DIRC study

Artem Ivanov

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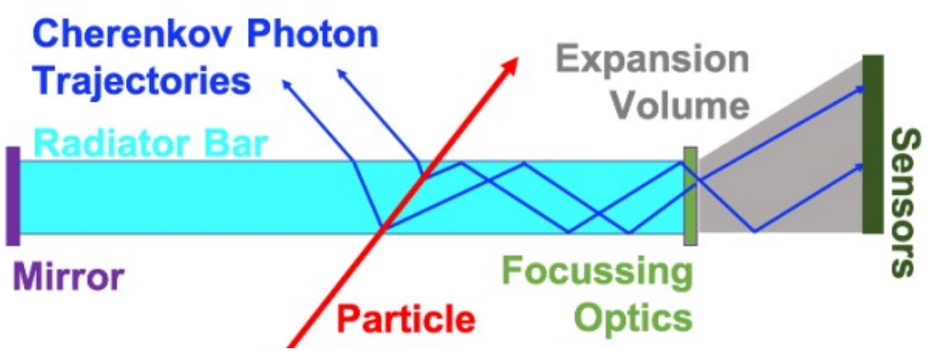
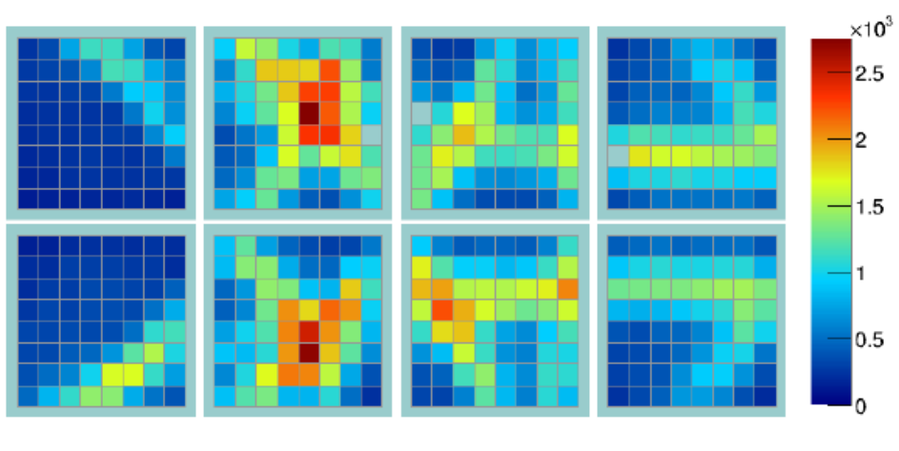
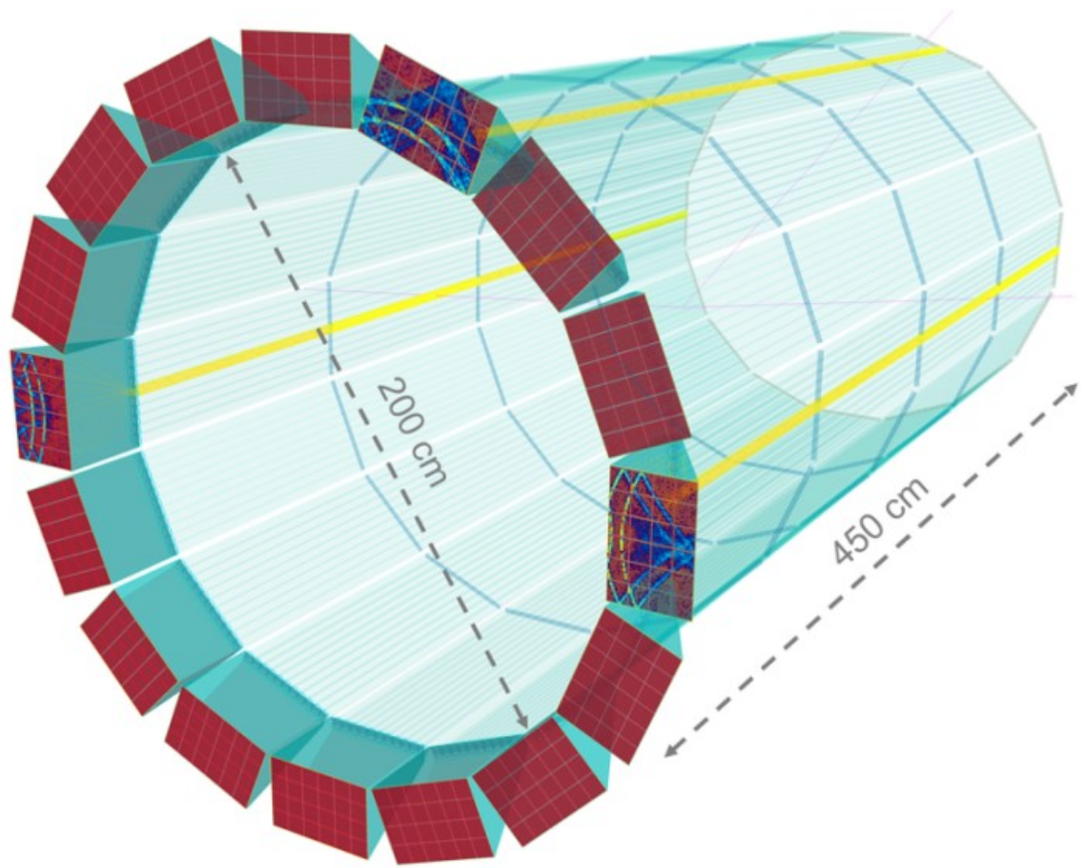
DIRC - Detection of Internally Reflected Cherenkov Light

Separate kaons and pions with at least 3 standard deviations for momenta up to 3.5 GeV/c

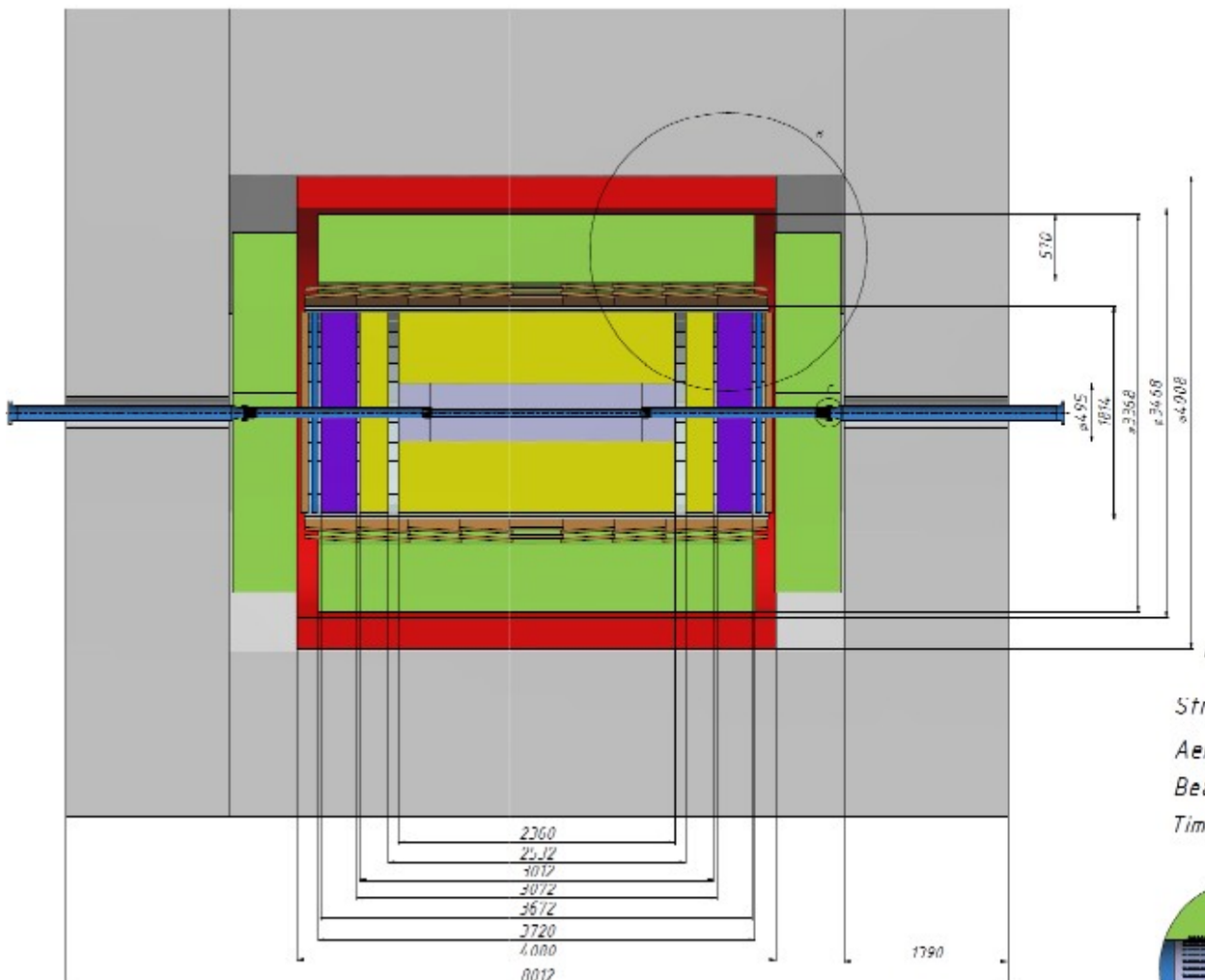
The PANDA Barrel DIRC Detector at FAIR

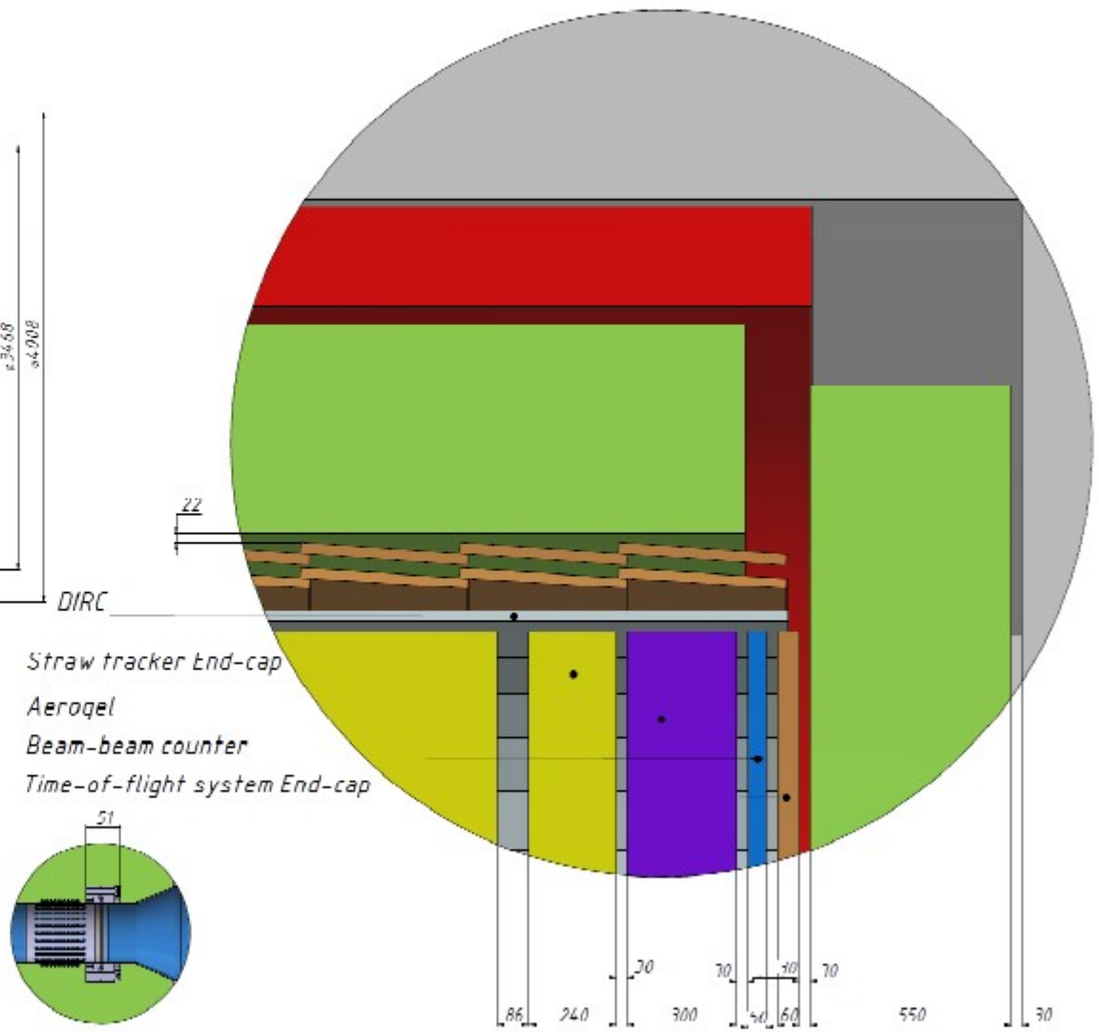






SPD geometry





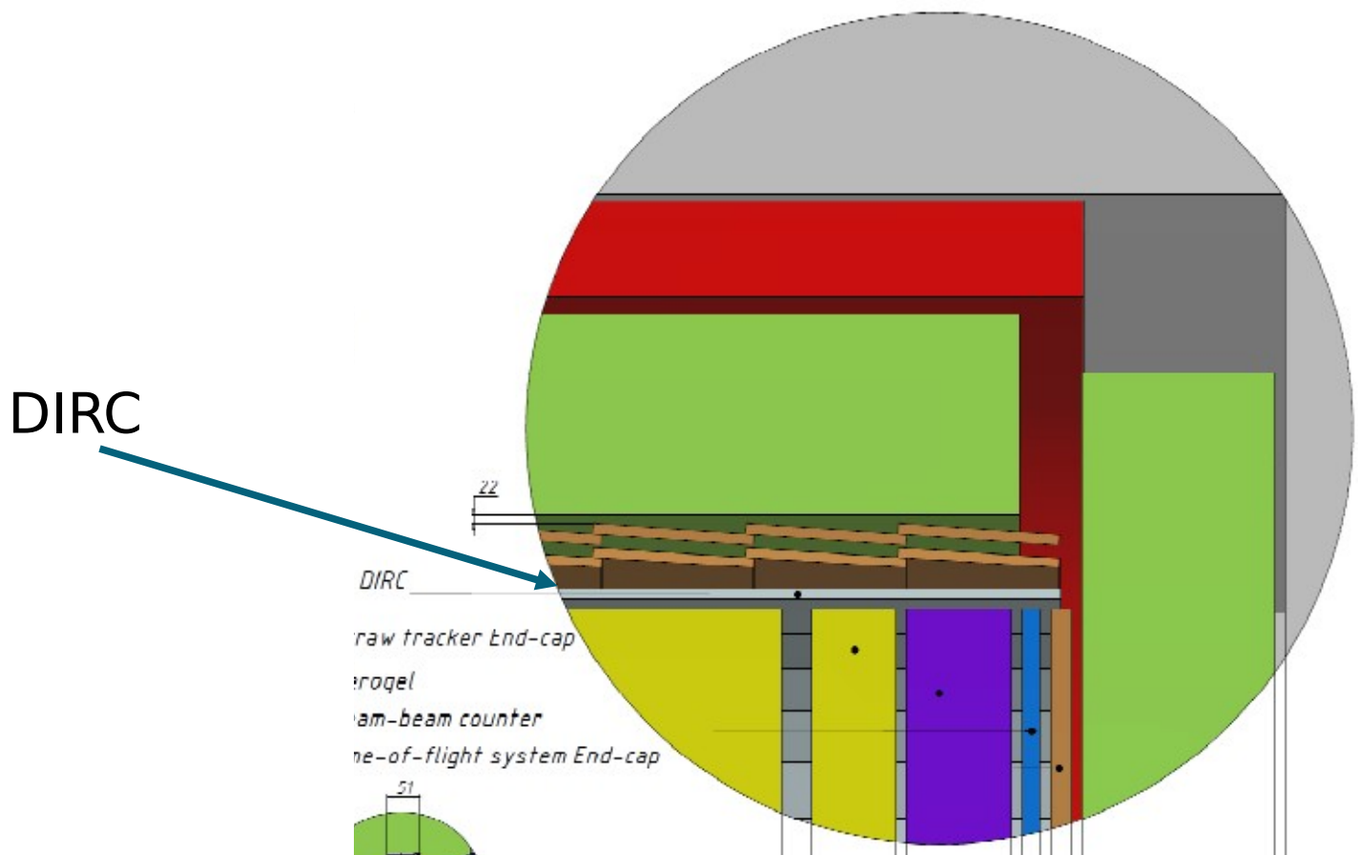
DIRC in SpdRoot: geometry

Module size = 77 (T) x 15 (W) x 3400 (L) mm

Number of module: 32

R: 907 mm

Location: between STRAW and TOF



DIRC in SpdRoot: material

Number of module: 32

Module size = 77 (T) x 15 (W) x 3400 (L) mm

Material: SiO_2 fused Silica (“Quartz”)

Atomic and nuclear properties of materials:

Silicon dioxide (fused quartz) (SiO_2)

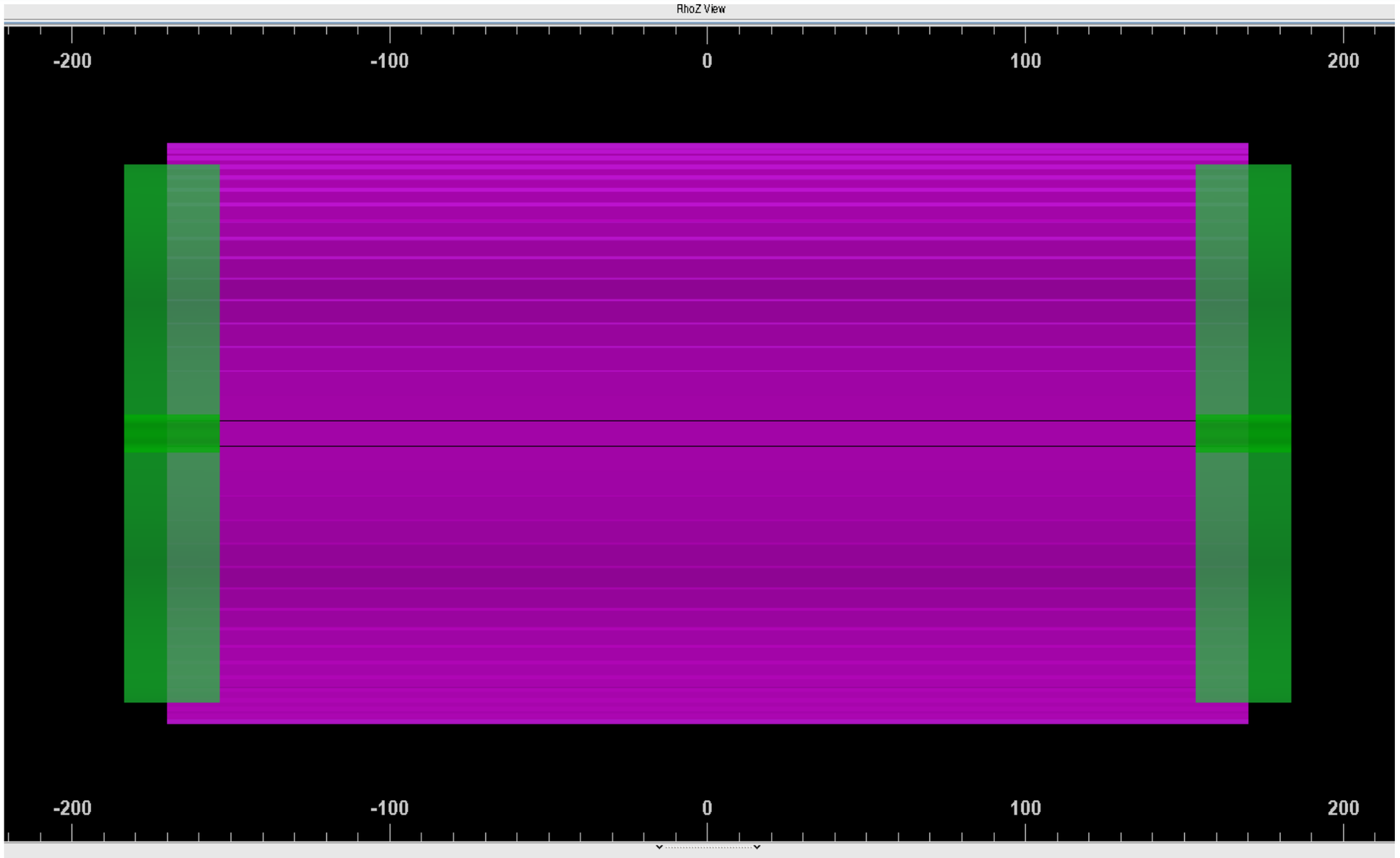
Quantity	Value	Units	Value	Units
<Z/A>	0.49930			
Density	2.20	g cm^{-3}		
Minimum ionization	1.699	MeV $g^{-1}cm^2$	3.737	MeV cm^{-1}
Nuclear collision length	65.2	g cm^{-2}	29.64	cm
Nuclear interaction length	97.8	g cm^{-2}	44.47	cm
Pion collision length	91.9	g cm^{-2}	41.77	cm
Pion interaction length	128.8	g cm^{-2}	58.56	cm
Radiation length	27.05	g cm^{-2}	12.29	cm

```
// fused material
TGeoElement *elSi = new TGeoElement("Silicon", "Si", 14., 28.09);
TGeoElement *elO = new TGeoElement("Oxygen", "O", 8., 16.00);

Double_t density = 2.200; // fused quartz
TGeoMixture *fusedsilica = new TGeoMixture("Quartz", 2, density);
fusedsilica->AddElement(elSi, 1);
fusedsilica->AddElement(elO, 2);
    Artem Ivanov, 4 months ago • implementation of DIRC detector
TGeoMedium *medfusedsilica = new TGeoMedium("medfusedsilica", 0, fusedsilica);
```

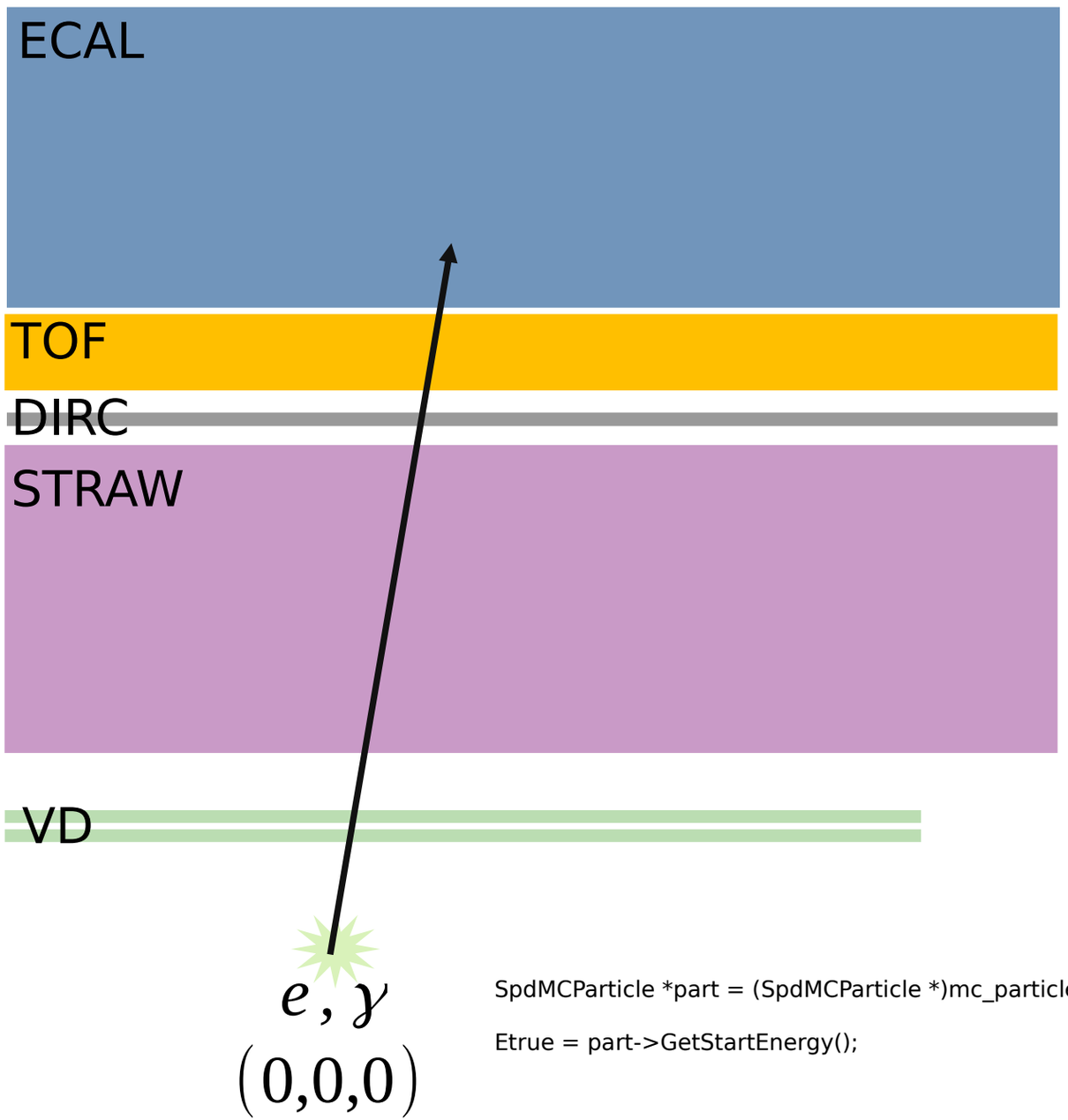
DIRC in SpdRoot: length

RICH
DIRC



Study

In Barrel




```
SpdEcalRCParticle *part = (SpdEcalRCParticle *)EcalParticlesRC_→EcalParticlesRC_→At(ip);
Ereco = part->GetEnergy();
```

Generated two samples:

1) with DIRC
2) without DIRC

TOTAL NUMBER OF RAD.L.

L = 110 cm, 85 degree

With DIRC = 0.28

Without DIRC = 0.16

```
SpdMCParticle *part = (SpdMCParticle *)mc_particles->At(it);
Etrue = part->GetStartEnergy();
```

$$\Theta \in [40-160] \ \ degree$$

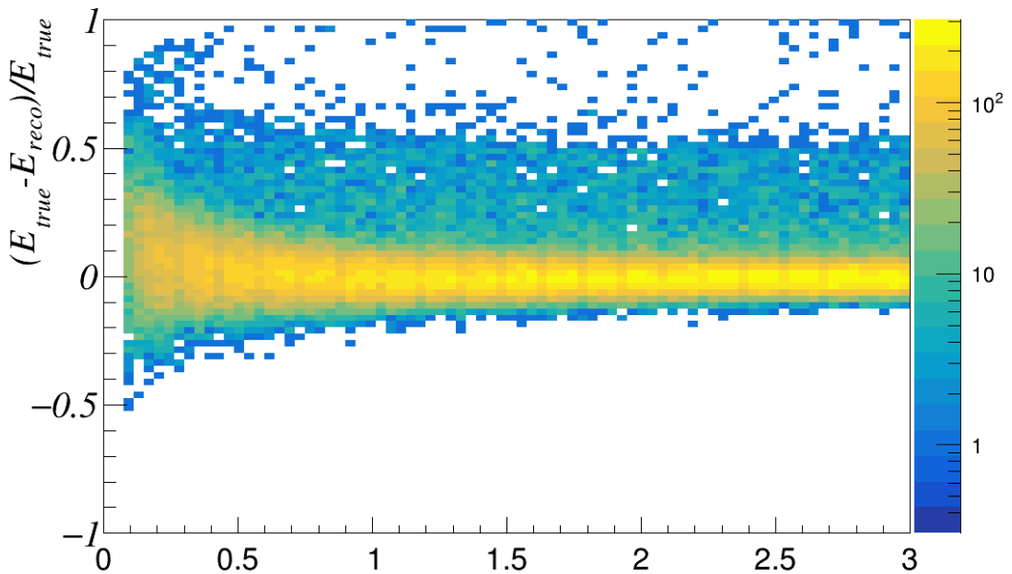
$$E \in [0.1; 3.0, step = 0.01\,GeV]$$

$(E_{true} - E_{reco})/E_{true}$

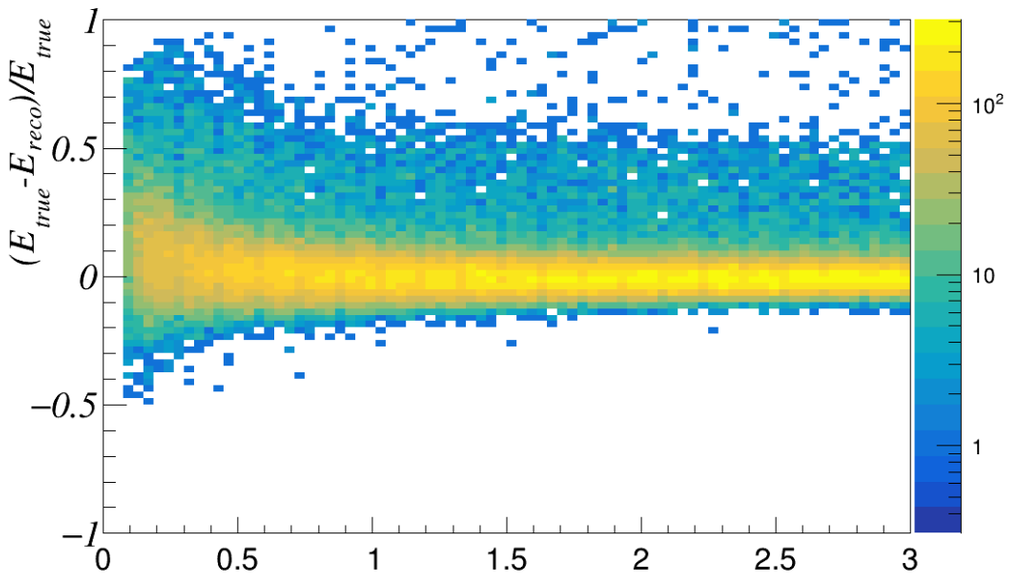
In Barrel

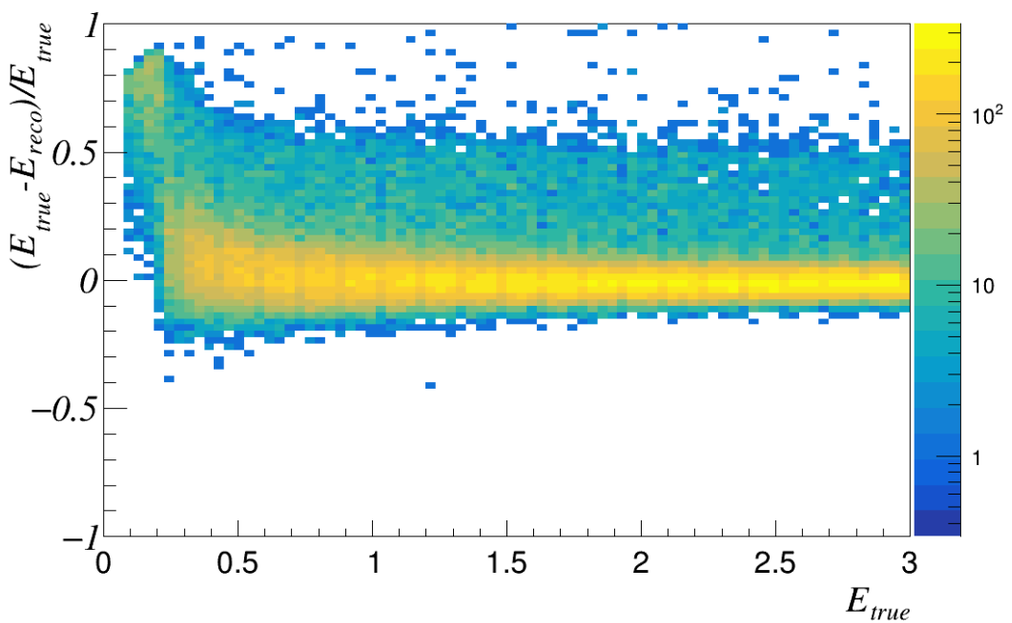
Without DIRC

With DIRC

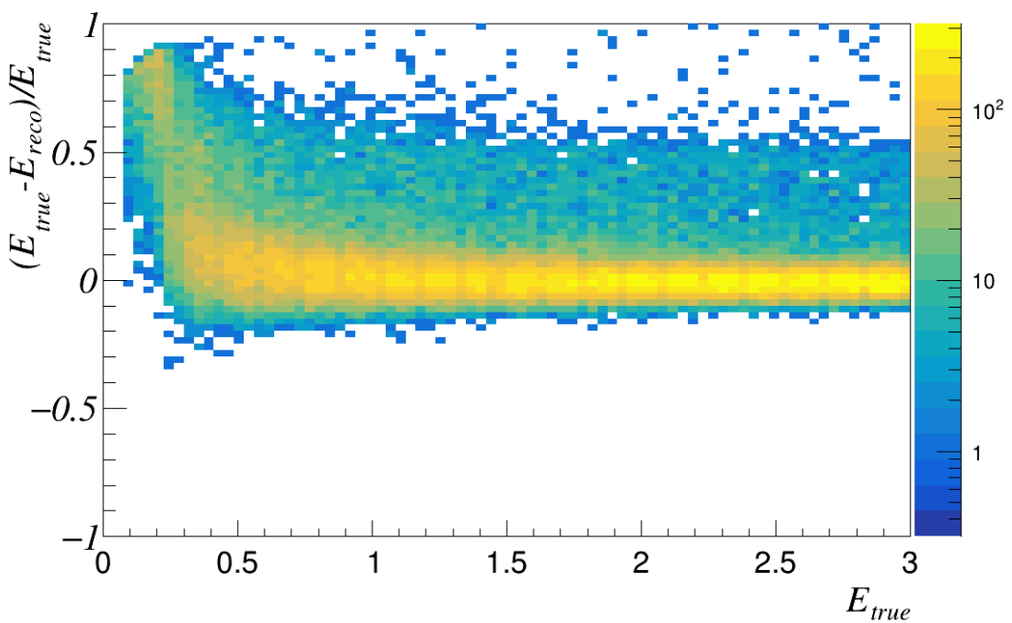


gamma





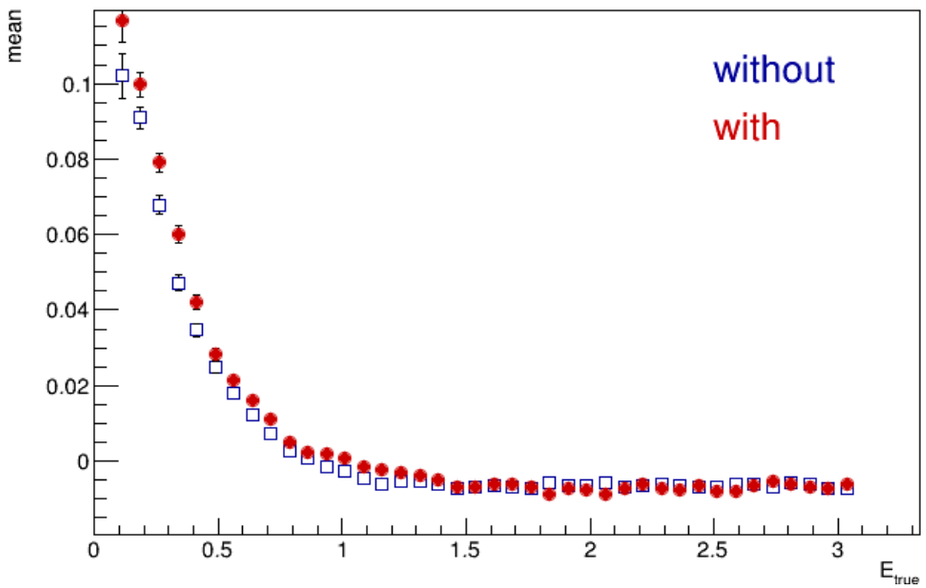
electron



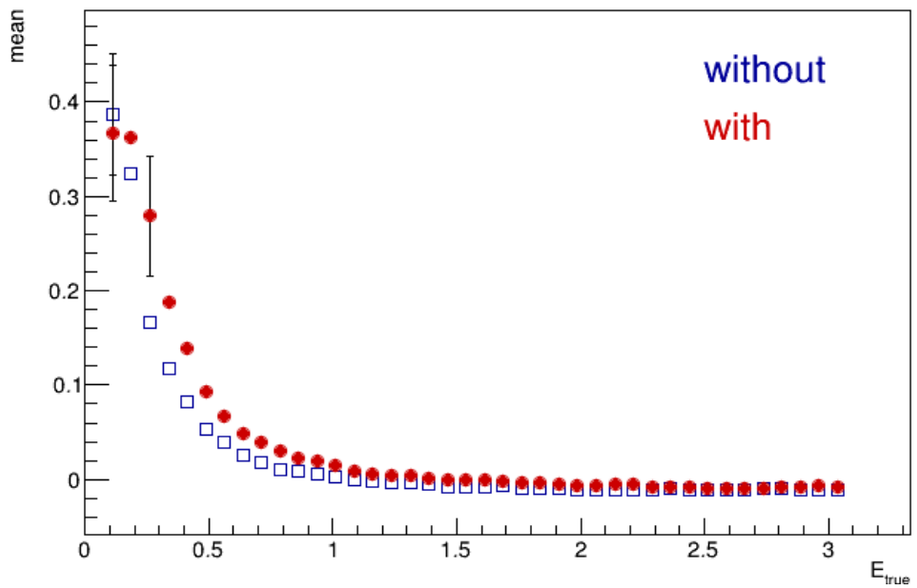
Mean and Sigma

In Barrel

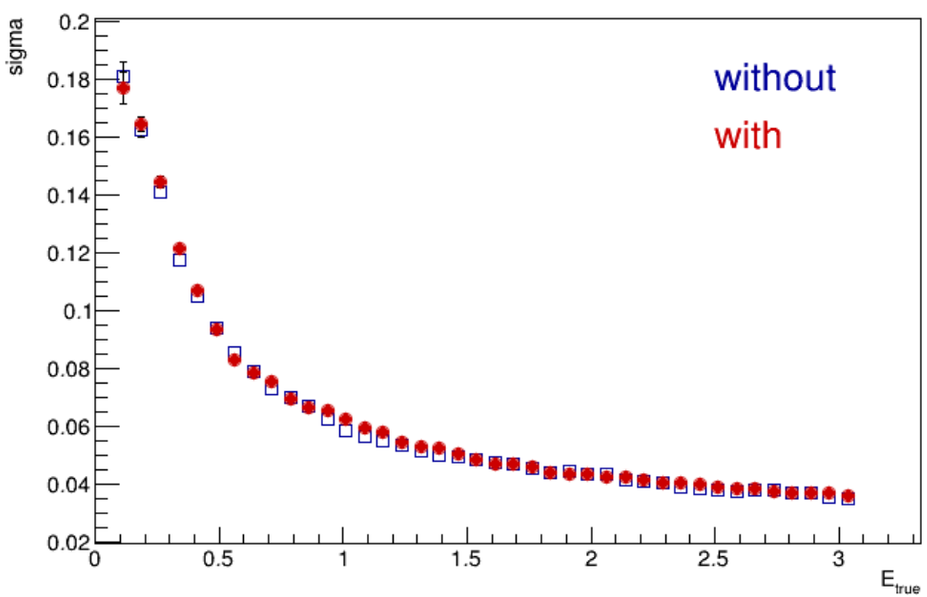
gamma



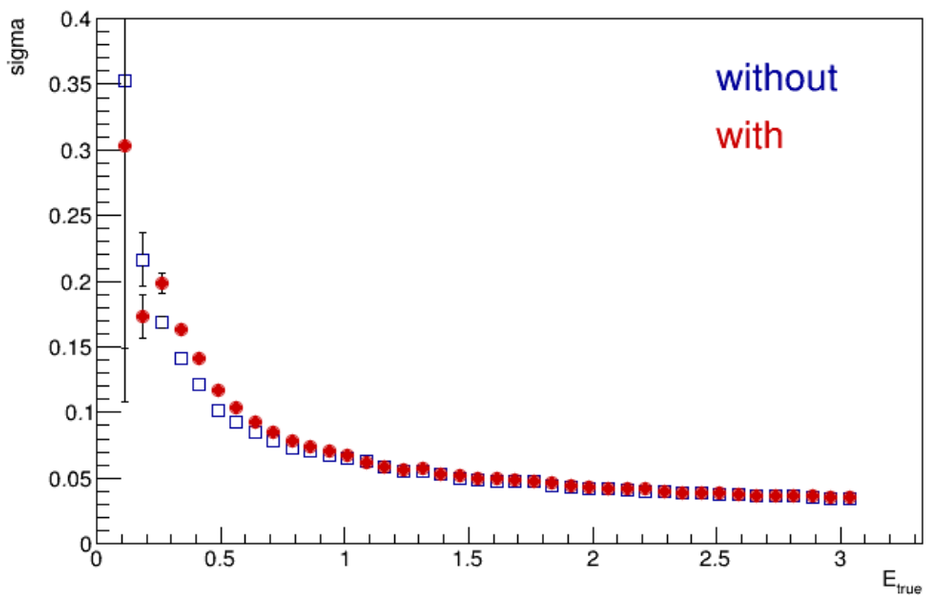
electron



mean



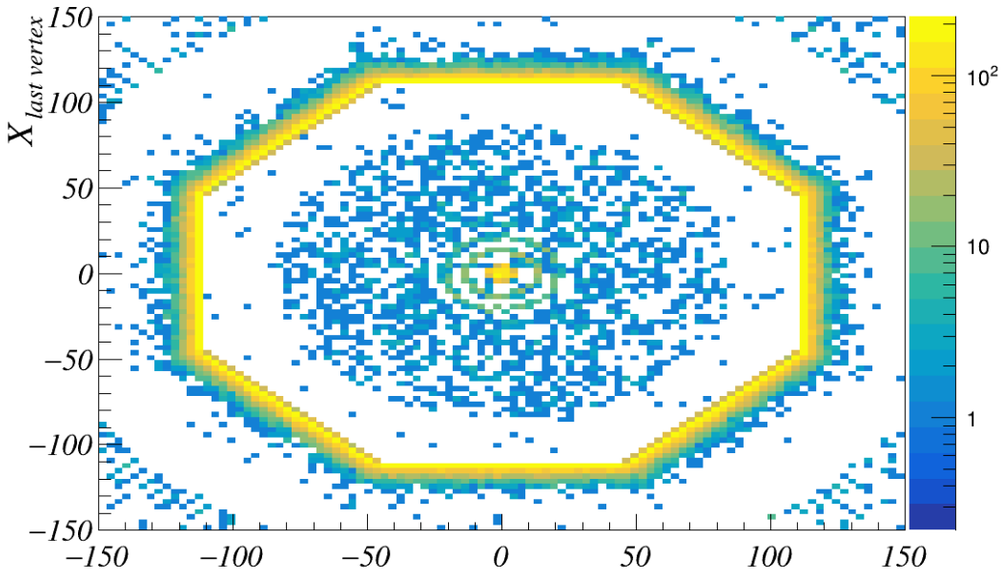
sigma



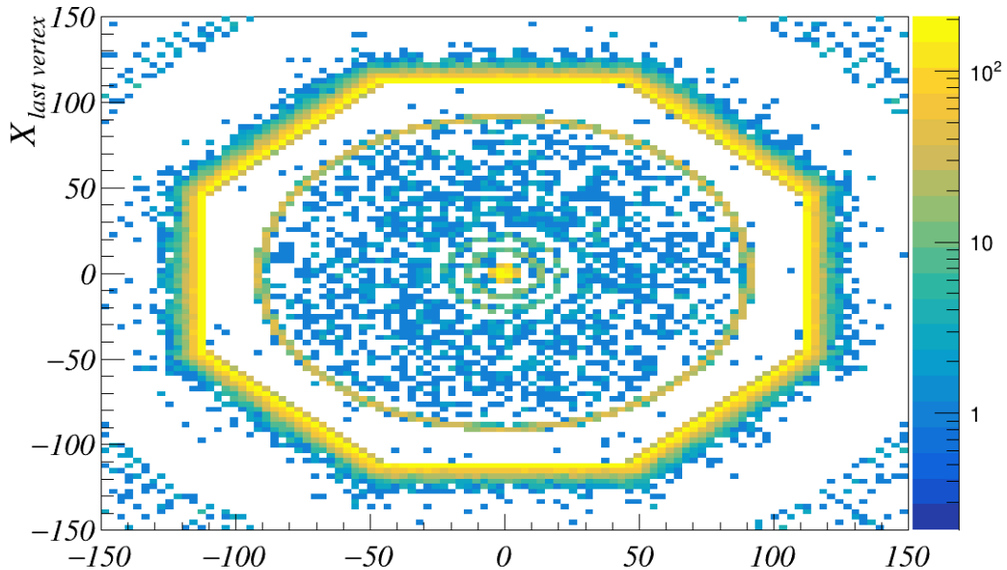
$X_{\text{last vertex}}$ vs $Y_{\text{last vertex}}$

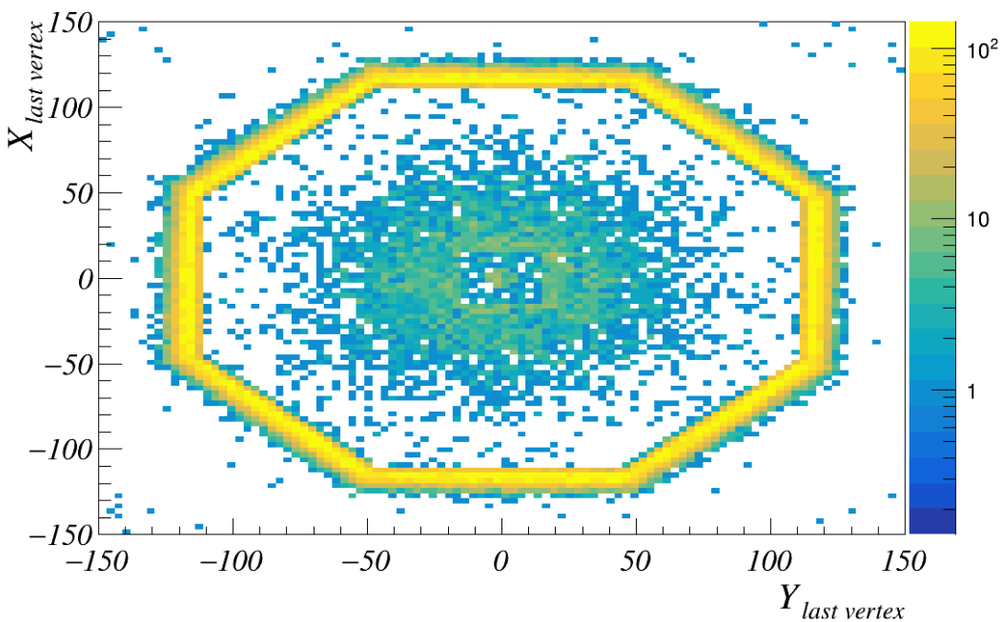
Without DIRC

With DIRC

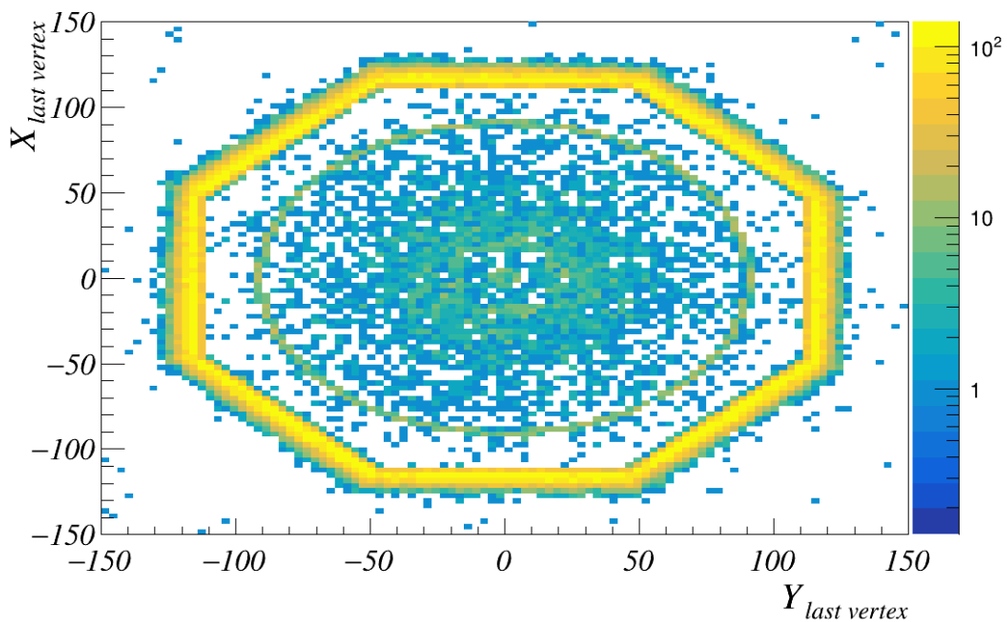


gamma





electron

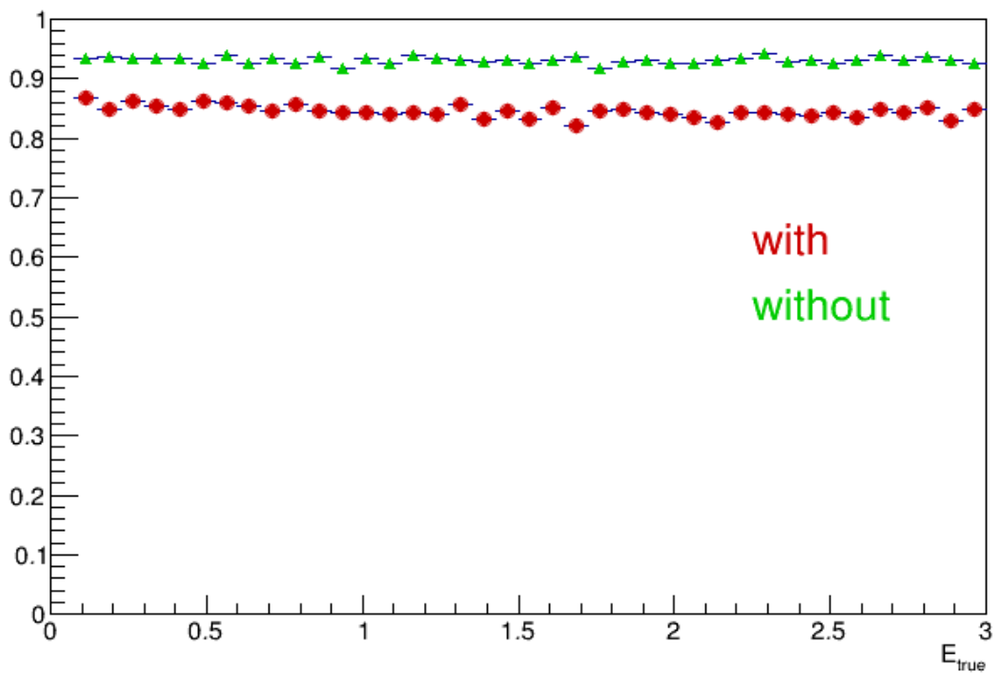


LO

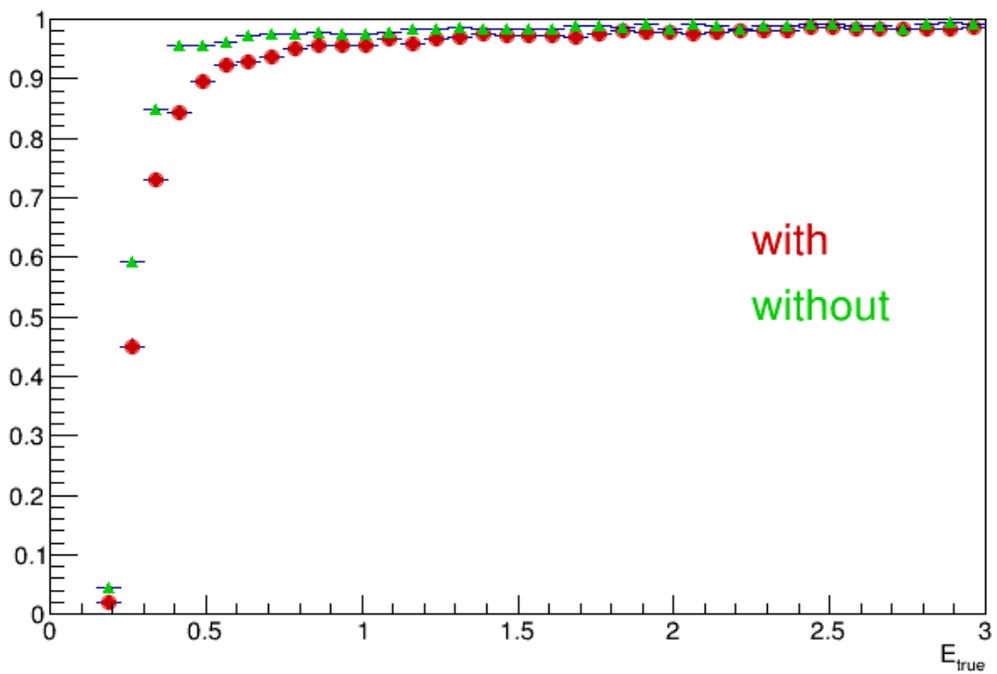
Efficiency

$$Eff = \frac{N_{\text{Last vertex in barrel}}}{N_{\text{total}}}$$

gamma



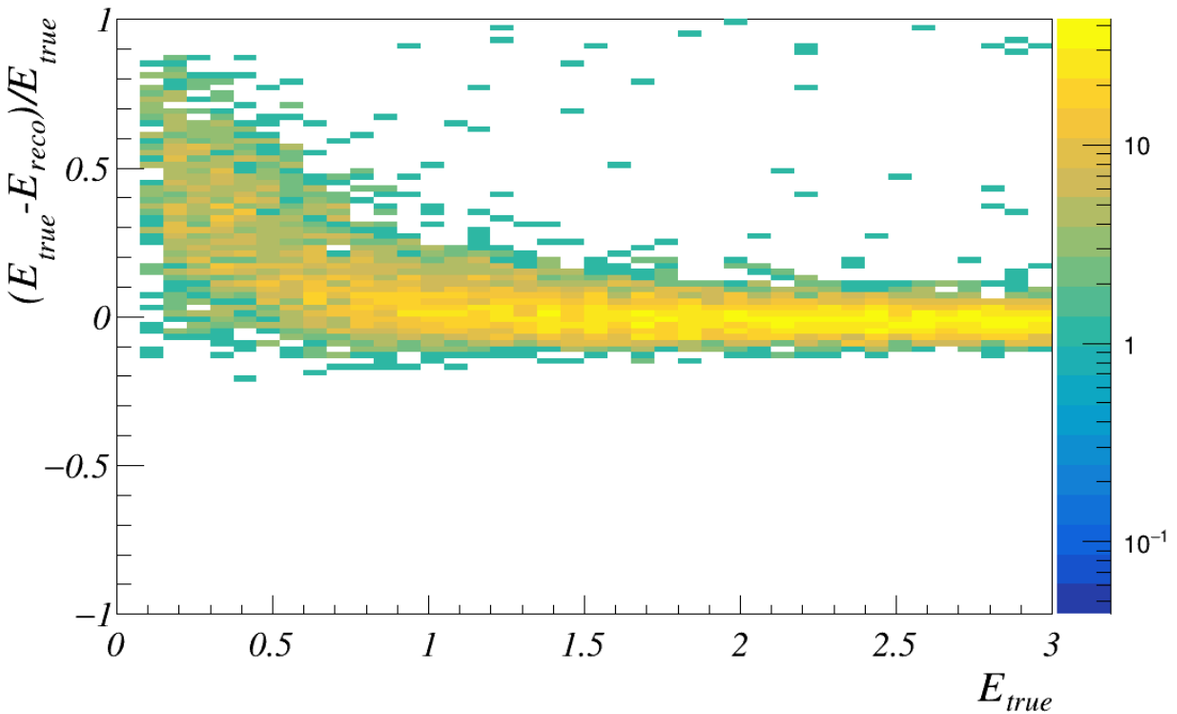
electron



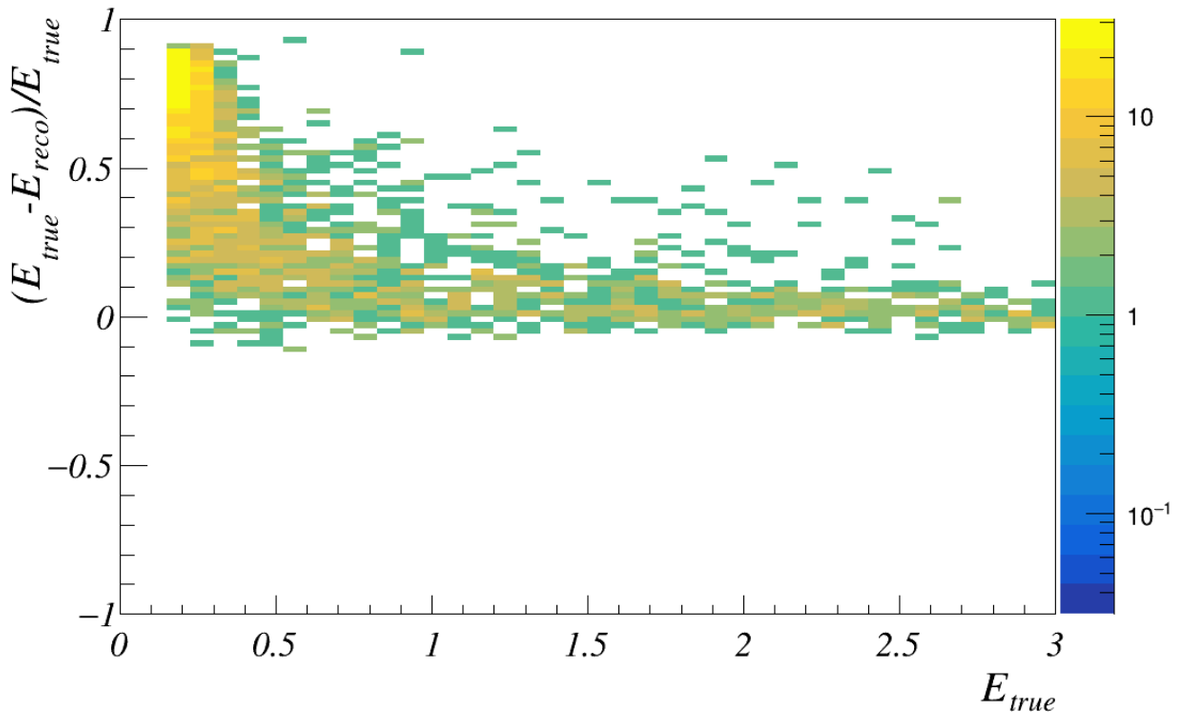
96% → 86%

$(E_{true} - E_{reco})/E_{true}$

gamma



electron



$R_{\text{last vertex}}$ in [89 - 92]

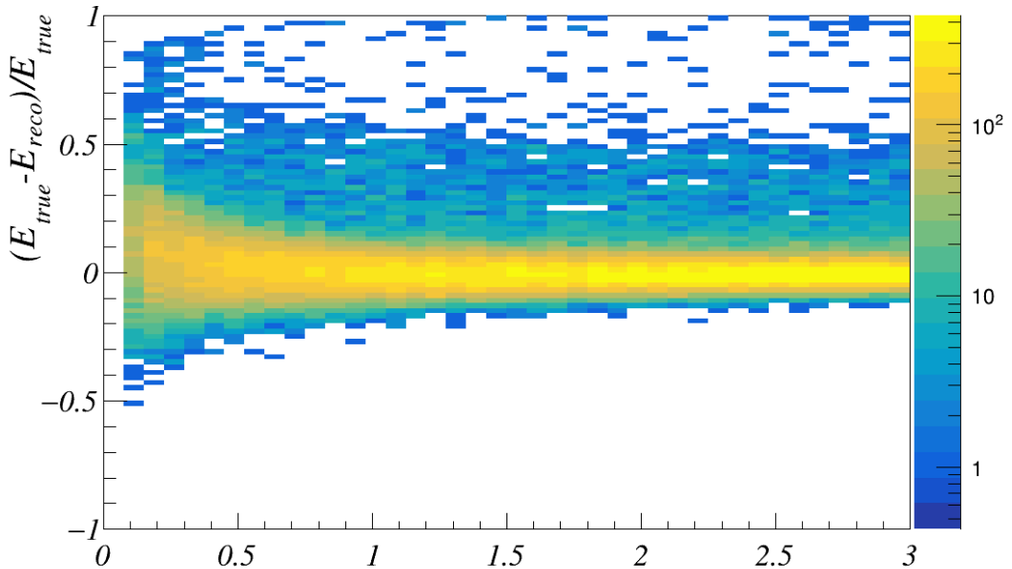
Conclusion

- Study for DIRC detector was done

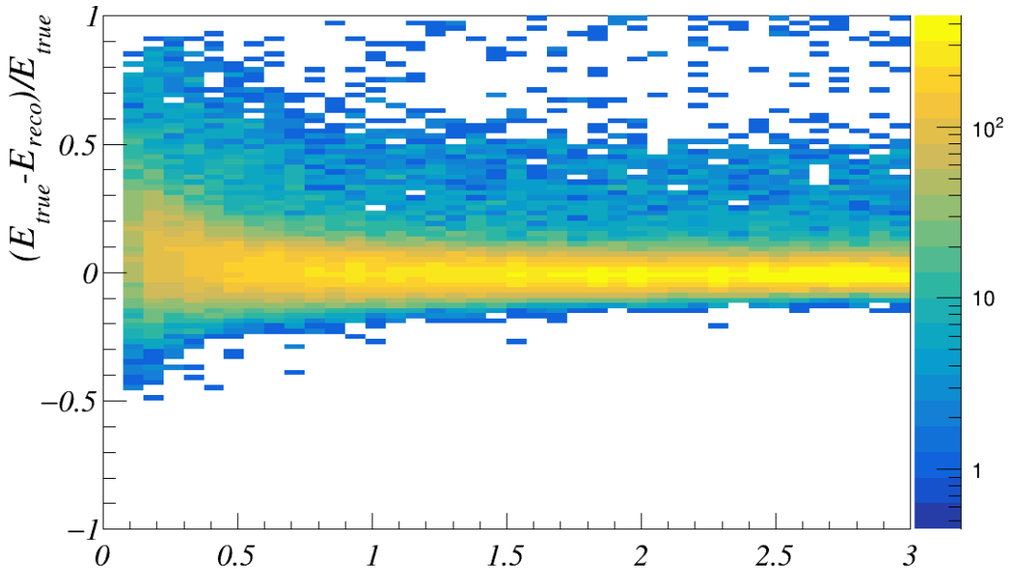
$(E_{true} - E_{reco})/E_{true}$, gamma

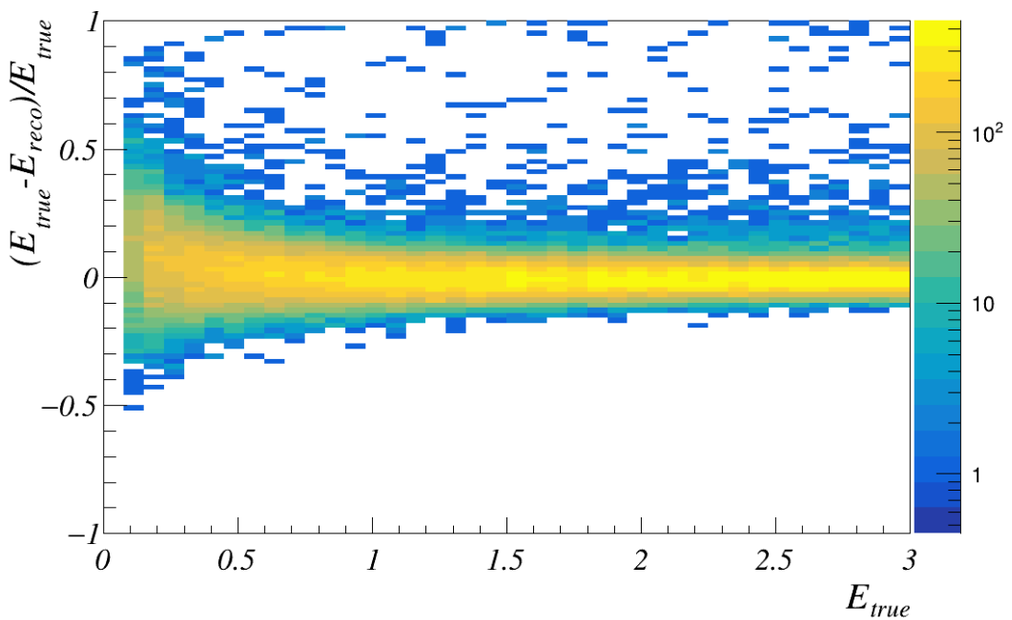
Without DIRC

With DIRC

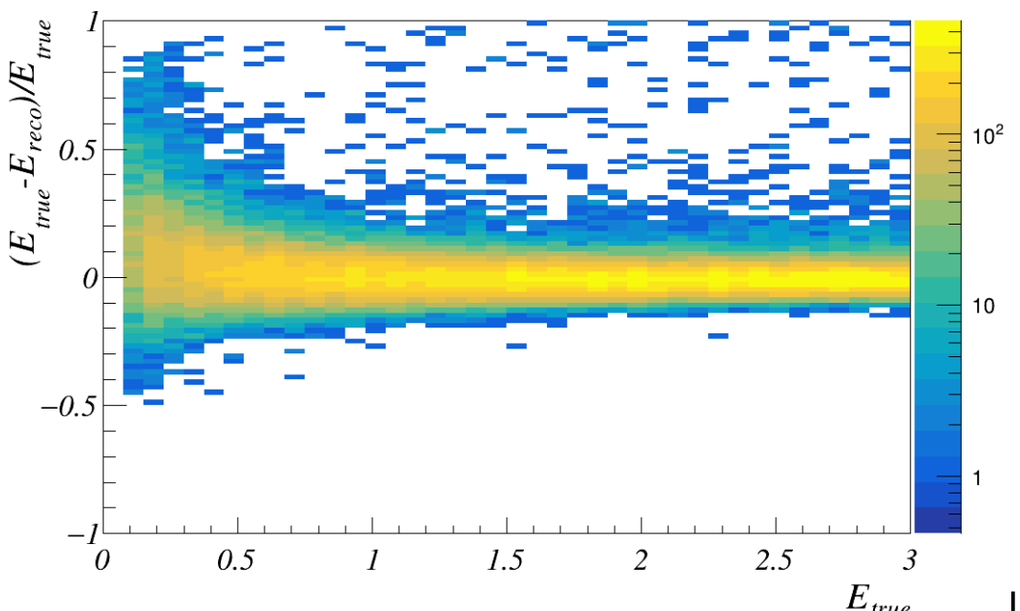


maxE





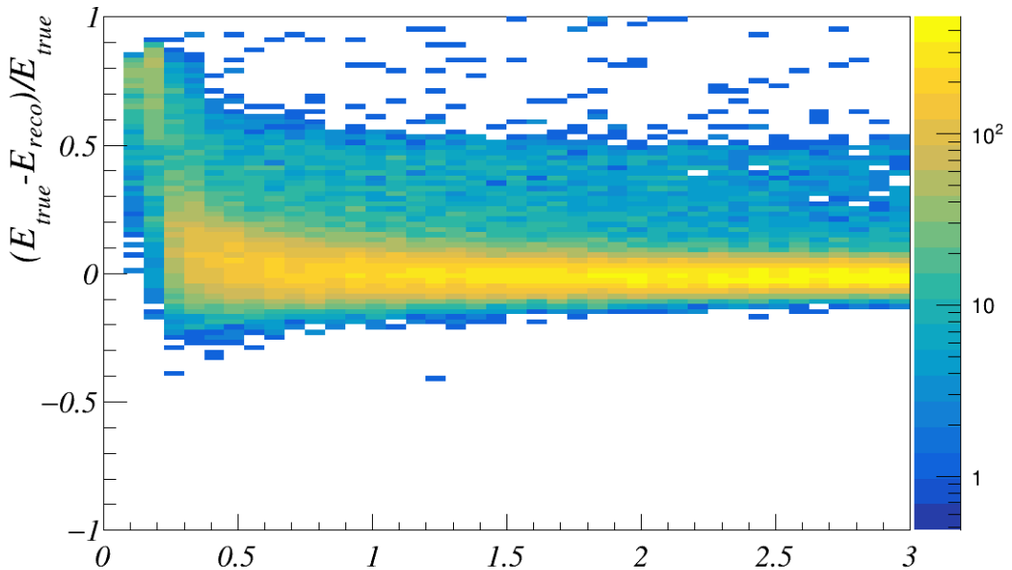
sumE



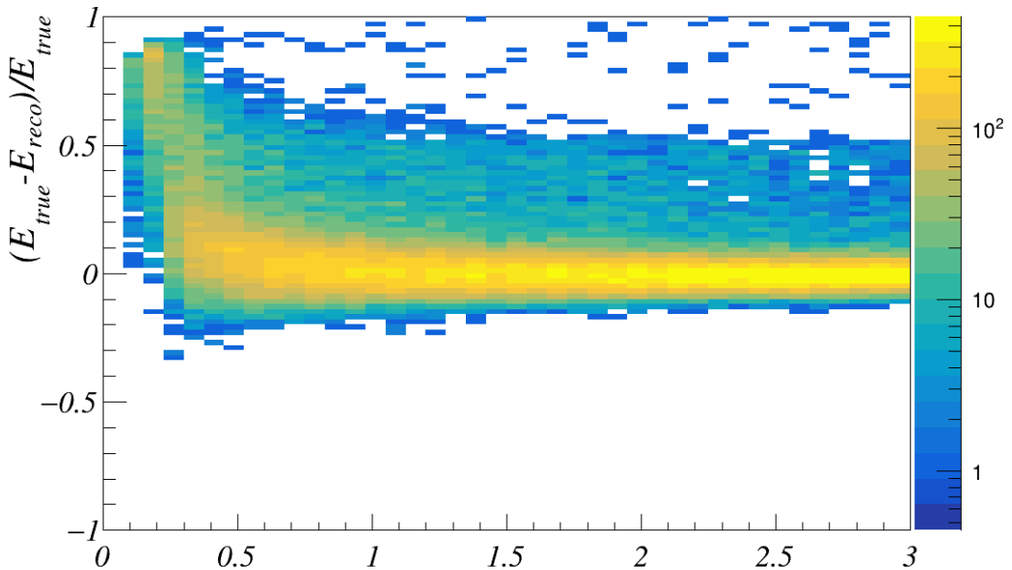
$(E_{true} - E_{reco})/E_{true}$, electron

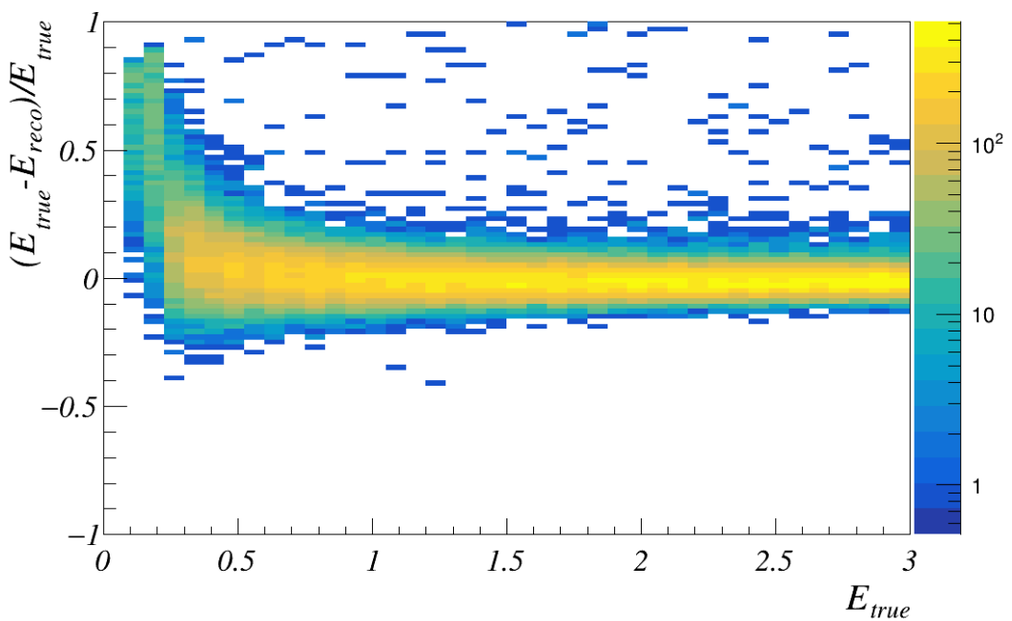
Without DIRC

With DIRC



maxE





sumE