MPD/ECal – geometry and simulation

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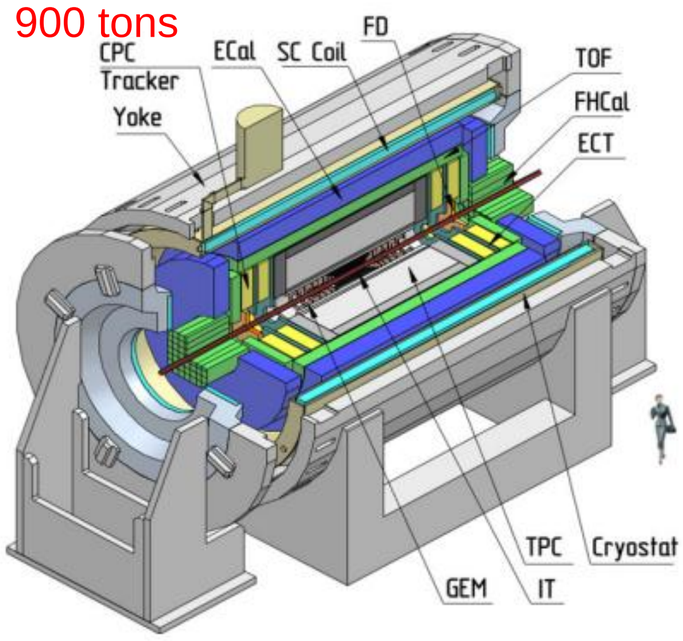
5 kgauss Ø4.6x7.4 m
900 tons

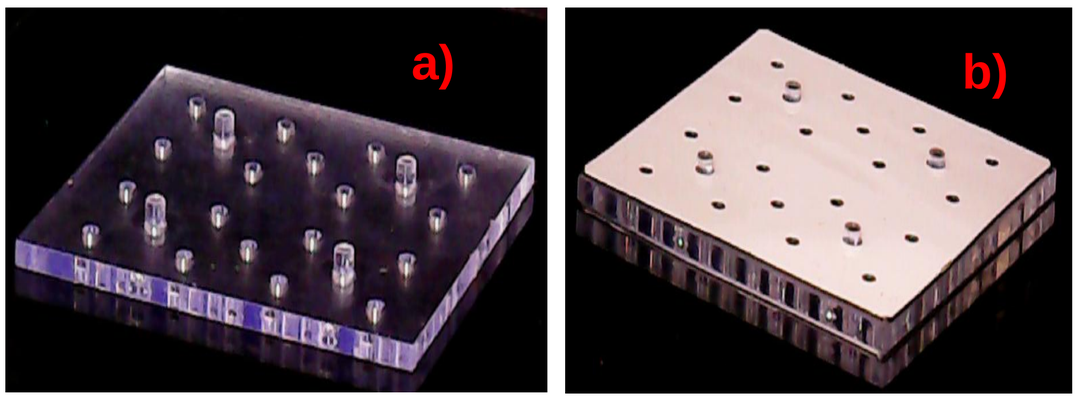


ECAL geometry

ECAL main tasks :
1) register photons
2) Identify e+/e- pairs, which are the main probes of the formation of quark-gluon plasma.
Dimensions: in/out diameter Ø3.45/4.6 m, length 6m, 38400 "shashlik" towers, total weight 60 tons, projective geometry.
Carbon fiber power frame weight ~10 tons

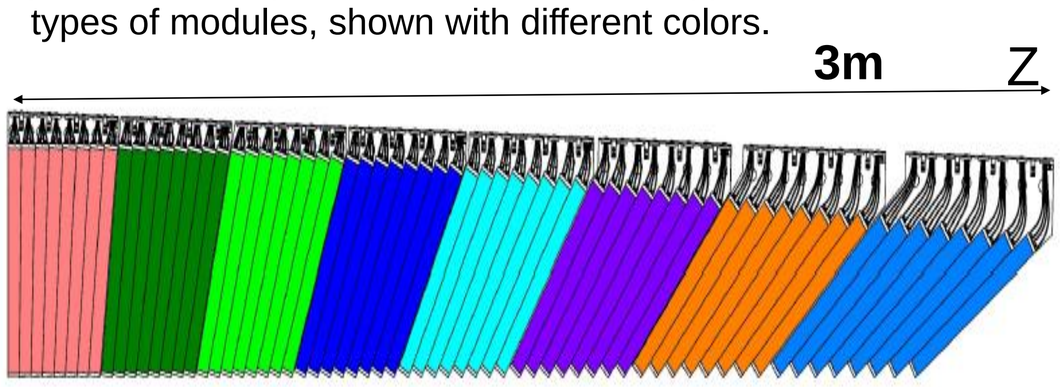
New in MPD/ECAL technology

1) Lego scintillator plates provide rigidity and accuracy to the box tower of 210 scintillator and Pb plates (11 Radiation lengths)



a) 40x40x1.5 mm scintillator with 4 lego pins + 16 holes for Ø 1.2 mm WLS + 2 holes for Ø 1 mm fixing strings;
b) 0.3 mm white painted Pb plate added

2) Box shaped towers are machined to truncated trapezoids with vertex angles 0.9º (1.2º) in RZ(XY)-plane to get projective geometry in a cylindrical volume with 64 types of towers and 8 types of modules, shown with different colors.



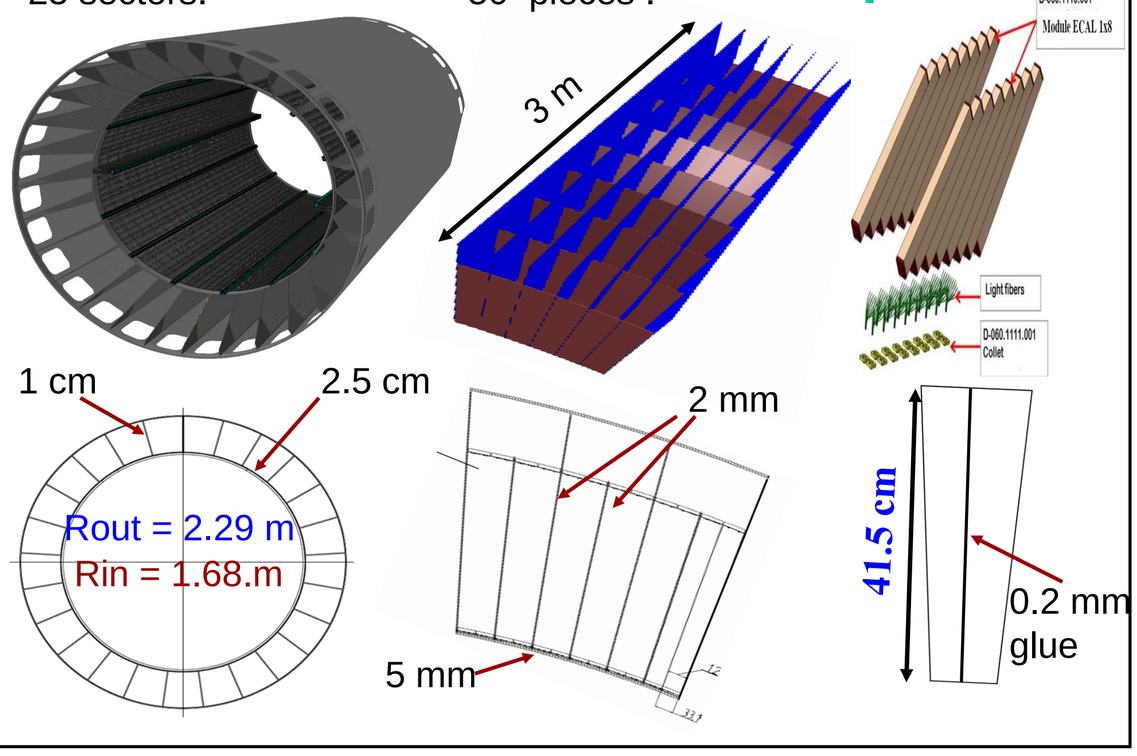
WLS fibers in each tower transport light to 6x6 mm^2 MPPC Hamamatsu S13360-6025PE (~64000 cells)

3) 9 tons carbon fiber supporting frame. It is the best structural material due to its strength and a large radiation length of 26.6 cm

Carbon fiber frame Ø4.6 m, length 8 m, 25 sectors.

Basket for 48 modules, total weight 1.2 tons, 50 pieces .

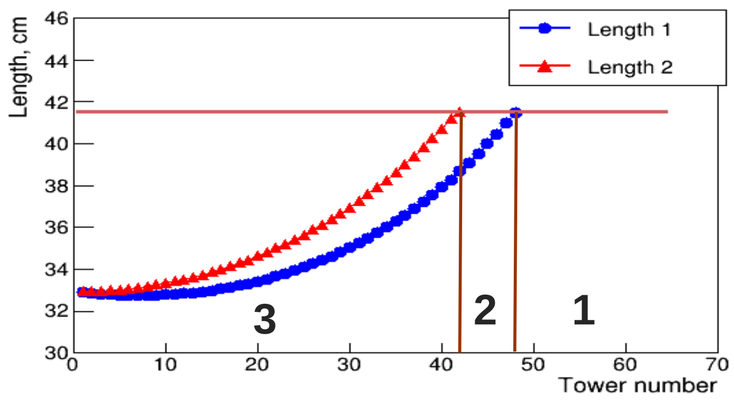
Module, 2x8 towers

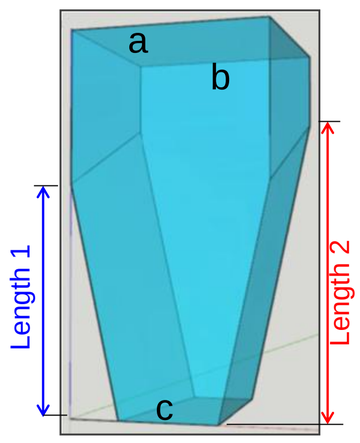


Simulation

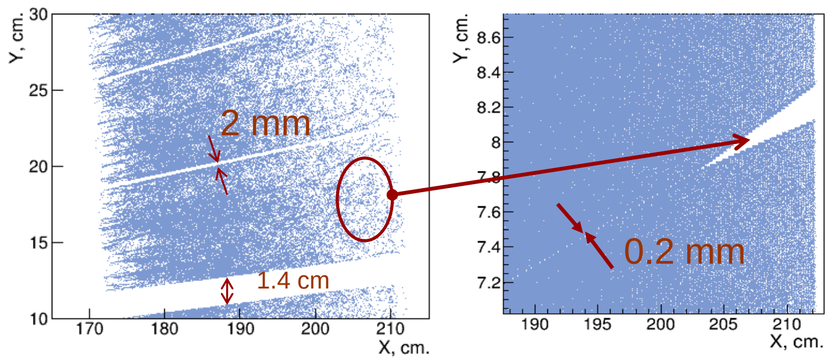
Geant4 in FairSoft and MpdRoot environment

64 tower types , each has shape , described by 1 or 2 or 3 arbitrary trapezoids (arb8), depending on type number



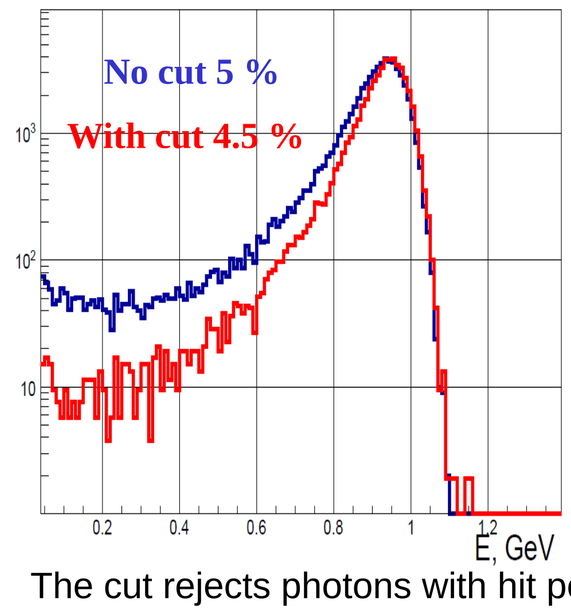


Test with simulated photons

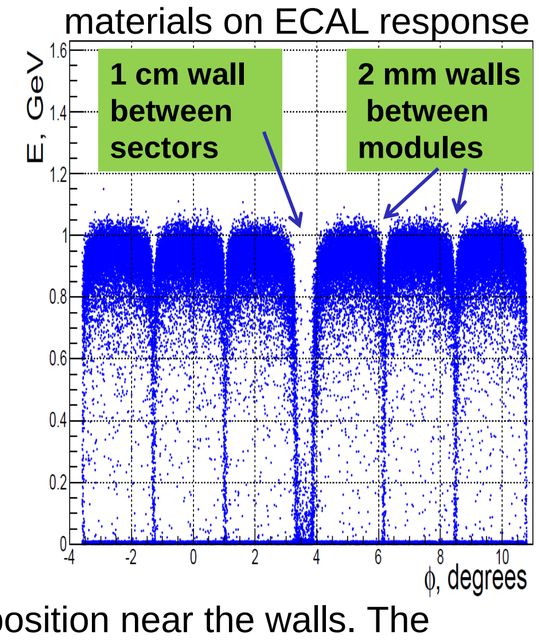


Hit production is based on geometric criteria. FindNode with Geant4 miss few percents of Geant4 points and has not been used. Simple cluster finder used "area around hit with maximal energy deposition" method. Area of 5x5 towers is good for low multiplicity and is slightly larger then the area within Molier radius which is 6 cm.

ECAL response to 1 GeV photons

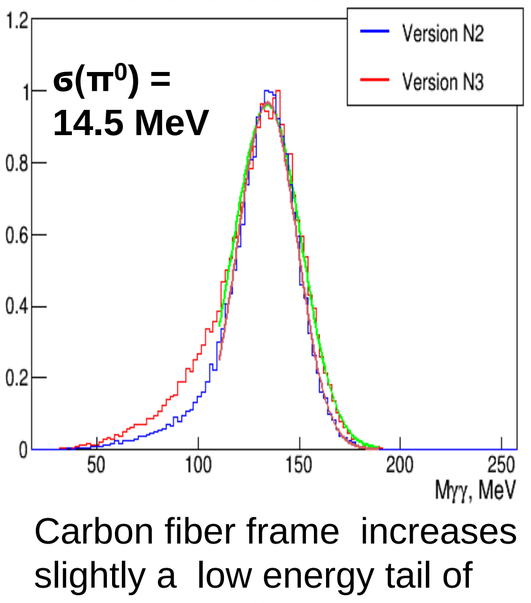


Effect of power frame passive materials on ECAL response



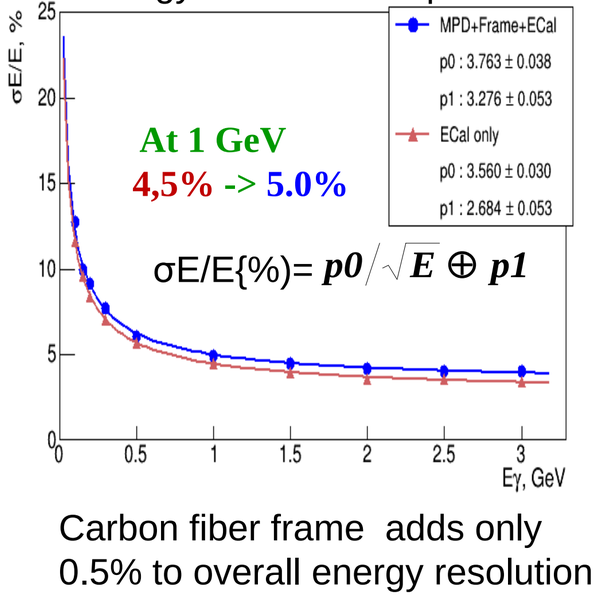
The cut rejects photons with hit position near the walls. The passive materials of the walls result in increase of non-gaussian low energy tail and uncertainty in energy resolution determination. But overall degradation of energy resolution is small ~ 0.5 %.

π^0 mass resolution



Carbon fiber frame increases slightly a low energy tail of γγ-mass distribution

Energy resolution for photons



Carbon fiber frame adds only 0.5% to overall energy resolution at 1 GeV

Now test of modules, produced at IHEP, is in progress at electron beams of LPI/Troitsk electron accelerator

*Работа выполнена при поддержке РФФИ, грант № 18-02-40054.