

**THE CORRESPONDENCE BETWEEN MATHEMATICAL ENTITIES
AND PHYSICAL REALITY
(Werner Heisenberg and Twentieth Century Physics)**

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Abstract:

Without any doubt, Quantum Mechanics and Relativity represent the most important contributions of twentieth century to Theoretical Physics. With their aid, it has been possible to construct a new image of matter, space and time. The Wave Mechanics based on Schrödinger's equation was to become the most popular formulation of the new Quantum Mechanics. But even before Schrödinger published his equation, an alternative formulation of Quantum Mechanics had been conceived by Werner Heisenberg (1901-1976). This alternative was called Matrix Mechanics. Heisenberg's point of departure was his conviction that in the atomic realm classical quantities-such as x, y, z and p_x, p_y, p_z – are meaningless, since they cannot be measured. He therefore decided to replace these classical quantities by some new quantities directly related to the quantum-mechanical stationary states. Since the observable frequencies emitted in transitions always involve the differences between the energies of two states, Heisenberg guessed that the relevant new quantities (matrices) ought to depend on two states. This famous German theoretical physicist, has the right to be considered among the most inspired and audacious discoverers of the new frontier in knowledge. In our work, which appears in the World Year of Physics (WYP-2005), declared also as "Einstein Year", we wish to underline the lucidity and the foresight of all his contributions to the new Mechanics of micro-objects that was born 80 years ago. So we could better seize the remark made by Niels Bohr, according to whom "Heisenberg was the creating genius of the fundamentals of Quantum Mechanics".