Results, immediate tasks and plan of work

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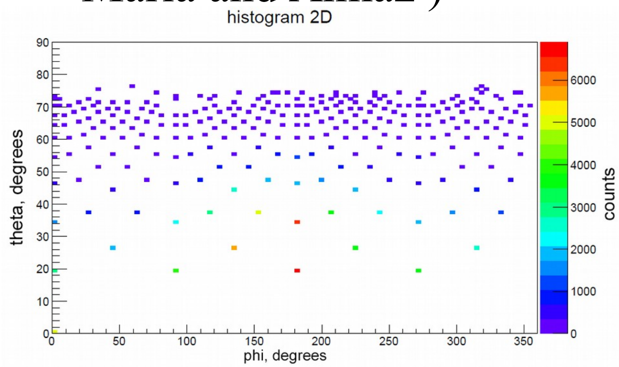
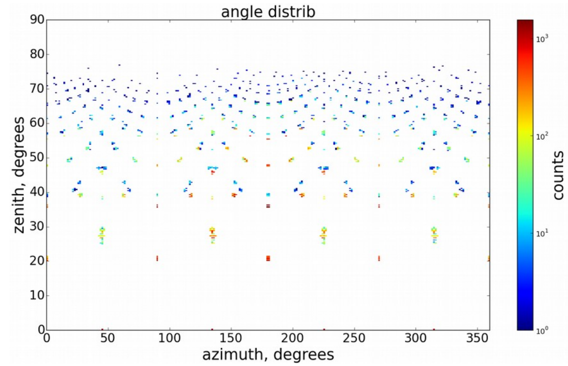
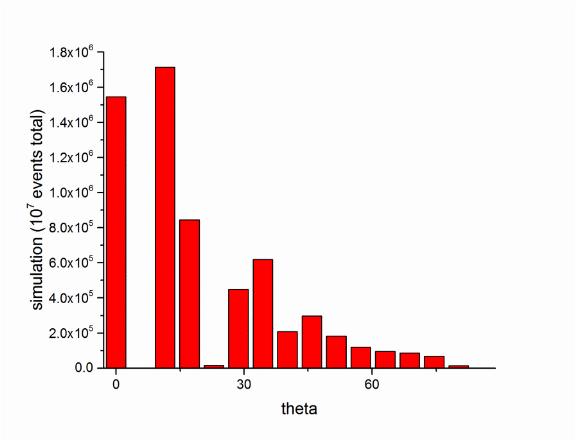
Results of work (Russian group)

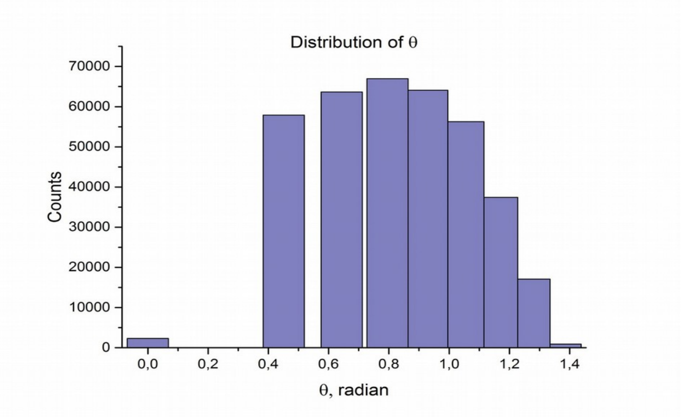
2 independent ways for data selection and reconstuction of muon tracks were created (by Maria and Almaz)





2 independent simulations of muon flux were done (Olga&Timofey; Alexander)

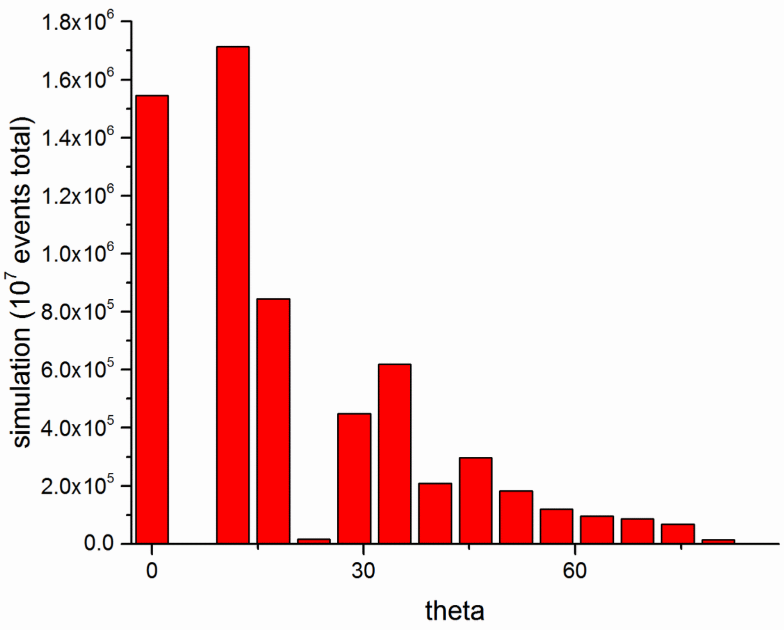




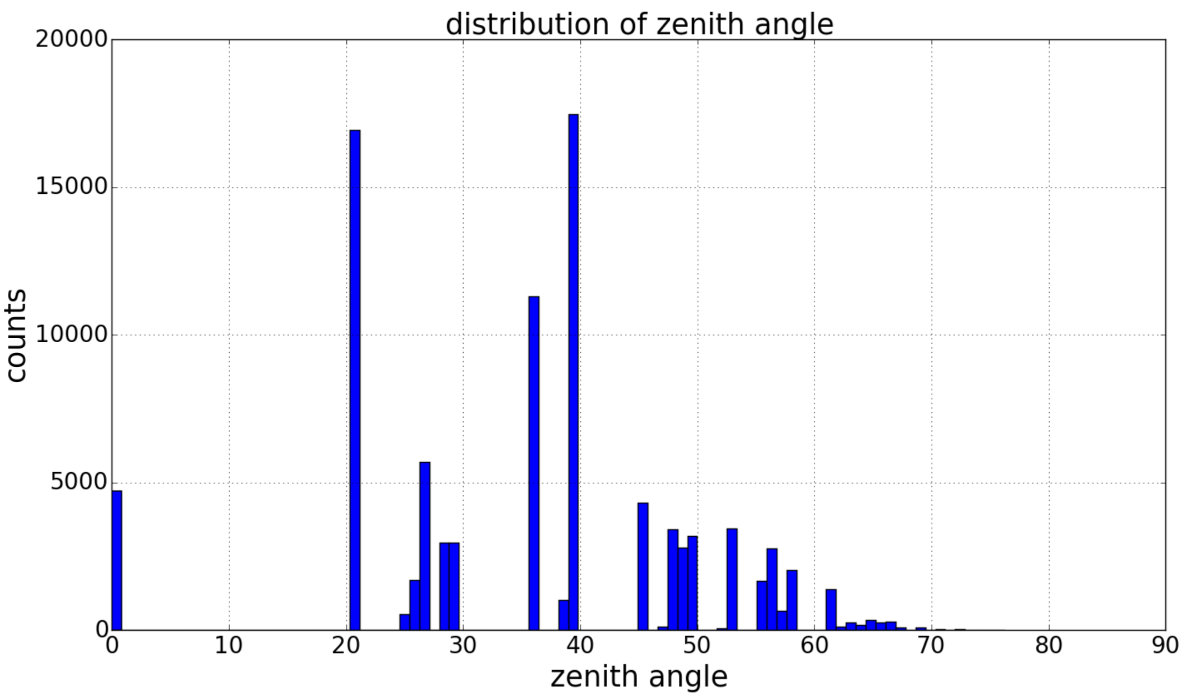
The histograms for angle distribution with taking into account geometry of installation were created (by Alexander)

Experimental data: 109083

After selection: 92780

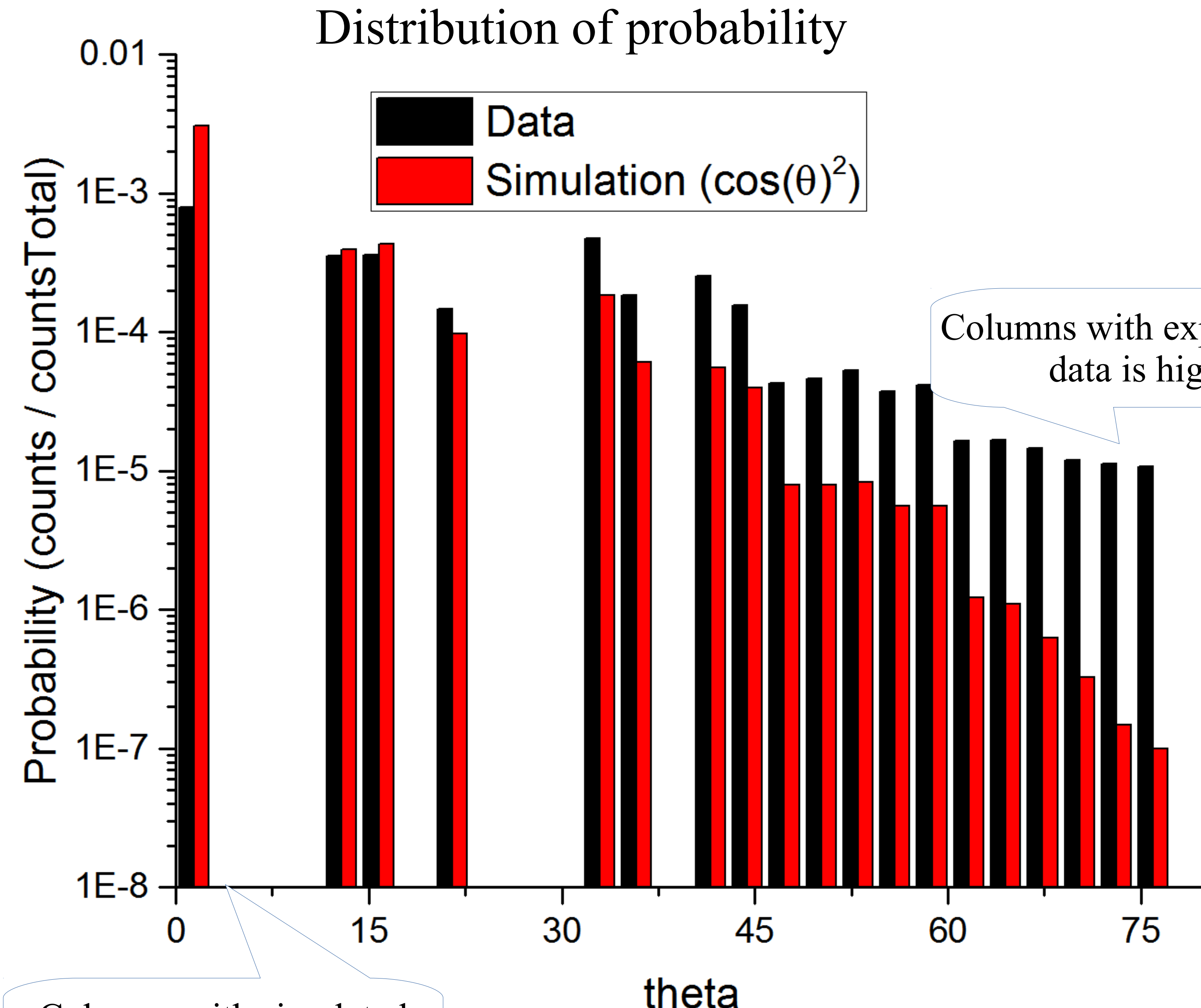


simulation



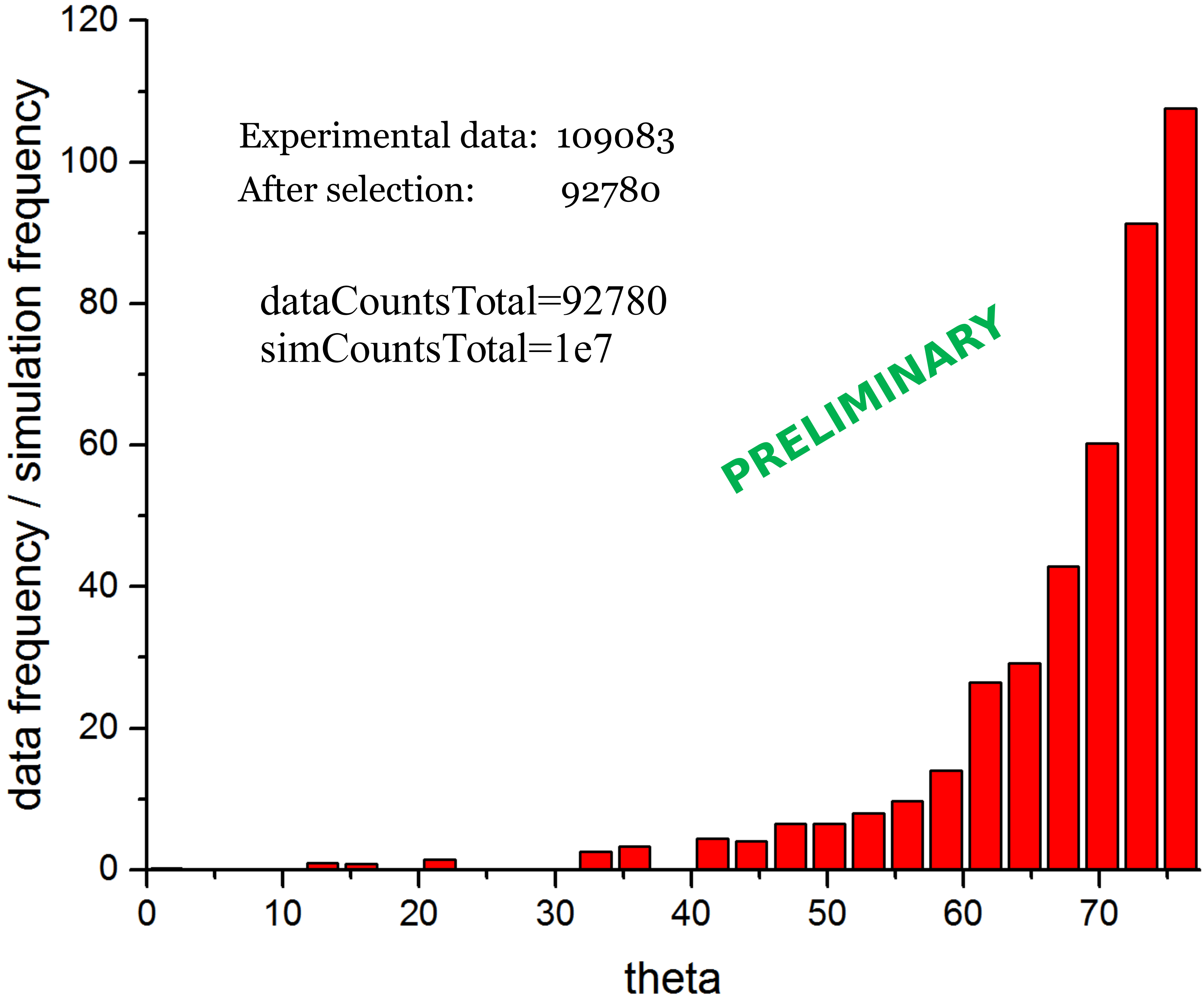
PRELIMINARY

Intersection between simulation and experimental data

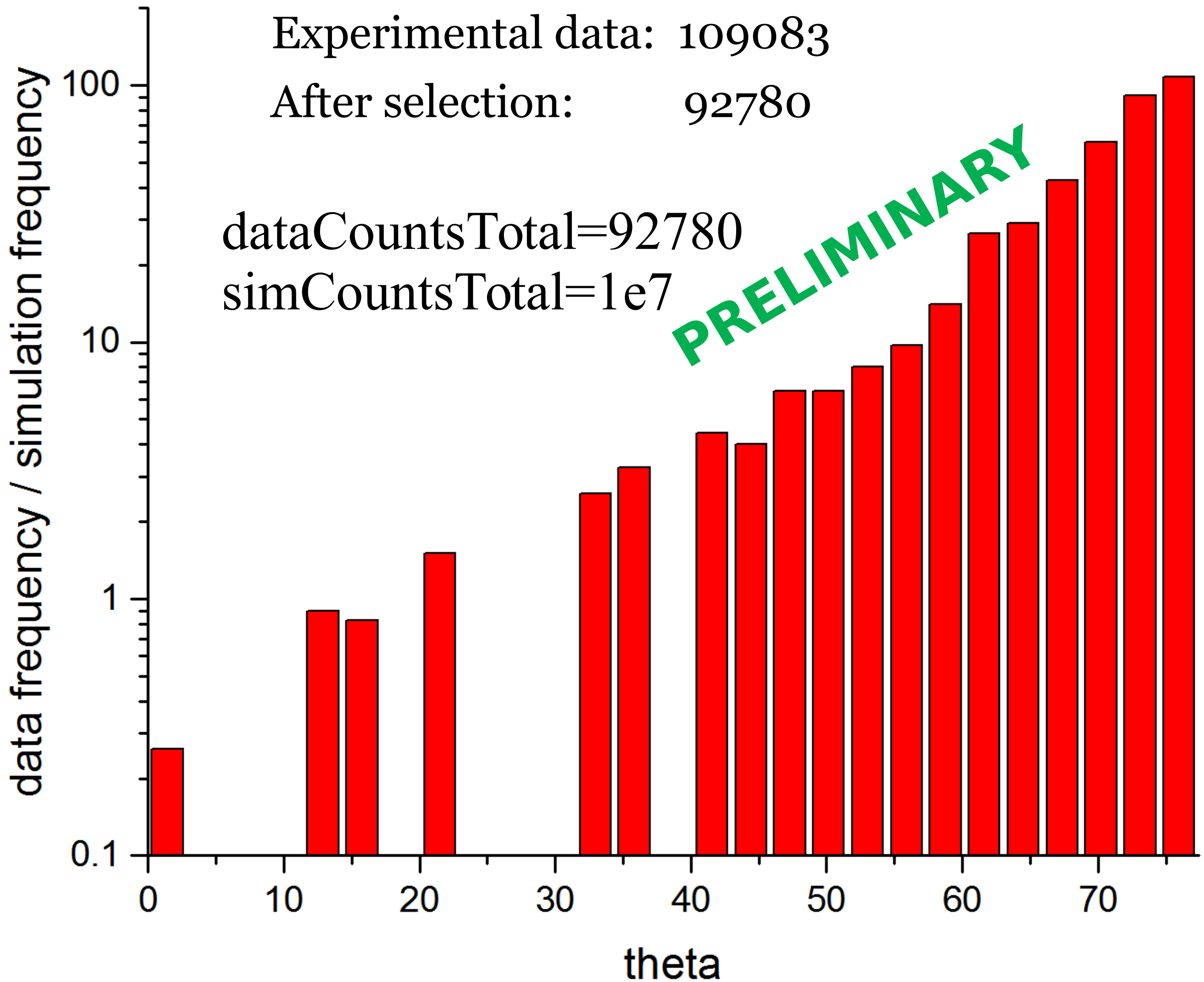


Columns with experimental data is higher

Columns with simulated data is higher

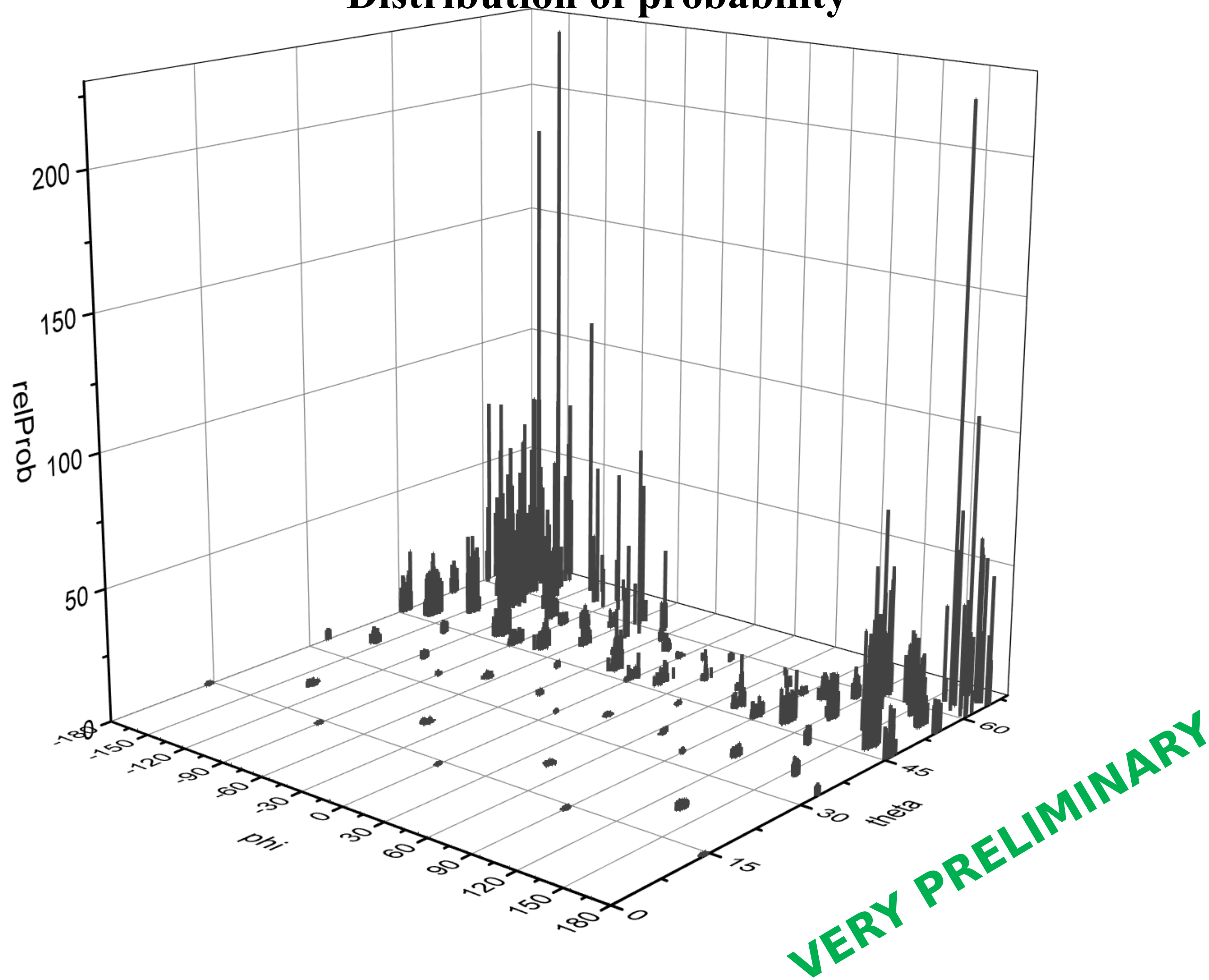


Experimental data: 109083
After selection: 92780
dataCountsTotal=92780
simCountsTotal=1e7
PRELIMINARY
data frequency / simulation frequency
theta
0
20
40
60
80
100
120
0
10
20
30
40
50
60
70



Experimental data: 109083
After selection: 92780
dataCountsTotal=92780
simCountsTotal=1e7
PRELIMINARY
data frequency / simulation frequency
100
10
1
0.1
0
10
20
30
40
50
60
70
theta

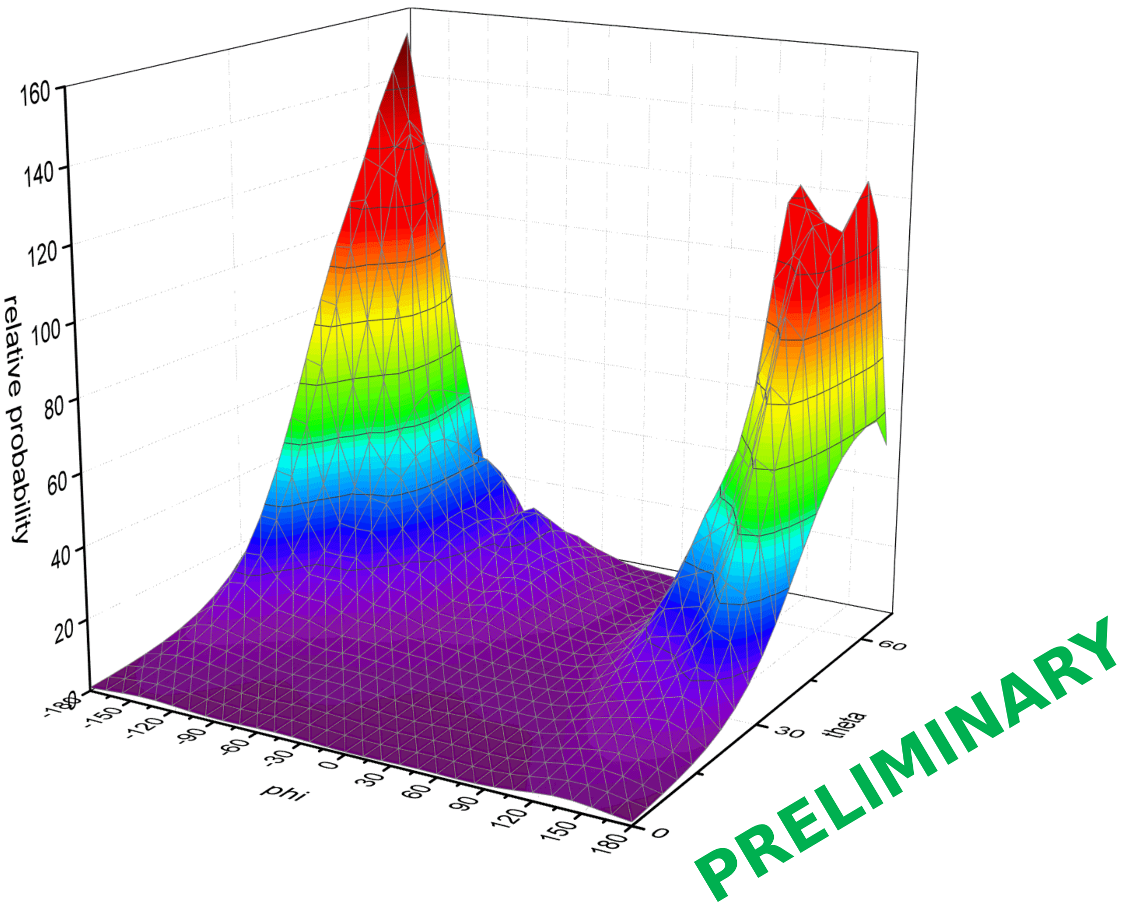
Distribution of probability



Plotting the result

- To plot 2d θ and φ distributions, reduce list of [θ/φ, relative probability] pairs by evenly spaced θ/φ. Y-value is determined as average.
- To plot 3d combined distribution, each line is replaced by bivariate Normal distribution with σ proportional to the angleErr (for smooth picture one needs the coefficient to be about 3). Then calculate sum of normal distributions on a pre-defined grid.

Pictures – 3d result

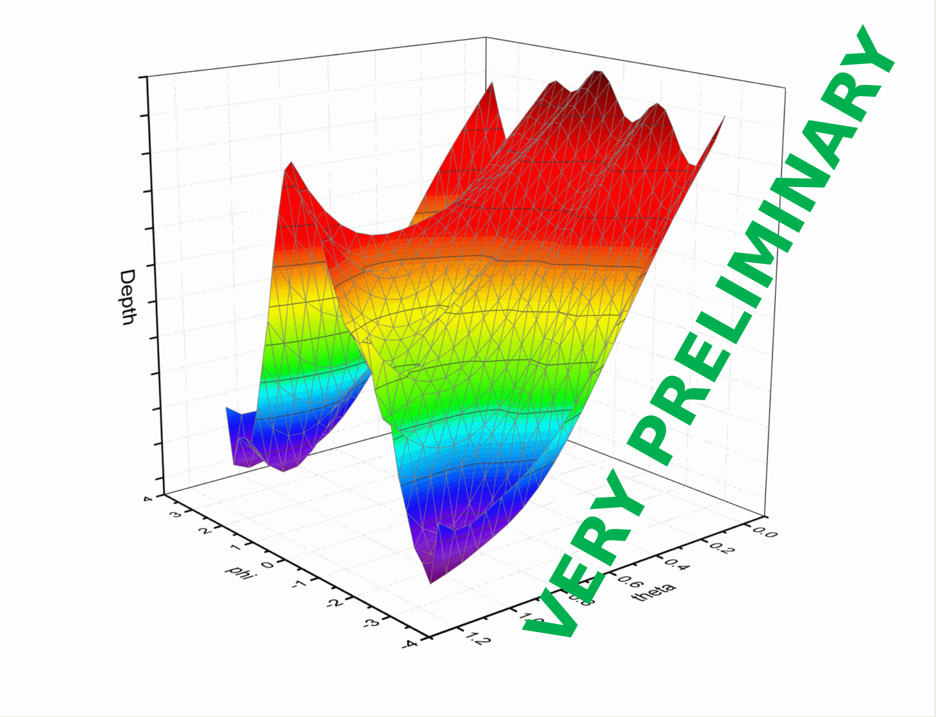


Column density calculation

- The muon flux reduction could be written as

$$\frac{N}{N_0} = e^{-l/l_0}$$

- The column density should be proportional to $-\ln(relProb)$



Problems with simulation

- The center of mass vector and its error depends on initial muon distribution. One needs to use “real” muon distribution to obtain correct values (otherwise there is a systematic shift in the direction estimation). In practice, when we obtain result with any distribution, we can then use it as initial distribution to correct angle estimations.
- The way of determining errors is simple and avoids problems with angles near boundaries, but it does gives only one average value for theta and phi both.

Problems with data evaluation

- One should use uniform angle distribution for geometry efficiency calculation, but “real” distribution for relative probability. So one needs two different simulation sets. **NOT DONE YET.**
- The result is discrete distribution with non-uniform grid. One needs to find a way for graphical representation of such results.

TODO

- Determine the way of compact result presentation (spherical functions?)
- Create particle random direction generator for result (spherical functions again?) and use it for angle definition correction
- Find a better way to describe direction distribution inside pixel set
- Compute absolute muon flux reduction using known muon flux on the surface as a reference
- Calculate actual column density

Applying simulation to the data

- Read the experimental data from Almaz file and combine it with simulation data in a following way:

name	dataCounts	simCounts	phi	theta	angleErr
[SC79_12, SC81_9, SC91_2]	29	563	-2.358	0.759	0.112
[SC79_12, SC81_9, SC91_1]	6	90	-2.147	0.884	0.085
[SC79_12, SC81_9, SC91_3]	7	582	-1.979	0.621	0.129
[SC74_0, SC83_12, SC85_13]	5	79	2.165	0.889	0.092
[SC76_5, SC81_8, SC91_2]	21	1794	-1.573	0.576	0.141

dataCounts – number of pixel set hits in data;
simCounts – number of pixel set hits in simulation;

- Calculate relative probability of pixel set as $\frac{dataCounts}{dataCountsTotal} / \frac{simCounts}{simCountsTotal}$ (see appendix for explanation).
- Remove all lines with dataCounts < 3 to avoid improbable high-weight events