TB2025 – Simulation results

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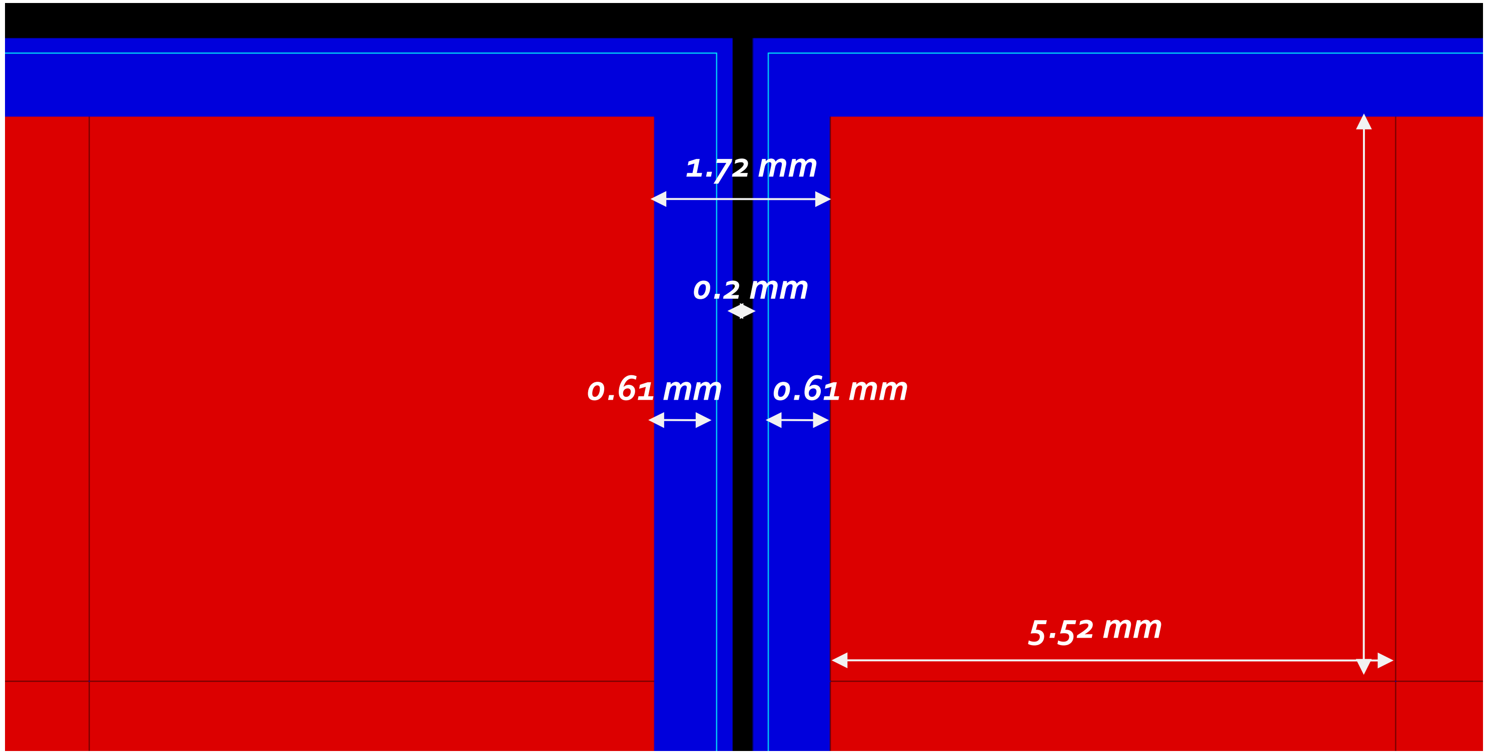
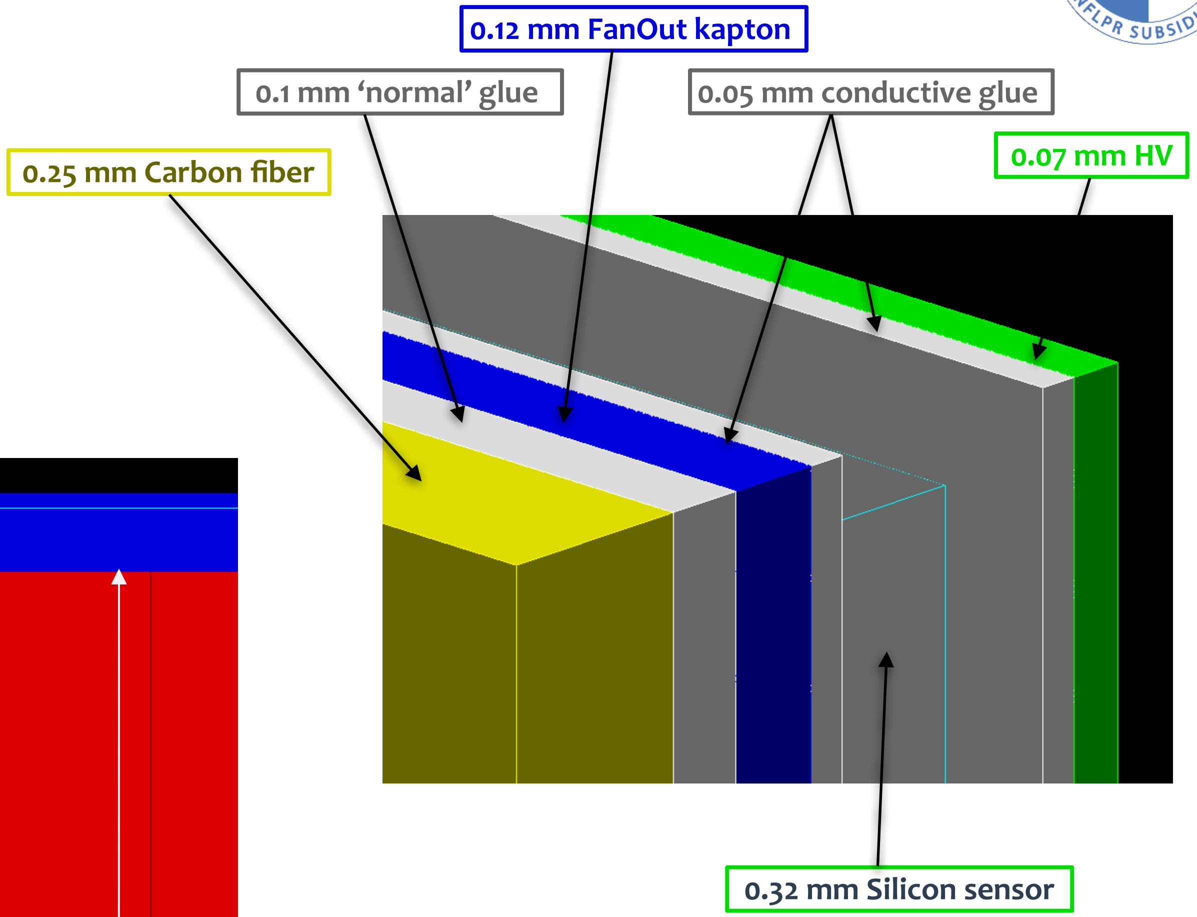
Geometries and materials

Si sensors

- *squared shape: 89.97 mm x 89.97 mm*
- *16 by 16 pads of 5.52 mm x 5.52 mm*
- *0.01 mm gap between pads*
- *total thickness: 0.96 mm*



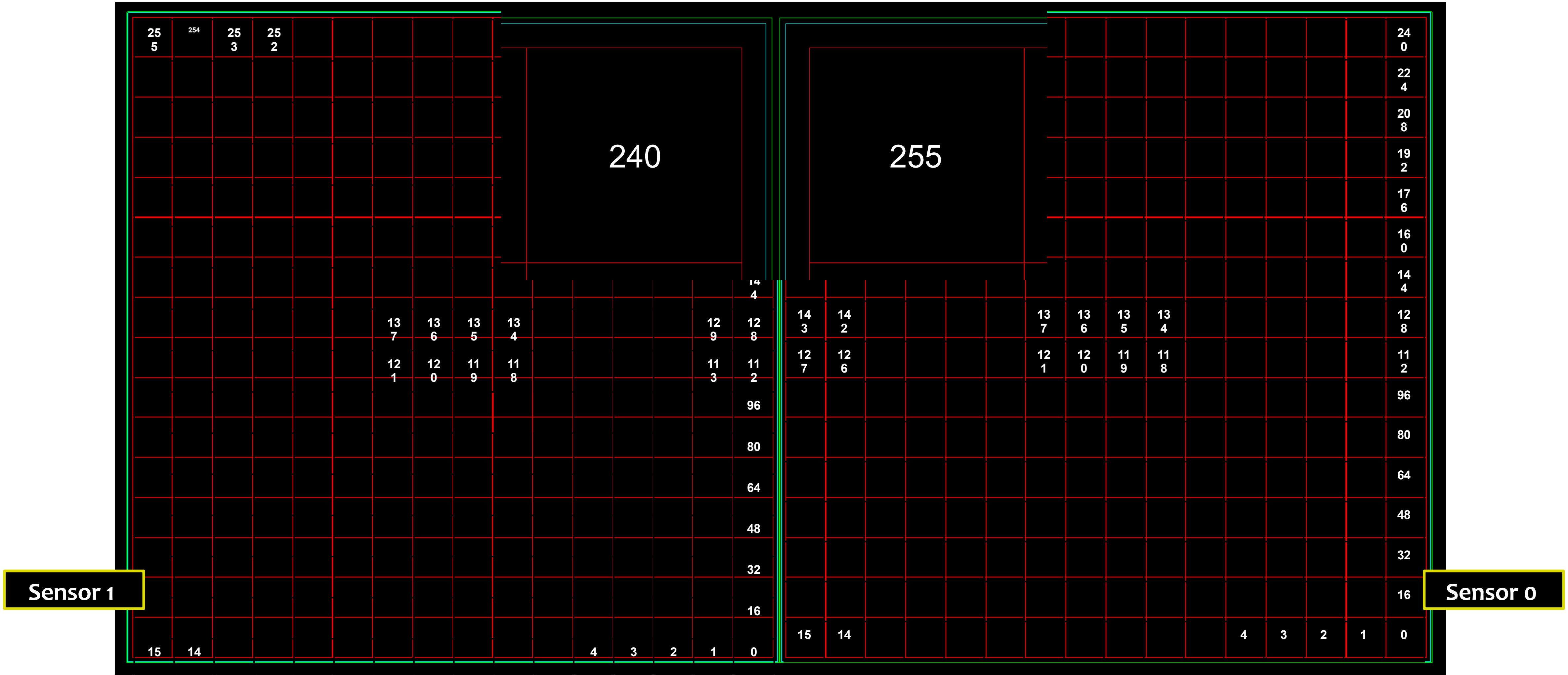


- *same as described in one of Adrian's talk*
- *thickness bellow 1 mm (relaxed to 1.2 mm for the testbeam 2025 ?!?)*

Geometries and materials

Layer construction

- *2 sensors placed side-by-side (not one layer with 2 sensors together !)*
- *pads numbering starting the right down corner*

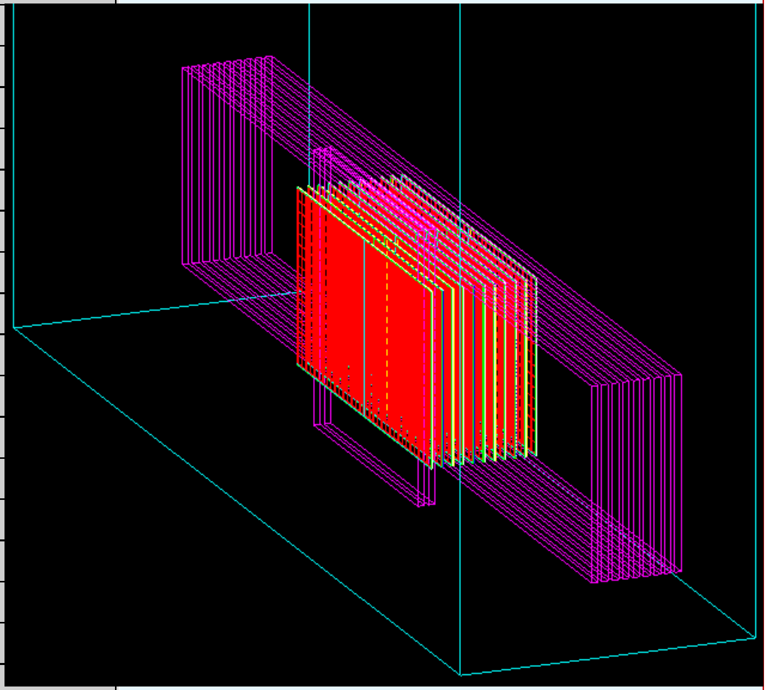


Geometries and materials

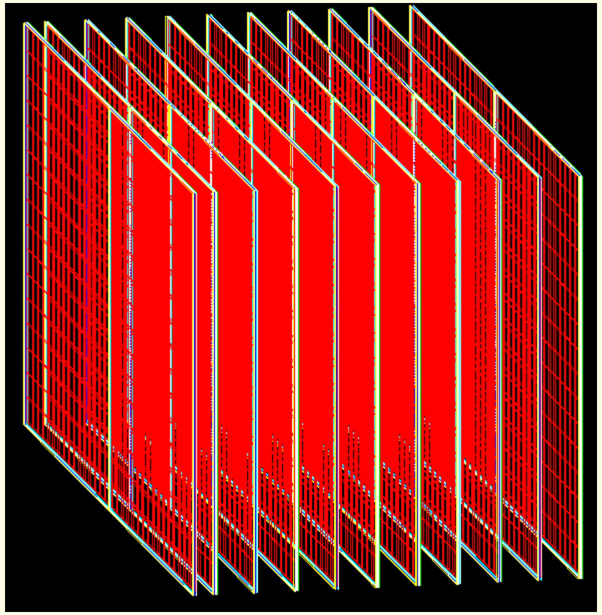
setups for investigation

- Setup 3: *11 layers with 11 X_0*

Stack configuration		
	Module	Tungsten
	V beam V	
Slot 0	N/A	
Slot 1		
Slot 2		
Slot 3		
Slot 4		
Slot 5		
Slot 6		
Slot 7		
Slot 8		
Slot 9		
Slot 10	12	Old 2
Slot 11	11	Old 1
Slot 12	9	N1
Slot 13	8	N2
Slot 14	7	N3
Slot 15	10	XM1
Slot 16	1	XM2
Slot 17	4	XM3
Slot 18	3	BJ1
Slot 19	6	BJ2
Slot 20	5	BJ3



- Setup 5: *11 layers without W*



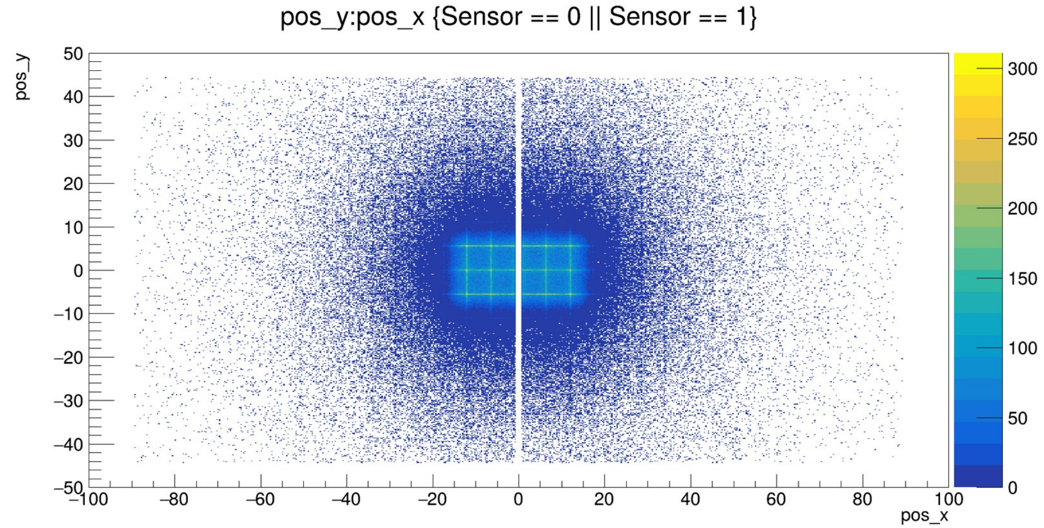
Stack configuration		
	Module	Tungsten
	V beam V	
Slot 0	N/A	
Slot 1	12	
Slot 2	11	
Slot 3		
Slot 4	9	
Slot 5		
Slot 6	8	
Slot 7		
Slot 8	7	
Slot 9		
Slot 10	10	
Slot 11		
Slot 12	1	
Slot 13		
Slot 14	4	
Slot 15		
Slot 16	3	
Slot 17		
Slot 18	6	
Slot 19		
Slot 20	5	

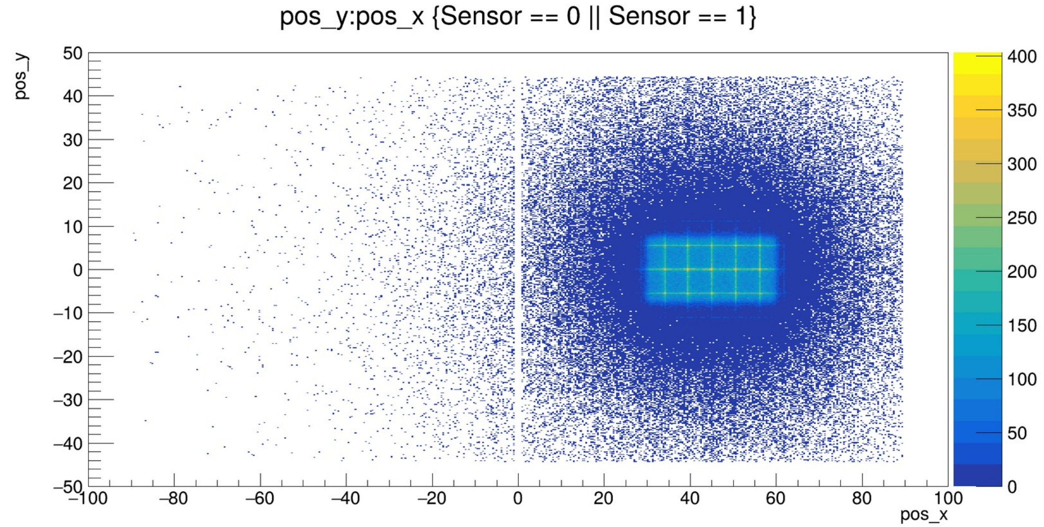
First results

hit maps

- 5 GeV

- Setup 3: *11 layers with 11 X_0*

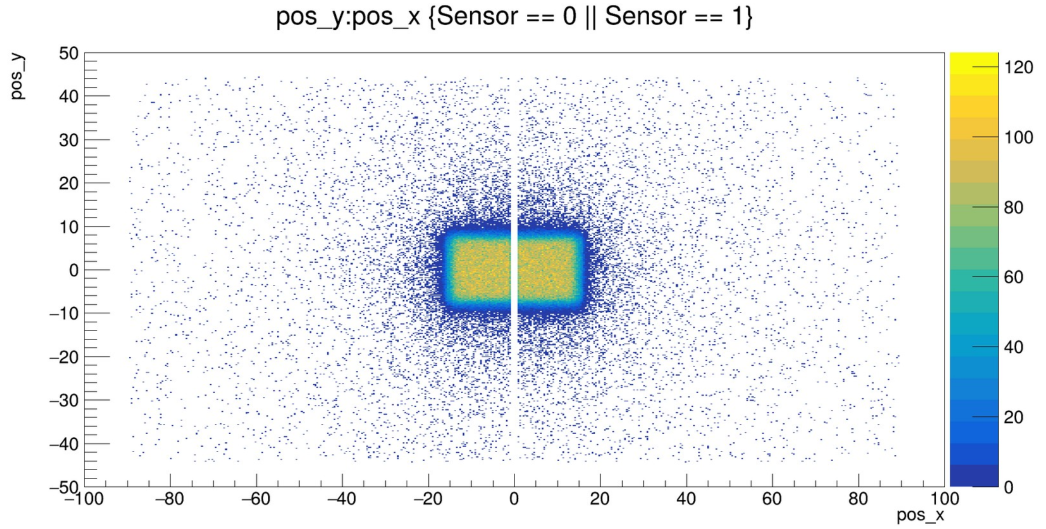


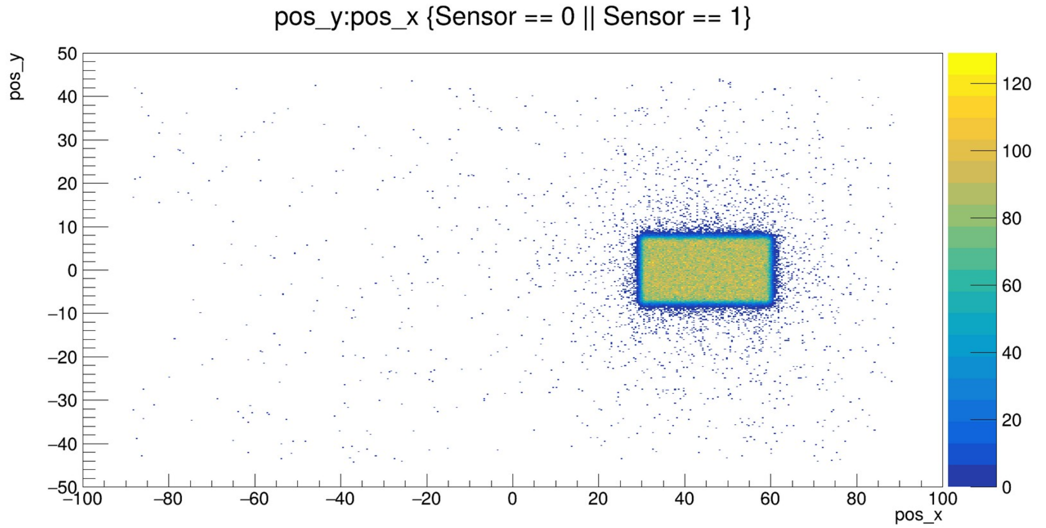


Beam centered between sensors
X: 0.0
Y: 0.0

Beam centered on sensor 1
X: 4.5
Y: 0.0

- Setup 5: *11 layers without W*



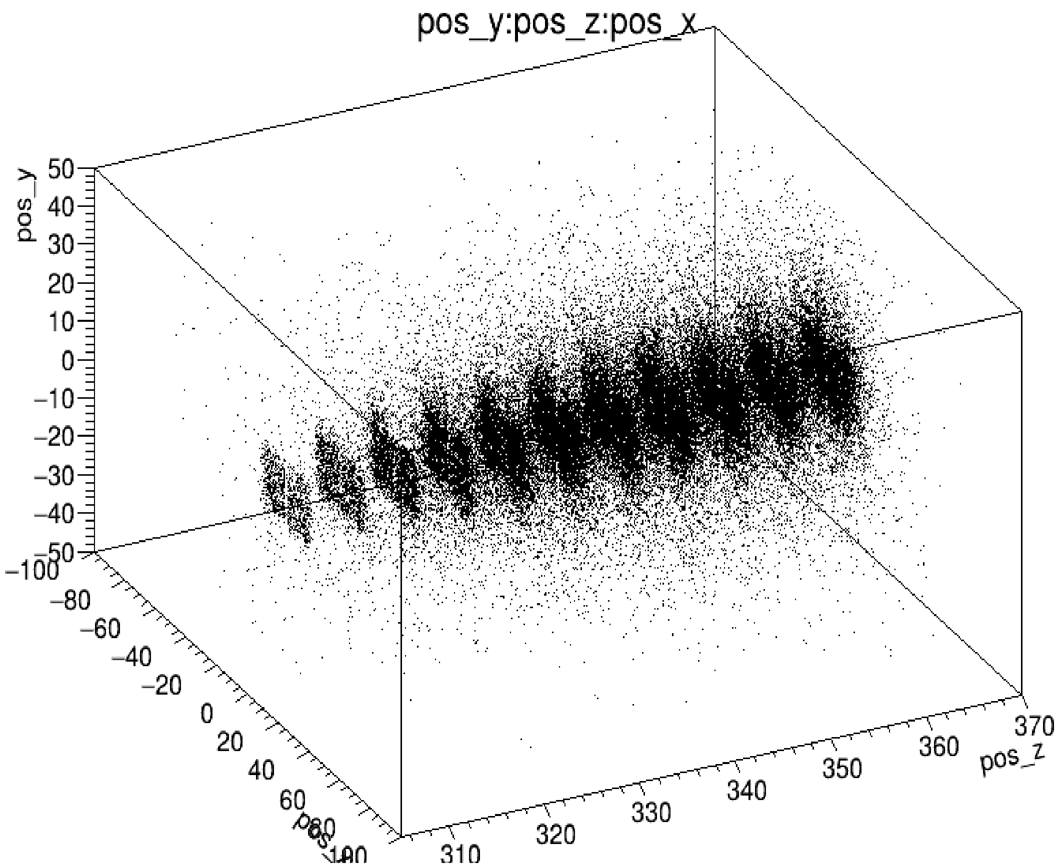


Results

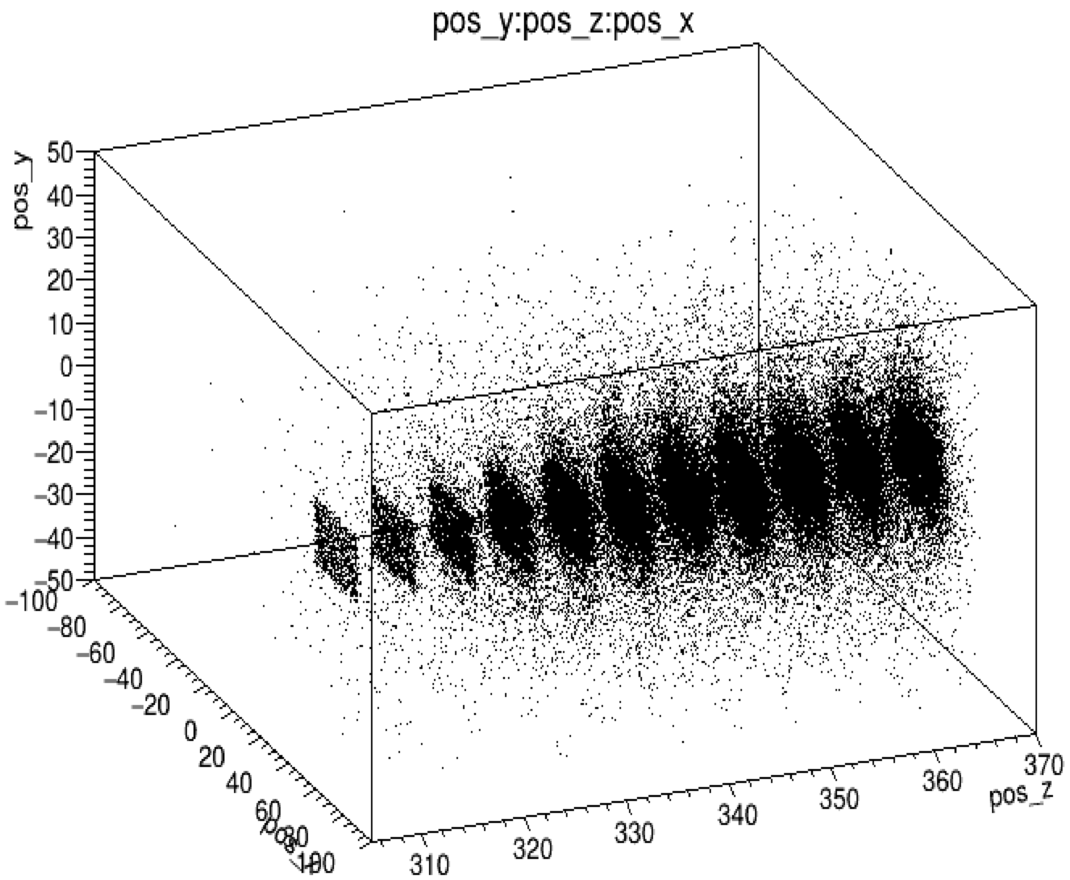
hit maps

▪ Setup 3: *11 layers with 11 X_0*

▪ 5 GeV



Beam centered between sensors
X: 0.0
Y: 0.0



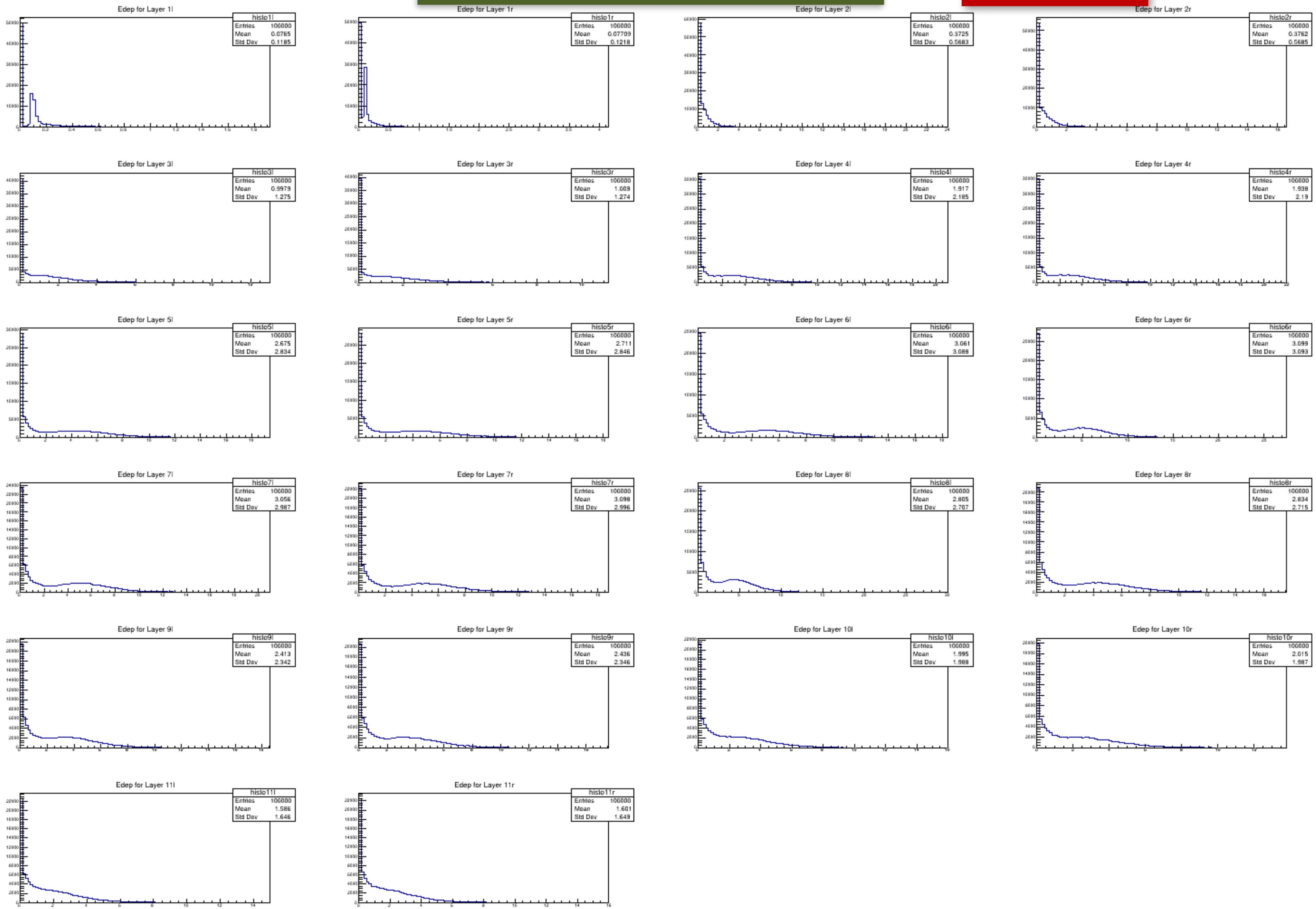
Beam centered on sensor 1
X: 4.5
Y: 0.0

Results

deposition on sensors

- Setup 3: *11 layers with 11 X_o*
- 5 GeV

Beam centered between sensors
X: 0.0
Y: 0.0

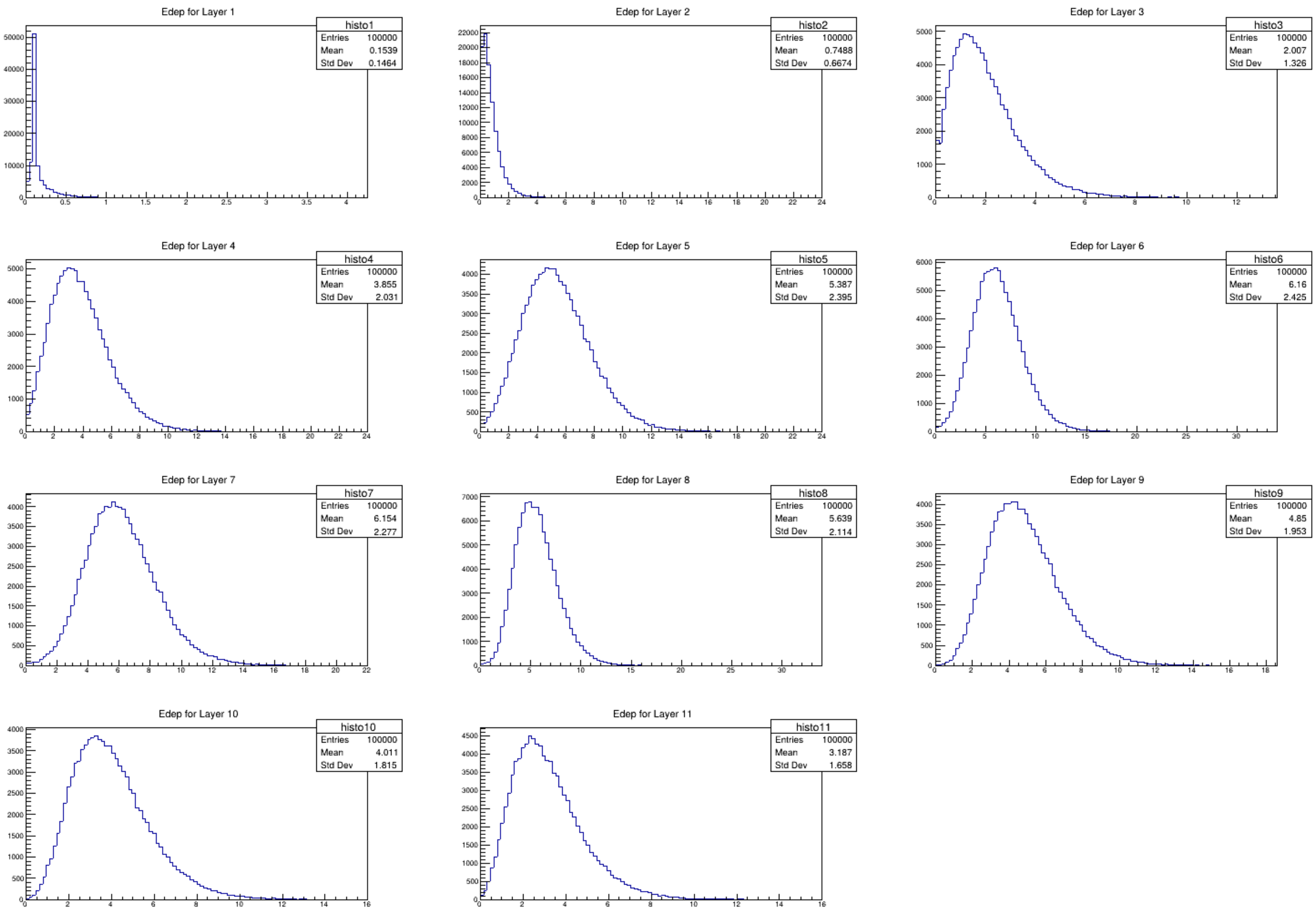


Results

deposition on layers

- Setup 3: *11 layers with 11 X_o*
- 5 GeV

Beam centered between sensors
X: 0.0
Y: 0.0



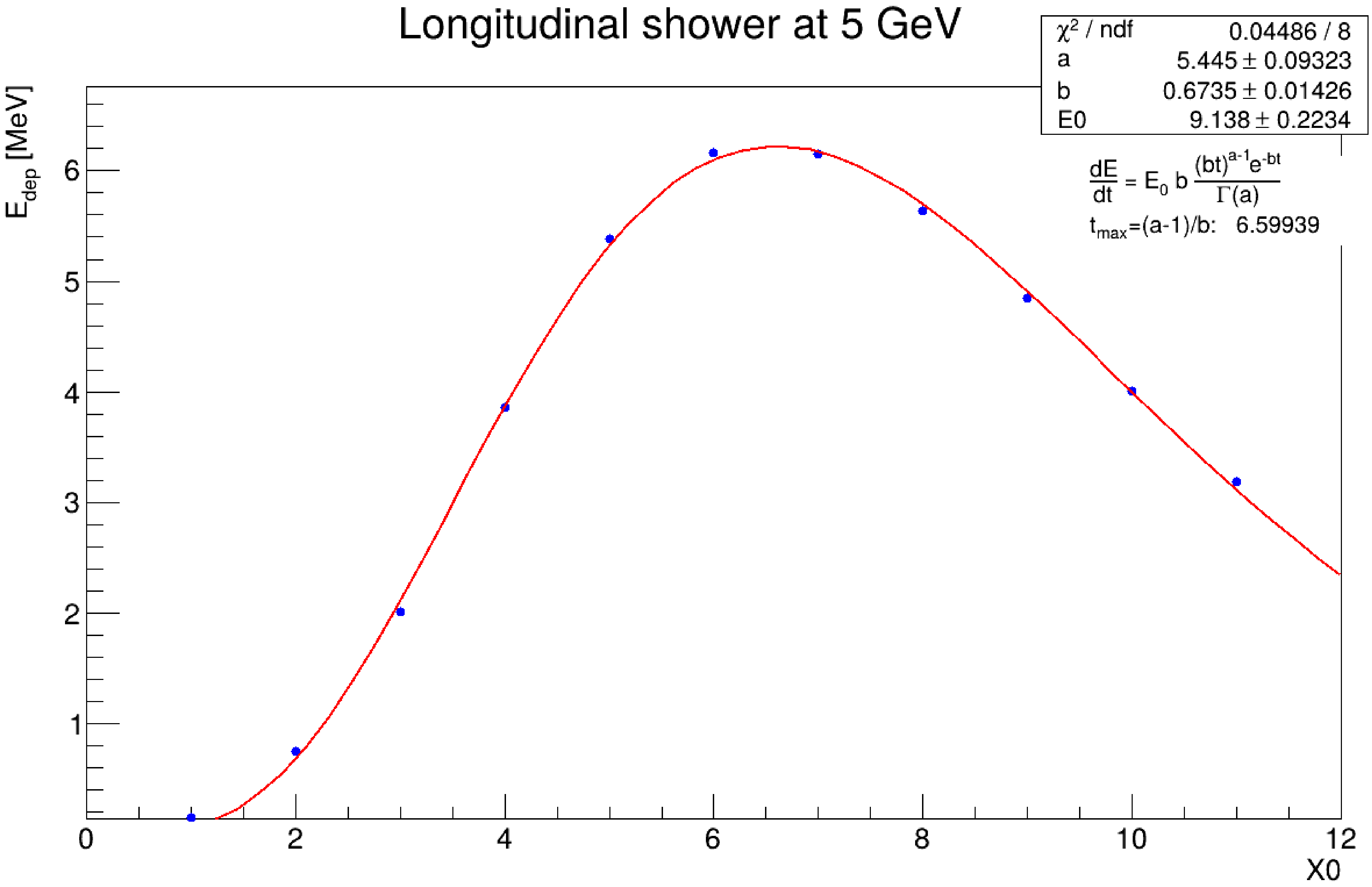
Results

longitudinal shower

- Setup 3: *11 layers with 11 X_o*

- 5 GeV

Beam centered between sensors
X: 0.0
Y: 0.0



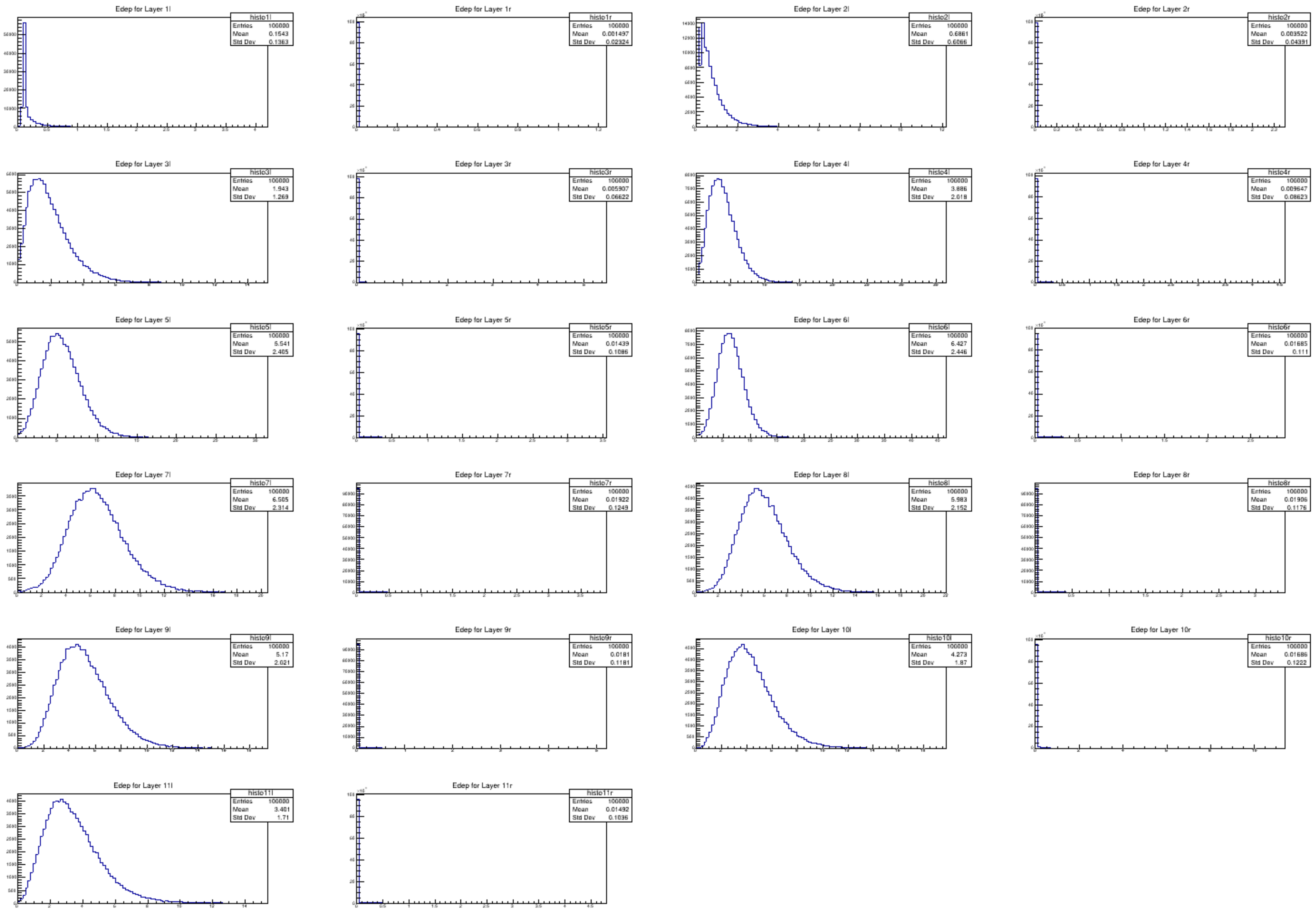
Results

deposition on sensors

- Setup 3: *11 layers with 11 X_o*

- 5 GeV

Beam centered on sensor 1
X: 4.5
Y: 0.0

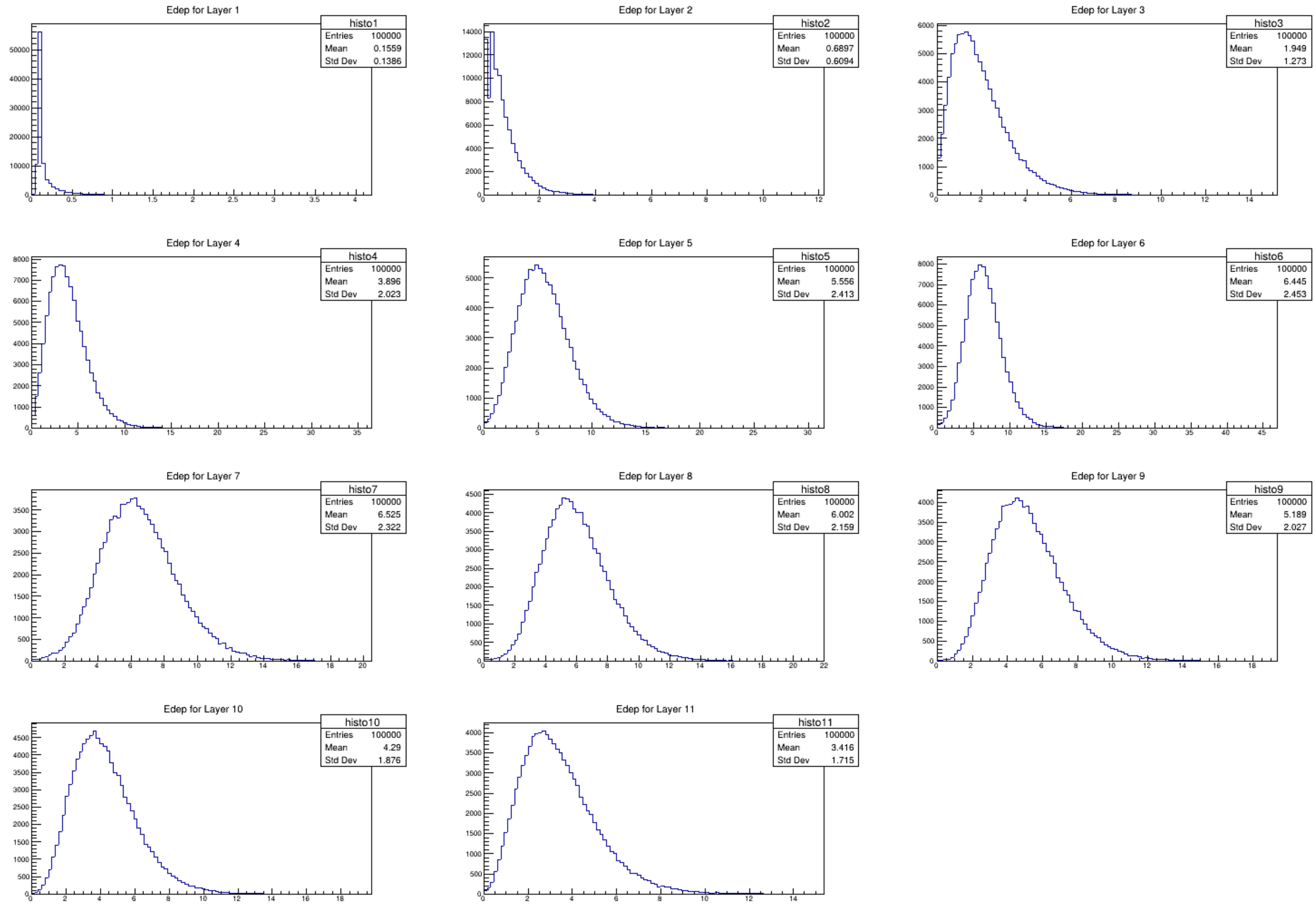


Results

deposition on layers

- Setup 3: *11 layers with 11 X_0*
- 5 GeV

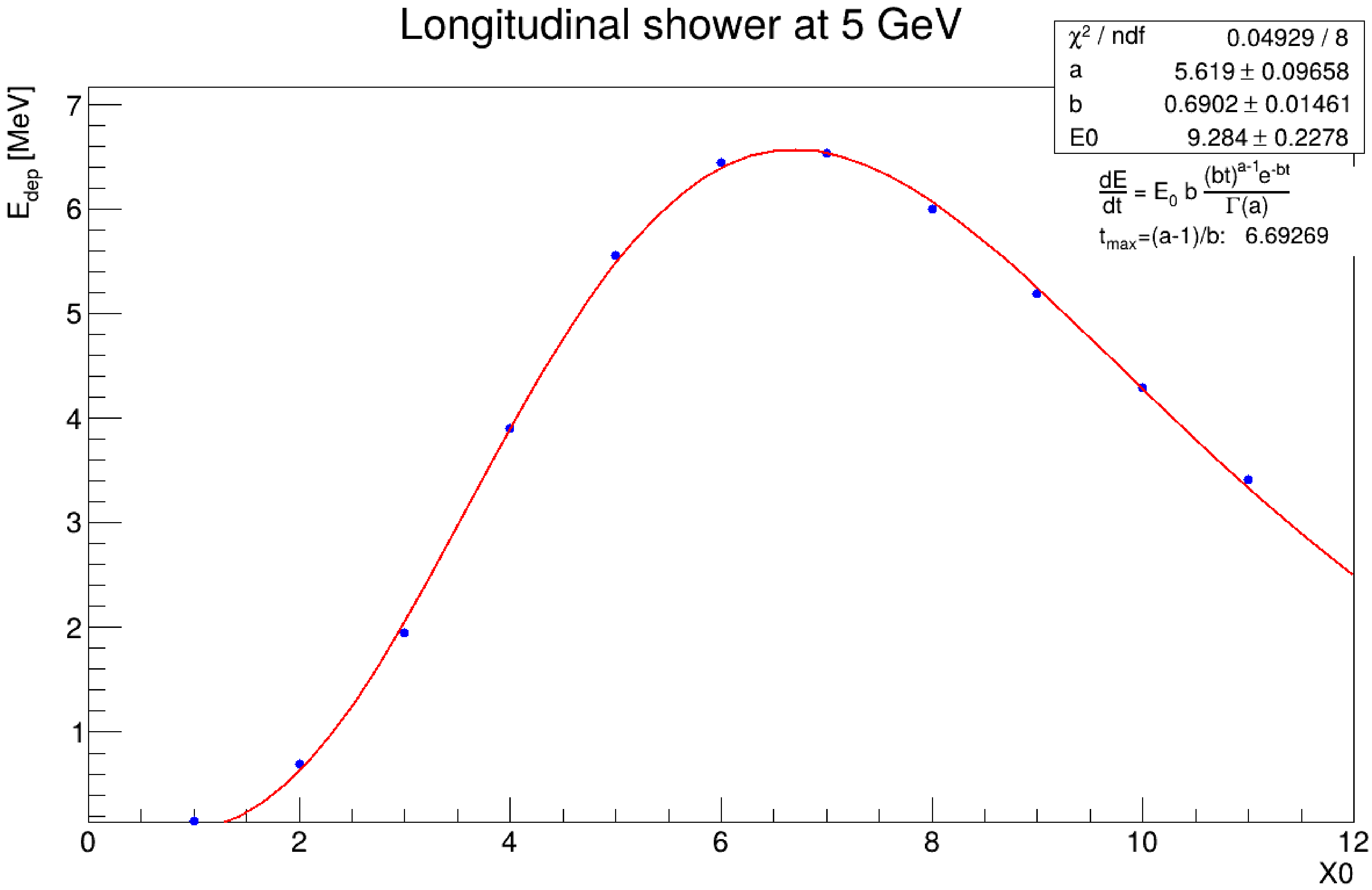
Beam centered on sensor 1
X: 4.5
Y: 0.0



Results

longitudinal shower

- Setup 3: *11 layers with 11 X_o*
- 5 GeV



Beam centered on sensor 1
X: 4.5
Y: 0.0

Results

deposition on sensors

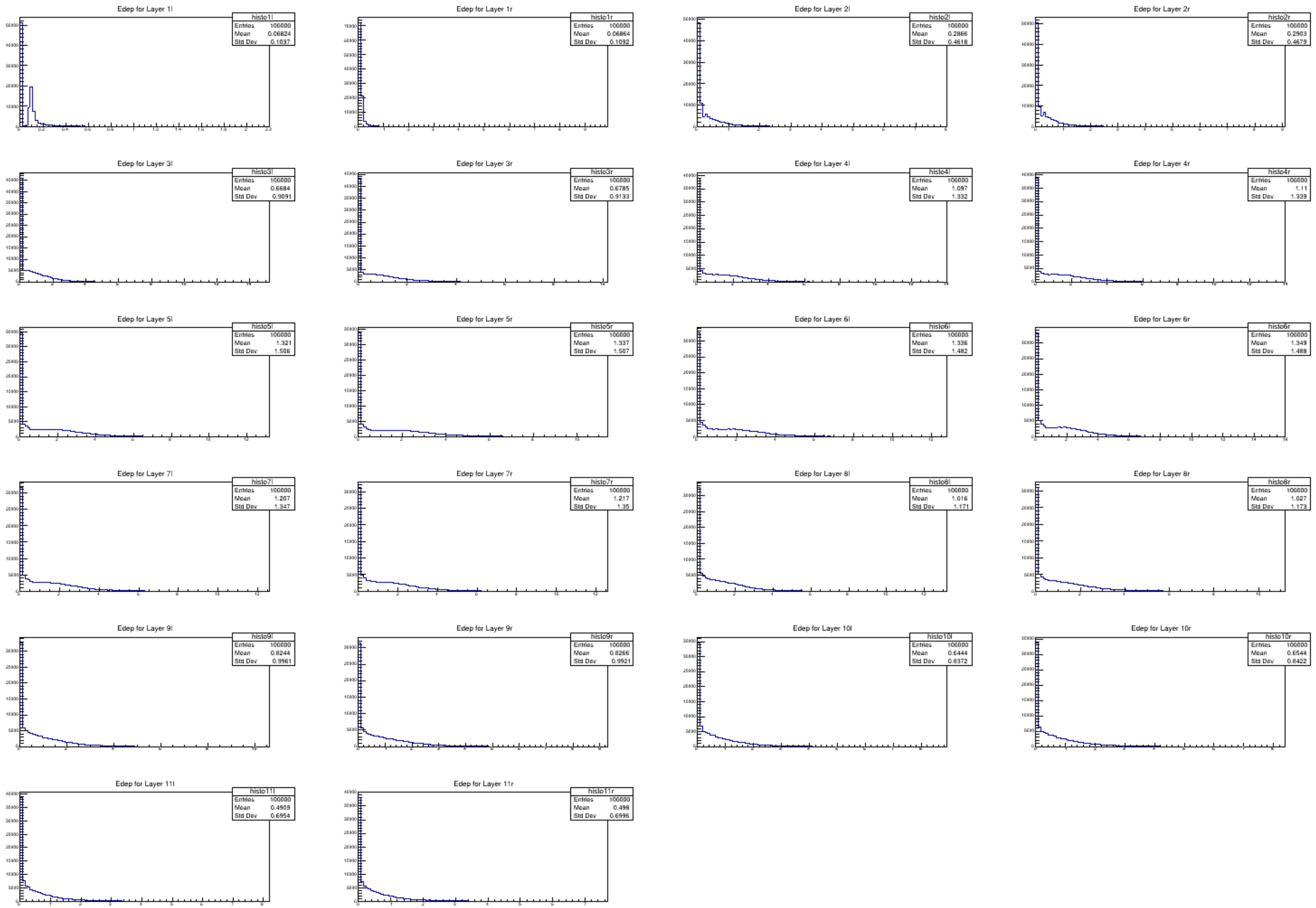
- Setup 3: *11 layers with 11 X_0*

- 2 GeV

Beam centered between sensors

X: 0.0

Y: 0.0



Results

deposition on layers

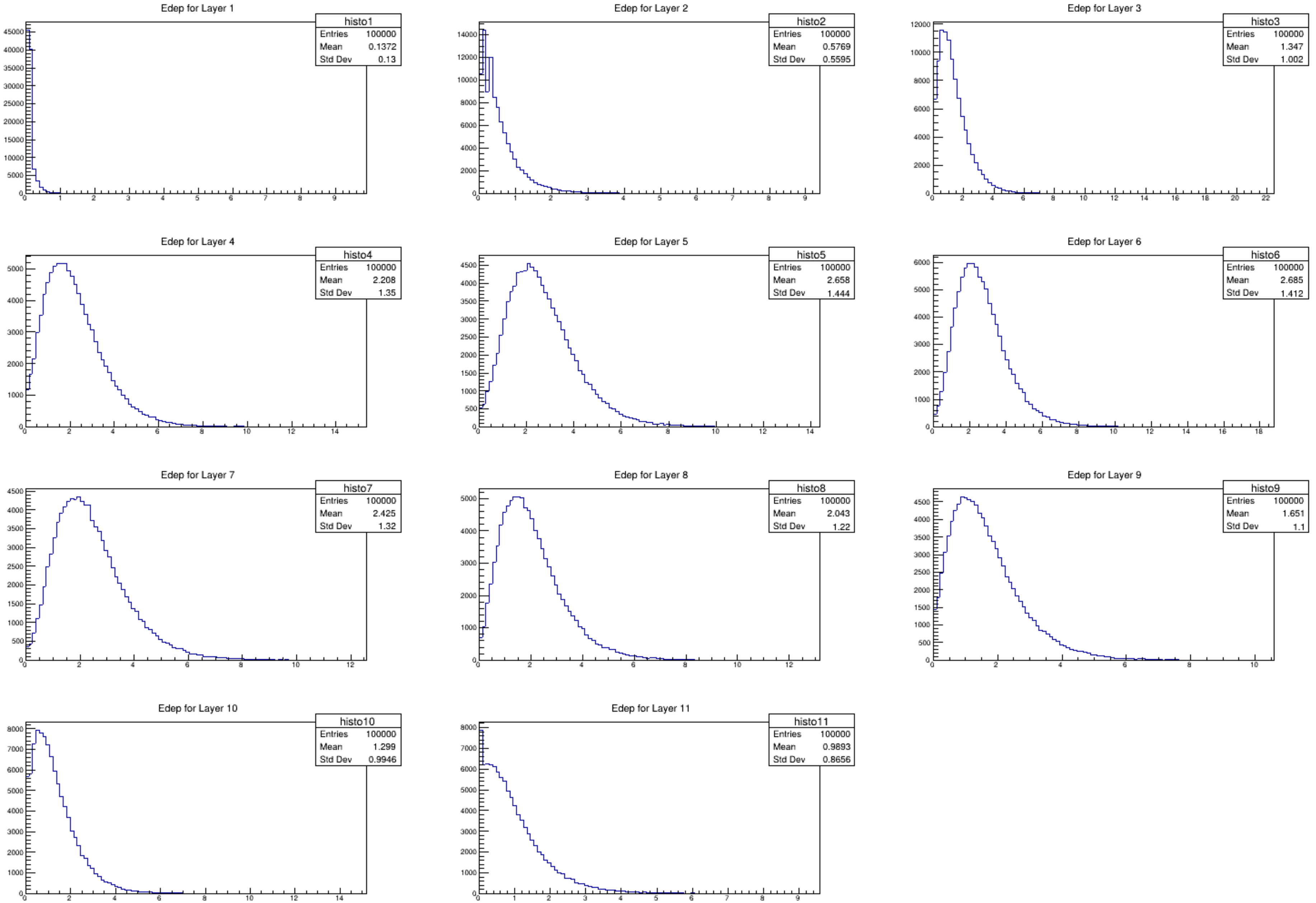
- Setup 3: *11 layers with 11 X_0*

- 2 GeV

Beam centered between sensors

X: 0.0

Y: 0.0



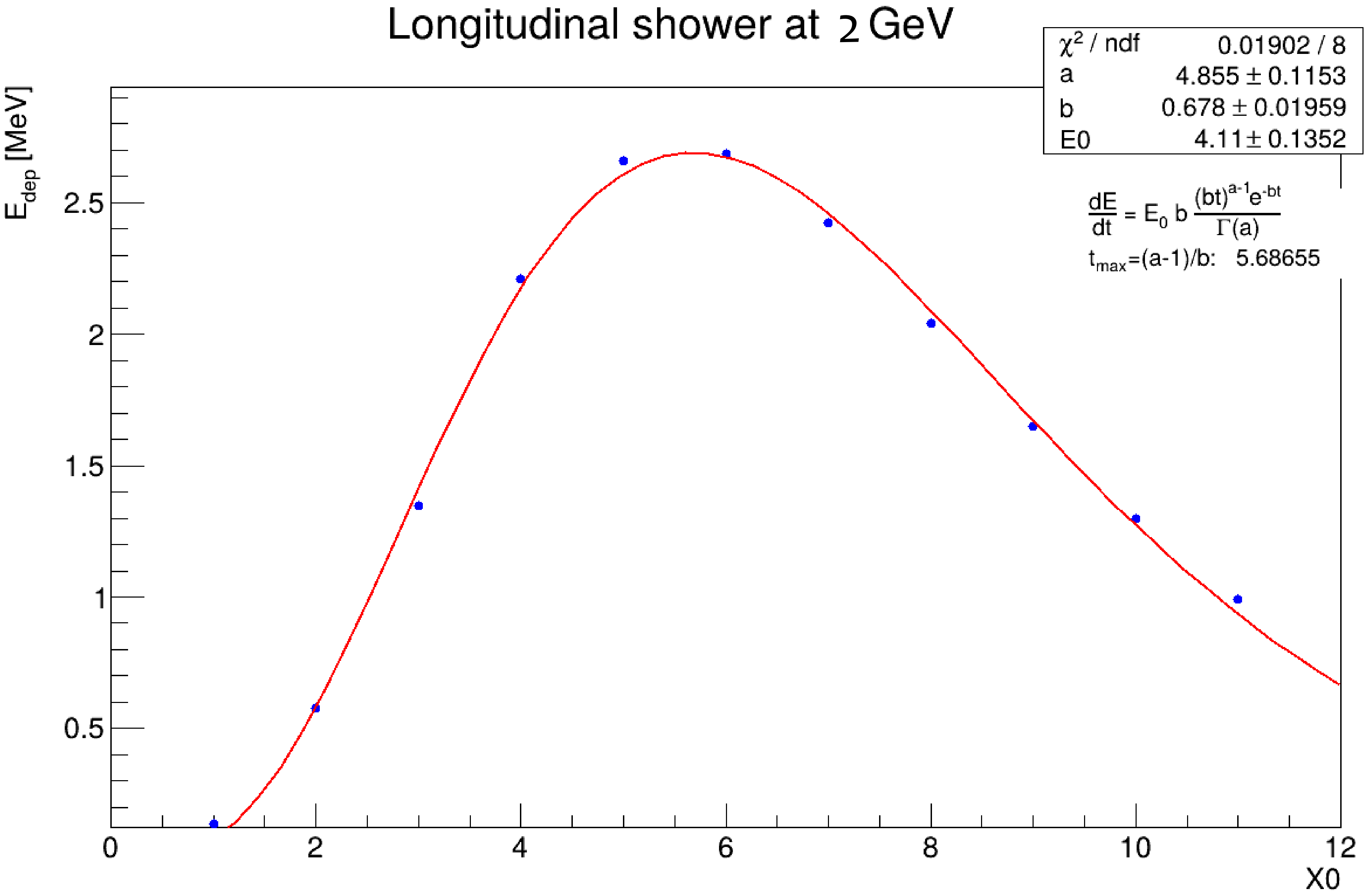
Results

longitudinal shower

- Setup 3: *11 layers with 11 X_o*

- 2 GeV

Beam centered between sensors
X: 0.0
Y: 0.0

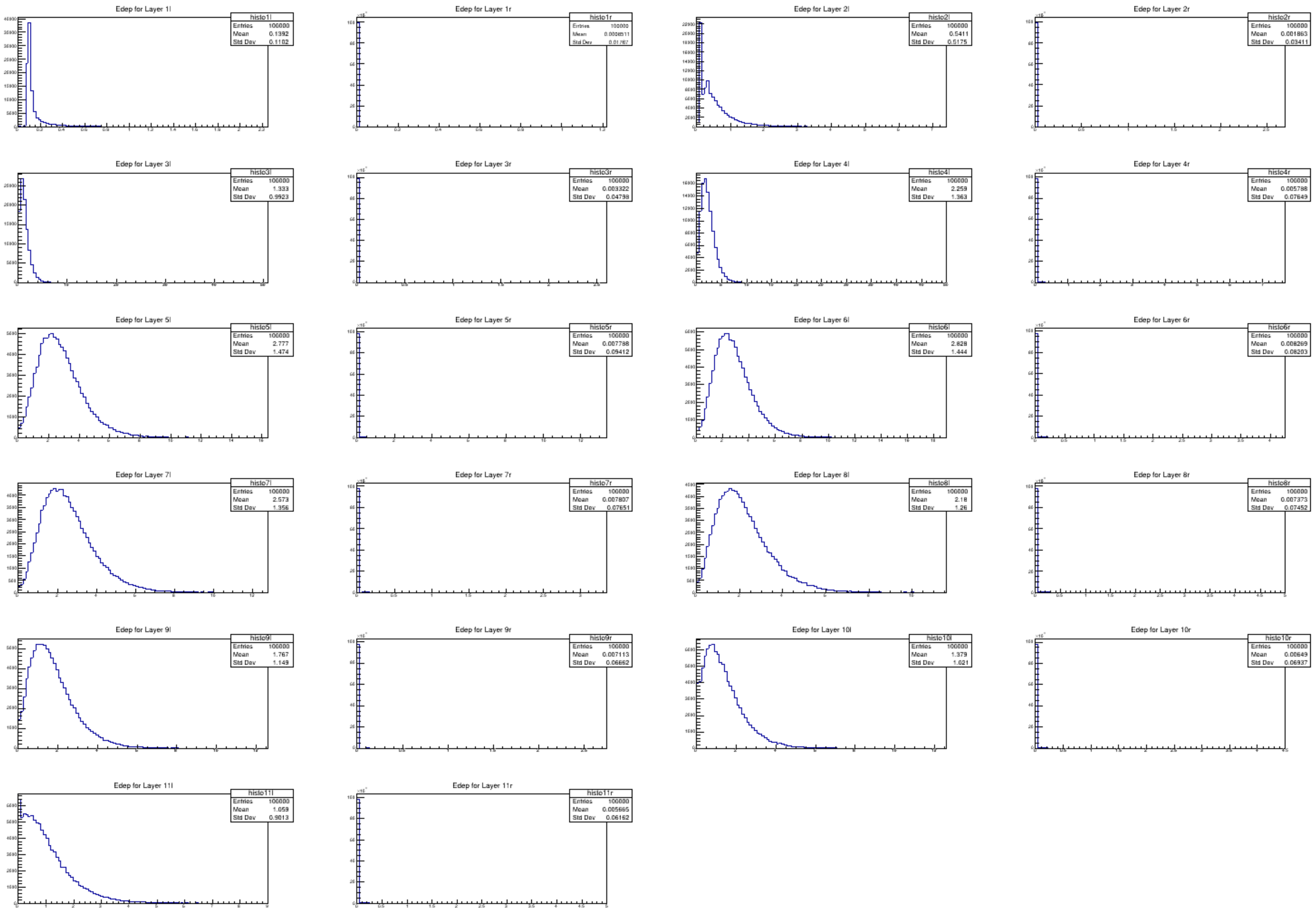


Results

deposition on sensors

- Setup 3: *11 layers with 11 X_0*
- 2 GeV

Beam centered on sensor 1
X: 4.5
Y: 0.0



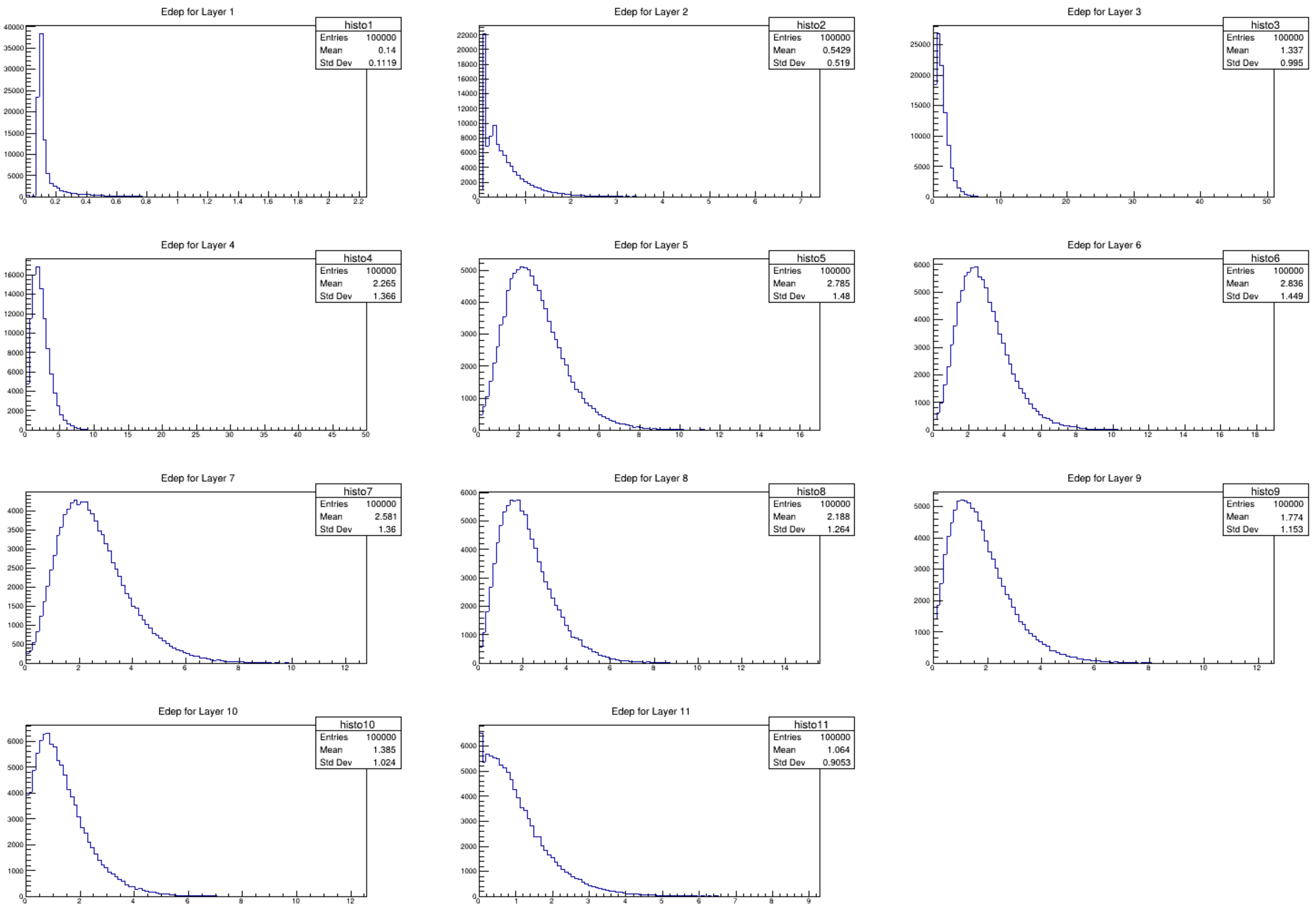
Results

longitudinal shower

▪ Setup 3: *11 layers with 11 X_0*

▪ 2 GeV

Beam centered on sensor 1
X: 4.5
Y: 0.0



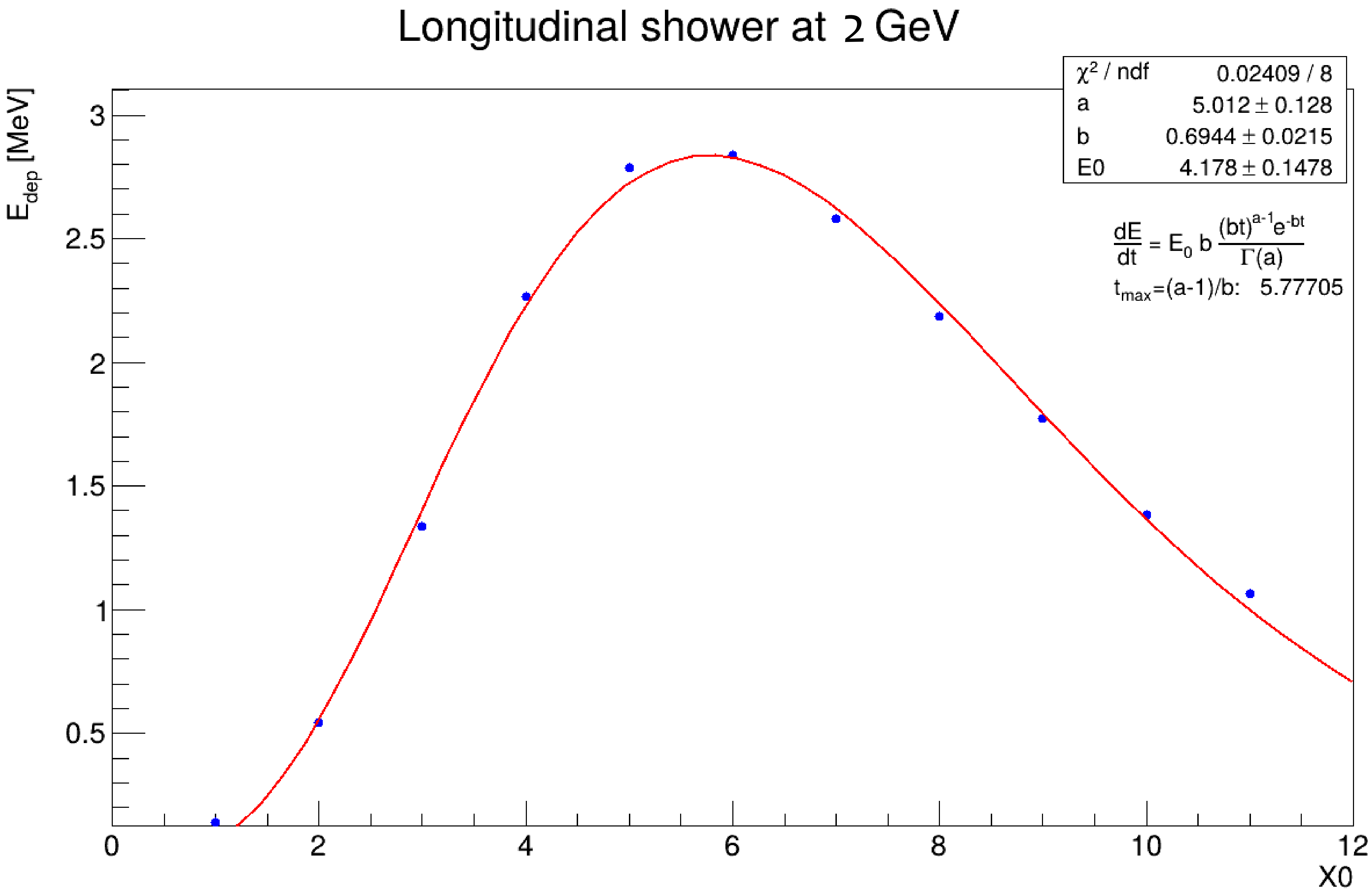
Results

hit maps

▪ Setup 3: *11 layers with 11 X_o*

▪ 2 GeV

Beam centered between sensors
X: 0.0
Y: 0.0



Some details

storage, code

Source code:

https://github.com/mpotlog/EcalP

Simulations results:

luxe.spacescience.ro

*/data3/*TB2025/simulation/*setupX*/*x*GeV/1.*visualization*/
*/data3/*TB2025/simulation/*setupX*/*x*GeV/2.*energy_deposition*/
*/data3/*TB2025/simulation/*setupX*/*x*GeV/3.*longitudinal_shower*/
*/data3/*TB2025/simulation/*setupX*/*x*GeV/…

Important!

in the next week we will have to stop luxe.spacescience.ro server for a few days to increase (*almost double it!*) the storage; the exact days for shutdown will be priory announced.

Tungsten simulations

motivation, approach

- Motivation: following the discussion of the influence of chemical composition and thickness of Tungsten plates on simulation results
-
- Goal: Investigate the differences between tungsten plates considering similar Geant4 conditions (*beam generator, physics list, sensitive detector, run manager*)
- Method: Tungsten plate placed in a sphere shell to acquire information on all particles generated
- Approach: Data collected from sphere and tungsten in separated HitsCollection

Tungsten simulations

geometry

XY dimensions:

G4double WdimX = 140.*mm;
G4double WdimY = 140.*mm;

no.	LABEL	z(mm)	z2(mm)	x(mm)	y(mm)
OLD-01	cut _______	3.5450	1.4350	139.930	~~116.855~~
OLD-02	cut _______	3.5525	1.4150	139.950	~~11[illegible]915~~
OLD-03	cut _______	3.5450	1.3950	139.920	~~11[illegible]865~~
OLD-04	cut _______	3.5525	1.4300	139.910	~~116.900~~
OLD-05	nom _______	3.5550	1.4375	139.900	139.920
OLD-06	nom MGS1-6	3.5625	1.4450	139.960	139.950
OLD-07	nom _______	3.5150	1.4250	139.970	139.940
OLD-08	nom B21____	3.5100	1.4600	139.930	139.950
OLD-09	nom _______	3.5050	1.4350	140.000	139.990
OLD-10	nom B15____	3.4975	1.4300	139.940	140.040
OLD-11	nom _______	3.4950	1.4650	139.980	140.000
OLD-12	nom 1______	3.4875	1.4950	140.020	140.010
OLD-13	nom _______	3.4650	1.4800	140.020	139.990
OLD-14	nom _______	3.4750	1.4725	139.970	139.980
OLD-15	cut _______	3.4775	1.4750	139.980	~~116[illegible]870~~

no.	LABEL	rho (g/cm3)	z (mm)
OLD-01	cut JINR__	rho = 17.55	z = 3.5450
OLD-02	cut MGS___	rho = 17.61	z = 3.5525
OLD-03	cut MGS___	rho = 17.65	z = 3.5450
OLD-04	cut MGS___	rho = 17.59	z = 3.5525
OLD-05	nom JINR__	rho = 17.48	z = 3.5550
OLD-06	nom MGS___	rho = 17.58	z = 3.5625
OLD-07	nom MGS___	rho = 17.60	z = 3.5150
OLD-08	nom JINR__	rho = 17.57	z = 3.5100
OLD-09	nom Plansee	rho = 18.21	z = 3.5050
OLD-10	nom MGS___	rho = 17.59	z = 3.4975
OLD-11	nom JINR__	rho = 17.44	z = 3.4950
OLD-12	nom Plansee	rho = 18.09	z = 3.4875
OLD-13	nom Plansee	rho = 18.20	z = 3.4650
OLD-14	nom JINR__	rho = 17.53	z = 3.4750
OLD-15	cut JINR__	rho = 17.36	z = 3.4775

Z dimension:

```
                                  //{old-01,  old-02, old-03, old-04, old-05, old-06, old-07, old-08,old-09, old-10,  old-11,  old-12,  old-13,  old-14,  old-15 }
G4double Wthickness[15] = {3.5450, 3.5525, 3.5450, 3.5525, 3.5550, 3.5625, 3.5150, 3.5100, 3.5050, 3.4975, 3.4950, 3.4875, 3.4650, 3.4750, 3.4775};
```

Tungsten simulations

materials

Old plate:

```
// Tungsten plate Old-03 (MGS)
G4Material* W_old3 = new G4Material(name="W_old3", density = 17.65*g/cm3, ncomponents=3);    // z=3.5450
W_old3->AddElement(elW,  93.00*perCent);
W_old3->AddElement(elNi,  5.25*perCent);
W_old3->AddElement(elCu,  1.75*perCent);
```

no.	LABEL	rho (g/cm3)	z (mm)
OLD-01	cut JINR__	rho = 17.55	z = 3.5450
OLD-02	cut MGS___	rho = 17.61	z = 3.5525
OLD-03	cut MGS___	rho = 17.65	z = 3.5450
OLD-04	cut MGS___	rho = 17.59	z = 3.5525
OLD-05	nom JINR__	rho = 17.48	z = 3.5550
OLD-06	nom MGS___	rho = 17.58	z = 3.5625
OLD-07	nom MGS___	rho = 17.60	z = 3.5150
OLD-08	nom JINR__	rho = 17.57	z = 3.5100
OLD-09	nom Plansee	rho = 18.21	z = 3.5050
OLD-10	nom MGS___	rho = 17.59	z = 3.4975
OLD-11	nom JINR__	rho = 17.44	z = 3.4950
OLD-12	nom Plansee	rho = 18.09	z = 3.4875
OLD-13	nom Plansee	rho = 18.20	z = 3.4650
OLD-14	nom JINR__	rho = 17.53	z = 3.4750
OLD-15	cut JINR__	rho = 17.36	z = 3.4775

- for all new plates use W 100%, rho = 19.25 g/cm3 and z=3.55 mm

- for JINR/MGS plates use average composition,
  AVERAGE : W 92.75%, Ni 5.25%, Cu 2.0%

Average plate:

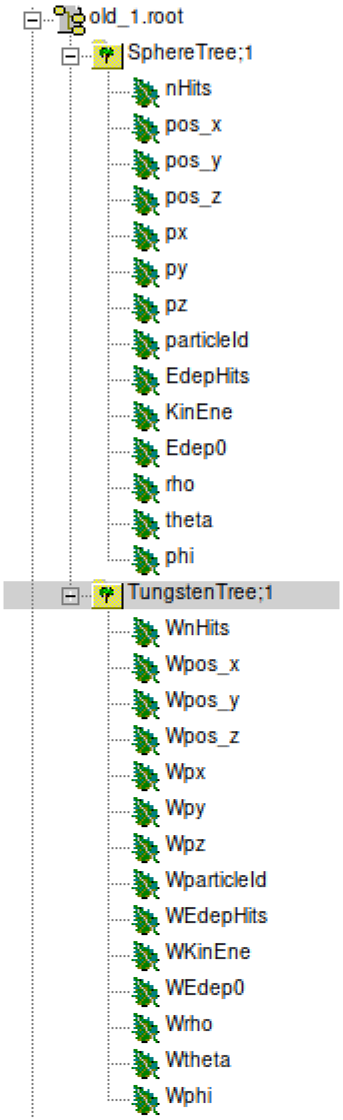
```
// Tungsten plate Average
G4Material* W_average = new G4Material(name="W_average", density = 17.55*g/cm3, ncomponents=3);    // z=3.5
W_average->AddElement(elW,  92.75*perCent);
W_average->AddElement(elNi,  5.25*perCent);
W_average->AddElement(elCu,  2.00*perCent);
```

Tungsten simulations

beam, data acquisition

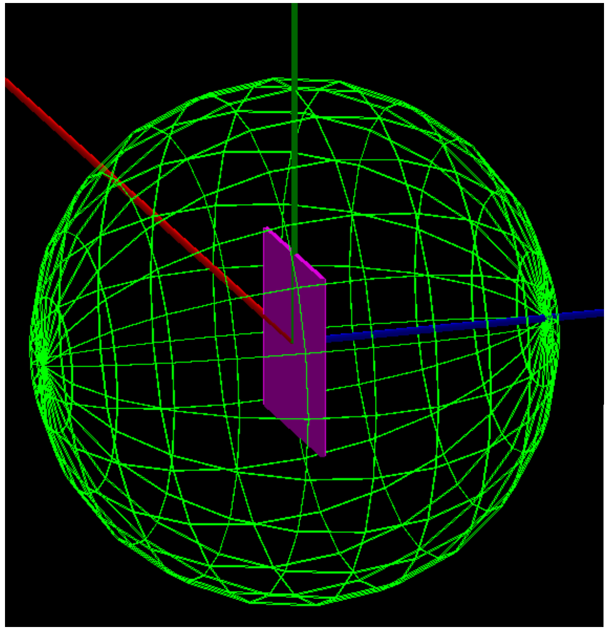
Beam:

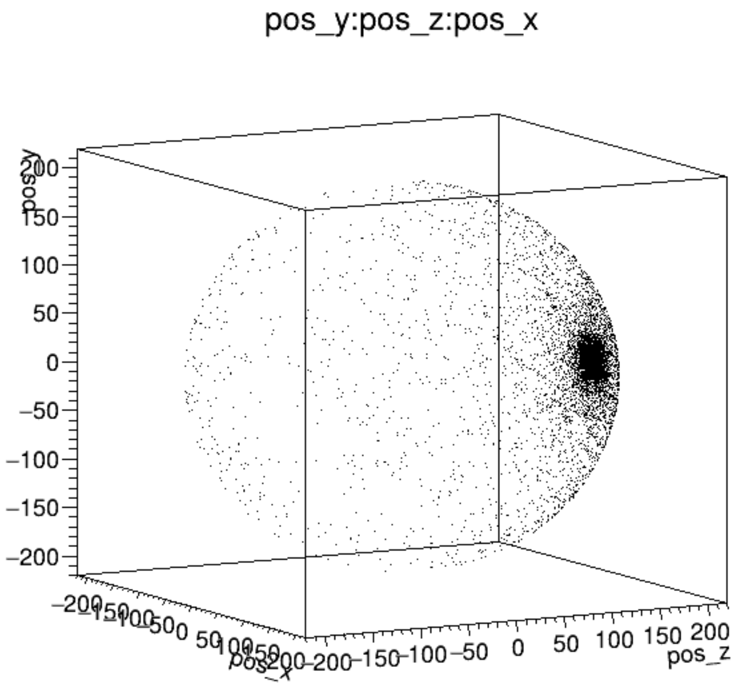
- **e- with 2 GeV & 5 GeV energy;**
- **rectangular shape: 15 x 30 mm²;**
- **Z position: -2 mm** (1 mm in front of tungsten plate)

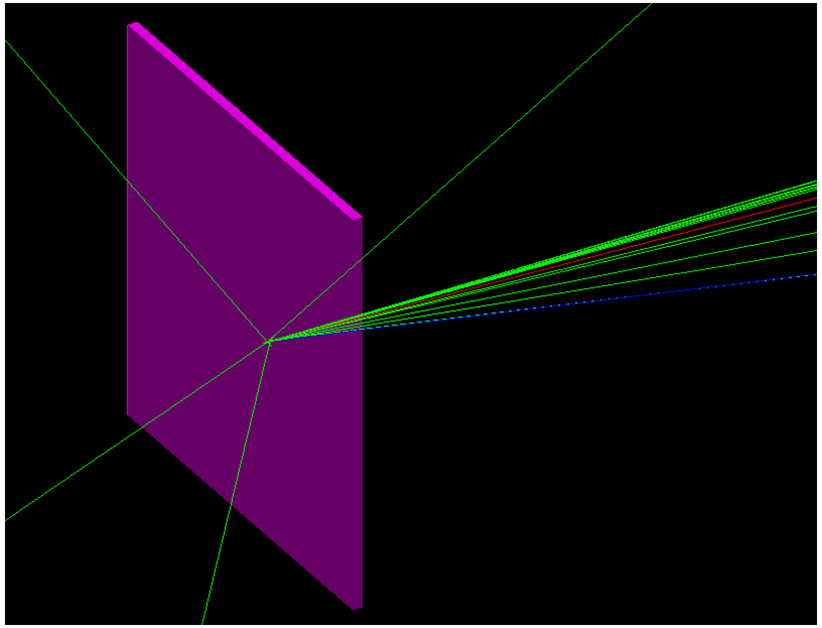


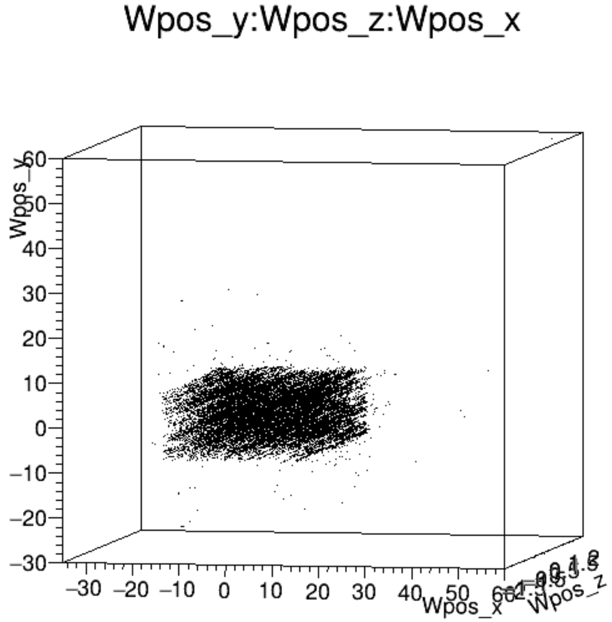
Tungsten simulations

visualization, hitmap



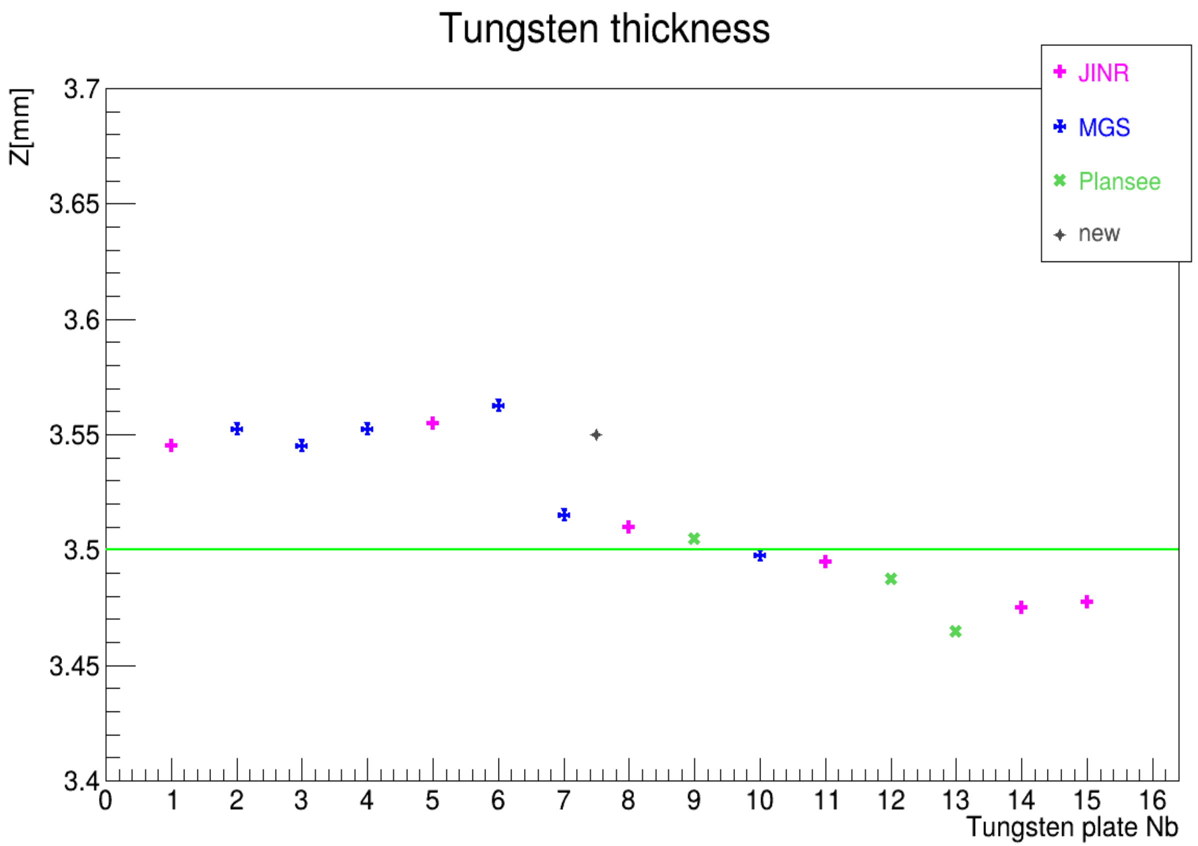


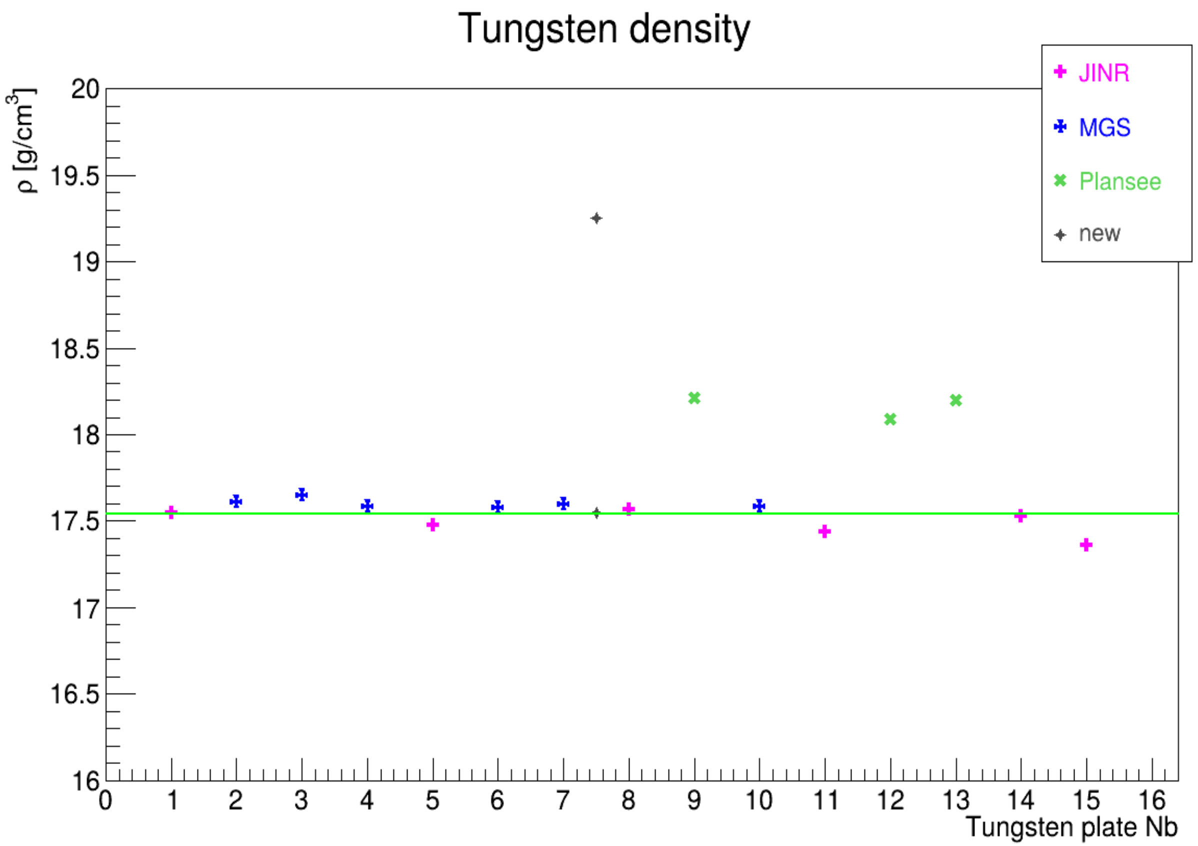




Tungsten simulations

general





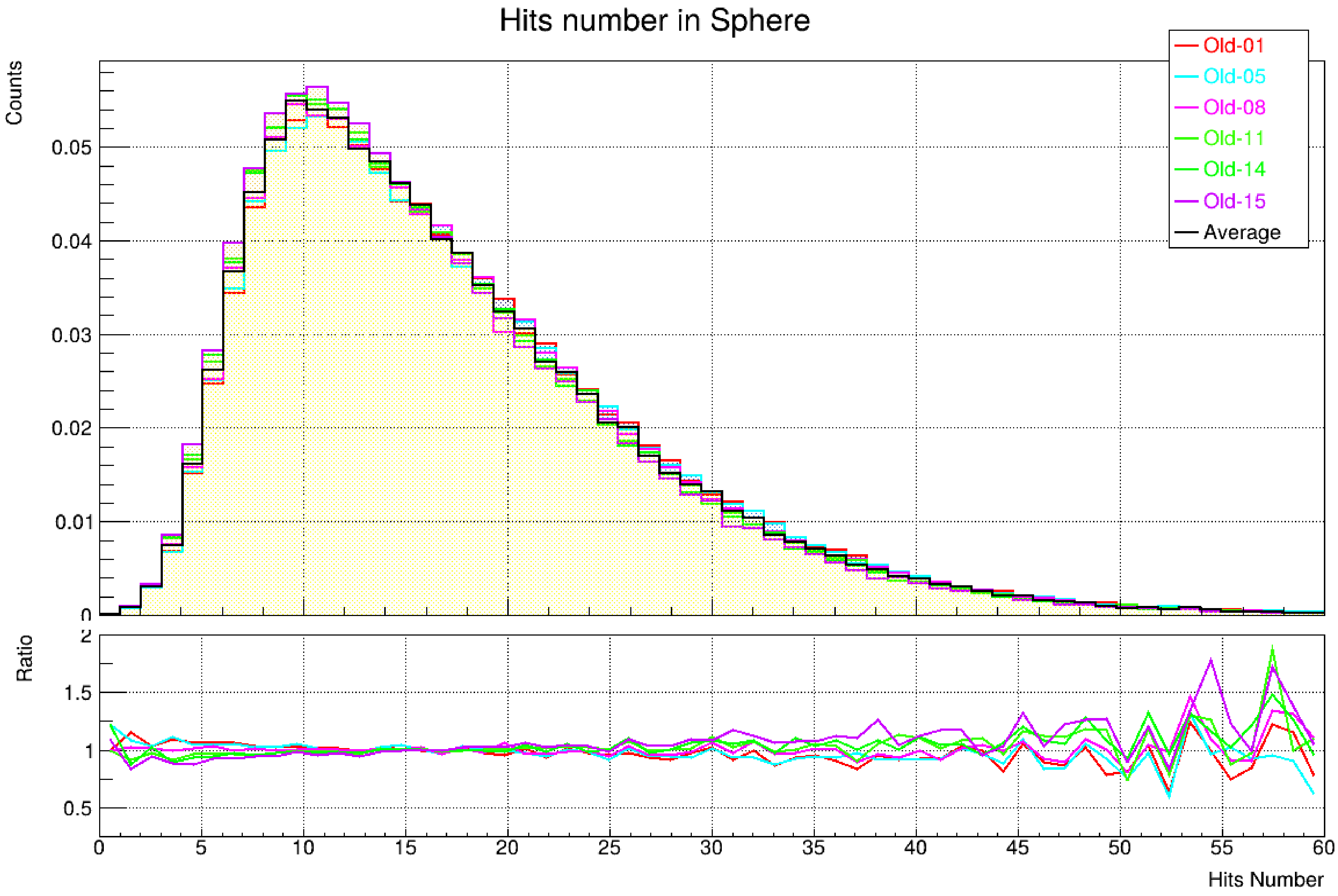
Tungsten simulations

JINR plates

- 5 GeV

Average plate:

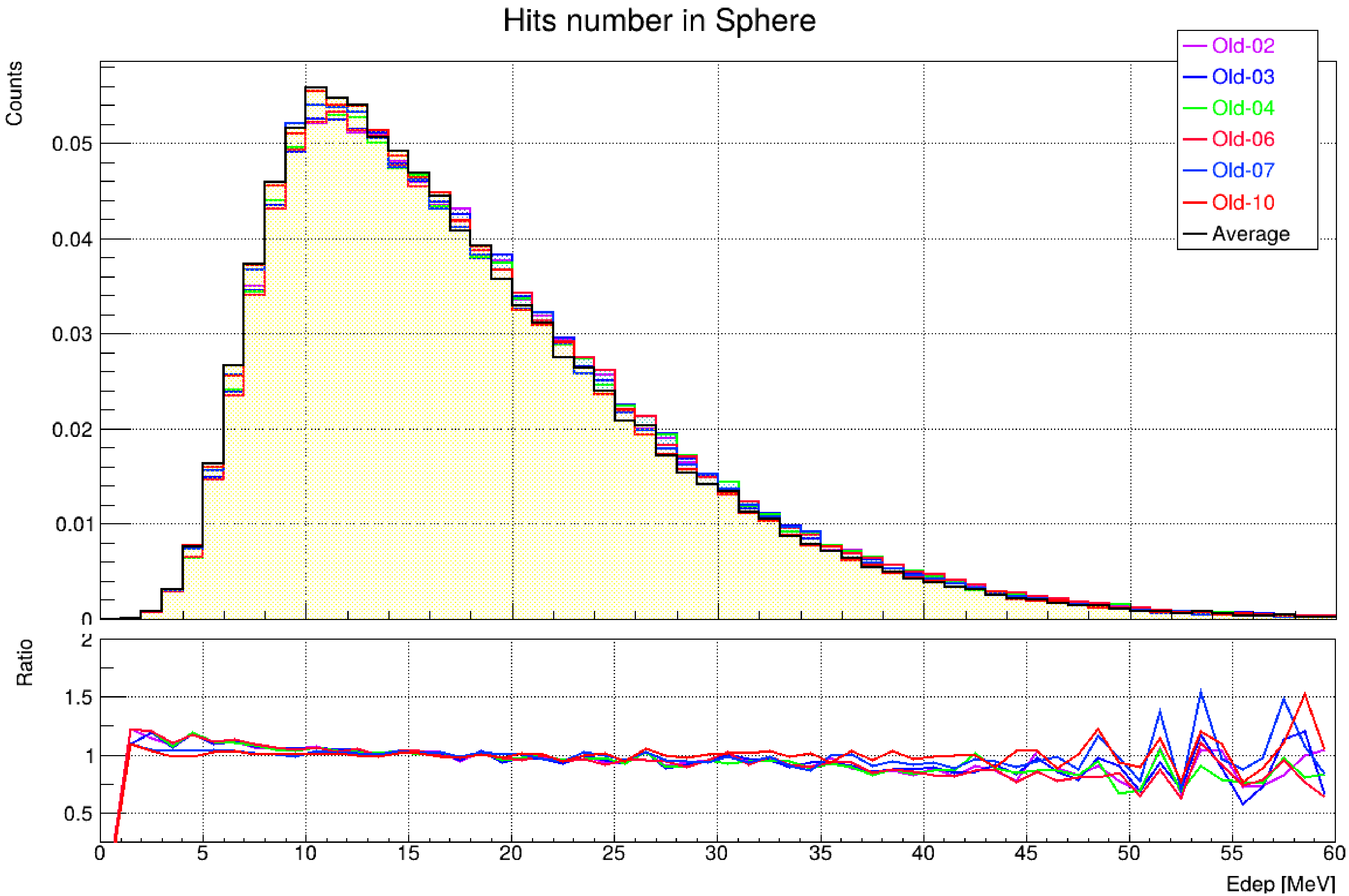
density = 17.55 g/cm³
W, 92.75 %
Ni, 5.25 %
Cu, 2.00 %
Z = 3.55 mm



Tungsten simulations

MGS plates

▪ 5 GeV



Average plate:

density = 17.55 g/cm³
W, 92.75 %
Ni, 5.25 %
Cu, 2.00 %
Z = 3.55 mm

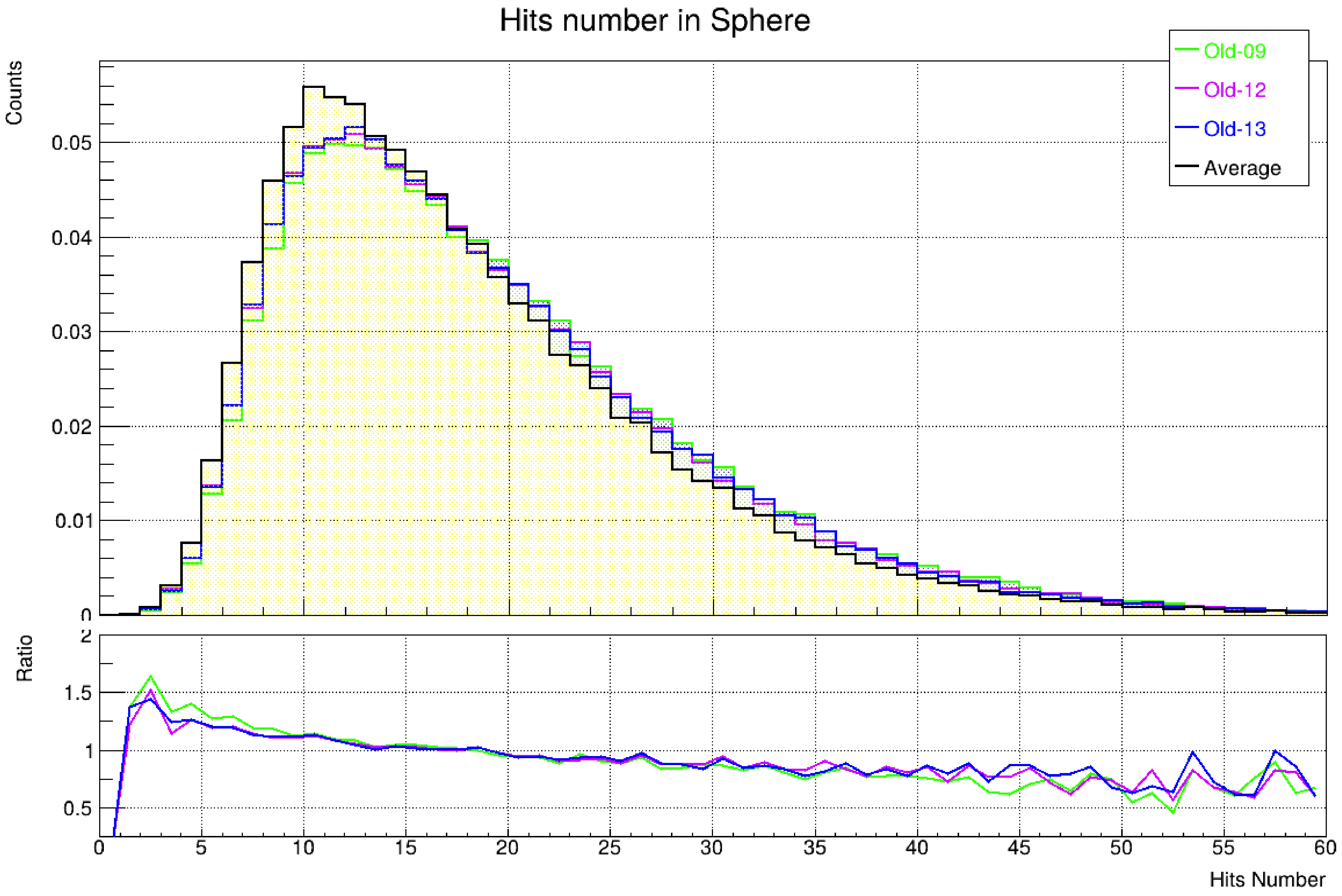
Tungsten simulations

Plansee plates

▪ 5 GeV

Average plate:

density = 17.55 g/cm³
W, 92.75 %
Ni, 5.25 %
Cu, 2.00 %
Z = 3.55 mm



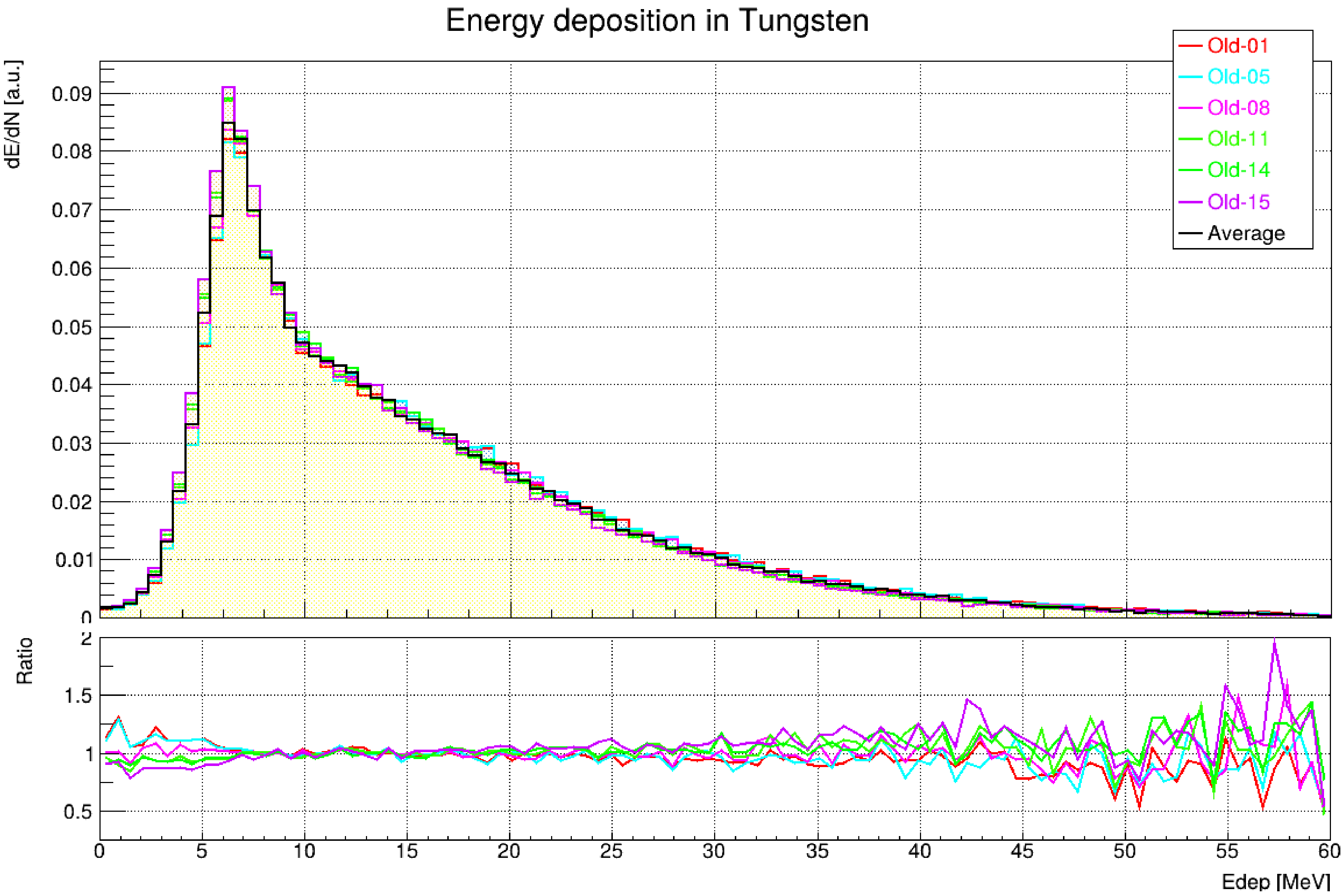
Tungsten simulations

JINR plates

▪ 5 GeV

Average plate:

density = 17.55 g/cm³
W, 92.75 %
Ni, 5.25 %
Cu, 2.00 %
Z = 3.55 mm



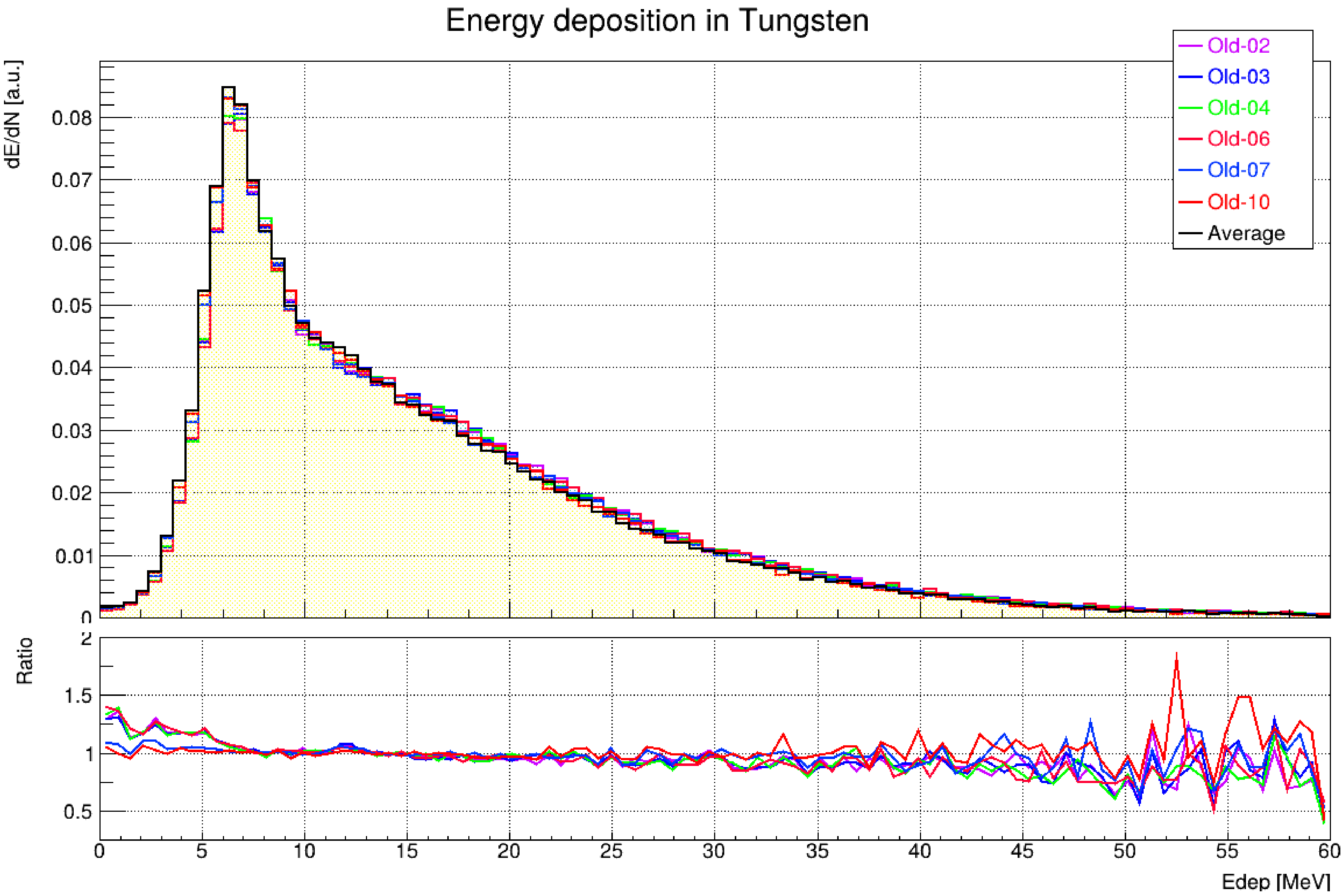
Tungsten simulations

MGS plates

▪ 5 GeV

Average plate:

density = 17.55 g/cm³
W, 92.75 %
Ni, 5.25 %
Cu, 2.00 %
Z = 3.55 mm



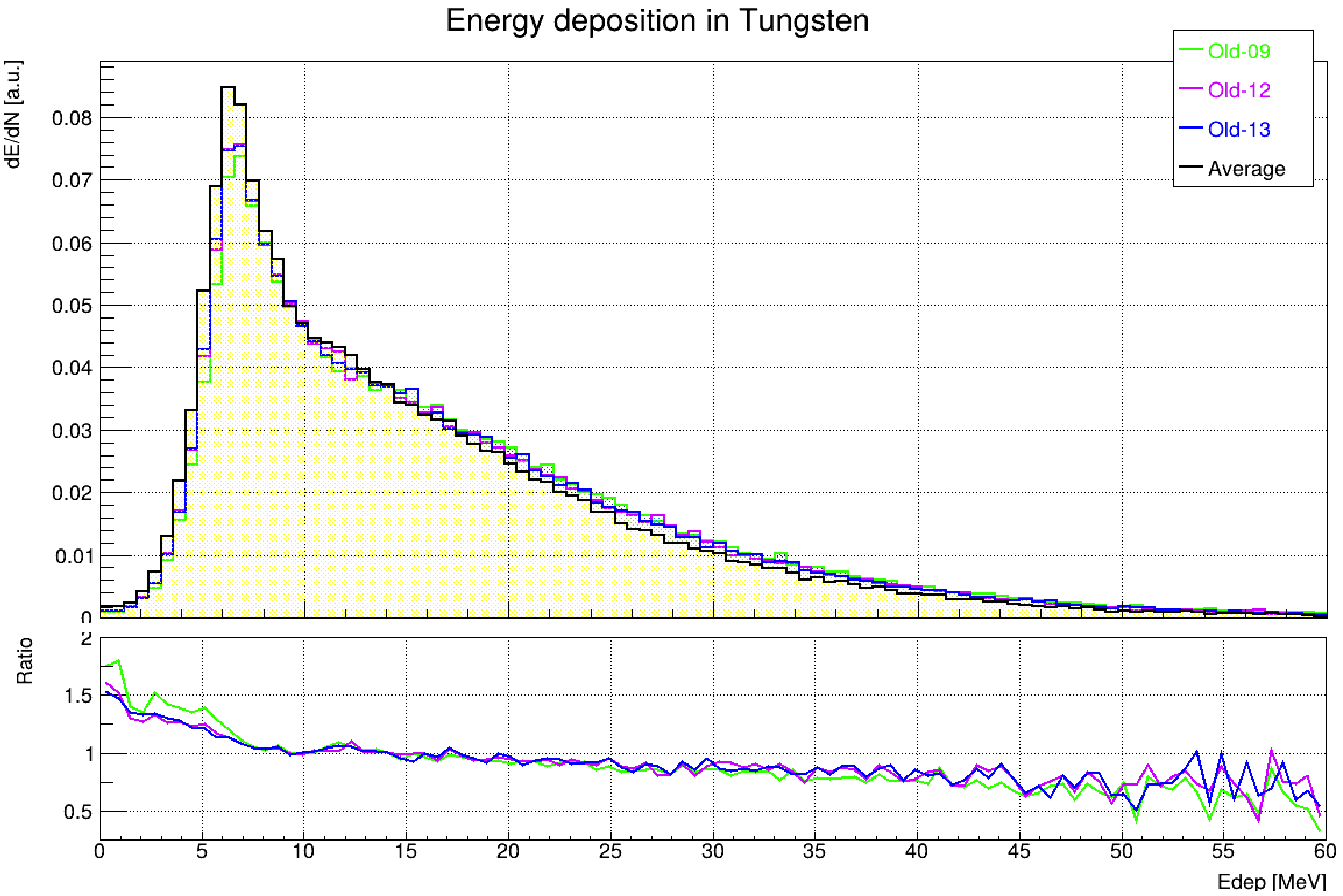
Tungsten simulations

Plansee plates

▪ 5 GeV

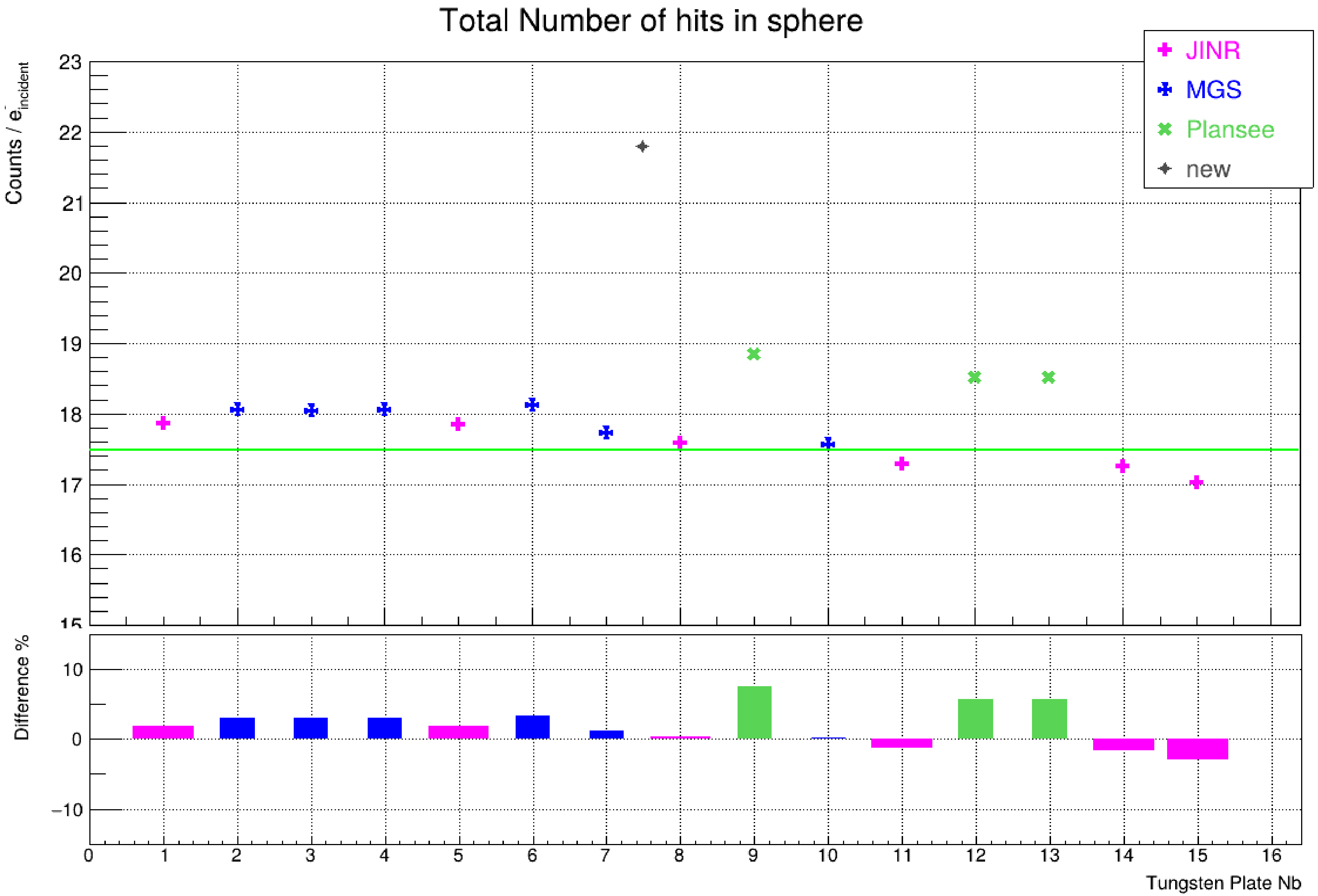
Average plate:

density = 17.55 g/cm³
W, 92.75 %
Ni, 5.25 %
Cu, 2.00 %
Z = 3.55 mm



Tungsten simulations
comparison

- 5 GeV



Average plate:

density = 17.55 g/cm³
W, 92.75 %
Ni, 5.25 %
Cu, 2.00 %
Z = 3.55 mm

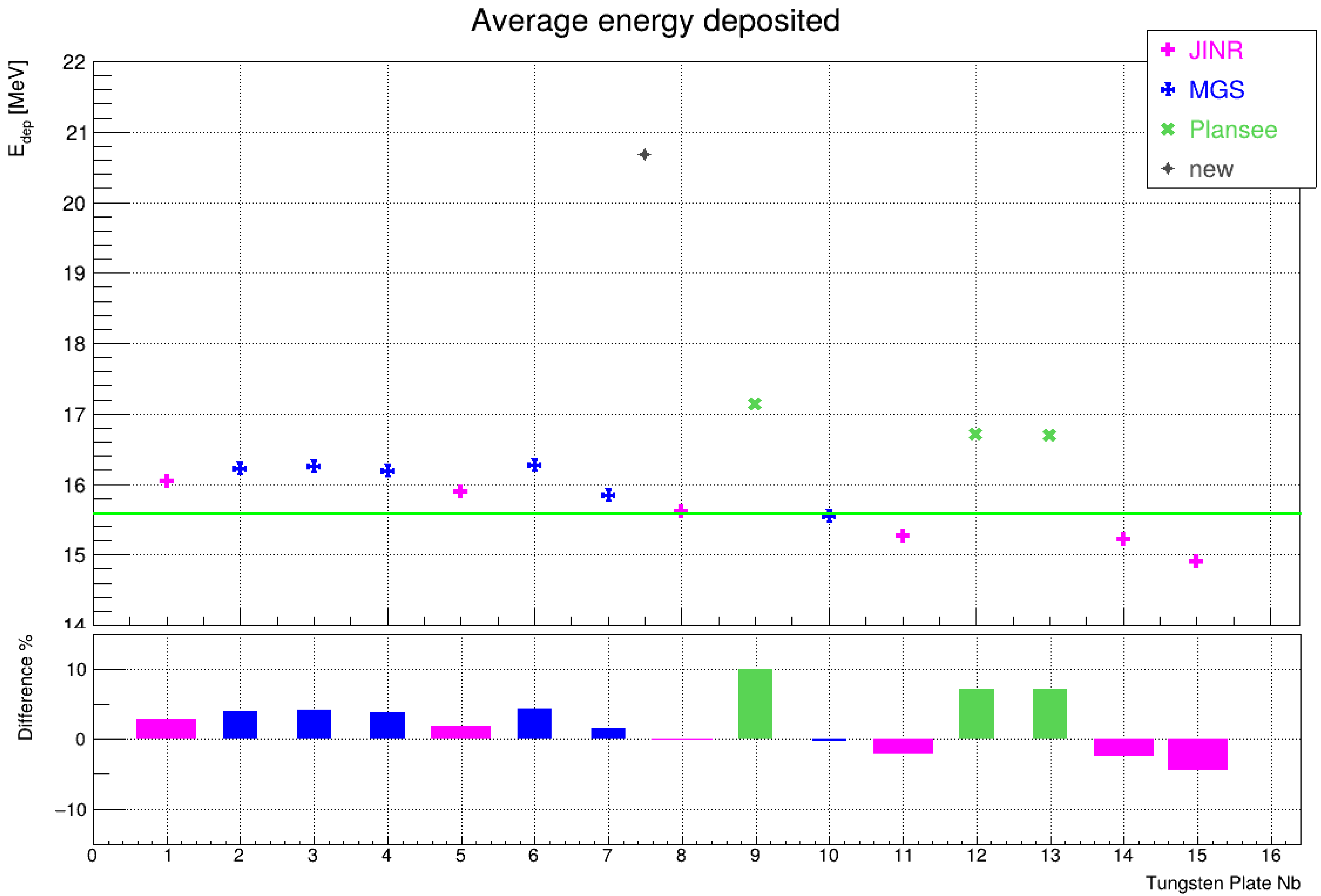
Tungsten simulations

comparison

- 5 GeV

Average plate:

density = 17.55 g/cm^3
W, 92.75 %
Ni, 5.25 %
Cu, 2.00 %
Z = 3.55 mm



Comparison

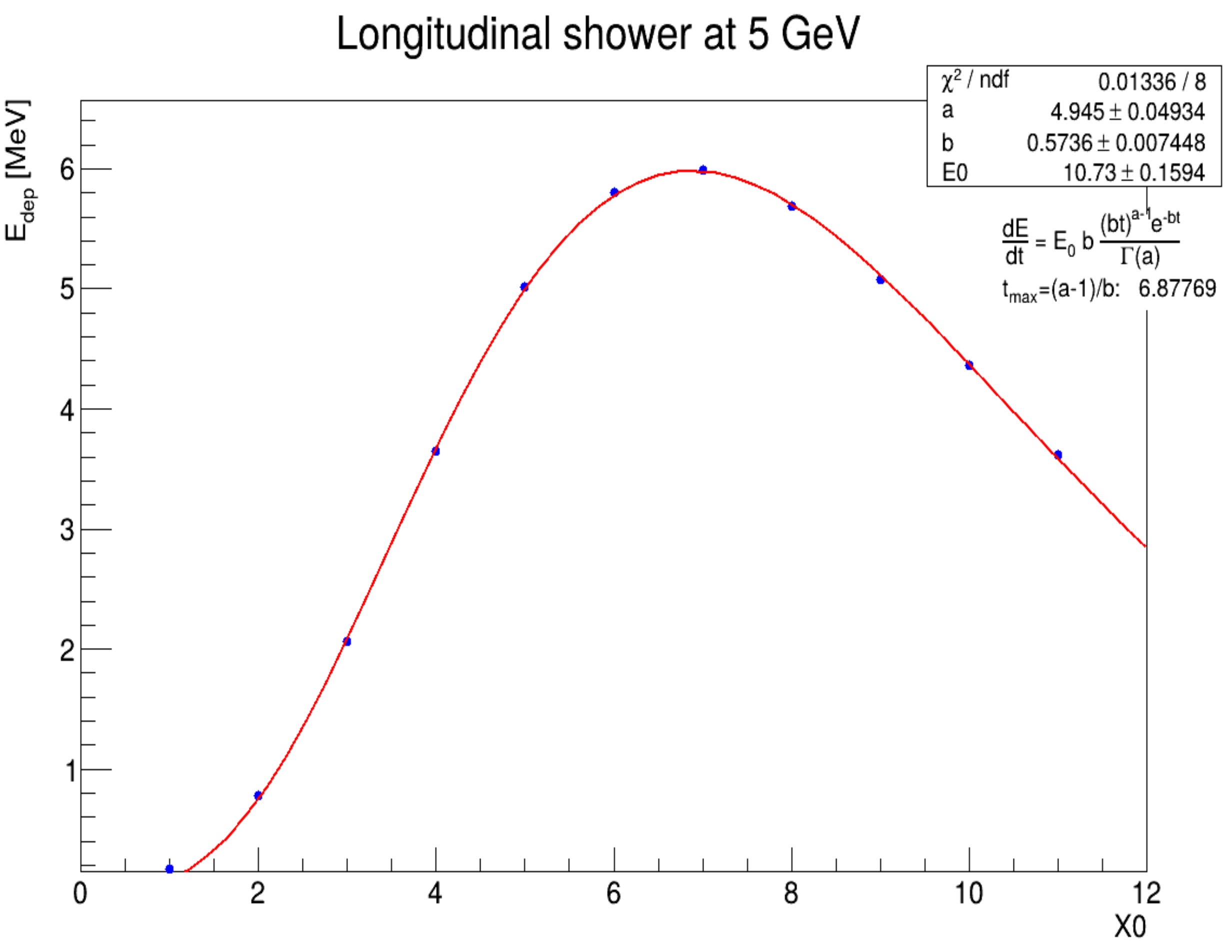
longitudinal shower

- Setup 3: *11 layers with 11 X_0*
- 5 GeV

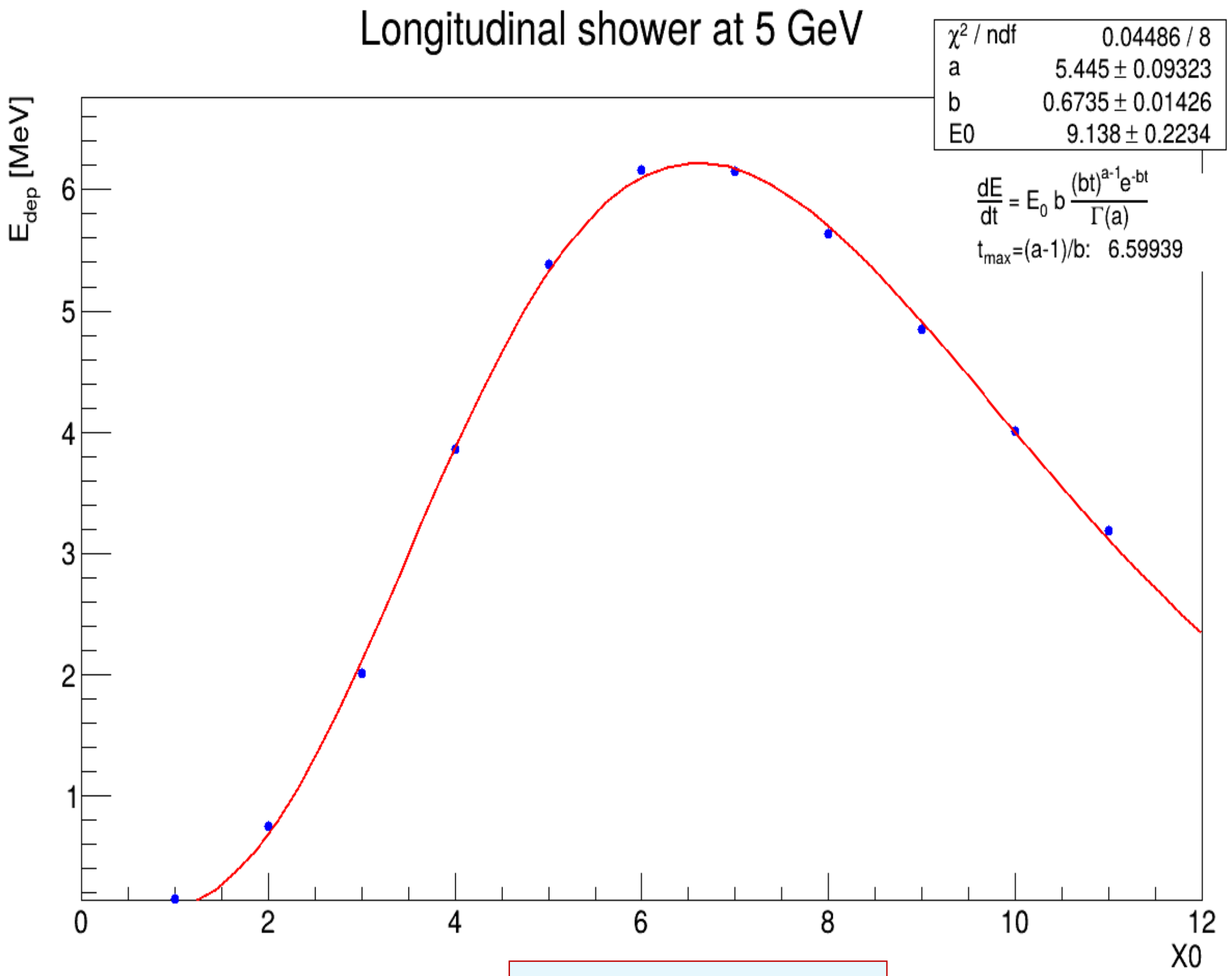
Beam centered between sensors

X: 0.0

Y: 0.0



Before



After

Conclusions

simulations

Geant4 Standalone Application

- defined electromagnetic calorimeter configurations used
- construct separate geometries files for DUT containing
- define source and control via GPS commands
- define sensitive detector and construct hits collection to gather information
- collect relevant data in a Root format
- get first results
- evaluation of tungsten plates

Thank you!