# The Mathematical World

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The measurement value of a quantity arises in the judgement of a single observer, in the synthesis of a sensible intuition (an immediate representation upon observation) and a mathematical concept conceived for the purpose. The value is then objectively and universally valid. Values judged for various notable physical quantities are presented in terms of the author's concept. A consistent mathematical system (the Mathematical World) built from valid mathematical statements made in the phenomenal world of our experience is hypothesised to underlie the phenomenal world and to regulate cognition in order to maintain the consistency of all measured values and their interrelationships. The Mathematical World is the analogue of Kant's noumenal world, which is the world as it is in itself, independent of human perception.

## 1 Introduction

Kant argued that cognition is acquired in the synthesis of a *sensible intuition* (an immediate representation of an object given through the senses) and an a priori (independent of experience) *concept of the understanding* [1]. According to Kant, the a priori concepts of the understanding (the 'categories') are common to all human beings, so that objects are *judged*[1] the same way by all. What is shown here, though, is that a measurement value (a number with a unit, i.e., a denominate mathematical *object*) is a judgement of *one person*, i.e., it is judged in the synthesis of an intuition upon observation and a mathematical concept in the 'understanding' of that person. The value so cognised is objectively and universally valid.

The author's most frequently used concept declares that the numerical value of a measurement (in any units) is equal to a rational power of $\pi/2$ [2, 3]. The numerical value of an *interesting measurement*[2] is often judged by the cogniser to be an integer power of $\pi/2$ or even a special integer power of $\pi/2$, as we will see. An additional concept allows that the power of $\pi/2$ is multiplied by an interesting constant, typically a power of $\alpha$, the fine structure constant, which provides the understanding with

[1] Judgement is Kant's term for the 'mediate cognition of an object', the act of subsuming the particular (an intuition) under a general rule (a concept).
[2] A measurement made of a quantity that draws the attention of the cogniser.

greater scope with which to judge the value. This expedient was learned from the relationship in Planck units between two 'interesting' quantities: the Bohr radius and the electron mass, that is, $a_0 = 1/(\alpha m_e)$.

The method is outlined by which the values of measurements are cognised. Example results are then shown. A discussion follows.

## 2 Method

The numerical value, *N*, of the measurement[3] is mapped to another number, *n*, that is located within a notional infinitely-divisible discrete framework of rational numbers. The function $f: N \rightarrow \ln(\mathrm{N})/\ln(\pi/2)$ is used to map *N* to *n*, and then because the inverse function $f^{-1}: n \rightarrow (\pi/2)^n$, maps *n* back to *N*, we see that $N = (\pi/2)^n$ and that *N* is equal, at least notionally, to a rational power of $\pi/2$, in accordance with the concept. The numerical value of a particularly interesting measurement is judged, based on experience [4], to be equal to an integer power of $(\pi/2)^{25}$, in some instances combined with a multiplication factor.

## 3 Example Results

The values judged by the author for the authoritatively-evaluated *central values* of various interesting physical quantities are shown in Table 1. To be clear, the values are of the same magnitude in both columns of the table. A value in the first column is that anyone will see in, for example, the Particle Listings of the Particle Data Group [5]. A value in the second column is as judged by the author in order to cognise the *appearance*[4] of the value.

Values of particle mass and decay width are the current (as of July 2026) evaluations of the Particle Data Group [5]. The values of the Planck mass, Bohr radius and Rydberg constant are the (current) CODATA 2022 recommended values. The total mass plus energy (mass equivalent) of the observable universe (radius 46.5 Glyr) was calculated for a critically dense ($1.87834 \times 10^{-29}\, h^2.\mathrm{g.cm}^{-3}$; $h = 0.674$ [6]) universe.

[3] The measurement value is as observed in the reference or as observed after a change of units.
[4] Kant's term for an object of sensible intuition.

In the expressions produced in judgement by the author and presented in Table 1 all figures in the exponents of $\pi/2$ are significant with respect to the central values of evaluation. The exponents of $\alpha$ and 2 are exact. The mass of the Higgs boson was found in relation to the magnitude of the Bohr radius [7]. The expression for the mass plus energy of the observable universe was found during calculation of the power of $\pi/2$ [7].

| **Measured quantity** | **Quantity as judged by the author** |
|---|---|
| top quark mass (172.60 GeV) | $(\pi/2)^{-125.0}$ kg |
| charm quark mass (1.2729 GeV) | $\alpha(\pi/2)^{-125.0}$ kg |
| up quark mass (2.16 MeV) | $(\pi/2)^{-150.0}$ kg |
| Planck mass ($2.176434 \times 10^{-8}$ kg) | $\alpha^{-1}(\pi/2)^{-50.0}$ kg |
| Higgs boson mass (125.13 GeV) | $2^{25}(\pi/2)^{-125.00}$ Planck masses |
| electron mass (0.51099895069 MeV) | $\alpha^{-1}(\pi/2)^{-125.00}$ Planck masses |
| Mass + Energy of the observable universe ($3.04 \times 10^{54}$ kg) | $\pi^{125.00}$ Planck units |
| Bohr radius ($5.29177210544 \times 10^{-11}$ m) | $(\pi/2)^{125.00}$ Planck lengths |
| Radius of the observable universe (46.5 Glyr) | $\alpha^{-1}(\pi/2)^{125.0}$ m |
| W boson mean life ($3.08 \times 10^{-25}$ s), calculated from a decay width of 2.14 GeV. | $(\pi/2)^{-125.0}$ s |
| Rydberg constant, $R_\infty$ (10973731.568157 $m^{-1}$) | $\alpha^{-1}(\pi/2)^{25.00}$ $m^{-1}$ |

**Table 1:** The measured values of some physical quantities, and the author's judgements of them

## 4 Discussion

In Kantian terms, the values of the measurements considered here have arisen in the judgement of one person: in the synthesis of sensible intuition and concept, mediated by the imagination. Since the numerical values of the measurements are necessarily constructed from rational numbers and familiar constants, cognition is facilitated and the measurement values are eminently understandable in terms of the mathematical concept. As judged, the measurement values are objectively and universally valid, they are consistent with all other values and they are mathematically intelligible. It seems that

knowledge of the value of a physical quantity is gained in cognition through the proper understanding, via a concept, of a sensible intuition of the measured value. The values of physical quantities in the phenomenal world reflect the judgements of human beings in general.[5]

Clearly, the values of the measurements considered here had not previously been judged in the synthesis of sensible intuition and mathematical concept or they would not have taken such distinctive values in terms of the author's concept. That they took such values *before* the author's cognition of them is consistent with Kant's view of time as an a priori form of sensible intuition that structures human experiences.

It seems that underlying the *phenomenal world* is a consistent mathematical system (the *Mathematical World*) that embodies all valid mathematical statements, including those about physical quantities and their interrelationships[6] that are produced through the cognitive processes of human beings. The Mathematical World regulates cognition to ensure the validity of mathematical statements made in the phenomenal world. The Mathematical World is analogous to Kant's noumenal world: the world as it is in itself, independent of our perception.

## 5 Conclusions

1. A measurement value is a judgement of one person, made in the synthesis of a sensible intuition and a mathematical concept.
2. The measurement values considered here are necessarily constructed from rational numbers and familiar constants, which facilitates cognition and ensures a measurement value is understandable in terms of the concept.
3. When cognised (by one person), measurement values are objectively and universally valid.
4. That the values of the physical quantities considered here may be expressed intelligibly in terms of the author's concept subsequent to their measurement is consistent with Kant's view of time as an a priori form of sensible intuition that structures human experiences.
5. The Mathematical World, the analogue of Kant's noumenal world, underlies the phenomenal world, embodies all valid mathematical statements produced in cognition, and regulates cognition to maintain consistency in the phenomenal world.

[5] It should be noted that the randomness of a quantity is also a judgement.

[6] Apparently unrelated physical quantities have been shown in [8] to be interrelated mathematically, demonstrating the power of the imagination in cognition.

**References**


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