The design of a Master Thesis

Andrea Donini
(curso organizado y supervisado con Pilar Hernández)

Motivation

- **Scientific writing is not taught at school**, nor during the undergraduate learning
- **WE** professional scientists **LEARN** how to write by **TRIALS AND ERRORS**, after many years of scientific papers publication and refereeing
- Many of us **NEVER LEARN!** You can be a very good scientist and a poor writer….

However,

we may learn from more experienced professional scientists

and

we may learn from more experienced professional writers

A Pulitzer Prize's suggestion

The 2006 Pulitzer Prize's winner Cormac McCarthy wrote a basic set of rules (suggestions…) on how to write a scientific article (in english)

Nature **574**, 441-442 (2019)

Some of them:

On the choice of the subject:

Decide on your paper's theme and two or three points you want every reader to remember. This theme and these points form the single thread that runs through your piece.

On simplicity:

If something isn't needed to help the reader to understand the main theme omit it.
Keep sentences short, simply constructed and direct.
Concise, clear sentences work well for scientific explanations.

On the style:

Inject questions and less-formal language to break up tone and maintain a friendly feeling. […] Similarly, use a personal tone because it can help to engage a reader. If you must talk about arbitrary colours of an abstract sphere, it's more gripping to speak of this sphere as a red balloon or a blue billiard ball.

Maybe the most important:

Just enjoy writing.

Not everybody enjoys writing!

Accelerated learning

Our main objective is that you may learn
the basic rules to write your Master's Thesis
by this summer…

Our final goal is to have a uniform (minimum) level in the Theses,
so as to simplify reading both for referees and normal readers
(this may be useful for us to read your theses, and for you to sell your thesis outside the academy)

Starting from a "standard recipe", you may then evolve into your own scientific style

General view

1. (Online?) class(es) on basic rules to write the Master's thesis
2. Practical exercise: organising the Thesis (email submission)
3. Correction of the practical exercise (either by mail or skype?)
4. Presentation to the class of one or two exercises
5. (Online?) class on basic rules to present your Master's thesis

Outline of the lectures

1. **STARTING**
    1. Choosing a language
    2. Choosing an editing language
    3. Choosing an editor

2. **ORGANIZATION OF THE THESIS**
    1. Understanding your subject
    2. What is “old”
    3. Appendices
    4. What is “new”
    5. Introduction and conclusions

1.

3. **GRAPHICS AND EQUATIONS**
    1. Drawing and inserting plots
    2. Explaining plots (captions!)
    3. Equations

4. **REFERENCING**

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4. **REFERENCING**

What this class it is not

We are not teaching you to write

We are not teaching you the language you use to write:
scientists write in a non-uniform language
that approximately resembles English

We are not teaching you physics

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4. **REFERENCING**

Part I: STARTING

1. Choose a language to write

Possible choices:

ENGLISH

CASTELLANO

VALENCIÁ

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Possible choices:

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I strongly suggest ENGLISH:

1. It is the (current) language of science
2. You read books and articles in english
3. It may be your first (or last) chance to write in english
4. Your thesis will be easier to show outside (to do a PhD abroad, to go to a private company, …)

Part I: STARTING

2. Choose a editing language

Possible choices:

NONE

Part I: STARTING

2. Choose a editing language

Possible choices:

NONE

There is only one choice possible:

LATEX

MAC: TEXSHOP https://pages.uoregon.edu/koch/texshop/

WINDOWS: MIKTEX https://miktex.org/download

LINUX: TEXLive (depends on which Linux)

https://repology.org/project/texlive/versions

Part I: STARTING

3. Choose an editor

This is up to you
(however, most Latex releases have their own editor)

Part II:ORGANIZATION

1. Understanding your subject

Usually, you and your advisor are the two persons that understand most of your thesis

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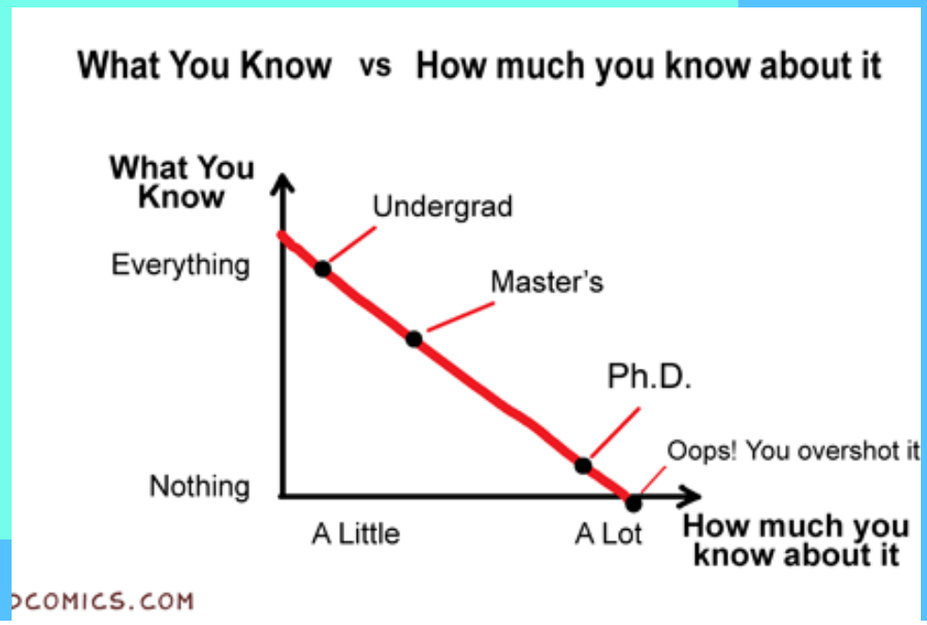
Usually, you and your advisor are the two persons that understand most of your thesis

Sometimes, only your advisor understand (most of) your thesis



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Usually, you and your advisor are the two persons that understand most of your thesis

The rest of the physicists that read your thesis divide into:
those that know the subject
and those that do not know the subject

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Part II:ORGANIZATION

WRITE FOR THE LATTER GROUP!

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Part II:ORGANIZATION

1. Understanding your subject

You should imagine that those that read

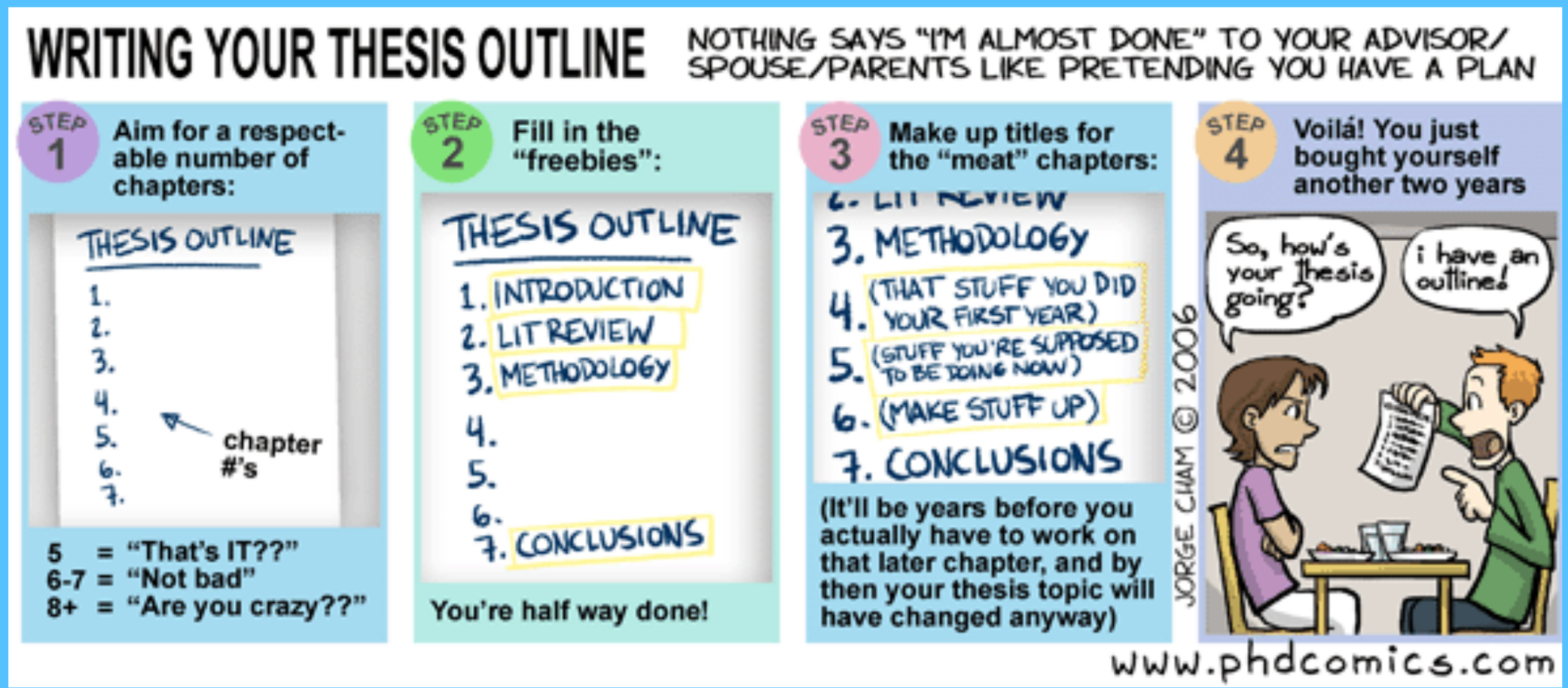
DO NOT KNOW DEEPLY THE SUBJECT OF YOUR THESIS
(give an overview of the subject)

but

THEY KNOW AND UNDERSTAND THE BASICS
(do not start with undergraduate stuff)

Part II:ORGANIZATION

1. Understanding your subject



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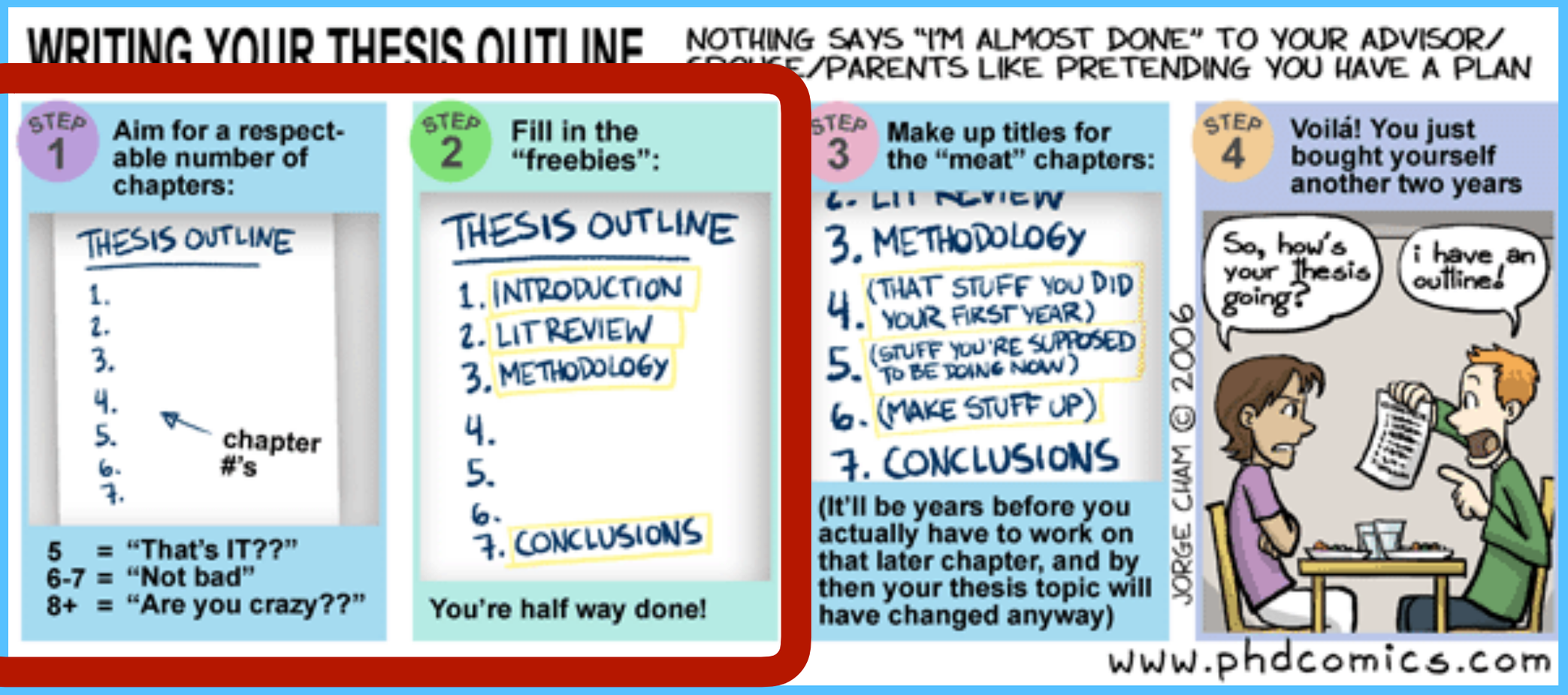

Part II:ORGANIZATION

An example from old theses

Thesis on SUSY

Contents

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An example from old theses

Introduction (motivation)

Thesis on SUSY

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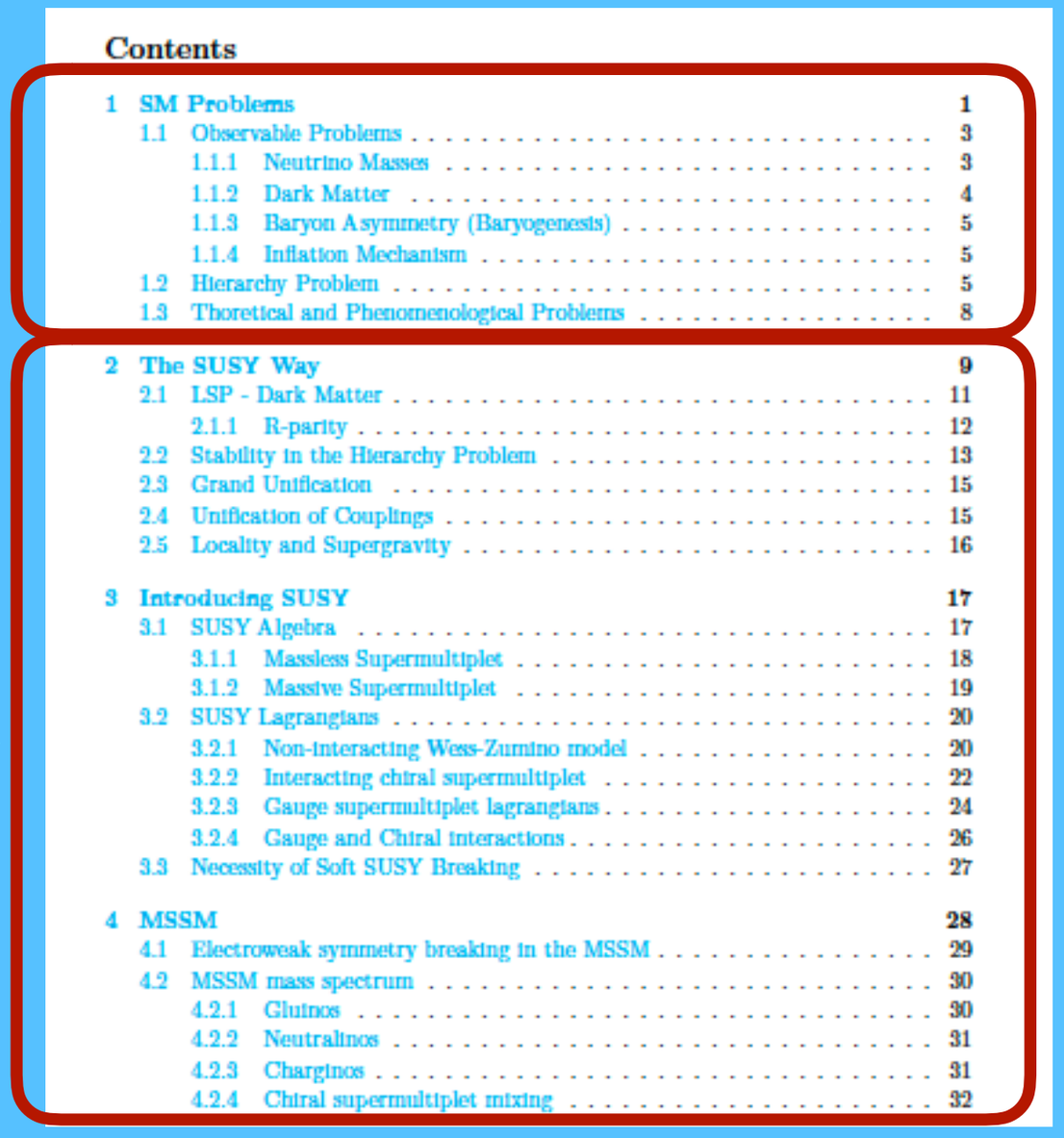
Introduction/ Motivation

Thesis on SUSY

“ Lil’ ” review



Contents

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Another example from old theses

Thesis on GR

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Part II:ORGANIZATION

Introduction/Motivation: 3-6 pages

"Old" Literature: 10 to 20 pages
(from textbooks and articles)

START FROM HERE! START NOW!

Your stuff: 10 to 20 pages

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SECOND PART TO WRITE…

Part II:ORGANIZATION

Introduction/Motivation: 3-6 pages

MOST IMPORTANT PART OF THE THESIS!
LAST TO WRITE!

"Old" Literature: 10 to 20 pages
(from textbooks and articles)

START FROM HERE! START NOW!

Your stuff: 10 to 20 pages

SECOND PART TO WRITE…

First: What is “old”

You should determine which amount of basic information is needed to introduce the subject

Who is your reader: a physicist that understand what you are doing, but do not know the basic literature on the subject (except for textbooks)

First: What is “old”

Example: Thesis on some topic in General Relativity

Do not explain what is General Relativity from scratch

If you need some non-standard formalism, introduce it

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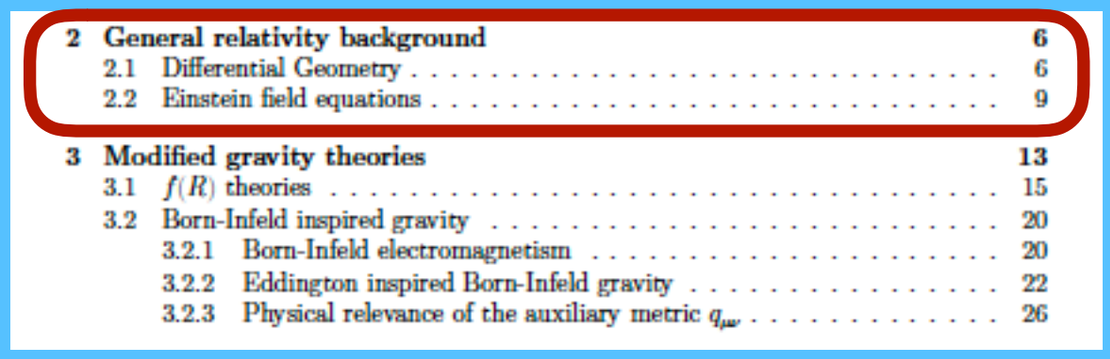
STANDARD: 3 pages



First: What is “old”

Example: Thesis on some topic in General Relativity

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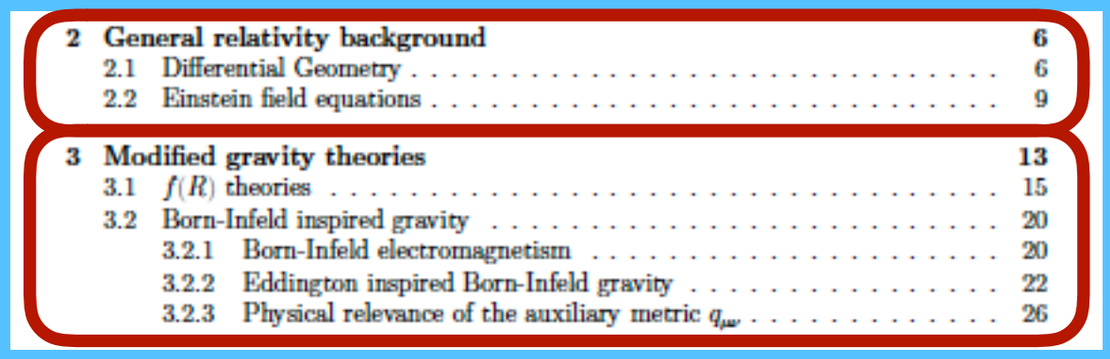
STANDARD: 3 pages

NON-STANDARD: ~10-15 pages



First: no Cut&Paste

This part of the thesis is the place where it is most probable to take a short-cut:
Cut&Pasting from holy books and articles

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A sensible excuse:
how may I write something about THIS better than THEM?

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This is NOT ALLOWED!
It is better to read the holy sources, try to understand and
TRY TO WRITE BY YOURSELF

First: no Cut&Paste

https://top-papers.com/how-to-avoid-plagiarism-in-research-papers/

1. **Paraphrasing: your own words, same concept**
2. **Citing: (small) text from other paper [citenumber]**
3. **Quoting: “(complete) text from other paper” [citenumber]**

Second: Appendices

They are the place where you must move
TECHNICAL STUFF
that you used but is:

A) boring to read in the main text

B) something that may be skipped

Thesis on Quantum Systems

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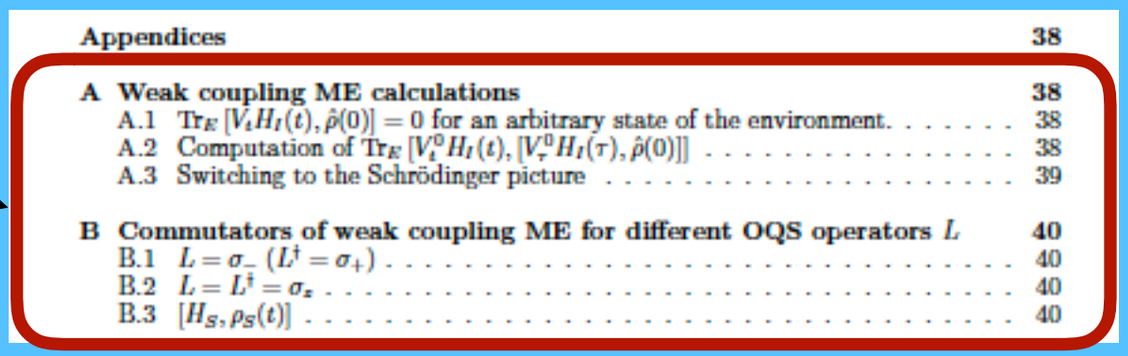
As many as you need….

No more than a couple of pages each

ems



Appendices 38

A Weak coupling ME calculations 38
A.1 $\mathrm{Tr}_E\,[V_t H_I(t), \hat{\rho}(0)] = 0$ for an arbitrary state of the environment. 38
A.2 Computation of $\mathrm{Tr}_E\,[V_t^0 H_I(t), [V_\tau^0 H_I(\tau), \hat{\rho}(0)]]$ 38
A.3 Switching to the Schrödinger picture 39

B Commutators of weak coupling ME for different OQS operators L 40
B.1 $L = \sigma_-$ $(L^\dagger = \sigma_+)$ 40
B.2 $L = L^\dagger = \sigma_z$ 40
B.3 $[H_S, \rho_S(t)]$ 40

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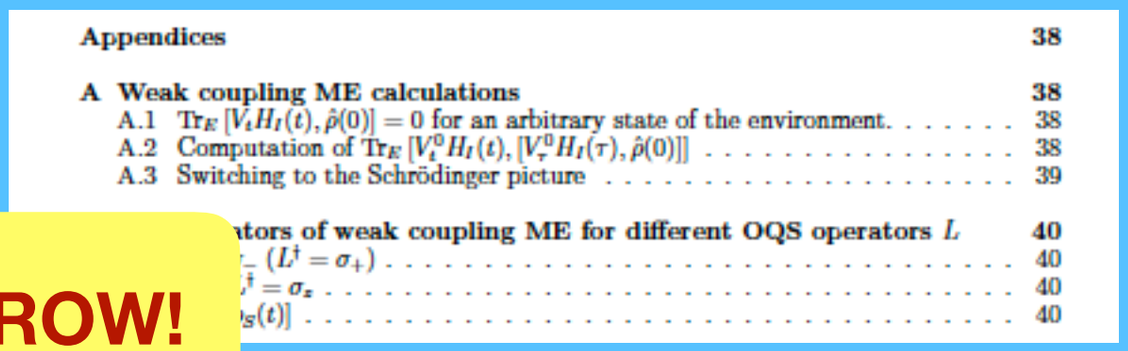
Thesis on Quantum Systems

Write these SECOND! TOMORROW!



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Third: Your “new” stuff

It must be very clear
WHAT is NEW, and WHAT is NOT NEW

A typical question at the defense:

“Ok, very nice. But….
Can you explain me PRECISELY which is the difference between what YOU have done and the LITERATURE?”

Third: Your “new” stuff

Literature: first chapters

Your work: last chapters

INTRODUCE WHAT IS OLD

You should have written this first; it is useful for you to explain differences

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COMPARE WITH WHAT IS OLD

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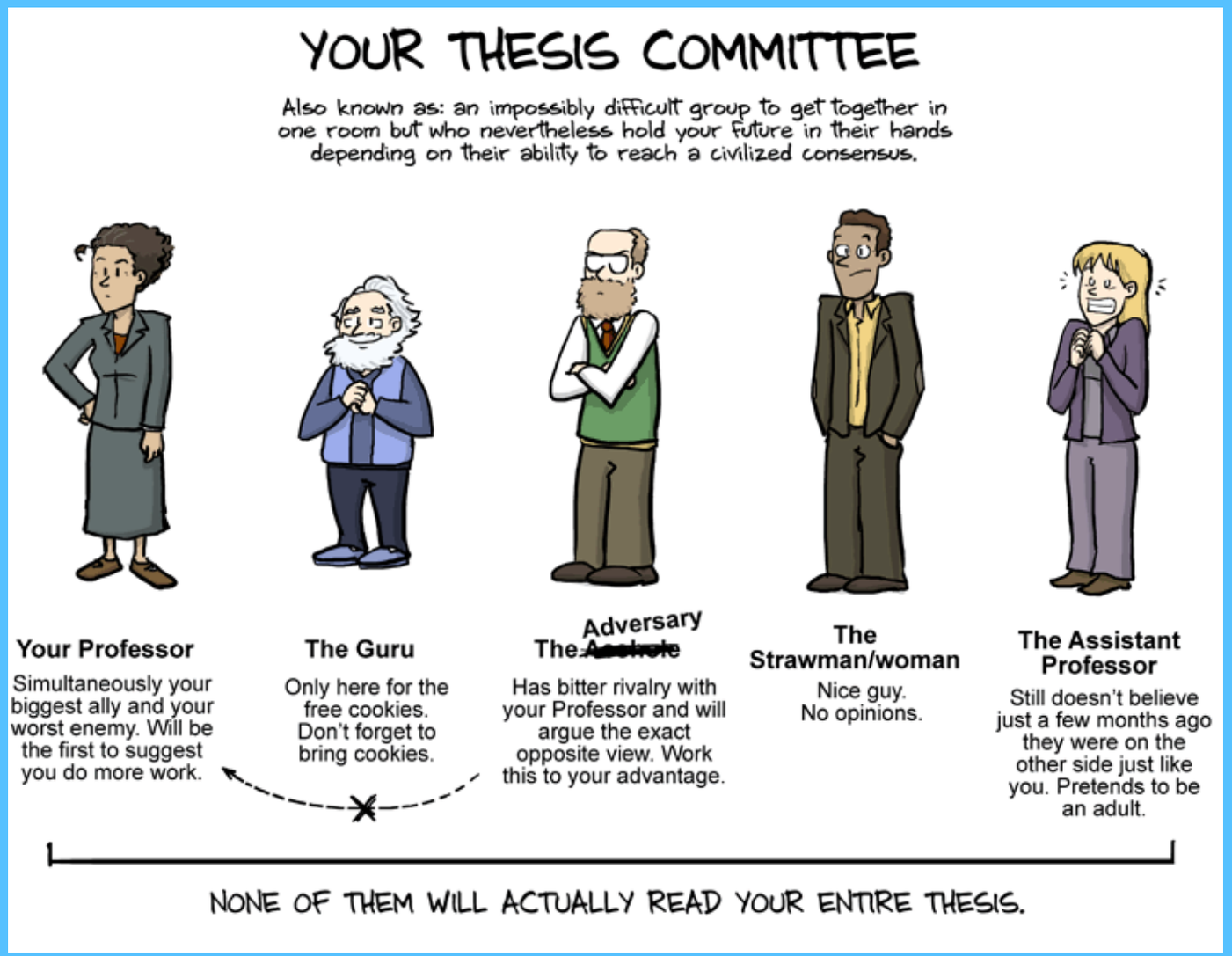
ELABORATE ON THIS: feel free!

Four: Introduction



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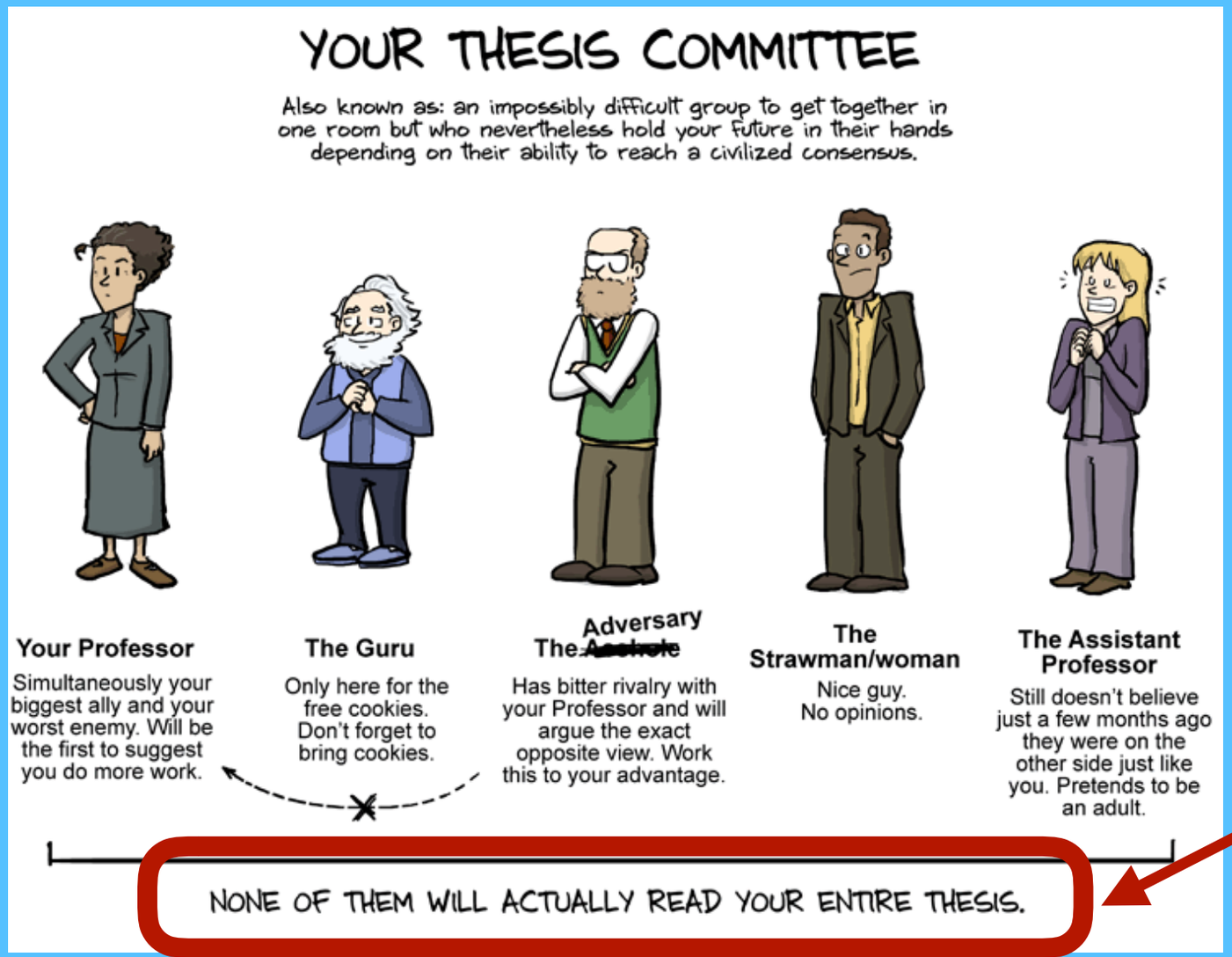

This sounds as a joke, but many times overlaps one-to-one with reality

Four: Introduction

It is a complete summary of the thesis:
one should understand what is written in the main body just from reading this. If you succeed, the reader will feel happy!

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Examples:

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Motivation for your specific research

Most important part of the Introduction: show that you know WHY you have done what you have done!

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"We have found that…
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Organization of the thesis: “In Chapt. 1 I review ….; in Chapt. 2….”

Five: Conclusions

It is a short summary of the thesis:
remind shortly the motivation and the results
with respect to the literature

This is the place to insert your work as
just one single brick in a big construction

Use a few words to explain possible future development,
“beyond the scope of this thesis.”