Study guide Graduation Project

Master Science and Technology of Nuclear Fusion

Eindhoven University of Technology

Course code & credits	3NFA45 (45 credits) / 3NFA60 (60 credits) / 3NFITD25 (25 credits) / 3NFIDD30 (30 credits) / 3NFIDD225 (22.5 credits)
Level:	Master
Program:	Science and Technology of Nuclear Fusion (STNF)
Responsible lecturer:	Prof. dr. ir. Henk Swagten, h.j.m.swagten@tue.nl
Contact person:	Cynthia Tarchichi, Education Coordinator AP, apse.education.coordinator.ap@tue.nl
Responsible STNF supervisor:	Examiner appointed for the graduation project by the Examination Committee Science and Technology of Nuclear Fusion

Content

1. Introduction

The master's graduation project is primarily meant to gain experience in the international fusion field by experimenting, modeling, analyzing, and/or designing new diagnostic systems or exploring new research questions. Students will learn the drawbacks and pitfalls of exploring unknown territories and will understand that abstraction and simplification are their main tools for success. In the graduation project students conduct independent academic research (or design), which includes a study of literature and of discussions in the field at an academic level.

The graduation project is the student's last opportunity to demonstrate their acquired competences in the Master program and the preceding bachelor's program(s). Therefore, the graduation project should involve as many as possible of the competences defined in the ACQA framework. Competences should be addressed and assessed within context. That is: competences are not to be demonstrated in isolation. For each individual graduation project, the project's goal-to-be-achieved provides this context.

The procedure for finding a suitable graduation project is to first clarify for yourself where your interest lies. You can inform yourself about the possible projects either via our database fusionprojects.tue.nl (password: TokamakDonutQ10) or by asking other students. After this one can make an appointment with one of the responsible academic supervisors. The academic supervisor will then try to find the best fit for a project with you and contact the potential daily supervisor (i.e., the person in charge of the project at the host location). It is strongly advised to take two different topics for your internship and your graduation project (e.g., design and research).

2. Learning outcomes of the graduation project

After finalizing the graduation project, you are able to:

- Formulate and analyze a scientific problem at an abstract level.
- Independently and iteratively set up, organize, and perform a complex experimental and/or theoretical scientific research project, while reflecting on it within the working environment.
- Gather, understand, and judge scientific literature about the research topic and incorporate the current insights in the literature into the research project.
- Carefully handle data, systematically investigate, critically interpret, and formulate the results and conclusions.
- Clearly communicate about the research project both orally (presentation and discussion) and in written form (report) on a specialist level, and also on a general level.
- Contribute to and take the lead in scientific discussions related to the research project.
- Illustrate and identify the scientific and societal relevance, impact, and limitations of the results and outcomes of the project.
- Contribute creatively and with perseverance to the research project.
- Show that they have a constructive and cooperative attitude to operate in a professional environment.

3. Assessment of the graduation project

You will finalize the graduation project with a graduation report, a presentation and defense at TU/e. A graduation committee chaired by the first TU/e examiner, your responsible Science and Technology of Nuclear Fusion supervisor, will assess your graduation project on each of the grading criteria (Report,

Presentation, Science Communication Product (SCP), Defense and Implementation of the work itself) according to the rules mentioned in the Graduation project assessment protocol.

During the defense, you will be asked questions regarding your work, but also more general fusion-related questions. You will be tested both on your scientific knowledge and on your ability to engage in a scientific discussion, including defending your thesis work, dealing with new ideas and placing your research project in the context of other research.

The double-diploma regulations for the composition of the graduation committee and the graduation committee can also be found in the Graduation project assessment protocol.

3.1. Retake

In case the graduation committee has graded the project with a final grade <6.0, and/or one of the components 'Report', 'Presentation', 'SCP' or 'Implementation of the work itself', is graded <6.0, or if by the agreed end date including allowed extra time the report, presentation and/or SCP are not delivered, the Graduation Project will be graded with an insufficient grade.

In that case a retake is offered. Together with the first TU/e examiner you will agree on what actions need to be taken in order to improve the project, e.g., rewrite the report and/or deliver the presentation again.

For the 45 credits graduation project the time allocated for the retake is at most 480 hours (an equivalent of 12 full-time working weeks). Discuss the planning together with your supervisor.

An extension of the retake is not possible. If by the end date of the retake the pass criteria are still not fulfilled or the report, presentation and/or SCP are not delivered, the student fails the Graduation Project. In general, a new project should be started.

4. Planning the graduation project

On the Graduation Project registration form, the end date of the Graduation Project is entered, as agreed between the academic supervisor and the student, using as a rule that a 45 EC project corresponds to an equivalent effort of 30 fulltime workings weeks. It is the express intention that the project, including the submission of the final report and the final presentation, is completed by this end date.

Should the student not succeed in making this deadline, at the latest 4 weeks after the agreed end date the student must submit the final report and SCP and give the final presentation and defense. If the student also fails to meet this extended deadline, this will result in an insufficient grade and the student will enter a retake procedure as described above in chapter 3.

Some further notice on the planning:

- The graduation project starts with an 8-week prelude phase in which the project is defined, and literature is studied, leading to a feasible project proposal, with a clear research question (or design requirement). Each graduation student will be assigned to a graduation circle. In the 4th week, a coaching session with the students of the graduation circle will be scheduled and in the 6th week, a short (max. 10 minute) presentation is given to your graduation circle and supervisors aiming to introduce your research question and to get feedback on your project definition. The prelude ends with a written report of a few pages. Ideally, this could function as

the introduction of your thesis report. More information on the prelude can be found on the education guide under downloads.

- Students can start the graduation project only at the start of the quartile (a slight delay of 2 weeks can still be accommodated for).
- Half-way through the project, the student will give a mid-term presentation (12 minutes), in which they need to give an update on their project and discuss what their motivation was, what their research question is, preliminary results and what their future work will be. It also serves as an evaluation to find out if the project is still on track or if an extension needs to be applied for.

5. Monitoring process of the graduation project

The monitoring process of the graduation project runs from the start date of the project to the day the graduation report is handed in. The process is coordinated by the academic supervisor.

Near the initial end date of the project as indicated on the registration form, both you and your responsible Science and Technology of Nuclear Fusion supervisor need to discuss together whether it is still feasible to have the graduation report handed in at least 10 working days before the end date of the graduation project (10 days in case of a double master project). If this seems not feasible anymore, you automatically use your additional time, or apply for an allowed extension (see chapter 4).

In case the report is handed in on time (at least 10 working days before the end date of the graduation project; 10 working days in case of double master project), the presentation, defense and grading by the graduation committee can take place.

In case a retake is needed (see chapter 3.1):

The end date of the retake is determined by the student in consultation with the responsible Science and Technology of Nuclear Fusion supervisor. The starting and end date of the retake is communicated to CSA-AP by the responsible Science and Technology of Nuclear Fusion supervisor.

5.1. Personal circumstances

If personal circumstances cause a delay, you and your responsible Science and Technology of Nuclear Fusion supervisor should contact the MSc. academic advisor. You can discuss whether continuation of the current project would be a feasible option. When there is a possibility for continuation of the project, new agreements regarding the throughput time of the project need to be made and communicated with the education coordinator.

Permission for longer extension can be asked from the Examination Committee in certain conditions comparable to those mentioned in Appendix 2 to Article 1.3.3, paragraph e, of the Regulations of the Examination Committee. In any case the following personal circumstances must be recognized: Illness, exceptional family circumstances, pregnancy and childbirth, dual career (top talent), or other situations involving circumstances beyond the student's control.

6. Guidelines graduation project report and presentation

The outcomes of the graduation project have to be described in a compact, written report in English, preferably not exceeding 50 pages or 20,000 words, without supplementary material. The format of the report needs to be agreed by your responsible Science and Technology of Nuclear Fusion supervisor. A checklist can be found in the appendix of this study guide, to guide students and supervisors on the

essential elements of the graduation project report and presentation. You must use the NF format for the title page graduation project NF.

During the graduation project, you prepare for the (final) presentation and defense. A checklist for presentation can be found in the appendix of this study guide, to guide you on the essential elements.

6.1 Confidentiality

Be aware that your company might want to make your final report confidential and impose an embargo:

- The company where you conduct your research may impose a two-year embargo on its own, at least two weeks before you hand in your final report to your responsible Science and Technology of Nuclear Fusion supervisor. They do not need to send a request to Science and Technology of Nuclear Fusion (TU/e) for further approval on this. In case of a two-year embargo, you must write a public summary (can be the abstract if it is allowed to make it public) in addition to the final report. Send the final report to the company & your responsible Science and Technology of Nuclear Fusion supervisor at least 10 working days before your final presentation. Only the final report is used for purposes related to the final assessment of your graduation project. The public summary will be published in the TU/e library until the embargo expires. Once the embargo expires, the final report is published in the TU/e library.

- In case of an embargo of two to five years, the company must send a request to the Dean APSE at least two weeks before you hand in your final report to your responsible Science and Technology of Nuclear Fusion supervisor. If the Dean APSE approves of the embargo of two to five years, you must write a public version of the final report in addition to your original final report. Send the final report to the company & your responsible Science and Technology of Nuclear Fusion supervisor at least 10 working days before your final presentation. Only the original final report is used for purposes related to the final assessment of your graduation project. The public version of the final report will be published in the TU/e library until the embargo expires. Once the embargo expires, the original final report is published in the TU/e library.

- In case the company wants to impose a non-disclosure agreement (NDA) for you and/or your responsible Science and Technology of Nuclear Fusion supervisor /graduation committee, please inform your supervisor and before signing, email the NDA to apse.csa.ap@tue.nl for further checks.

More information on the confidentiality of your report can be found on these pages:

- Guidelines Graduate School (topic i)
- Internship and graduation project agreement

7. Organization of the graduation project

Properly organizing your graduation project will take some time. Following the steps below can help you with this. It is very important that you follow these steps proactively; it is your responsibility to make sure that you arrange things in time and follow procedures accurately.

7.1 Preparing the graduation project

When?	Who?	What?

Few months before start graduation project	Student with your mentor	Have your third competence development interview (CDI-III) before you start your graduation project. Make sure on Osiris that your study program has been accepted by the study program committee. Check the prerequisites for starting the graduation project. How to find a project: 1. Clarify for yourself • Is there a competence (often: design) that needs to be addressed somehow? • Can I go abroad or are there still any restrictions in effect? • Do I still need to or want to go abroad? • Are there any similar boundary conditions from a possible double master? • What kind of work do I like/am I good at/am I not good at, but I would like to improve on (experimental work that is hands-on, experimental work that is mainly data analysis, numerical work that does or does not include coding, analytical theory i.e. pencils and paper)? • Do I want to work in a small team with lots of freedom or in a bigger team where my own contribution might be less visible (for instance: Fusor vs ITER). • Is there any topic that has really fascinated me in the lectures and that I would like to learn more about? 2. Inform yourself about possible projects using our database fusionprojects.tue.nl (password: TokamakDonutQ10) and asking other students. 3. Make an appointment with one of the lecturers, but only after steps 1 and 2. 4. The supervisor will then try to find the best fit for a project with you and contact the potential daily supervisor (i.e., the person in charge of the project at the host location). 5. It is strongly advised to take two different topics for your internship and your graduation project (e.g., design and research).
Before the start of the graduation project	Student	If you plan to go abroad, please visit the education guide exchange programs for studying abroad and visit Mobility Online. For contact with exchange please sent an email to: apse.exchange.ap@tue.nl.
Before the start of the graduation project	Student	Register for the graduation project with a webformhttps://studiegids.tue.nl/opleidingen/graduate-school/masters-programs/science-and-technology-of-nuclear-fusion/forms on the education guide. For a double diploma project, complete 2 forms. To be sent to your academic supervisor of the graduation project (2 supervisors if you do a double diploma program). See also the education guide. Put the agreed (with you and your academic supervisor) start- and end date and topic on the form. A 45 EC project corresponds to 30 weeks of full-time equivalent effort (NF only) and a 60 EC project to 40 weeks (double diploma). It is the express intention that the project, including the submission of the final report and the final presentation, is completed by this end date. If you want to change courses: Approval of your changed study program. You should list your desired changes on the NF Study Program Form, and submit the fully completed form to the Study Program Committee NF via Osiris Zaak, Send a copy (Cc) to your mentor too. The changes for the Study program for the Combined program NF-MAP or a double Diploma program should be submitted at the education guide for double degree programs.
	Student	Enroll yourself for the correct course code in Osiris.
	Student	Read this study guide for the graduation project Science and Technology of Nuclear Fusion (STNF).
	Student	Read the assessment protocol for the graduation project Master STNF.

7.2 During the graduation project

When?	Who?	What?
During the graduation project day 1	Student with responsible STNF supervisor	You will be added to a graduation circle of the prelude phase that starts every quartile. An initial research idea will be presented and discussed for feedback with the peer group and the involved lecturer in week 4. In week 6 the research proposal will be presented with the students of the peer group, the supervisors and involved lecturer. In week 8 the prelude report (and phased project plan) has to be written. Feedback on the draft report is given by fellow students and the involved lecturer. At the end of the prelude phase the report is submitted to the academic supervisor for approval. The decision will be sent to the student and secretariat (they receive the final report too to file). You are also asked to give a midterm SL presentation (SLII) approximately halfway through your project. Have a look at the education guide under downloads: How to write a good report and How to give a good presentation. Also check canvas for information on SL and the Science Communication.
During the graduation project	Student/check-ups with responsible STNF supervisor	Doing the graduation project and writing thesis.
Four weeks before the examination committee NF meeting	Student via "OSIRIS"	Apply for Examination Committee NF meeting via OSIRIS (withdraw until 5 working days prior to the examination). As you take a double diploma program, please apply for two Examination Committees. Inform Secretary Fusion.

7.3 Finalizing the graduation project and the report

When?	Who?	What?
Well before the end date of the graduation project	Student and responsible STNF supervisor	Determine the composition of the graduation committee according to the regulations set by the Examination Committee. Contact the secretary Fusion for the date and venue (or online) and for sending the invitation letter, meeting requests and SL invitation with abstract.
At least 10 days before the end date of the graduation project	Student	Hand in your graduation report and science communication product at the external location (if applicable), and to all members of the graduation committee. Sign the TU/e Code of Scientific Conduct for the Master's thesis form.
After handing in the report	Graduation Committee	The graduation committee will assess the report and the responsible STNF supervisor will assess the implementation of the work before the presentation takes place.
End date of the graduation project	Student & Graduation Committee	Prepare and deliver a presentation in final science lunch III, and deliver a defense about your graduation project. The presentation should take about 15 minutes, with approximately 10 minutes for a discussion afterwards. Thereafter, in a meeting with the committee only, the defense takes place lasting at most 1 hour.
After the presentation and defense	Responsible STNF supervisor	Your responsible STNF supervisor, also first TU/e examiner, in consultation with the graduation committee, will grade your graduation project on each of the grading criteria according to the rules mentioned in the assessment protocol. After the evaluation, immediately following the presentation and defense, you will be directly informed by the responsible STNF supervisor about the (sub) grades including a short motivation. The final written feedback and (sub)grades will be filled in on the assessment form and communicated to you by the responsible STNF supervisor.

		The first TU/e examiner sends the assessment form, the TU/e Code of Scientific Conduct for the Master's thesis form and your report (and if applicable the public summary or public version) to CSA-AP. When the assessment form is handed in at CSA-AP, your grade will be processed, the report will be stored.

Appendix GRADUATION PROJECT MSC NF – Checklist for REPORT

CHECKLIST for REPORT

Assessment, length limit, scientific level, general recommendations

- ☐ The report will be **graded by the graduation committee**, which is the responsible supervisor and (at least) two other examiners. Other (daily) supervisors will be consulted when involved in giving feedback to your report.
- ☐ The **key assessment criteria** of your report can be consulted in the Assessment Protocol Graduation Project MSc Science and Technology of Nuclear Fusion (STNF).
- ☐ The report is sufficiently compact. Without references and appendices, you should typically not exceed **50 pages or 20,000 words**. The length of individual sections/chapters should be carefully balanced considering their relevance and importance within the full report.
- ☐ The **scientific level of your report** should be such that typically other MSc (STNF)students in the research group, working on similar subjects, can basically follow the content. It can be assumed that topics and theory within BSc-AP courses, including related courses within your track, are familiar, and do not need to be repeated (see later in Main chapters / sections).
- ☐ To be able to judge the required level and other key elements of your report (as will be discussed below), **ask your supervisor for exemplary reports**, which were delivered by other MSc-STNF students. These examples may guide you in the writing process of the project.
- ☐ Before starting up the actual writing process, **discuss with your supervisor(s) the general outline and structure of your report**. This may guide you in carefully planning timely delivery of sections or chapters, including the required feedback from your supervisors and its implementation. For details on structure and chapters, see the next sections.
- ☐ Based on the outline of your report, it is strongly advised to **startup up the writing process at an early stage** in your project, to warrant sufficient progress and to prevent a too high workload at the end. Involve your supervisor in discussing the progress in your report, e.g., by identifying what sections can be written at an early stage, and how to deal with feedback and corrections.

Structure

- ☐ When you are able to identify the **main conclusions based on the core results**, the whole report should revolve around explaining and supporting this. This requires an introduction and motivation of the project, and concise background theory and experimental or theoretical tools. Then you will report on results including discussion and conclusions. This is the core of your work, and the rest of the report should support this in a direct and compact way.
- ☐ In the chosen **structure of the report**, the reader is optimally guided through all chapters of the full report. All individual chapters and sections are carefully tied together and always placed within the larger framework of the report.
- ☐ Apart from the main sections or chapters (see below: Introductory part & Main chapters / sections), the report has four compulsory parts. The report starts with (1) **Title page**, (2) **Summary or Abstract**, and (3) **Table of Contents**, and is completed at the end by (4) **References or Bibliography**.
- ☐ **Appendices / Supplementary material** is usually added to give additional details in data and analysis, not suitable (in extent and/or detail) for the main chapters in your report. In the main chapters, properly refer to this additional material.

- ☐ The full report, main chapters including supplementary sections, should warrant the **replication of your research** (data, analysis, etc.). Others should be able to repeat and confirm the basic findings of your study, using the information given in your report.
- ☐ **Lists of Abbreviations, Symbols, Tables, and/or Figures** can be optionally added to the report, usually before the start of the Introductory part. Keep the use of acronyms to a minimum.

Title page, title of the report

- ☐ You must use the NF format for the title page graduation project NF
- ☐ The title page containing at least:

  (1) Title, optional subtitle (2) Student initials, surname, ID (3) Study load of graduation project, 45/60 EC (4) Name of Master's program(s) + master track (5) Month and year of finalized report (6) Name of supervisor (7) Supervisor's research group, department (8) Members of thesis committee (9) Indication on whether or not the thesis is public (10) Statement that the Master's thesis follows the TU/e Code of Scientific Integrity.

- ☐ The **title of the report is compact and contains key words** of the research, methods, or techniques. It optionally hints towards the overall result or conclusion of the thesis work.
- ☐ A **subtitle is optionally added** when more detailed key words are required to frame the research, methods, or conclusions.

Summary / Abstract

- ☐ The summary/abstract at least contains:

  (1) Background of the graduation work (2) Research objectives or hypothesis (3) Research methodology, and (4) Obtained main results and factual conclusions.

- ☐ The **abstract is sufficiently concise** for the reader to have fast access to the impact of the work. Typically, it fits to half a page, and never exceeds a full page.

Introductory part

- ☐ To clarify the motivation and objectives of your work, the introduction usually starts with an **adequate scientific, technological, and/or societal background** to the work, including a representative selection of references to relevant scholarly literature.
- ☐ After identifying the open issue or quest in the research field, the introductory part should clearly state **your motivation and actual research objectives** of the present study.
- ☐ In connection to motivation and objectives, the introductory part optionally includes a **short, written outline of the remaining chapters/sections** of the thesis, to optimally guide the reader. It may also optionally include a preview of the main conclusions of your thesis work.

Main chapters / sections

- ☐ Following the Title page, Summary/Abstract and Table of Contents, (and preceding the references) the report contains a selection of logically structured main chapters/sections, typical examples:

  Introduction (see earlier), Background, Technology Assessment, Methods, Research Tools, Theory, Results, Interpretation, Discussion, Recommendations, Outlook.

  Please note that these chapter/section titles are just examples, these are not mandatory!

A customized selection and ordering of these typical chapters/sections is used such that the actual results and discussion are well positioned within the entire report. Alternative titles for your chapters, which are specific to your project and your storyline, can be considered. As mentioned earlier, discuss this with your supervisor at an early stage!

- ☐ In view of the length-limit indication (50 pages or 20,000 words), **chapters on theory, methods and tools are carefully configured preferably without extensive reproduction of textbook-like elements.** Use appropriate references (ideally including hyperlinks) to other sources when writing these chapters, and keep in mind that these parts should be written in a way to optimally introduce the actual research results and discussion.

References/Bibliography and Appendices/Supplementary

- ☐ The **list of references/bibliography**, positioned at the end of the report, is logically structured and sufficiently clear, using a consistent format. In the main text, references to this list are systematic and precise. A reference management tool is recommended.
- ☐ A standard **reference/bibliography style** has been chosen that is commonly accepted, such as used in physics papers by American Physical Society (APS), Institute of Physics (IOP), or Nature/Science.
- ☐ **Appendices / Supplementary material** can be included to avoid a too lengthy or detailed report and/or to facilitate reproduction of the actual research.

Technical requirements: figures, tables, equations, symbols, concepts

- ☐ For style/conventions/type facing of **figures, tables, equations, symbols** etc., the guidelines in Experimental Physics courses of the BSc program Applied Physics at TU/e can be consulted.
- ☐ For style/conventions/type facing, also **typical (applied) physics papers can be consulted**, see e.g., guidelines at the American Physical Society (APS), Institute of Physics (IOP), or Nature/Science journals.
- ☐ Relevant **physical/technological concepts, parameters and symbols** are introduced at their first occurrence. When using **equations and physical arguments** that are not derived or introduced in thesis, and which cannot be considered as basic physics knowledge, they should be properly cited.
- ☐ All **figures and tables carry a caption** containing all the information necessary to understand what is actually shown. The full interpretation/explanation of the figure/table should be in the main text, it does not belong to the caption.
- ☐ All **figures and tables are referred to in the main text**. Numbering is dictated by appearance in the text. All **equations carry a number**, unless they are integrated as part of the main text, and all **equations are part of a running sentence**. Automatic numbering of figures, tables and equations is recommended.

Appendix GRADUATION PROJECT MSC NF – Checklist for PRESENTATION

CHECKLIST for PRESENTATION

Assessment, audience, duration, general recommendations

- ☐ The presentation will be **attended and graded by the examination committee**: the responsible supervisor, and (at least) two other examiners. Daily supervisors will usually be present and consulted for the assessment. Attendance by other group members (students, staff) is usually facilitated.
- ☐ The **key assessment criteria** for your presentation can be consulted in the Assessment Protocol Graduation Project MSc Science and Technology of Nuclear Fusion.
- ☐ The **presentation should last 15 minutes (20 minutes for a double master program)**, thereafter follows a **discussion of typically 10 minutes**. Generally speaking, presenters in physics often spend 1-2 minutes per slide, which means that presentations are typically supported by **10-20 slides** (excluding a series of slides belonging to an animated sequence).
- ☐ The **scientific level of the presentation** should optimally match the audience. Ensure that the presentation is at a level such that all other BSc-AP and MSc-Fusion students in your research group are able to grasp the essentials of your talk. It can be assumed that topics and theory within BSc-AP courses, including related courses within your track, are familiar. Still, those not directly involved in your project usually need more introduction and explanation than you might think.
- ☐ Unlike your report, your **presentation is not meant to show all you have done** in the project. In most cases, this means you have to boil down your work its essence and make it understandable even for the non-experts. Not all subjects covered in the report need to be contained in the presentation, also the order of subjects can be completely different.
- ☐ You are strongly advised to **carefully prepare and practice your presentation** well in advance, preferably with your supervisor(s) or other students working on similar subjects. This will help you optimize the timing, design, and physics content, including your actual performance.
- ☐ Before designing and detailing your slides, **discuss with your supervisor(s) the outline of your talk**, which is related to the main message and subjects to be discussed. See the following section.

Message and motivation, subjects, structure

- ☐ To make a strong outline, it is very important to **identify the main take-home message of the presentation**. Try to capture the message of your presentation in a single sentence. Identify which topics need to be explained and what results need to be shown in order to convey the main message. All you present is there to explain or support the take-home message!
- ☐ At the start of your talk, **try to immediately catch the attention** by clear opening sentences or statements. Consider showing a compact, catchy version of the project title or to immediately highlighting the main take-home message. Carefully practice these first sentences, these are key in getting and keeping the attention of the audience. A catchy image on the opening slide may also help to attract attention.
- ☐ In the first part of the talk, you should carefully **introduce the motivation behind the project**. This requires giving sufficient background information about physics or technology in this particular field, within the research (sub)group.
- ☐ In the introductory part, clearly mention the **actual research question of your work**. This is typically followed after the motivation and narrows down to your actual contribution or quest. You may anticipate the conclusions to better guide the audience through your presentation.

- ☐ Keep the attention of the audience by a **coherent and recognizable structure** of the presentation and consider implementing intermediate conclusions. As mentioned, be critical in selecting what is needed to support the message, in terms of background, theory, results, figures, etc. Be aware that the words you speak when moving from one slide to the other are very important in creating a clear storyline – prepare those links with care.
- ☐ Unlike your report, **a table of contents or outline is not required** to guide the audience, it may even weaken the narrative; a well-prepared message, storyline and supporting slides are much more essential.
- ☐ For each figure, scheme or diagram you are showing, **take time to explicitly highlight and explain all details of graphs**, such as what is plotted along axes and what the different curves or data sets mean. You know what is in the graphs, but an audience needs enough time to consume this new information and recognize what is shown.
- ☐ You should finish the presentation in a natural way, which most likely puts the **main conclusions, take-home message, or outlook**, at the end of your talk. Keep the concluding part compact to regain full attention from the audience. Try to close the circle by answering the research question you posed at the start of the presentation.

Stage performance

- ☐ By preparing yourself optimally, you should be able to demonstrate **engagement, confidence, enthusiasm, and liveliness**. Since this is one of the key elements for a successful presentation, specifically ask for feedback on these aspects while practicing the presentation with others.
- ☐ It is **natural to be nervous about your presentation**. You have to learn to recognize the symptoms and to appreciate them for optimizing your performance. By systematically practicing and analyzing your presentations, you gain experience and nervosity may actually help your performances. You may consider using video recordings of your presentation in the preparation phase.
- ☐ When **speaking to the audience**, your voice should be loud enough with a clear articulation and lively intonation. Use a conversational pace but try to make variations when appropriate. Use body language or even supporting tools and try to continuously keep eye contact with your audience.
- ☐ As a **junior scientific presenter**, the sentences you are using should be compact and at a proper scientific level, and your explanations and reasoning should be correct and clear, and structured in a logical way. Only use physics terms and English that you feel comfortable with. Make sure that all your statements are supported by either data or references.
- ☐ A good way to test your presentation is to record yourself on camera and then **critically review your own performance** given all the feedback you already received. Compare it with your own experience of what you liked and disliked at other presentations or lectures. Obviously, you may consider sharing your recordings with fellow students/friends for additional feedback.

Technical requirements

- ☐ When designing your slides, **use current TU/e templates** online available.
- ☐ Mention your name, supervisors, research group or location (usually but not necessarily all on the title slide). Acknowledge others that contributed to your work, number your slides. Give correct references when using pictures and other material, from literature or other sources.
- ☐ To ensure the audience is mostly concentrating on you and your narrative, **use a limited number of compact phrases or words on your slides**. The format/layout of these text elements on your slides should be coherent and well-readable during the full presentation. In many cases, a slide carries a

dedicated title of your slide with a limited number of words, and the main conclusion of that slide is displayed as well – make this coherent for the full presentation.

- ☐ Put great effort into **carefully designing your figures, schemes, and diagrams**, preferably eye-catching and as simple as possible, containing limited elements that are very well visible in size and color. Consider breaking up figures or diagrams into parts and introduce them sequentially. As a rule of thumb: figures/graphs from the report should be fully redesigned for use in your talk. Often figures from literature need to be remade or simplified. Properly align different graphical elements and text to assure a structured layout.
- ☐ Using **tables with numbers** is in most cases not recommendable, as well as **mathematical derivations**. In the case of showing **formulas or equations**, usually try to show these in a compact, understandable, and attractive way.
- ☐ Use **animations in your slides** when it will benefit your narrative and performance, e.g., when explaining a complicated concept, or when elements in figures are added sequentially. Make sure to carefully prepare and practice animated sequences when you do add them. Avoid too many control/mouse clicks – in particular assure that information stays projected enough time.

Questions and discussion

- ☐ After **finishing the presentation**, usually applause will be given, and the audience (including examiners) are allowed to ask questions. As a rule of thumb: do not end with a question, in particular “Are there any questions?”, but you may thank the audience for their attention, and you could add “I will be happy to answer any of your questions”. Discuss with your supervisor in advance who is initiating/regulating the questions, which is usually the chair of the meeting.
- ☐ For all **questions after the talk**, repeat the question in your own words and direct your answer to the entire audience. When needed, immediately go back to the slide in question for supporting the discussion (in PowerPoint: type slide number, press enter)
- ☐ In **answering questions**, explain your thoughts naturally and open-mindedly, similar to scientific discussions. Show respect for all types of questions and try to judge whether your answers are well received. If you do not fully understand the question, ask for further clarification.
- ☐ Be prepared for unexpected **questions or interruptions during your presentation**. Discuss with your supervisor in advance how to handle these situations.
- ☐ Consider having **back-up slides** when you anticipate additional discussion on specific results or subjects. Make sure you are able to quickly navigate to this supporting material.