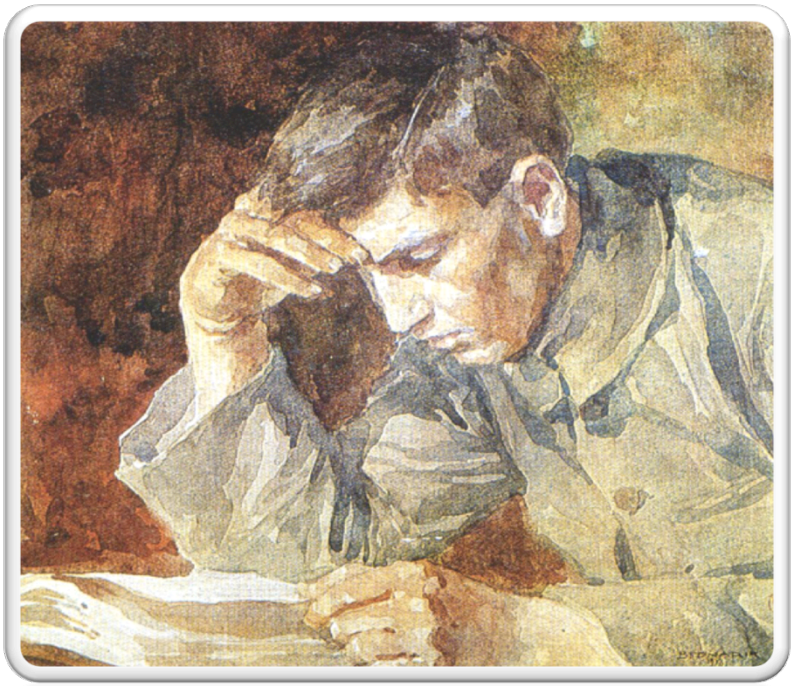
The Physics of Particle Detectors



Journal Club

SS 2012

Erika Garutti

Scope

- Read scientific papers
  - to acquire a specific information
  - to broaden ones knowledge

- Write scientific papers
  - publication of (own/collaboration) results
  - own thesis

Types of papers

- Theoretical
  - prove theorems
  - describe new algorithms
- Implementation
  - describe new software tools
- Experimental
  - describe results of experiments
- Survey/Review
  - review current results in a field of research

Anatomy of a Scientific Paper

Are All Apples Red?

by

Ida Cortland

Abstract:

We examined several apples' color. Although most are red, some are not.

Introduction:

An age-old question is: are all apples red? MacIntosh (1993) thought so. G. Smith (1999) begs to differ. We hope to resolve this issue once and for all.

Methods:

We went to the local grocery store and bought one of every apple they had. We took them home and looked at them.

Results:

We found four red apples, one green apple, and two yellow apples.

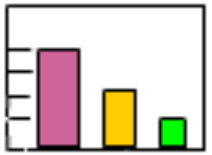


Figure 1

Discussion:

Since we found one yellow apple and two green apples, it must be true that all apples are not red. We concur with G. Smith's findings.

References:

MacIntosh (1993) *Journal of Fruit Science*. 4(3): 121-135.

Smith, G. (1999) *Apple Technology Today*. 7(3):4-8.

The structure of a paper

- Title & author list
- Abstract
- Introduction
- Materials and Methods
- Results
- Discussion/Conclusion
- Open problems

Title & author list

- Title
  - what is this paper about?

- Author list
  - who did the work? where are they from?
  - try to remember the names: these people may become collaborators, colleagues, or bosses sometime in the future.
  - also useful when planning a postdoc or future job

Abstract

- gives a brief background to the topic
- describes concisely the major findings of the paper
- relates these findings to the field of study

➔ Follows the same logical order as that of the paper as a whole

Reading papers:

- read the Title and the Abstract and, before going on, review in your mind what you know about the topic.
- Clarify whether you know enough background to appreciate the paper.

➔ If not, you might choose to read the background in a review or textbook

Introduction

- Describes the accepted state of knowledge in a specialized field
- focuses more on a particular aspect directly linked to the work described in the paper
- If the authors are testing a hypothesis, the source of that hypothesis is spelled out, findings are given with which it is consistent
- Major conclusions of the paper are presented at the end of this section, so that the reader knows the major answers to the questions just posed

Reading papers:

- If you are very familiar with the field, the Introduction can be skimmed or even skipped

Materials and Methods

- describes the materials used in the experiments and the methods by which the experiments were carried out
- should be detailed enough to allow other researchers to replicate the work
- In practice, these descriptions are often highly compressed, and they often refer to previous papers

Reading papers:

- the logical flow of most papers goes straight from the Introduction to Results, accordingly, the paper should be read in that way as well, skipping Materials and Methods and referring back to this section as needed to clarify what was actually done

Results

- Describes the experiments and the reasons they were done
- the logic of the Results section follows directly from that of the Introduction.
- Different style in writing:
  - results and discussions combined
  - discussion in a separate session

Reading papers:

- Take time to look at the plots while reading the text
- Ask yourself if the results do make sense to you before entering the discussion section (reading / reviewing)
- Be always critical: the results may be TOTALLY wrong !!!

Discussion/Conclusion

- The data in the paper are interpreted = analyzed to show what the authors believe the data show (bias)
  - Any limitations to the interpretations should be acknowledged,
  - Fact should clearly be separated from speculation
- The findings of the paper are related to other findings in the field
  - show how the findings contribute to knowledge,
  - or correct the errors of previous work

Reading papers:

- This is the most important part of the paper where you need to reflect and ask yourself critical questions

Open problems / Outlook

- Not always present in papers
- It is good practice to give an outlook and state the limitations of a study

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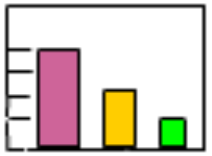

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Reading scientific papers

… to acquire a specific information

Answer the questions:

- Does the paper contain the information I need?
  Clear abstract and conclusions

- Is the information self contained?
  Clear structure between sections
  Proper usage of references

- Is the information clear and complete?
  Clear writing
  Balance between expert/non-expert

Reading scientific papers

… to acquire a specific information

Answer the questions:

- Does the paper contain the information I need?
  Clear abstract and conclusions

A B S T R A C T

The high-rate performance of a multiwire proportional chamber of the LHCb muon detector was tested. The chamber, equipped with the final front-end electronics, was tested using a ~100 GeV muon beam superimposed on a 662 keV γ flux of variable intensity produced by the ^{137}Cs radioactive source of the CERN Gamma Irradiation Facility (GIF). No significant variation in the muon detection efficiency or in the time response of the chamber was observed at the highest gamma rate.

topic

method

result

Reading scientific papers

… to acquire a specific information

Answer the questions:

- Does the paper contain the information I need?
  Clear abstract and conclusions

8. Conclusions

???

Methods are described using a combination of standard pixel electronics with an added strip readout, could also provide a fast trigger with a similar improvement in spatial resolution.

Reading scientific papers

… to acquire a specific information

Answer the questions:

- Is the information self contained?
  Clear structure between sections
  Proper usage of references

In the radiotherapy with ion beams a high conformation of the dose to the prescribed target volume can be achieved thanks to the steep increase of the dose deposition at the end of the particle path (Bragg peak) [1]. By placing the peak

Detailed definition

Name of effect and reference to paper first describing it

Reading scientific papers

… to acquire a specific information

Answer the questions:

- Is the information clear and complete?
  Balance between expert/non-expert

Reading scientific papers

… to broaden ones knowledge

Answer the questions:

- Is the paper well written?
  Clear/short sentences, good English, logic structure

- Are there too many acronyms or undefined variables?
  CMB, APD, WQUQWU, a, b, α, β, …

- Is the information clear and complete?
  Balance between expert/non-expert

- Is the topic discussed in a broad enough contest?
  relevance of the paper for the committee,
  comparison to other similar results

comprehension

value assessment

Answer questions:

After reading a paper you should be able to answer these questions:

a. What questions does the paper address?

b. What are the main conclusions of the paper?

c. What evidence supports those conclusions?

d. Do the data actually support the conclusions?

e. What is the quality of the evidence?

f. Why are the conclusions important?

Writing scientific papers

- You wrote already a thesis and will soon write a second one
- Was the structure of your thesis correct? (slide 5)
- Does the thesis answer the key questions (slide 20)

- Is it well written? ➔ most difficult for non-English speakers

  some standard tip:

  - keep the sentences short! (always make two out of one)
  - read some “scientific writing” guide first (example: http://www.biochem.arizona.edu/marc/Sci-Writing.pdf)

- Most important you are writing a scientific document = make sure it is scientific! (avoid prose-formulas, self explaining variables; use equations when possible to simplify and clarify the text, quote the right numbers)

Quote the right number

The results of ones measurements / study should be clearly reposted in the text (not only in Figure captions)

➔ Mind the precision with which you know a value and you want to quote a value:

The temperature coefficient α_T was in the range of (0.050 ± 0.001) %/K to (0.058 ± 0.001) %/K for all channels, whereas the breakdown voltages at 25 °C were between (68.25 ± 1.24) V and (68.35 ± 1.33) V in the case of the MPPC400 and between (68.44 ± 1.09) V and (68.66 ± 0.83) V in the case of the MPPC1600.

Ask yourself the question:

- Is a number relevant for the reader?
- Why?
- If yes, give the reader the possibility to judge the “quality” of this number. (The breakdown voltage is 68.1±0.2 V, where the power supply stability is 50mV …)
- If not, give a range/approximation ((The breakdown voltage is ~68V)

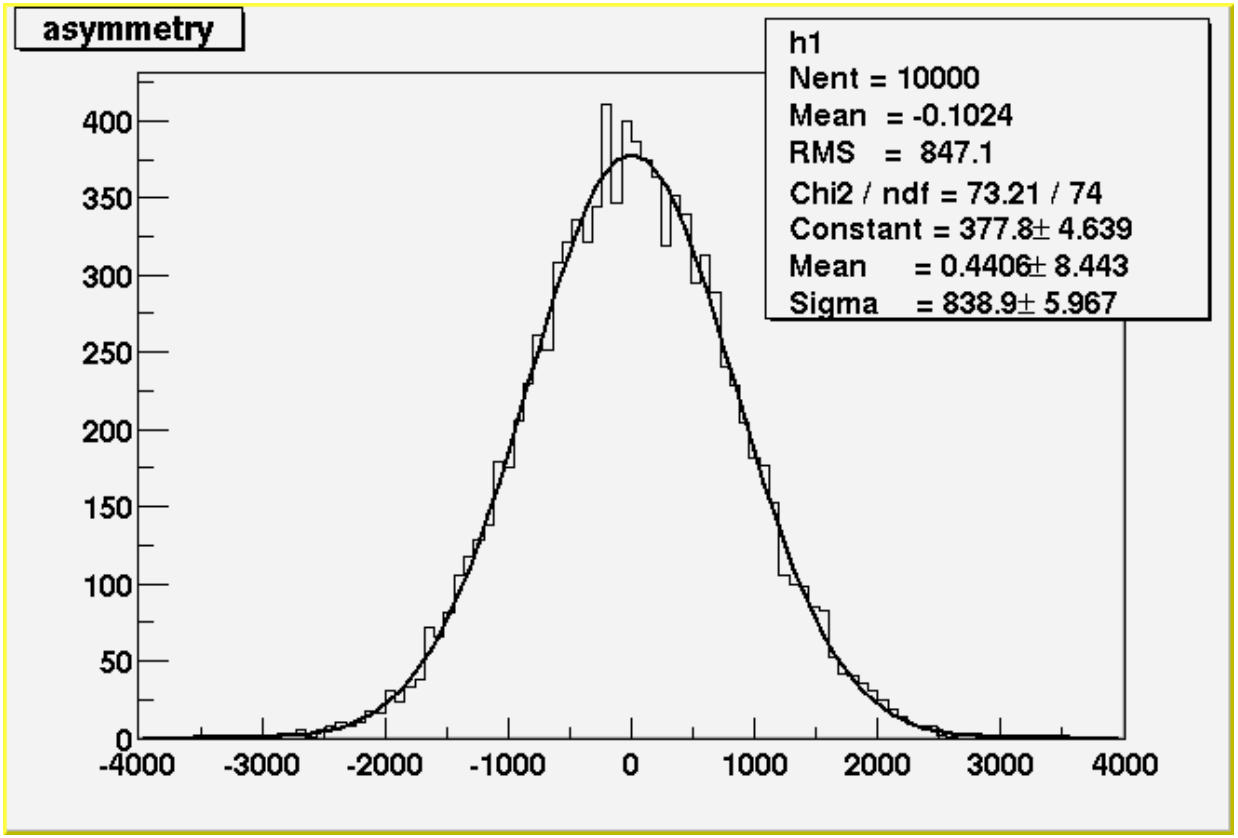
Acknowledgments

Large part of the content of this lecture is taken from:

John W. Little and Roy Parker, University of Arizona

Some discussion examples

What do you need to know to discuss this plot?
What can you conclude from this plot?



Some discussion examples

Statement in the paper: … “the energy resolution of the detector is 15% at the photo-peak energy”
Do you agree with this statement?

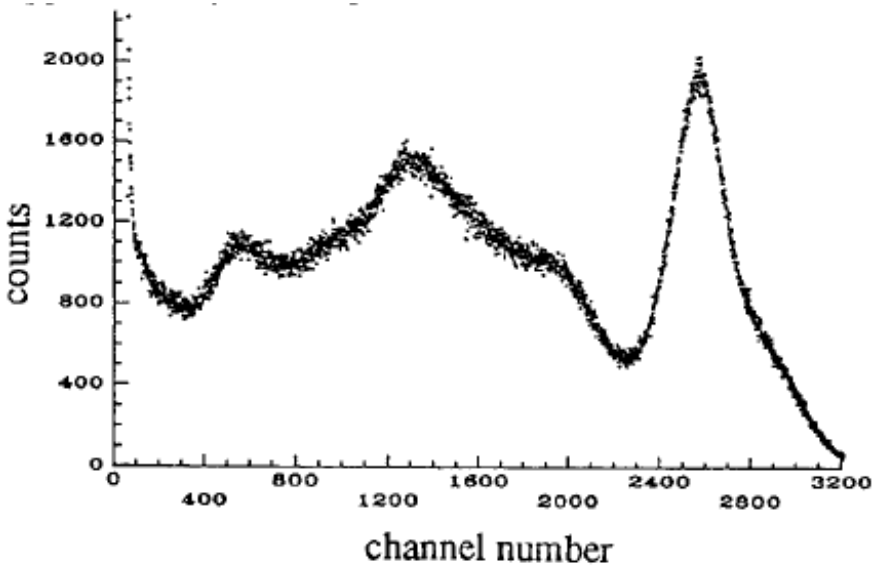
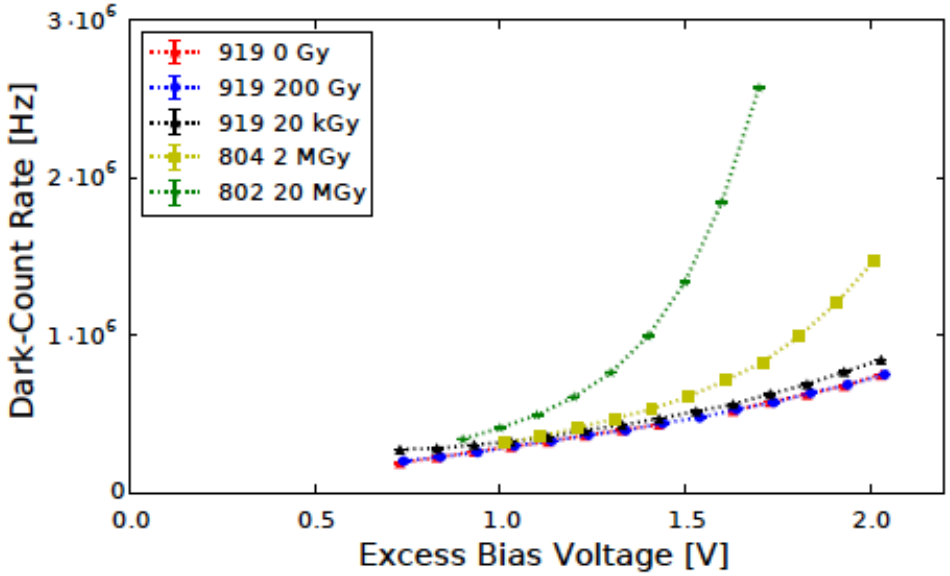


FIGURE 1. The spectrum of Ge-68 in a small piece of LSO crystal (2 x 2 x 10 mm). This crystal is coupled to a PMT (Hamamtsu R647-04) via its 2x2 mm side. The x-axis is the channel number.

Some discussion examples

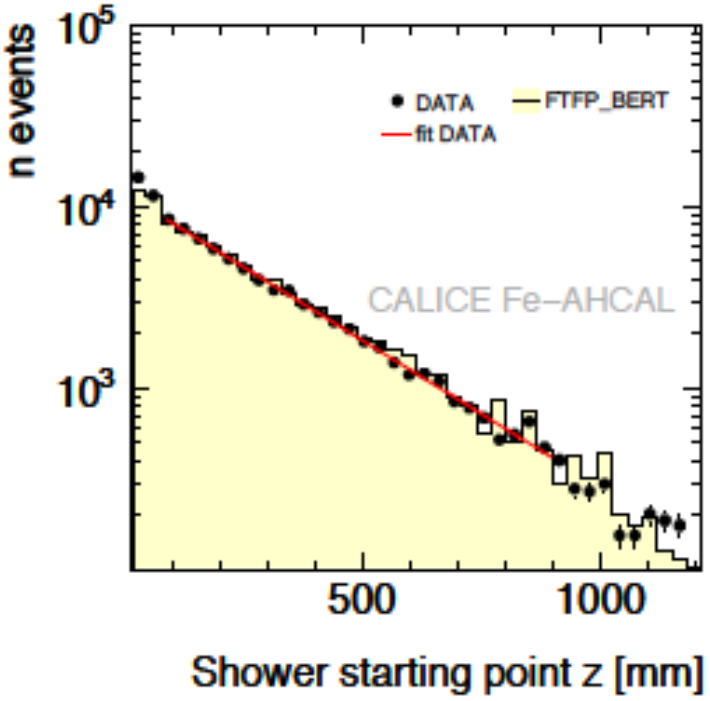
What do you need to know to discuss this plot?
What can you conclude from this plot?



14: Dark-count rate for several SiPMs as function of the excess bias voltage, V_o and after irradiation to 200 Gy, 20 kGy, 2 MGy, and 20 MGy.

Some discussion examples

How do you judge this plot?



Some discussion examples

Do you understand the setup?
What is the critical experimental aspect?
How do results depend on experimental conditions?
Are there sufficient systematic studies?