Writing Physics at University

GUIDES FOR WRITING IN SPECIFIC DISCIPLINES

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1 What is Physics?

Physics is the science that studies matter, its motion and behaviour through space and time, and the related magnitudes of energy and force. The main goal of physics is to understand how the universe behaves, from the subatomic scale to the cosmological scale, by formulating physical principles and laws, usually in a quantitative form. In general, the various areas of knowledge in physics can be encompassed into three broad areas: applied physics, fundamental physics, and astrophysics. The study of these fields includes two aspects: theoretical and experimental (or observational in the field of astrophysics).

2 General characteristics of writing in Physics

As in any collective work, the progress of scientific knowledge requires good communication of ideas, concepts and processes, whether addressed to the scientific community or to the general public. The guiding idea for an author writing a text on any subject should be, "What I can't explain to another, I don't really know."

Writing well in physics means expressing yourself clearly and without unnecessary details. It is necessary to use a simple and direct style, impartial and objective, which avoids confusion, ambiguous language, complicated sentences and an excess of subordinate clauses. The use of terminology, typical of scientific language, contributes to this because we refer to concepts in precise and unequivocal terms. However, depending on the communicative purpose and the reader, the degree of formality and the use of the terms vary to suit them. In general, the use of previously undefined notions in the text should be avoided, unless they are suggested by the context of the writing. Acronyms or abbreviations are sometimes used when you do not want to repeat the same set of words or a concept, although it is recommended not to overuse them if this makes the text more difficult to read.

While the use of the International System of Units (IS) is recommended, it is common to find that different fields of specialization employ the system of units commonly accepted by that community.

Texts in physics must be impartial and objective. They are organized following a hierarchy of logical sections and subsections with clear titles that give a brief idea of the common thread of the text. They detail the collection of data and how a physical law can be inferred from it or, in a more theoretical field, how results can be deduced from first principles. It is also important to link and compare one's own results with the work of other researchers (known as the *literature*).

An important aspect is to use verbal forms appropriately. In general, the present tense is used to state facts, and to analyse and discuss data. This is the verb tense that is most used in research articles. The past tense is used to describe experimental methods and specific observations, and to cite previously published results. The future tense is used to

refer to further research that the research group intends to develop as a result of the work presented.

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Care is necessary regarding the use of the active and passive voice. To begin with, if it is a text to be published, it is necessary to consult the style preferences of the journal before writing the manuscript. In general, it is good to combine the two voices, always pursuing communicative clarity and avoiding ambiguity. Thus, in some situations, the passive voice is recommended, because it helps to create a more formal, depersonalized and objective style, especially when the agents are unknown. On the other hand, the active voice creates a clearer and more direct style, while passive sentences can produce complicated structures that can make the text difficult to understand.

Impersonal writing often requires the passive voice, which can lead to difficult-to-understand or ambiguous sentences if used excessively. For this reason, the use of first-person pronouns (and the use of the active voice) is often recommended to make the meaning clearer, especially with regard to the authorship of the facts being explained.

A formal way to be more direct and less ambiguous is through impersonal, active sentences in which a third-person subject (e.g. the research team or research group) replaces the first-person pronoun (I or we). Thus, attention is maintained on the facts rather than on the researchers, especially when referring to their own results or conclusions.

In general, the use of subjective language, which can be questioned or interpreted in other ways, or the use of adjectives and adverbs that may insinuate personal ideas or beliefs should be avoided. It is always preferable to use concrete and specific language instead of abstract and confusing expressions.

3 Typical text types in Physics

Physicists usually write lab reports, research project proposals, reports on project results, literature reviews, records of experiments, informative texts and research articles. Below are some pointers on lab reports and research articles, as these are the most common texts produced by students and teaching staff, respectively.

Lab reports consisting of data collection from the non-computerized reading of devices should begin with a corresponding data table. This should include the experimental

uncertainties associated with data collection. The data tables must then be represented in appropriate graphs, taking care that names and units appear on the correct axes and scales of representation. A basic mathematical analysis is then needed to determine the purpose of the practice, which usually corroborates a physical law that has been studied in theory. When performing this analysis, the magnitudes and parameters of the analysis must be identified and the units and uncertainties associated with these parameters must be given. Finally, it is necessary to include some conclusions and bibliographical references.

Research article. Most of the literature in physics is related to research and consists of original articles that include detailed descriptions of the problem in question, the research that is related to it, the experimental methods used in it and the theoretical framework in which it is set. The results of the research should be carefully documented and the conclusions should be drawn after analysing, discussing and interpreting these results, comparing them with the literature. In order to follow these recommendations, the text is organized into logical sections with clear titles: abstract, introduction, methodology, results and discussion, conclusions, acknowledgements and bibliography.

Typically, a research article begins with a brief abstract that outlines the rest of the text. The purpose of this summary is to give the reader a general idea of the aspects mentioned so that they can read the full article if they want further information. The impersonal form is normally used in this section.

The introduction to a paper raises a research question and provides basic information to establish the importance of the research that will be presented in the article. To highlight its relevance, it also usually includes a brief and well-cited literature review of related research that has been done previously, either by the authors of the article themselves or other research groups. This background research makes the central issue of the article better defined. The introduction should also indicate the objectives of the research or a hypothesis, which can be confirmed or refuted by the results and conclusions reached. In many cases, the introduction also contains a description of how the rest of the article is structured.

In the case of experimental research, the experimental section (or section of materials and methods or instrumentation and methodology) shows all the resources and equipment that have been used in the research and details the experimental procedures in a way that allows other research groups to replicate the work. Therefore, in this case, this section must also include the relevant suppliers with the model or version number of material used. Sometimes the raw data and detailed procedures that support the experimental results are included in a separate section called *Additional Information*. In the case of astronomy, data processing is very important, which is why there is usually a section dedicated to data acquisition and another dedicated to reduction or processing, within the same body of the article. In a theoretical article, after the introduction, the fundamental assumptions on which the work is based are established and are often

accompanied by a brief explanation of the theoretical framework in which the research is developed.

The results and their analysis and discussion can be presented in a single section or in separate sections. The presentation is not simply a technical description of the procedures; the introduction should continue by explaining the research progress that ultimately leads to the final results. These results must then be analysed, discussed, and interpreted, comparing them with previous results that can be found in the literature. This discussion should allow the starting hypotheses to be confirmed or refuted. If a single section of results and discussion is used, each result is analysed and interpreted accordingly.

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In the conclusions section, a summary of the most relevant points of the article is made, the main objectives and results achieved are summarized, the importance of the work presented is highlighted again and, finally, the future lines of work are described. The first person plural is normally used in this section.

Finally, the references section details all sources used in the text. The order of the list of references and the format of each item depend on the style decided by the journal in which the article will appear. How these references are cited in the main body also depends on the style of the journal and may consist, for example, of a number in square brackets or a superscript.

The format described here for a research article is very similar to that of a bachelor's degree dissertation, a master's degree thesis or a doctoral thesis. The latter two types of thesis, however, tend to give more detail in both the background and developments, experimental or theoretical, and the particular aspects that the authors consider appropriate, as there is no limit to the length of the thesis.

4 Writing conventions in Physics

Formulas and quotients

Within a sentence, a formula should be treated as one more noun. Thus, if a formula appears in a separate line, it is not preceded by a colon. In the resumption of the text, after the formula, the lowercase is used. Like any other noun, it is governed by general punctuation rules and therefore can be followed by any punctuation mark. For example, if the formula matches the end of a paragraph, a full stop is written after it.

If you decide to include fractions and formulas in the same line of text, without taking up more space vertically, you should use parentheses when necessary to avoid confusion, for example, 4/(3a) instead of 4/3a.

Each element that makes up the fraction or formula must be specified and each symbol involved must be defined. These should be near to the fraction or formula. Sometimes it is also necessary to indicate the units because the constants of a formula can depend on the units of the variables.

Names of formulas, theories, principles, and laws are written in lower case except for proper names that are part of the denomination (Taylor's formula, Einstein's theory of relativity, Newton's third law, Van der Waals equation and the second principle of thermodynamics).

Particular characteristics of the symbols used in physics

The names of the units of measure are written in lower case and standard type. However, if a symbol comes from a proper name, the initial is capitalized. Unit symbols never have a full stop at the end [m (meter), s (second) or A (ampere)].

The symbols of the physical variables are, in general, a single letter of the Greek or Latin alphabet, uppercase or lowercase, which must be entered in italics (*T* for temperature, *I* for electric current intensity, *v* for frequency, *t* for time).

Physical constants are written in italics, whether in the Greek or Latin alphabets, and are written in uppercase or lowercase, depending on how the spelling is fixed. If these letters are accompanied by a subscript, it is written in standard text (k_B for the Boltzmann constant, *h* for the Planck action constant, α for the fine-structure constant).

Unit symbols never have a full stop at the end [m (meter), s (second) or A (ampere)].

Vectors and matrices can be written in italics and in uppercase or lowercase letters, depending on how the spelling is fixed (***B*** for the magnetic induction vector, ***I*** for the moment of inertia tensor, ***r*** for the position vector of a particle).

A space must be left between the quantity and the symbol of the unit (28 km, 35 °C, 54 %), except for the degree, minute and second angle symbols (32° 28' 14"). To prevent the figure from appearing separately from the symbol, it is recommended to use the nonbreaking space (Ctrl + Shift + spacebar in Word and   in HTML).

5 Works and websites of interest in Physics writing

1. *SI Brochure: The International System of Units* [online]. 9th ed. Sèvres: BIPM, 2019. Bureau International des Poids et Mesures. [https://www.bipm.org/en/publications/si-brochure]

International System of Units reference website, the most used system internationally.

2. *Biblioteca en Línia*. Barcelona: Termcat, Centre de Terminologia. [https://www.termcat.cat/en/biblioteca-en-linia/biblioteca-terminologica/arees-tematiques/%20F%C3%ADsica]

Glossaries of terms related to various physical disciplines (meteorology, physics, metrology, natural hazards, etc.) with equivalences in other languages.

3. *Así no se escribe* [online]. Instituto de la Ingeniería de España. [https://www.iies.es/single-post/asi-no-se-escribe]

Post created to help correctly write magnitudes, symbols, and measurement results in a clear and simple way.

4. *La simbologia i la formulació en els textos científics* [online]. Institut d'Estudis Catalans. Oficina de Correcció i Assessorament Lingüístics. [https://criteria.espais.iec.cat/2023/05/15/3-2-1-la-simbologia-i-la-formulacio-en-els-textos-cientifics-5/]

This website offers a guide for using symbols and formulae in scientific texts.

5. *Vocabulari de física*. Serveis Lingüístics i Comissió de Dinamització Lingüística de la Universitat de Barcelona. [https://www.ub.edu/ubterm/obra/fisica/]

The vocabulary contains the basic terms in the field of physics and presents them indexed in Catalan followed by translations into Spanish and English.

6. *Termes d'astrofísica*. Serveis Lingüístics i Comissió de Dinamització Lingüística de la Universitat de Barcelona. [https://www.ub.edu/ubterm/obra/astrofisica/]

It contains the basic terms in the field of astrophysics and presents them indexed in Catalan followed by translations into Spanish and English.

7. *Diccionari d'astronomia*. Serveis Lingüístics i Comissió de Dinamització Lingüística de la Universitat de Barcelona. [https://www.ub.edu/ubterm/obra/astronomia/]

The dictionary contains the basic terms in the field of and astronomy and presents them indexed in Catalan followed by translations into Spanish and English.

8. *Guide for Writing in Physics and Dual-degree Engineering*. Southwestern University. [https://www.southwestern.edu/live/files/4179-guide-for-writing-in-physicspdf]

This guide from Southwestern University in Texas has been designed to provide an introduction to the conventions, or rules, of writing in physics for students to use to complete assignments. It contains information about writing in physics: common types, research papers, conventions, citations and formatting, and common errors to avoid.

9. *CODATA Internationally Recommended 2018 values of the Fundamental Physical Constants*. The NIST Reference on Constants, Units, and Uncertainty. [https://physics.nist.gov/cuu/Constants/index.html]

Set of values of the fundamental physical constants recommended by CODATA for 2018 and published by the National Institute of Standards and Technology (USA).

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