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Quantities and units —

Part 10:
Atomic and nuclear physics

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www. iso. org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www. iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www. iso .org/iso/foreword. html.

This document was prepared by Technical Committee ISO/TC 12, *Quantities and units*, in collaboration with Technical Committee IEC/TC 25, *Quantities and units.*

This second edition cancels and replaces the first edition (ISO 80000-10:2009), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the table giving the quantities and units has been simplified;

— some definitions and the remarks have been stated physically more precisely;

— definitions in this document have been brought in line with their equivalent ones in ICRU 85a.

A list of all parts in the ISO 80000 and IEC 80000 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

0 Special remarks

0.1 Quantities

Numerical values of physical constants in this document are quoted in the consistent values of the fundamental physical constants published in CODATA recommended values. The indicated values are the last known before publication. The user is advised to refer to the CODATA website for the latest values, https://physics.nist.gov/cuu/Constants/index.html.

The symbol $\hbar$ is the reduced Planck constant, it is equal to $\dfrac{h}{2\pi}$, where h is the Planck constant.

0.2 Special units

1 eV is the energy acquired by an electron in passing a potential difference of 1 V in vacuum.

0.3 Stochastic and non-stochastic quantities

Differences between results from repeated observations are common in physics. These can arise from imperfect measurement systems, or from the fact that many physical phenomena are subject to inherent fluctuations. Quantum-mechanical issues aside, one often needs to distinguish between a *stochastic* quantity, the values of which follow a probability distribution, and a *non-stochastic* quantity with its unique, expected value (expectation) of such distributions. In many instances the distinction is not significant because the probability distribution is very narrow. For example, the measurement of an electric current commonly involves so many electrons that fluctuations contribute negligibly to inaccuracy in the measurement. However, as the limit of zero electric current is approached, fluctuations can become manifest. This case, of course, requires a more careful measurement procedure, but perhaps more importantly illustrates that the significance of stochastic variations of a quantity can depend on the magnitude of the quantity. Similar considerations apply to ionizing radiation; fluctuations can play a significant role, and in some cases need to be considered explicitly. Stochastic quantities, such as the energy imparted and the specific energy imparted (item 10-81.2) but also the number of particle traversals across microscopic target regions and their probability distributions, have been introduced as they describe the discontinuous nature of the ionizing radiations as a determinant of radiochemical and radiobiological effects. In radiation applications involving large numbers of ionizing particles, e.g. in medicine, radiation protection and materials testing and processing, these fluctuations are adequately represented by the expected values of the probability distributions. "Non-stochastic quantities" such as particle fluence (item 10-43), absorbed dose (item 10-81.1) and kerma (item 10-86.1) are based on these expected values.

This document contains definitions based on a differential quotient of the type $\mathrm{d}A/\mathrm{d}B$ in which the quantity A is of a stochastic nature, a situation common in ionizing radiation metrology. In these cases, quantity A is understood as the expected or mean value whose element ΔA falls into element ΔB. The differential quotient $\mathrm{d}A/\mathrm{d}B$ is the limit value of the difference quotient $\Delta A/\Delta B$ for $\Delta B \to 0$. In the remarks of the definitions falling in this category, a reference to this paragraph is made.

Quantities and units —

Part 10: Atomic and nuclear physics

1 Scope

This document gives names, symbols, definitions and units for quantities used in atomic and nuclear physics. Where appropriate, conversion factors are also given.

2 Normative references

There are no normative references in this document.