HiDRa Simulation Updates

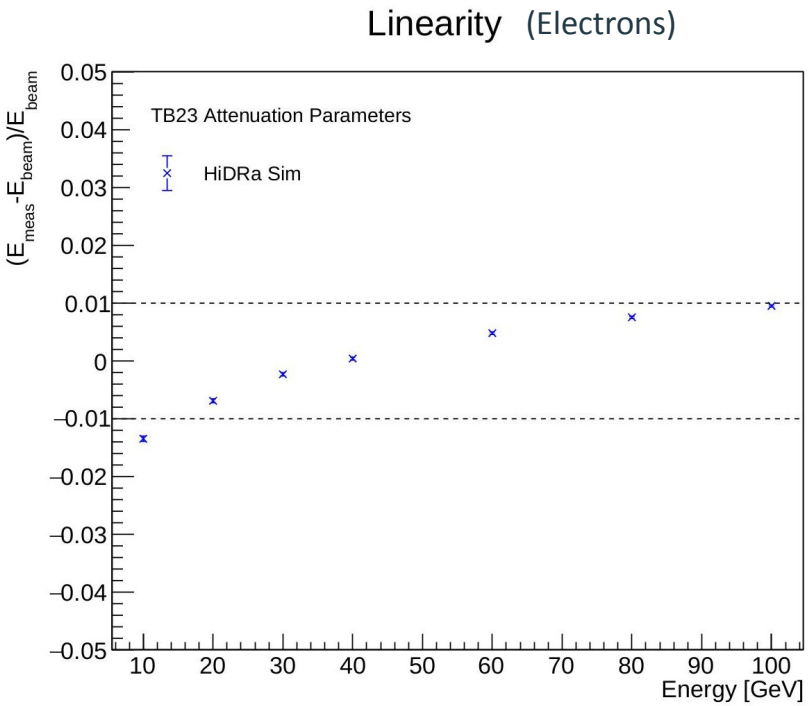
Andrea Pareti - 20/02/2024

Attenuation Length

Light attenuation in optical fibres added to my HidraSim fork
(https://github.com/AndreaPareti/HidraSim)

Attenuation parameters as measured during 2023 test beam:
const G4double SAttenuationLength = 191.6*CLHEP::cm; // from test beam data
const G4double CAttenuationLength = 388.9*CLHEP::cm; // from test beam data

After calibration with positrons the #photoelectrons per GeV reads
double SciPheGeV_Steel = 155.582; //TB2023
double CerPheGeV_Steel = 49.327; //TB2023



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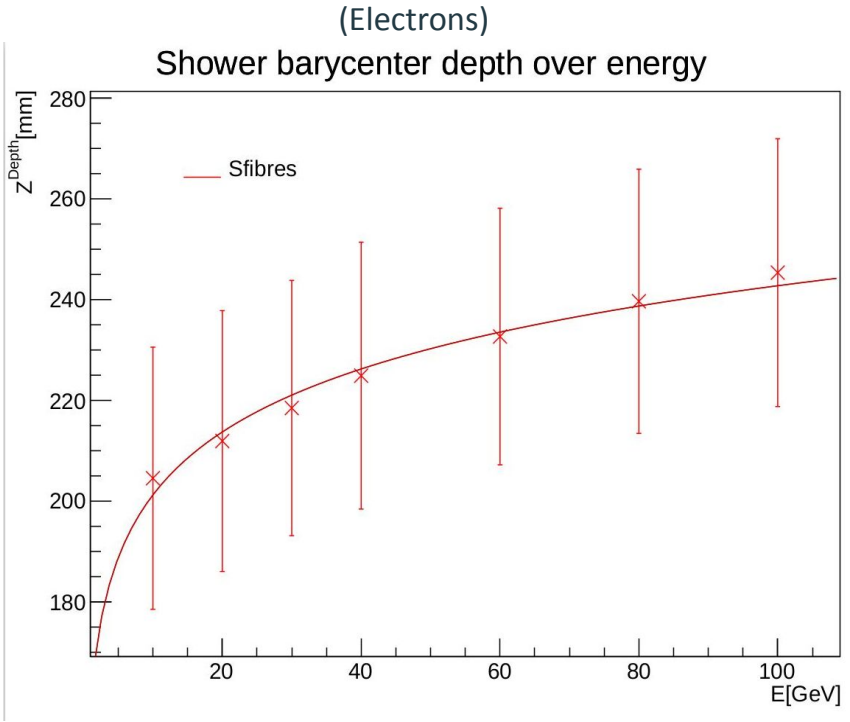
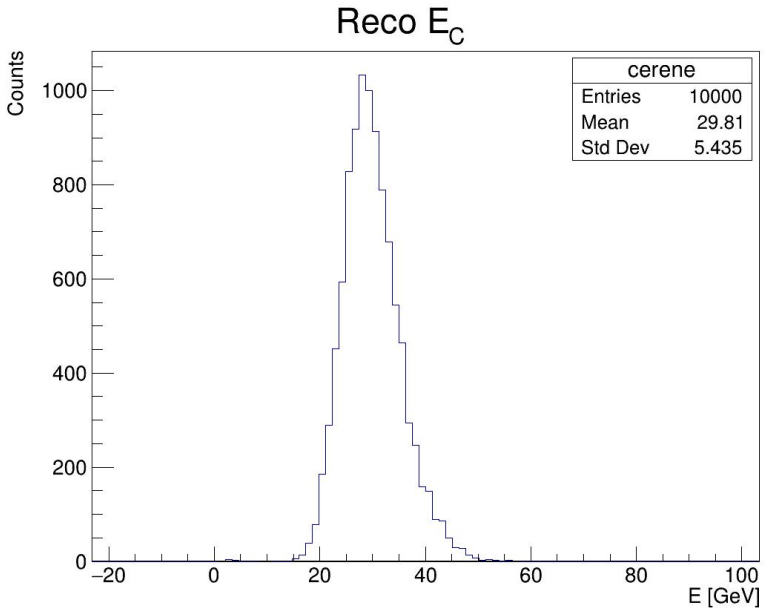
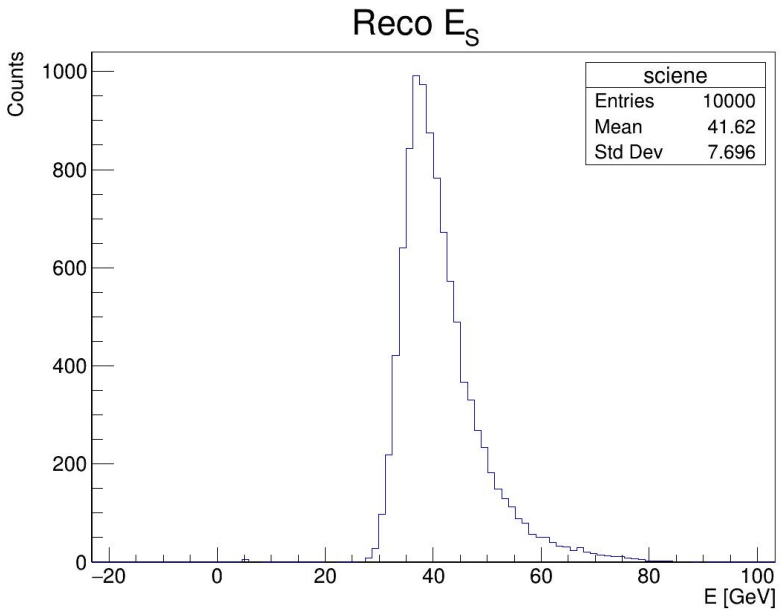


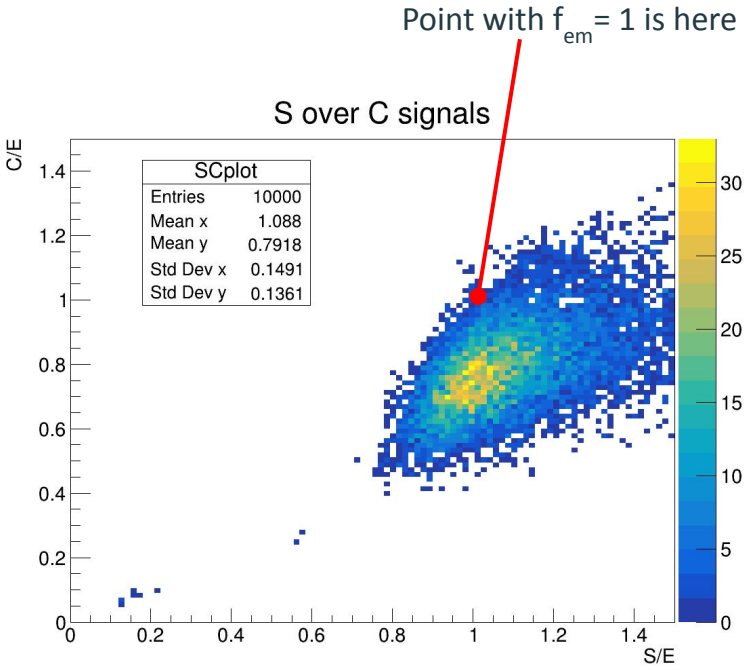
Attenuation Length

Reconstructed energy in C and S fibres after calibration with electrons
Important tail at high energies (most probably due to hadron showers developing deep inside the calorimeter)

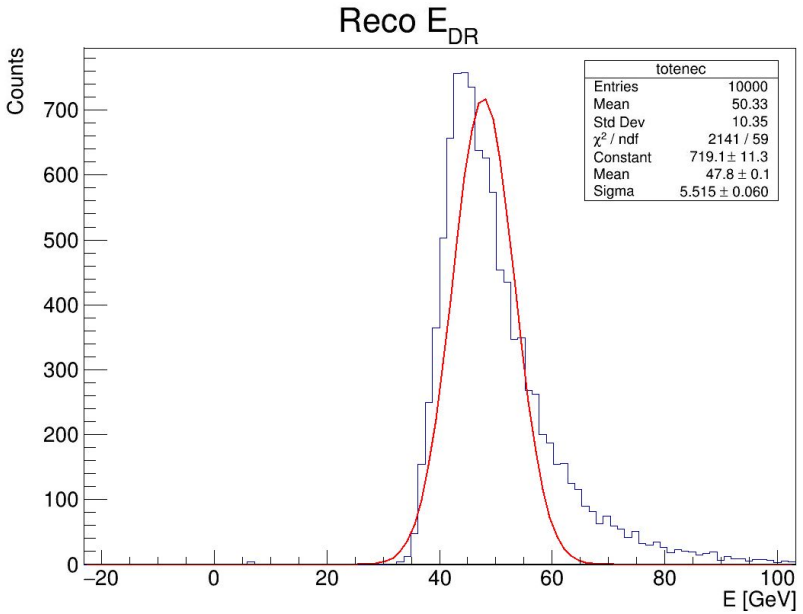




Attenuation Length



Using a standard value of χ and applying DR formula one finds energies much higher than expected due to this tail (definitely not gaussian shape)
Here: χ=0.3



Attenuation Length

const G4double SAttenuationLength = 191.6*CLHEP::cm; // from test beam data
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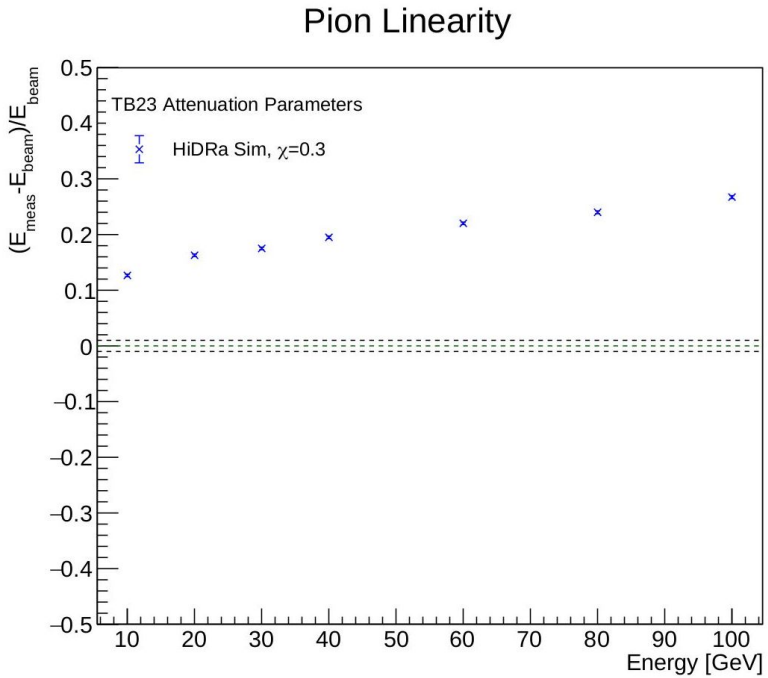
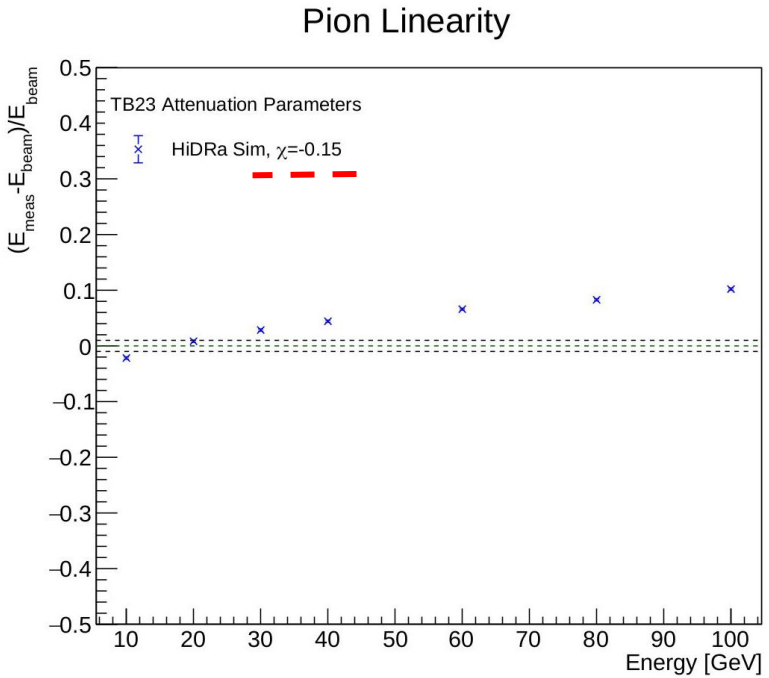
Do these values even make sense for an optical calorimeter?
Do we have any number for SPACAL/DREAM/RD52 ?

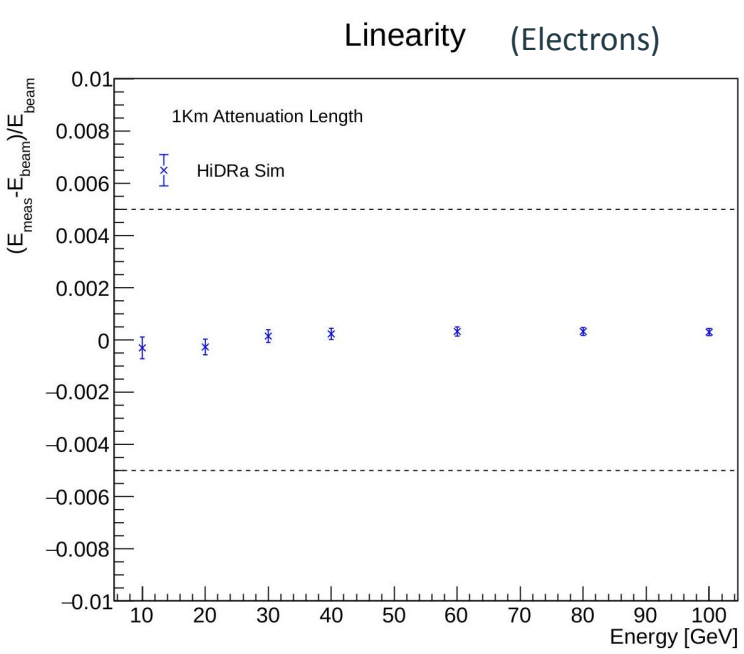
Brute forcing some values for chi to try recover linear response

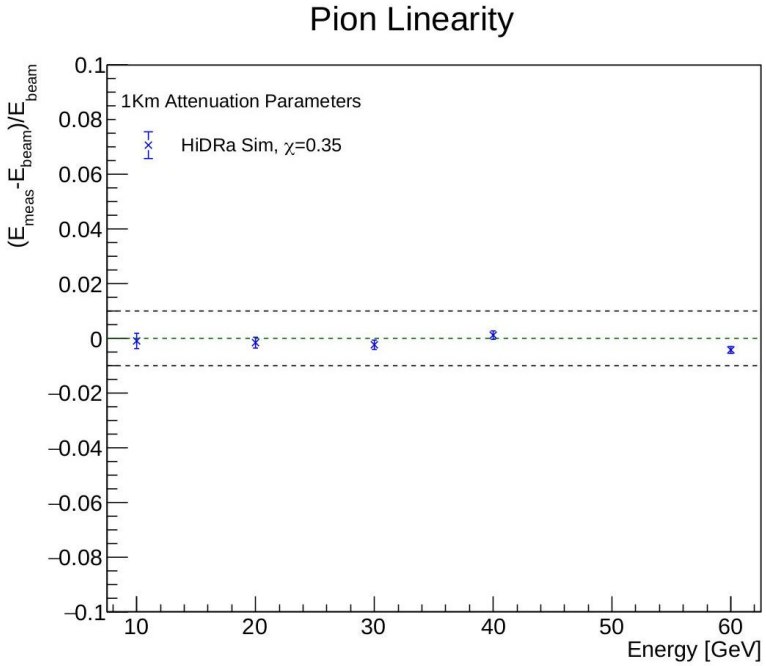




Attenuation Length

Quick test to see what happens with ~no losses, setting a one kilometre attenuation length
double SciPheGeV_Steel = 510.40757142857143; // 1Km Attenuation Length
double CerPheGeV_Steel = 88.42804285714286;   // 1Km Attenuation Length
(light yield in TB2023 simulation is higher than original HidraSim)

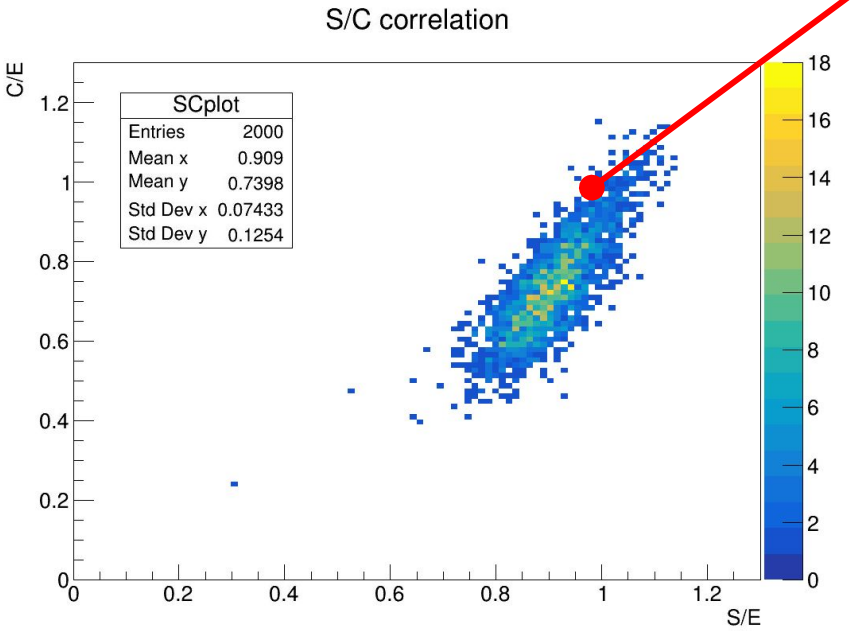


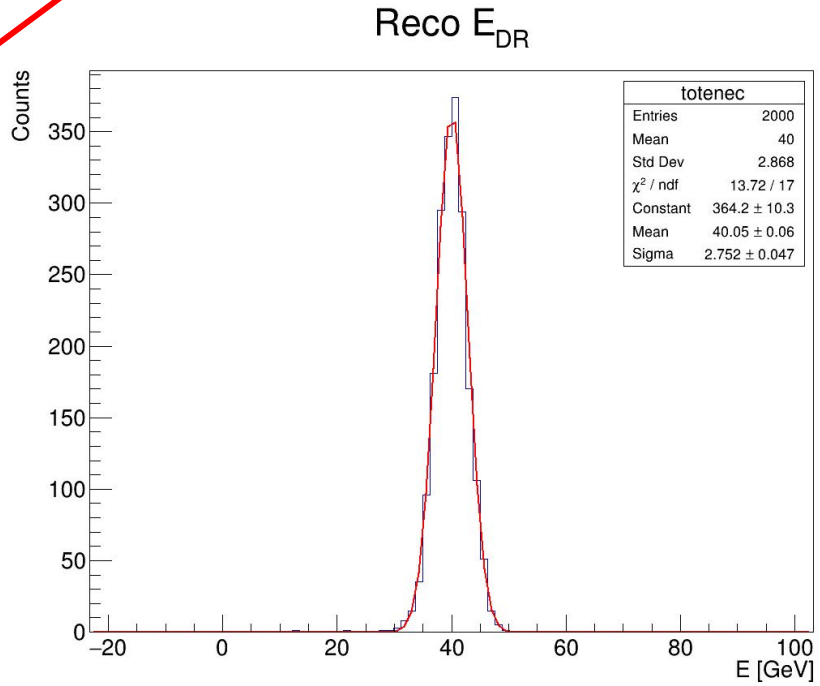


Attenuation Length

double SciPheGeV_Steel = 510.40757142857143; // 1Km Attenuation Length
double CerPheGeV_Steel = 88.42804285714286; // 1Km Attenuation Length

This seems much better
High energy tail disappeared
Are these fibres for sale?





Attenuation Length

From Datasheet:
Attenation S: ~6m
Attenuation C: ~20m (pessimistic esteem)
double SciPheGeV_Steel = 348.305; //datasheet
double CerPheGeV_Steel = 79.042; //datasheet

3.Performance

Table2

Item		Acceptance Criterion and / or [Test Condition]	SK - 40 Specification			
			Unit	Min.	Typ.	Max.
Maximum Rating	Storage and Operation Temperature	No Deterioration in Optical Properties*	℃	- 55	—	+ 70
	Operation Temperature under high humidity	No Deterioration in Optical Properties** [95 %RH]	℃	-	—	+ 70
Optical Properties	Transmission Loss	650 nm Collimated Light] [Standard condition] [10 m - 1 m cutback]	dB/km	—	—	150
Mechanical Characteristics	Minimum Bend Radius	Loss Increment =< 0.5 dB [Quarter bend]	mm	20	—	—
	Tensile Strength	[Tensile Force at Yield Point] [JIS C 6861]	N	65	—	—

All tests are carried out under temperature of 25℃ unless otherwise specified.

* Attenuation change shall be within 10 % after 1,000 hours.
** Attenuation change shall be within 10 % after 1,000 hours, except that due to absorbed water .

On Mon, Oct 9, 2023 at 10:50 AM Franco Bedeschi <bed@fnal.gov> wrote:

Ciao Gabriella,

non mi tornano i tuoi numeri. A me sembra che il picco di emissione sia intorno a 460 - 480 nm. Vedi il plot M2All.pdf allegato dove ho messo le curve di emissione per tutte le
una curva di emissione sul plot dell'attenuazione nel secondo file M2Only.pdf.

Riporto inoltre per questa fibra una tabellina di attenuazioni e la media nel range: Min wave: 431 nm, max wave: 584 nm

Wavelength: 460, attenuation = 408.364 cm
Wavelength: 480, attenuation = 579.128 cm
Wavelength: 520, attenuation = 926.937 cm
Wavelength: 560, attenuation = 1191.41 cm
Wavelength: 600, attenuation = 1778.86 cm
Wavelength: 620, attenuation = 826.382 cm

Average attenuation length = 661.467

Nel contratto avevamo richiesto almeno 4 metri di lunghezza di attenuazione mediata sullo spettro di emissione, quindi 6.6 m sono sufficienti a soddisfare le richieste.

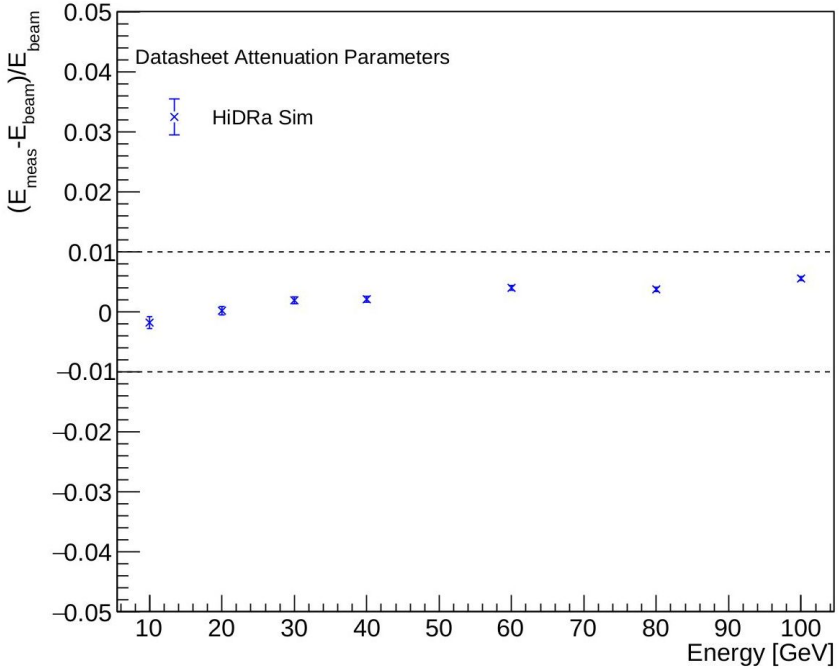
Ciao,
Franco Bedeschi

Should be something around 26-28 metres

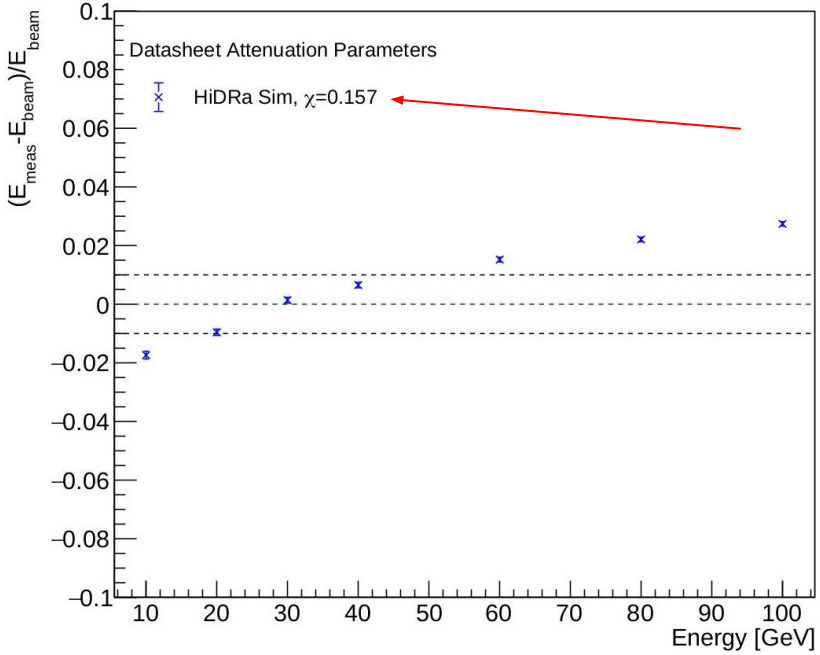
Attenuation Length

χ still has a somewhat strange value, but it works more or less

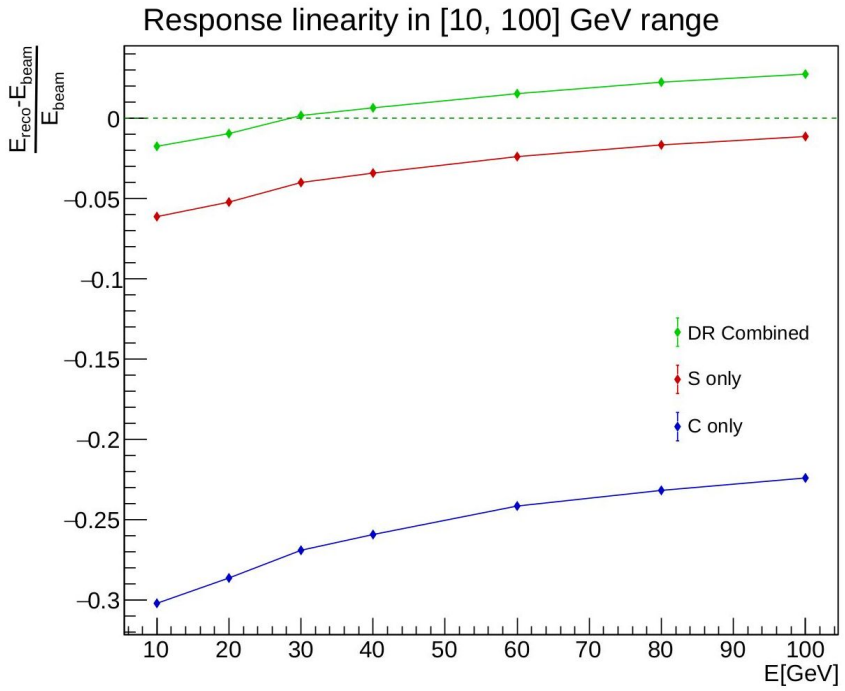
Electrons Linearity



Pion Linearity



Attenuation Length

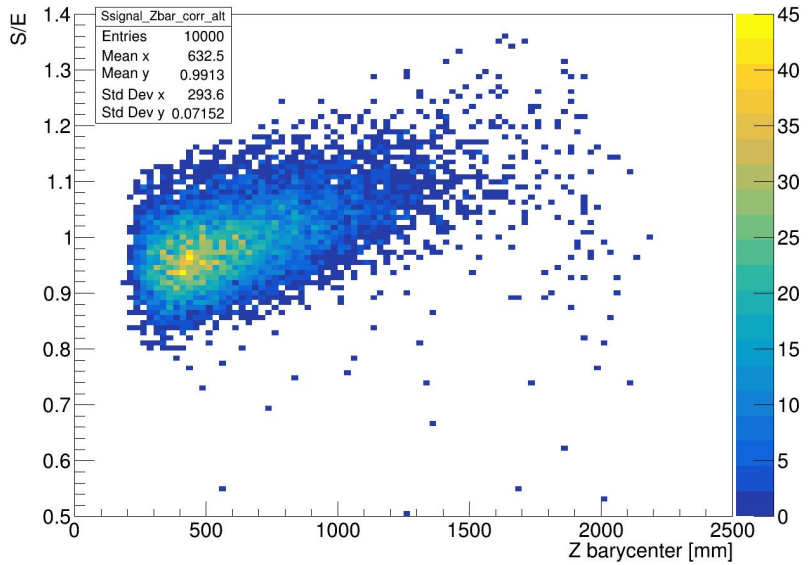


Attenuation Length

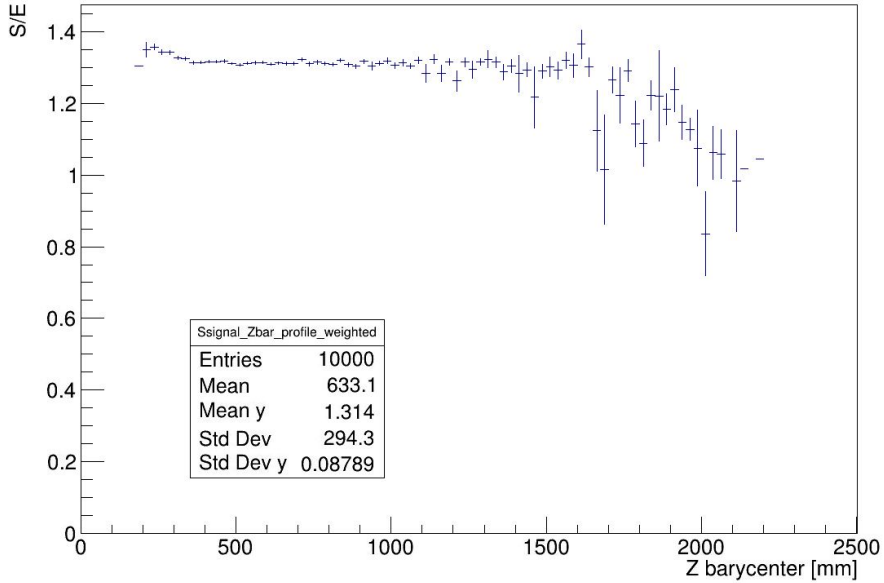
Weighting for light attenuation corresponding to barycenter Z position

$w = e^{(2500-z)/\lambda}$

S correlation with shower Z barycenter



S profiled with shower Z barycenter



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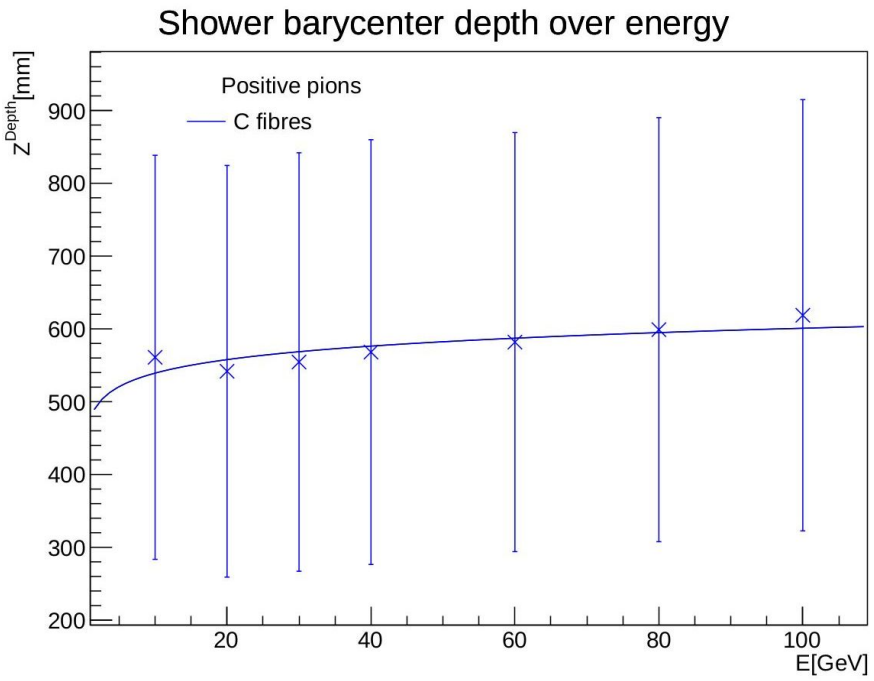

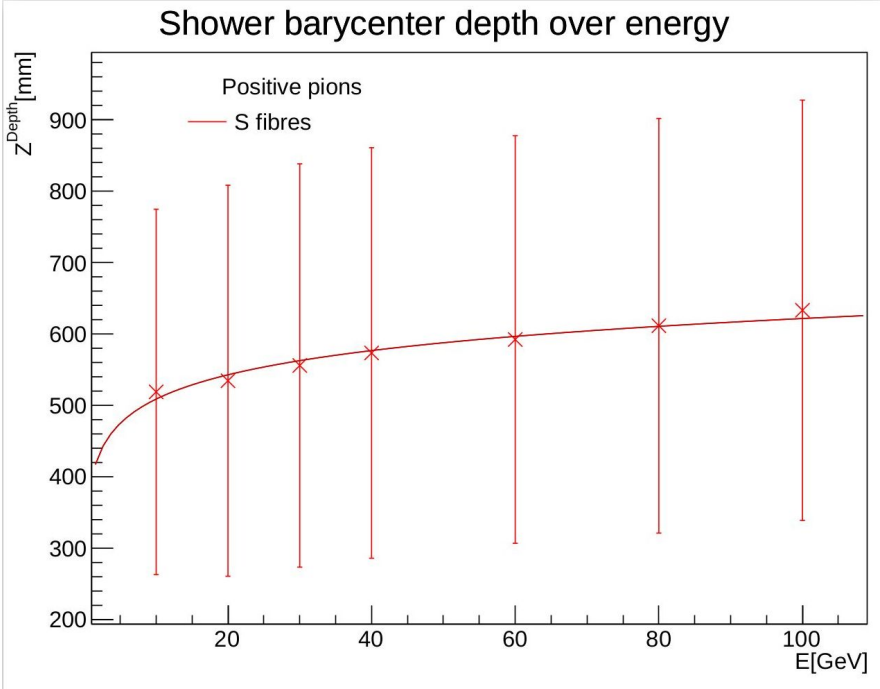

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