

6046 pdf
GEMBILLO, G.
2007

World Futures, 63: 38–41, 2007
Copyright © Taylor & Francis Group, LLC
ISSN 0260-4027 print / 1556-1844 online
DOI: 10.1080/02604020600948958

 **Routledge**
Taylor & Francis Group

ANALOGY BETWEEN THE THEOREM OF PYTHAGORAS AND THE RELATIONS OF UNCERTAINTY OF HEISENBERG

GIUSEPPE GEMBILLO

Department of Philosophy, University of Messina, Messina, Italy

In this work I propose an analogy between Pythagoras's theorem and the logical-formal structure of Werner Heisenberg's "relations of uncertainty." The reasons that they have pushed to me to place this analogy have been determined from the following ascertainment: Often, when in exact sciences a problem of measurement precision arises, it has been resolved with the resource of the elevation to the square. To me it seems also that the aporie deriving from the uncertainty principle can find one solution with the resource to this stratagem. In fact, if the first classic example of the argument is the solution of the incommensurability between catheti and the hypotenuse of the triangle rectangle, one of the last cases is that which is represented from Heisenberg's principle of uncertainty.

KEYWORDS: *Heisenberg, Pythagoras, relations, theorem, uncertainty.*

PRELIMINARY STATEMENT

Werner Heisenberg always looked for the metaphysical foundations of the scientific theories and for the background from which the theories originated. During this quest, Heisenberg was charmed by the symbolic and explicative power of geometric figures, especially of triangles. In this respect, he was strongly influenced by the pages of Plato's *Timaeus* in which the Greek philosopher wrote that "the demiurge makes physical elements from elementary triangles."

I think that Heisenberg would have been even more fascinated if he had discerned an analogy, in my opinion very interesting, between the specific properties of a particular triangle and the logical-formal structure of the "relations of uncertainty."

EXPLANATION

The triangle that shows some analogy with Werner Heisenberg's relations of uncertainty is the triangle that makes the formulation of the theorem of Pythagoras possible.

I will show the analogy beginning from universally accepted principles.

Address correspondence to Giuseppe Gembillo, Department of Philosophy, University of Messina, via Concenzione 10, 98122 Messina, Italy. E-mail: gembillo@unime.it

ANALOGY BETWEEN THE THEOREM OF PYTHAGORAS AND THE RELATIONS OF UNCERTAINTY OF HEISENBERG

GIUSEPPE GEMBILLO

Department of Philosophy, University of Messina, Messina, Italy

In this work I propose an analogy between Pythagoras's theorem and the logical-formal structure of Werner Heisenberg's "relations of uncertainty." The reasons that they have pushed to me to place this analogy have been determined from the following ascertainment: Often, when in exact sciences a problem of measurement precision arises, it has been resolved with the resource of the elevation to the square. To me it seems also that the aporie deriving from the uncertainty principle can find one solution with the resource to this stratagem. In fact, if the first classic example of the argument is the solution of the incommensurability between catheti and the hypotenuse of the triangle rectangle, one of the last cases is that which is represented from Heisenberg's principle of uncertainty.

KEYWORDS: Heisenberg, Pythagoras, relations, theorem, uncertainty.

PRELIMINARY STATEMENT

Werner Heisenberg always looked for the metaphysical foundations of the scientific theories and for the background from which the theories originated. During this quest, Heisenberg was charmed by the symbolic and explicative power of geometric figures, especially of triangles. In this respect, he was strongly influenced by the pages of Plato's *Timaeus* in which the Greek philosopher wrote that "the demiurge makes physical elements from elementary triangles."

I think that Heisenberg would have been even more fascinated if he had discerned an analogy, in my opinion very interesting, between the specific properties of a particular triangle and the logical-formal structure of the "relations of uncertainty."

EXPLANATION

The triangle that shows some analogy with Werner Heisenberg's relations of uncertainty is the triangle that makes the formulation of the theorem of Pythagoras possible.

I will show the analogy beginning from universally accepted principles.

Address correspondence to Giuseppe Gembillo, Department of Philosophy, University of Messina, via Concenzione 10, 98122 Messina, Italy. E-mail: gembillo@unime.it

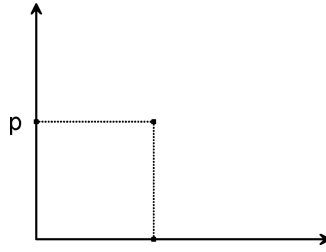


Figure 1. The Cartesian coordinates.

In classic mechanics, the position and the velocity of a body are represented, as it is well known, by the Cartesian coordinates, conjugating themselves at the intersection of their projections (Figure 1).

As a consequence of the relations of uncertainty, which prohibit the exact determination of the position and of the velocity of an elementary particle, “canonically conjugates,” this representation is not valid in quantum mechanics.

However, the Cartesian coordinates, valid in classical mechanics, were not replaced by any other representation in quantum mechanics. I suggest that we employ the Cartesian coordinates even in quantum mechanics, but with a fundamental change: I propose that we replace the projections of the points that in the Cartesian coordinates represent the position and the velocity, with the diagonal connecting the points themselves (Figure 2).

This way, the classic right-triangle is obtained. It represents the relations of uncertainty: the total amplitude of the probability of the contemporary determination of position and velocity of an elementary particle is not represented by the usual “point,” but by the square constructed on the line that joins the points indicating the position and the velocity of the elementary particle; this line is equivalent to the hypotenuse of the “constructed” right-triangle. The particular determination of the position *or* of the velocity, instead, is obtained from the squares constructed on the respective cathetuses.

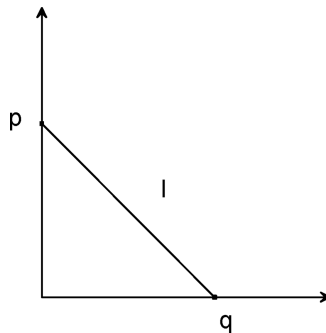


Figure 2. The diagonal connecting the points representing the position and the velocity.

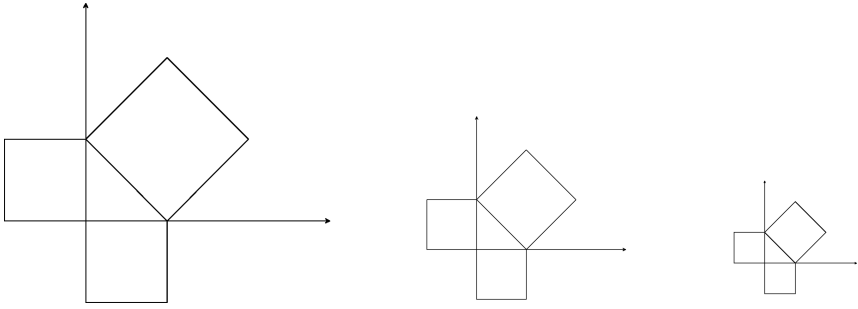


Figure 3. The relation remains constant.

When the triangle takes the isosceles configuration, the approximation of the individual values is equitably distributed, that is,

$$p^2 = \frac{1}{2}I^2; \quad q^2 = \frac{1}{2}I^2.$$

As long as we try to approximate the value of the conjugate variables, we shall always have an isosceles triangle. This confirms that the relation remains constant (Figure 3).

The process will be terminated only by the nullification of the distinction between the indication of position and the indication of velocity at the “zero point.”

However, if we determine accurately only one of the values, the triangle immediately undergoes a variation of the cathetutes, as a consequence of the relative determination (Figure 4).

As we approach the determination of an individual value (e.g., q) the amplitude of the probability of the correlated value (i.e., whereas its “indeterminacy”), represented by the square constructed on the corresponding cathetus, increases, whereas the relation remains constant.

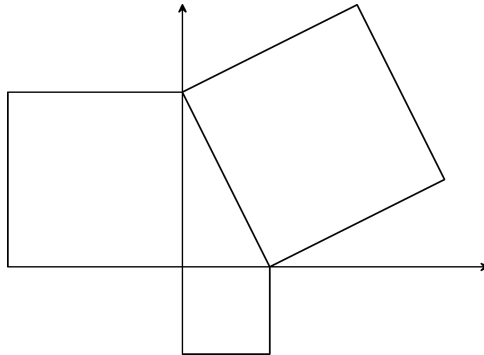


Figure 4. The variation of determination.

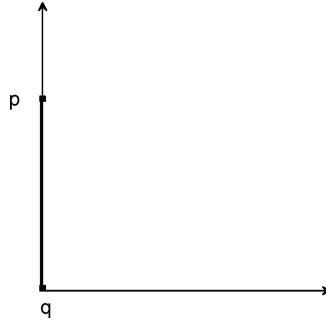


Figure 5. The triangular configuration vanishes.

When we determine the value of q to the zero point, the triangular configuration vanishes and, with it, the relation itself, as Heisenberg demonstrated (Figure 5).

We have now shown the analogy; we still have to tackle two unsolved problems: (1) The role maintained by Cartesian coordinates; and (2) the reason for the analogy itself.

With regards to the former, we can observe that *the same relationship* found and formalized by Niels Bohr by means of the principle of correspondence persists: as the classical physics is a “borderline case” of the quantum physics, equally the point of intersection of the Cartesian coordinates remains always inside the square constructed on the hypotenuse (Figure 6) and it is too a borderline case.

With regards to the latter problem, which concerns “the reason to be” of the analogy, I think that it is explained by the fact that the hypotenuse assumes the role of Planck’s constant.

The analogy with the constant h shows that if the *sum* of the squares constructed on the cathetuses is equal to the square constructed on the hypotenuse (i.e., $p^2 + q^2 = I^2$), the *product* of these squares is always higher than the constant h ($p^2 \cdot q^2 \sim I^2$). Therefore, as Heisenberg showed:

$$p_1 \cdot q_1 \sim h$$

This condition explains the analogy and makes it noteworthy.

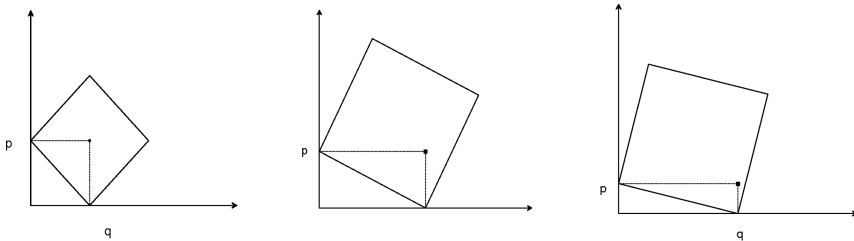


Figure 6. The point of intersection of the Cartesian coordinates remains always inside the square.

Copyright of *World Futures: The Journal of General Evolution* is the property of Routledge and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.