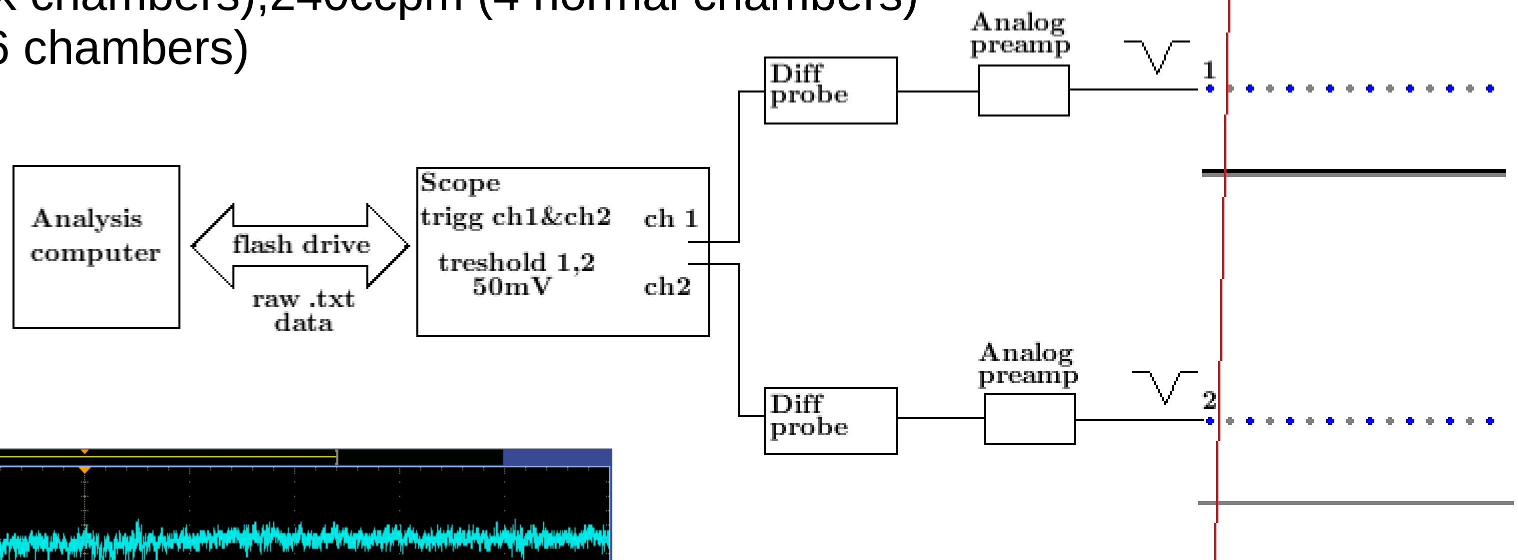
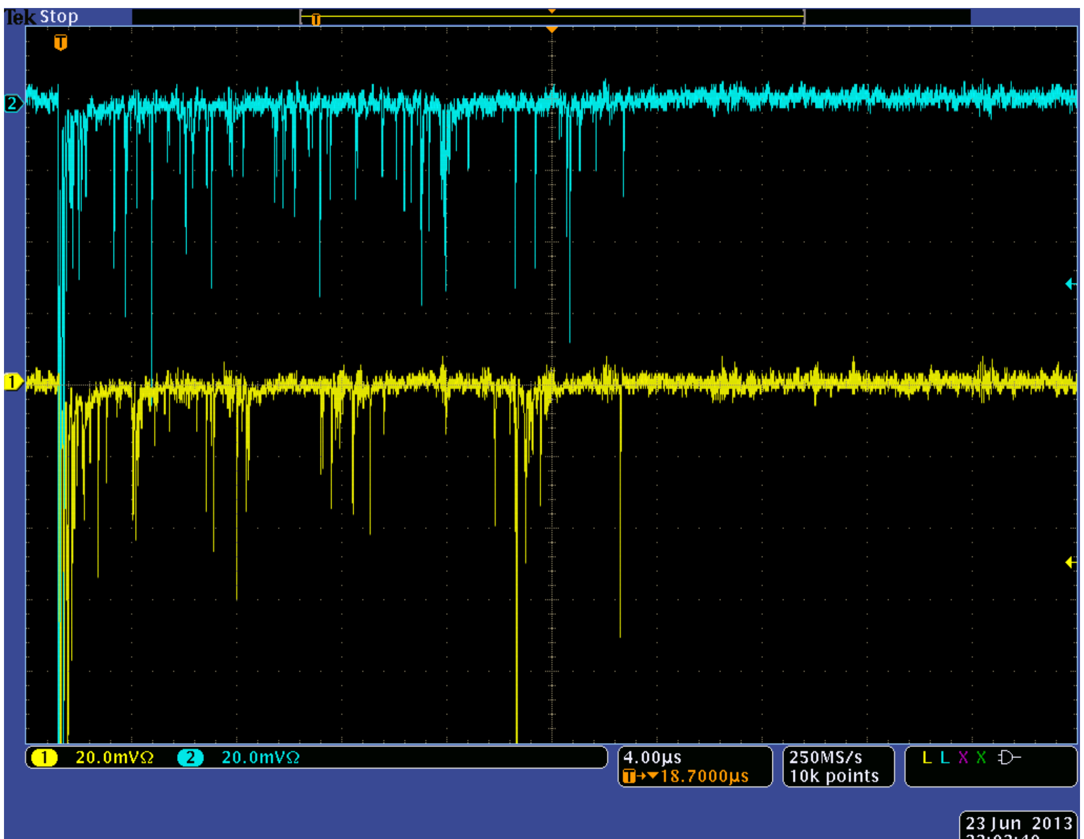
The determination of the diffusion coefficient of the thick FDCs in an experiment with cosmic muons in BlueCrab clean room.

Slide 1. Scheme of the experiment.

HV: U=2550/-500 V
Gas: Ar/CO2 mixture 40/60
Flow: 200ccpm (2 thick chambers);240ccpm (4 normal chambers)
Oxygen: ~60 ppm (all 6 chambers)

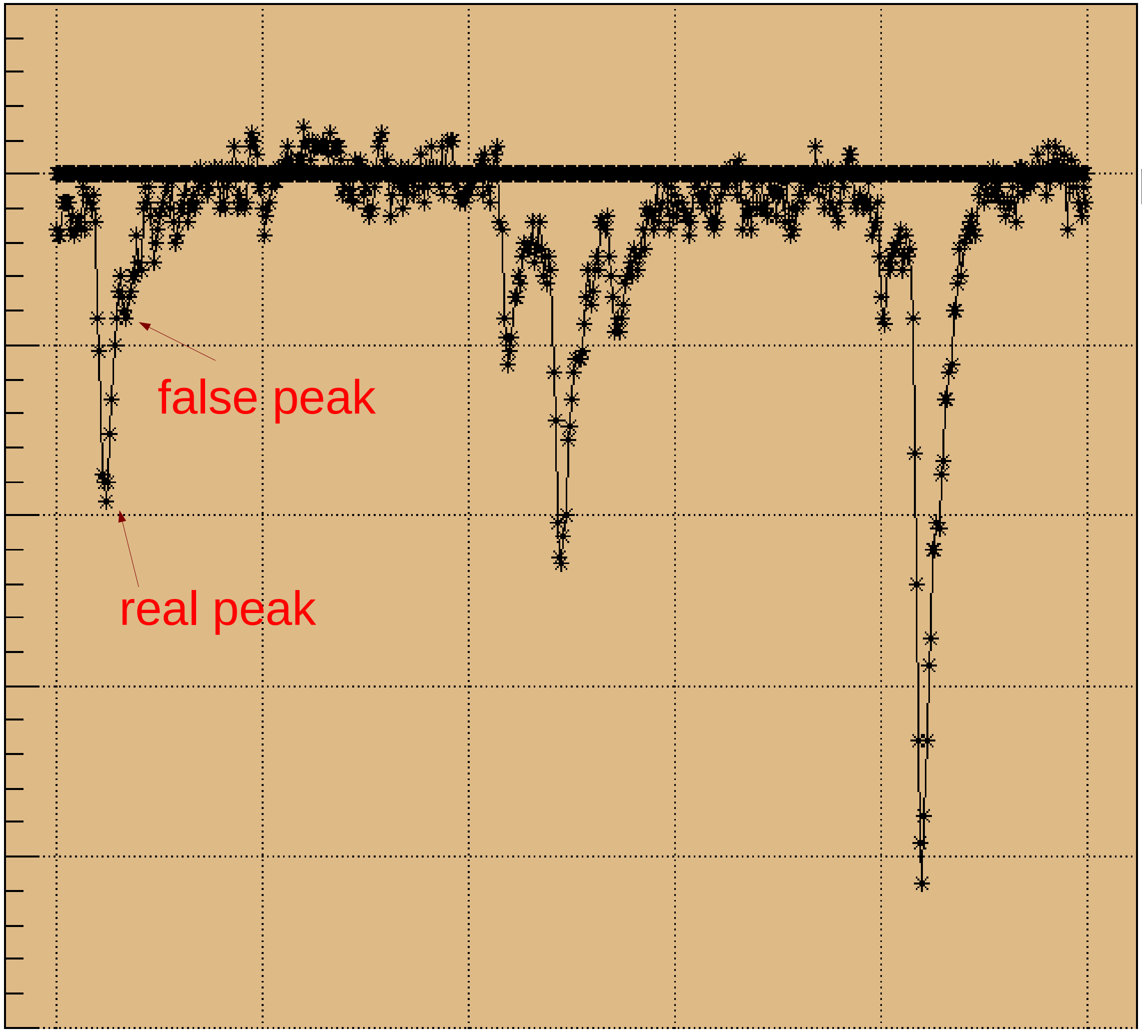




Additional visual determination was used to avoid "bad" non perpendicular events.

Number of collected events : 1124

Slide 2. Technique of data analysis.



Each event consist of a certain number of peaks distributed in time. Peaks represent the arrival of one or more electrons to the anode wires.

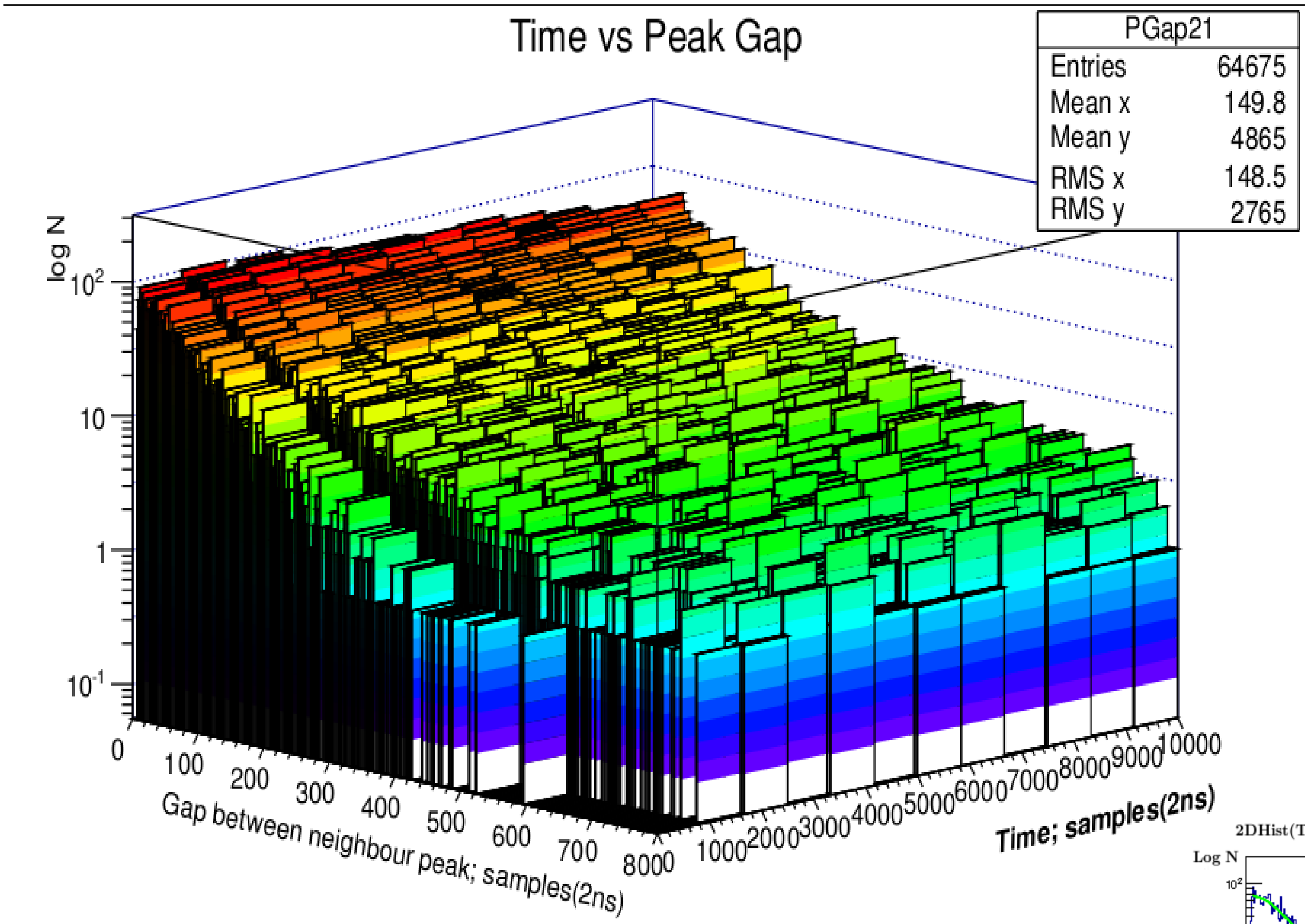
Raw data from scope is converted to 2 arrays of points.

Point contains two coordinates :

-X Time (measured in 2ns samples)
-Y Amplitude (measured in mV)

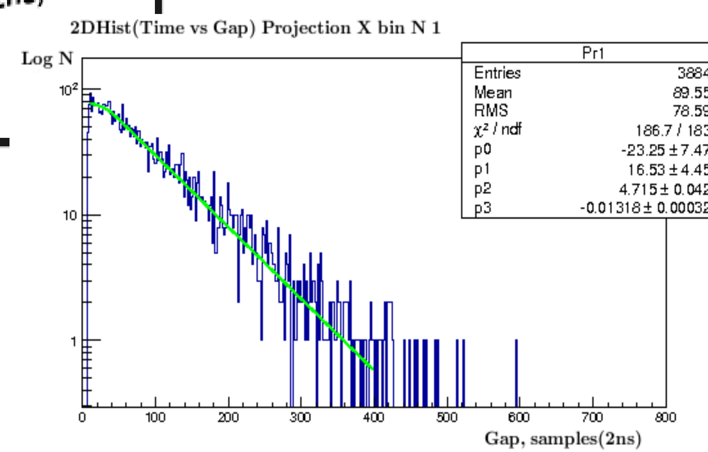
The program passes through time range from 200 to 10000 sample and determines the peaks position in time, counts them and avoids false peaks.

Slide 3. The next step.



The data allow us to made 2-D plot Time vs Peak gap.

This plot used to made projections to time scale.



Slide 4. Little bit of math statistics.

Time of arrival and the distance between two neighboring peaks can be explained by two physical processes.

I. Primary ionization is “the Poisson process", a continuous-time counting process $\{N(t), t \geq 0\}$ because that possesses the following properties:

- $N(0) = 0$
- Independent increments (the numbers of occurrences counted in disjoint intervals are independent from each other)
- Stationary increments (the probability distribution of the number of occurrences counted in any time interval only depends on the length of the interval)
- No counted occurrences are simultaneous.

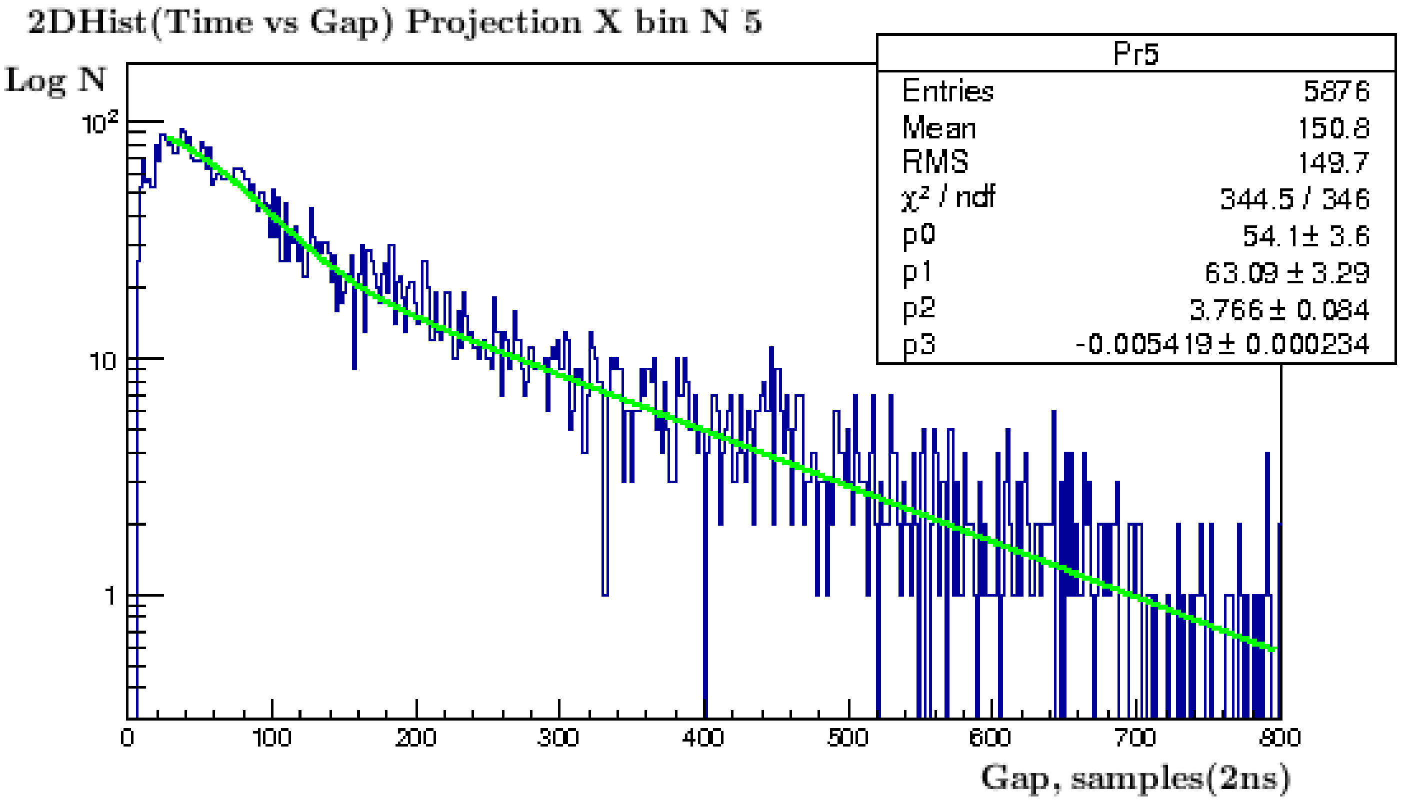
Consequence : in the Poisson process time interval T between two neighboring events has an exponential distribution. $f(y) = \alpha e^{-\alpha y}$

II. During the drift in electric fields, electrons diffuse following a Gaussian distribution.

$$f(x_1) = \frac{1}{\sqrt{2\pi}\sigma} e^{\left(-\frac{(x_1-\bar{x})^2}{2\sigma^2}\right)} \quad f(x_2) = \frac{1}{\sqrt{2\pi}\sigma} e^{\left(-\frac{(x_2-\bar{x})^2}{2\sigma^2}\right)} \quad y = x_1 - x_2 \quad f(y) = \int_0^{+\infty} f(x_1) f(y - x_1) dx_1 = \cdots = \frac{1}{\sqrt{2\pi}\sigma} e^{\left(-\frac{(y)^2}{4\sigma^2}\right)}$$

Function which is sum of two distribution function used to fit the projections.

Slide 5. Fit and conclusion.



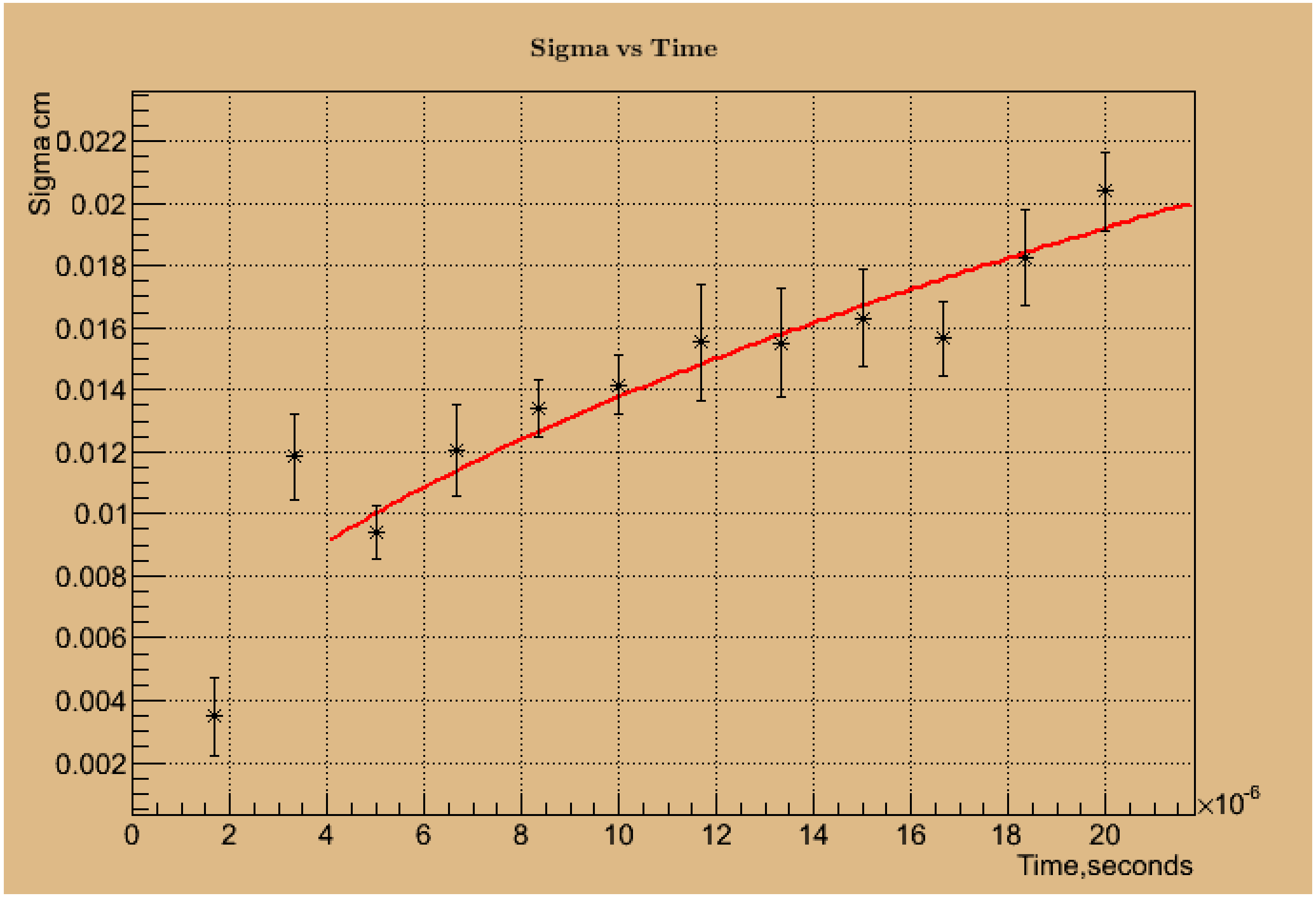
Fit function f(x)=[0]*exp(-(x*x)/(2*[1]*[1])))+expo(2)

Par 1 = sqrt(2) * sigma , where $sigma^2 = 2*D*T$

D-diffusion coefficient;

T-time;

Slide 7. Diffusion coefficient.



V_{drift} ~0.15 cm/microsecond

used to convert sigma

Fit function f(x)=[0]*sqrt(x+[1])

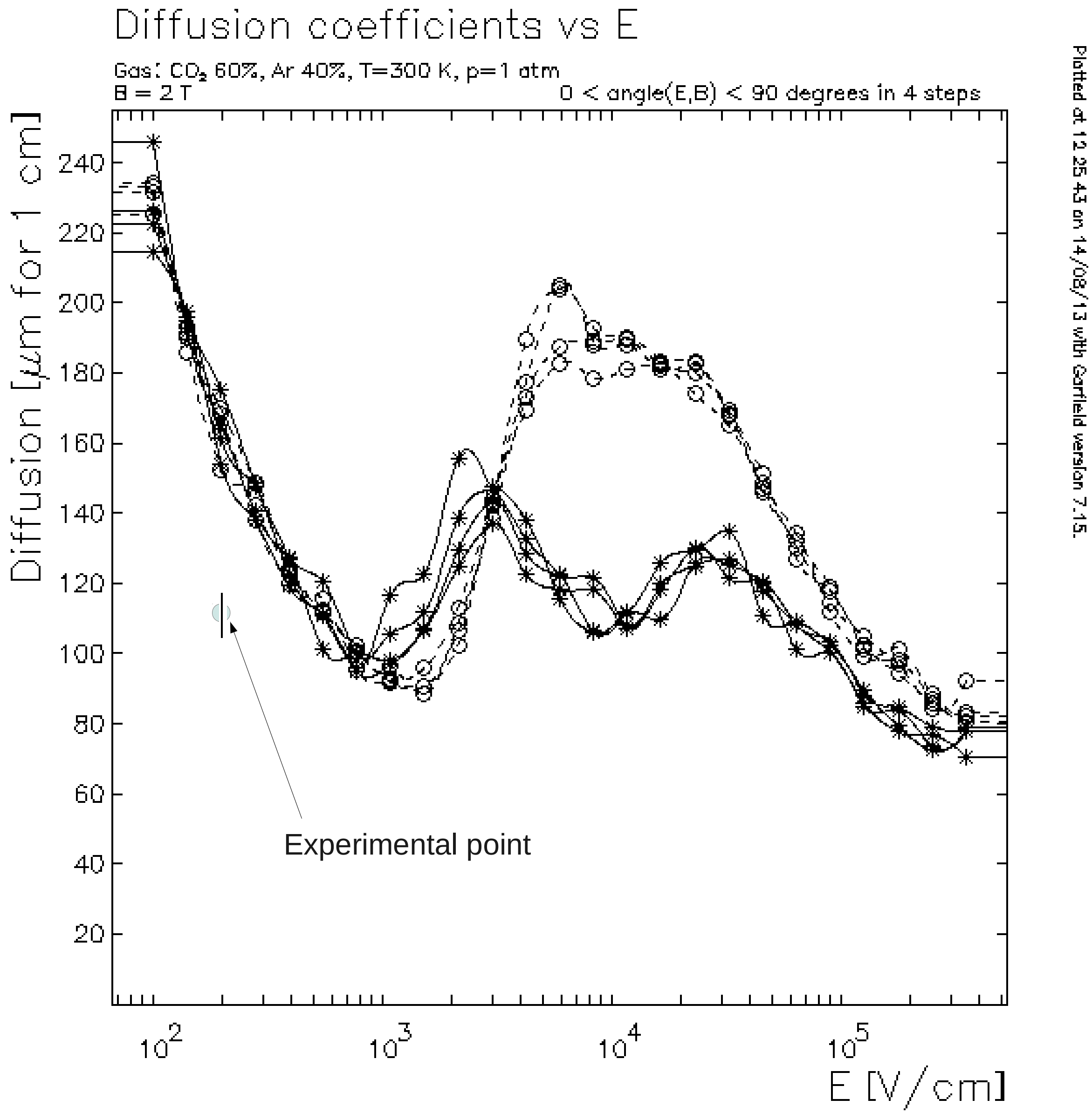
Fit results :

χ^2 / ndf	5.148 / 8
p0	4.232 ± 0.2714
p1	5.947e-07 ± 1.371e-06

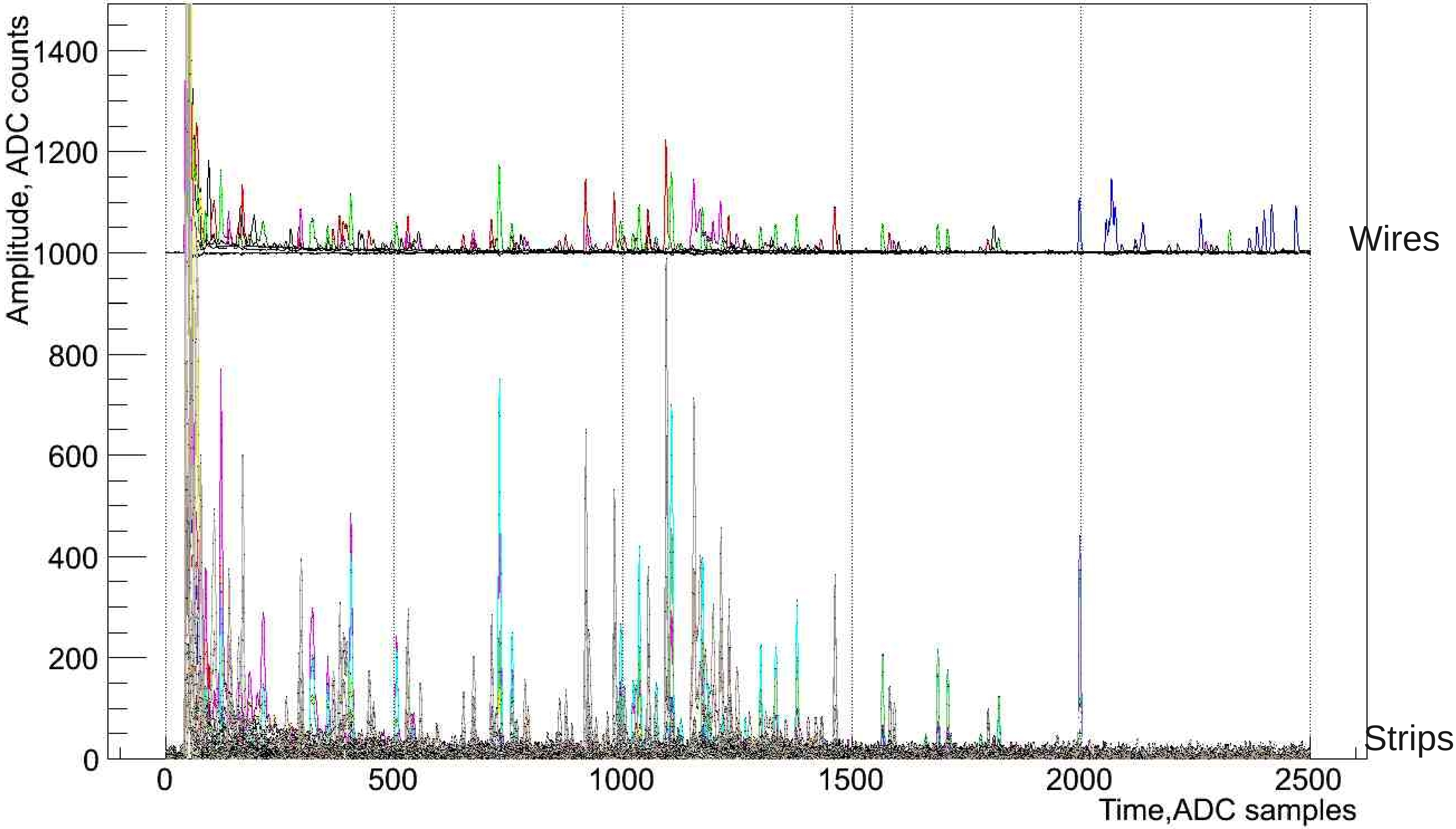
D_{exp} = (8.95 ± 1.61) cm^2/ s

$D_{garfield}$ = 15.98 cm^2 / s

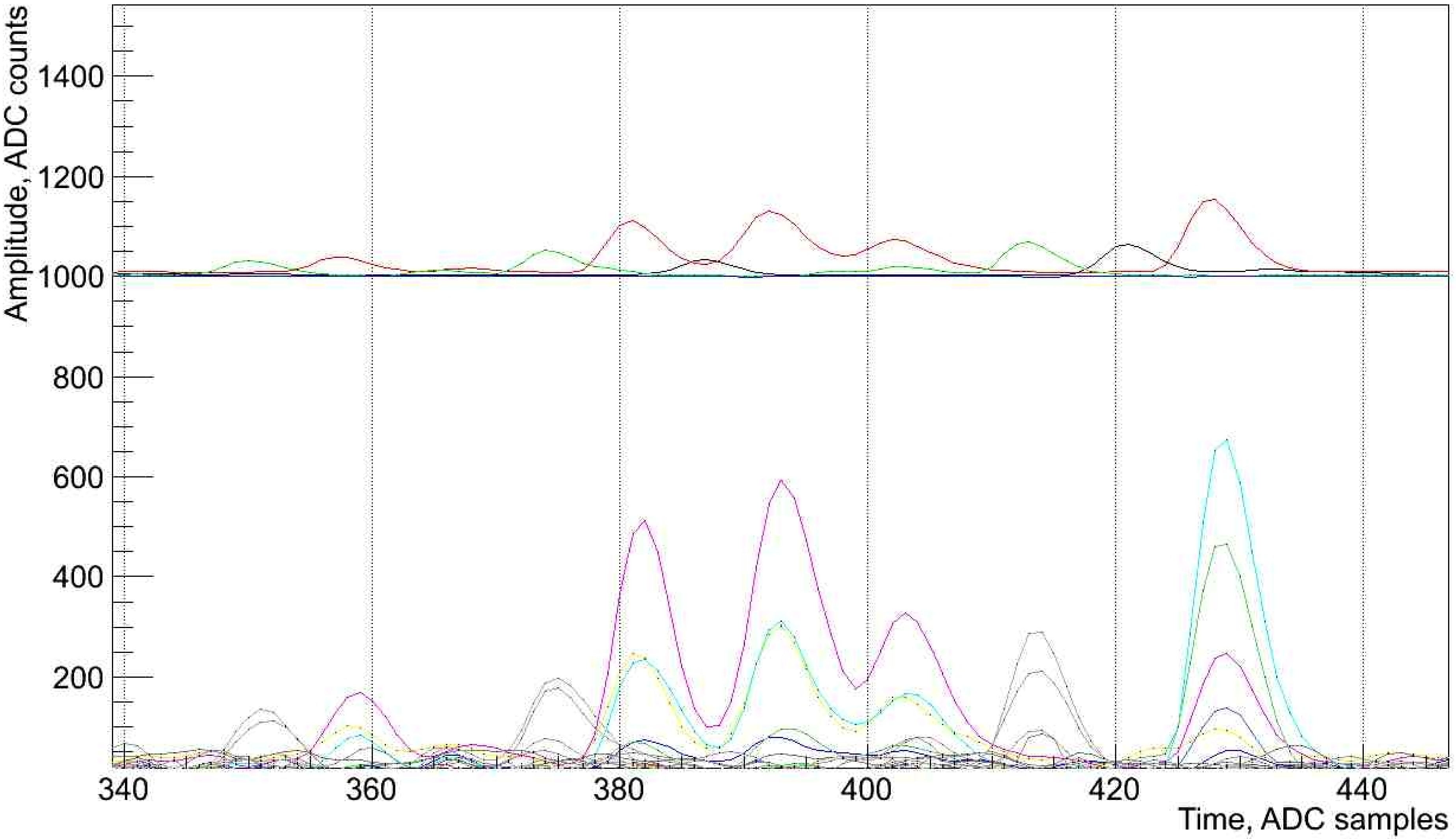
Slide 6.The Garfield calculations.



Slide 8. EEL-126 tick FDC cosmic experiment raw results.



Slide 9. EEL-126 tick FDC cosmic experiment raw results.



Slide 10. Summary.

1) The experiment allows to estimate diffusion coefficient.

2) Efficiency of single electron registration is high.

3) Disagreement with Garfield calculation can be explained by incorrect concentration of elements in the gas mixture or incorrect drift velocity calculation.

4) Experiment demonstrated possibility of cluster counting.

5) Analysis of the data taken from experiment in EEL-126 will improve results .