Good scientific practice
for scientific qualification reports and theses
in physics

Recommendations of the Konferenz der Fachbereiche Physik

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Motivation and summary

It is the genuine responsibility of the faculties or departments to establish the framework conditions for academic qualification reports and theses. However, this almost always takes place in a university-wide context, which in turn is subject to external influences such as increased sensitivity to academic integrity or the discussion about AI tools such as generative large language models (LLM).

With the presented recommendation, the Conference of Physics Departments (KFP) aims to compile physics-specific aspects of good scientific practice. On the one hand, this should help departments deal with suspected cases of scientific misconduct and, on the other hand, provide them with arguments when concepts and standards from other subjects are transferred to physics even though they are not appropriate to the culture of physics (such as the concept of "self-plagiarism"). There is also a risk that the current discussion on how to deal with 'artificial intelligence' in the broader sense will lead to regulations that do more harm than good. In this regard, too, the KFP's recommendation is intended to strengthen the position of the departments.

Above all, however, this recommendation is intended to assist young scientists, supervisors and reviewers in their everyday work and serve as a guideline. In doing so, they are continuing the KFP's 2016 recommendation in light of recent developments.

In general, practising good scientific practice is an important learning objective during undergraduate and doctoral studies. Subject-specific aspects must be taken into account here. Characteristics of physics include (i) frequent work in teams with intensive interaction and supervision, (ii) early involvement in research, which, at least in the case of doctoral studies, regularly leads to publications before the completion of the qualification report or thesis, and (iii) a weaker link between the scientific content of a report or a thesis and the form of its presentation compared to other disciplines, especially the humanities – although, of course, results in physics must also be presented carefully and in an appropriate external form.

In addition to compliance with general rules of physical research, the concepts of 'transparency' and 'traceability' run through the presented KFP recommendation as specific requirements. This begins with the open-ended design of the research, includes the handling of experimentally or numerically determined data and its documentation, and also concerns the transparent presentation of one's own contributions to publications with multiple authors.

'Transparency' and 'traceability' are also the central requirements when dealing with AI-supported tools and in the design of industrial doctoral projects and other qualification projects in which third parties pursue their own interests.

The responsibility of the students to adhere to good scientific practice is matched by a corresponding responsibility on the part of their direct supervisors, but also on the part of the respective department. The latter must ensure that contact persons are available in cases of

conflict and tension and that the qualification work is assessed fairly and as objectively as possible.

Since it is common practice in physics, as in other natural sciences, to first publish scientific results as a team of several authors in scientific journals, qualification reports and theses often do not contain the first publication of the scientific results, but rather an expanded presentation of results already published elsewhere. For this reason, in addition to the classic monograph, cumulative “Habilitation”-theses and doctoral dissertations are becoming increasingly popular, although they pose their own challenges in terms of transparency and accountability.

Ignorance of these circumstances occasionally leads to accusations of 'self-plagiarism'; however, it is only natural that the description of one's own results in a qualification thesis is similar or identical to that in an underlying publication. However, it goes without saying that the description of one's own independent contribution to the scientific achievement must correspond to the facts. But it is just as obvious that discussions with and advice from supervisors are incorporated into a qualification report or thesis.

The influence of AI will have a particularly strong impact on those parts of qualification reports that are intended to describe the embedding in the scientific context. Even today, corresponding text passages can be generated automatically with little effort and high quality. When dealing with such rapid developments, a reference to the general principles of good scientific practice is certainly more helpful than detailed regulations that quickly become outdated.

Preliminary remark

As science and society are constantly evolving, the discussion about which scientific and science ethical standards qualification reports and theses at universities must meet cannot come to an end. Such questions are not only discussed within the scientific community, but also repeatedly, and unfortunately often in a rather unqualified manner, in the media and among the general public. Recently, artificial intelligence (AI) and, in particular, large language models (LLMs) have added impressive and rapidly evolving tools for creating texts and images, but also, for example, computer code and statistical analyses; these tools can also be misused, but in any case, suggest a change in working style. It may therefore be necessary to fundamentally rethink the concept of publications in general and reports and theses in particular in the future.

The Konferenz der Fachbereiche Physik (KFP) welcomes and follows this discussion. However, the discourse on scientific and science-ethical standards is more complex than most of the examples of obvious scientific malpractice suggest. Standards of good practice are based on general principles. They can, however, be accentuated differently from subject to subject and, in the course of time, also be altered.

An adequate assessment of breaches of conduct with regard to good scientific practice within the framework of reports and theses requires that the rules practiced at the time at which the report or thesis was authored within the particular subject in question are known. Subject-related issues may arise in physics, for example from the common and desirable collaboration in teams or the usual practice of rapidly publishing research results in order to participate in the scientific discourse.

The KFP thus regards it as important to record the current standards expected for a scientific report or thesis and to adapt previous recommendations where necessary. The present paper expands and modifies the corresponding recommendation of the KFP from 2016 [KFP2016] and takes into account general recommendations such as [DFG], [AFT12], [HRK22] and [WR23]. In particular, the rapidly changing publishing landscape and the advance of AI in everyday research make a revision of the KFP's recommendation appear expedient.

The recommendations to be found here apply to bachelor, master and doctoral theses, and are also applicable to “Habilitation”-theses. They are also appropriate for reports that have to be made during the undergraduate course of study, such as reports on practicals, in order that students obtain the correct orientation at the earliest possible point within their studies and develop a critical view of possible problems. The academic requirements to be fulfilled for each of these types of reports differ considerably. From the point of view of good scientific practice, however, they should in principle all be handled in the same fashion. Note that other criteria may exist for the publication in scientific journals and for the execution of other scientific projects, and that these may have a direct impact on cumulative qualification theses, for example. In this context, it is also worth mentioning the increasing number of publications with several, sometimes even numerous 'first authors', as well as the specification of the

contributions of individual authors required by many journals, for example within the framework of the CRediT taxonomy.

Qualifying reports and theses are always subject to the regulations of the applicable ordinances of each university, and these can be more detailed or, in some aspects, even in contradiction to the guidelines listed here. An example is the prohibition on publishing research results before submitting the qualification thesis, which is absolutely unusual in physics. Furthermore, regulations laid down by third parties that provide funding, by international collaboration agreements, industry partners or publishers may also be relevant for the publication of research results.

The KFP recommends making this document available to persons involved in preparing qualifying reports and theses, where applicable with references to local conditions. In this fashion, it should enable one to determine even after considerable time what exactly had constituted the rules of scientific practice at the time of submission of the qualifying report or thesis. At the same time, it appears sensible to discuss in which manner some rules, which purposely have been kept vague, can be made more precise. For scientific qualifying reports or theses, at present there is still – as already noted in 2016 – no general consensus on, for example, how long, by whom, and in which form experimental or numerical data as well as the associated software should be kept or even be made accessible. In general, however, the requirements for storage and accessibility are currently increasing, not least as a result of the visions of FAIR data and open science.

The most important goal of these recommendations is to provide an orientation for all those involved with the production and evaluation of scientific qualifying reports and theses in physics. However, it should also help committees responsible for study and doctoral regulations to draft them in such a way that subject-specific practice can be implemented and defended against inappropriate external demands. Moreover, this paper should provide a contribution to the debate on the further development of scientific and science-ethical standards.

For the sake of readability, the German version of this document often uses the generic masculine form for personal and functional designations. It goes without saying that this always refers to persons of any gender identity in the same way.

Recommendation for good scientific practice for scientific qualifying reports and theses in physics

The criteria listed here for good scientific practice in conjunction with qualifying reports and theses draw on two aspects of scientific work, the process of obtaining new physical insights as well as the communication and representation of the results. Unlike in philosophy, for example, where a new idea or insight is closely interwoven with its linguistic representation, and the process of gaining knowledge can therefore often hardly be separated from its linguistic formulation, in physics the processes of gaining new insights and preparing them for publication can usually be distinguished from each other relatively clearly. The most important qualification goal in physics is the ability to gain new insights; nevertheless, care must also be taken in presenting these insights, and high standards must be set for the external form of a qualification thesis. The ability to appropriately present and communicate the results to the professional community must also be demonstrated in the qualification thesis. This is the purpose of traditional doctoral dissertations and "Habilitation"-theses in the form of monographs, as well as student reports and theses. Even though the presentation of one's own results has lost importance due to the approval of cumulative theses and the waiver of "Habilitation"-theses in the context of, for example, junior professorships, qualification reports and theses will continue to play an important role for the foreseeable future. This is particularly true for large-scale projects, such as those in particle physics, where doctoral students often have to wait a very long time for the results to be published. In such cases, the dissertation is often the only way to present one's own work.

Utilizing the rules of good scientific practice is an important goal of learning within undergraduate and graduate studies, in particular in bachelor and master theses, but also already relevant at an earlier stage, for example, during the undergraduate practical experiments. The authors of reports and theses themselves are responsible for upholding the rules and regulations of good scientific practice. They are guided by their supervisors, who advise in such a way as to see that the rules of good scientific practice are upheld.

1. General

Science thrives on transparency, traceability and reproducibility. At the level of qualification reports and theses, the precise formulation of research questions, appropriate methodology, embedding in the context provided by the state of the art, and reference to relevant literature contribute significantly to this. Today, online resources and AI tools have made these tasks easier, to the point where they seem like a trivial challenge. University lecturers and supervisors must therefore gain and develop experience and criteria for distinguishing between good presentation and true understanding.

As the German word for science – "Wissen-schafft" – suggests, science usually requires the creation ("Schaffen") of knowledge ("Wissen") and thus the publication of results. However, bachelor's or master's theses are primarily examination achievements and, as such, are not

initially public. However, as they are proof of the ability to carry out (guided) scientific work, the standards of good scientific practice must also be applied to them.

2. Obtaining scientific results

As a prerequisite for obtaining a scientific qualification, the candidate must provide proof of his/her capability to perform appropriate scientific research at the respective level. In physics this is usually provided through work done in collaboration within a research project, or, at the latest during doctoral studies, through independently carrying out a research project.

Thus, before addressing the standards required for the *presentation* of scientific results, the question of standards that should be adhered with regard to the actual *process of performing research* must be addressed in physics.

2.1. Dealing with data

Physical insights are often gained through experimental or numerical data. The process in which this data is obtained and the way the data are handled is thus of central importance. Good scientific practice already starts with the design of an experiment or a numerical evaluation. These must be designed such as not a priori to exclude or suppress “unwanted” results.

Scientific research includes providing an understandable description of the methods used and the results obtained so that these can be reproduced. Scientific research must include a readiness to call the results into question. Facts and arguments that shed doubt on a working hypothesis may not be ignored.

In any case, it is inadmissible to falsify data, i.e. to manipulate data or fraudulently place data in another context in order to render these compatible to a desired result. It is regarded as particularly grossly fraudulent to invent or to suppress relevant data.

The process of preparation, analysis and interpretation of data, in order to deduce physical results from primary data generated experimentally or numerically must be clearly laid out. Here, different techniques such as filtering and smoothing can be used, the use of which must be presented in terms of transparency and traceability. If data points or sets of data are weighted differently or in fact completely disregarded, this must be scientifically justifiable and must be documented accordingly.

2.2. Documentation

Scientifically generated primary data, together with the processes associated with them for further evaluation (including e.g. parameters of the experiment or the computer programs used) must be documented and archived, so that a reconstruction of the scientific results presented in the qualification report or thesis is possible. In which form this should occur, is at present not clearly regulated, and can probably not be done generally for all fields within physics: aspects that may play a role here include the sometimes extremely large volume of data that may be generated in specific experiments or the regulations laid down within large

collaborations. At the beginning of a project, the persons involved (authors, supervisors, institution) should agree on the practices for documentation and long-term archiving.

Expectations and requirements for the description, storage and publication of scientific data have risen sharply in recent years. This has been driven not least by political guidelines and generous funding, for example from the initiative to create a National Research Data Infrastructure (NFDI), as well as widespread political and public support for the so-called 'FAIR principles' (acronym: findable, accessible, interoperable, reusable), which go well beyond the principles of reproducibility and transparency. As part of their qualification work, young scientists should familiarise themselves with the FAIR principles and, where appropriate, implement them, especially since universities, publication bodies and third-party funding providers often set explicit requirements for data documentation. Fortunately, as requirements increase, so too do the archiving options available and, as a result, presumably also access to third-party data.

2.3. Working together in a team

Physics research projects are often performed within teams, and in some fields of physics even very large research teams are unavoidable and appropriate. Thus, within the framework of a physics qualification report or thesis, often the capacity for teamwork is an important characteristic. At the same time, such a qualification report or thesis has to be presented as the author’s own work. This can lead to rather difficult circumstances.

In complex projects such as doctoral theses, it is often difficult to separate out the individual contributions from each of the persons involved. For this reason, it is strongly recommended that the contributions towards the progress made on the project be documented at regular intervals. This is the responsibility of all persons involved.

At the latest in the qualification thesis itself, the contribution of the author must be clearly distinguished as far as possible. The direct supervisors of a thesis are best placed (sometimes they are the only ones who are able) to assess whether the corresponding presentation corresponds to the facts, is not exaggerated and does not contradict the presentations of the contributions of other persons involved in the research in their qualification theses. This fact is in a certain tension with the sometimes required separation of supervision and assessment.

2.4. Supervision aspects

With the exception of „Habilitation“-theses, physics qualification reports and theses are usually performed under the supervision of an advisor or an advisory team. For reports and theses that are performed at the undergraduate or master level, it is the responsibility of the supervisor to convey knowledge and aid the student in developing the necessary capabilities but also to assure the quality standards. At the latest, at the doctoral level, the role of the supervisor shifts to being more of that of a mentor, who acts as a knowledgeable discussion partner, and who can point out problems and possible perspectives.

In Germany it is common practice that the supervisor of a report or thesis also acts as an examiner for the same, and provides an evaluation thereof. The research questions of the

qualification report or thesis are often part of a larger research project of the supervisors. In most cases, this occurs without friction, but not always. Therefore, quality assurance and the duty of care of the departments must be taken into account, especially when designing the doctoral programme.

With regard to quality standards, the Wissenschaftsrat [WR23] demands: "*If the primary supervisor prepares an assessment, the independence of the assessment must be guaranteed by a second assessment, which is written without knowledge of the first assessment. Joint publications by the second assessor and the doctoral candidate are to be excluded. Obtaining an external review is particularly desirable if the highest grade is proposed*." The KFP concurs with this assessment.

A minimum requirement regarding the department's duty of care for students, doctoral candidates, postdoctoral researchers and all early career researchers is that these individuals know to whom or to which body they can turn for advice, mediation or redress in the event of a conflict or even in advance in the event of tensions or perceived stress. Various solutions are possible and common in this regard: from ombudspersons to regular discussions in a Thesis|PhD Advisory Committee or mentors with a certain professional distance. Usually, these decisions are not made by physics departments, but by university committees or, in practice, by third-party funding bodies such as the DFG or BMBF.

2.5. AI tools

The role of AI tools and similar resources for presenting results is discussed in detail below. For the actual acquisition of scientific results, any form of use of such resources is legitimate and sensible: Young scientists should, for example, use the best, possibly AI-supported tools when searching for literature, automatically generate simple computer code or use computer algebra systems to support analytical integrations. However, the ultimate responsibility for the correctness and relevance of the results naturally remains with the individual scientist. This responsibility increases even further as AI tools are capable of producing texts that are incorrect but appear very convincing without intensive review. In terms of transparency, traceability and reproducibility, the approach, apart from the literature search, should be presented in a comprehensible manner, just as the measuring instruments used are usually listed explicitly. A special feature of many AI tools is that they can deliver unpredictable and not clearly reproducible results, which further reinforces the demand for transparency in knowledge acquisition.

2.6. External influences

Qualification reports and theses in physics are sometimes performed together with companies that may have a commercial interest in the results of a research project. Often the results generated – sometimes the project itself – underlie specific confidentiality or non-disclosure agreements, for which the legal status may be complex (see also [DHV16], [HRK17]).

With a view to performing scientific qualification reports or theses, it should at least be guaranteed that the supervisor at the university is comprehensively informed about the

concept that is to be followed and is constantly informed about the progress of the project and in such detail that he/she can make a well-substantiated evaluation of the contribution made by the undergraduate, master or doctoral student. Other reviewers must also be able to assess the academic achievement underlying the thesis. Projects in which the legitimate interests of non-university partners do not allow this are unsuitable for qualification reports or theses.

3. Presentation of scientific results

For each qualification level, the presentation of scientific results is important, but secondary to and subordinate to the process of gaining knowledge.

The presentation of the results of bachelor's and master's theses is regulated in examination regulations and is generally unproblematic. Knowledge of and compliance with these regulations is usually ensured within the framework of typically close supervision.

In contrast, the presentation of scientific results in dissertations and postdoctoral theses is more complex. In the natural sciences, and especially in physics, it is customary to publish scientific results first in peer-reviewed journals. Scientific qualification reports or theses are therefore often not the place in which the results are published for the first time, but which provide an extended presentation of these published results.

In addition to the traditional monograph, cumulative “Habilitation”- and doctoral theses, as well as hybrid forms, are becoming increasingly popular [VW]. Both forms are expected to coexist for the foreseeable future. Proponents of monographs emphasise the necessary overall view of the topic and the easier attribution of results, while proponents of cumulative qualification theses point out that also there, articles must be placed in the overall scientific context and that supplementary appendices can be added; also one's own contribution to the publications must generally be presented in detail.

In any case, not only the skill in obtaining results and the author’s general physics knowledge should come across; also the quality of the presentation of the results in such a thesis forms an essential criterion for the evaluation and decision to award the corresponding academic degree. A qualification report or thesis must conform to the standards of good scientific practice, which in different fields may differ somewhat. The following remarks thus pertain primarily to the fields of physics

3.1. Independence

A scientific qualification report or thesis must be an independently created intellectual accomplishment of the author. This precludes that the report or thesis is written, even in part, by a third party and is claimed as the work of the author, even if the third party agrees to this (ghostwriting).

At the same time, in physics it is part of the scientific discourse that parts of the qualification report or thesis are presented in advance to another person, e.g. to the supervisor, for critical

commentary. Such commentary can (and often will) also refer to the interpretation of the scientific results themselves, the organization of the subject matter, or the chain of arguments within the report or thesis. For doctoral theses, the commentary should rather have the character of a collegial feedback. For reports and theses within undergraduate or master studies, it is also a duty of the supervisor to aid the student in developing the competences necessary for writing such a report or thesis. Within the development of the study program, this aspect should play a lesser role.

In particular, in cases in which qualification reports and theses are based on projects involving many people and which may have led to joint publications in scientific peer-reviewed journals, one may assume that the interpretation of the scientific results and the question of their adequate representation was duly discussed by all members of the project prior to publication in a qualification report or thesis. It is therefore difficult to define an abstract line beyond which such a document no longer can be seen as the result of independent research of the submitting author. Thus, for research performed within the framework of collaborations, it should explicitly be made clear what the individual contribution of the author is. This is not a matter of quantitative allocations, but rather of descriptions within the framework of, for example, a Contributor Roles Taxonomy [CRediT] with defined roles that are typically assumed by contributors to research results. Additional security for doctoral candidates can be created if the doctoral committee confirms that the presentation of the individual's own contribution is sufficient before the thesis is submitted or during the review process.

When assessing a thesis from the perspective of a potentially inadmissible appropriation of third-party intellectual property, derivations and equations represent a special case, as the formulation and presentation of equations naturally offer little leeway. Therefore, the use of already known equations in the qualification thesis does not constitute inadmissibility, provided that these can be attributed to general specialist knowledge or the source is transparently cited and already published derivations are appropriately marked.

It may occur that the author of a qualifying report or thesis concurrently participates in the supervision of another person’s qualifying report or thesis for example when doctoral students supervise bachelor- or master-candidates. The results obtained thereby can be used by the author, if he/she provided a substantial contribution to obtaining these. In this case, it is important to reference the other qualification report or thesis and to clarify the contribution of the other person involved.

3.2. Embedding in the scientific context

In a qualification report or thesis it must be clearly recognizable what the original contribution of the author is, and where he/she draws on thoughts and results of others or refers to specialist’s general knowledge. If portions written by other authors are included, either literally or paraphrased, or where ideas, concepts or results of others are utilized, these must be declared and referenced. This holds for the entire qualification report or thesis, including introductory sections.

It can happen that someone performs scientific research and obtains specific results, and then publishes these, not realizing that others have already done so. The author of a qualification report or thesis, but also the supervisor, has, however, to have informed him/herself adequately about the scientific environment surrounding the project, and should do sufficient research to avoid such cases, as far as is possible.

In order to embed the research performed into its scientific context, scientific qualification reports or theses often contain parts in which specialist's general knowledge including descriptions entailing formulae or established experimental or theoretical techniques are presented. Usually in this case no special sources must be quoted, unless the author refers to some particularly original presentation or if specific passages are taken verbatim. What is considered as general knowledge of specialists would be the putative knowledge of scientists working in the field of the qualification report or thesis.

3.3. Own reports and texts

It is not uncommon that authors of physics qualification reports or theses have already published the results of their research in peer-reviewed journals or elsewhere; sometimes this is even required. Co-authors are also regularly involved in this process. If results have been published in advance, authors must provide references to the first instance of publication.

Having done so, it is then usually not necessary to refer to this first instance of publication every time a statement or result is taken from it. Text passages, formulations, illustrations or equations from your own previously published work may be reproduced, provided that this use is transparent and your own contribution is clearly indicated. Under certain circumstances, it may be sufficient to mention the use of your own publications at the beginning of the respective chapters or at the relevant passages in the text, indicating which passages and illustrations have been taken more or less directly, and to specify your own contribution. For publications with several authors, however, this is only applicable to results or passages for which the author has made a substantial contribution which is clearly identified.

The use of illustrations from one's own publications is reasonable and permissible, provided that reference is made to the original publication in the caption. Furthermore, the copyright regulations of the original publication must be checked and complied with. A fundamental distinction must be made between copyright, rights of use and good scientific practice. For example, plagiarism is fundamentally a violation of scientific integrity and may, in addition, also constitute a violation of copyright and rights of use. These aspects will not be discussed further here, as they are rarely controversial in practice and questions can be clarified by the legal departments of the universities.

When assessing how to deal with one's own publications, it is always necessary to consider the overall context of the thesis and the effect on an expert reader. In particular, the concept of 'self-plagiarism' as such is not helpful in physics, where knowledge acquisition takes precedence over presentation and advance publications and teamwork are the rule rather than the exception: Anyone who has formulated a circumstance in the best possible way in a

publication will rightly want to use this formulation again. On the other hand, the literal or only slightly modified use of text passages that are taken from one's own publications but that one has not written oneself is not permitted without quotation marks or corresponding references.

Most doctoral theses in physics are currently written in monographic form but are clearly based on previous publications with several co-authors. In such publications, it is often not possible to distinguish meaningfully which passages or which achievements and results can be attributed to which author. Therefore, joint publications are often assumed to be a team effort in which all participants played a significant role.

3.4. AI tools and handling of sources

In view of the dramatic developments in the field of AI, especially generative models for text and image creation, a description of good scientific practice can only be a snapshot and merely have guidance purposes (see, for example, [FAQ24]). It is quite possible that, under the influence of AI, the general and introductory passages of qualification reports and theses in particular will change rapidly. A good introduction can be a great help in getting started with reading, as well as in understanding and classifying the results presented below. However, since AI tools can already provide a quick overview of a field of research and substantiate it with sources, "demonstrating broad knowledge" is likely to become less important than "concretely classifying one's own results in a research context".

In accordance with DFG guidelines, it is considered good scientific practice that, if AI-supported programmes in the form of generative models are used to create text and images or to generate content components, it must be made transparent which software was used, for what purpose, where and to what extent. On the other hand, AI that does not affect the scientific content of the work (e.g. grammar, style and spelling checks, translation programmes) does not need to be disclosed. Of course, the scientific responsibility for, e.g., 'hallucinating' language models or AI-generated translations remains with the author of the qualification work, who must also be aware of the risk of potential copyright infringements by generative models.

It is not yet clear to what extent professional and creative prompting for generative language models will replace the formulation of one's own texts as an achievement. Grey areas will remain here for the foreseeable future.

Reference to the software used or citation of secondary literature does not release from the general obligation to verify the original sources of important statements. However, general knowledge of specialists may be assumed and does not need to be substantiated by citations.

As automatic translations become more reliable and commonplace, the question arises as to how to deal with original sources in foreign languages. In the interests of transparency, a reference to an automatic translation should become as commonplace as, for example, stating the date of access for changing internet sources.

3.5. External influences

It is part and parcel of an adequate representation of the research performed that all external factors be clarified, which may, in the view of an objective third party, throw doubt as to whether a completely independent scientific judgement was formed. Thus, it is particularly important that support obtained from a company or other stakeholders be clearly stated.

Referees of qualification reports or theses that are written in conjunction with a company must have full access to all relevant data, so that they are able to obtain their own complete picture of the scientific quality of the research that was performed. Regulations for this must be made before the project starts, and the legal department of the University in question should be involved in the process.

In principle, doctoral theses and postdoctoral theses must be made publicly available, as they are intended to generate knowledge and not merely demonstrate competence. This is sometimes at odds with commercial interests, such as exploitation through patents or publication in renowned journals. In such cases, from the perspective of good scientific practice in physics, there is no reason not to delay publication for an appropriate period of time, even if this may delay further progress in knowledge.

Concluding remarks and Acknowledgements

The original German version of these recommendations was approved after thorough discussion in the General Meetings of the Konferenz der Fachbereiche Physik (KFP)on 4th November 2025 and 13th June 2025 in the General Meeting on 3rd November 2025. It replaces the KFP recommendation of 2016 [KFP16], corresponds to the status of the discussion at the end of 2025, and will be updated as necessary.

Note that this English version is only a translation of the original German version. This latter one is the binding text.

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Sources and selected online resources (as of June 2025)

[KFP16] Recommendation of the Conference of Physics Departments: "Good scientific practice in scientific qualification theses in physics", https://www.kfp-physik.de/dokument/KFP_Gute_wissenschaftliche_Praxis_160603.pdf

[DFG] Documents of the German Research Foundation (DFG), https://www.dfg.de/de/grundlagen-themen/grundlagen-und-prinzipien-der-foerderung/gwp

[AFT12] Joint position paper of the General Faculty Council (AFT), the Faculty Councils and the German University Association (DHV) dated 9 July 2012: "Good scientific practice in scientific qualification theses", https://allgemeiner-fakultaetentag.de/2012/07/09/gute-wissenschaftliche-praxis-bei-wissenschaftlichen-qualifikationsarbeiten/

[HRK22] Resolution of the 33rd General Assembly of the HRK dated 10 May 2022: "Model statutes for ensuring good scientific practice and dealing with suspected cases of scientific misconduct", https://www.hrk.de/positionen/beschluss/detail/mustersatzung-zur-sicherung-guter-wissenschaftlicher-praxis-und-zum-umgang-mit-verdachtsfaellen-wisse/

[WR23] Position paper of the German Council of Science and Humanities: "Structure of doctoral studies in the German science system", printed paper 1196-23, April 2023 https://www.wissenschaftsrat.de/download/2023/1196-23

[NFDI] Web presentation of the National Research Data Infrastructure (NFDI) e.V., https://www.nfdi.de/

[DHV16] Resolution on industrial doctorates by the German Association of University Professors and Lecturers dated 20 January 2016: "Industrial doctorates– to the rules of good scientific practice", www.hochschulverband.de/cms1/fileadmin/redaktion/download/pdf/resolutionen/Industriepromotion.pdf

[HRK17] German Rectors' Conference: "Key points for quality assurance in doctoral programmes with external employment contracts", 14 November 2017, https://www.hrk.de/fileadmin/redaktion/hrk/02-Dokumente/02-01-Beschluesse/Eckpunkte_Promotion_mit_externem_Vertrag_14112017.pdf

[VW] In order to avoid potential problems with publishers' exploitation rights in the case of cumulative qualification theses, publications are often listed in the appendix but later replaced by a DOI when the thesis is published, e.g. by the respective university library. The main text then contains, for example, a summary (approximately 4000 characters) of the outsourced publication, 'emphasising the individual contributions of the doctoral candidate'.

[CrediT] CrediT, Contributor Roles Taxonomy, ANSI/NISO Z39.104-2022 (American National Standards Institute, 2022), https://doi.org/10.3789/ansi.niso.z39.104-2022

[FAQ24] Katrin Frisch: "FAQ Artificial Intelligence and Good Scientific Practice" or "FAQ Artificial Intelligence and Research Integrity", https://zenodo.org/records/14045172