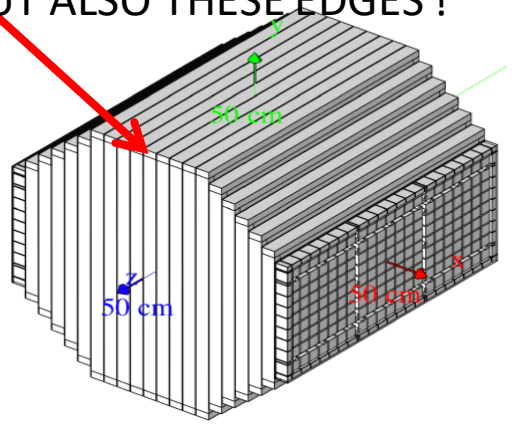
*REDUCING THE MASS WITHOUT <u>CHANGING</u> THE VOLUME/shape (geo. Acceptance)*

**Reduce Number of crystals**
**Increase the gaps**

**Reduce the size crystals (2.8*2.8)**
**Increase the gaps**

*REDUCING THE MASS <u>CHANGING</u> THE OVERALL VOLUME/shape*

CUT ALSO THESE EDGES ! → APPROACH A SPHERE ?




Sergio Bottai , 29/03/2021

# *REDUCING THE MASS WITHOUT CHANGING THE VOLUME (geo. Acceptance)*

**Reduce Number of crystals**
**Increase the gaps**

Reduction of depth ($\lambda$)

Less interaction
Reduced effective acceptance

Less
sampling

less electron/proton discrimination

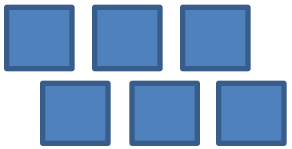
Less homogenus CALO
Less resolution

More leakage
Less resolution

**Reduce the size crystals**
**Increase the gaps**

Same problems except for the
decrease of sampling.

With large gaps the misallinment of the cubes increases resolution



**Reduce Number of crystals**
**Increase the gaps**

Mass reduction 20x20x20/(21x21x21) =0.86*1500kg
( -206kg)

**Gaps + 1,5mm**

**5,5mm Z,Y 9,5mm in Z**

**Reduce the size crystals 2.8cm**
**Increase the gaps**

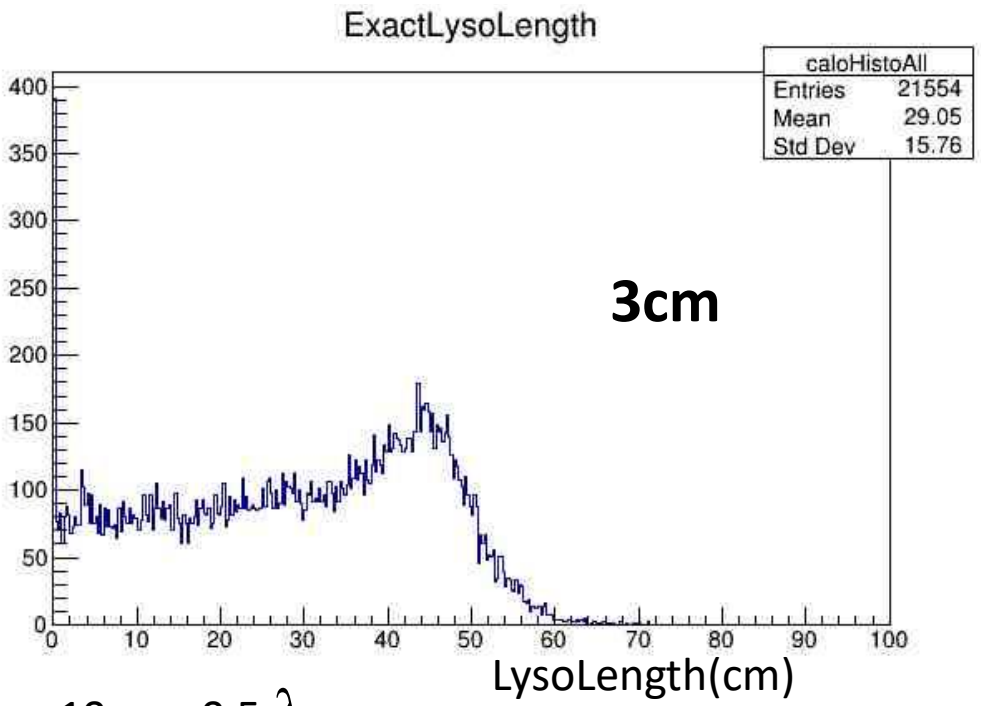
Mass reduction = 0.81*1500kg ( - 280Kg)
**Gaps + 2mm**

**6mm Z,Y 10mm in Z**

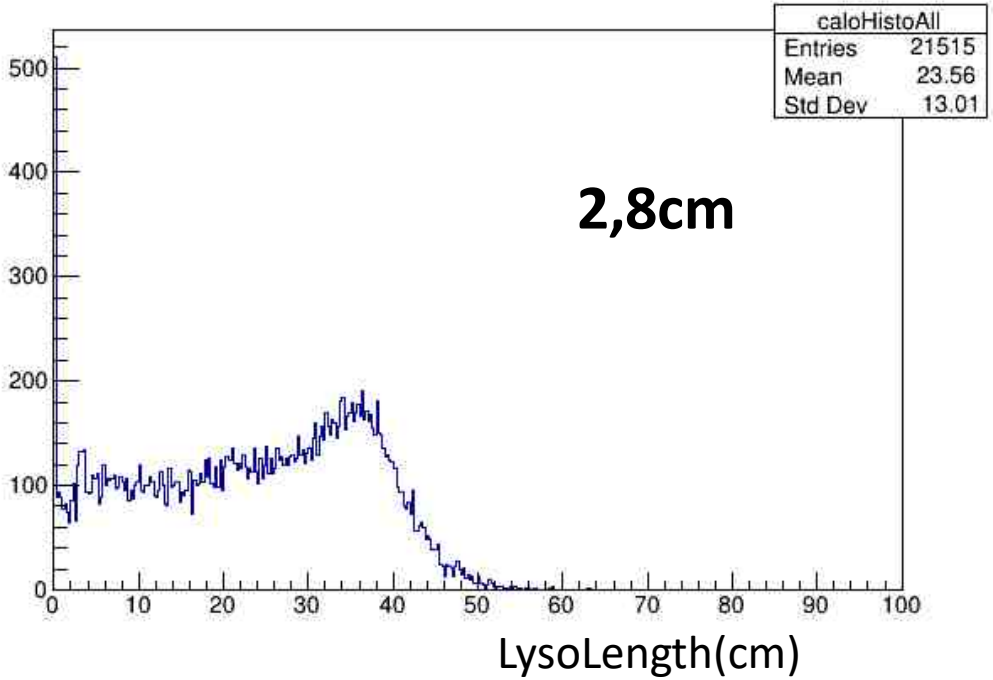
Less light in one cube (93% for the MIP)
Less space for fibers – no less than 2,8 cm ?

**WE EXPECT VERY SIMILAR PERFORMANCE FOR GIVEN MASS REDUCTION**

# 10 TeV PROTONS - HerdSoftware




10cm≈ 0.5 $\lambda_I$




The average LysoLength(cm)

Is reduced from 29 to 23,6

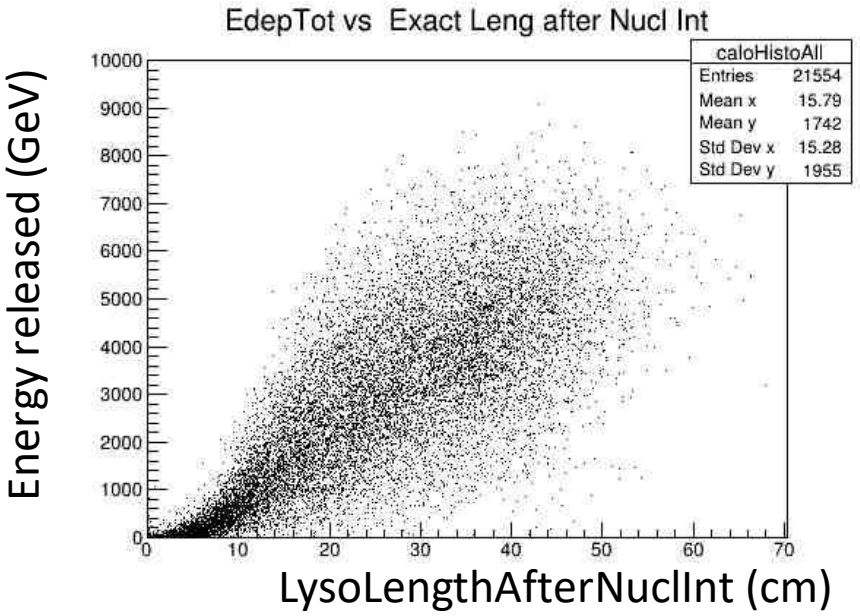
**0.81** reduction factor , in accordance with reduced mass ( and not by 2,8/3 )

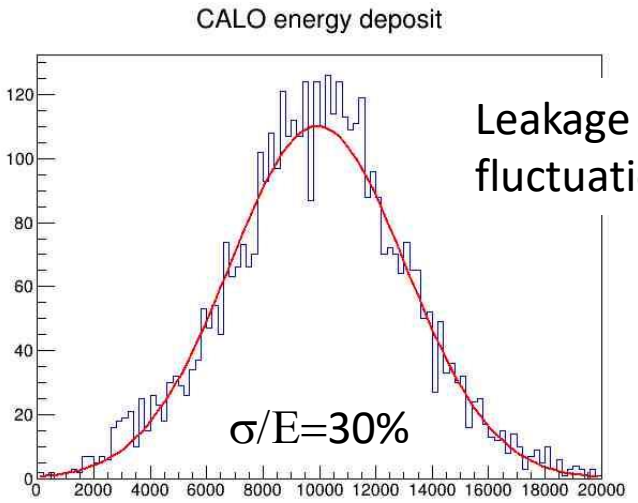
The fraction of INTERACTING PROTONS is reduced from 73% to 67%

This reduce 'directly' the effective acceptance by ≈10%

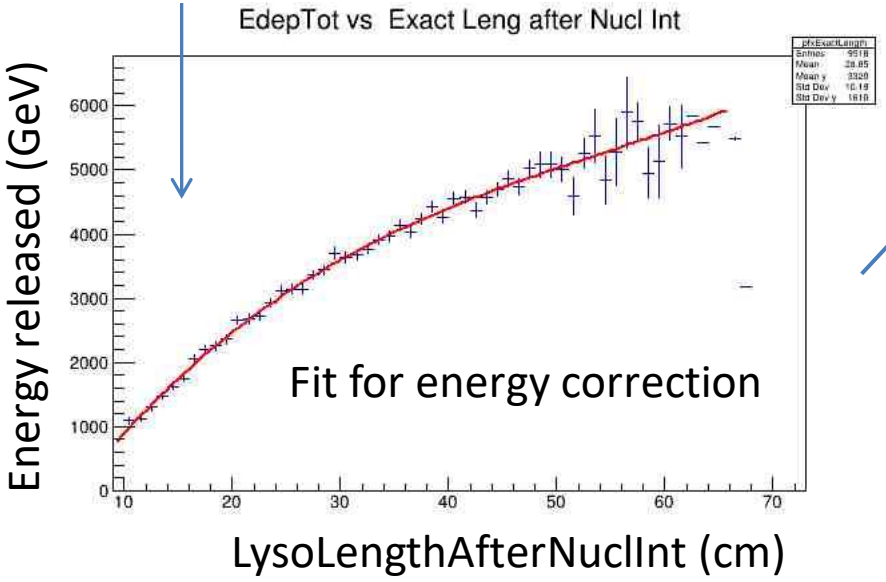
10 TeV protons - HerdSoftware

**Standard 3cm configuration**




Leakage fluctuations !



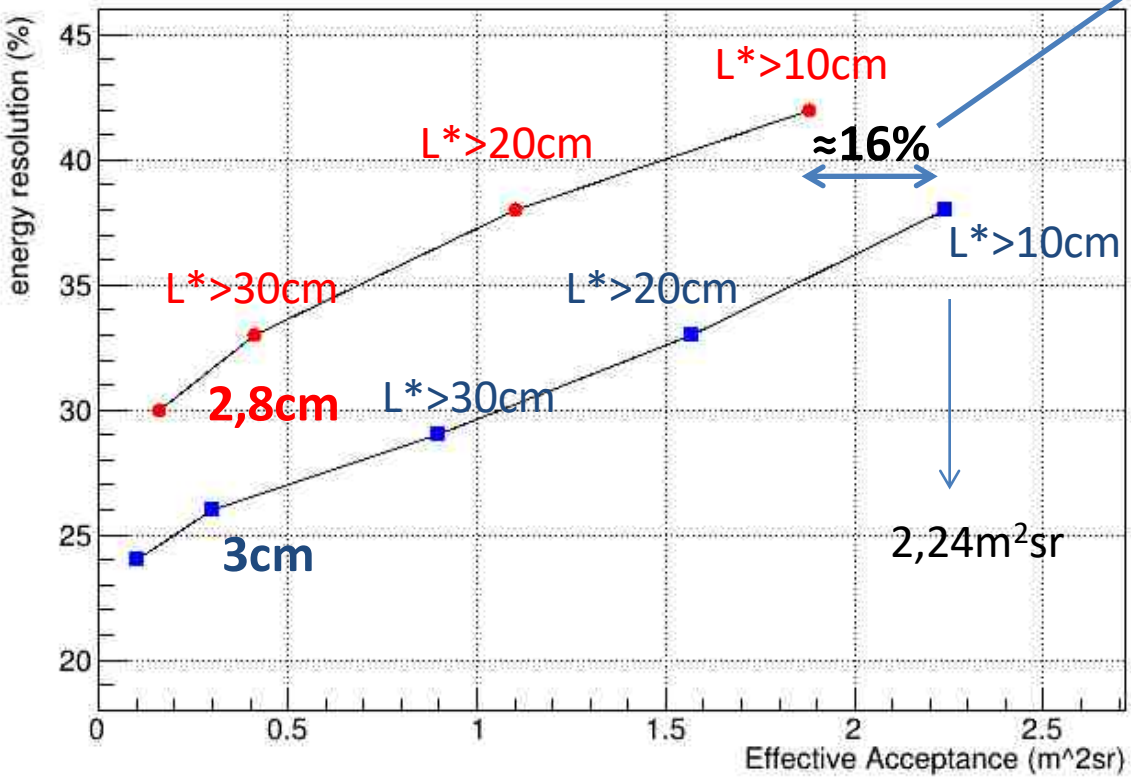

After correction, with
L*=LysoLengthAfterNuclInt>30cm

But with acceptance ≈1 m^sr
Only downward going particles

EFFECTIVE ACCEPTANCE CALCULATED FOR ONLY DOWGOING PARTICLES **5 FACES**

GEOMETRIC ACCEPTANCE = 4,4 (m^2sr)  (X **1,65**=7,28(m^2sr) for **every directions**)

10 TeV protons




Almost given by different fraction of interacting protons

L*=10cm≈ 0.5 $\lambda_I$

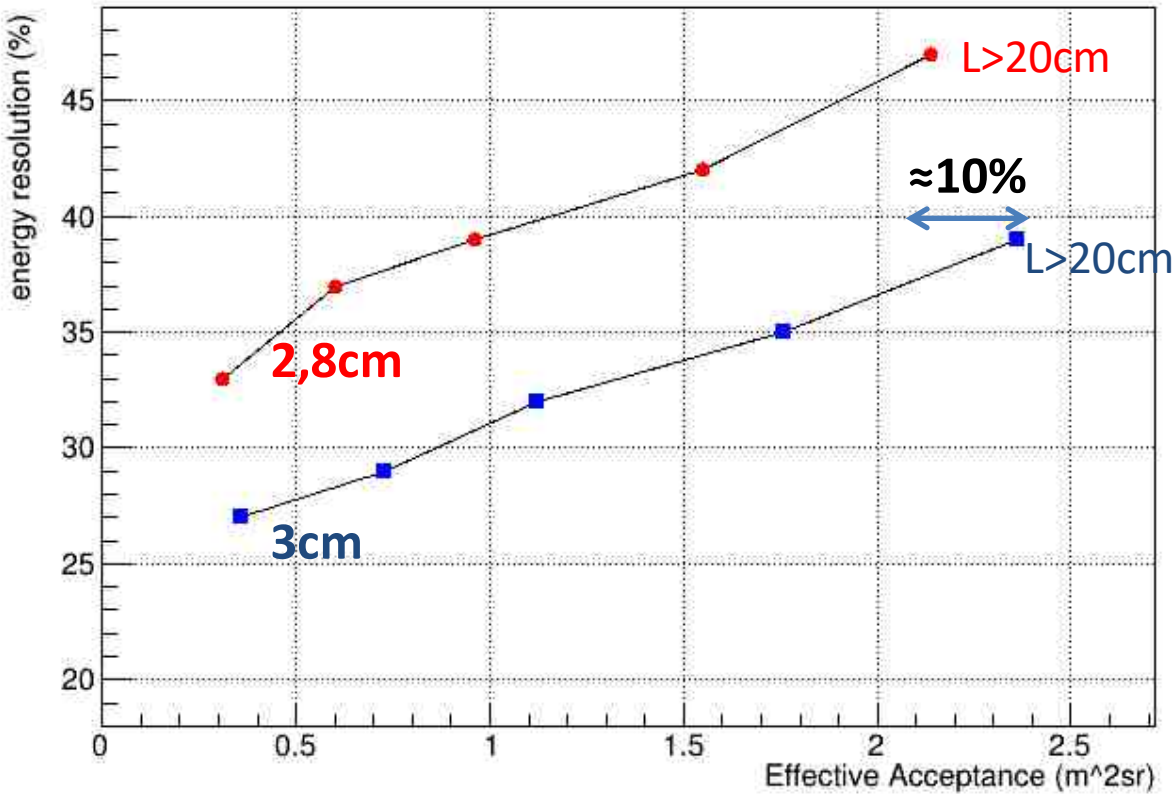
FOR CONSTANT ACCEPTANCE $\sigma/E(2{,}8\text{cm}) \approx \sigma/E(3\text{cm}) + 7\%$

EFFECTIVE ACCEPTANCE CALCULATED FOR ONLY DOWGOING PARTICLES **5 FACES**

GEOMETRIC ACCEPTANCE = 4,4 (m^2sr) (X **1,65**=7,28(m^2sr) for **every directions**)

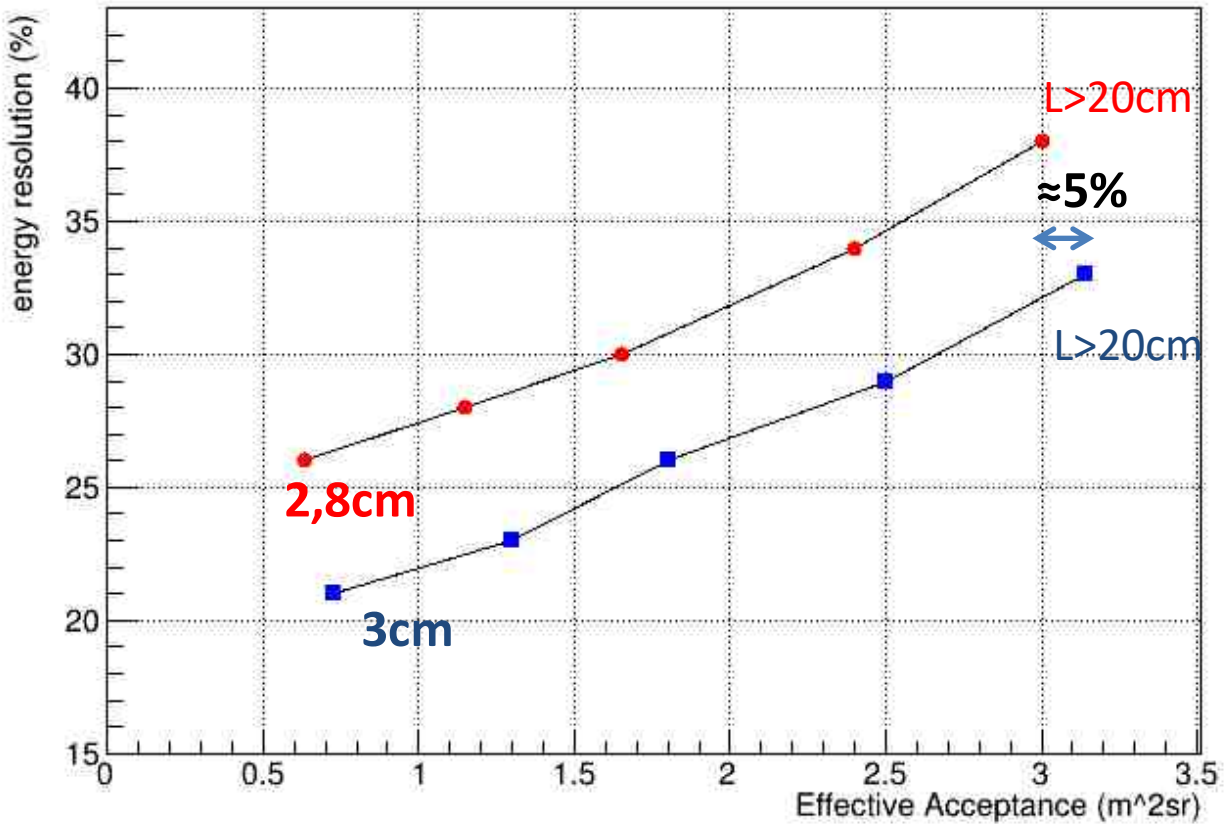
10 TeV protons

**ANALYSYS USING Total length L (LYSO + CARBON FIBER). INTERACTIONS ON PSD INCLUDED**



NUCLEI

# 10 TeV CARBON




FOR CONSTANT ACCEPTANCE $\sigma/E(2{,}8\text{cm}) \approx \sigma/E(3\text{cm}) + 5\%$

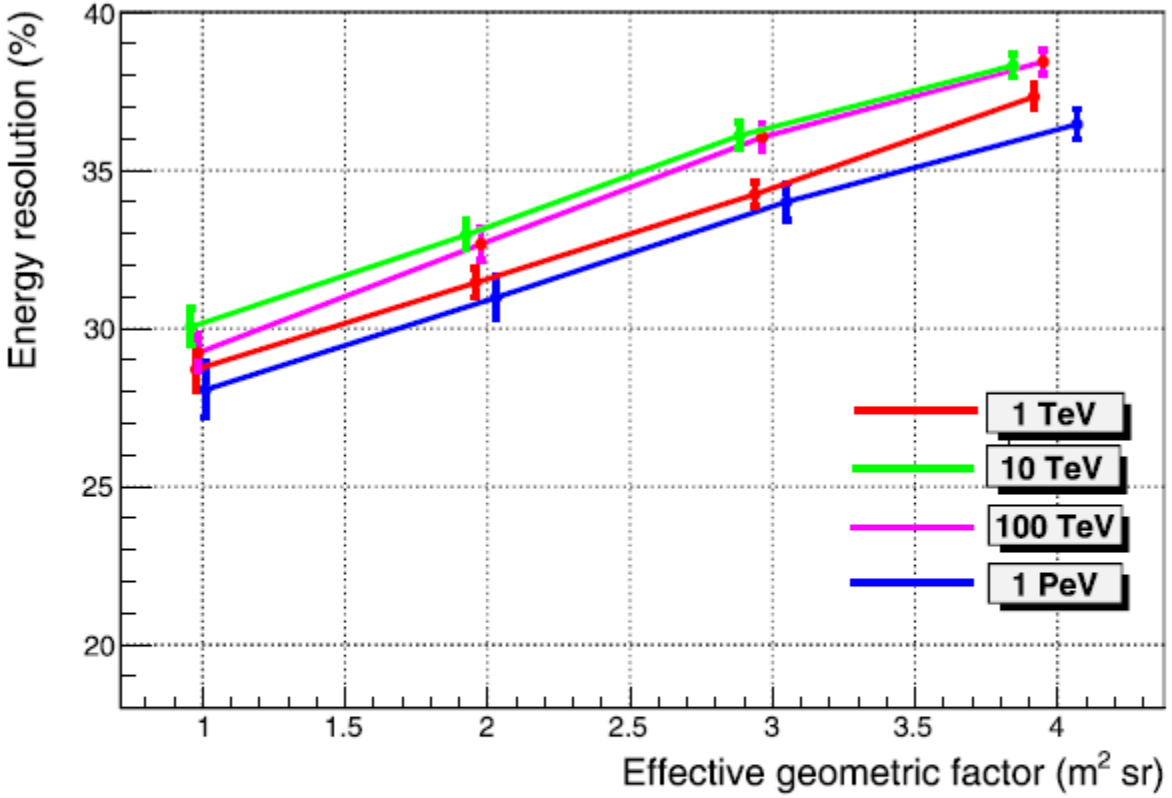
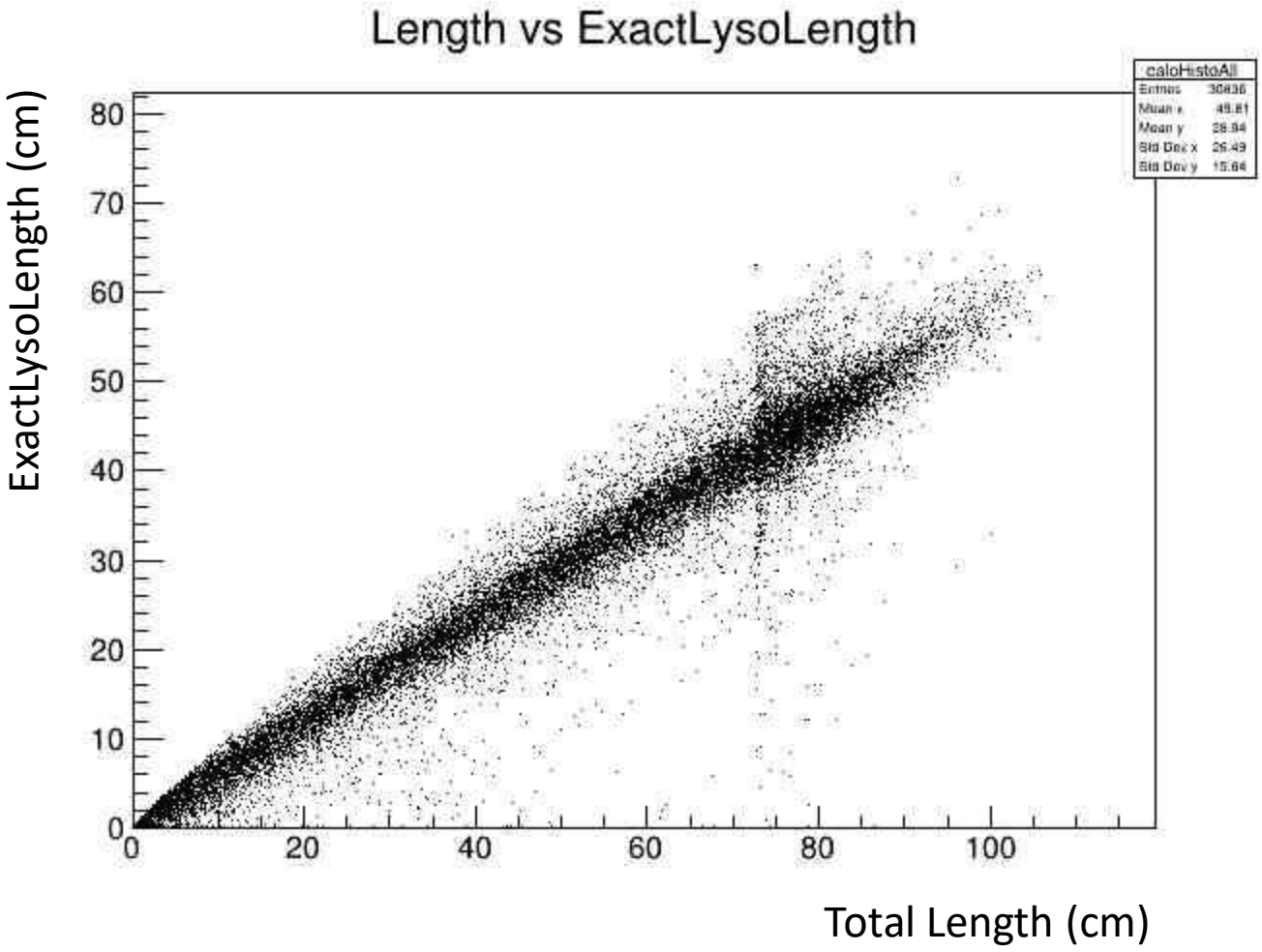
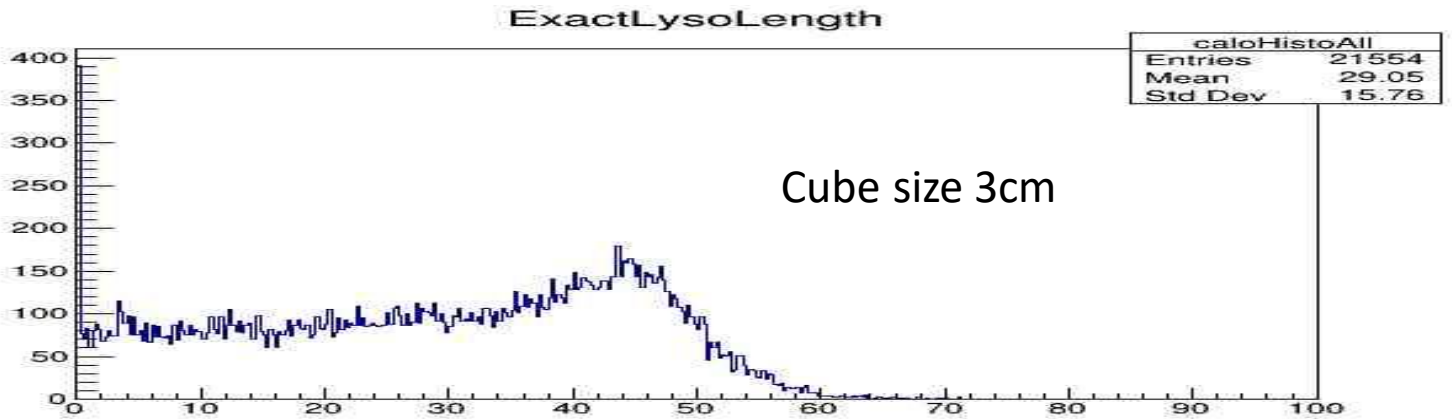
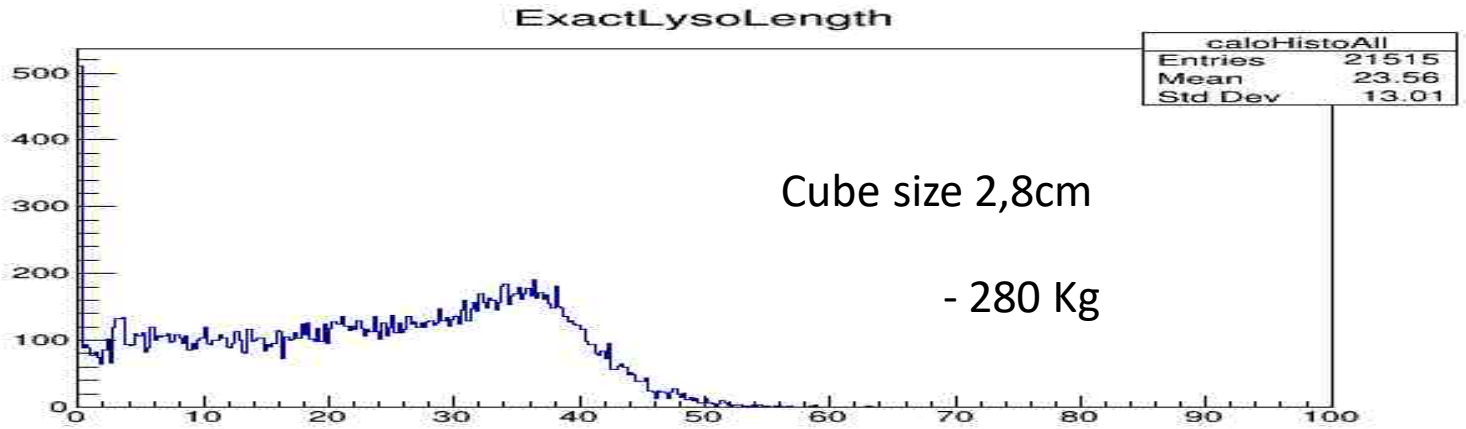
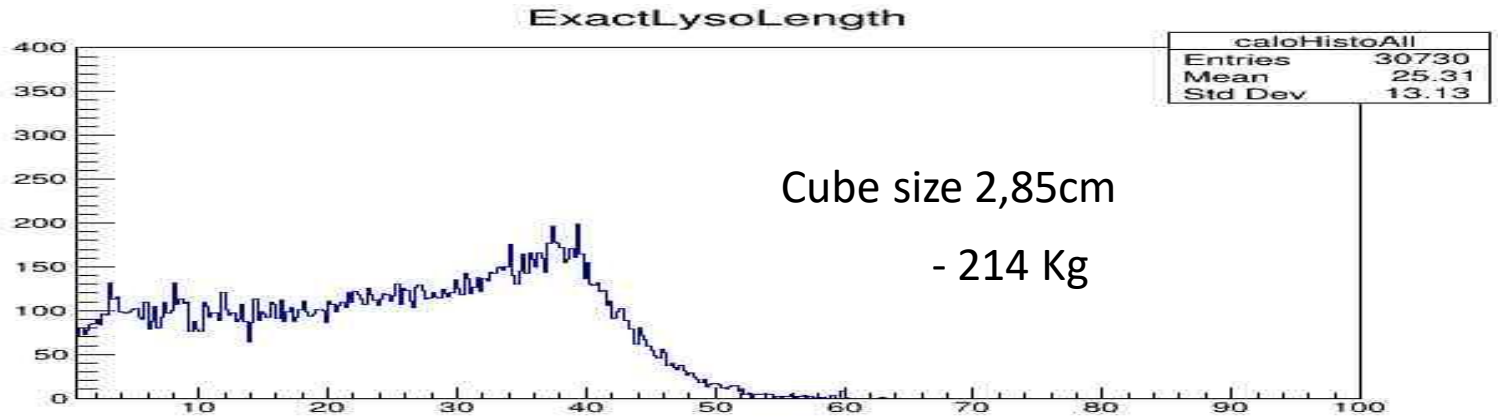



**Fig. 4.** Average energy resolution for CsI cubic calorimeter as a function of the effective geometric factor. The simulated primary particles are protons, from 1 TeV up to 1 PeV. The analysis for the different energy samples uses the same algorithm which iteratively determines the appropriate energy dependent calibration coefficients.


Length vs ExactLysoLength
caloHistoAll
Entries 30836
Mean x 49.81
Mean y 28.94
Std Dev x 26.49
Std Dev y 15.64
ExactLysoLength (cm)
Total Length (cm)
0
10
20
30
40
50
60
70
80
0
20
40
60
80
100

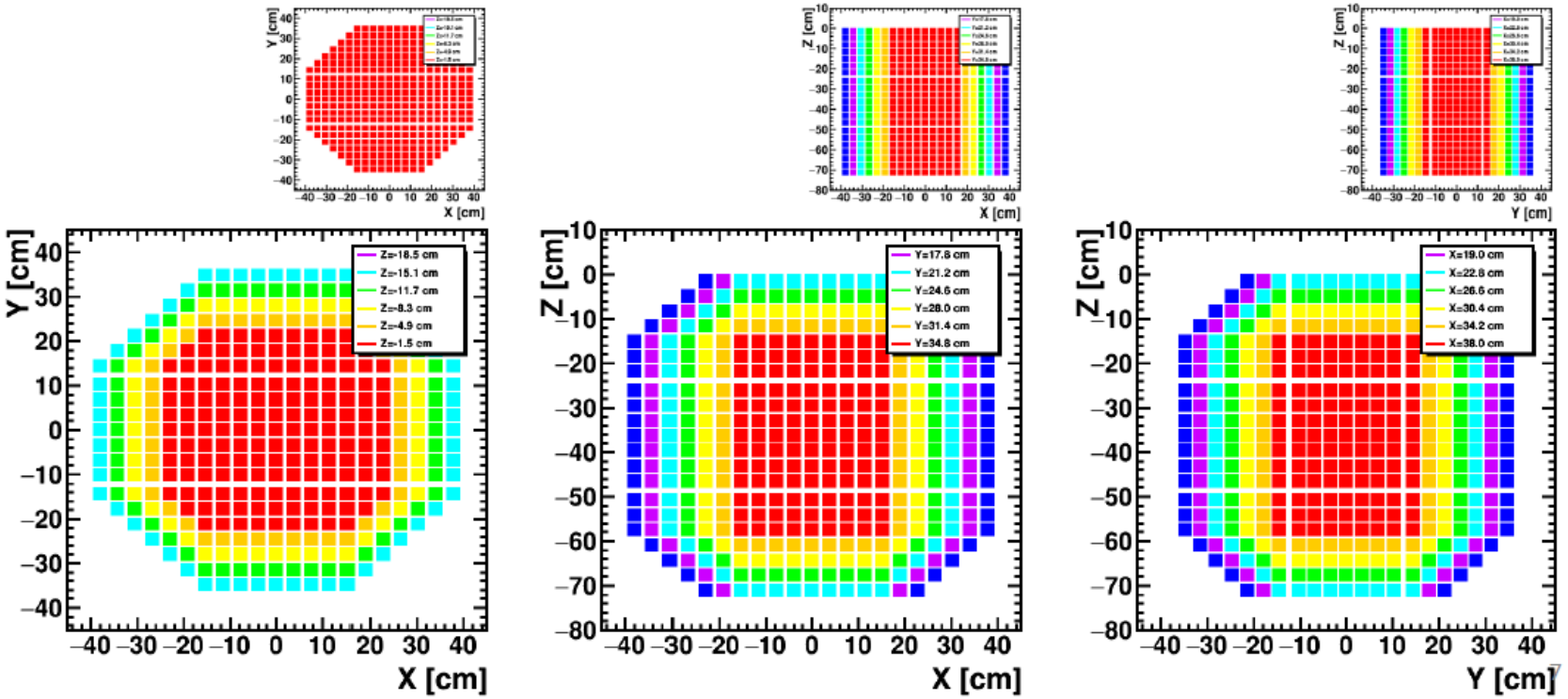

ExactLysoLength
caloHistoAll
Entries 21554
Mean 29.05
Std Dev 15.76
Cube size 3cm

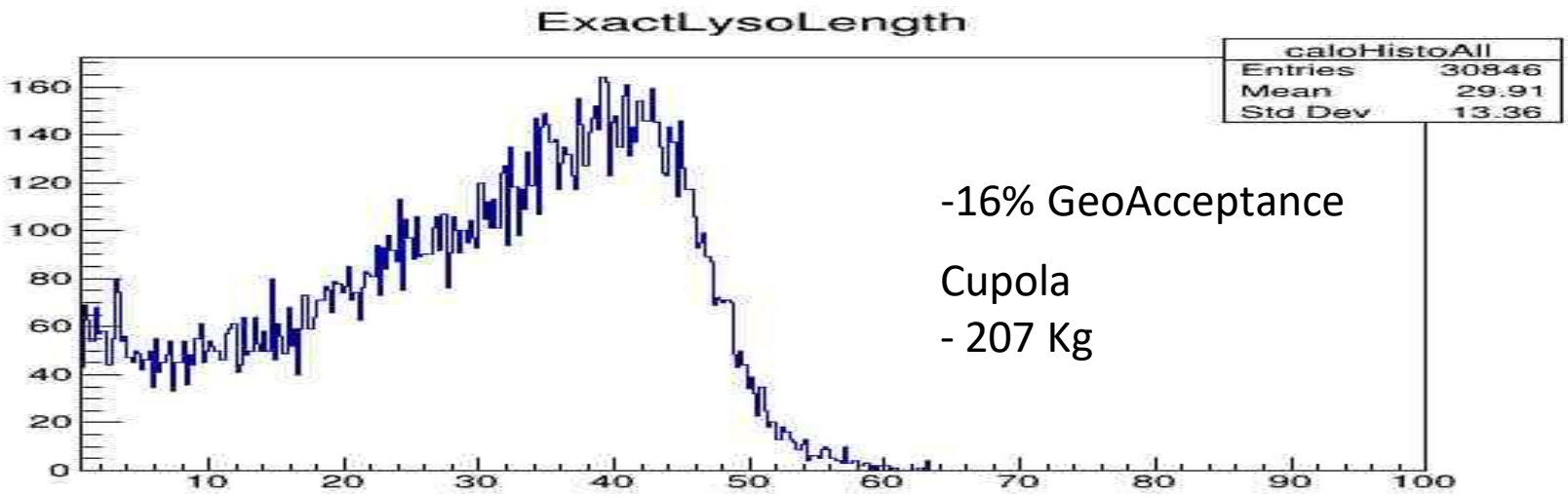

ExactLysoLength
caloHistoAll
Entries 21515
Mean 23.56
Std Dev 13.01
Cube size 2,8cm
- 280 Kg


ExactLysoLength
caloHistoAll
Entries 30730
Mean 25.31
Std Dev 13.13
Cube size 2,85cm
- 214 Kg

# CALO Geometry Figure of Merit

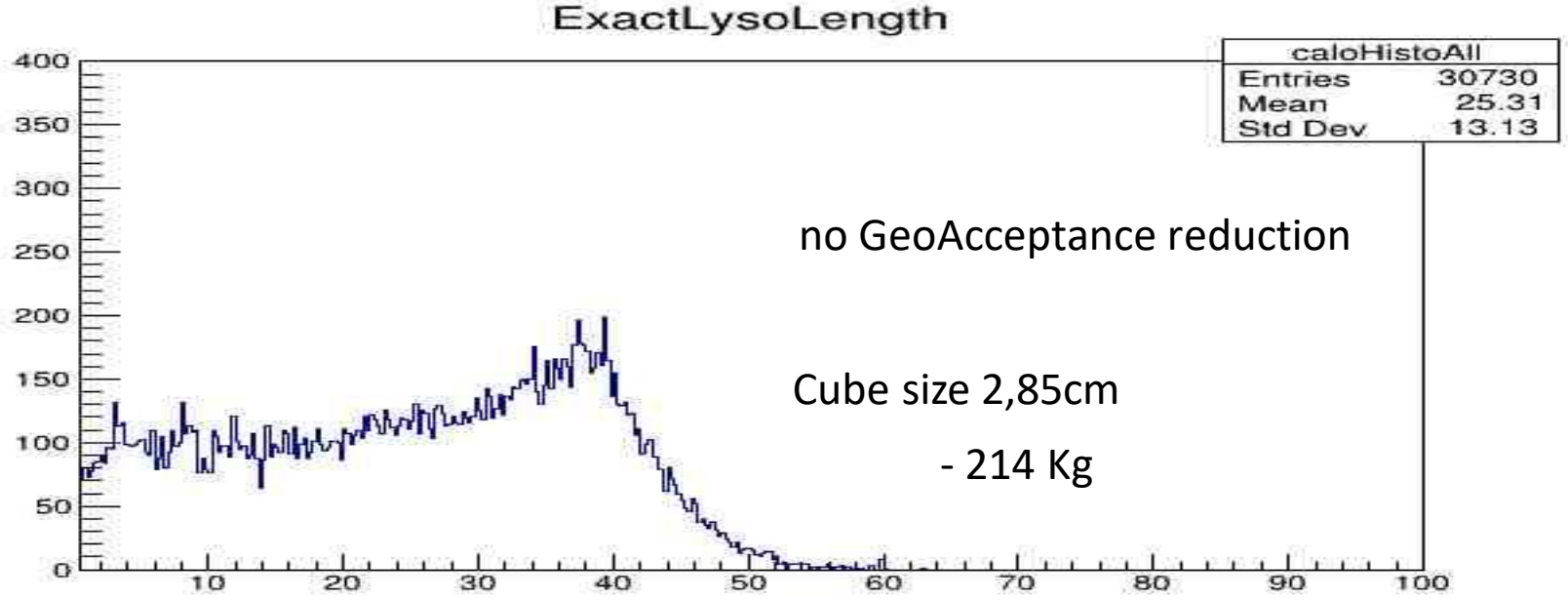
| Configuration | Crystal size [cm] | Nb. Crystals | Weight [kg] | Delta Weight [kg] | Geom. Accep. [m²sr] | Accep. l>20cm [m²sr] | Accep. l*>10cm [m²sr] |
|---|---|---|---|---|---|---|---|
| Nominal | 3.0 | 7497 | 1497.90 | | 4.37 | 3.02 | 2.28 |
| Cupola S Top-4 Bot-4 | 3.0 | 6457 | 1290.11 | -207.79 | 3.69 | 2.78 | 2.03 |






-16% GeoAcceptance

Cupola
- 207 Kg




no GeoAcceptance reduction

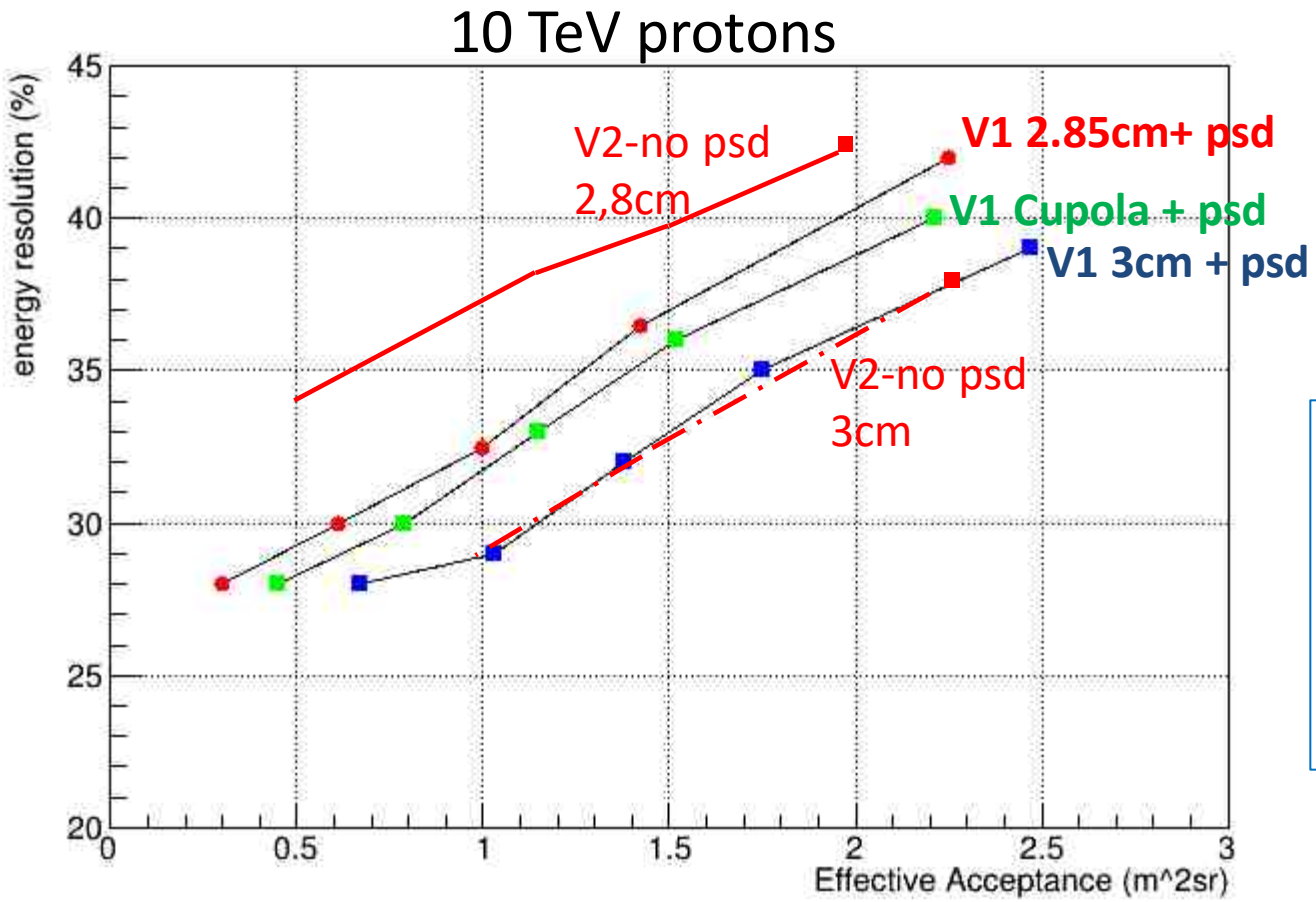
Cube size 2,85cm

- 214 Kg

EFFECTIVE ACCEPTANCE CALCULATED FOR ONLY DOWGOING PARTICLES **5 FACES**

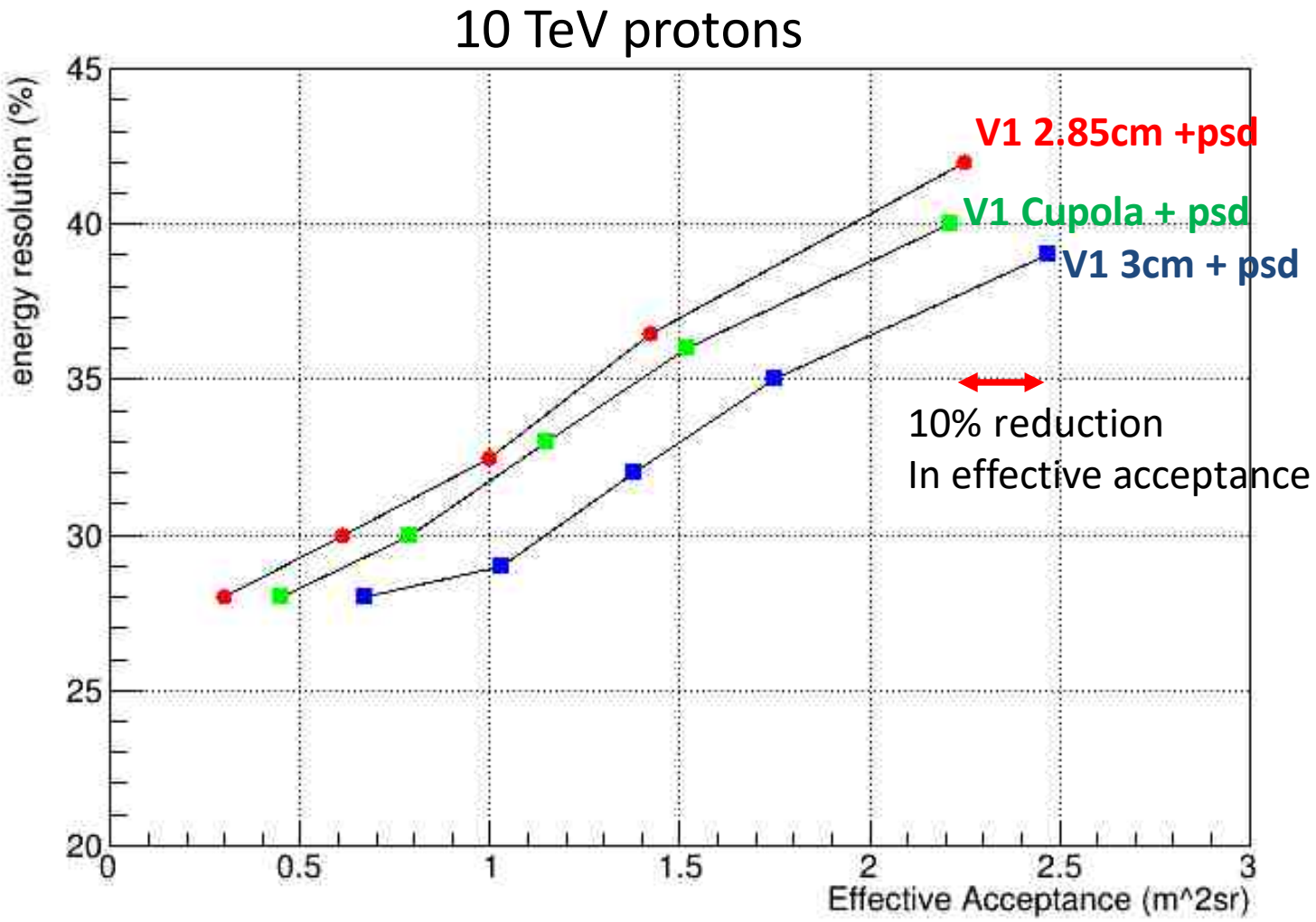
- New V1 caloConfiguration. Gaps filled with homogeneus Carbon 1g/cm3
- In case of cube size reduction the enlarged gaps are filled completely

**ANALYSYS USING LysolengthAfterInt L* (only LYSO), INTERACTIONS ON PSD INCLUDED**




Cuts :
L*>10cm
>20cm
>25cm
>30cm
>35cm

- New V1 caloConfiguration. Gaps filled with homogeneus Carbon 1g/cm3
- In case of cube size reduction the enlarged gaps are filled completely




Cuts :
L*>10cm
>20cm
>25cm
>30cm
>35cm

FOR CONSTANT ACCEPTANCE $\sigma/E(2{,}85\text{cm}) \approx \sigma/E(3\text{cm}) + 4\%$

FOR CONSTANT ACCEPTANCE $\sigma/E(\text{Cup}) \approx \sigma/E(3\text{cm}) + 2{,}5\%$