LICEO SCIENTIFICO STATALE
"Arcangelo Scacchi"

Extreme Energy Events
Science inside Schools

Basic Data Analysis using Root

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Summary

- ✓ The Aim
- ✓ Data download
- ✓ The main routine
- ✓ Latitude effect
- ✓ Altitude and cosmic rays

The Aim

- ✓ Write a macro to read the csv file trending
- ✓ Calculate the average of:
  - RateTrackEvents
  - RateTrackEvents0_10,
  - RateTrackEvents10_20,

    … … …
  - RateTrackEvents60_90
- ✓ Write the averages in a file out.txt
- ✓ Create three Histograms about RateTrackEvents, RateTrackEvents0_10 and RateTrackEvents50_60
- ✓ Compare the Rate at two different latitudes: Bari and Treviso
- ✓ Compare the Rate at two different altitudes: Bari and L'Aquila

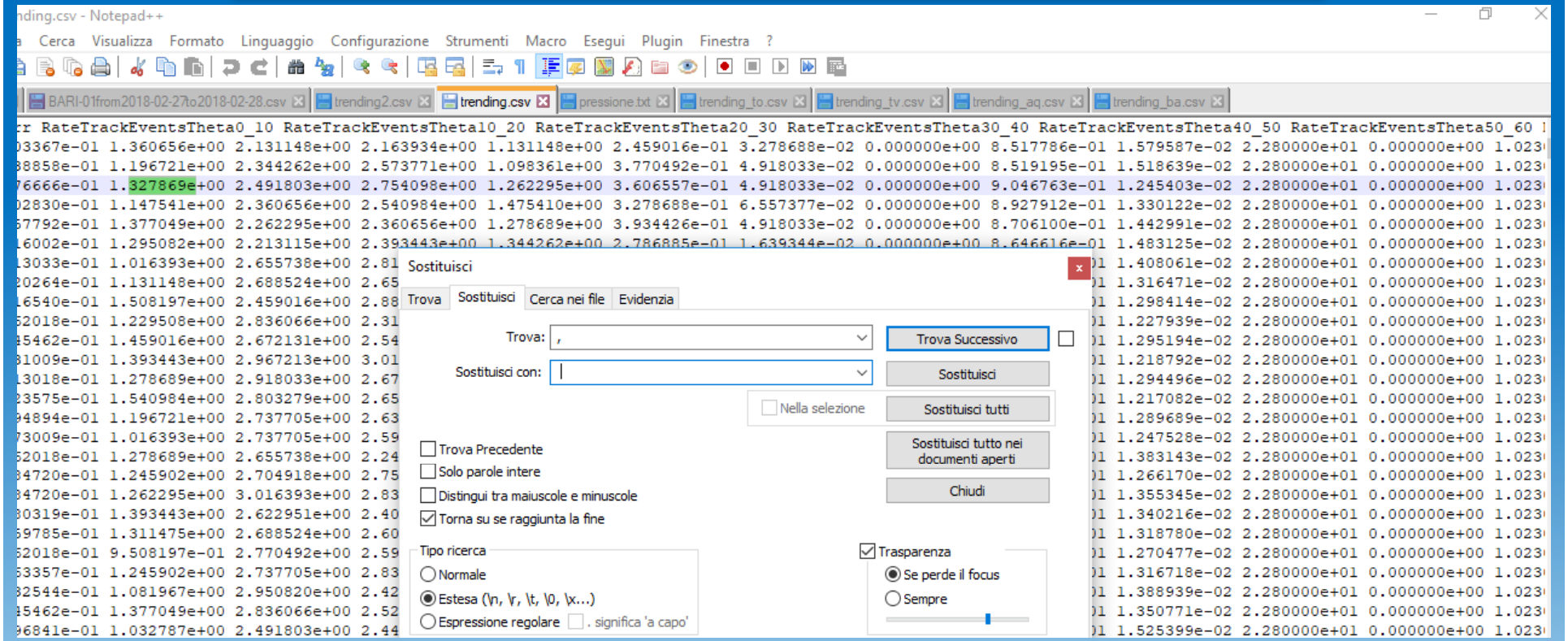
The Download

iatw.cnaf.infn.it/eee/monitor/

School	Day	Time	Name of the last trasferred File	Number of Files trasferred today	Last Entry in the e-logbook of the Schools	Name of the last File analyzed by DQM	DQM daily report	RATE of Triggers for the last Run in DQM	RATE of Tracks for the last Run in DQM	Link DQM
ALTA-01 [Event Display]	ven 07 giugno	13:33	ALTA-01-2019-06-07-00023.bin	0 [History]	*	ALTA-01-2019-06-07-00022.bin	08/06 [History]	12.0	10.0	ALTA-01
ANCO-01 [Event Display]	dom 05 gennaio	23:10	ANCO-01-2020-01-05-00033.bin	0 [History]	12:36 23/12/2019	ANCO-01-2020-01-05-00033.bin	05/01 [History]	17.0	12.0	ANCO-01
AREZ-01 [Event Display]	dom 05 gennaio	23:37	AREZ-01-2020-01-05-00058.bin	0 [History]	13:16 05/01/2020	AREZ-01-2020-01-05-00058.bin	05/01 [History]	32.0	28.0	AREZ-01
BARI-01 [Event Display]	dom 05 gennaio	23:26	BARI-01-2020-01-05-00978.bin	0 [History]	17:41 28/12/2019	BARI-01-2020-01-05-00978.bin	05/01 [History]	10.0	8.0	BARI-01
LAQU-01 [Event Display]	dom 05 gennaio	23:21	LAQU-01-2020-01-05-00071.bin	0 [History]	*	LAQU-01-2020-01-05-00071.bin	05/01 [History]	43.0	41.0	LAQU-01
TREV-01 [Event Display]	dom 05 gennaio	22:42	TREV-01-2020-01-05-00016.bin	0 [History]	09:54 05/01/2020	TREV-01-2020-01-05-00016.bin	05/01 [History]	7.0	6.0	TREV-01

Accessing to the daily report we downloaded the csv file “tranding” for the same date12-17-2020 and relative to three telescopes: BARI-01, LAQU-01 and TREV-01

The download



Using WordPad ++ we substituted the separator "," with a space and put the three files in a directory Root devoted to input/output files.

The main routine: variables declaration

```
{
    // Variables declaration
    double RateTrackEvents =0;
    double RateTrackEventsTheta0_10 =0;
    double RateTrackEvents10_20 =0;
    double RateTrackEvents20_30 =0;
    double RateTrackEvents30_40 =0;
    double RateTrackEvents40_50 =0;
    double RateTrackEvents50_60 =0;
    double RateTrackEvents60_90 =0;

    double RateTrackEvents_Media =0;
    double RateTrackEventsTheta0_10_Media =0;
    double RateTrackEventsTheta10_20_Media =0;
    double RateTrackEventsTheta20_30_Media =0;
    double RateTrackEventsTheta30_40_Media =0;
    double RateTrackEventsTheta40_50_Media =0;
    double RateTrackEventsTheta50_60_Media =0;
    double RateTrackEventsTheta60_90_Media =0;
    int nrighe =0;
    double pressure[2000];
    double rate[2000];
```

The main routine: reading Data

```
ifstream filedati("C:\\root\\trending_ba.csv");\\file  reading
    if(filedati.fail()) \\Error  management
        {
        cout<<"The file doesn't exist, check the path!"<<endl;
        break;
        }
    string titolo[22];
    double BinStart, BinEnd,...
for(Int_t i=0; i<22; i++){ \\Loading  Data
        filedati >> titolo[i];
    }
    //Create three Histograms
    TH1F h1("hist1","Rate Bari-01", 50, 6, 9);
    TH1F h2("hist2","Rate 0-10", 50, 0.7, 1.6);
    TH1F h3("hist3","Rate 50-60", 6, 0.0, 0.09);
```

The main routine: Histograms and Averages

```
while(filedati>> BinStart>> BinEnd>>…>> UniqueRunId)
        {
        cout << "I have read \n"<<BinStart<<" "<<BinEnd <<" "…
<<endl;
        \\Fill the Rate Histograms
        h1 -> Fill(RateTrackEvents);
        h2 -> Fill(RateTrackEventsTheta0_10);
        h3 -> Fill(RateTrackEventsTheta50_60);
         \\Calculate the Rate Averages
        RateTrackEvents_Media = RateTrackEvents_Media +
RateTrackEvents;
        RateTrackEventsTheta0_10_Media =
RateTrackEventsTheta0_10_Media + RateTrackEventsTheta0_10;
…  ….
        RateTrackEventsTheta60_90_Media =
RateTrackEventsTheta60_90_Media + RateTrackEventsTheta60_90;
        nrighe++;
        }
```

The main routine: the output

```
RateTrackEvents_Media = RateTrackEvents_Media/(double) nrighe;
RateTrackEventsTheta0_10_Media =
RateTrackEventsTheta0_10_Media/(double) nrighe;
…   ….
RateTrackEventsTheta60_90_Media =
RateTrackEventsTheta60_90_Media/(double) nrighe;
//write the averages in a output file
ofstream fileout("C:\\root\\out.txt");
fileout<<"Media Rate: " <<RateTrackEvents_Media<<"\n";
fileout<<"Media Rate 0-10: " <<RateTrackEventsTheta0_10_Media<<"\n";
…   …
fileout<<"Media Rate 60-90: " <<RateTrackEventsTheta60_90_Media;
h1 -> Draw();
TCanvas *c2 = new TCanvas();
h2 -> Draw();
TCanvas *c3 = new TCanvas();
h3 -> Draw();
}
```

Run Time

The out.txt file with the averages and the Output Data on the Screen:

ROOT session

```
 0.0130495 23 0 1024 22.197 24.028 22.8406 4.4733e+009
Ho letto
4.09007e+008 4.09007e+008 9.06557 0.385507 7.80328 0.357663 1.11475 2.4918 2.4918 1.40984 0.262295 0.0327869 0 0.86076 0
.0147218 23 0 1024 22.1618 24.6338 23.0536 4.4733e+009
Ho letto
4.09007e+008 4.09007e+008 9.19672 0.388286 8.04918 0.363254 1.37705 2.4918 2.29508 1.4918 0.360656 0.0327869 0 0.875223
0.0139523 23 0 1024 21.5635 24.4572 22.5141 4.4733e+009
Ho letto
4.09007e+008 4.09007e+008 8.18033 0.366202 7.21312 0.343872 1.03279 2.29508 2.37705 1.18033 0.295082 0.0327869 0 0.88176
4 0.0144545 23 0 1024 21.3027 24.2677 21.8211 4.4733e+009
Ho letto
4.09007e+008 4.09007e+008 8.90164 0.382006 7.91803 0.360283 1.16393 2.59016 2.36066 1.47541 0.311475 0.0163934 0 0.88950
3 0.0134539 23 0 1024 21.9145 24.5882 22.5857 4.4733e+009
Ho letto
4.09007e+008 4.09007e+008 8.45902 0.372387 7.52459 0.351218 1 2.5082 2.34426 1.06557 0.52459 0.0819672 0 0.889535 0.0137
997 23 0 1024 21.929 25.029 22.671 4.4733e+009
Ho letto
4.09007e+008 4.09007e+008 8.90164 0.382006 7.83607 0.358413 1.22951 2.63934 2.32787 1.14754 0.47541 0.0163934 0 0.880295
 0.0139306 23 0 1024 21.3253 24.5295 21.8584 4.4733e+009
Ho letto
4.09007e+008 4.09008e+008 8.67213 0.377049 7.60656 0.353125 1.32787 2.22951 2.52459 1.18033 0.344262 0 0 0.877127 0.0142
736 23 0 1024 22.2455 24.6332 21.7091 4.4733e+009
Ho letto
4.09008e+008 4.09008e+008 8.42623 0.371665 7.45902 0.349684 1.26229 1.96721 2.5082 1.2459 0.459016 0.0163934 0 0.885214
0.01406 23 0 1024 21.8842 25.0958 22.8987 4.4733e+009
Ho letto
4.09008e+008 4.09008e+008 9.01639 0.38446 7.96721 0.3614 1.39344 2.22951 2.14754 1.63934 0.491803 0.0655738 0 0.883636 0
.013673 23 0 1024 21.8076 25.1331 22.7261 4.4733e+009
Info in <TCanvas::MakeDefCanvas>:  created default TCanvas with name c1
root [3]
```

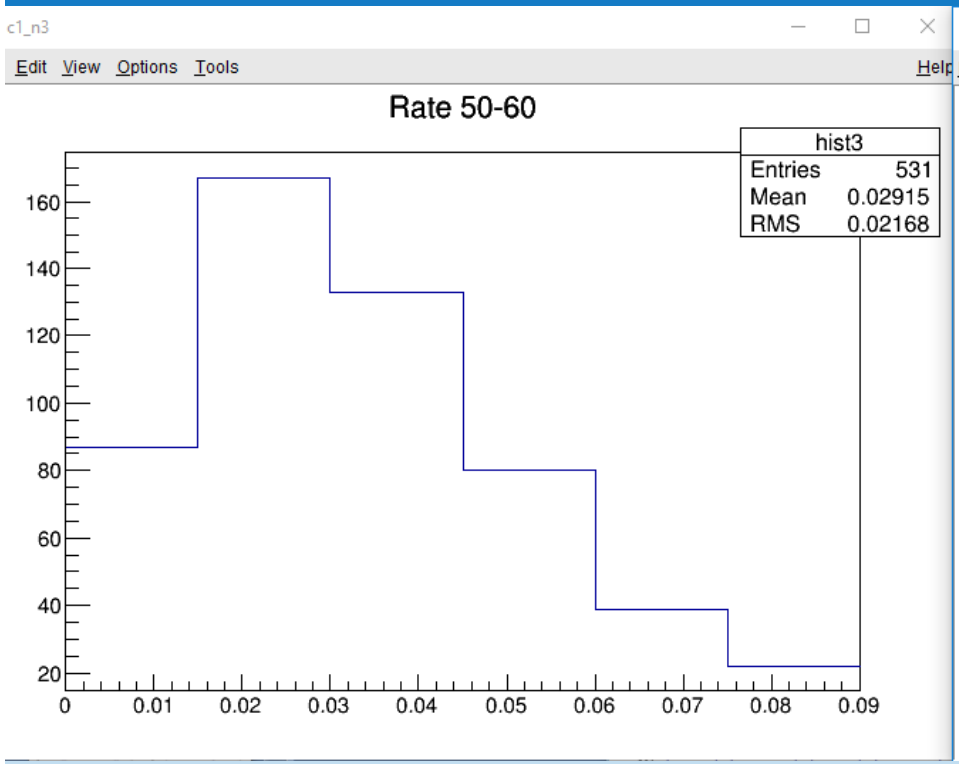
out - Blocco note

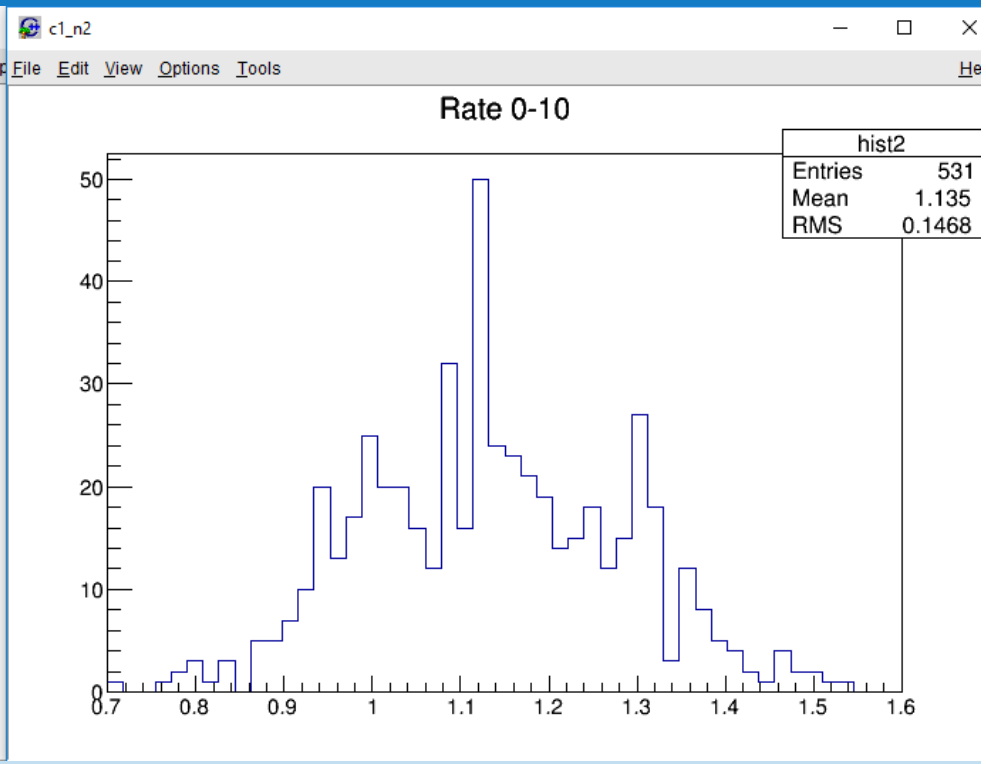
File Modifica Formato Visualizza ?

```
Media Rate: 7.60044
Media Rate 0-10: 1.13377
Media Rate 10-20: 2.39496
Media Rate 20-30: 2.3576
Media Rate 30-40: 1.32231
Media Rate 40-50: 0.362168
Media Rate 50-60: 0.029607
Media Rate 60-90: 3.08728e-005
```

Rate at different Angles:

At Run Time the routine creates the Histograms about the Rate at different Angles Theta:

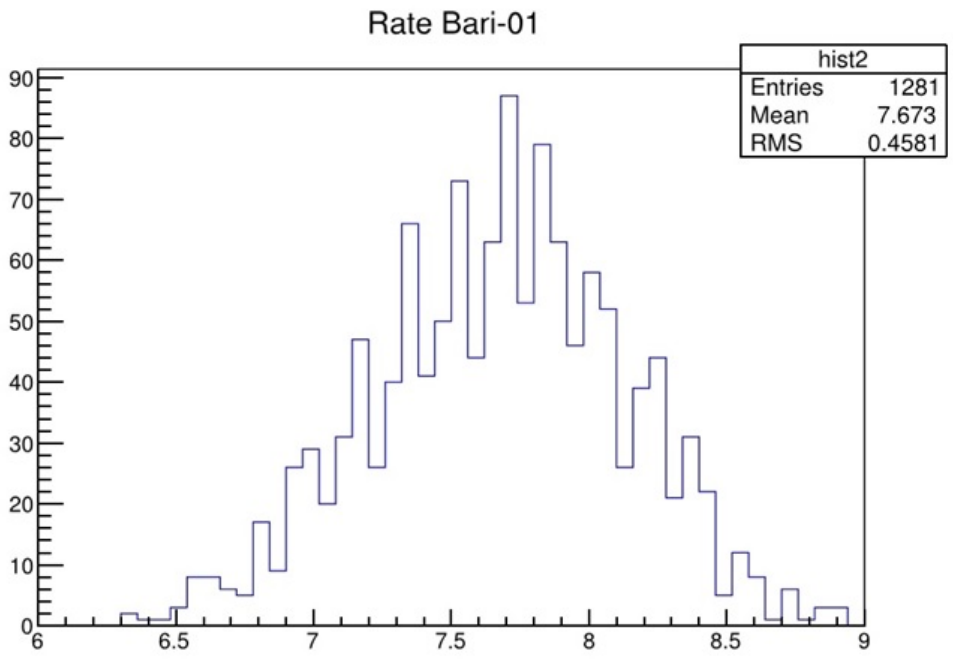


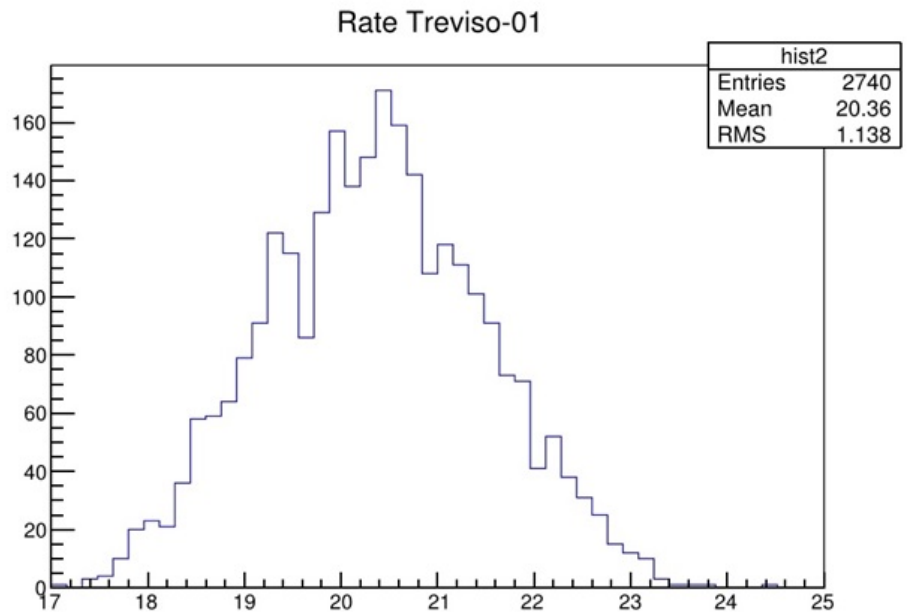


Latitude effect

The rate increases with increasing degrees of latitude:

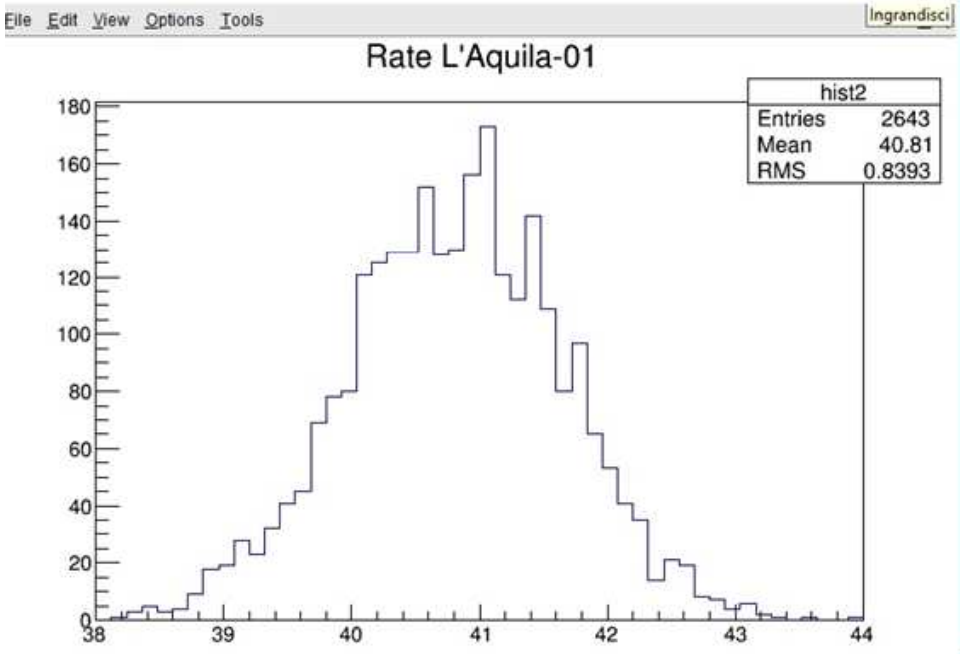
at the equator only the most energetic particles reach the ground, at the poles the particles reach the ground even with little initial energy. We compare the Rate at two different latitudes (Bari and Treviso):

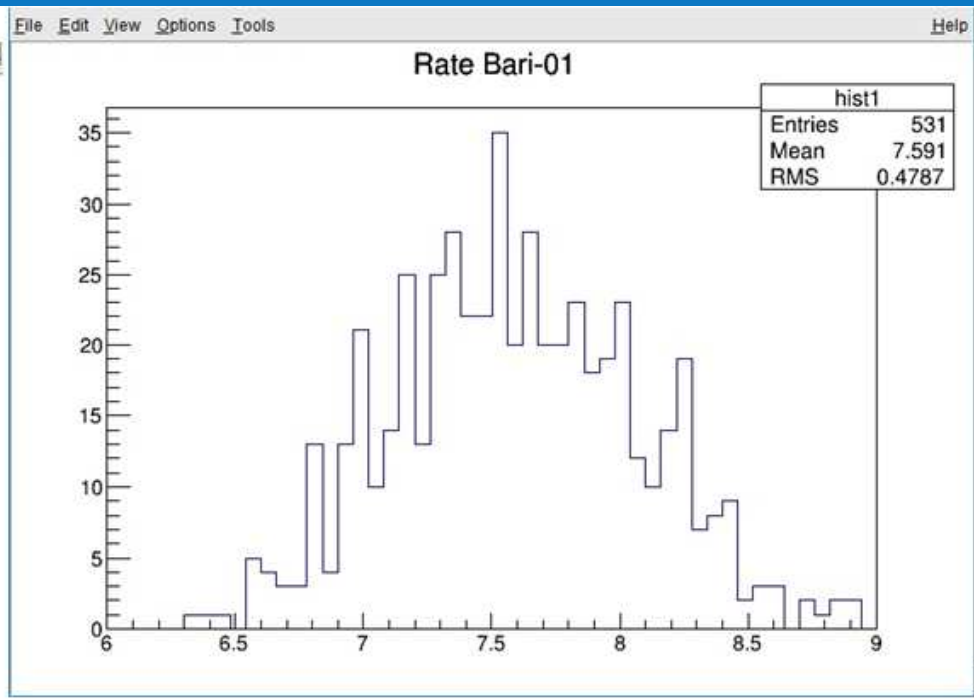




Altitude and cosmic rays

We compared the rate at different altitudes (L'Aquila and Bari):





```
*************************************
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*                                   *
*                                   *
_ *     Thanks for your attention!    * _
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/ / *    Liceo Sc. «A.Scacchi»        * \ \
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