Poisson Statistics

Your Name
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Abstract (5 POINTS)

In this section, you are expected to give a brief information on your findings and what they imply. The abstract should be at least one paragraph long.

I. Introduction & Theory (15 Points)

Start with the historical importance of the experiment. Then, you should mention about the theory that is tested/observed in your own words. You need to derive the formulas that are not straightforward. In case you want to refer to a book, article or website, please follow to the rules for giving a reference, for example APA.

II. Experimental Setup & Method (10 Points)

In this section, first of all, sufficient information about the experimental setup should be given. A photograph or drawing showing the experimental setup should be included. The procedure should then be summarized with reference to the equipment included in the setup.

III. The Data (10 Points)

Data table must be added in this section, otherwise your report will not be graded. However, if your data are too long to give here and so will ruin the integrity of the report, it should be included in the Appendix.

IV. Analysis & Results (50 Points)

In this section, data analysis should be done in the light of the instructions given in the laboratory and the results should be indicated clearly. If the analysis part is absent, your report will not be graded.

Part 1

- Plot the number of counts (the ones taken in 100 seconds intervals) as a function of high voltage and indicate the plateau region. State the operating voltage you have chosen for the Geiger Muller tube.
- Plot the histograms for four sets of data and state their means and the standard deviations.
- Fit a Poisson and a Gaussian distribution together on each histogram obtained in the previous step. Do not forget to multiply the Poisson and Gaussian distributions with a free parameter (since the histograms are not normalized). State the best fit parameters.
- State χ^2/ndf values of the Poisson and Gaussian distributions for each histogram given by the data analysis software.
- Use the mean and standard deviations of the data set to plot $\sqrt{\mu}/\sigma$ as a function of μ. The mean and the standard deviation of a data set are automatically calculated and given by Root in the histogram legend.

Part 2

- Calculate the value of α by dividing the total number of peaks to the elapsed time on the paper extracted from the chart recorder (1 mm = 1 second).
- Plot the histograms for the data of n=0 and n=1 cases obtained from the chart recorder.
- Fit the modified version of the Poisson distribution function to the histograms in the previous step in order to obtain the alpha values as a best fit parameter.
- State the best fit parameters and χ^2/ndf values for each histogram given by the data analysis software.

V. Conclusions (10 Points)

Comment on your result. Is your experimental data consistent with the theory? What is the measure of this? If not, what may have gone wrong? In particular,

- for Part 1, compare the χ^2/ndf values of the Poisson and Gaussian distributions for each histogram, and comment on the goodness of the fits. Also, state how the representation of the histograms by two distribution functions changes as the mean value becomes larger within the data sets,
- for Part 2, compare and comment on the expected (the one obtained from the total number of peaks divided by the elapsed time) and experimental (the ones obtained from fits) values of α.

VI. Acknowledgement

Optional part that you may use to thank anyone who has contributed.

REFERENCES

[1] E. Gülmez. *Advanced Physics Experiments*. 1st. Boğaziçi University Publications, 1999.

VII. APPENDIX

Here, you can share the content that you prefer not to include in the data and analysis sections because you think that it violates the integrity of the report. In addition, you must attach the data and the codes you use in the analysis, otherwise your report will not be graded. Formulas that are not specific to the experiment but used in the analysis can be given in this section; for example error propagation and weighted mean.

```
{
 TH1F *histo = new TH1F("histo","Histogram",10, 30, 40);

 float data[10] = {32,34,36,38,35,35,35,31,39,37};
 for (int i=0; i<10; i++) histo->Fill(data[i]);
 histo->Draw();

}
```