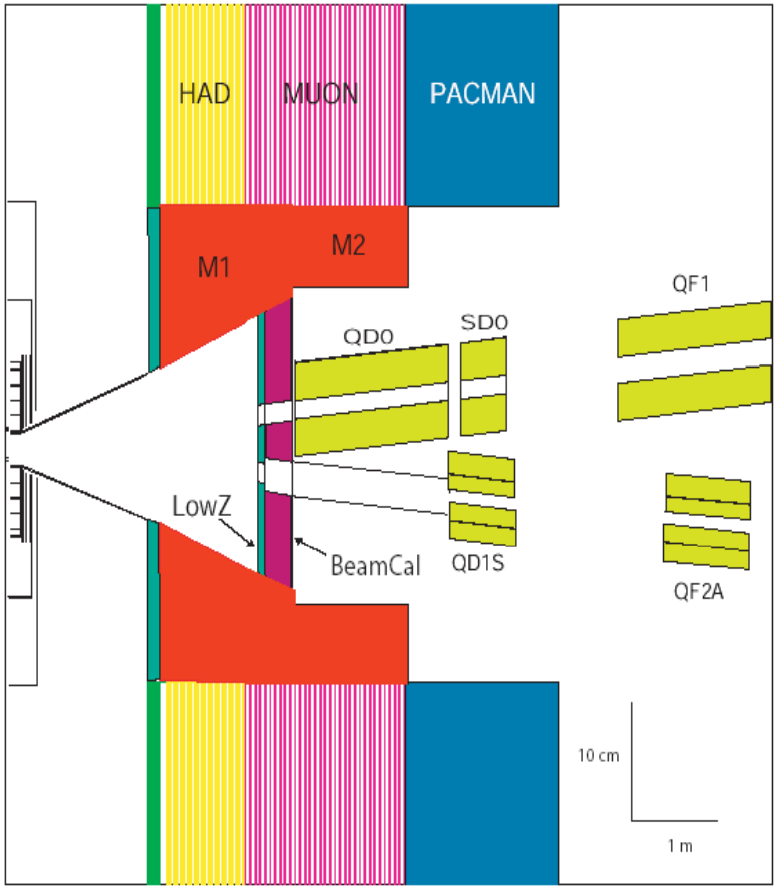
New LumiCal has less photons

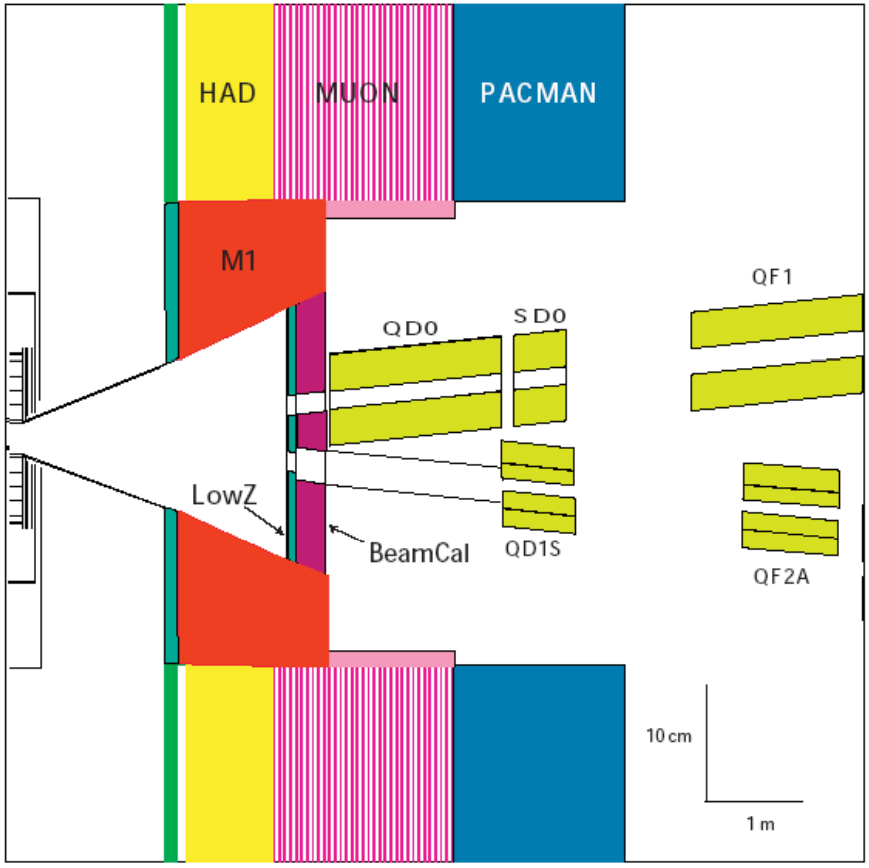
 # photons increases by moving the BeamCal forward.

But the rate is acceptable if δZ < 30 cm.

Endcap photon rate increases quadratically at δZ > 30 cm.

Is M2 NEEDED or NOT????





No M2 Mask Needed