

# Physics & Astronomy Rubric background document

2023-2024

The rubric consists of two documents, a grading form and a secondary document with more detail on the criteria and performance levels per element. This file constitutes the latter, the grading form can be found in the appendix. Students are assessed on three categories: the Thesis, a Presentation and the Internship performance. Each category is subdivided into sub-categories. Each subcategory is graded individually. **To pass the overall internship, the grade for each category (i.e. thesis, presentation, and internship performance) must be at least 5.0.**

There are two versions of the rubric: the **LAB** version is designed for an internship that requires physical presence (e.g. internships requiring lab work). The **non-LAB** version is designed for an internship that does not (e.g. theoretical or other types of experiments based mainly on analysis/programming, etc.). They differ in the weights of the grade given to the Internship performance category. Which version of the rubric is used to grade the internship should be decided at the beginning of the internship.

## Instruction for assessors

Each subcategory can be given one of four different grades: fail ( $\leq 5.0$ ), pass (6.0 - 7.5), good (7.5 - 9.0), and excellent ( $\geq 9.0$ ). **The cumulative score provides a range for the final grade.** When both assessors have filled out the form, and the grades differ more than 1.0 point, they should discuss and motivate the final result.

## 1 Internship performance (50%)

### Scientific comprehension - 20%

#### Scientific literature

This subcategory assesses the student's understanding and application of relevant scientific literature.

- F:** *The student has not demonstrated through citation, nor verbally/orally an awareness of the relevant scientific literature.*
- P:** *The student has demonstrated through citation, verbally/orally a minimum awareness of the relevant scientific literature.*
- G:** *The student has demonstrated through citation, verbally/orally an understanding and awareness of the relevant scientific literature, and is able to summarize the main aspects with few mistakes.*
- E:** *The student has demonstrated through citation, verbally/orally an understanding and awareness of the relevant scientific literature, and additionally applied this understanding where appropriate to the project outcomes or open questions.*

#### Motivation

This subcategory assesses the student's understanding of the scientific motivation of the internship, including the main goal and how it connects with the previous literature.

- F:** *The student has not demonstrated verbally nor orally the scientific motivation of the internship.*

- P:** *The student has demonstrated an adequate awareness of the scientific motivation of the internship, and understands aspects of it. But the student does not fully understand it.*
- G:** *The student has demonstrated an adequate awareness of all aspects of the scientific motivation. But the student did not fully understand the design and outcomes of the internship, based on the motivation.*
- E:** *The student has demonstrated an awareness of the scientific motivation, applied the motivation to project outcomes, as well as can draw scientific conclusions based on the internship outcomes that are related to the original motivation.*

## Scientific theory

This subcategory assesses the specific scientific theory related to the internship, outside of the internship-related knowledge.

- F:** *The student is not properly able to explain the physical concepts related to the internship, during the course of the internship.*
- P:** *The student adequately demonstrates a basic level of understanding of the physical concepts, but cannot explain it in adequate detail or without a number of mistakes.*
- G:** *The student demonstrates a sufficient level of understanding of the physical concepts during the course of the internship, and can explain the relevant details with minimal number of mistakes.*
- E:** *The student demonstrates a mastery of the physical concepts during the course of the internship, can explain all the relevant details, as well as possesses/grasps through communication additional questions/answers that expand the students knowledge beyond the essential theoretical concepts related to the internship.*

## Methods & implementation - 50% Lab, 65% Non-Lab

### Internship-related knowledge

This subcategory assesses the development of scientific knowledge (specific to methods, techniques, analysis, etc) that is related to the internship.

- F:** *The student failed to develop and demonstrate through discussion, performance or writing, significantly new scientific knowledge related to the internship.*
- P:** *The student demonstrated an adequate improvement in scientifically-related knowledge, either through discussion, performance or writing. However, the student was not often able to apply this knowledge during the internship.*
- G:** *The student demonstrated an improvement in scientifically-related knowledge through discussion, performance or writing, and was able to apply this during the course of the internship to the project.*
- E:** *The student demonstrated an excellent improvement in scientifically-related knowledge, either through discussion, performance, or writing, applied this knowledge during the course of the internship, and additionally independently acquired additional knowledge beyond the essential either through question/answer sessions, literature, or other means related to the internship.*

### Critical thinking

This subcategory assesses the critical thinking of the student throughout the course of the internship.

- F:** *The student failed to sufficiently apply critical thinking skills, either through analysis, critique of literature, or application of scientific methods throughout the course of the internship.*

- P:** *The student demonstrated through written or verbal discussion adequate critical thinking skills, but was unable to do so independently.*
- G:** *The student demonstrated through written or verbal discussion critical thinking skills, including initiating scientific discussion, postulating, and asking questions related to the internship.*
- E:** *The student demonstrated through written or verbal discussion critical thinking skills, including initiating scientific discussion, postulating, and asking questions related to the internship. The student additionally demonstrated scientific critique during the internship, based on acquired knowledge, as well as promoted new scientific discussion or understanding with the supervisor(s).*

#### **Participation - 25% Lab, 10% Non-Lab**

#### **Presence**

This subcategory assesses the physical presence and participation of the student in internship-related activities (discussion, group meetings, etc.).

- F:** *The student was not sufficiently present for internship-related activities, such as group meetings, internship meetings, etc.*
- P:** *The student was present for essential internship-related activities, but was also absent frequently (unexcused).*
- G:** *The student was satisfactorily present for all essential internship-related activities, with minimal absence (unless excused).*
- E:** *The student was satisfactorily present for all essential internship-related activities, as well as voluntarily invested additional time and/or efforts into the internship that was not required.*

#### **Project Management 5%**

#### **Project management**

This subcategory assesses how well the student organized and managed the internship independently. This is solely concerned with organizational matters, such as organizing and arranging all necessary meetings with supervisors, etc. This subcategory is graded on a three point scale: either fail, sufficient with many errors, or sufficient.

## **2 Presentation (20%)**

#### **Presentation quality - 20%**

#### **Language and verbal presentation**

This subcategory assesses both the correct use of proper English and scientific language as well as the quality of the verbal presentation.

- F:** *The student did not use grammatically correct English or proper scientific language, and the speech was hard to follow. The student was also not well-prepared, and unable to present the slides without additional preparation tools (e.g. script).*
- P:** *The student used proper language, but made many mistakes. The student also was not well-prepared, stopping in the middle of the presentation, or selectively reading the slides.*
- G:** *The student used proper language and the presentation was easy to follow. The student made few mistakes and only occasionally had to stop or look at additional notes.*
- E:** *The student used proper language, and the presentation was easy to follow. The talk was free of any noticeable mistakes, and the presentation was well-prepared as demonstrated by the student speaking to the audience the whole time.*

## Design and visual presentation

This subcategory assesses the structure and visual quality of the slides.

- F:** *The structure and quality of the presentation was poor. It was not properly linked to the verbal presentation, and was not easy to follow. The slides contained many mistakes, such as unrelated or vague text, or poorly formatted images, graphs, and/or figures.*
- P:** *The structure and quality of the presentation was sufficient. It however contained multiple formatting and/or context errors.*
- G:** *The structure and quality of the presentation was sufficient. It also contained a minimum number of formatting and/or context errors.*
- E:** *The structure and quality of the presentation was outstanding. It also contained no formatting/context errors, and the slides complemented the verbal presentation.*

### Presentation content - 60%

## Motivation

This subcategory assesses the introduction of the presentation, and how well the student explains the scientific motivation for the project. This includes a proper explanation of the scientific literature and background knowledge, as well as the physical understanding, and the motivation for the internship.

- F:** *The student is unable to motivate the internship project. In addition, there was an insufficient discussion about the scientific literature and background physical understanding. Finally, the underlying physical questions are not well-stated.*
- P:** *The student sufficiently motivates the internship. But there are multiple errors, such as the student does not adequately address the scientific literature and background physical understanding, and/or does not well-state the problem.*
- G:** *The student sufficiently motivates the internship and reviews the most relevant literature and physical understanding with small errors. The student also well-states the physical problem.*
- E:** *The student sufficiently motivates the internship and reviews all relevant scientific literature, concisely, as well as the physical understanding without error. The student also well-states the physical problem.*

## Approach

This subcategory assesses how well the approach is discussed and presented, namely how the internship problem was solved. For experimental internships, this is related to the instrumentation. For theoretical internships, this can for example be related to approximations, modeling, etc.

- F:** *The student fails to review the approach(es) used in the internship and how these approaches solve the motivated problem.*
- P:** *The student sufficiently reviews the approach(es) used in the internship, but with multiple errors or omissions. The student also does not demonstrate a deep grasp of the methodology.*
- G:** *The student sufficiently reviews the approach(es) used in the internship, with small errors or omissions. The student demonstrates through discussion an understanding of the methodology, but potentially with omissions/errors.*
- E:** *The student sufficiently reviews the approach(es) used in the internship, free of any error or omissions. The student also fully demonstrates an understanding of the methodology and its relevance.*

## Internship results

This subcategory assesses the quality of the results during the internship, and how well and precisely they are explained. This includes discussing the analysis and interpretation of the results and sources of error.

- F:** *The student is unable to present the internship results without excessive critical mistakes and without demonstrating a sufficient level of understanding of the results or sources of error. Also, the analysis may not be discussed.*
- P:** *The student sufficiently presents the internship results, but with many errors. The student may also not properly explain certain aspects of the internship, such as explaining sources of error, or discussing in depth the analysis, without making mistakes. The student also does not discuss in-depth the scientific implications of the results.*
- G:** *The student sufficiently presents the internship results, with minor mistakes. The student also discusses sources of error and analysis. The student may also present the scientific implications of the results, but with some minor mistakes.*
- E:** *The student sufficiently presents the internship results. The student also discusses sources of error and analysis. The student also presents the scientific implications of the results, all of which free of mistakes.*

## Conclusion

This subcategory assesses the conclusion of the presentation, and if the student concisely summarizes the main points of the presentation as well as presents an outlook.

- F:** *The student fails to present a conclusion and outlook, or does not properly summarize the main findings of the presentation.*
- P:** *The student sufficiently presents a conclusion. But potentially does not provide an outlook, or summarize the main points of the presentation, or does not present the conclusion in a concise way.*
- G:** *The student properly summarizes the main points of the internship, in a concise way. Additionally, the student provides a brief outlook based on the results.*
- E:** *The student properly summarizes the main points of the internship, in a concise way. The student additionally provides a critical and convincing insight into future work, potentially including critique about the work done and how it could be improved, and the future impact on the field.*

## Question handling - 15%

### Question/Answer

This subcategory assesses how well the student understands questions during the presentation, and precisely and concisely answers them.

- F:** *The student is unable to properly comprehend most of the questions, including those that may be deemed as basic questions related to what is presented. This may include not being able to answer questions related to information they presented themselves. The student is also unable to provide sufficient answers to questions.*
- P:** *The student is able to answer the basic questions that are related to the presented content. There are a number of mistakes in the answers, or the student is not often able to answer critical questions that test the understanding of the topic that is not direct.*
- G:** *The student is able to answer most questions that are posed, both direct as well as more critical thinking questions that test a deeper understanding of the topic, with few mistakes. The answers contain some mistakes, or may not necessarily be very concise.*

- E:** *The student is able to address all the open questions without mistake, both about the presentation and content directly presented, as well as questions that test the deeper level of understanding of the topic. The answers are also presented precisely and concisely.*

#### **References (presentation) - 5%**

#### **Citations**

This subcategory assesses if all information is properly cited. This subcategory is graded on a three point scale: either fail, sufficient with many errors, or sufficient.

### **3 Written Thesis (30%)**

#### **Introduction - 20%**

#### **Literature overview**

This subcategory assesses the quality and depth of the review of relevant literature related to the internship.

- F:** *The student does not properly review nor discuss the scientific literature, including the most relevant references, that are related to the internship.*
- P:** *The student provides a superficial review of the scientific literature, only citing the most important references. Additionally, the relevant literature is not well-explained or reviewed in depth.*
- G:** *The student provides a proper review of the scientific literature, citing the most relevant papers. The review of the literature is sufficient, with minor errors in understanding or minor omissions.*
- E:** *The student provides a proper review of the scientific literature, citing all the relevant papers. Furthermore, there is a complete review and discussion of the scientific literature in perspective to the internship, without error.*

#### **Motivation**

This subcategory assesses the introduction of the thesis, and how well the student explains the scientific motivation for the project. This includes a proper explanation of the background knowledge, as well as the physical understanding, and the motivation for the internship.

- F:** *The student does not properly motivate the physical questions related to the internship, including the open questions and/or challenges related to the topic.*
- P:** *The student provides a brief motivation, but there are multiple omissions or errors in the discussion, weak links to the scientific background, for example in the physical understanding or in the stated problem.*
- G:** *The student sufficiently motivates the internship goals, and links this to the open questions and challenges. There are only minor omissions and mistakes in the discussion.*
- E:** *The student sufficiently motivates the internship goals, and links this to the open questions and challenges. The discussion is free of omissions and errors and the problems and questions are clearly stated.*

#### **Scientific results - 55%**



## Approach

This subcategory assesses how well the approach is discussed and written, namely how the internship problem was solved. For experimental internships, this is related to the instrumentation. For theoretical internships, this can for example be related to approximations, modeling, etc.

- F:** *The student fails to review the approach(es) used in the internship and how these approaches solve the motivated problem.*
- P:** *The student sufficiently reviews the approach(es) used in the internship, but with multiple errors or omissions. The student also does not demonstrate a deep grasp of the methodology.*
- G:** *The student sufficiently reviews the approach(es) used in the internship, with small errors or omissions. The student demonstrates through discussion an understanding of the methodology, but potentially with omissions/errors.*
- E:** *The student sufficiently reviews the approach(es) used in the internship, free of any error or omissions. The student also fully demonstrates an understanding of the methodology and its relevance.*

## Internship results

This subcategory assesses the quality of the results during the internship, and how well and precisely they are explained. This includes discussing the analysis and interpretation of the results and sources of error.

- F:** *The student is unable to present the internship results without excessive critical mistakes. The writing illustrates that the student has not demonstrated a sufficient level of understanding of the results or sources of error. Also, the analysis may not be discussed.*
- P:** *The student sufficiently presents the results of the internship, but with many errors. The student may also not properly explain certain aspects of the internship, such as sources of error, or discussing in depth the analysis, without making mistakes. The student also does not discuss in-depth the scientific implications of the results.*
- G:** *The student sufficiently presents the results of the internship, with minor mistakes. The student also discusses sources of error and the analysis. The student may also present the scientific implications of the results, but with some minor mistakes.*
- E:** *The student sufficiently presents the results of the internship. The student also discusses sources of error and the analysis. The student also presents the scientific implications of the results, all of which free of mistakes.*

## Presentation of the scientific data

This subcategory assesses the presentation of scientific data, for example clear figures, statements about error bars, and/or proper mathematical notation.

- F:** *The scientific data, including figures and/or formulas was not properly presented or in some cases completely lacking, including major errors. These major errors can include improperly plotted data, lack of reference to error bars or figure details, as well as improper mathematical notation. The improper presentation of scientific data in this case may also lead to an improper statement or improper claim, posing integrity issues.*
- P:** *The scientific data, including figures and/or formulas was sufficiently presented. However, there were multiple errors, that, for example, in certain places distract from the conveyed statements. These errors can include improperly plotted data, lack of reference to error bars or figure details, as well as improper mathematical notation.*

**G:** *The scientific data, including figures and/or formulas was sufficiently presented. However, there were a few minor errors, for example related to formatting. These errors can include improperly plotted data, lack of reference to error bars or figure details, as well as improper mathematical notation.*

**E:** *The scientific data, including figures and/or formulas are sufficiently presented and free of errors.*

### **Conclusion - 10%**

#### **Conclusion**

This subcategory assesses the conclusion, namely if the student concisely summarizes the main points of the thesis as well as presents an outlook.

**F:** *The student fails to present a conclusion and outlook, or does not properly summarize the main findings of the thesis.*

**P:** *The student sufficiently presents a conclusion. But potentially does not provide an outlook, or summarize the main points of the thesis, or does not present the conclusion in a concise way.*

**G:** *The student properly summarizes the main points of the internship, in a concise way. Additionally, the student provides a brief outlook based on the results of the thesis.*

**E:** *The student properly summarizes the main points of the internship, in a concise way. The student additionally provides a critical and convincing insight into future work, potentially including critique about the work done and how it could be improved, and the future impact on the field.*

### **Writing quality - 10%**

#### **Language**

This subcategory assesses both the correct use of proper English as well as scientific language.

**F:** *The student did not use grammatically correct English or proper scientific language, and the writing was hard to follow.*

**P:** *The student used proper language, but there were many mistakes and imprecise language.*

**G:** *The student used proper language. The student made few mistakes either in grammar or in the use of scientific language.*

**E:** *The student used proper language, and the language was easy to follow. The thesis was free of any noticeable mistakes.*

#### **Design**

This subcategory assesses the structure and visual quality of the thesis.

**F:** *The structure and quality of the thesis was poor and did not follow the template guidelines nor have a logical structure. In addition there were numerous formatting and/or context errors.*

**P:** *The structure and quality of the thesis was sufficient. It however contained multiple formatting and/or context errors.*

**G:** *The structure and quality of the thesis was sufficient. It also contained a minimum number of formatting and/or context errors.*

**E:** *The structure and quality of the thesis was outstanding. It also contained no formatting/context errors.*

### **References (thesis) - 5%**



## **Citations**

This subcategory assesses if all information is properly cited. This subcategory is graded on a three point scale: either fail, sufficient with many errors, or sufficient.