

The design of a Master Thesis

Andrea Donini

(curso organizado y supervisado con Pilar Hernández)

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

3.

GRAPHICS AND EQUATIONS

1. Drawing and inserting plots
2. Explaining plots (captions!)
3. Equations

4.

REFERENCING

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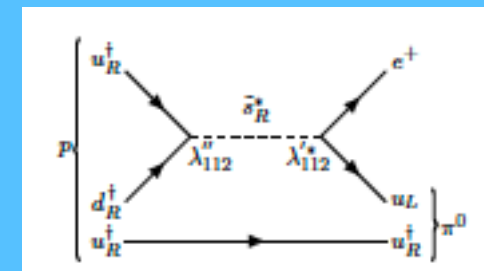
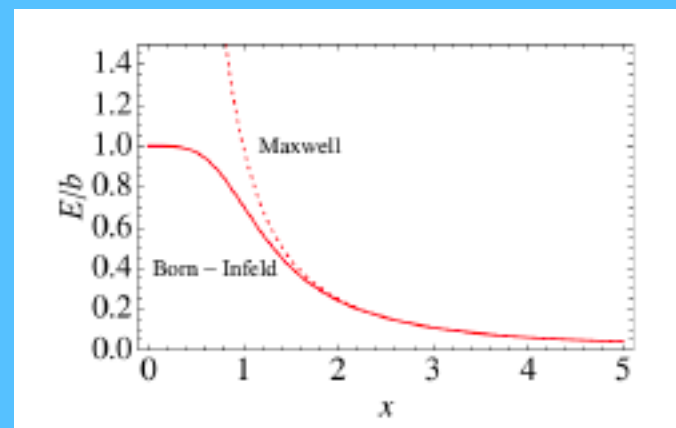
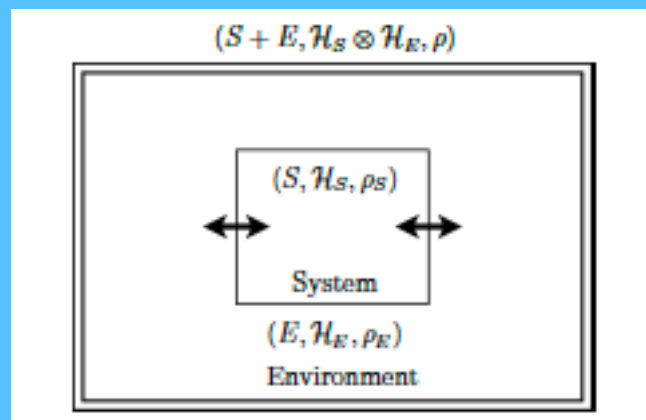
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4. REFERENCING

Class Number Two

Part III: Graphics

Pictures are an important tool
to present physics results



Graphics are easily imported into Latex in any format.
Having them in .pdf is usually better....
(for those using Word I have no idea...)

Part III: Graphics

**You should produce your figures with the software
you prefer**

Part III: Graphics

You should produce your figures with the software you prefer

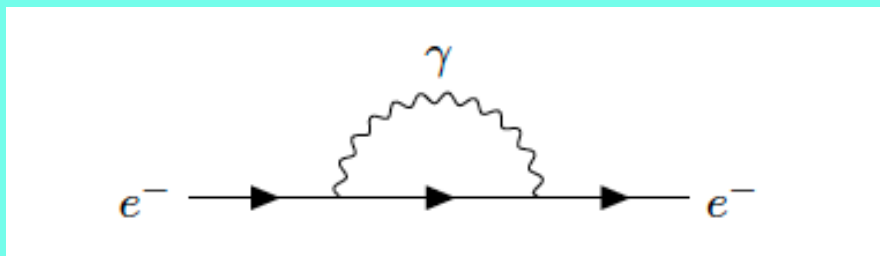
They may be of two kinds:

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They may be of two kinds:

Theory

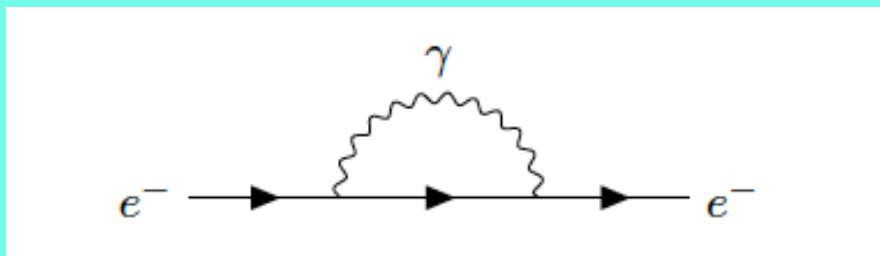


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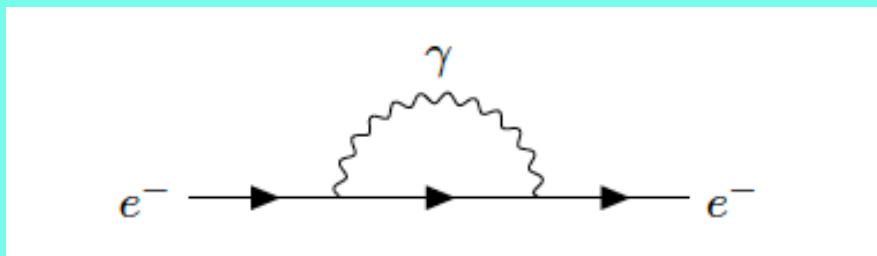
Clean, simple

Part III: Graphics

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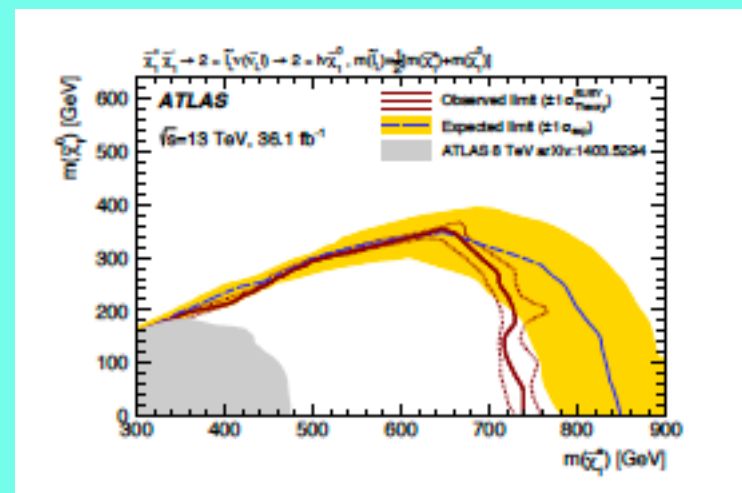
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Clean, simple

Pheno/Exp

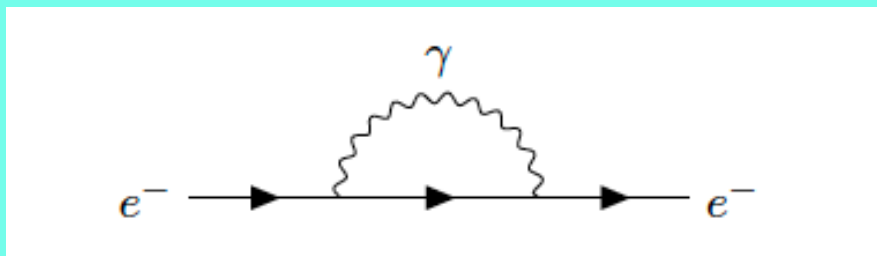


Part III: Graphics

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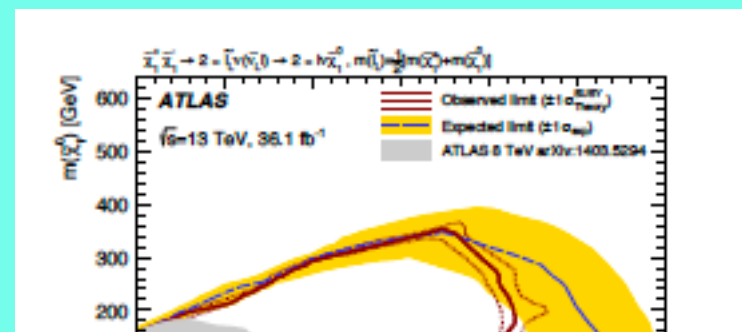
They may be of two kinds:

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Clean, simple

Pheno/Exp



Messy, filled

Part III: Graphics

A Figure is made out of two pieces:

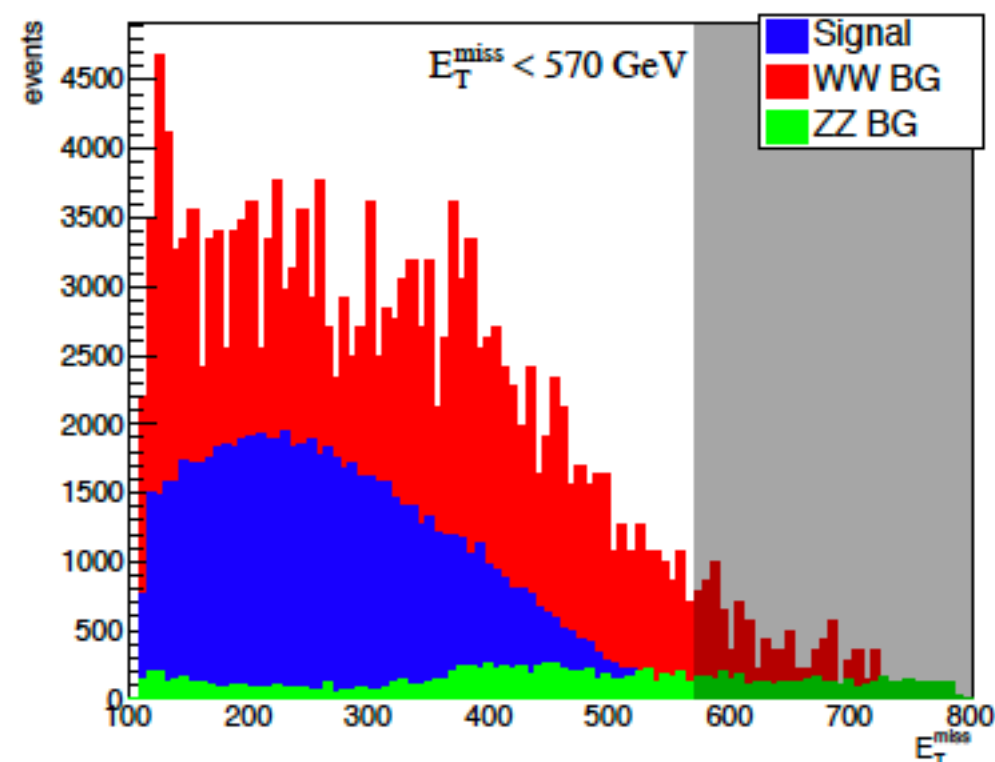


Figure 5.6: Histogram showing all the cuts being applied for the E_T^{miss} . Here we have scaled the number of events in accordance with equation 5.3.29.

Part III: Graphics

A Figure is made out of two pieces:

1. The graphic object

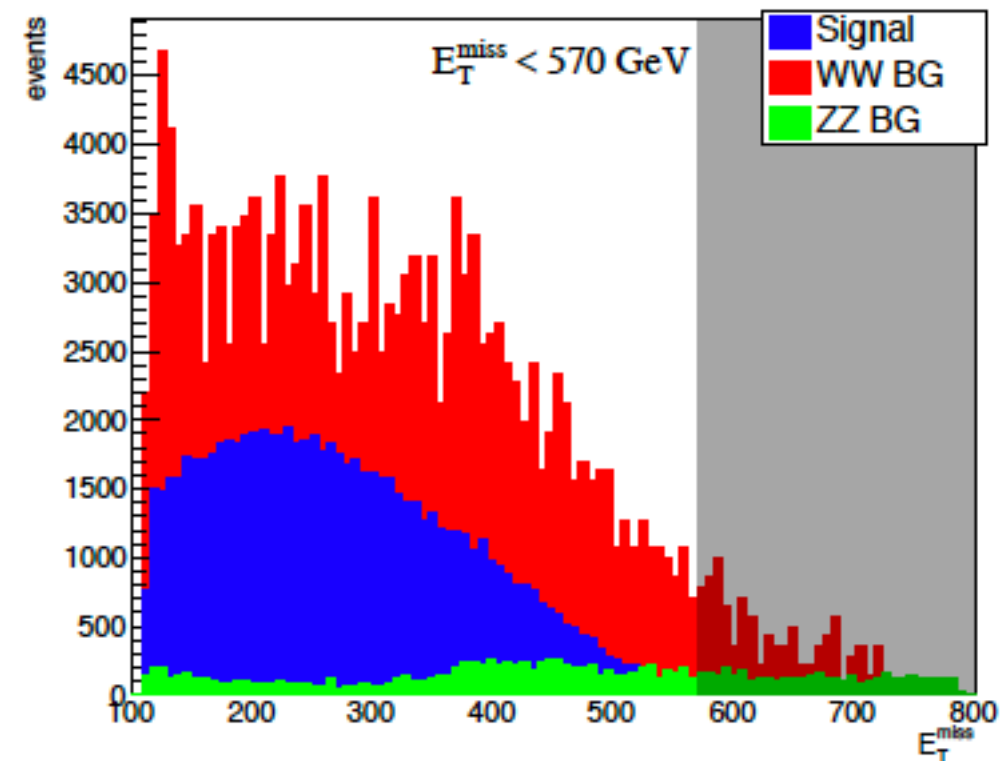


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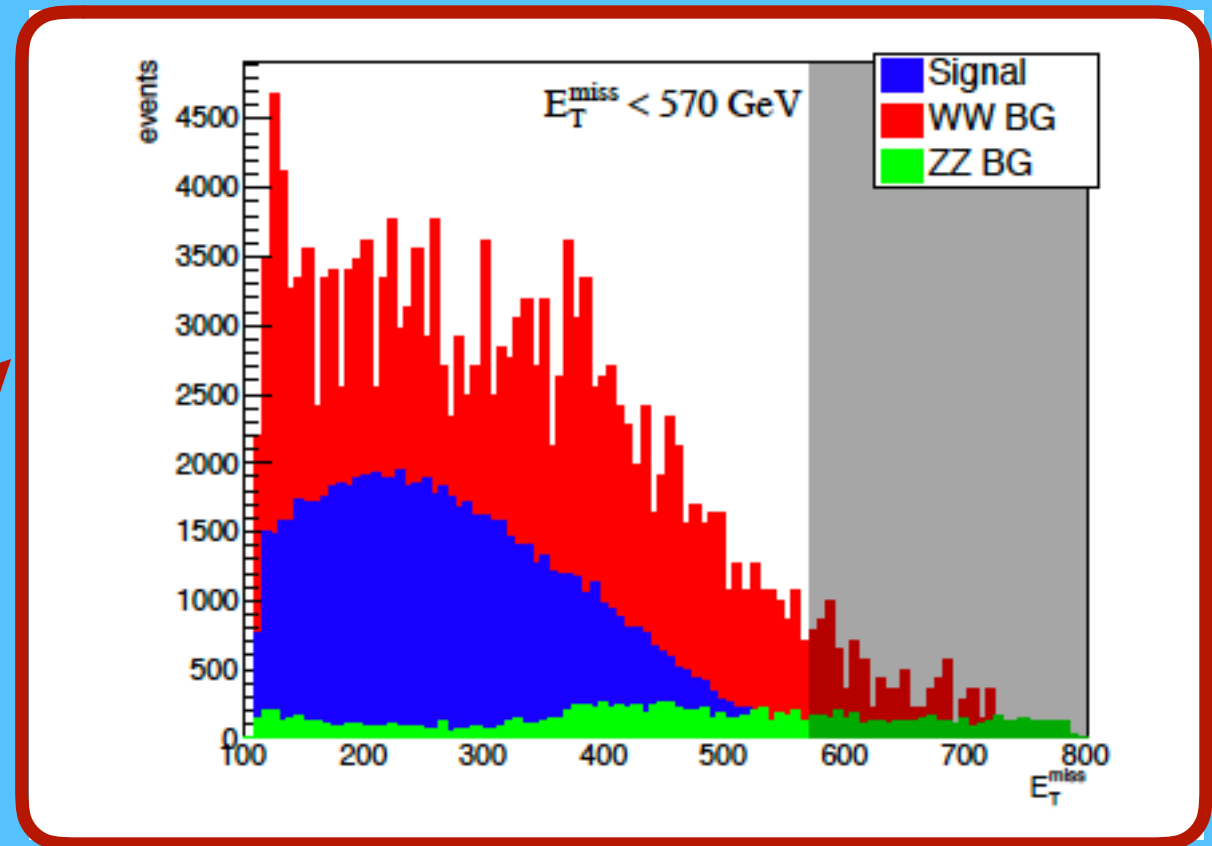


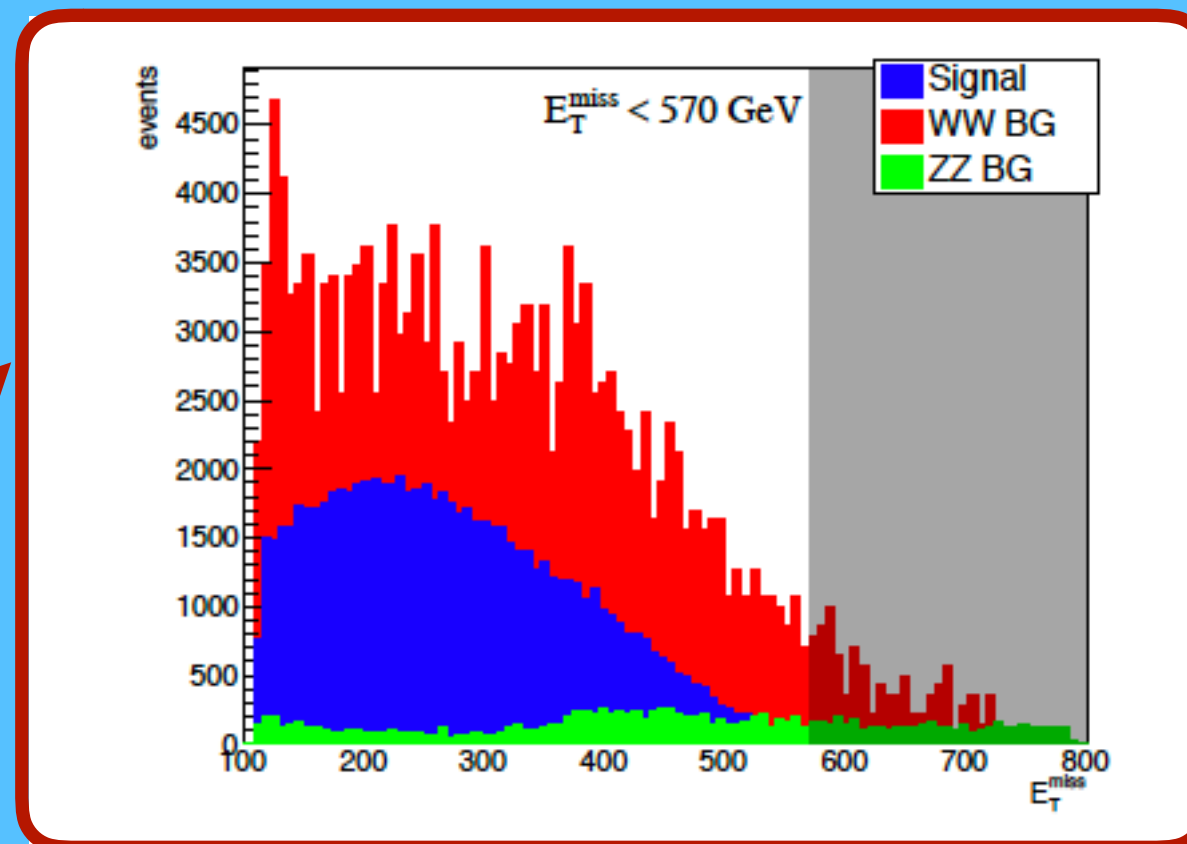
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Captions are not an optional!

Figure 5.6: Histogram showing all the cuts being applied for the E_T^{miss} . Here we have scaled the number of events in accordance with equation 5.3.29.

Part III: Graphics

Graphic objects:

legends should be **simple**
and clear (not too many
Items)

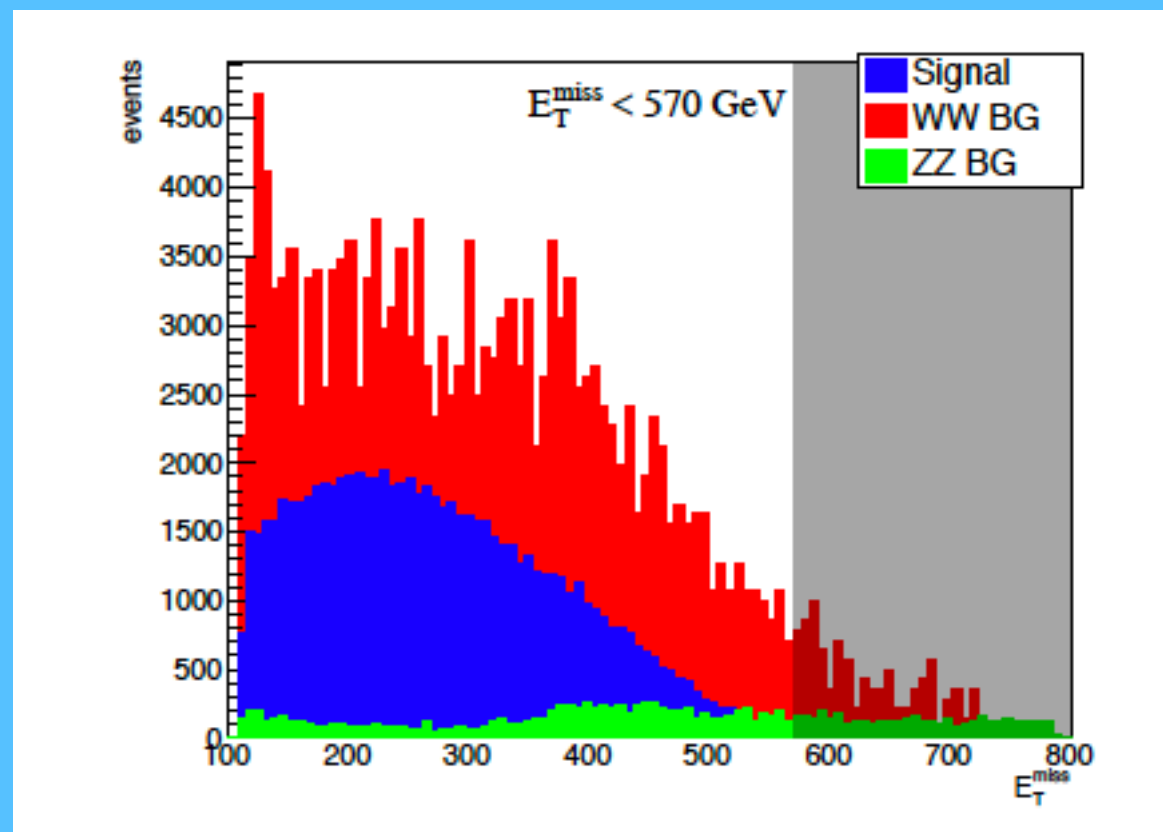


Figure 5.6: Histogram showing all the cuts being applied for the E_T^{miss} . Here we have scaled the number of events in accordance with equation 5.3.29.

Part III: Graphics

Graphic objects:

legends should be **simple**
and clear (not too many
Items)

they should be
readable in B&W
(if color legends,
use **DARK/LIGHT** colors,
large contrast)

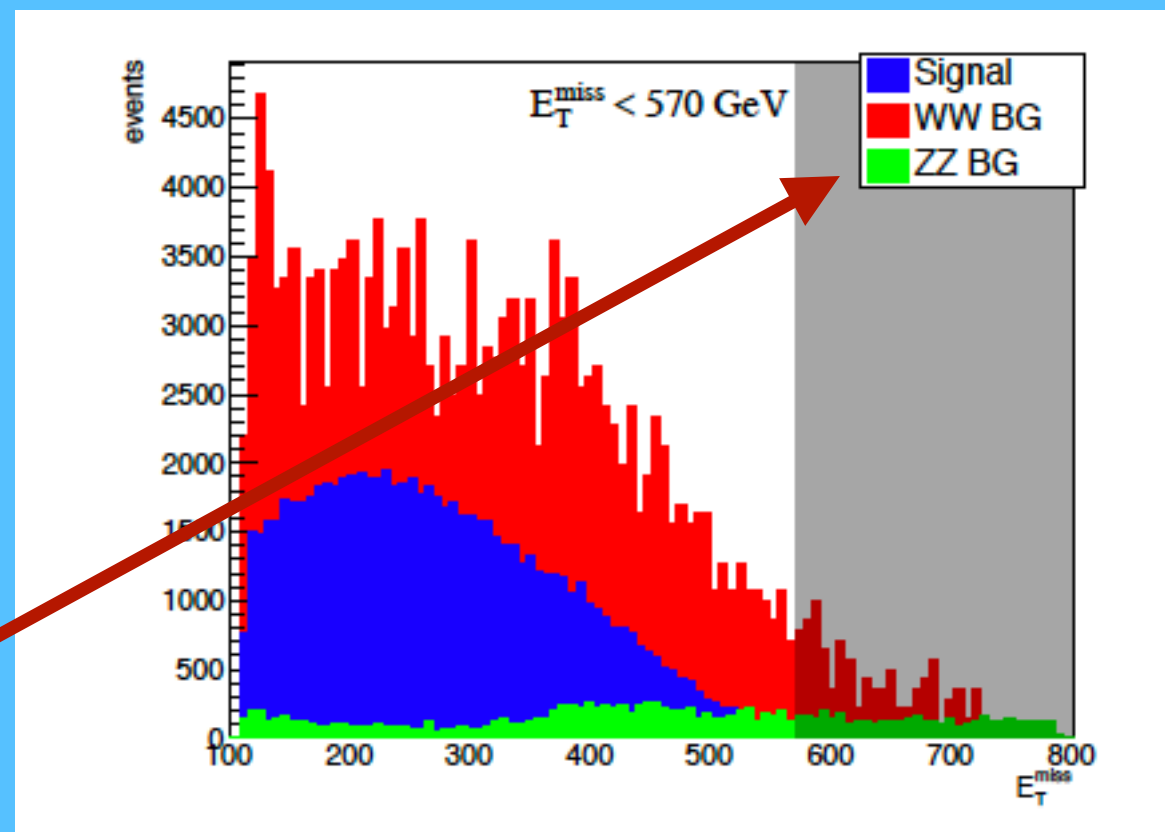


Figure 5.6: Histogram showing all the cuts being applied for the E_T^{miss} . Here we have scaled the number of events in accordance with equation 5.3.29.

Part III: Graphics

Captions: you have two choices

SELF-CONTAINED:
all the information needed
to understand the picture

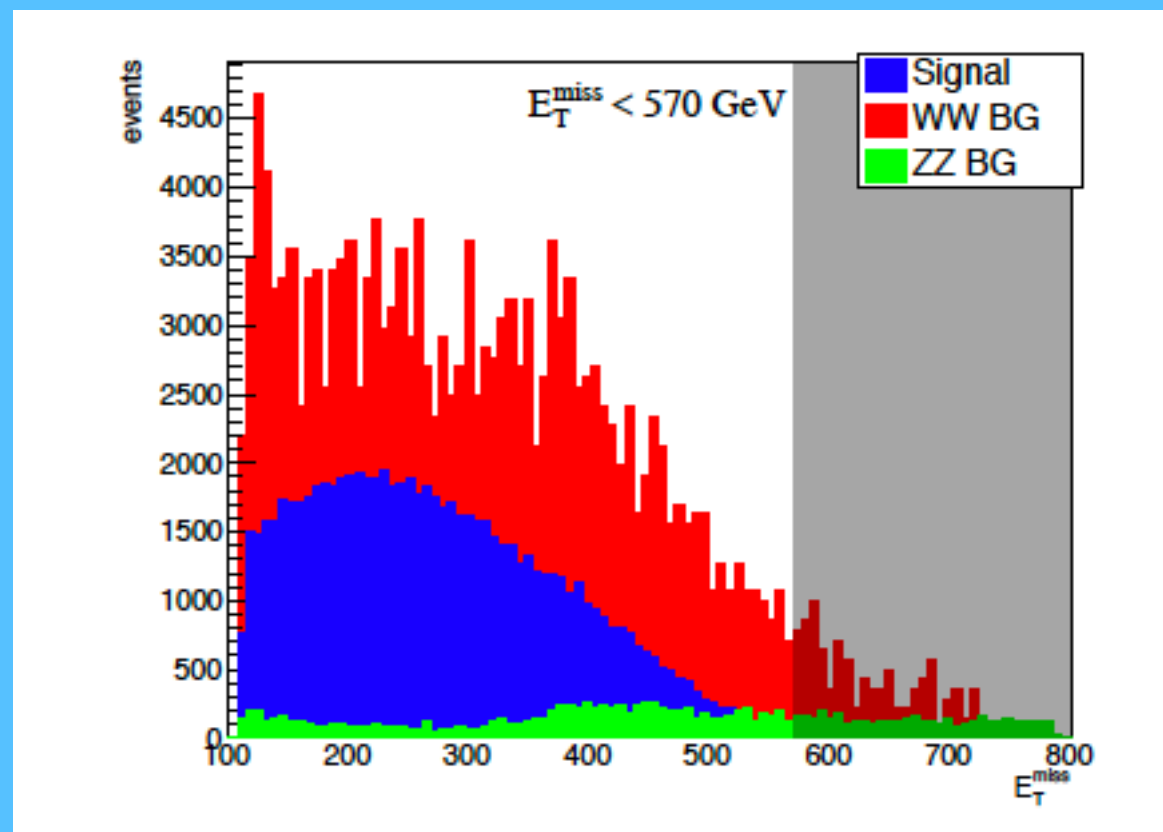


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Part III: Graphics

Captions: you have two choices

SELF-CONTAINED:
all the information needed
to understand the picture

REFER TO THE TEXT:
only basic information
and refer to the main text

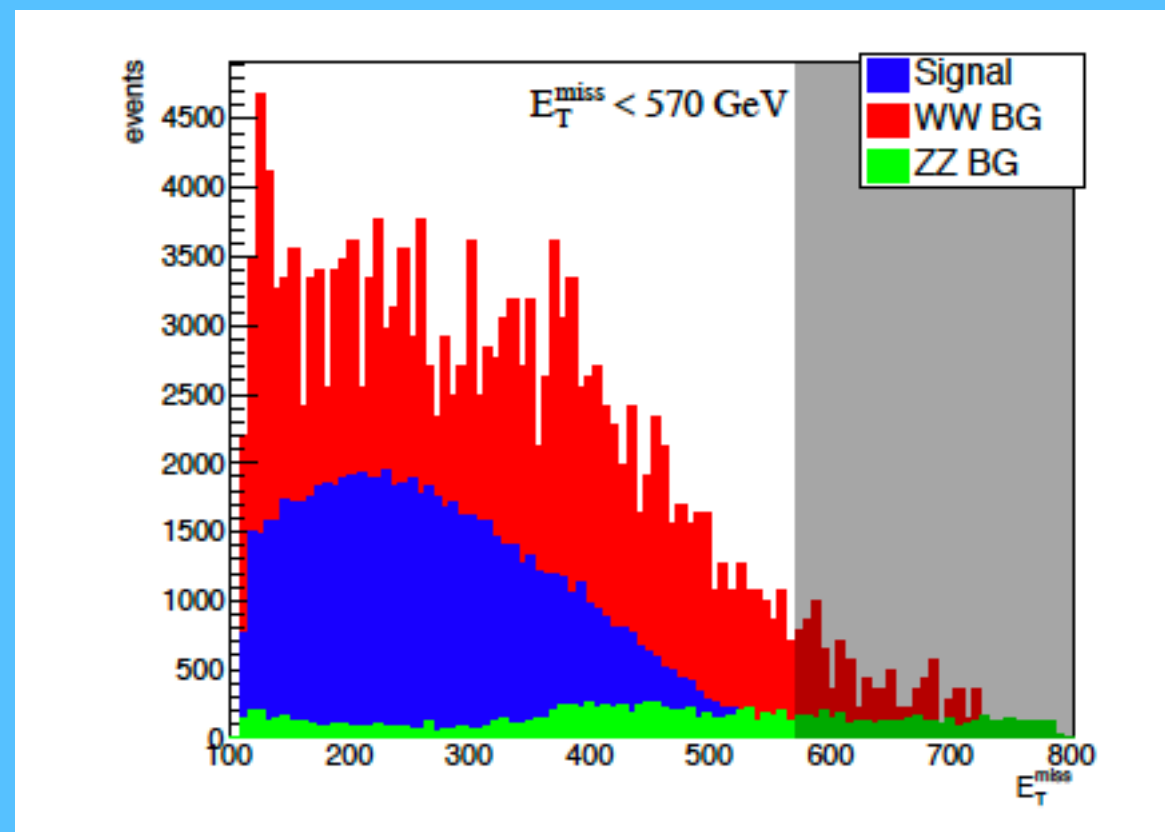


Figure 5.6: Histogram showing all the cuts being applied for the E_T^{miss} . Here we have scaled the number of events in accordance with equation 5.3.29.

Part III: Graphics

Captions: you have two choices

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all the information needed
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In a thesis, much better
the first option.
Remember that you should
help the reader!

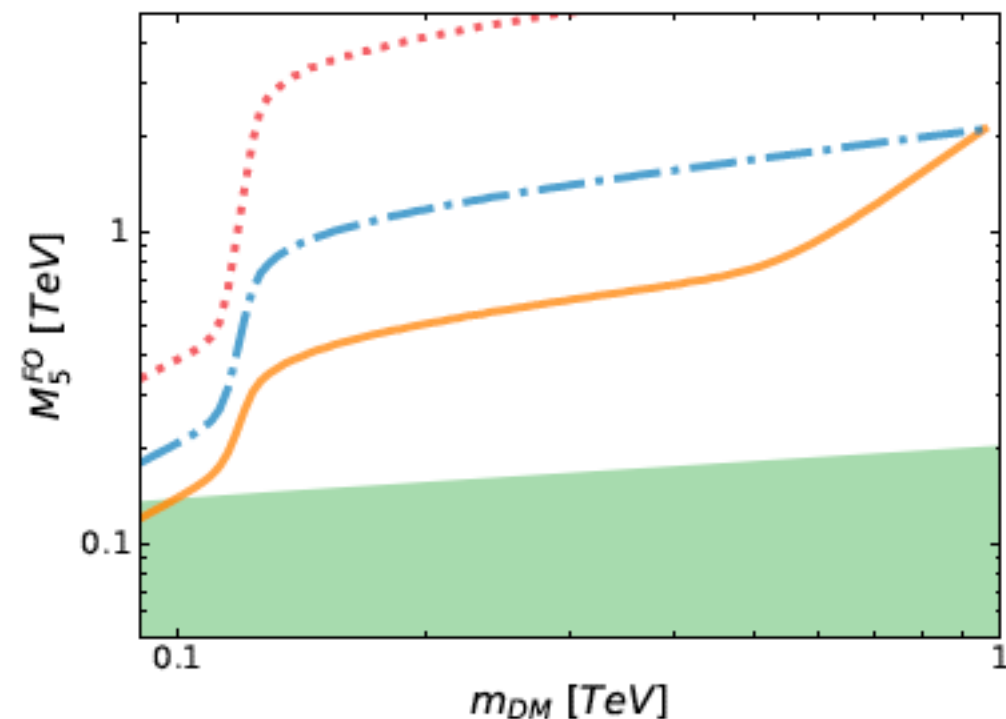


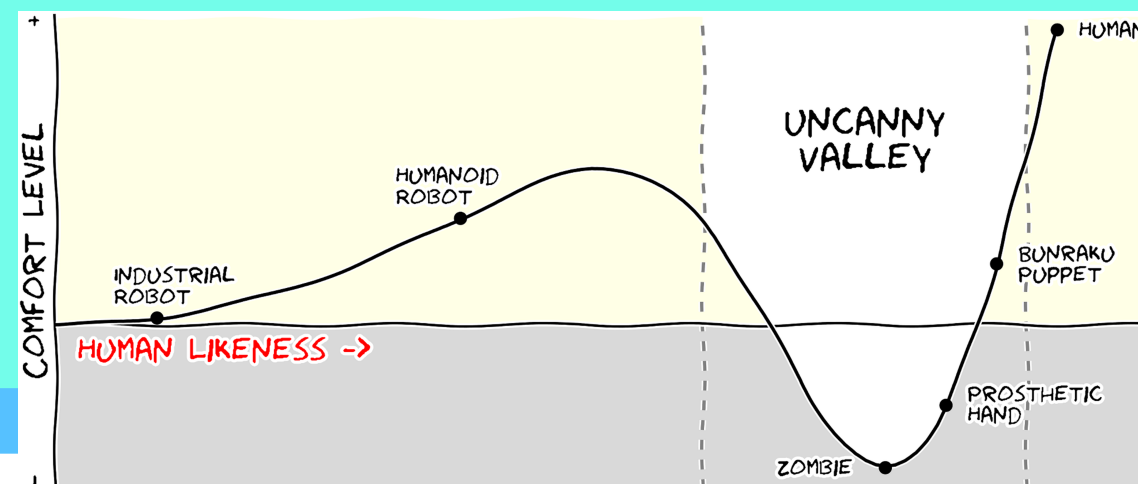
Figure 5. The scale needed to achieve the freeze-out relic abundance, M_5^{FO} , as a function of the DM mass m_{DM} , for $k = 250$ GeV. Solid orange, dot-dashed blue and dotted red lines correspond to scalar, fermion and vector DM, respectively. The green-shaded area, on the other hand, is the experimental bound in the (m_{DM}, M_5) plane from XENON1T [56].

Recipes for a good figure

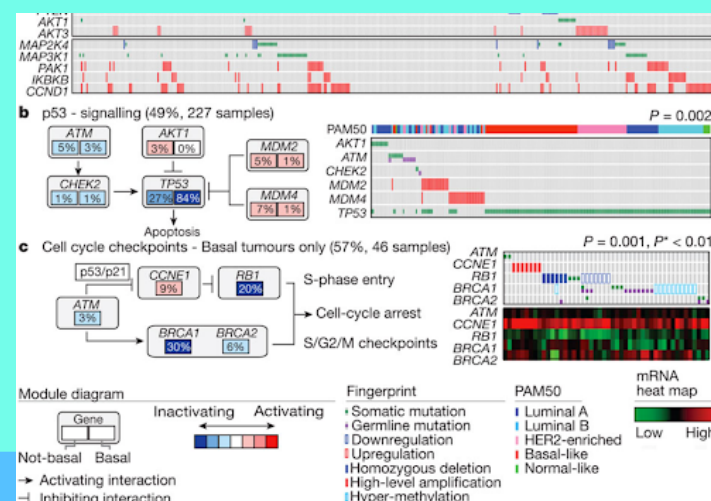
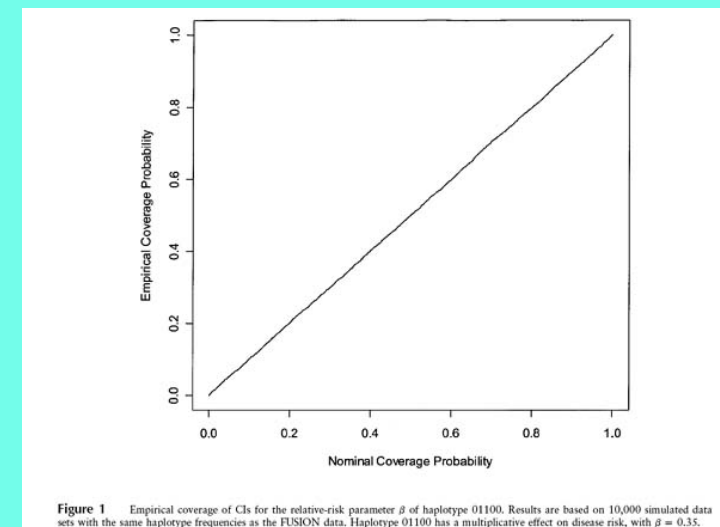
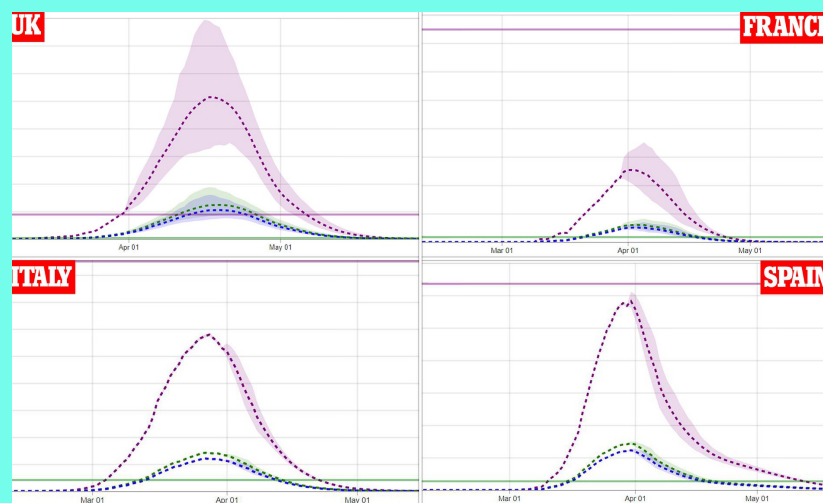
You may find interesting tips here:

<https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1003833#s7>

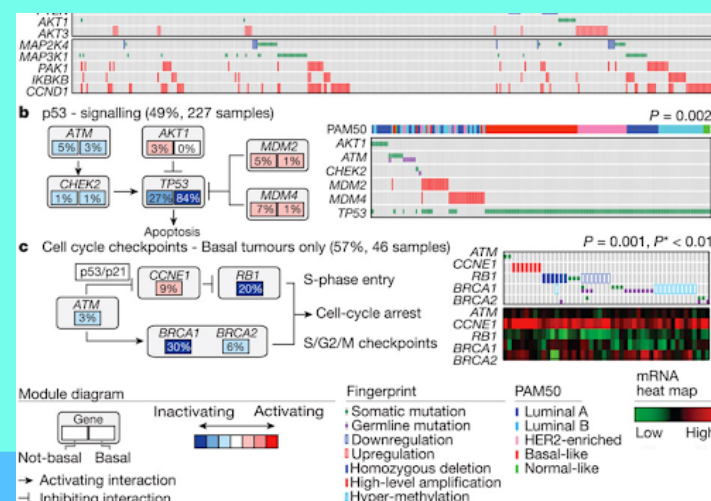
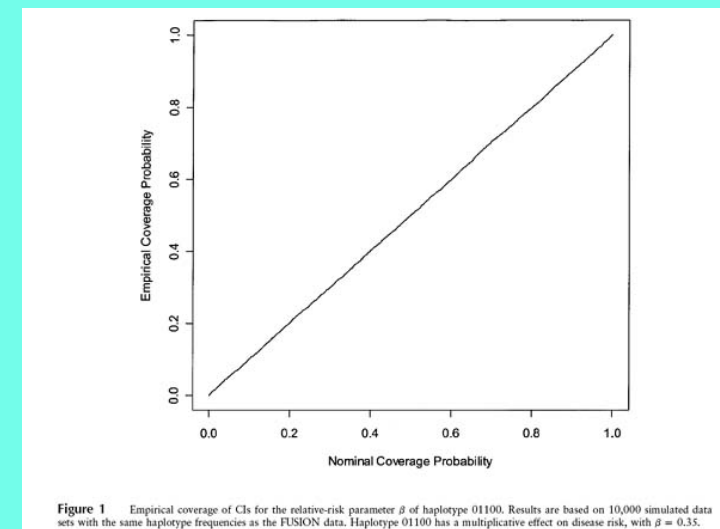
message and readability of the figure is the most important aspect while beauty is only optional



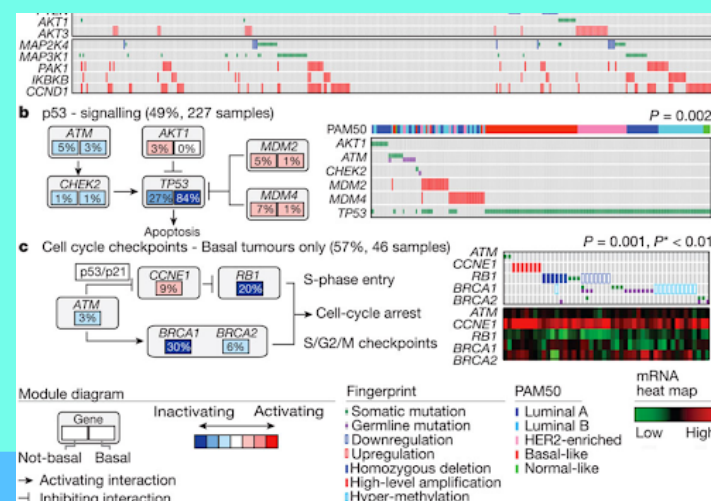
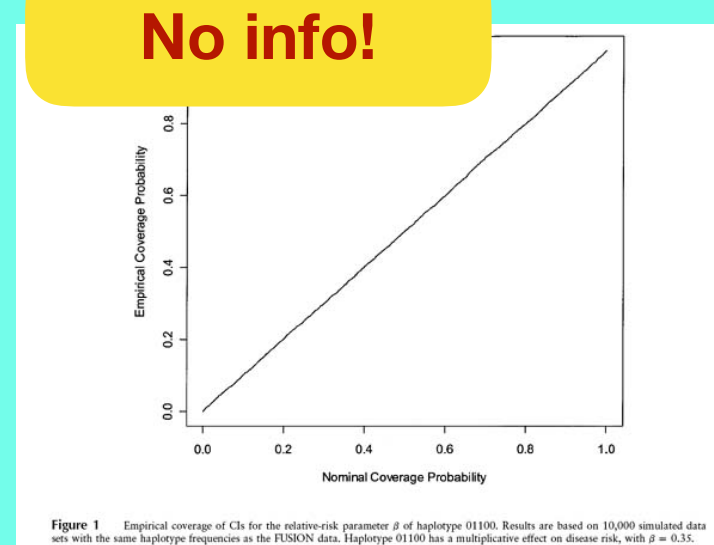
Recipes for a bad figure



Recipes for a bad figure



Recipes for a bad figure



Recipes for a bad figure

No scales!



No info!

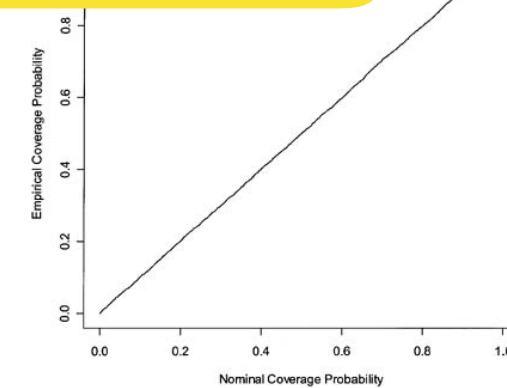
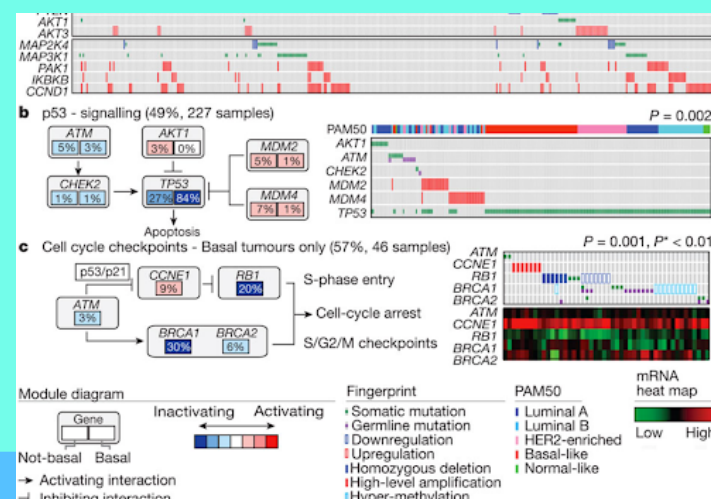


Figure 1 Empirical coverage of CIs for the relative-risk parameter β of haplotype 01100. Results are based on 10,000 simulated data sets with the same haplotype frequencies as the FUSION data. Haplotype 01100 has a multiplicative effect on disease risk, with $\beta = 0.35$.



Too much info!

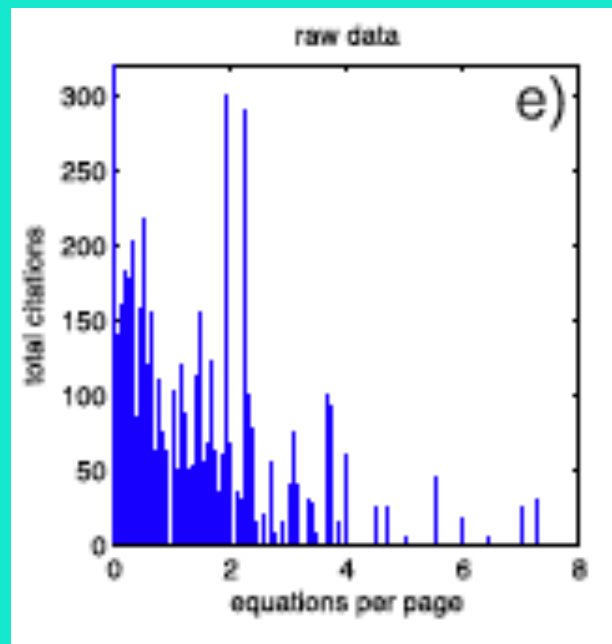
Part III: Equations

An equation is not just an aesthetic tool!

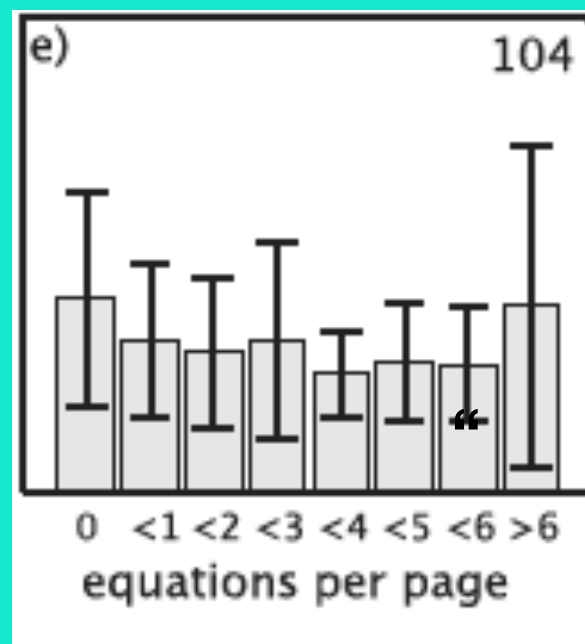
It should be written **ONLY if is
necessary to explain something**

**If you feel like writing equations
to proof you are a real theorist,
use the appendices!**

Part III: Equations



Citations as a function of number of equations in a biology paper



Citations as a function of number of equations in a physics paper

“Essential equations capturing the assumptions and structure of a model should be presented in the main text, whereas non-essential equations, such as those describing intermediate steps to solutions, need only be given in the appendices.”

Higginson,
Fawcett,
New J. Phys. 18 (2016)

Kollmer, Pöschel, Gallas, New J. Phys. 17 (2015)

Part III: Equations

An equation is not just an aesthetic tool!

You should define **ALL of the elements in the equation**

$$\delta\phi = \epsilon\psi, \quad \delta\phi^* = \epsilon^\dagger\psi^\dagger, \quad (3.1.3)$$

where ϵ^α is an infinitesimal, anti-commuting, two-component Weyl fermion object that parameterizes

**The reader should be able to understand
each one of the symbols appearing in an equation**

Part III: Equations

An equation is not just an aesthetic tool!

It is not compulsory to be able to derive the equation

$$\frac{dn_{\text{DM}}}{dt} = -3H(T) n_{\text{DM}} - \langle \sigma v \rangle [n_{\text{DM}}^2 - (n_{\text{DM}}^{\text{eq}})^2]$$

However, you should be able to explain what the equation means (what the left and right hand sides represent)

Part III: Equations

It is n



ol!

quation

However, you should be able to explain what the equation means (what the left and right hand sides represent)

Part III: Equations

NEVER EVER write an equation in
the Introduction or the Conclusions

(if you are not Einstein
and the equation is not $E = mc^2$)

Part III: Equations

An equation must be treated with the same punctuation as a standard sentence, as if you were reading it

$$\begin{cases} m_r^2 \equiv m_{\Phi_0}^2 = \frac{8}{9}k^2 \left(1 - \frac{2\epsilon_{UV}}{9}\right) + \mathcal{O}(\epsilon^2), \\ m_{\Phi_n}^2 = k^2 + \frac{n^2}{r_c^2} \left[1 - \frac{6(n^2 + k^2 r_c^2)(\epsilon_{UV} + \epsilon_{IR})}{9n^2 \pi k r_c + \pi k^3 r_c^3}\right] + \mathcal{O}(\epsilon^2). \end{cases}$$

Part III: Equations

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Part IV: Referencing

**It is extremely important to quote
the relevant bibliography
in a thesis!**

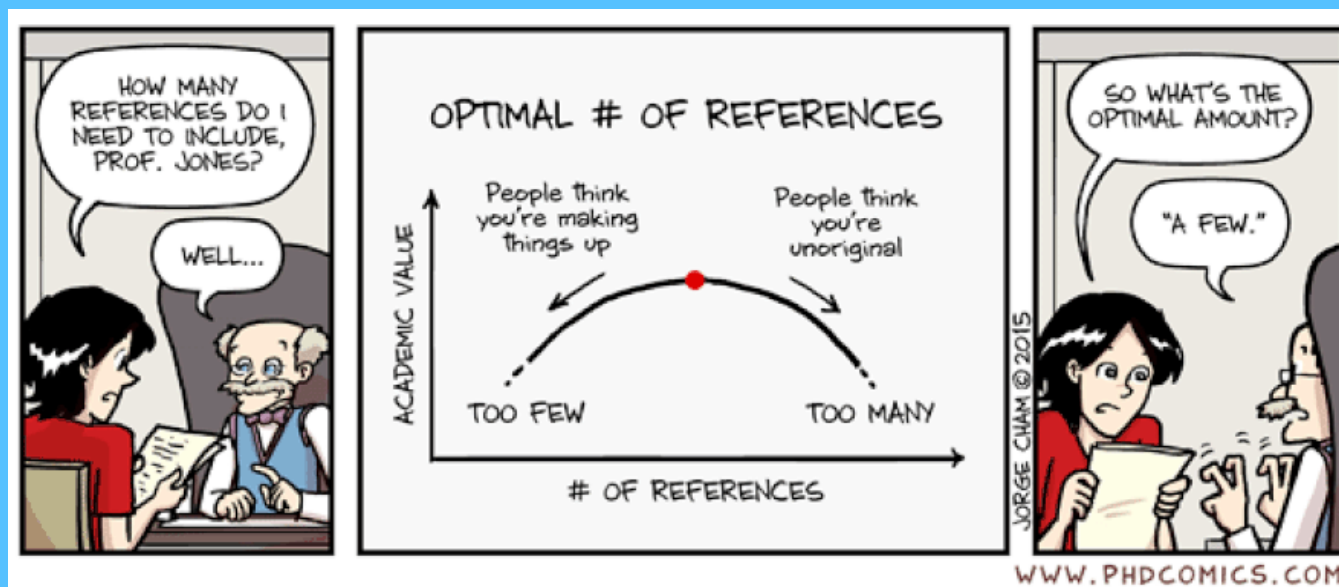
You should quote **the original source where something
important for what you are saying was first published**

Part IV: Referencing

What should you be quoting? Better more than less!

Part IV: Referencing

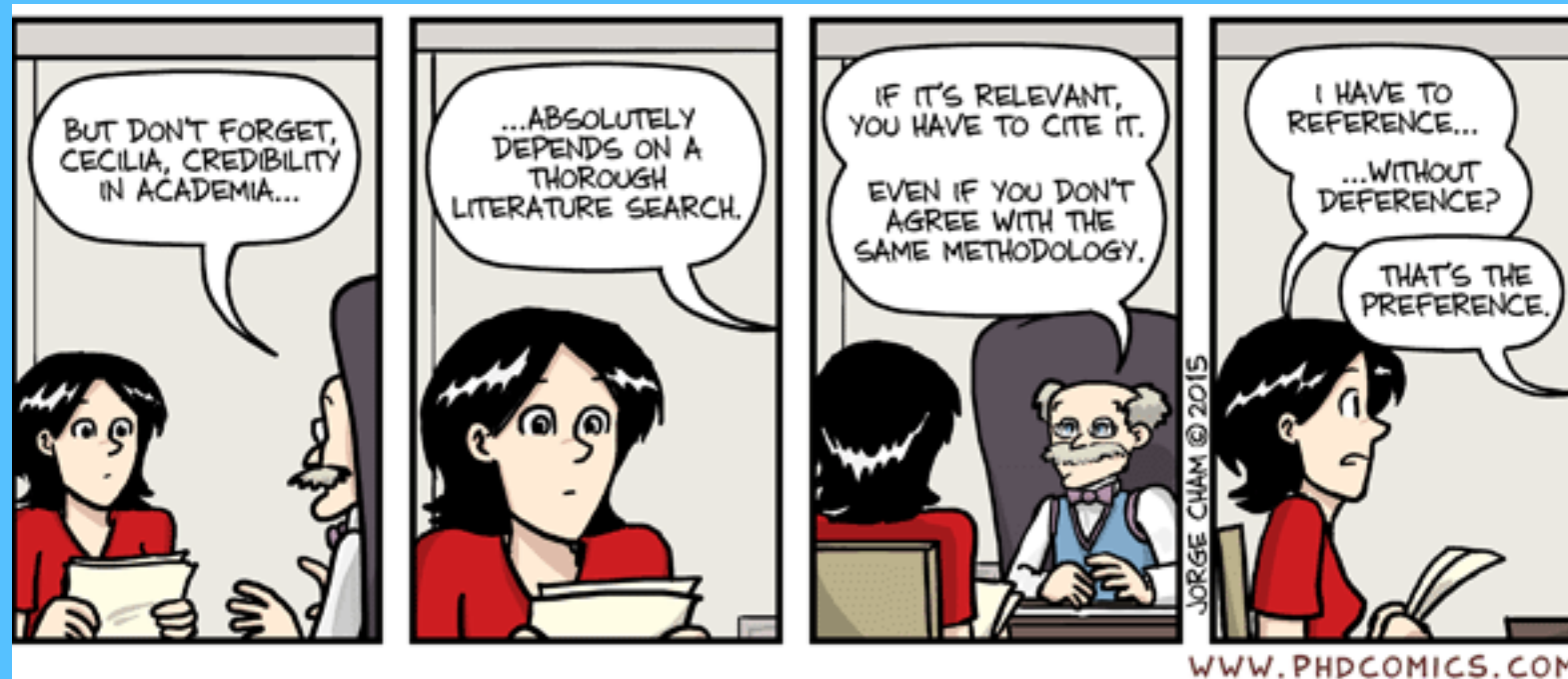
What should you be quoting? **Better more than less!**



“A few” is explicitly ambiguous .
Better replace it by
“Quite a few”

Part IV: Referencing

What should you be quoting? **Better more than less!**



“A few” is explicitly ambiguous .
Better replace it by
“Quite a few”
Actually, cite it all!

Part IV: Referencing

**Most of you have studied “classical” physics
on textbooks or reviews**

An example: A SUSY review

hep-ph/9709356
version 7, January 2016

A Supersymmetry Primer

STEPHEN P. MARTIN
Department of Physics, Northern Illinois University, DeKalb IL 60115

Part IV: Referencing

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An example: A SUSY review

A Supersymmetry primer

- [Stephen P. Martin](#) ([Northern Illinois U.](#) and [Fermilab](#))

Sep 17, 1997

153 pages

Published in: *Adv.Ser.Direct.High Energy Phys.* 21 (2010) 1-153, *Adv.Ser.Direct.High Energy Phys.* 18 (1998) 1-98

e-Print: [hep-ph/9709356](#) [hep-ph]

DOI: [10.1142/9789812839657_0001](#), [10.1142/9789814307505_0001](#)

Report number: FERMILAB-PUB-97-425-T

View in: [ADS Abstract Service](#)

Part IV: Referencing

**Most of you have studied “classical” physics
on textbooks or reviews**

You should quote first THE ORIGINALS:

- [8] S. Coleman and J. Mandula, Phys. Rev. **159** (1967) 1251;
- [9] P. Fayet, Phys. Lett. B **64**, 159 (1976).
- [10] P. Fayet, Phys. Lett. B **69**, 489 (1977), Phys. Lett. B **84**, 416 (1979).
- [11] G.R. Farrar and P. Fayet, Phys. Lett. B **76**, 575 (1978).
- [12] P. Ramond, Phys. Rev. D **3**, 2415 (1971); A. Neveu and J.H. Schwarz, Nucl. Phys. B **31**, 86 (1971); J.L. Gervais and B. Sakita, Nucl. Phys. B **34**, 632 (1971).
- [13] Yu. A. Gol’fand and E. P. Likhtman, JETP Lett. **13**, 323 (1971).
- [14] J. Wess and B. Zumino, Nucl. Phys. B **70** (1974) 39.

Part IV: Referencing

Most of you have studied “classical” physics
on textbooks or reviews

AND then the textbooks and reviews that you used.....

- [16] J. Wess and J. Bagger, *Supersymmetry and Supergravity*, (Princeton Univ. Press 1992).
- [17] P.P. Srivastava, *Supersymmetry and Superfields and Supergravity; an Introduction*, (Adam-Hilger, 1986).
- [18] P.C. West, *Introduction to Supersymmetry and Supergravity*, (World Scientific 1990).
- [19] R.N. Mohapatra, *Unification and Supersymmetry: The Frontiers of Quark-Lepton Physics*, Springer-Verlag, New York 1992.
- [20] D. Bailin and A. Love, *Supersymmetric Gauge Field Theory and String Theory*, (Institute of Physics Publishing, 1994).

Part IV: Referencing

If it is absolutely unavoidable to quote
a sentence from someone else,
you should quote it as:
“sentence from someone else”

Part IV: Referencing

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a sentence from someone else,
you should quote it as:
“sentence from someone else”

The same would happen if you were writing
a sentence from the Quijote...

A piece of scientific writing is, above all,
a particular form of literature
(remember Cormac McCarthy... and Newton)

Part IV: Referencing

Strongly suggested: BibTeX

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Strongly suggested: BibTeX

First: go to iNSPIRE <https://inspirehep.net/>

Part IV: Referencing

Strongly suggested: BibTeX

First: go to iNSPIRE <https://inspirehep.net/>

Second: once found the paper, copy the bibtex entry
into a file called **filename.bib**

Part IV: Referencing

A BibTeX entry from iNSPIRE

```
@article{tHooft:1972tcz,  
  author    = "t Hooft, Gerard and Veltman, M. J. G.",  
  title     = "{Regularization and Renormalization  
              of Gauge Fields}",  
  journal   = "Nucl. Phys.",  
  volume    = "B44",  
  year      = "1972",  
  pages     = "189-213",  
  doi       = "10.1016/0550-3213(72)90279-9",  
  SLACcitation = "%%CITATION = NUPHA,B44,189;%%"  
}
```

Drop it in Filename.bib

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**Add this line just before the end
of your latex document**

`\bibliography{Filename}`

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Compile with BibTeX

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}
```

Drop it in Filename.bib

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`\bibliography{Filename}`

Compile with BibTeX

This is the result:

[1] G. 't Hooft and M.J.G. Veltman, Nucl. Phys. B44 (1972) 189,

Acknowledgements

You should acknowledge **ANY** help or useful discussions with anyone you talked to (but, really, this is up to you),
AND, MOST IMPORTANTLY,
all the grants that payed you to travel, attend workshops or schools, or anything else....
(this is not up to you, as the IFIC funding depends on this)



Thank you!

Thank you!

And remember.....

