

# Writing a Research Review

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# Aims of this talk

This talk is not intended to be a comprehensive guide to writing a report. For now it is specific to the Research Review, but most of what is discussed is equally relevant to any scientific report (e.g., your MSci project report).

There are many issues to keep in mind when writing a research review:

- Communicating to the right audience at the right level.

- Keeping your message organized in a clear and logical way.

- Good style, grammar, punctuation, etc.

# The audience

When writing anything, consider carefully:

Who is going to read it?

What is their prior knowledge of the subject?

For your research review, take your target audience to be physicists who are not necessarily specialists in the topic of your review.

Try to keep the level of the report consistent. Do not start with

All matter is made up of tiny particles called atoms.

and on the next page say

At zero detuning, paths through adjacent AT split states interfere constructively leading to enhanced absorption EIA on the three photon resonance  $|0\rangle \rightarrow |1\rangle \rightarrow |2\rangle \rightarrow \{|3'\rangle, |3\rangle\}$ .

(Kondo et al., arxiv:1510.01729)

# The chapter/section outline

A possible outline:

1. Introduction
2. Theoretical background on the Higgs boson
3. Overview of experimental methods
  - 3.1 The Large Hadron Collider
  - 3.2 The ATLAS and CMS experiments
4. Summary of recent experimental results
  - 4.1 Higgs boson production rates
  - 4.2 Measurements of the Higgs boson mass
5. Theoretical interpretation of recent measurements
  - 5.1 Tests of supersymmetry using rate measurements
  - 5.2 Tests based on mass measurements
6. Prospects for future studies of the Higgs boson
7. Conclusions

# Background info vs. recent research

The research review is not intended to be simply a report on a certain topic, but rather should describe the current frontier of research on that topic.

Clearly you can't write about a research frontier without some background knowledge. Therefore you will want to summarise well-established material that is needed to understand the recent advances.

The Research Review should identify recent papers published in peer-reviewed journals. Summarising the results of these papers should constitute the bulk of your review.

# What your reader does and doesn't know

Consider two ways of describing a measurement:

- (1) The measurements placed constraints on  $\kappa_f$  and  $\kappa_V$ .
- (2) The measurements placed constraints on the parameters  $\kappa_f$  and  $\kappa_V$ , which are related to the coupling strength of the Higgs boson to fermions and bosons, respectively. These quantities will be defined more precisely in Section 5.1.

With (1), the reader probably thinks something has been missed and may try to skip back to find where quantities  $\kappa_f$  and  $\kappa_V$  were introduced.

In (2), it is clear that these quantities are being mentioned for the first time and it is not expected that the reader should have prior knowledge about them.

# Adjusting sentences to fit the context

- 1) The device was built with graphene.
- 2) The device was built using a material known as graphene.
- 3) The device was built using a form of carbon known as graphene.
- 4) The device was built using a recently discovered form of carbon known as graphene (Geim and Novoselev, 2004).

The choice of the most appropriate sentence will depend on the context. Ask yourself at the point where the sentence appears what the reader knows about graphene and what role this information plays in what you're trying to say.

# The introduction

The introduction should cover two main points:

First, it should state briefly what the report is all about and what research is being reviewed.

Second, it should give a sort of “roadmap” to the rest of the report. This can be of the form:

“Chapter 2 provides background on the theory of the Higgs boson, and the main experimental facilities are described in Ch. 3. In Ch. 4, recent studies of the properties of the Higgs boson are presented and in Ch. 5 research on the theoretical interpretation of the measurements is described...”

The roadmap is not always included in reviews but I would suggest doing this.



# Chapter structure

In analogy with the introduction, each chapter should start by explaining its place in the larger narrative and providing a roadmap to its sections, e.g.,

## Chapter 5

### Theoretical interpretation of recent measurements

The experimental results reviewed in Ch. 4 have provided the basis for a number of tests of theoretical models. Section 5.1 summarises tests of supersymmetric models based on the measured Higgs boson production rates. Higgs boson mass measurements have been used to test a variety of models such as compositeness, as described in Sec. 5.2.

#### 5.1 Tests of supersymmetric models

...

# Sections and paragraphs

If you find yourself using a concept in a section that is only defined later on, consider reordering.

If you find yourself describing something in a section that is unrelated to the section title, consider whether it could be discussed better elsewhere, or whether the section could be broken into subsections.

Each paragraph should address a single well-defined topic. If you find yourself talking about different issues in different parts of a paragraph, it's too long.

Before you dive into a detailed technical description, make sure your reader understands why this detail is necessary and where the discussion is heading.

# Equations

Equations should be treated grammatically as parts of sentences:

The energy  $E$  and momentum  $p$  of a particle of mass  $m$  are related by

$$E^2 = p^2 c^2 + m^2 c^4, \quad (2.3)$$

where  $c$  is the speed of light. Using Eq. (2.3) one can determine...

Chapter, Section, Equation, etc. uppercase when used with counter.

Mathematical variables are in italics (in LaTeX, use math mode, i.e.,  $E^2 = p^2 c^2 + m^2 c^4$ ).

Functions such as  $\sin$ ,  $\cos$ ,  $\exp$  and units are not italicised (in LaTeX, use  $\sin$ ,  $\cos$ ,  $\exp$   $\{\text{rm cm}\}$  or  $\text{mbox}\{\text{cm}\}$ , etc.).

Subscripts are italicised if they refer to a mathematical variable, e.g.,  $p_x$  ( $x$  is a variable), but not italicised otherwise, e.g.,  $G_F$  ( $F$  stands for Fermi, not a variable). In latex:  $G_{\text{rm F}}$

# I, we, one, etc.

I think first person singular sounds awkward.

First person plural can be less awkward but usually not appropriate for a review (who are “we”?).

Best to use a mixture of:

Passive voice: From these results it may be concluded that...

“One”: From these results one may conclude...

Or name the subject as appropriate: From these results, the authors of Ref. [37] concluded that...

Or rearrange the sentence, e.g., “...The results of the study led to the conclusion that...”

# References

**Numbered style:** “...the authors of Ref. [17] have concluded...”

In the bibliography, numbered in order of first appearance,

[17] A. Smith and B. Jones, *Investigation of XYZ*, Journal of Interesting Things, 53 (2011) 373-379; e-print arXiv:1107.12345.

**Author-year style:** “... a recent study (Smith et al., 2011) concluded that...”

In the bibliography references ordered alphabetically by author:

A. Smith and B. Jones, *Investigation of XYZ*, Journal of Interesting Things, 53 (2011) 373-379; e-print arXiv:1107.12345.

**To cite a website (e.g., for background info),**

[23] Website of the ATLAS Collaboration `atlas.web.cern.ch`.

# References (continued)

In LaTeX, “... in Ref.~\cite{smith2011}...”

Then in the bibliography (after `\begin{thebibliography}`):

```
\bibitem{smith2011} A. Smith and B. Jones, {\it Investigation of XYZ}, Journal of Interesting Things, 53 (2011) 373-379; e-print {\tt arXiv:1107.12345}.
```

Other useful tools: BibTeX (see e.g. [bibtex.org](http://bibtex.org))

If you use a figure from a published source, cite it in the figure caption, e.g.,

Figure 3.3: Invariant mass distribution of photon pairs showing the existence of the Higgs boson (from Ref. [37]).

(As an aside, caption font should be smaller than text font; figure caption goes below the figure; table caption above the table.

Always refer to figures/tables in the text itself.)

# Miscellaneous

Use British spelling.

Do not cut/paste. We can tell.

Use language precisely. Think carefully about what the words mean:

This derivation shows...

This calculation shows...

This theorem shows...

This equation shows...