Version 1.6.3, July 2022

Guidelines for Theses

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Read the following document carefully. If you think that it is important to deviate from any of the guidelines below, think again. If you still think it is necessary, ask me whether I think so too.

1 Formal aspects

- Before you officially submit your thesis, run it by me.
- You may use the TTK logo for your thesis if you follow these instructions. You get the official logo from me.
- After you have submitted your thesis, send a tar-ball of the sources, as well as a PDF of your thesis to me.
- Your LaTeX file must compile with standard installations of `latex` or `pdflatex`. If you really feel the need to include non-standard style files, include them in the tar-ball with the LaTeX sources of your thesis.

2 Orthographical and grammatical comments

- Please remember that, with very few exceptions, every sentence needs a verb, a noun, and an object.
- Decide whether you use British or US spelling. Do not mix the two.
- Hyphenation in English is different from German, but follows some rather simple rules.[1] Some of the most important rules are:

[1] `https://en.oxforddictionaries.com/punctuation/hyphen`

  - Hyphens are rare. Examples: bottom quark, Standard Model, etc.
  - Compound adjectives almost always need a hyphen. Examples: heavy-flavor symmetry, well-known facts, etc.

- Relative clauses are not separated by a comma (most of the time). In other words: there is no comma before "that" or "which" in general. There are exceptions though, check yourself.

3 General remarks

- Write only things that you can defend/explain.
- Assume that you write the thesis for the second referee: he/she knows everything about QFT, the SM, etc., but little about what you actually did.
- Your own work should take the largest part of your thesis.
- Clearly state the sources that you have used for each part of your thesis.

4 Giudelines on specific parts

4.1 The introduction

- Do not explain/derive the Standard Model or any other concept which is part of the QFT I+II lecture course.
- Put your work into context:
  - Cite the relevant literature and describe in at least 1/2 sentence what it contains.
  - Why is your work relevant?
  - What in your work goes beyond what already exists?

4.2 The main part

- Only describe methods/techniques that you actually used and that are relevant for your work.

- Describe the methods that you used in such a way that it would have been useful to you one year ago.
- If a central part of your work is to produce software, describe it in some detail in the main text. If relevant, describe algorithms in schematic form. Avoid explicit code in the main text; if necessary, put it into an appendix. Provide me with a full version of your software.[2]
- If the new software is not the central part of your thesis, describe it briefly in the appendix.
- If you used existing software, briefly refer to it ("... was solved using Mathematica [1]"); if relevant, give an example for the command line or the parameter settings.

4.3 Equations

- Equations require a "=" sign:

$$a^2 + b^2 = c^2\,, \tag{1}$$

$$E = mc^2\,, \tag{2}$$

$$i\hbar\partial_t\psi(\vec{x},t) = -\frac{\hbar^2\nabla^2}{2m}\psi(\vec{x},t)\,. \tag{3}$$

- Be generous with equation numbers (i.e., use `equation` rather than `equation*`), but avoid numbering each equation in a single block of equations, unless it makes sense.
- Equations must be treated as part of a sentence, i.e. they include punctuation.
- Refer to equations in the text as "Eq. (1)", "Eqs. (1), (2)", and "Eqs. (1)–(3)".

4.4 The results

- With very few exceptions which should be discussed with me, the following rules apply to plots:
  - Plots should all be in the same style, if possible (axis label font, plot label font, line styles, etc.). Use as few different aspect ratios as possible, and recall that the golden ratio supposedly is the visually most pleasing one; also recall that 16:9 is *not* the golden ratio (except for the media industry).

[2] All software produced in the context of your work belongs to the university.

  - All plots should contain all the relevant information, i.e., they should be self-explanatory for an expert without reading the details in the figure caption.
  - Each plot should be included in the LaTeX sources as a separate PDF file, i.e. do not combine two or more plots into the same external PDF file. This also holds for Feynman diagrams (do not generate them on the fly). I recommend to use `FeynGame`[3] [2] for the latter (if you find bugs in this program, or miss any features, let me know).
  - If possible, the plots should be readable also in b/w format, i.e. use different line styles.
  - The thickness of the lines, tick marks, etc. should be visible also on an average-quality projector.

- Choose representative parameters for your numerics.
- Try to find significant observables.

4.5 Citations and reference list

References are important. Prepare them thoroughly to show the appropriate appreciation for other people's work.

- `inSpire`[4] is a useful tool to *draft* the list of references. But you *always* have to edit the list manually afterwards, making sure that the spelling of the title and authors agrees with what is actually on the paper (umlaute, accents, order of authors, etc.)
- Use exactly the format shown in the list of references [1,3–7] to these guidelines, i.e.:
  - Authors are given as initials (separated by a dot without blank), blank, last name.
  - If there are exactly two authors, separate their names by "and".
  - If there are $n > 2$ authors, separate the first $n - 1$ by commas, the last one by a comma and the word "and".
  - If there are $n > 3$ authors, you may replace all but the first one by "*et al.*" (including the italic font).
  - Full title in italics, separated from the author list by a comma.

[3] `https://web.physik.rwth-aachen.de/user/harlander/software/feyngame`.
[4] `http://inspirehep.net`

  - Journal name in italics (using standard abbreviations, e.g. *Phys. Rev.*), volume in bold face, e.g. *Phys. Rev. D* **74**. Note that the letter "D" is part of the journal title, not part of the volume.
  - Year of publication in brackets, separated by a blank.
  - Page or article number, separated by a blank.
  - Optionally: arXiv number and hyperlink (in PDF).
  - If the article is not published in a journal, provide a valid reference which clearly indicates where the article can be found (e.g., the `arXiv`[5] number).
  - You may also include references to "private communication", if applicable.
  - Also include references to programs (`Mathematica`, `FORM`, etc.) and provide the URL where they can be obtained, if applicable.
  - Do not include the DOI number, unless you have no other way of identifying the article.

- Sort the list according to the occurrence of the references in the main text (this can be achieved with `sortref`,[6] for example).

- Use `bibtex` only if you know what you are doing. *Never ever* bother me with technical questions about `bibtex` and related style files. Do not blame `bibtex` for deviations from the rules above.

- Citation in the main text:

  - Use the reference number and put it in square brackets. Example: "The Higgs boson was discovered in 2012 [8, 9]".
  - If the reference is part of the sentence, precede it by "Ref." or "Refs.". For example: "These terms can be found in Ref. [10]."

4.6 Acknowledgments

(Note the spelling; in BE, it is "acknowledgements".) Acknowledgments are neither a comedy contest, nor a place for insider enigmas. Be polite and objective. Ask me about the sources for your financial support.

[5] `http://arxiv.org`
[6] `https://web.physik.rwth-aachen.de/~harlander/software/sortref/sortref`

References

[1] Wolfram Research Inc., *Mathematica, Version 12*, `https://www.wolfram.com/mathematica`

[2] R. Harlander, S. Klein, and M. Lipp, *FeynGame*, *Comp. Phys. Commun.* **256** (2020) 107465, `arXiv:2003.00896 [physics.ed-ph]`.

[3] R.V. Harlander, H. Mantler, and M. Wiesemann, *Transverse momentum resummation for Higgs production via gluon fusion in the MSSM*, *JHEP* **11** (2014) 116, `arXiv:1409.0531 [hep-ph]`.

[4] R.V. Harlander, P. Kant, L. Mihaila, and M. Steinhauser, *Higgs boson mass in supersymmetry to three loops*, *Phys. Rev. Lett.* **100** (2008) 191602, `arXiv:0803.0672 [hep-ph]`.

[5] G. Aad et al., *Measurements of the Total and Differential Higgs Boson Production Cross Sections Combining the $H \to \gamma\gamma$ and $H \to ZZ \to 4\nu$ Decay Channels at $\sqrt{s}$ =8 TeV with the ATLAS Detector*, *Phys. Rev. Lett.* **115** (2015) 091801, `arXiv:1504.05833 [hep-ex]`.

[6] V. Ahrens, T. Becher, M. Neubert, and L.L. Yang, *Renormalization-Group Improved Prediction for Higgs Production at Hadron Colliders*, *Eur. Phys. J. C* **62** (2009) 333, `arXiv:0809.4283 [hep-ph]`.

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[9] S. Chatrchyan et al., *Observation of a New Boson at a Mass of 125 GeV with the CMS Experiment at the LHC*, *Phys. Lett. B* **716** (2012) 30, `arXiv:1207.7235 [hep-ex]`.

[10] R.V. Harlander and T. Neumann, *Probing the nature of the Higgs-gluon coupling*, *Phys. Rev. D* **88** (2013) 074015, `arXiv:1308.2225 [hep-ph]`.