THE COSMIC MUON

Determining the half life of Muon

Group 3

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COSMIC RAYS

- Very high energy (100-1000 TeV) particles originating in outer space.
- Primary cosmic rays consists of about 99% nuclei(proton, alpha particle, lithium nuclei etc)
- They Interact with nucleons in atmosphere to produce pions and kaons.
- Pions decay into muons.
- Muons:leptons with 200 times mass of electron,and same charge(both+/-)

- Muons and relativity

  The detection of muons at surface of earth despite very high place of formation and its short life time verified the concept of time dilation.

- Fermi coupling constant

  In particle physics Fermi’s interaction is an explanation of beta decay.

  $G^2 = (192*\pi^3)/\tau*m^5$

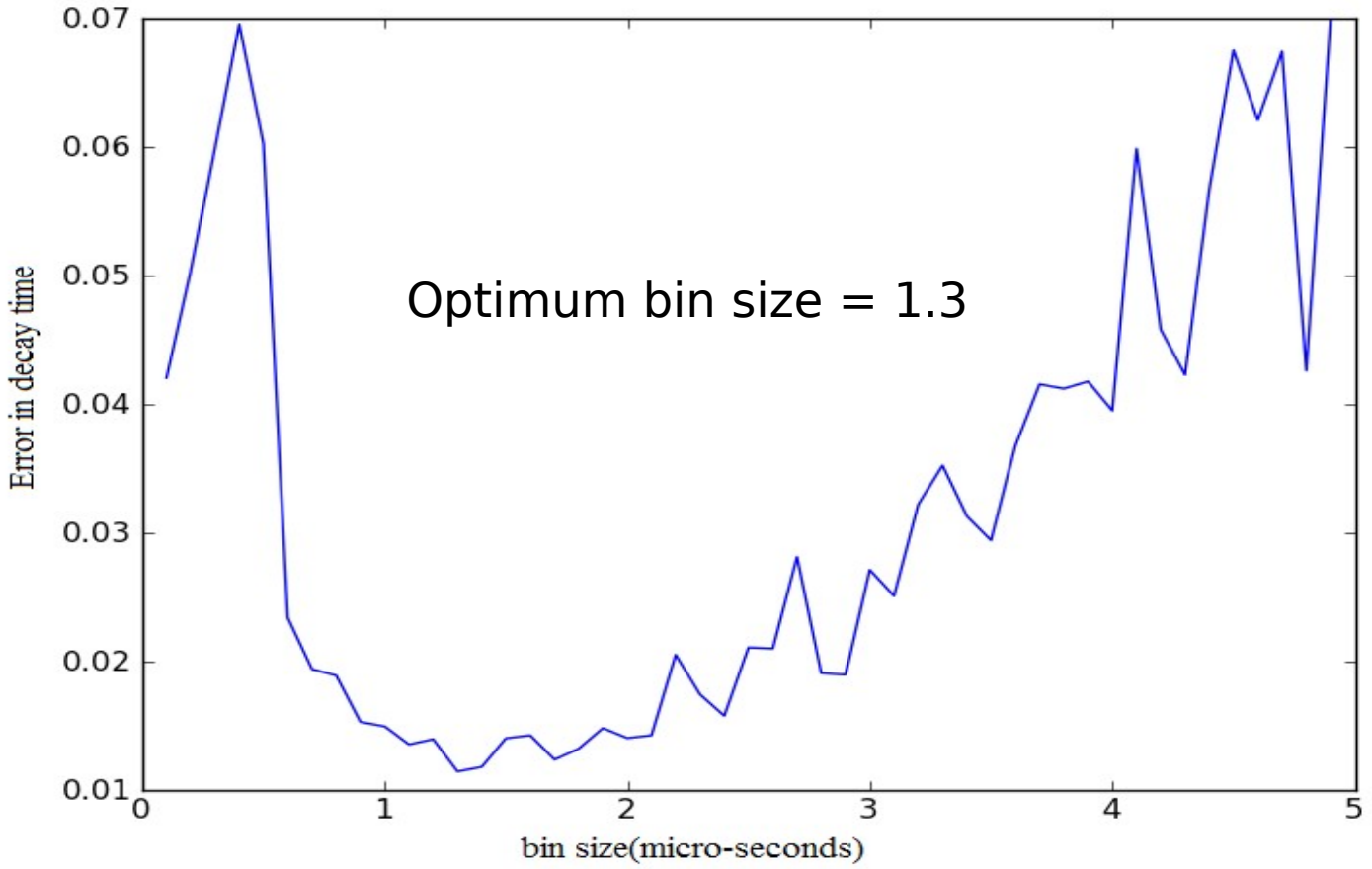
APPARATUS

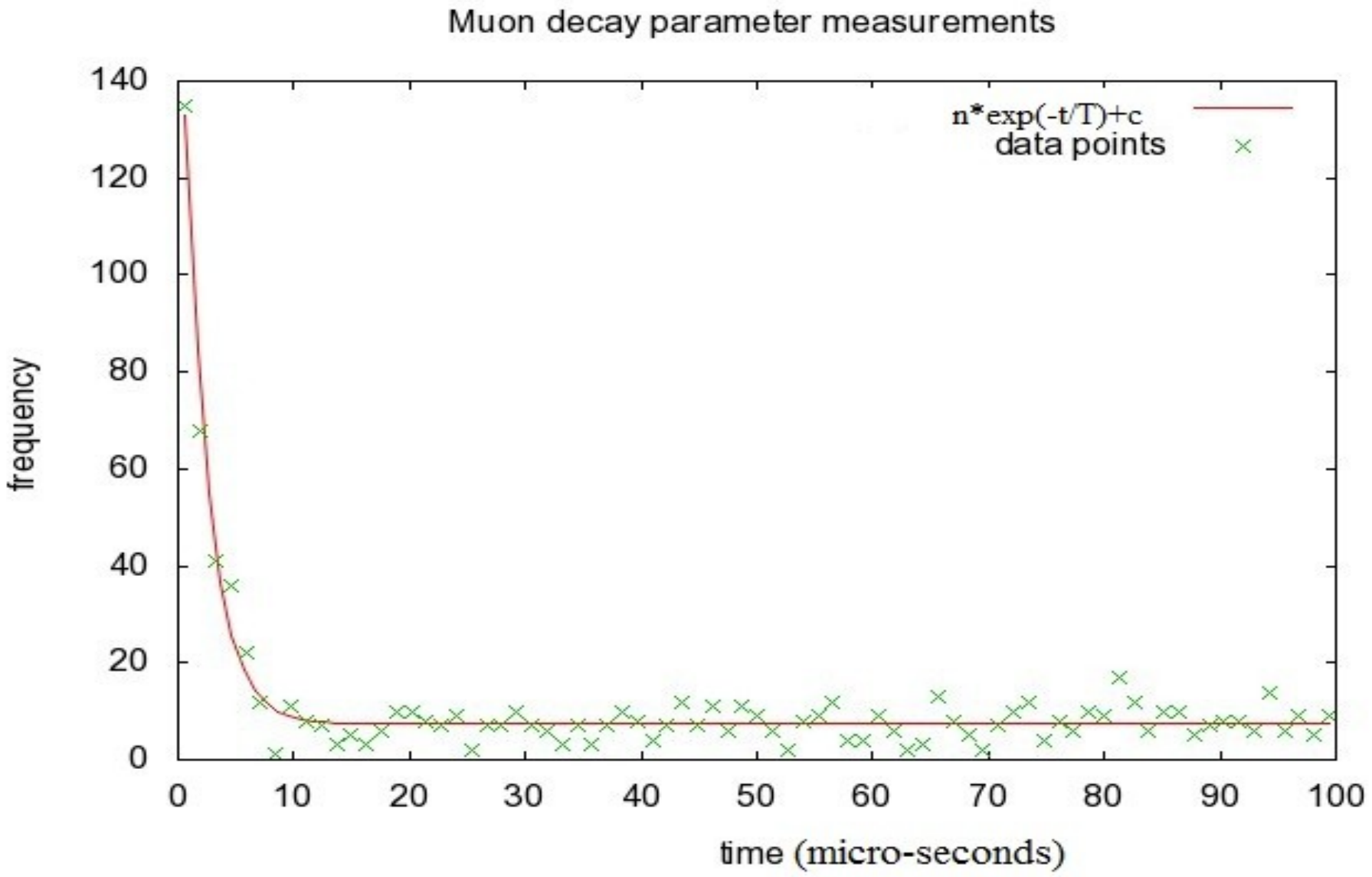
- Scintillators
  - When it is struck by an incoming particle, it absorbs its energy and re-emit in form of light.
- Photomultiplier tubes
  - Amplifies the signal by photoelectric effect and secondary emission.
- 5 VDC power supply
- GPS unit

- DAQ BOARD
  - For this setup, the DAQ board takes the signals from the counters and provides signal processing. The DAQ board can analyze signals from up to four PMTs. The board produces a record of output data whenever the PMT signal meets a predefined trigger criterion (for example, when two or more PMTs have signals above some predetermined threshold voltage(-300mV in this experiment), within a certain time window).

ANALYSIS OF ARCHIVE DATA

- Binning the data




Muon decay parameter measurements
n*exp(-t/T)+c
data points
frequency
time (micro-seconds)
0
20
40
60
80
100
120
140
0
10
20
30
40
50
60
70
80
90
100

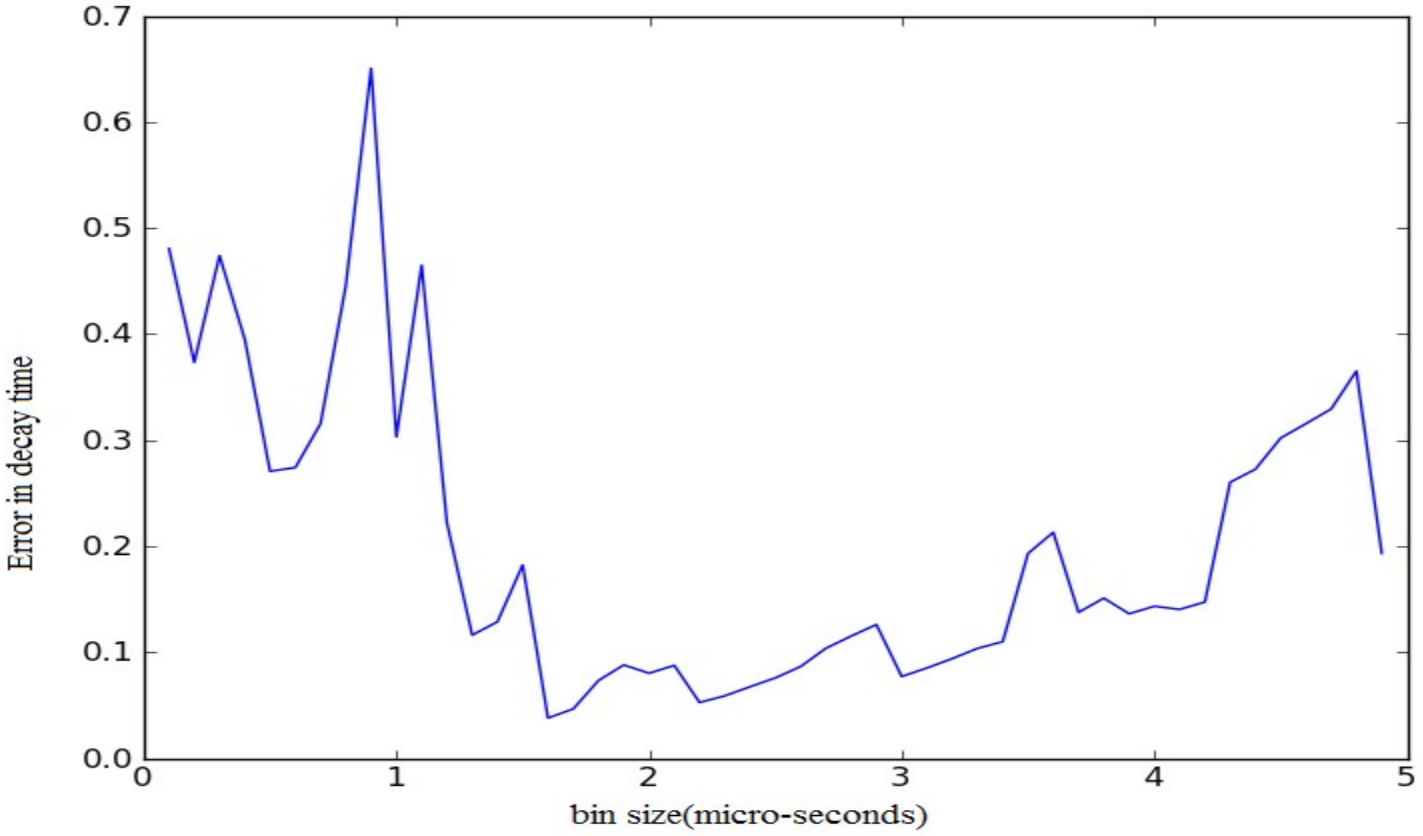
FIT PARAMETERS

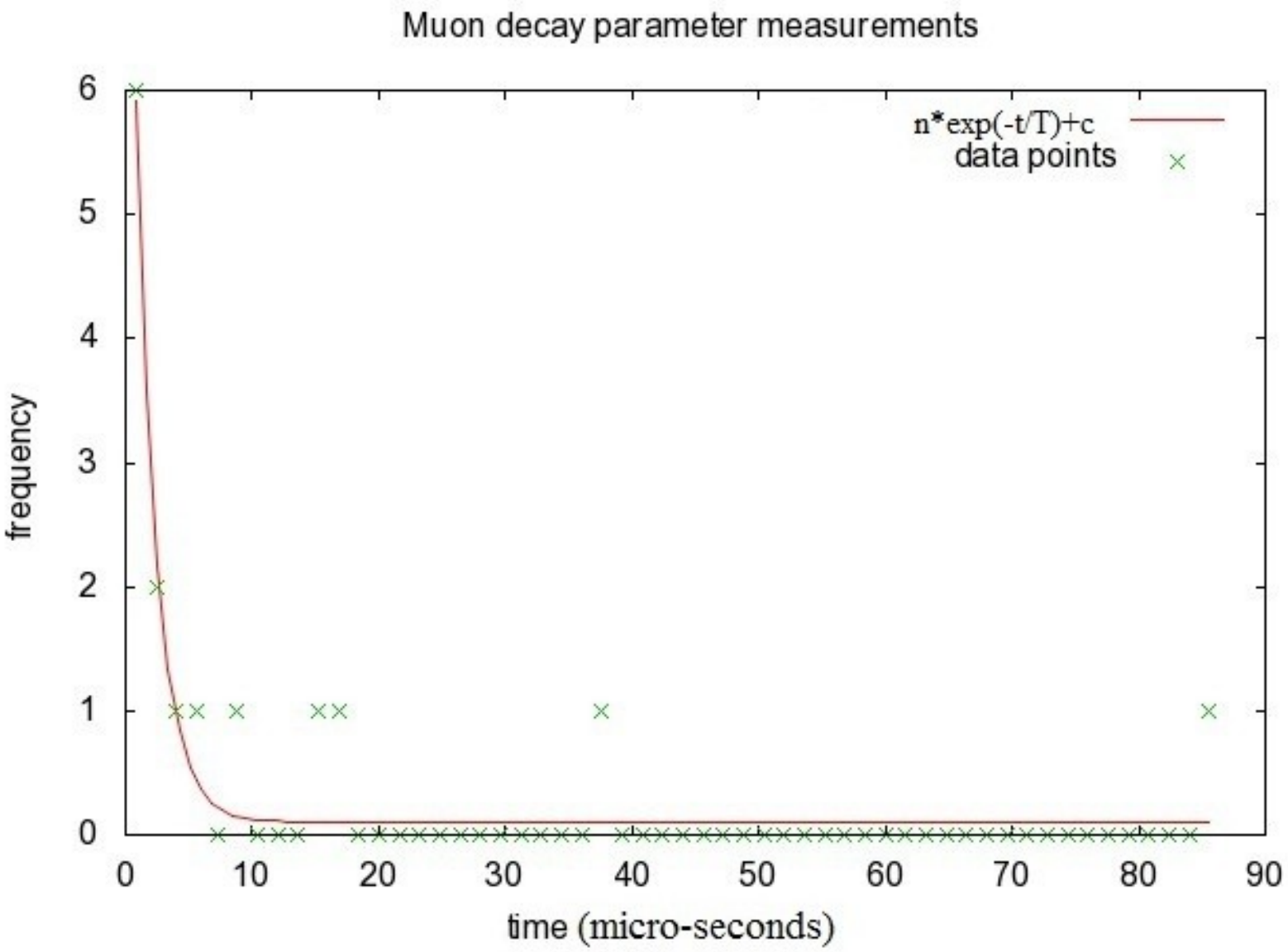
- τ = (2.06 +/- 0.01) μsecs
- N = 170 +/- 40
- C = 7.3 +/- 0.1
- C was considered to account for background error. (Assuming constant in time)
- Fermi coupling constant :

  $(1.204 \pm 0.003) \times 10^{-5}\ GeV^{-2}$

ANALYSIS OF OUR DATA

- Binning the data




Muon decay parameter measurements
n*exp(-t/T)+c
data points
frequency
time (micro-seconds)
0
1
2
3
4
5
6
0
10
20
30
40
50
60
70
80
90

FIT PARAMETERS

- τ = (1.66 +/- 0.03) μsecs
- N = 9.4 +/- 0.7
- C = 0.103 +/- 0.001
- Fermi Coupling Constant

  (1.342 +/- 0.009) $x10^{-5}$ GeV^{-2}