Event selection and background rejection methods

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Task: measure flux of muons and reject background.

Causes of background events

It is the result of interactions between

pixels and gamma-background from:

- the laboratory walls
- construction details of detectors
- etc.

Frequency of random double events

bottom level -> other levels

$$F_1 = (f_0 * N_1) * \left((N_2 + N_3) * f_0\right) * \Delta t = 9.58 * 10^{-3} Hz$$

middle level -> other levels

$$F_2 = (f_0 * N_2) * \left((N_1 + N_3) * f_0\right) * \Delta t = 9.58 * 10^{-3} Hz$$

$f_0 = 4Hz$ is frequency of background events for pixel

$\Delta t = 20\ ns = 20 * 10^{-9}[s]$ is trigger window.

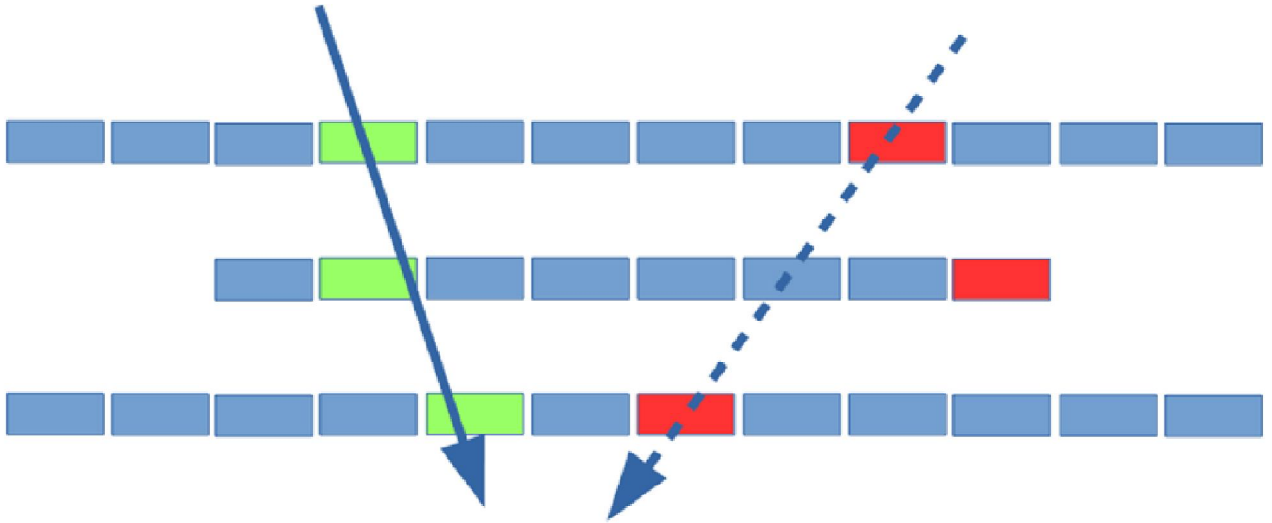
$N_{1,2,3}$ is number of pixels on bottom, middle and top levels.

Summary:

$$F_{summ} = F_2 + 2 * F_1 = 2.5 * 10^{-2} Hz$$

Triple events

- Events: 3 hits on 3 different levels.
- Number of events: 109 083.
- Pixels muon events must lie on a straight line.



Frequency of non-muon triple events

$$F_3 = (f_0 \cdot N_1) \cdot \Delta t \cdot (f_0 \cdot N_2) \cdot \Delta t \cdot (f_0 \cdot N_3) = f_0^3 \cdot \Delta t^2 \cdot N_1 \cdot N_2 \cdot N_3 \ \text{Hz},$$

$$F_3 = 10^{-7}$$

F_3 is frequency of non-muon triple events.

$N_{1,2,3}$ is number of pixels on bottom, middle and top levels.

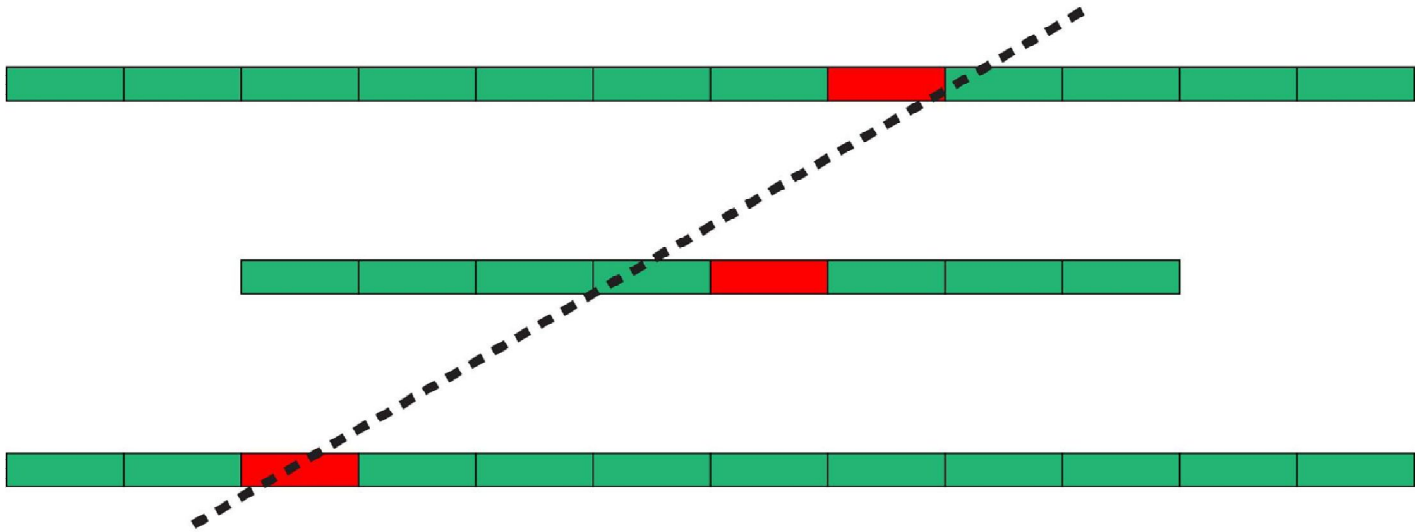
$f_0 = 4Hz$ is frequency of background events for pixel

$\Delta t = 20\ ns = 20 * 10^{-9}[s]$ is trigger window.

LSM analysis (by Maria)

Without selection: 109083
After: 98774

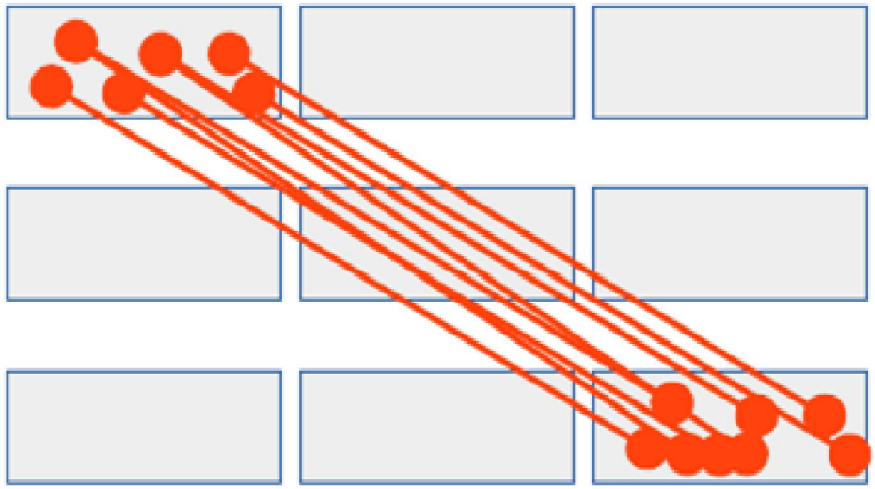
Selection bias: $\chi 2 \leqq 16$,
$\chi 2$=(the total distance to the activated pixels)/($\sigma 2$)



“Direct line” method(by Almaz)

Experimental data: 109083
After cut: 95634

We select only those events through which "you can draw a straight line."

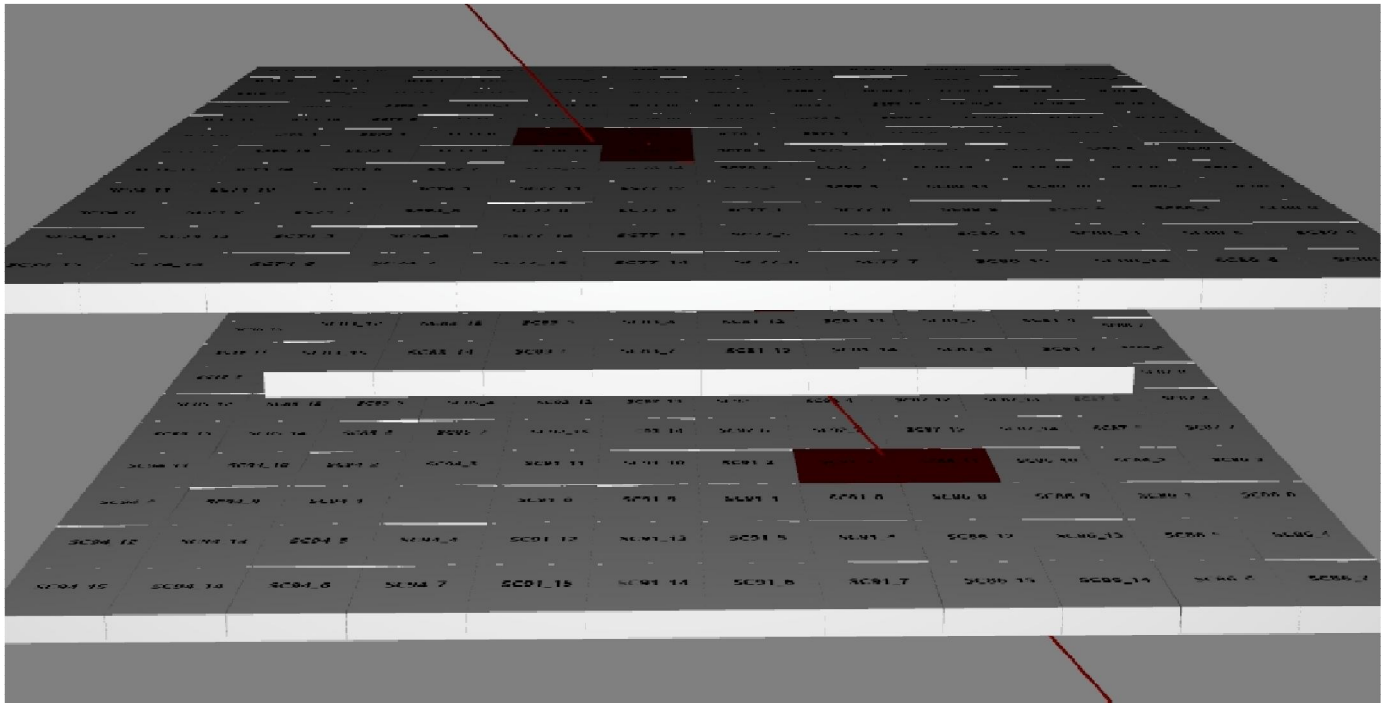


It is difficult to estimate the angle error.

Слайд 7

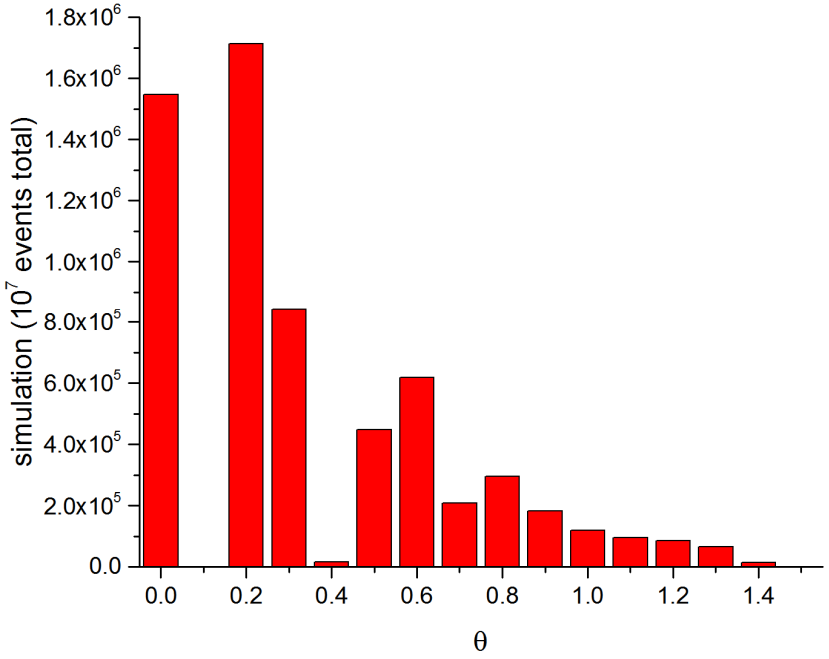
2 обязуюсь поменять это убожество на более корректную картинку
Алмаз Фазлиахметов;

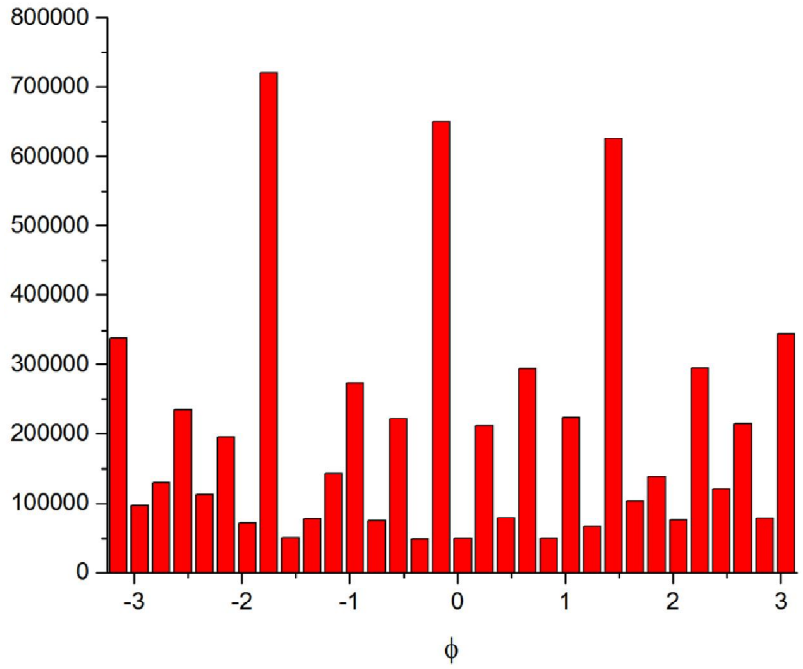
Geometrical simulation



name	simCounts	phi	phiErr	theta	thetaErr
[SC76_8, SC84_6, SC92_8]	24525	0.012	1.812	1.462	0.080
[SC73_1, SC84_15, SC85_1]	24482	0.001	1.809	1.462	0.081
[SC75_13, SC84_3, SC93_13]	24430	-0.002	1.817	1.462	0.081
[SC76_15, SC83_1, SC92_15]	24429	-0.004	1.819	1.461	0.081

Results of simulation



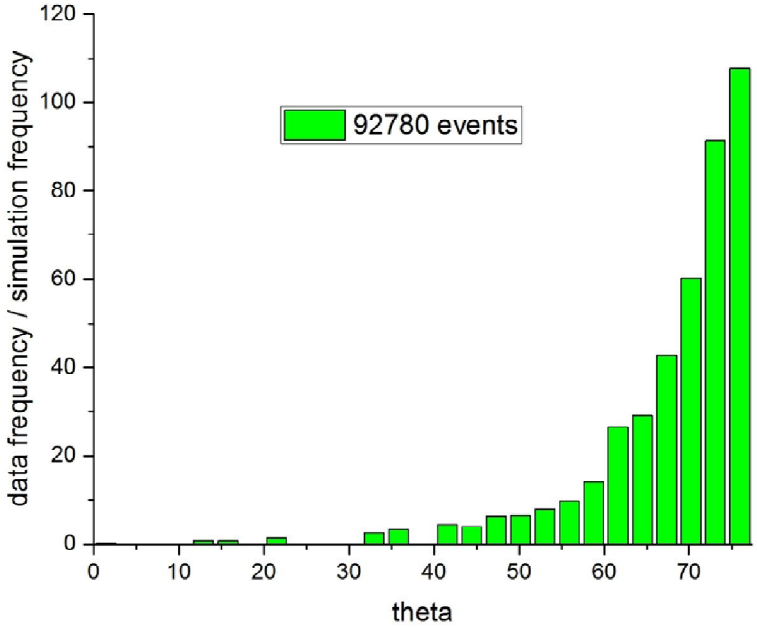


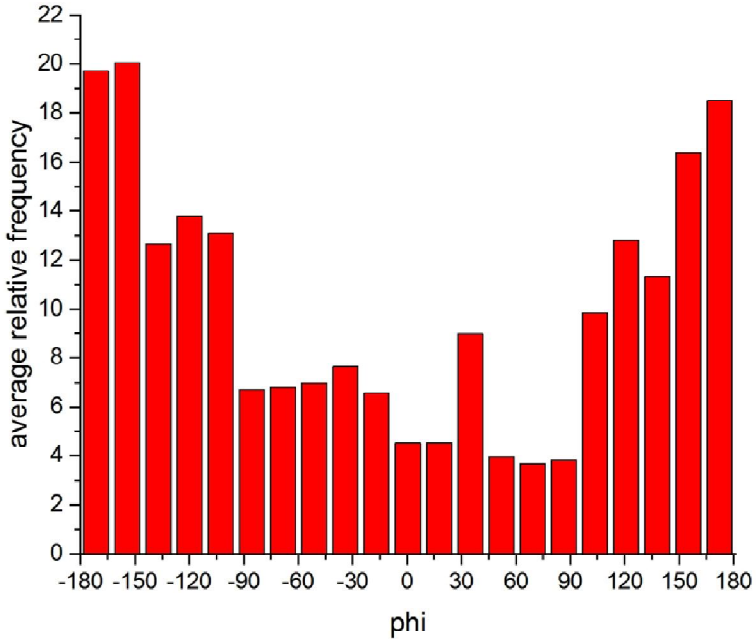
Intersection between experimental and simulated data

Experimental data: 109083

After selection: 92780

Results (normalized on exp. data)





Слайд 10

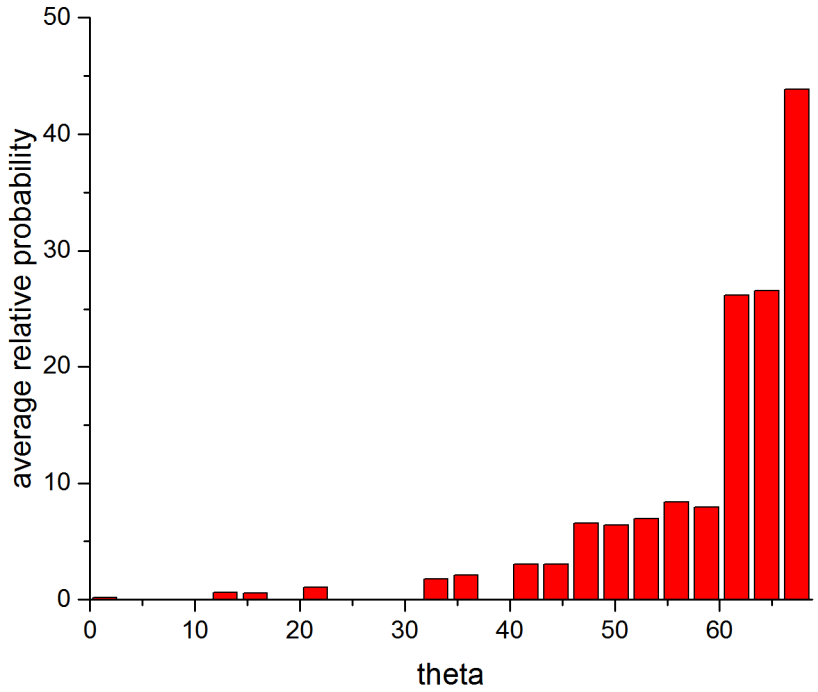
3 Уточни это число у Нозика

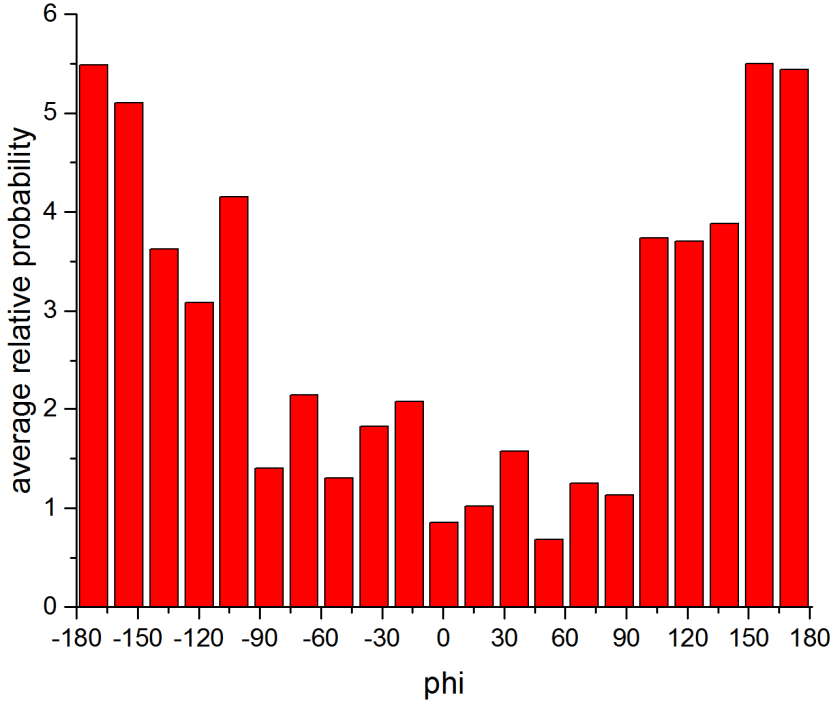
Алмаз Фазлиахметов;

Result of additional cut

After additional cut: 87388 events

There was also additional cut: all events with 1 or 2 hits were rejected. It remained 87388 events after that.





Слайд 11

1 Надо добавить картинки как на предыдущем слайде после этого обрезания
Алмаз Фазлиахметов;

Results

Method	Number of input events	Number of selected events
Method of Maria	109083	98774
Method of Almaz	109083	95634
Method of Alexander	109083	87388

Conclusion

- Maria, Alexander and Almaz have analized muon flux with 3 different methods.
- Simulation helps us to estimate improbable events, to take into account the efficiency of pixels and to neglect background events.
- Next step of analysis requires exactly means of angle’s errors.

Thanks you for attention!

Простой отбор событий

Частота равна 4 Гц. Временной промежуток равен 2 мкс.
В итоге частота случайных событий равна 3*10^(-4) Гц.

$$F_3 = (f_0 \cdot N_1) \cdot \Delta t \cdot (f_0 \cdot N_2) \cdot \Delta t \cdot (f_0 \cdot N_3) = f_0^3 \cdot \Delta t^2 \cdot N_1 \cdot N_2 \cdot N_3 \ \text{Hz},$$

Простой отбор событий