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Good scientific practice for scientific theses in physics

Recommendations at the Conference of the Department of Physics

www.kfp-physik.de

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Preliminary Remarks

For some years now, the discussion concerning scientific and ethical research standards applicable for scientific theses increased not only within science itself but also in general public.

The Conference of the Department of Physics (CDP) welcomes this discussion. Certainly, different from what is suggested by the majority of obvious scientific misconduct, the question for such standards is much more complex. Though resting on universal principles, they may differ between departments and, over time, are subject to change.

For an adequate assessment of those infractions, a confident handling of the rules of Good Scientific Practice (GSP), in accordance to the technical specifications of the respective department at the time the thesis is written is vital. Subject-specific aspects in physics are the result of teamwork, the basis for interdisciplinary cooperation, and the common practice of project-related, near-term publishing.

The CDP attaches importance to the documentation of valid standards for GSP. The herewith presented document, focussed on interests of physics, rests on the corporate policy paper of the following three parties: (1) General Faculty Day (Allgemeiner Fakultätentag), (2) Faculty Days (Fakultätentage), (3) German University Association (Deutscher Hochschulverband). Suggestions by the German Research Association (Deutsche Forschungsgesellschaft, DFG) and the Rector's Conference (Hochschulrektorenkonferenz) were also recognised.

This document deals with the in general accepted standards for the elaboration and writing of scientific theses in the field of physics. In some cases, yet, they do not comply with the striven standards. Furthermore, the exact wording of those standards is still debatable.

It is essential to provide the earliest possible, corresponding academic education regarding the awareness of these problems. Therefore, the CDP's suggestions are not only related to bachelor and master theses, but to dissertations and habilitation treatises, as well as to traineeship protocols. Widely differing in their scientific demand, the shared factor has to be GSP. Scientific publications as well as specific project implementations might require an exceptional set of rules. Discussion seems in place for evaluation and clarification of deliberately vague worded rules.

Scientific theses are always subject to the respective examination regulations. Those might be more detailed or even contradictory. As an example, research results are forbidden being published before the thesis' submission. Furthermore, third-party donors can suggest own guidelines. It is recommended to pass the potentially adjusted guidelines to all personal involved in the qualification process for the purpose of sustainable proof of GSP at the respective time.

References:

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1. *Gute wissenschaftliche Praxis für das Verfassen wissenschaftlicher Qualifikationsarbeiten,* Gemeinsames Positionspapier des Allgemeinen Fakultätentags (AFT), der Fakultätentage und des Deutschen Hochschulverbands (DHV) vom 9. Juli 2012. (www.hochschulverband.de/cms1/uploads/media/Gute_wiss._Praxis_Fakultaetentage_01.pdf)
2. *Sicherung guter wissenschaftlicher Praxis,* Deutsche Forschungsgemeinschaft, Wiley-VCH, Weinheim, 2013. (www.dfg.de/download/pdf/dfg_im_profil/reden_stellungnahmen/download/empfehlung_wiss_praxis_1310.pdf)
3. *Gute wissenschaftliche Praxis an deutschen Hochschulen,* Empfehlung der 14. Mitgliederversammlung der Hochschulrektorenkonferenz am 14. Mai 2013. (www.hrk.de/uploads/tx_szconvention/Empfehlung_GutewissenschaftlichePraxis_14052013_02.pdf)

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Good scientific practice for scientific theses in physics

The above mentioned criteria for the GSP are associated with two major aspects of scientific work: (1) the production and (2) presentation of new data. Beginning with the first semester, a provisioning of an early, corresponding academic education regarding the necessity of a good everyday GSP is one of the main objectives. Responsibility for the compliance of the rules of GSP lies with the authors themselves, while being supervised by their respective counsellors.

1. Production of scientific results

The prerequisite for any scientific qualification's acquisition is the proof of the ability for scientific work. Usually in physics, this is accomplished by participating in a research project or by independent scientific work after dissertation.

1.1. Handling of data

Before we are able to ask for certain standards concerning the presentation of data we have to answer the question of how to conduct scientific research projects in a standardised manner, first.

Physical results are promised on experimentally or numerically collected data. Therefore, GSP already begins with the experiment's design or the respective numerical calculation. Scientific research depends on a transparent documentation of the work process, including all methods and all results. The disposition to constantly challenge one's own work is essential. Neither unfavourable results nor the own working hypotheses challenging scientific arguments are allowed being excluded.

Deliberately falsifying data is inadmissible – in any case. This includes manipulating data with intend to defraud, using them out of context to fit into the desired result. At worst, data are manufactured or supressed. This must not to be confused with the common processing of data, meaning (1) editing, (2) evaluation / analysing and (3) interpretation to deduce physical statements from primary data obtained by an experimental or numerical approach. Different prioritisation or complete elimination of data sets is exclusively permitted by pure scientific considerations and has to be traceably documented.

1.2. Documentation

It is recommended to discuss and clarify the mode of presentation and a sustainable archiving system for the collected data with all parties, right at the beginning of a thesis.

Primary data as well as material and methods which were use, have to be documented and archived in a very detailed and transparent way so that it is possible to reproduce every single aspect of the respective work. A generalized set of rules for all fields of physics may be hard to create and establish with regard to in parts enormous data sets and different rules valid for big cooperations.

1.3. Teamwork

Relatively frequent, research projects require large research teams, depending on the field of physics. Theses have to be written autonomously but, at the same time, can be part of these large research projects. In this context, transparent and detailed documentation is essential.

1.4. Supervision

Except for habilitation treatises, physical theses are realised under qualified supervision of a single person or team. During bachelor or master theses, for example, supervision serves the purpose of evaluating the scientific content and the student's capabilities. In the course of the dissertation phase, supervision changes into mentoring.

In Germany it is common practice that the supervisor / advisor of a thesis also serves as an examiner for the respective work. Is the supervisor also advisor, superior and later assessor and examiner that constellation could be seen as problematic. Therefore, it is advisable to call a reference person or a committee being able to mediate in case of conflict. Those respective institutions have not been structurally anchored everywhere, yet.

1.5. External influences

Occasionally, physical research theses are realised in partnership with companies having an economically motivated interest in the results. Frequently, those results and even the respective projects are subject to certain confidentiality agreements. To avoid major legal problems concerning the theses' assessment, the supervisor in question must be allowed to be fully briefed on the work's main concept as well as on every progress. In the end, the supervising person must be able to evaluate the respective theses to their full depth.

2. Presentation of scientific results[2]

It is common practice in physics to first publish research results in specialised, scientific journals. Scientific theses contain an augmented representation of results being published somewhere else in advance. Publishing in scientific journals is based on an own set of rules.

In some special cases, in particular the habilitation treatise, it is possible to forgo writing separate scientific theses, if the results are already published in scientific journals (cumulative theses). But usually, the results have to be concise in research theses, even if being already published.

Besides the actual presented abilities shown in the course of producing the data, the quality of those data's presentation is a substantial evaluation criterion regarding the academic awarding. The theses have to comply with GSP which can differ between different disciplines, wherefore the following implementations are only applicable for physics.

[2] Compare resolution concerning economical dissertations of Deutschen Hochschulverbands, January 1st 2016, www.hochschulverband.de/cms1/fileadmin/redaktion/download/pdf/resolutionen/Industriepromotion.pdf

2.1. Autonomy

Scientific theses have to be an autonomous intellectual performance by the author excluding the possibility of the theses or parts being written by someone else, even with their consent (ghostwriting).

It is also common practice to present theses for constructive criticism before the final submission. Content-related aspects could be interpretation and discussion of the results and the technical as well as the argumentative structure. Comments for theses during the course of study aim at the basic scientific abilities, whereas for dissertations they should be expressed as loyal feedback.

Research results from projects which were processed by a large number of scientists due to the structure of the respective project are usually discussed by all persons involved before being put on paper. Consequently, a clear line to separate the different contributions is hard to draw and therefore also the threshold above which a work will not be accepted as autonomous work by the author. For such theses it is imperative to unambiguously document the own input.

Simultaneously, a theses' author is allowed to participate in another theses' mentoring. Subject to the condition of a significant contribution it is allowed to use in this manner obtained data, if marked and quoted correctly.

2.2. Embedment in the scientific context

It has to be marked very precisely which part of the body of thought is owned by the author, which parts are based on thoughts and experiences of others and which parts are common knowledge. Literal sections taken from third persons as well as their concepts, results and thoughts have to be quoted following the routine practice of scientific quotation which applies to all sections of scientific theses.

It lies within the realms of possibility to conduct certain experiments and calculations and publishing the results without the knowledge that others already have done the exact same thing. If possible, this situation has to be avoided by a preceding, extensive enquiry of the project's scientific setting.

To embed own results in the scientific context physical theses include paragraphs presenting broad discipline-specific knowledge as well as commonly used formulas and established experimental or theoretical techniques. In this case, no references are needed as long as no striking examples or literal paragraphs created by others are used. The question of what is and is not discipline-specific common knowledge goes by the alleged knowledge of discipline-intern scientists.

2.3. Individual work and texts

It is not uncommen to publish main contents in scientific journals or elsewhere before the actual thesis is written. In that case a clear referral and the reference of the primary publication are needed in the thesis. Simultaneously, it is not necessary to refer to that reference every time the information is used. For publications including a number of scientists this is only valid for information in which the author has significant share. Concerning the usage of illustrations from the author's own work the primary publication has to be quoted in the illustration's capture, but

only if in agreement with the copyright terms of the primary publication.

2.4. External influences

An adequate presentation includes a complete disclosure of all external factors which, for objective third parties, could nurse doubts concerning the scientific judgment's independency. Therefore, it is imperative to indicate every supporting and / or funding company and other stakeholders.

For theses being written in cooperation with companies it is required to disclose all relevant data to such an extent that the referee is able to arrive at an independent and exhaustive judgment of the work's quality. The obligation of a publicly accessible dissertation also has to be taken into account. Respective arrangements have to be made in advance. Potentially, the university's legal department has to be called in.

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These present suggestions were approved after detailed discussion on May 18th, 2016 by the plenary assembly at the Conference of the Department of Physics (CDP). It presents the topic as matters stand and will be updated, if necessary.

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