Some progresses of SSA study

25th October 2013

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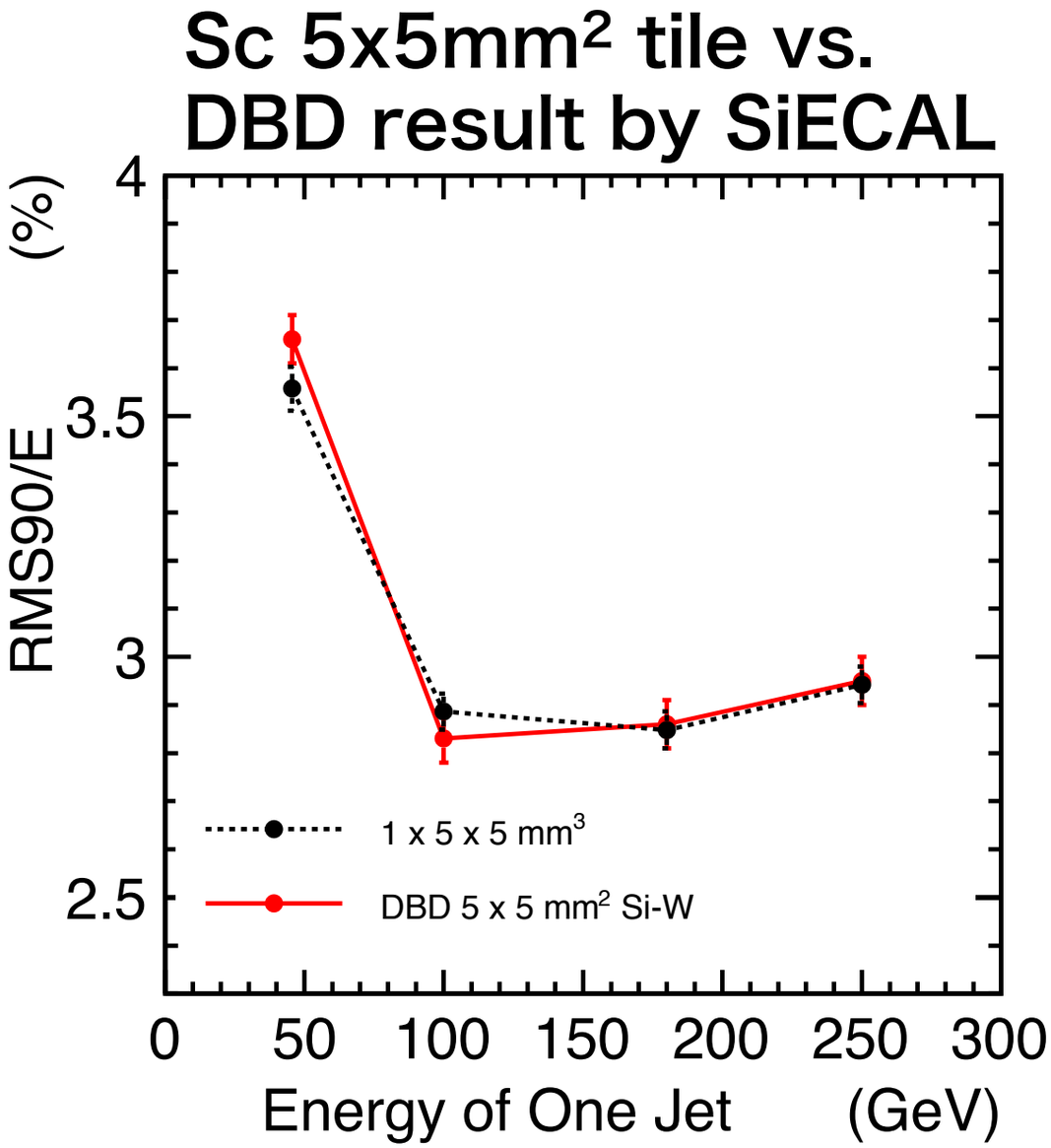
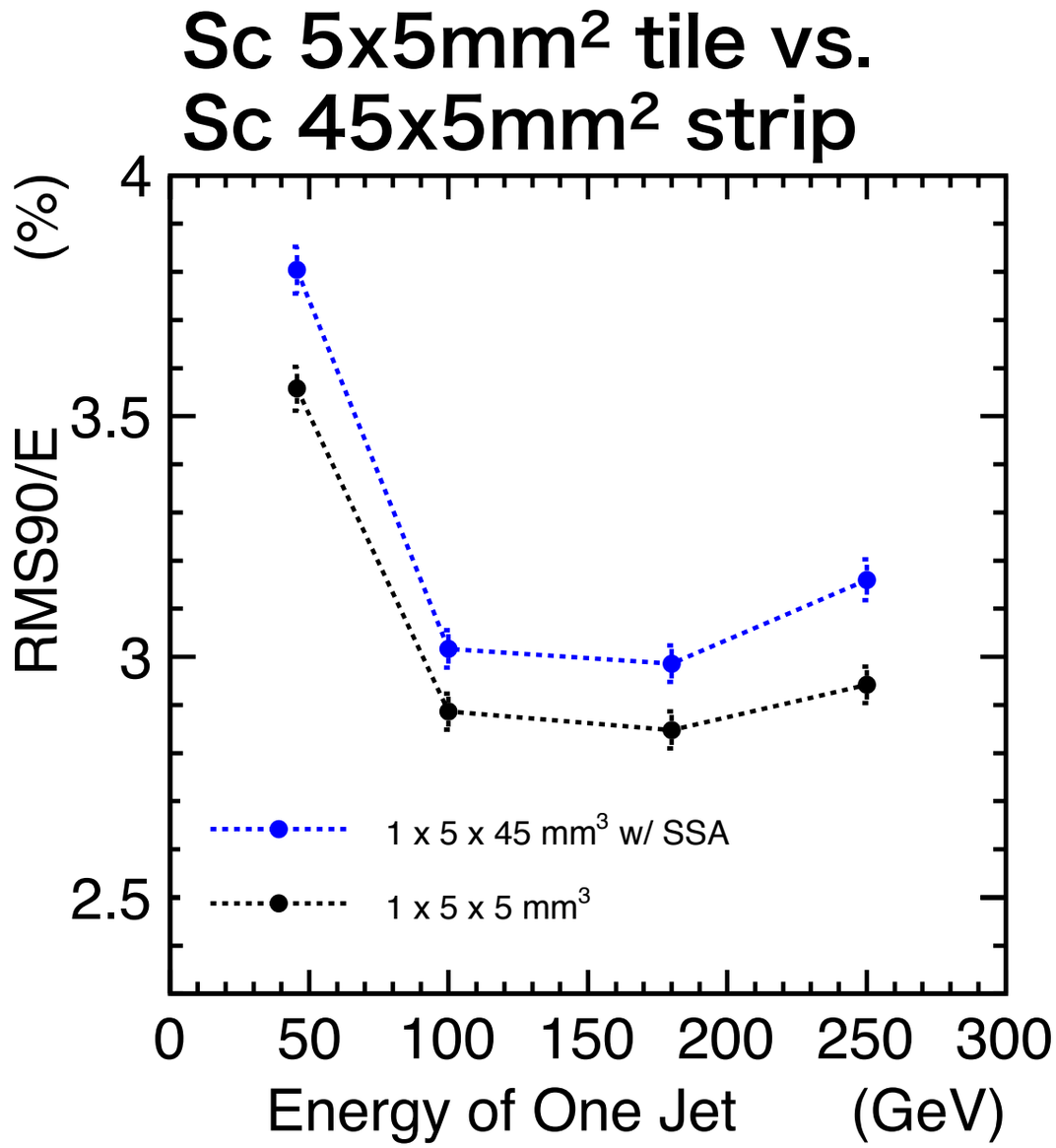
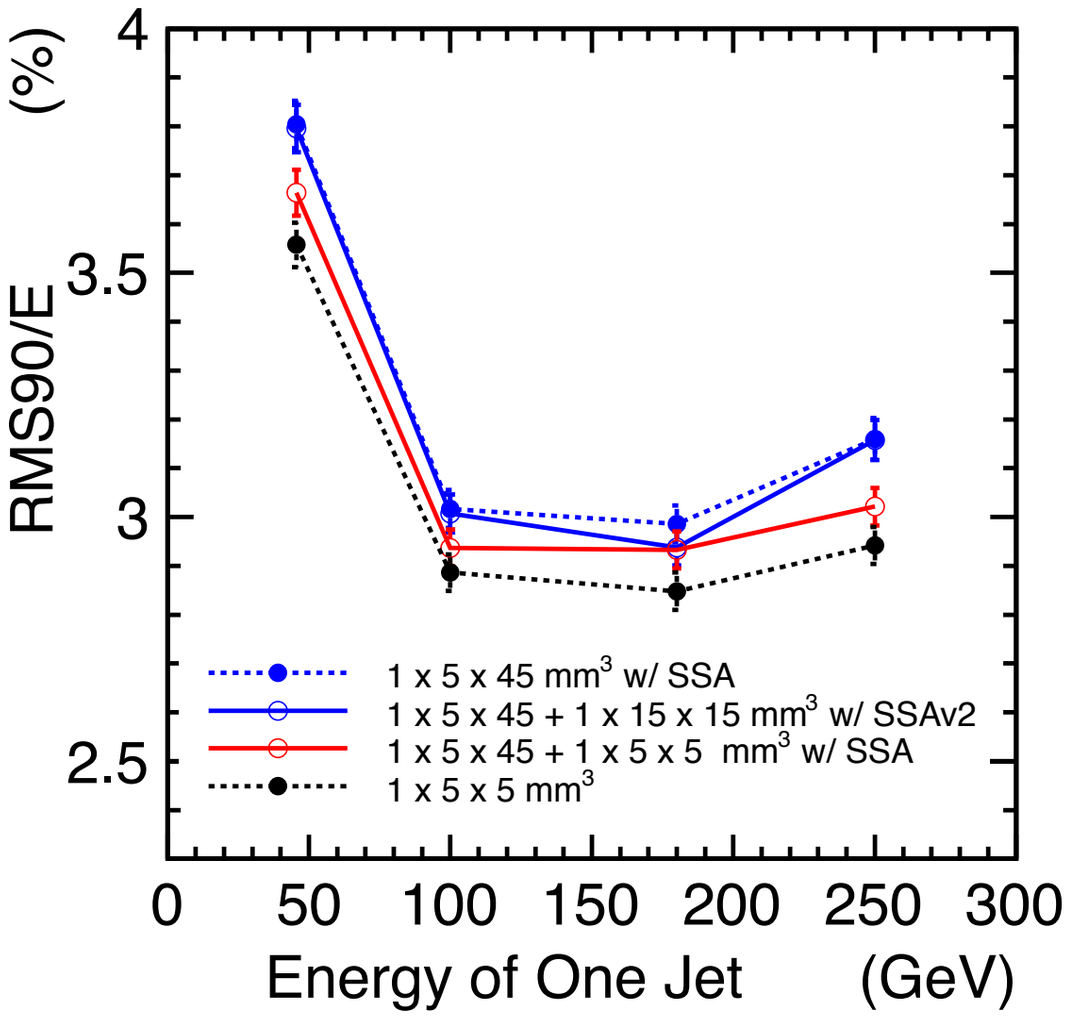
For Physics-Software meeting of ILD-Asia

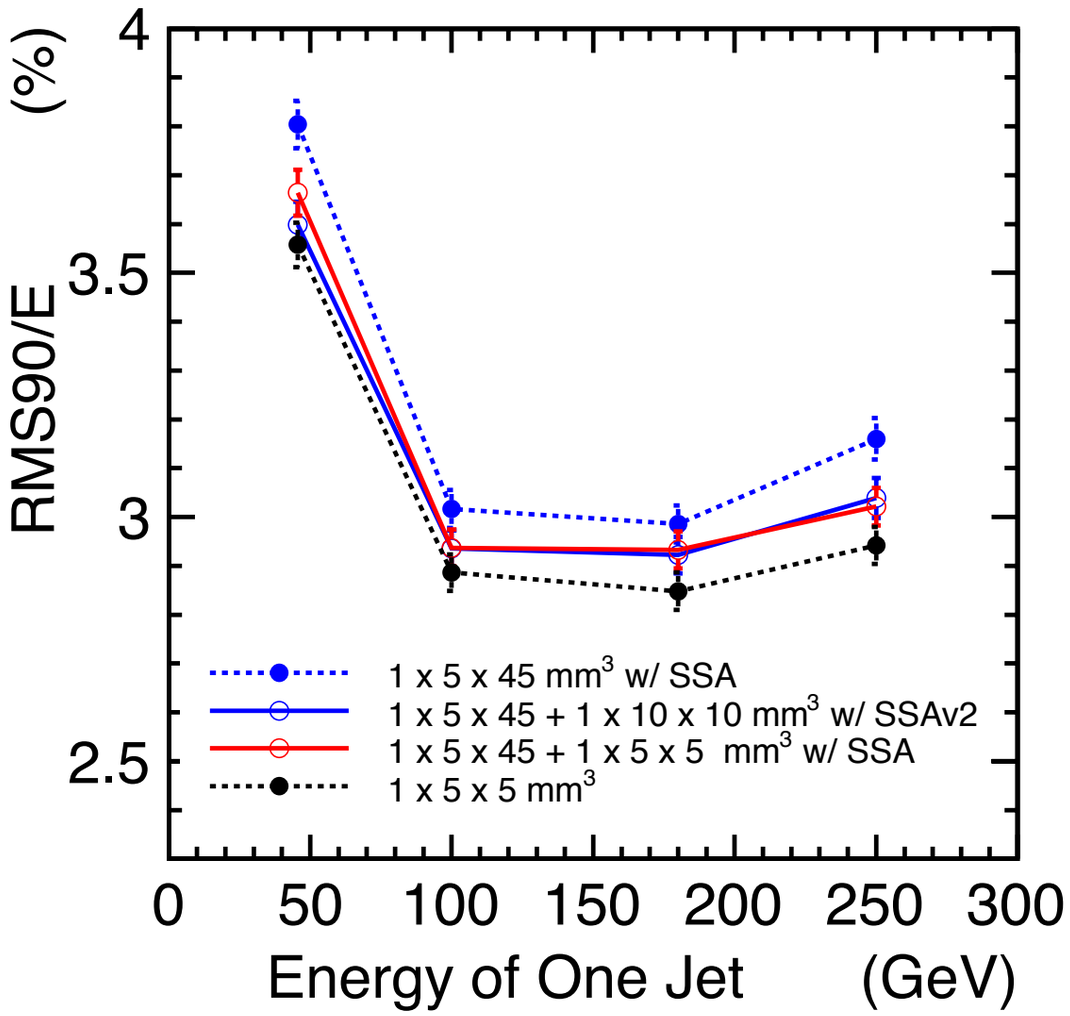
uds jet energy: ScECAL vs DBD(Si-W-ECAL)





alternative half of layers are replaced with tile layers to avoid the ghosts



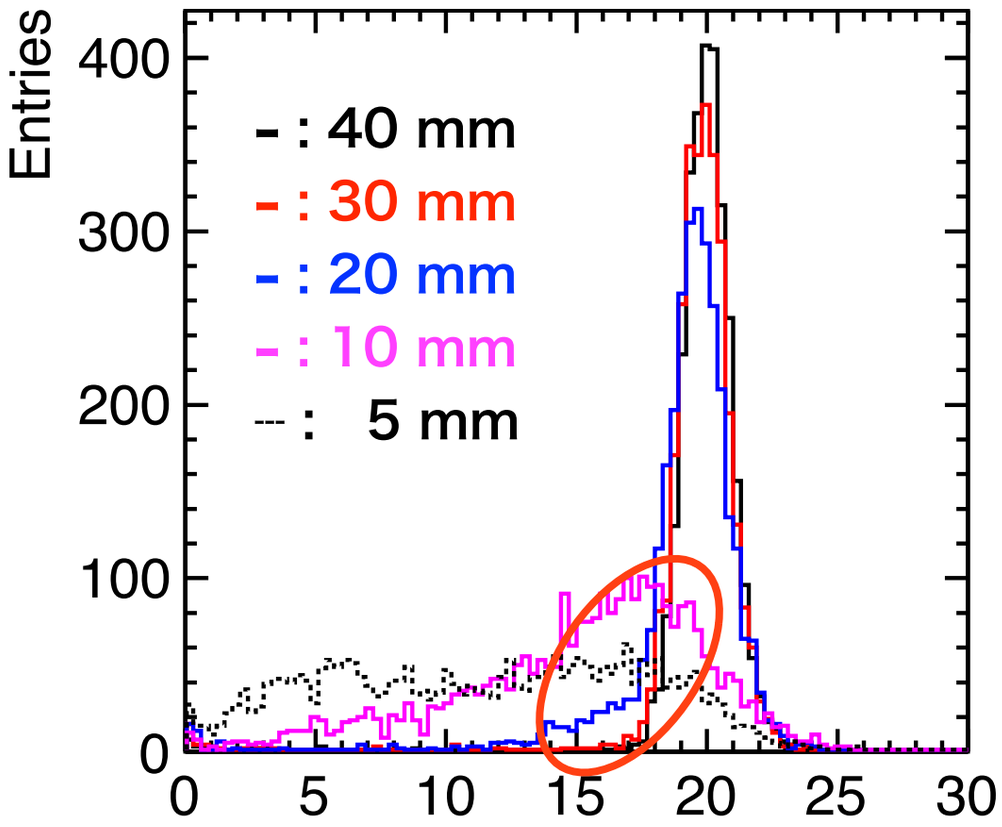


alternate with 5x5 mm² tile layers (right ⊖)
➡ close to all 5x5 mm² tile ScECAL (right -●-·).
alternate with 15x15 mm2 tile layers ➡ not so improves ●
alternate with 10x10 mm2 tile layers (left ●)
➡ almost similar to the alternative with 5x5 mm²

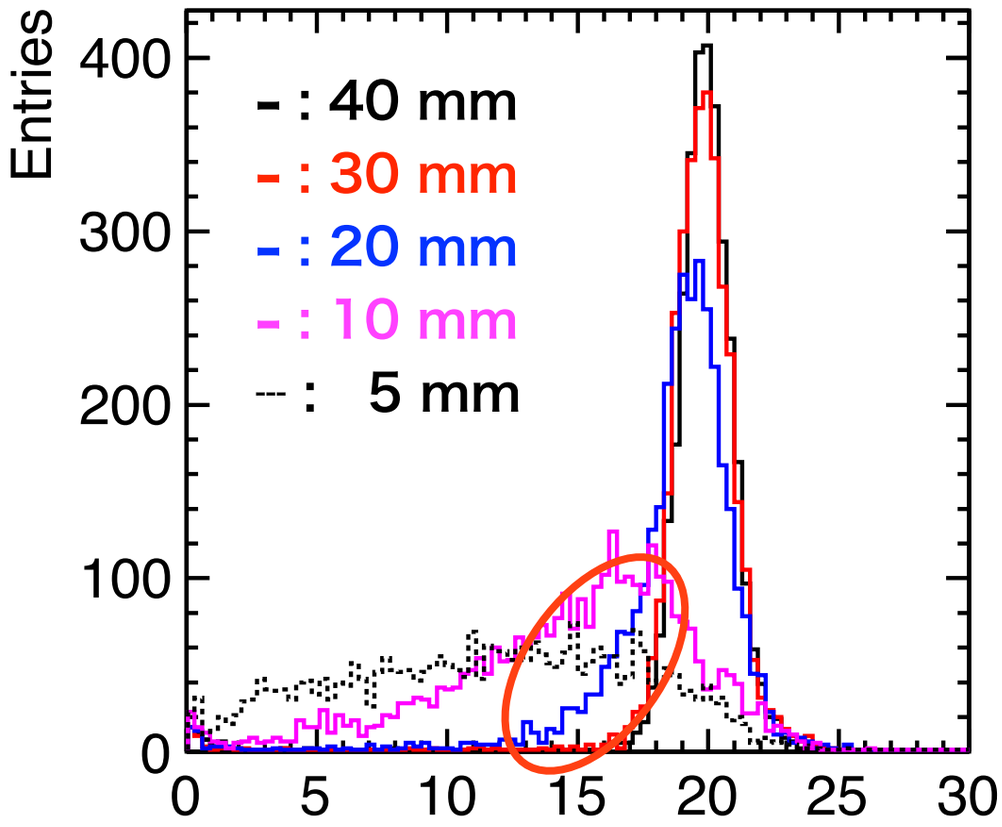
Measured photon energy (1 γ event)

π^+ 10GeV + photon 20 GeV

5x5mm²x1mm Tile

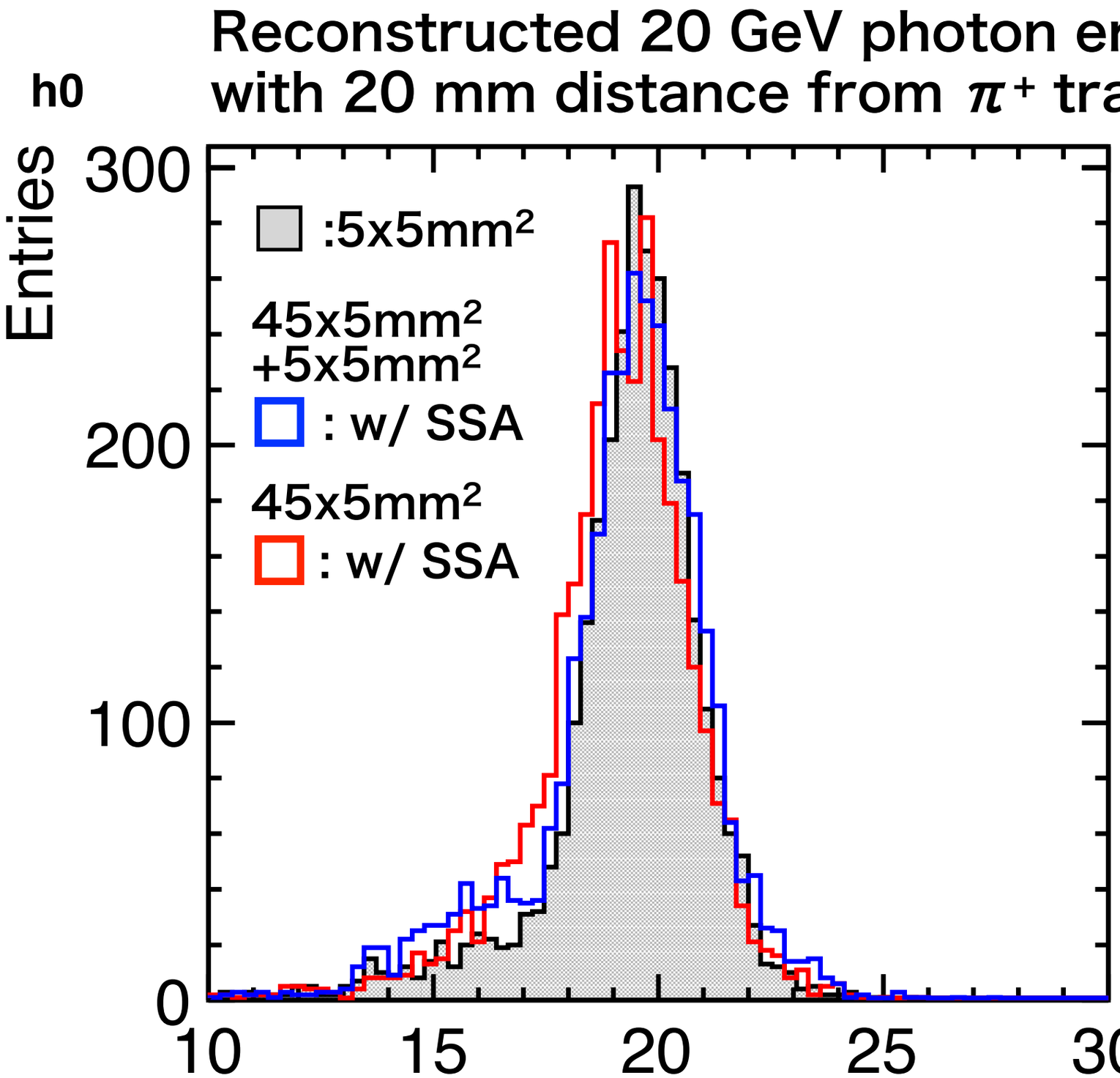


45x5mm²x1mm Strip SSA



- distance > 30 mm ➡ Both types have good energy resolution.
- distance = 20 mm ➡ Strip SSA has a bit leading spread.
- distance <10 mm, 5 mm ➡ Both do not have good resolution.

π^+-γ separation



alternatively replacing with 5x5mm² improves photon energy than pure 45x5mm² strip ECAL,

Leading tail rises rather like a peak with alternative tile/strip case.

18th Oct

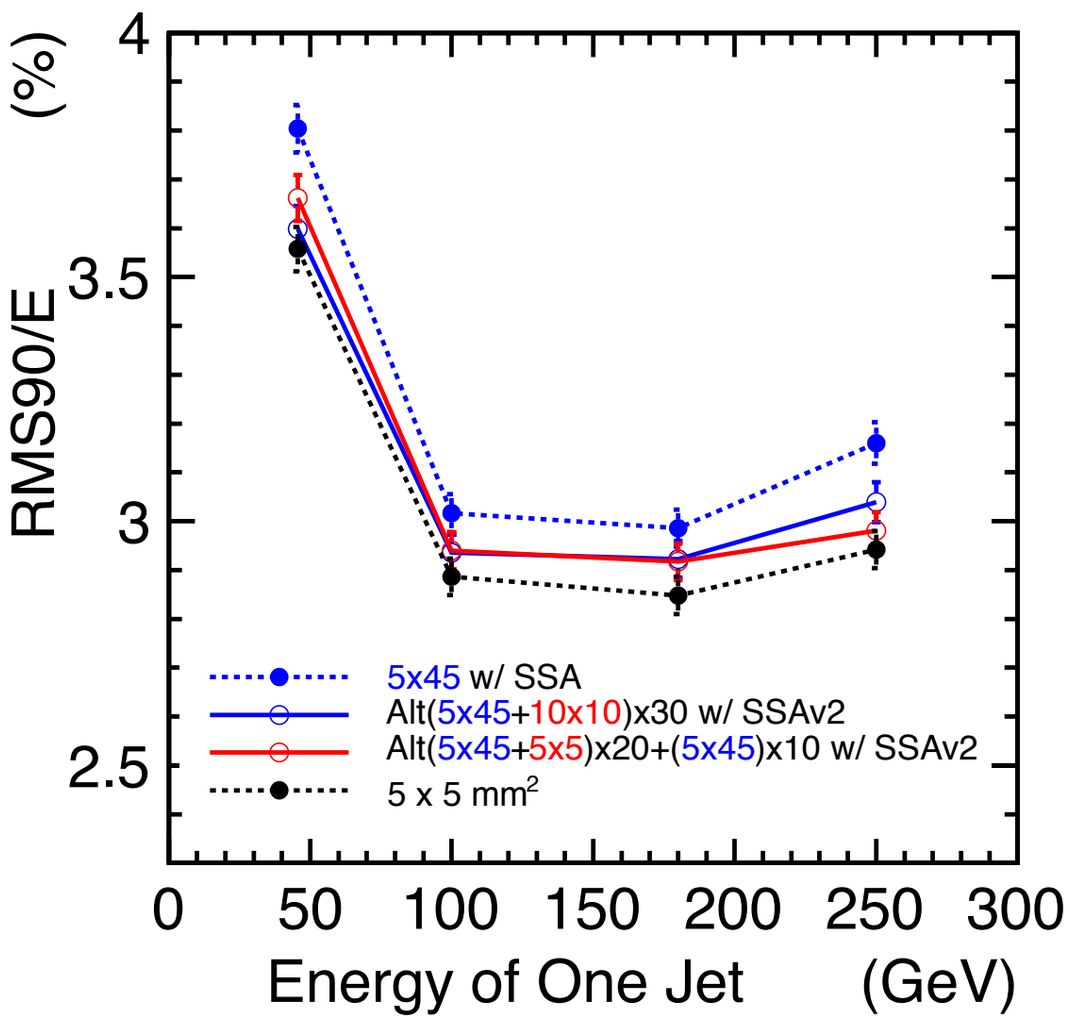
Summary and plan

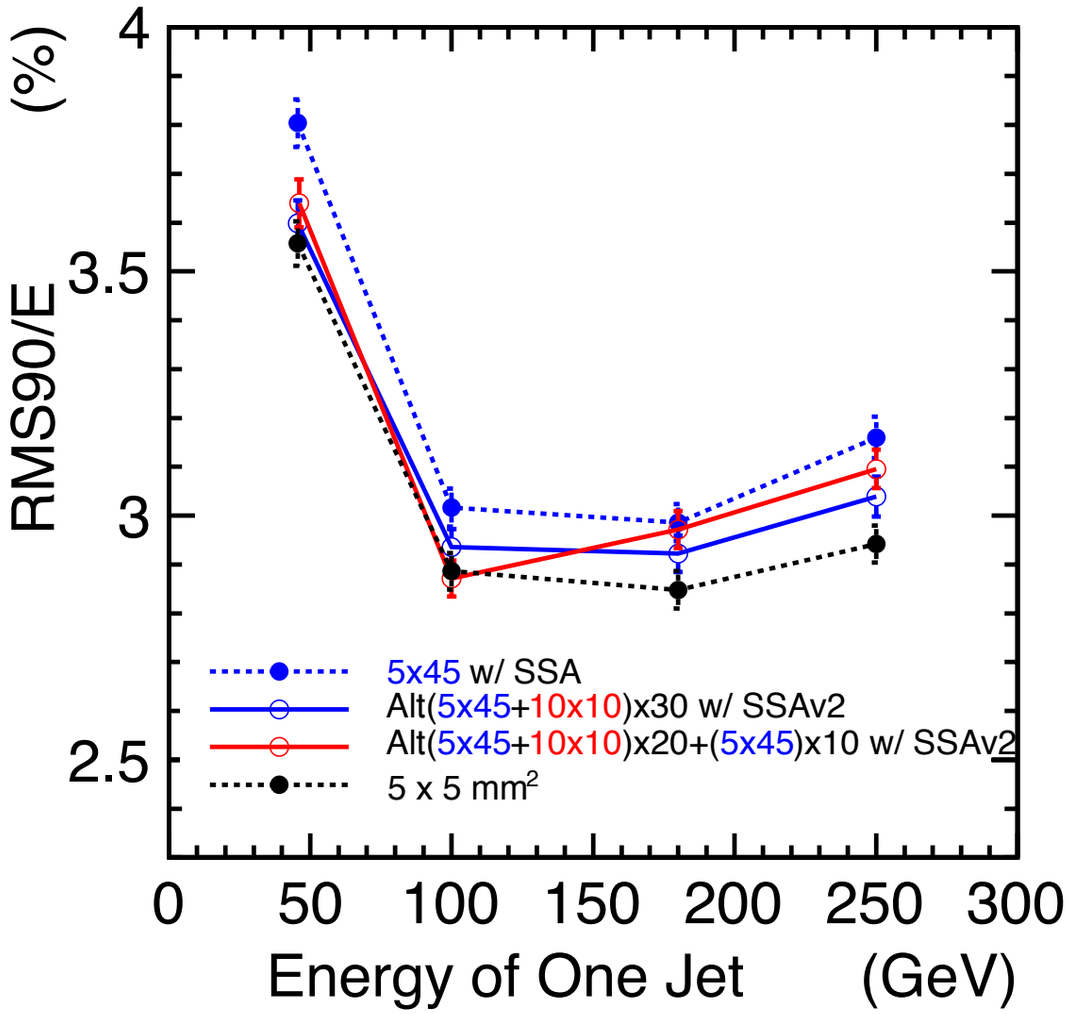
- 5x5 mm² ScECAL has similar performance of JER to DBD result of SiW ECAL,
- a bit degrading (~0.2%) with 45x5 mm² ScECAL w/ SSA,
- alternately replacing layers with 5 x 5 mm² tile significantly improves the JER of strip ScECAL,
- alt.15 x 15 mm² tile layers cannot so improve the situation,
- alt. 10 x 10 mm² tile layers make the same effect as the 5x5 mm²,
- alternate insertion of 5 x 5 mm² tile layers certainly improves π^{+}-γ separation.

Plan

- 20 layers (strip45x5/5x5tile), 10 layers (strip 45x5), running
- 20 layers (strip45x5/10x10tile), 10 layers (strip 45x5),
- n layers (strip45x5/10x10tile), 30-n layers (strip 45x5).

alternate strip/tile 20 layers + strip 10 layers



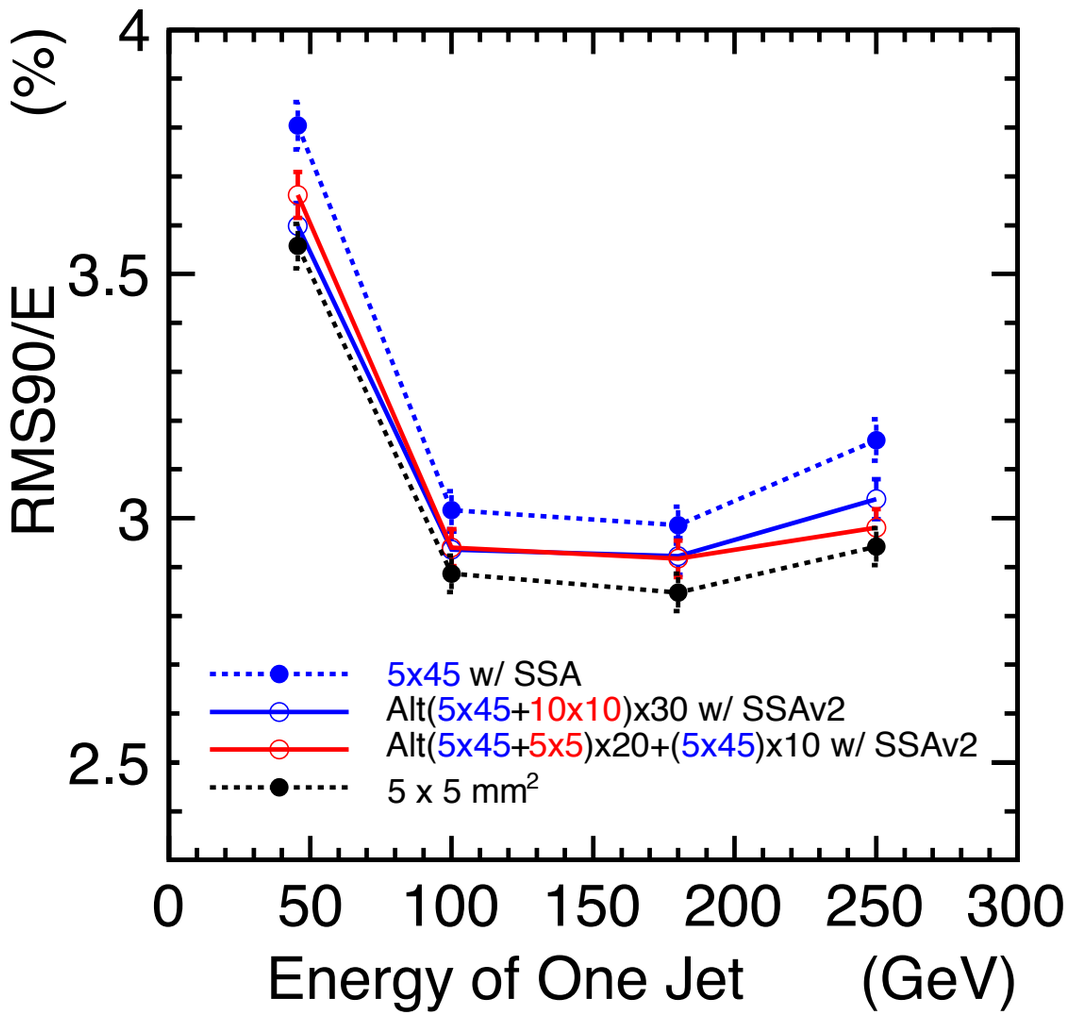


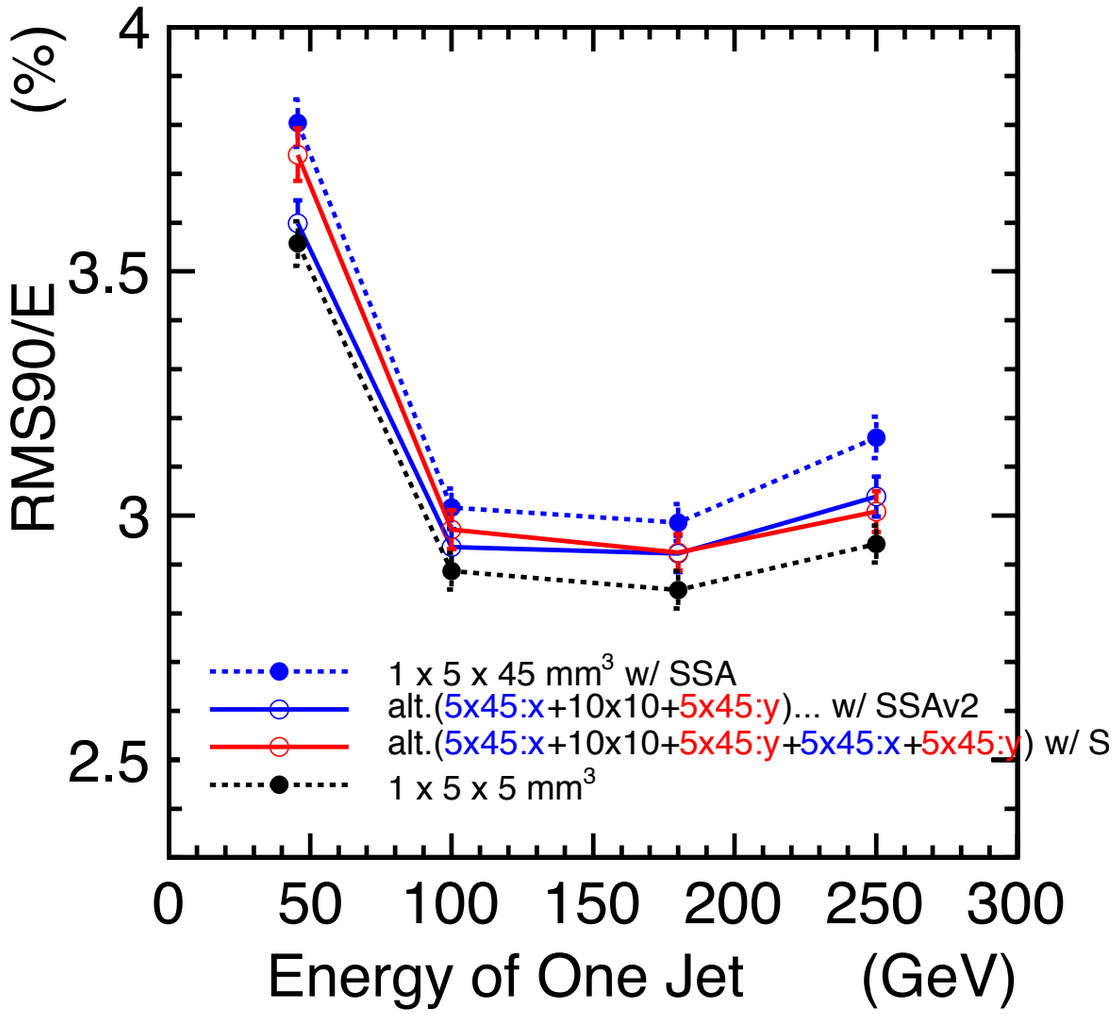
: alt.(X:45x5 + 10x10 + Y:45x5 + 10x10) x 30 layers

Left: alt.(X:45x5 + 5x5 + Y:45x5 + 5x5) x 20 layers
+ (45x5:X + 45x5:y) x 10 layers

Right: alt.(X:45x5 + 10x10 + Y:45x5 + 10x10) x 20 layers
+ (X:45x5 + Y:45x5) x 10 layers

alternate strip/tile 20 layers + strip 10 layers



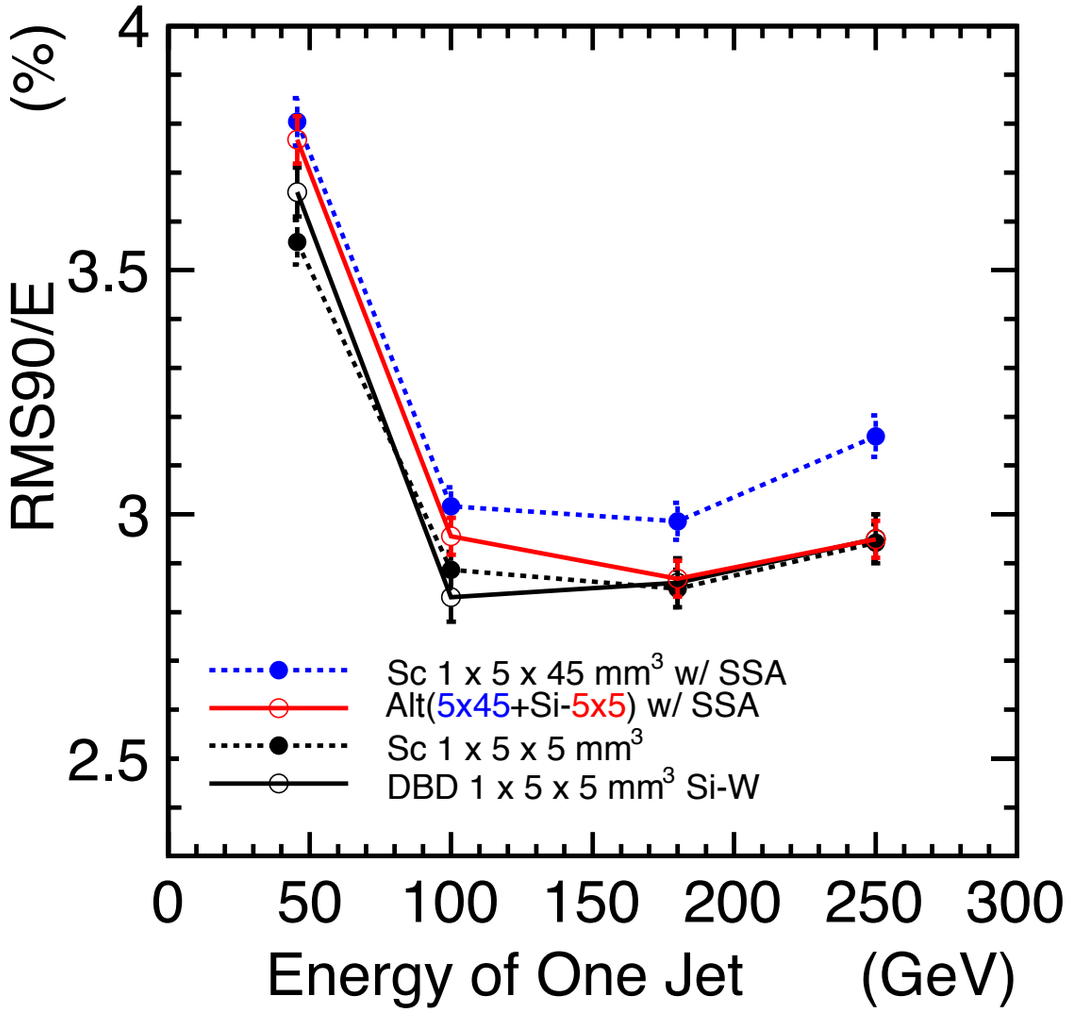


: alt.(X:45x5 + 10x10 + Y:45x5 + 10x10) in 30 layers

Left: alt.(X:45x5 + 5x5 + Y:45x5 + 5x5) in 20 layers
+ (45x5:X + 45x5:y) in 10 layers

Right: alt.(X:45x5 + 10x10 + Y:45x5 + 10x10
+ X:45x5 + Y:45x5) in 30 layers

alternate hybrid for tau decay

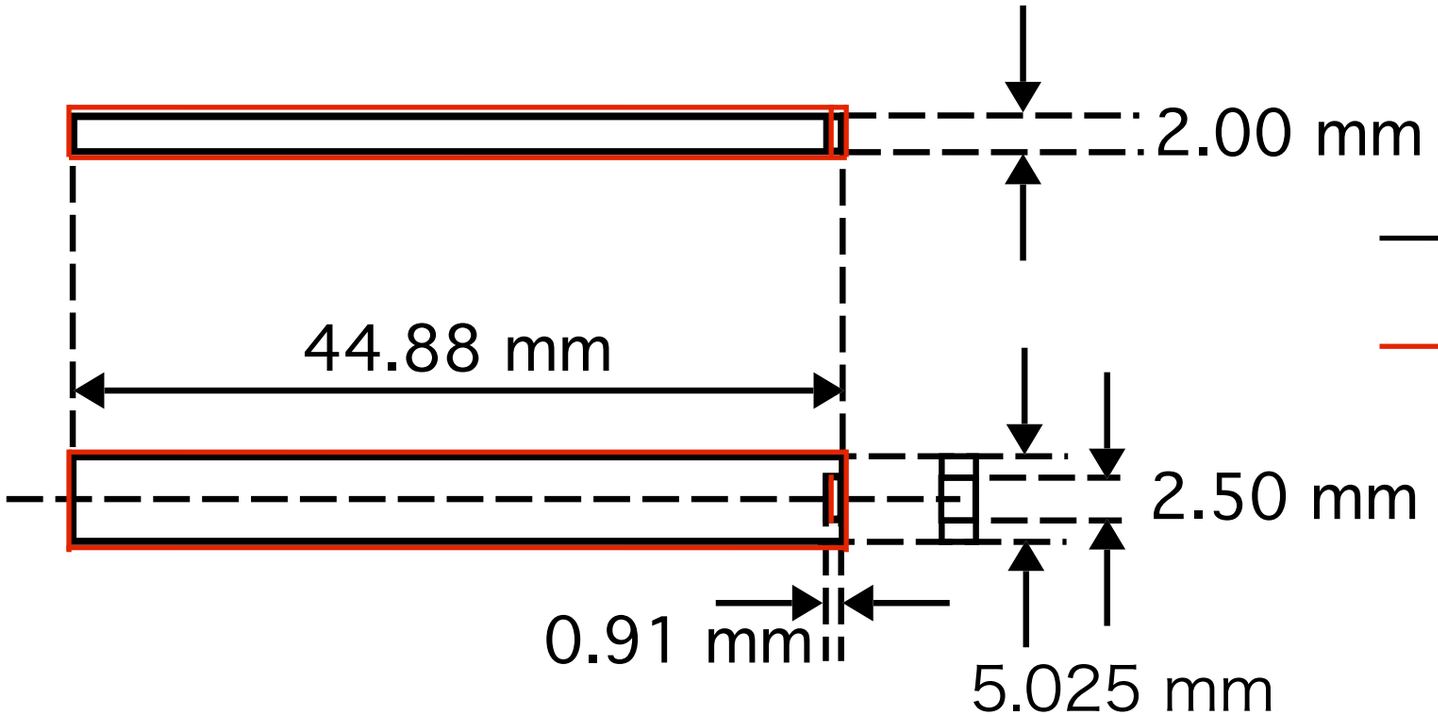


T.Ogawa studies tau decays comparing among 4 types,

1. pure Si-W ECAL,
2. alternate Si-tile/Sc-strip ECAL,
3. pure Sc-strip ECAL

JER for those types of ECALs

Default design of ScECAL in Mokka and changed film thickness of reflector



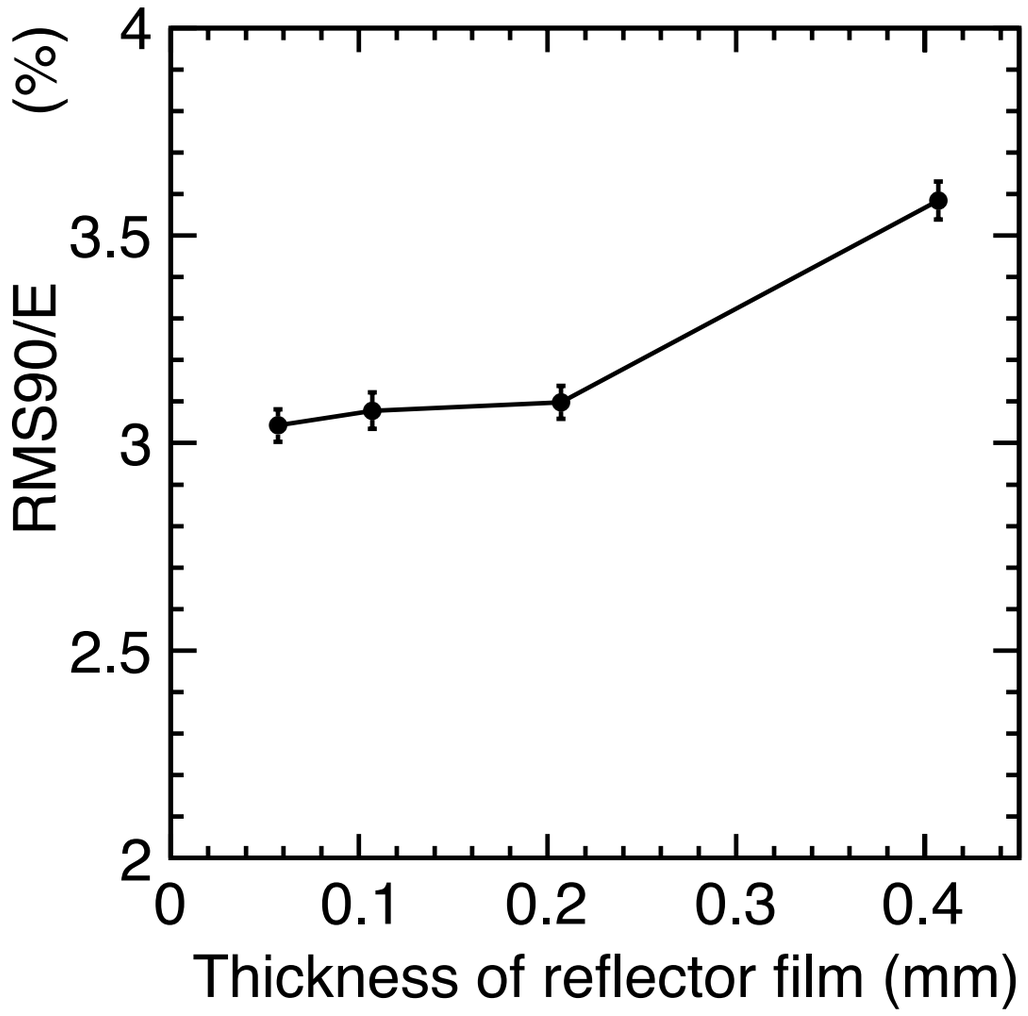
— : Scintillator surface

— : Reflector film (0.057 mm)

In this study thickness of reflector is changed to:
0.107 mm, 0.207 mm and 0.407 mm.
keeping;
- width of scintillator + reflector to 5.14 mm (default), replacing a part of scintillator with excess of reflector film,
- thickness of scintillator = 1.0 mm,
- thickness of scintillator + reflector + PCB = 1.914 mm, replacing a part of PCB with excess of reflector film,

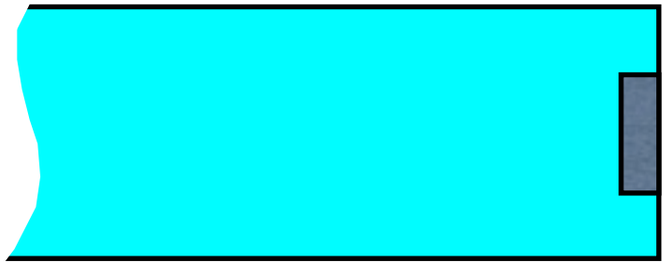
very ideal design in order only to see effect of side dead vol.

Effect of reflector thickness

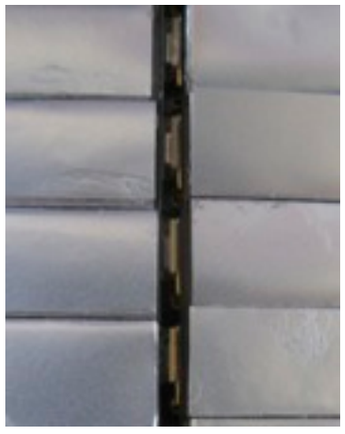


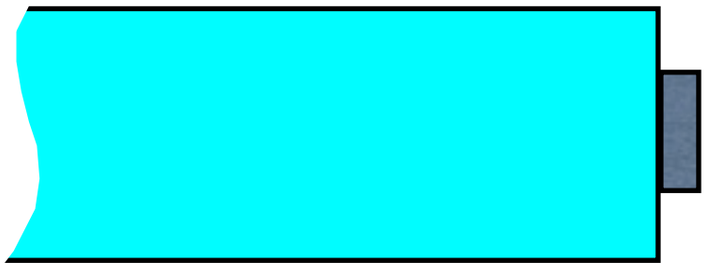
There is no significant deterioration of jet energy resolution due to the dead volume comes from reflector thickness at least up to 0.2 mm.

Default design of ScECAL in Mokka and changed MPPC dead volume.



default:
no dead volume on both side of MPPC

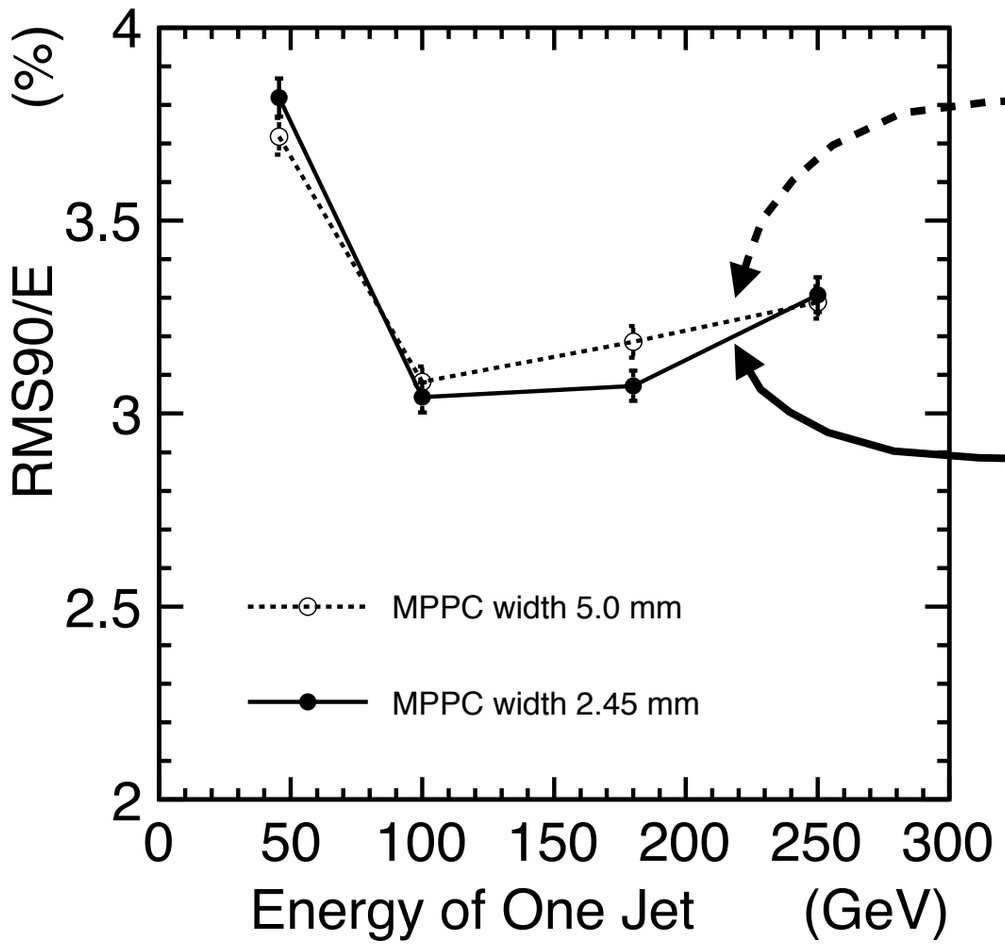


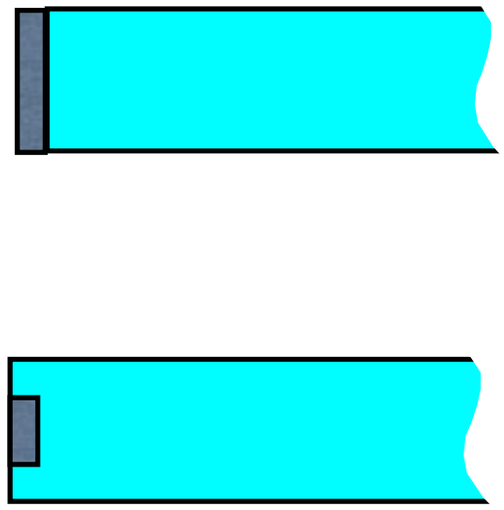


technological prototype:
has dead volumes on both side of MPPC.

instead to make air dead volume, MPPC size is extended to the width of scintillator; an MPPC also makes a dead volume in Mokka.

Effect of dead volume on both side of MPPC





There is no significant deterioration of jet energy resolution due to the dead volume side of MPPC.

Summary

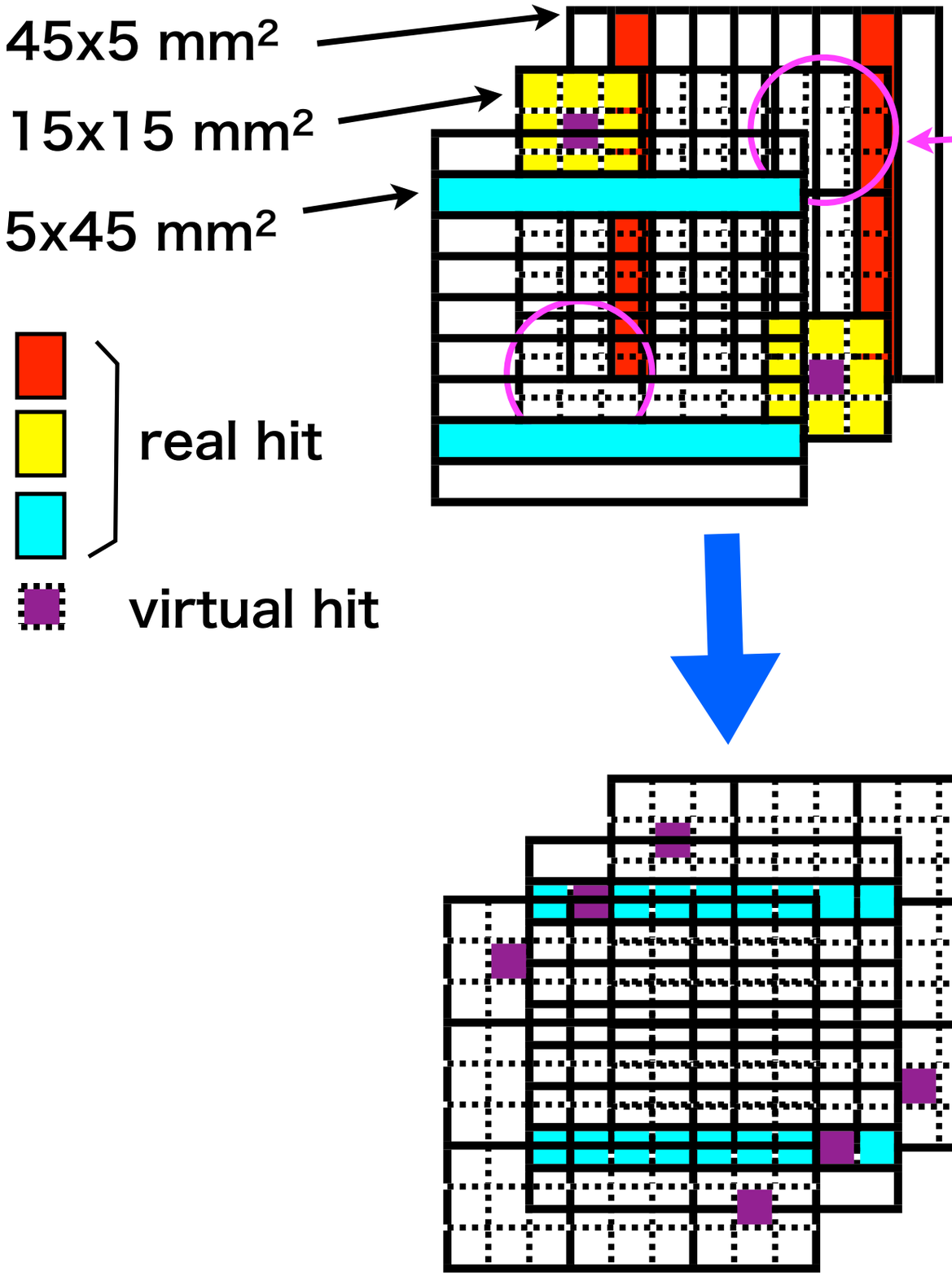
There is no significant deterioration due to the dead volume from reflector and MPPC.

outlook:

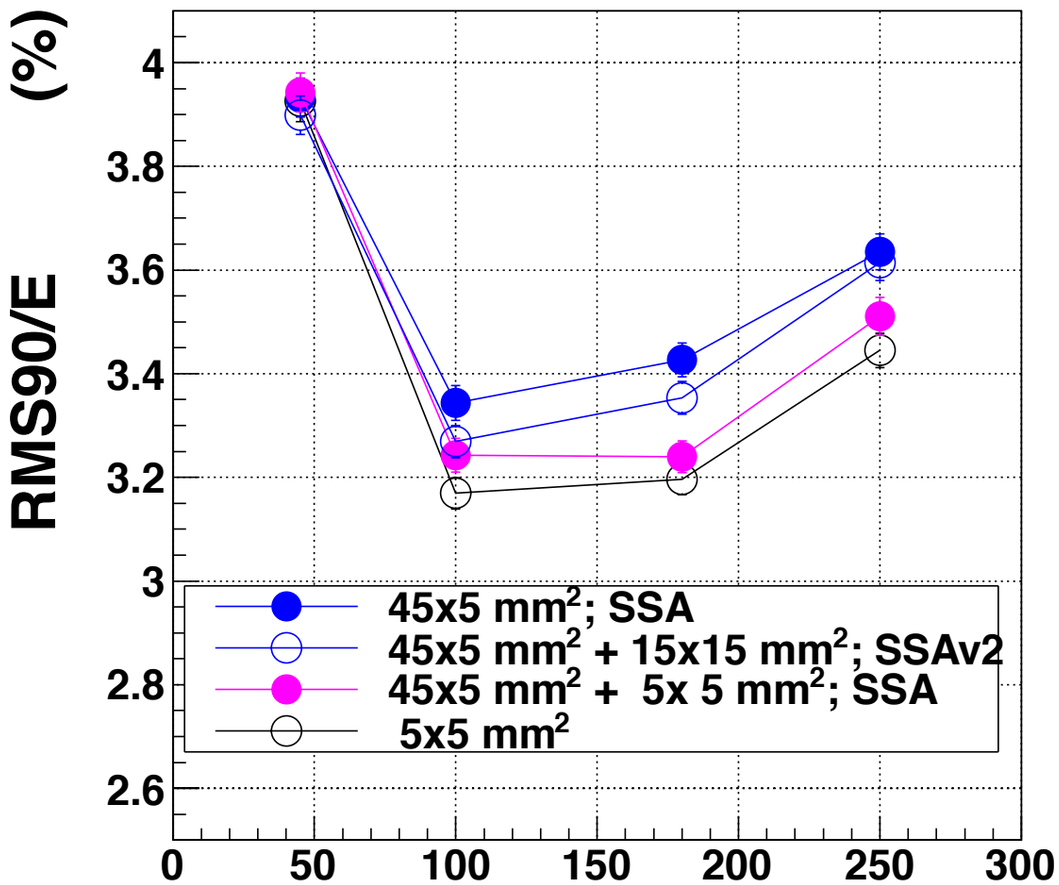
MPPC saturation effect

Response non uniformity

Other solution(2)



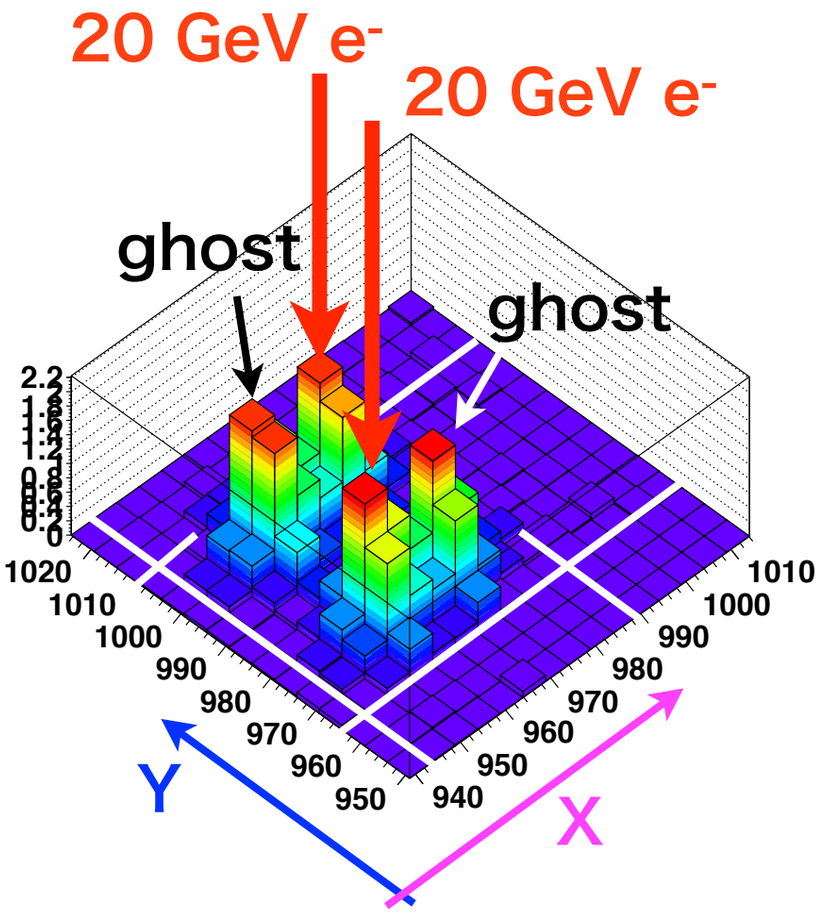
a layer is affected by the second nearest layers

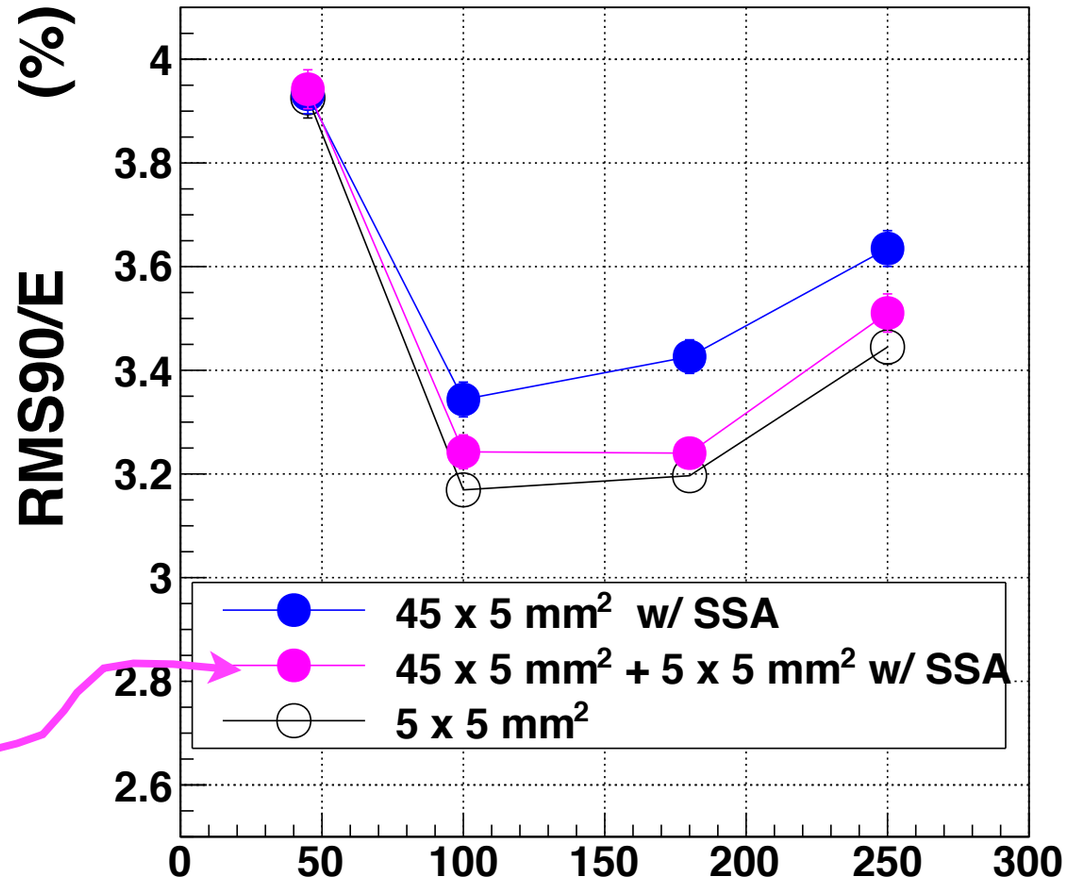


effect decrease as energy becomes higher

➡ test 10 x 10 mm²

ghost problem and its solution(1)





Solution

5 x 5 mm² interleaved between strip layers

↓ too small for current technology

Use Si - layers for 5 x 5 mm² layers

= Hybrid ECAL