

Результаты летней школы ТГУ-CERN

Выполнил:

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О себе

- Закончил авиационный колледж.
- Никогда не умел и не умею программировать.
- Закончил РФФ на кафедре радиофизики, руководитель Якубов В.П.
- Увлёкся квантовой физикой и прошел Квантум.
- Хочу оказаться полезным в этом мире =)

Что я изучал?

- Синтез цифровых фильтров
- ПЛИСС технологии
- цифровая обработка изображений, цифровая обработка сигналов и полей
- радиолокация, статистическая радиофизика,
- метаматериалы
- обратные задачи радиофизики.

Результаты по Geant4

TestEm0

Изменяем начальные условия в TestEm0.in

```
/run/initialize
```

```
#
```

```
/testem/det/setMat Aluminium (Lead)
```

```
/gun/particle gamma
```

```
/gun/energy 20 keV
```

```
/run/beamOn
```

Результаты по Geant4

TestEm0

school@inter:~/projects/geant4/makhmanazarov_rm/TestEm0/build



```
mean free path      :          1.19 mm          2.60865 cm          5.82593e+288 pc          1.74742 cm
  1.06849 mm
  (g/cm2)           :          321.301 mg/cm2          7.04335 g/cm2          2.88022e+285 kg/cm2          4.71802 g/cm2
  288.494 mg/cm2
```

Idle> /run/beamOn

gamma (20 keV) in Aluminium (density: 2.7 g/cm3 ; radiation length: 8.89302 cm)

```
processes :          phot          compt          conv          Rayl          total

cross section per atom :          139.445 barn          6.36306 barn          0 pbarn          9.33068 barn          155.139 barn

compCrossSectionPerVolume :          8.40335 cm^-1          0.383455 cm^-1          0 cm^-1          0.562292 cm^-1          9.34909 cm^-1
cross section per volume :          8.40335 cm^-1          0.38334 cm^-1          0 cm^-1          0.572274 cm^-1          9.35896 cm^-1
cross section per mass :          3.11235 cm2/g          14.1978 mm2/g          0 um2/mg          21.1953 mm2/g          3.46628 cm2/g

mean free path      :          1.19 mm          2.60865 cm          5.82593e+288 pc          1.74742 cm          1.06849 mm
  (g/cm2)           :          321.301 mg/cm2          7.04335 g/cm2          2.88022e+285 kg/cm2          4.71802 g/cm2          288.494 mg/cm2
```

Idle> █

Результаты по Geant4

TestEm0

school@inter:~/projects/geant4/makhmanazarov_rm/TestEm0/build

```
mean free path      :          1.19 mm          2.60865 cm          5.82593e+288 pc          1.74742 cm
  1.06849 mm
  (g/cm2)           :          321.301 mg/cm2          7.04335 g/cm2          2.88022e+285 kg/cm2          4.71802 g/cm2
  288.494 mg/cm2
```

Idle> /run/beamOn

gamma (20 keV) in Aluminium (density: 2.7 g/cm3 ; radiation length: 8.89302 cm)

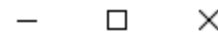
processes :	phot	compt	conv	Rayl	total
cross section per atom :	139.445 barn	6.36306 barn	0 pbarn	9.33068 barn	155.139 barn
compCrossSectionPerVolume :	8.40335 cm ⁻¹	0.383455 cm ⁻¹	0 cm ⁻¹	0.562292 cm ⁻¹	9.34909 cm ⁻¹
cross section per volume :	8.40335 cm ⁻¹	0.38334 cm ⁻¹	0 cm ⁻¹	0.572274 cm ⁻¹	9.35896 cm ⁻¹
cross section per mass :	3.11235 cm ² /g	14.1978 mm ² /g	0 um ² /mg	21.1953 mm ² /g	3.46628 cm ² /g
mean free path :	1.19 mm	2.60865 cm	5.82593e+288 pc	1.74742 cm	1.06849 mm
(g/cm2) :	321.301 mg/cm2	7.04335 g/cm2	2.88022e+285 kg/cm2	4.71802 g/cm2	288.494 mg/cm2

Idle> █

Результаты по Geant4

TestEm0

school@inter:~/projects/geant4/makhmanazarov_rm/TestEm0/build



```
mean free path      :          1.19 mm          2.60865 cm          5.82593e+288 pc          1.74742 cm          1.06849 mm
(g/cm2)             :          321.301 mg/cm2       7.04335 g/cm2       2.88022e+285 kg/cm2       4.71802 g/cm2       288.494 mg/cm2
```

```
-----
Idle> /testem/det/setMat Lead
```

```
Idle> /run/beamOn
```

```
gamma (20 keV) in Lead (density: 11.35 g/cm3 ; radiation length: 5.61253 mm )
```

processes :	phot	compt	conv	Rayl	total
cross section per atom :	28784.1 barn	23.4428 barn	0 pbarn	783.137 barn	29590.7 barn
compCrossSectionPerVolume :	949.456 cm ⁻¹	0.773271 cm ⁻¹	0 cm ⁻¹	25.8321 cm ⁻¹	976.061 cm ⁻¹
cross section per volume :	949.456 cm ⁻¹	0.773319 cm ⁻¹	0 cm ⁻¹	25.9601 cm ⁻¹	976.189 cm ⁻¹
cross section per mass :	83.6525 cm ² /g	6.81339 mm ² /g	0 um ² /mg	2.28724 cm ² /g	86.0079 cm ² /g
mean free path (g/cm2) :	10.5324 um	1.29313 cm	5.82593e+288 pc	385.206 um	10.2439 um
	11.9542 mg/cm2	14.677 g/cm2	2.88022e+285 kg/cm2	437.209 mg/cm2	11.6268 mg/cm2

```
-----
Idle> █
```

Результаты по Geant4

TestEm0

$$I(x) = I_0(x) \exp\left(\int_0^d \alpha(x) dx\right) \longrightarrow I(x) = I_0(x) \exp(-\alpha x)$$

$$\alpha = \frac{1}{L_{free}}$$

$$x = -L_{free} \ln\left(\frac{1}{1000}\right)$$

Для алюминия $x = 12.0707$ см

Для свинца $x = 2660.91$ м

Результаты по Geant4

TestEm5

/testem/det/setAbsMat Aluminium (Lead)

/testem/det/setAbsThick 12.0707 cm (2660.91 um)

/testem/gun/setDefault

/gun/particle gamma

/gun/energy 20 keV

/run/beamOn 1000

Результаты по Geant4

TestEm5

```
school@inter:~/projects/geant4/makhmanazarov_rm/TestEm5Build
===== run summary =====
The run was 1000 gamma of 20 keV through 12.1 cm of Aluminium (density: 2.7 g/cm3 )
Total energy deposit in absorber per event = 19.91 keV +- 42.36 eV
----> Mean dE/dx = 0.001649 MeV/cm      (0.0006108 MeV*cm2/g)
From formulas :
  restricted dEdx = 0 MeV/cm      (0 MeV*cm2/g)
  full dEdx      = 0 MeV/cm      (0 MeV*cm2/g)
Leakage :  primary = 94.93 eV +- 42.36 eV      secondaries = 0 eV +- 0 eV
Energy balance :  edep + eLeak = 20 keV
Total track length (charged) in absorber per event = 3.699 um +- 13.09 nm
Total track length (neutral) in absorber per event = 1.176 mm +- 36.51 um
Number of steps (charged) in absorber per event = 2.103 +- 0.03128
Number of steps (neutral) in absorber per event = 1.095 +- 0.0101
Number of secondaries per event : Gammas = 0;   electrons = 1.035;   positrons = 0
Number of events with the primary particle transmitted = 0 %
```

Результаты по Geant4

TestEm5

```
school@inter:~/projects/geant4/makhmanazarov_rm/TestEm5Build
===== run summary =====
The run was 1000 gamma of 20 keV through 2.66 mm of Lead (density: 11.3 g/cm3 )
Total energy deposit in absorber per event = 19.97 keV +- 20.67 eV
-----> Mean dE/dx = 0.07504 MeV/cm      (0.006611 MeV*cm2/g)
From formulas :
  restricted dEdx = 0 MeV/cm      (0 MeV*cm2/g)
  full dEdx      = 0 MeV/cm      (0 MeV*cm2/g)
Leakage : primary = 17.49 eV +- 17.48 eV      secondaries = 15.47 eV +- 11.05 eV
Energy balance : edep + eLeak = 20 keV
Total track length (charged) in absorber per event = 553.5 nm +- 17.65 nm
Total track length (neutral) in absorber per event = 10.63 um +- 327.1 nm
Number of steps (charged) in absorber per event = 2.284 +- 0.06619
Number of steps (neutral) in absorber per event = 1.041 +- 0.006582
Number of secondaries per event : Gammas = 0;   electrons = 1;   positrons = 0
Number of events with the primary particle transmitted = 0 %
```

Результаты по машинному обучению



```
1 import numpy as np
2 import pandas as pd
3 from sklearn.naive_bayes import GaussianNB
4 from matplotlib import pyplot as plt
5 import warnings
6 warnings.filterwarnings('ignore')
7 from pylab import rcParams
8 rcParams['figure.figsize'] = 9, 6
9
10 import pandas
11 df = pandas.read_csv("training.csv");
12
13 def AMS(w, y, y_pred):
14     s = (w * (y == 1) * (y_pred == 1)).sum()
15     b = (w * (y == 0) * (y_pred == 1)).sum()
16     bReg = 10.
17     return np.sqrt(2 * ((s + b + bReg) * np.log(1 + s / (b + bReg)) - s))
18
19 df[["log_PRI_met_sumet", "log_PRI_met", "log_DER_pt_ratio_lep_tau"]] = np.log(
20 df[["PRI_met_sumet", "PRI_met", "DER_pt_ratio_lep_tau"]]
21 )
22
23 columns = ["log_PRI_met_sumet", "log_PRI_met", "log_DER_pt_ratio_lep_tau"]
24 df["Y"] = df["Label"].map({
25     "s": 1,
26     "b": 0,
27 })
28
29 from sklearn.metrics import accuracy_score
30 gnb = GaussianNB()
31 train = df[columns].to_numpy()
32 weight = df["Weight"].to_numpy()
33 target = df["Y"].to_numpy()
34 model = gnb.fit(train, target)
35 predict = model.predict(train)
36 print("Accuracy =", accuracy_score(target, predict))
37 print("AMS1 =", AMS(weight, target, predict))
38 #
39 #
40 #from sklearn.tree import DecisionTreeClassifier
```

```
Accuracy = 0.683396
AMS1 = 1.2750309370283022
```

Спасибо за внимание!