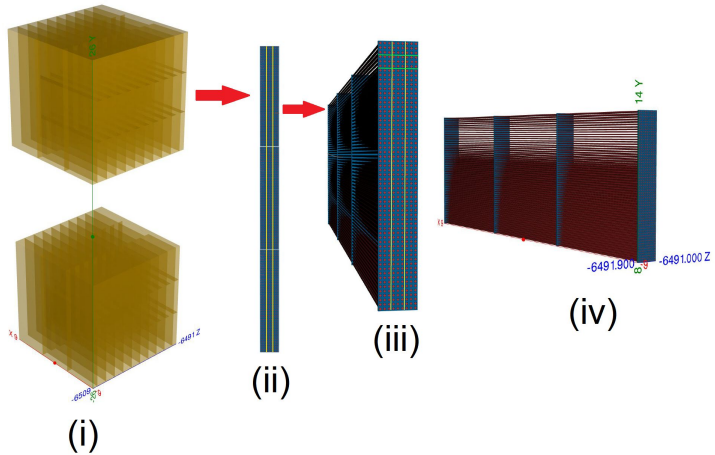
Luminosity Monitors



TDR update
Nick Zachariou

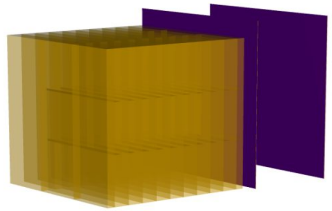
Luminosity PS/Direct Photon

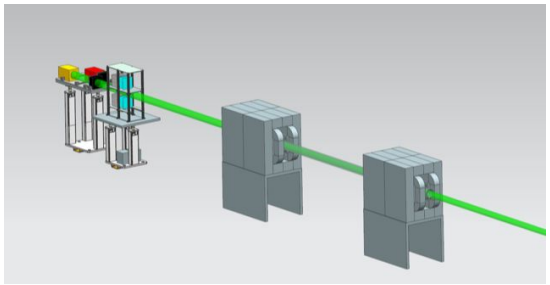
Detector Design
- Overview
- Detector requirements
- Radiation requirements
- Test beam results

Performance
- Studies required for the detector
- Event reconstruction
- Clusterization

Mechanics and Integration
- Structure
- Support structures

Status in dd4hep
- Calorimeters
- Trackers
- Beam line components (converter/exit windows)





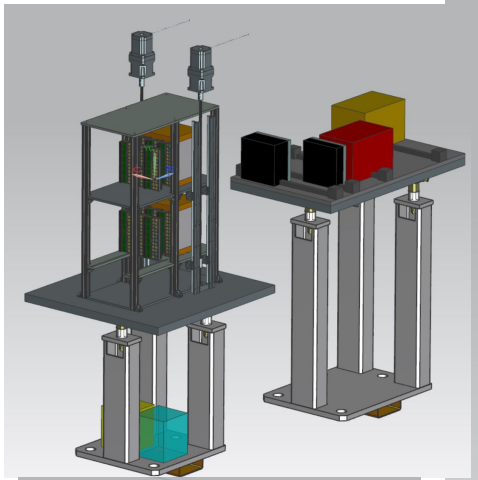
Readout
- SiPM Boards
- DAQ
- Tracker

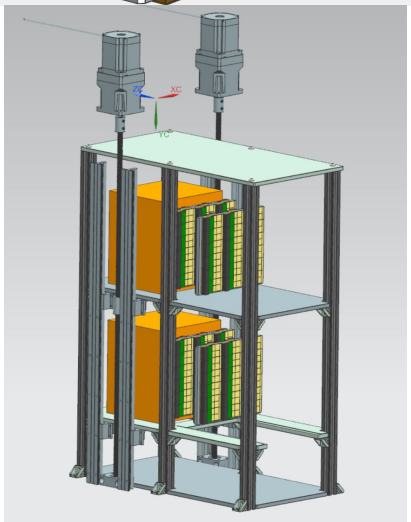
Cooling
- Tracker Cooling
- Converter cooling

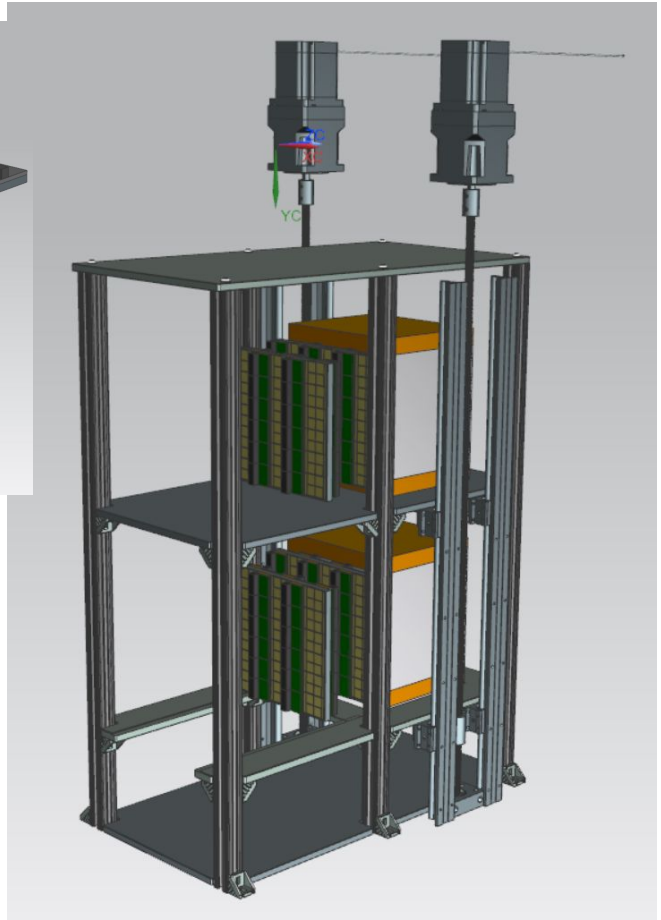
Monitoring System
- LED system
- Temperature monitoring

Ready
Work in progress
Lots to do

Lumi Integration







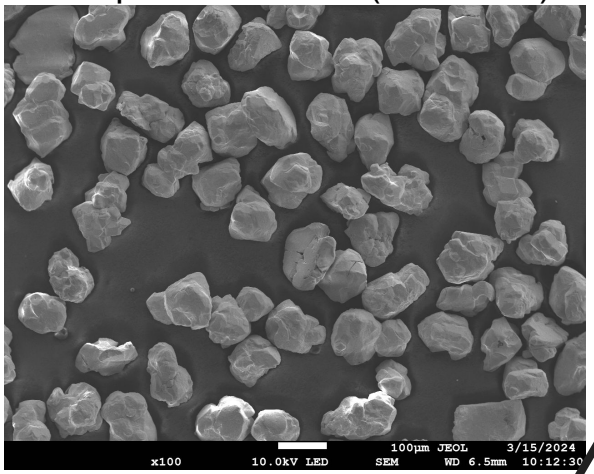
Support from JLab designers
Thanks to Yulia and Jonathan

Lumi - Calorimeter Prototyping Materials

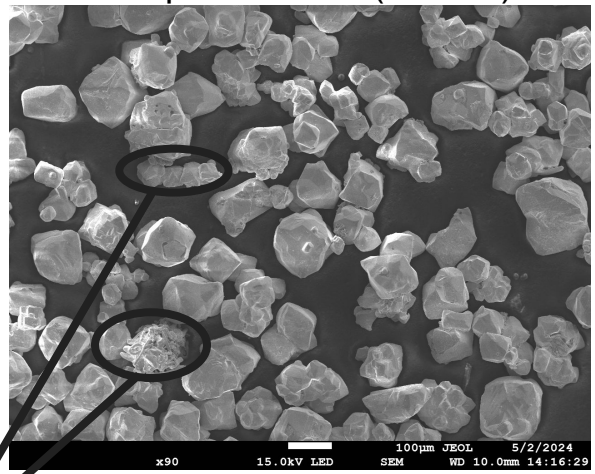
Equipment needed for prototype construction acquired

- Epoxy
- Fibres
  - Kurraray sample
  - Mi-Net (luxium) sample
- W Powder samples
  - sPHENIX sample from China
  - New US supplier, Buffalo Tungsten
- SiPMs - Order soon
- Construction moulds/meshes in place

Sample from China (sPHENIX)



Sample from US (Buffalo)



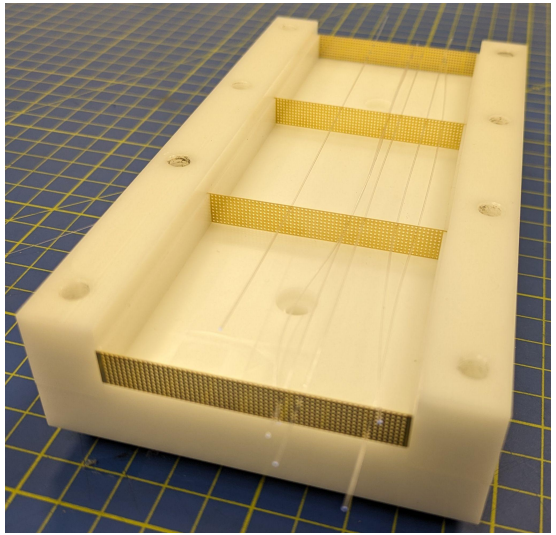
- Similar grain sizes (~100 µm)
- Some non-uniform shapes/grains in Buffalo Tungsten sample

Lumi Calorimeter - Calorimeter Module Moulds

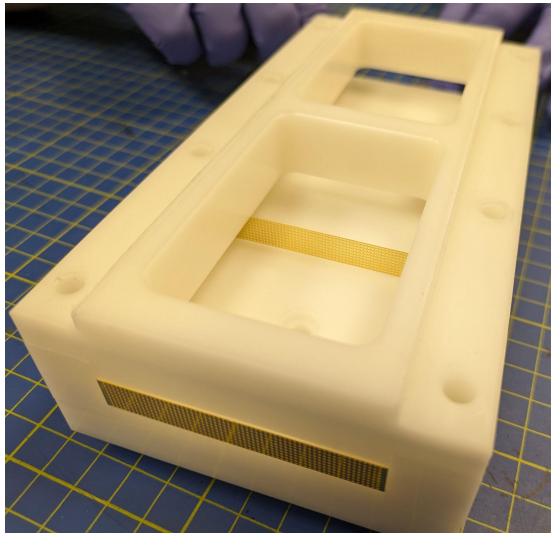
Moulds for module construction created

- First iteration machined at the University of York
- Need to feed fibres through mesh, slot into mould
- Pour tungsten powder into top of mould
  - On vibrating table (also acquired)
- Pour epoxy
- Cure in low temperature oven

Mould with meshes and fibres in place



Mould with top in place, powder will be poured in openings



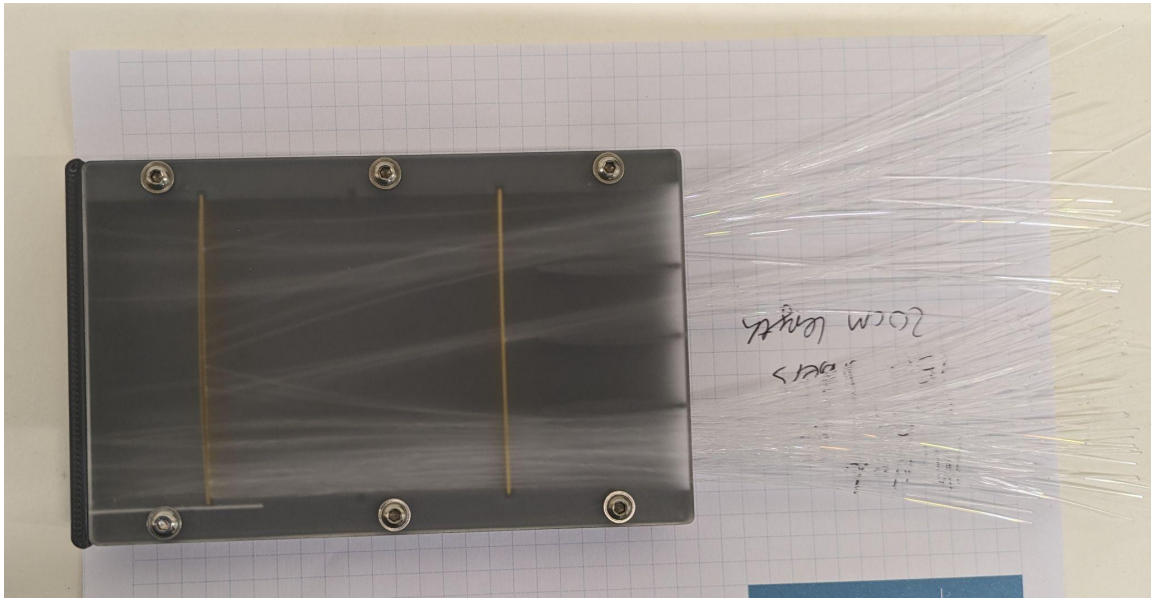
- Mesh holders for (~540) fibres slot into mould

Lumi Calorimeter - Calorimeter Fibre Holders

Need holder to feed fibres through thin brass meshes

- 3D printed first iteration of holder
- Next iteration - 4 meshes stacked
- Working relatively well so far, but need to evolve to final design quickly
- Fiddly step!

- Fibre holder with roughly 150 (out of total 540 per module) fibres fed in
- 2 meshes per slot in this design
  - Need to iterate

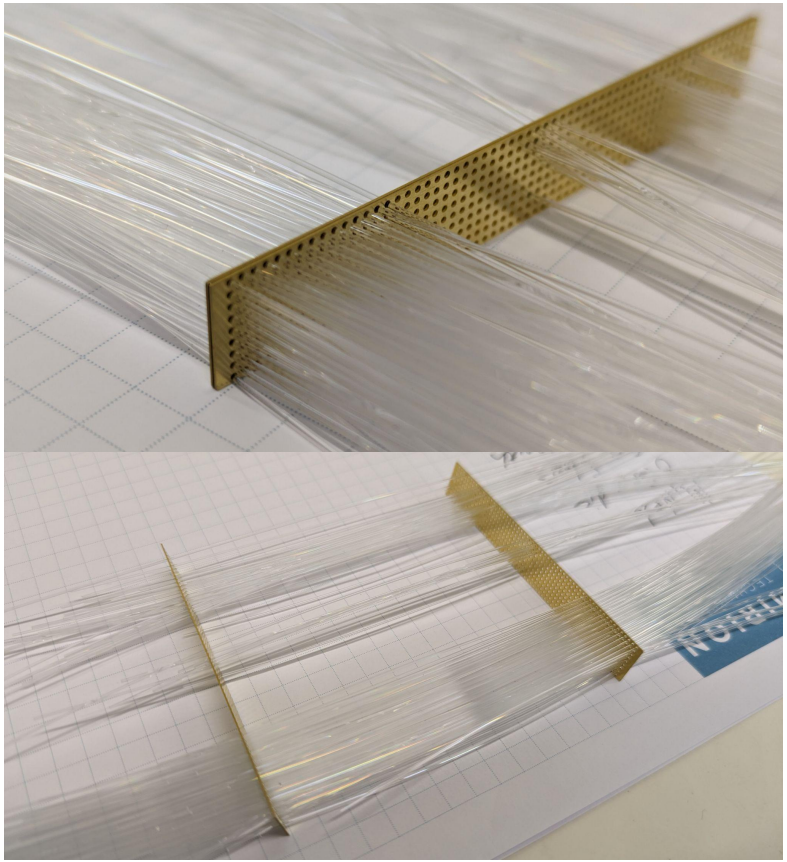


Lumi Calorimeter - Calorimeter Fibre Filling

Once fed through mesh, need to separate

- From previous test, doable but tricky
- ~2cm tolerance in length of fibres compared to mould to slot meshes
- Despite issues with holder, relatively good filling fraction so far

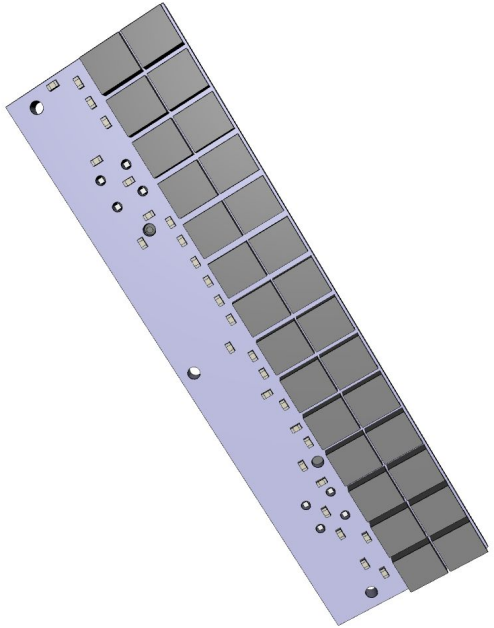
Next steps: Tungsten fill/Epoxy

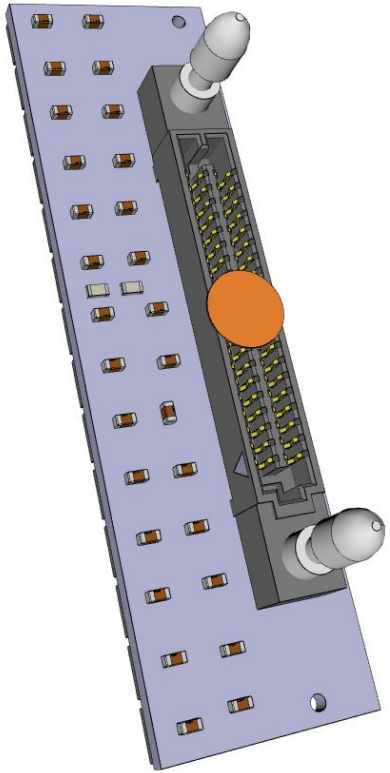


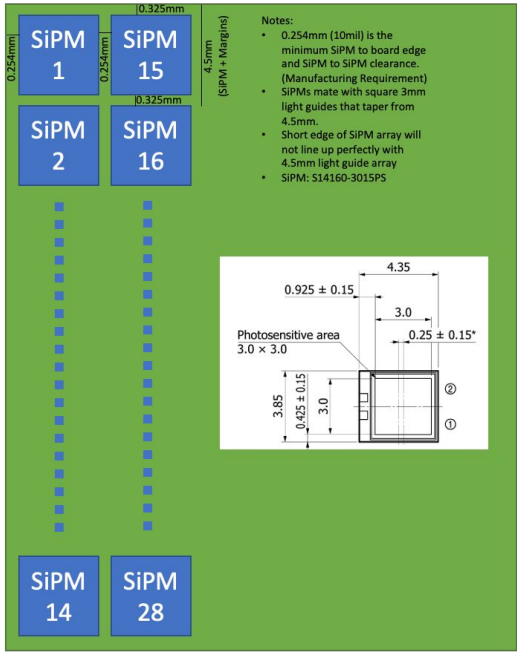
Lumi Calorimeter - Calorimeter

Readout

Support From Steve and Fernando







Lumi PS Tracker

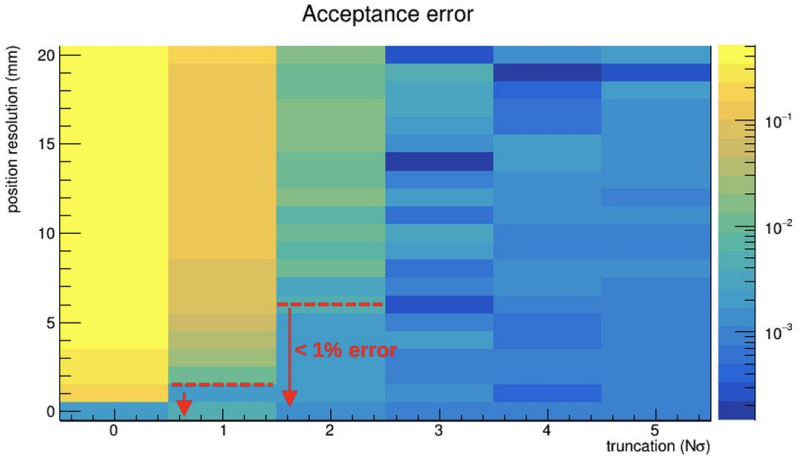
*** Simulation assumed ideal beam. Neglected magnetic effect in x-direction.**

Simulations underway

- AC-LGADs - Pixelated version

160K readout channels per layer

- Simulations to establish needed resolution



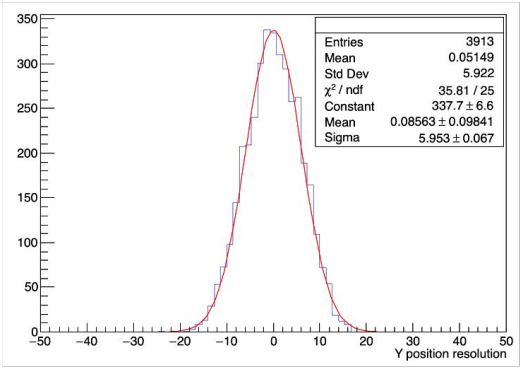
Acceptance error depends on truncation and position resolution.

How much truncation to expect??

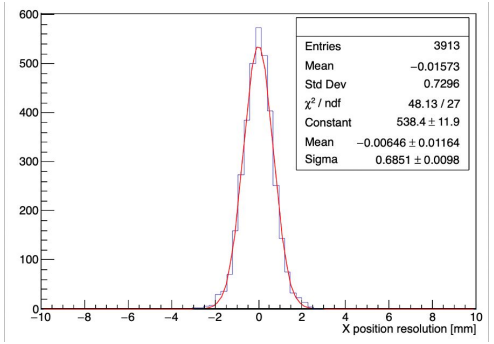
Difficult to answer, but discussions with Christoph Montag suggest that Nσ=2 might be a reasonable max. Corresponds to a 630 urad angle of electron beam at IP.

- To achieve < 1% error, we need a X_γ resolution of **< 6 mm**.

Only 0.5 mm resolution (No charge sharing)

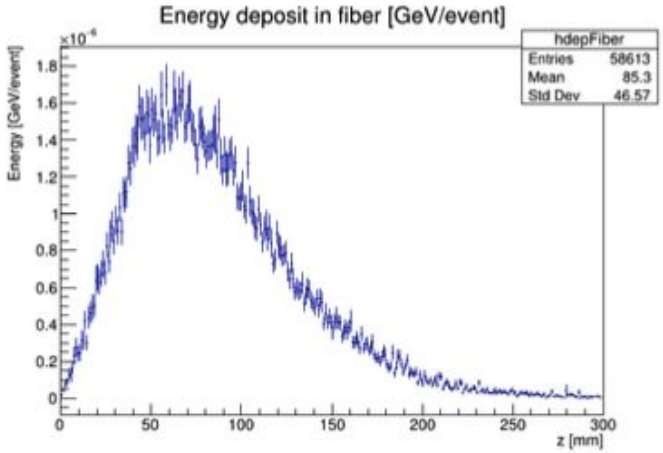


Y direction resolution at photon vertex 6 mm



x direction resolution at photon vertex ~0.5 mm

Direct photon calorimeter irradiations

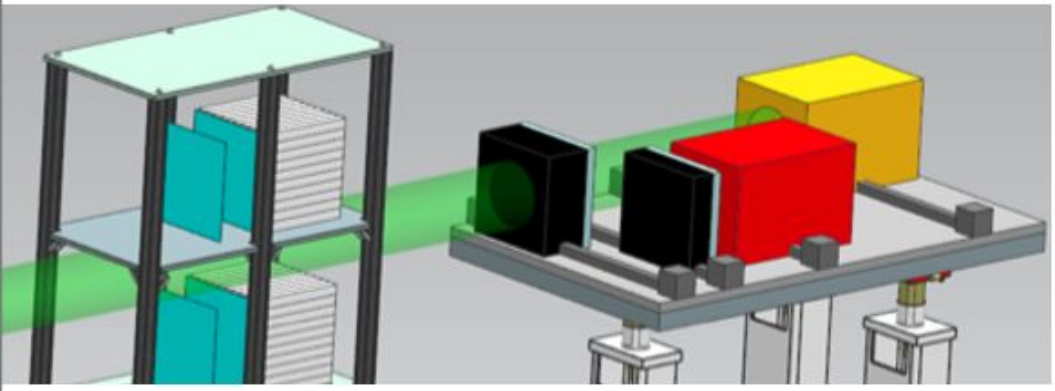


G4 simulations were performed to predict **3D distributions of doses** due to bremsstrahlung itself ⇒ maximum of annual local dose of about **7 MGy** was found, assuming 100 fb^{-1} :

- Only quartz fibers can be used then;
- Irradiation levels can be partially mitigated by changing calorimeter position from time to time ⇒ **at 10 fb^{-1}** <u>one can use SciFi</u> as dose < 0.1 MGy.

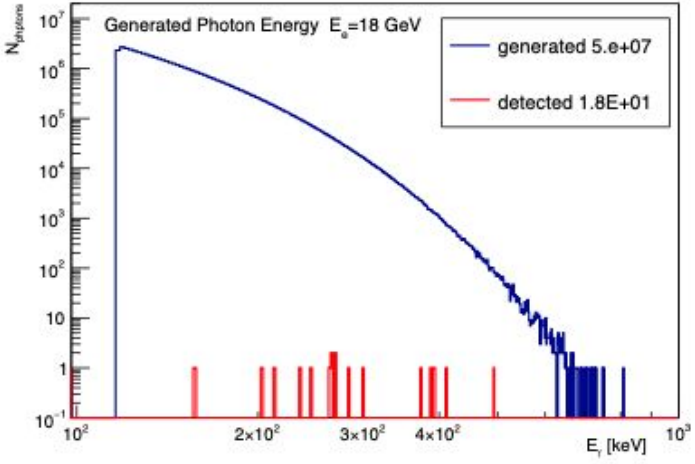
← **fiber irradiation profile** was also studied, for "spaghetti" calorimeter type, to predict fiber light output drops due to (irreducible) bremsstrahlung irradiation, and resulting calorimeter calibration changes and induced non-uniformities

SR attenuation



Special ultra-fast SR event generator was developed to simulate hard part of SR spectra ($E_\gamma > E_{cr}$) → **more than 10^8 events simulated in G4**

Only SR at 18 GeV needs significant amount of absorber – as 35 cm of graphite (which is less than 2 X_0) for example:



Paper describing in detail these findings is being drafted