Forward and Large Angle Calorimeter Update

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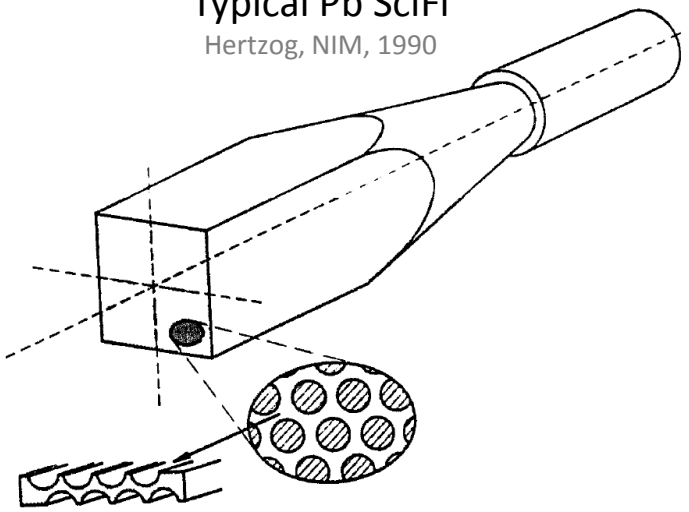
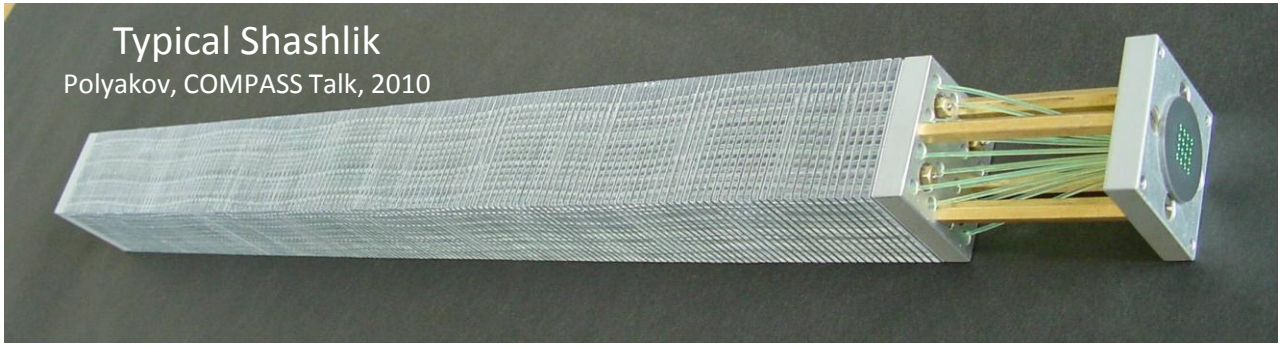
- Calorimeter Options
- Design Options
- Simulation Update

Compare of calorimeter types

A. Shashlik calorimeter
B. SciFi calorimeter – Pb
C. SciFi calorimeter – Fe
   – Combined with end cap

Typical Pb SciFi
Hertzog, NIM, 1990





Compare option A & B

Shashlyk and SciFi-Pb

- Similarity
  - Pb-scintillator based sampling calorimeter
  - Similar in resolution and radiation hardness
  - Both fit the need of SoLID
- Choice : Shashlyk
  - Easier to read out light:
    Photon collection area 100 times smaller than SciFi
  - Matured production

Compare A & C for the forward Calo. The choice - Shashlik

Reason of choosing Shashlik over Scifi/Fe in endcup

- Shashlik is cheaper.
  - It's production module cost cheaper or similar to SciFi fiber cost alone.
- Shashlik is more mature.
  - SciFi/Fe needs R&D
- Shashlik is easier.
  - several suppliers with good experience are available.

The Challenge of Shashlik

- Field resistive readout or extend fibers to readout outside of magnet.
- Preshower/shower with separate readout
- Radiation hardness of WLS fiber and scintillator.
- WLS fiber light attenuation length

Two suppliers of Shalyik

- Both are in contact.
- 1. IHEP@Protvino for design and production
- 2. IHEP@Moscow and INR@Troizk for design and Uniplast for production

IHEP@Protvino

- 10x10cm module costs about $1k each.
- They can make mode as large as 25x25cm.
- They can make shape other than square, like hexagon or ring-sector.
- A lot of radiation hardness measurements of scintillators and fibers are done at CERN.
- The calorimeter data from TPE experiment at CLAS is under analysis, will serve as a initial beam test for these modules.

IHEP@Moscow, INR@Troizk and Uniplast

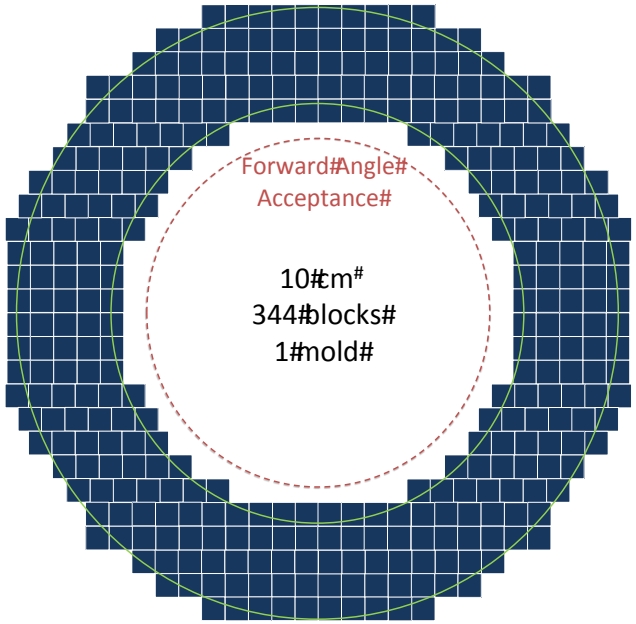
- 10x10cm module costs about $1k each also
- Past project: PHENIX, LHCb, HERA-b etc
- Current project: BELLE-2 etc

Compare readout options

- Large angle calorimeter
  A. In field readout (1.5T), APD sensors
  B. Transport photons through fiber and outside readout (Preferred)
     - Radiation resistant
     - Lower cost to use PMTs instead of expensive APD
     - Easy to maintain
- Forward calorimeter
  A. In field readout (<~100G?), PMT
  B. Transport photons through fiber and outside readout
  – Options still under study.

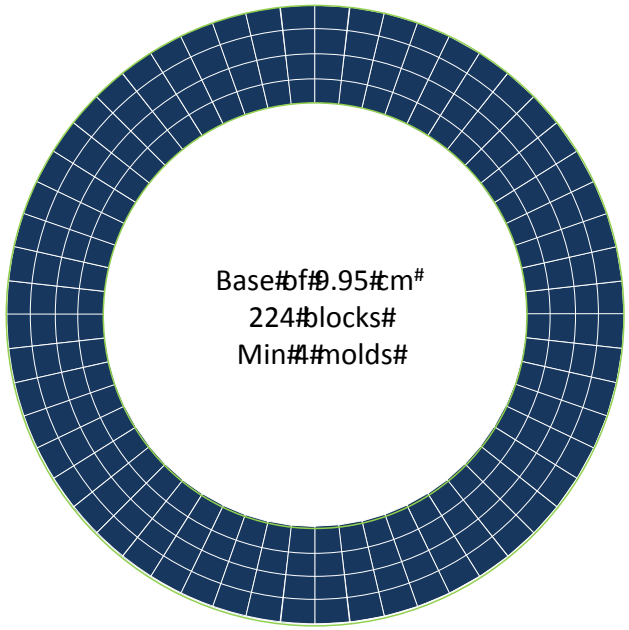
- KURARAY Y11 fibers can have longer attenuation length and good radiation hardness.
- Work in progress: clear/WLS fiber connectors

Design: Preliminary Study



Square 10*10 cm

Hexagon (same area as square)



Ring Sector

Design: Configuration Summary

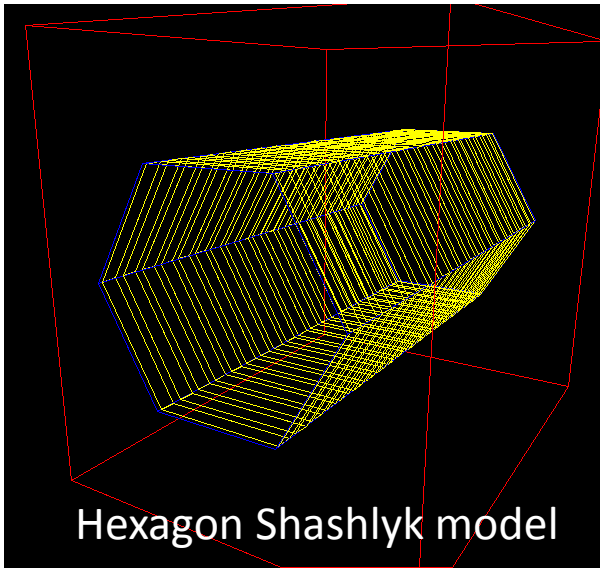
	Hexagonal		Square		Sector	
	Small	Large	Small	Large	Small	Large
Size (cm)	10	10	10	10	10.5	9.95
Blocks	620	352	620	344	384	224
Molds	Min 1	Min 1	Min 1	Min 1	Min 6	Min 4
Total	972 blocks 1 molds ~ $730.4k		964 blocks 1 molds ~ $724.8k		608 blocks 10 molds ~ $925.6k	

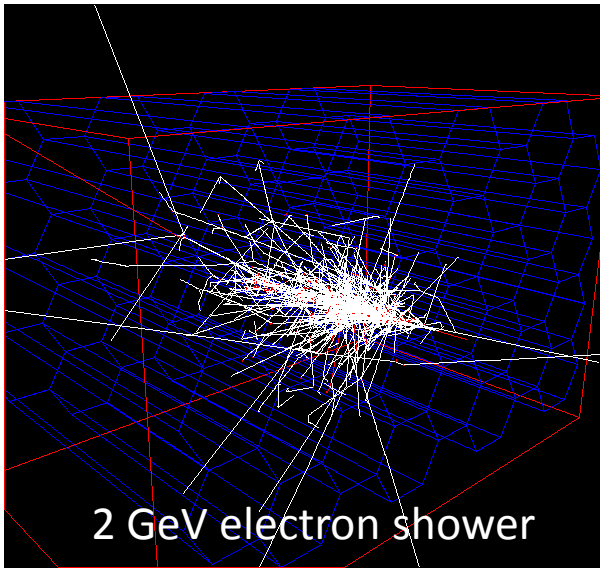
Preferred Configuration: Square

- Cheaper
- Suppliers have better experience with it
- Easier to assemble

Simulations/ Hexagon prism layout

- Preliminary studied in Geant4

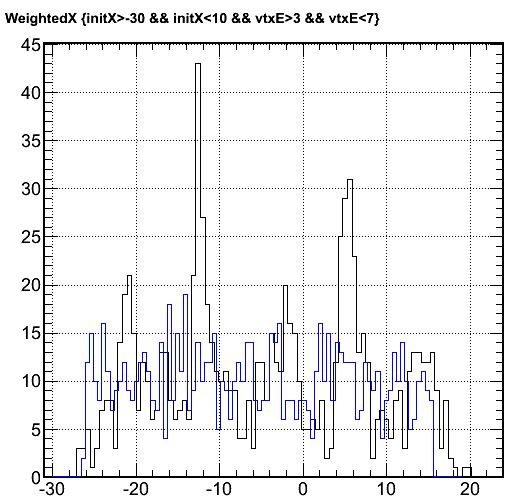


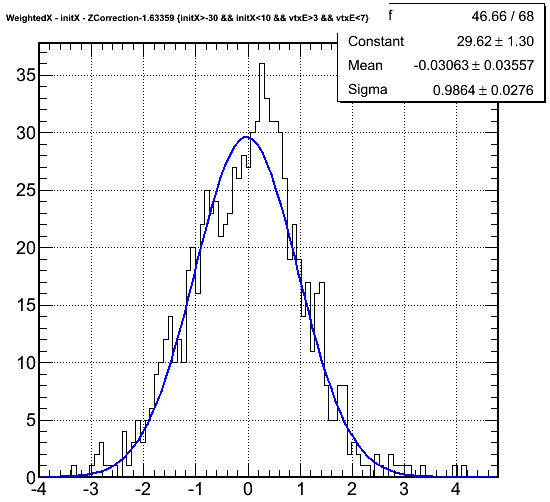


Position resolution

10cm hexagon block

- Energy weighted position average:
  - (Left) black: measured position. blue: real position
  - (Right) position residual and fit





- Resolution ~ that for 10cm square blocks
  - Simulation for square shown in last col. meeting

Background study

- To look for
  - The background are dominated by lower energy particles
  - Energy distribution in calorimeter very inhomogeneous
  - Radiation hardness for scintillator tiles ~200krad
- Simulated in two steps
  1. Generate background in GEMC, full setup
     - in progress of verification
  2. Simulate and tune the configuration in stand alone MC

Step 2: simulation of Energy deposition in scintillator tiles

- First layer of the Shashlyk: a 1~2 g/cm^2 Pb plate
  - Shields lower energy EM radiation
- Confirmed with simulation
  - Photon/electron < 4MeV are blocked
  - Can increase the threshold by make 1st Pb layer thicker
  - To be weighted by EM bgd from GEMC to give radiation dose