SiD Vertexing

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SLAC

- Status
- Geometry design updates and main questions
- Snowmass activities and goals

Current Status (I)

- The main activities since LCWS05 has been the geometry design studies, and we have reached an updated SiDAug05 geometry for GEANT. However, tools for looking at GEANT simulation output is rather limited.
- Some key mechanical design issues are coming to focus, but much work is needed to bring real solutions. Bill Cooper is taking on the overall mechanical design coordination.
- VXD based tracking reconstruction from Nick Sinev is now also working for the endcaps, but code needs to migrate to official LCIO format.

Current Status (II)

- **Sensor R&D of many flavors could be potentially used for SiD. These R&D's are mostly organized among a small groups of institutions as generic R&D and typically not tied to a particular detector concept, and the sensor R&D status are rarely reported at SiD tracking meetings.**
- **The general requirement for the sensors are fairly clear so that much of the other parts of VXD design can proceed still to a large extent independent of the eventual chosen technology.**

Current Status (III)

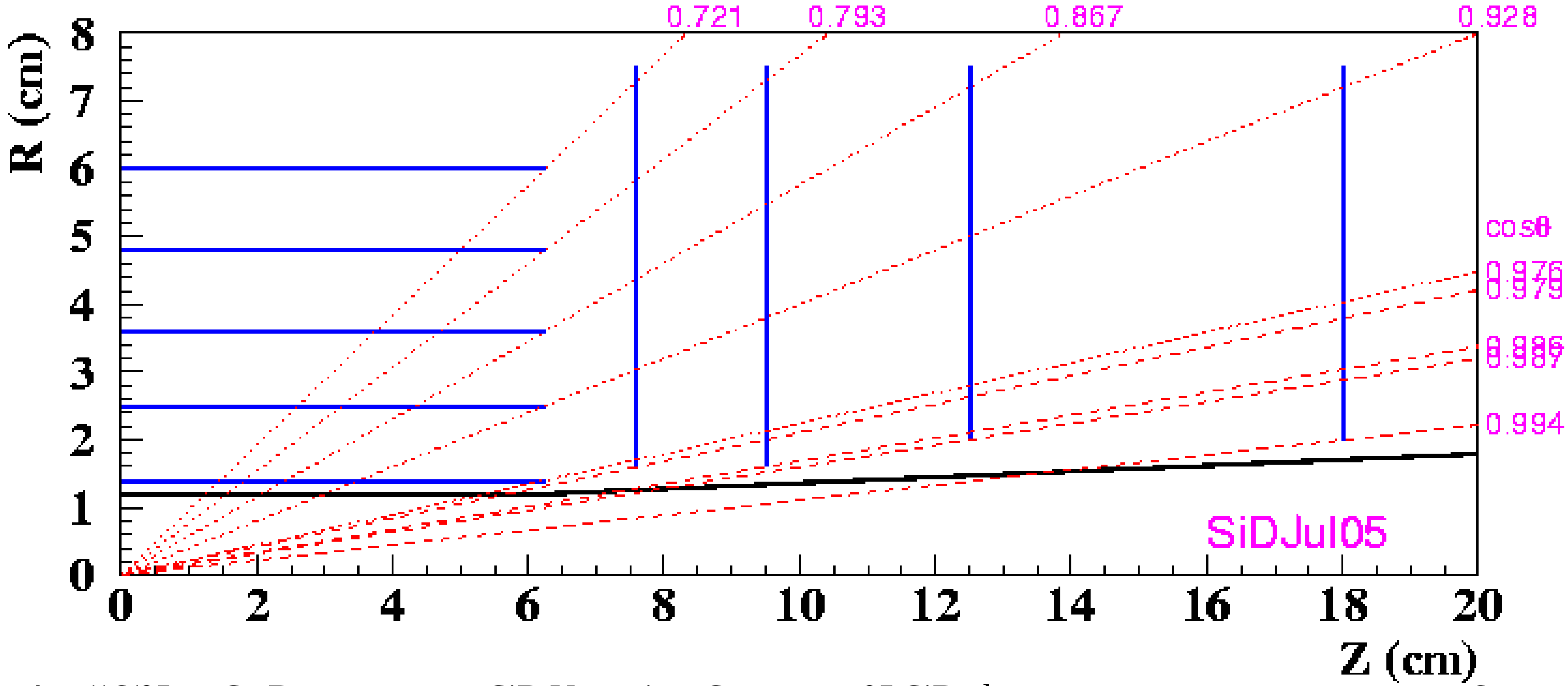
- Known sensor R&D projects which are paying interests for possible deployment in SiD:
  - Macro/micro CMOS pixel. Yale/Oregon/Sarnoff
  - CPCCD, ISIS. UK LCFI
  - MAPs. FNAL
  - CCDs. Japan
- Two main issues which will have significant overall design consequences:
  - Sensor to operation cold or just slightly below room temperature ?
  - What level of readout is needed (if any) during bunch train (possible show stopper of EMI effect ?)

The Common Design Goals

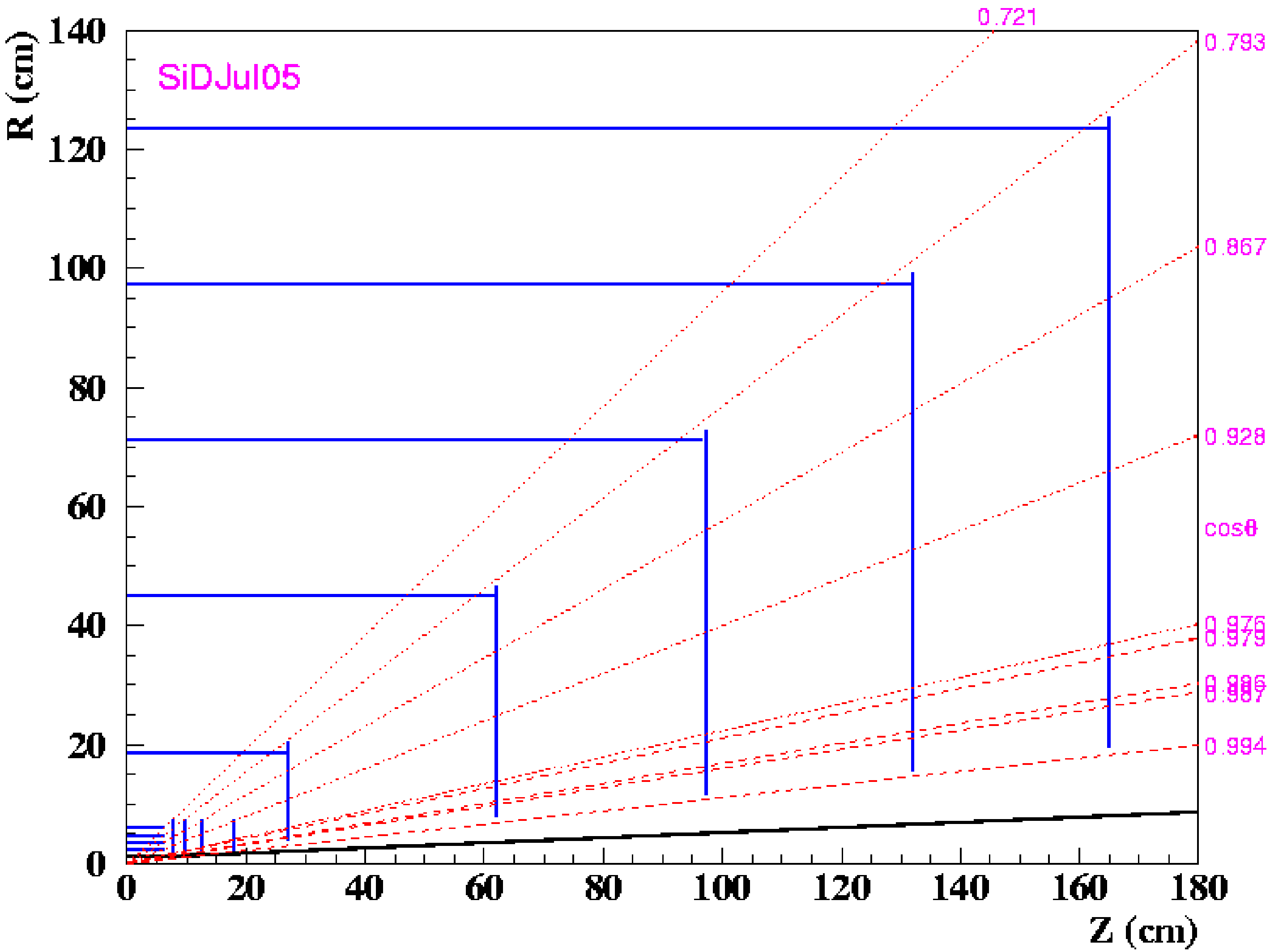
- **Physics vertex detector for physics**
  - b-tag is \`easy', but c-tag needs attention (e.g. H->cc, W->cs)
  - Vertex charge will be the most effective quark charge identifier at LC. e+e- ->QQ asymmetry, W->cs, and many angular distribution analyses can benefit. Combinatorial reducer.
- **Detector performance goals**
  - Spatial resolution <~4μm in both XY and Z
  - Low multiple scattering at ~0.1% r.l./layer
  - VXD self-tracking.

Current SiD Geometry (SiDAug05)

The main feature of the current SiD VXD layout is the combination of relative short barrel and a set of endcap disks. By no means a proven winning strategy yet, but really needs to be explored (long barrel end region is sensitive to radial alignment and ionization fluctuation at very low θ)



Tracker+VXD matching



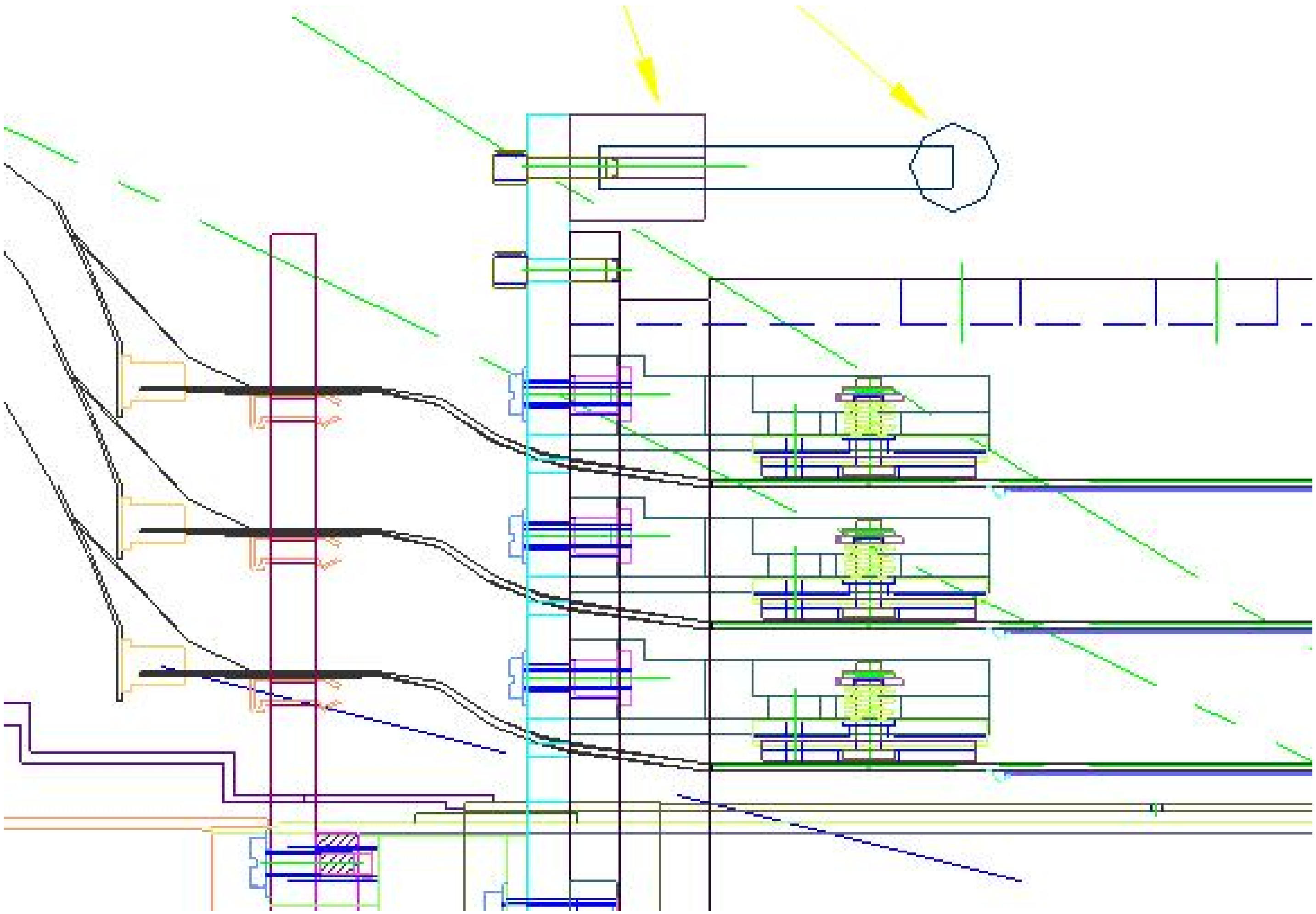
VXD geometry updates

- Barrel layer 2,3 lowered by 1mm in radii
- All endcap discs moved out in Z
- All endcap discs outer radii 7.0->7.5cm for more robust endcap/barrel overlap
- Limit endcap disc inner radii to two types (1.6cm,2.0cm)

VXD Barrel Material

	SLD VXD3		SiD VXD	
Beampipe liner	Ti 50μm	0.14%	Ti 25μm	0.07%
Beampipe	Be 760μm	0.22%	Be 400μm	0.07%
Inner gas shell	Be 560μm	0.16%	-	
Ladder/layer		0.41%		0.11%
Outer gas shell	Be mesh	0.48%		0.28%
Cold N2 Gas		0.05%		0.05%
Cryostat coating	Al 500μm	0.58%		0.22%
Cryostat foam	Urethane	0.44%	NilFlam	0.16%

SLD VXD3 endplate region



Endcap Region Material

	SLD VXD3		SiD VXD
Barrel Endplate	Be/Fe/gap 3mm	1.5%	Composite ? 0.5%
Barrel support annulus	Be	~2.4%	1.0% ?
Ladder blocks	Al_2O_3 (smeared)	3.0%	1.0% ?
Striplines	Kapton/Cu (face on)	0.5%	0.2%
Stripline clamp support	Be plate with holes	~1.0%	0
Stripline connectors	Hit it 0.4%; smear	0.14%	0
Cryostat	Foam	0.4%	0.4%

- What to replace the sliding blocks ?
- Readout can be replaced by optical system similar to ATLAS (T>-10C) with a very small transceiver and very thin fibers.
- Still needs power strips
- No need of clamp and connectors in active fiducial volume.

More Endcap materials

- The cone section of the beampipe is 1mm Be and need to add some liner which should be x3 thicker than center.
- Add disc mechanical support, 1mm thick Be rings with 7mm radial width around outer and inner perimeters of the discs (absorbing the material for space frame rods linking these rings in these rings).
- A cone/cylinder of material just outside the coned section of beampipe for VXD fiber/strips/cooling material.

Geometry Studies

- Not yet have full chain of code to examine resolution from GEANT output. Immediate goal is make a cheater track to fit true hits.
- Various other standalone tools can be used to check resolution consistency.
- Fast simulation and engage in real vertexing analysis for physics benchmark. See Sonja's talk tomorrow.

Snowmass Activities and Goals

- **VXD mechanical design discussions (Tuesday Aug/23 1:30pm at Club room). Brainstorm on major issues such as thin barrel endplate support.**
- **EMI pickup discussion and what to do for SLAC beam tests (probably also Tuesday Aug/23 later half of the afternoon session at Club room)**
- **Simulation training (tutorial Wednesday Aug/17 Club room). Start making tools to look at GEANT output.**

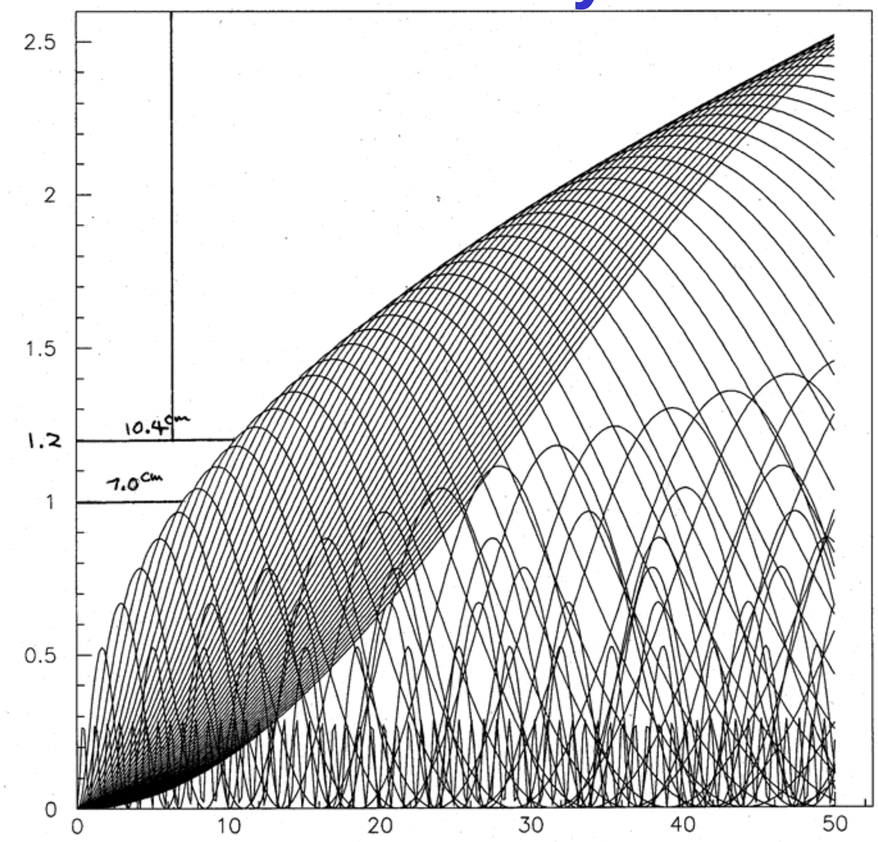
Beampipe radius choice

The ILC beam parameters at LCWS05 resulted in an updated beampipe and VXD geometry

The old 1cm beampipe radius looked risky.

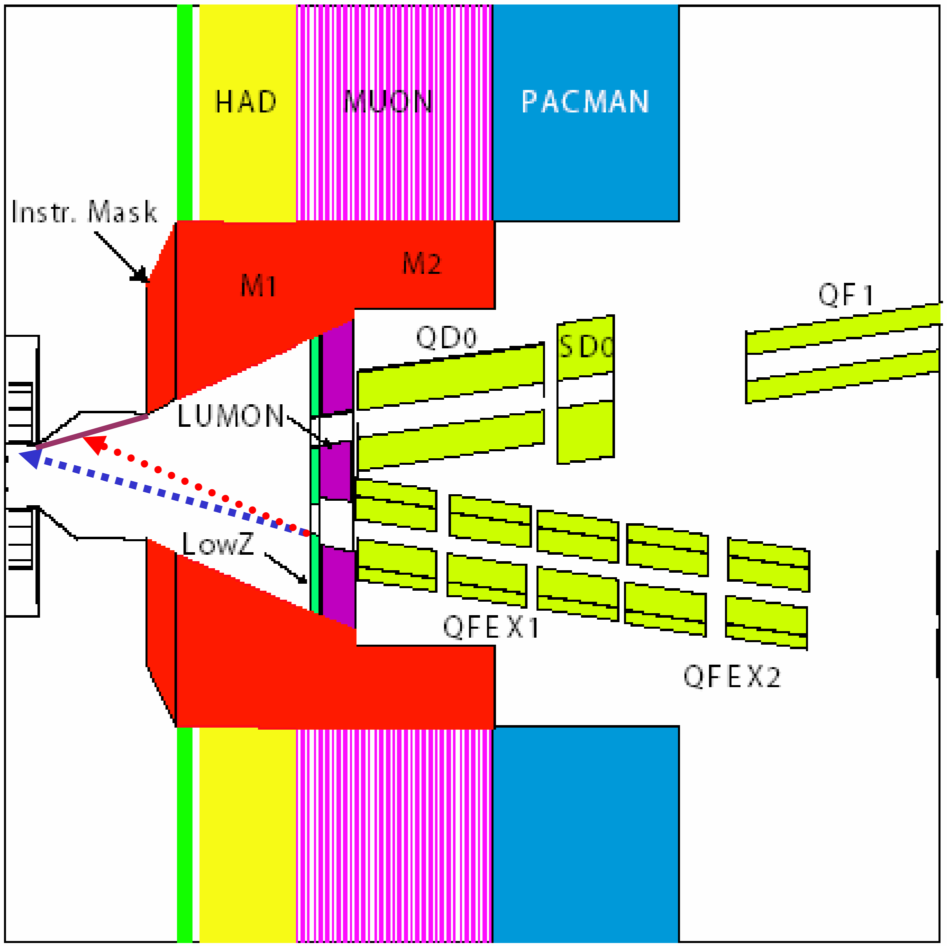
The new beampipe inner radius is R=1.2cm and VXD sensors starts at R=1.4cm with a half barrel length of 6.25cm.

Takashi Maruyama



500 GeV Nominal 5 Tesla
+20mrad crosssing angle

Beam Line Related Issues



From Takashi Maruyama (LCWS05) for 20mrad crossing angle

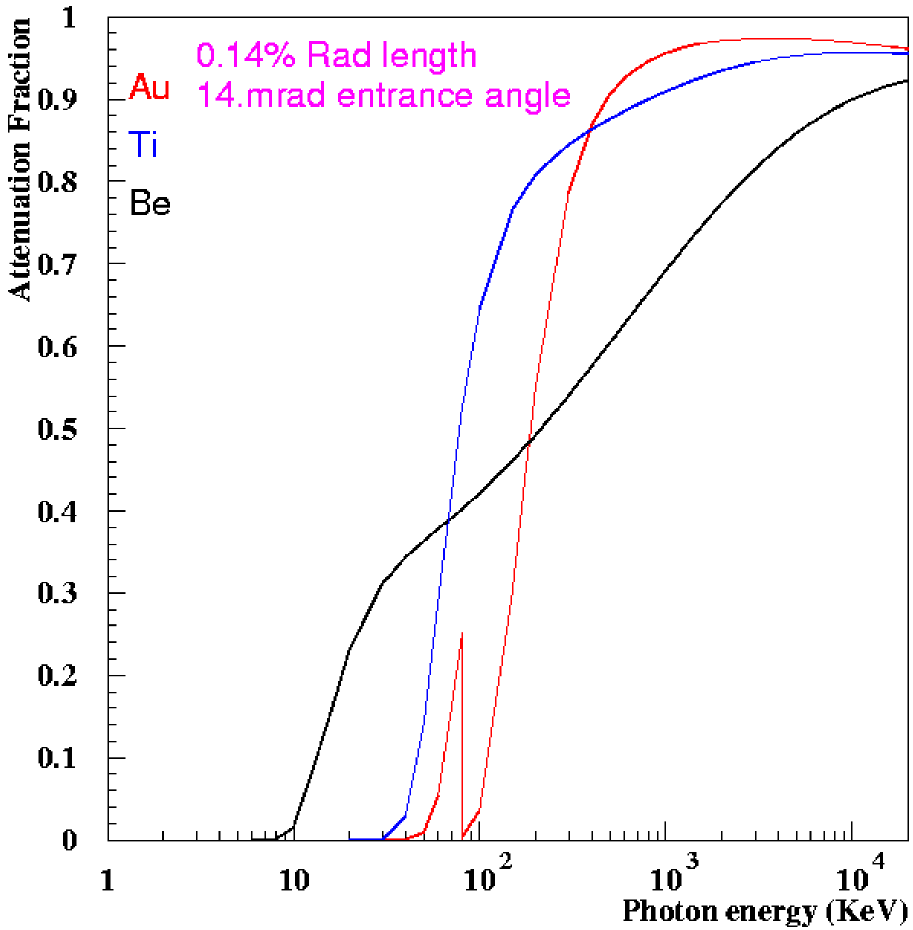
Main synchrotron back scatter source is expected to be the beam hole edges at z=3.15m

- **Entrance angle to central barrel beampipe ~14mrad (worst case)**
- **Entrance angle to coned section of beampipe ~43mrad (need ~3 times thickness than central)**

If beam crossing angle is 2mrad, entrance angle for central section can go down to ~5mrad (~3 times thinner central liner)

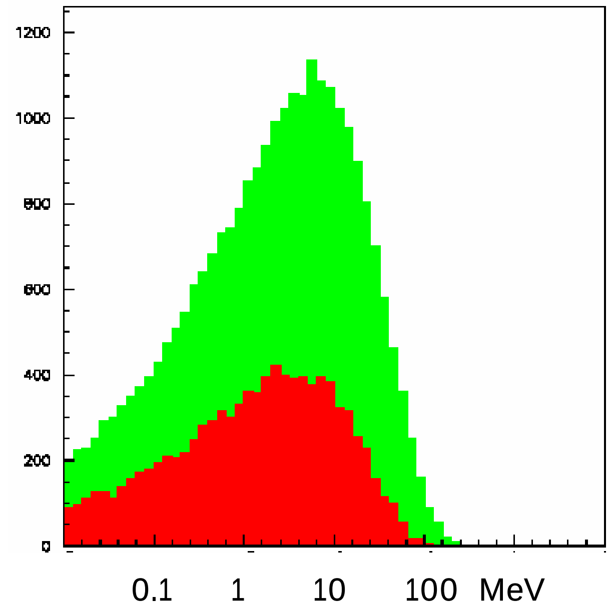
How do VXD cables, cooling pipes etc. get out pass the M1 ? They present material in front of the instrumented M1 coverage.

Beampipe Liner



Direct synchrotron

(backscatter spectrum to be calculated)



From Takashi Maruyama

Liners help taking out low energy synchrotrons, but is the attenuation adequate for high energy synchrotrons ?