Einstein Equivalence Principle: A Special Case of Zero-Totality

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Abstract. Duality, both mathematical and physical, has several different meanings. The most intriguing duality with the longest history of investigation from the classical period to modern physics is wave-particle. In projective geometry, mathematical logic, and linear optimization we find the *symmetry* of the roles played by points and lines, De Morgan's laws, and dual theorem spaces. In physics, especially electromagnetism and string theory, dualities are derived from special relativity by applying the Lorentz transformation to the electric field where it becomes transformed into a magnetic field. Bohr regarded wave-particle duality as a paradox but yet a fundamental law of nature. Einstein considered waves and particles as contradictory pictures of reality and although his search, in the tradition of Newton and Maxwell, for unification failed it continues as a desired goal. Terms used in the unification attempt can be rather misleading. *Equivalences*, *dualities, symmetries*, *correspondences*, and *conservation laws* are sometimes used interchangeably. The relationship between continuous gravitational fields and discrete gauge forces is called an AdS/CFT correspondence, or a gauge-gravity duality, requiring extra compactified dimensions appearing as quantum gravity. In this paper we will show how a foundational principle of general relativity which equates gravitational mass to inertial mass, the Einstein Equivalence Principle, not only satisfies a zero-totality condition but can also be regarded as duality in the Rowlands sense. Discrete particles are obviously not *equivalent* to continuous waves and dual theories are needed to explain both types of phenomena. In this paper we will also investigate why theories which attempt to unite phenomenon that are continuous (wave, time, electric, kinetic, gravitational) with those that are discrete (particle, space, magnetic, potential, inertial) generally fail.

Keywords: Zero-Totality, Rowlands Duality, Continuity, Discreteness, Einstein Equivalence Principle, Maldacena Correspondence.

1. Overview

De Broglie [1] wrote in 1970:
"When I conceived the first basic ideas of wave mechanics in 1923–24, I was guided by the aim to perform a real physical synthesis, valid for all particles, of the coexistence of the wave and of the corpuscular aspects that Einstein had introduced for photons in his theory of light quanta in 1905."

In 1926, Erwin Schrödinger published an equation describing how a matter wave should evolve—the matter wave analogue of Maxwell's equations—and used it to derive the energy spectrum of hydrogen.

At the Fifth Solvay Conference in 1927, Max Born and Werner Heisenberg [2] stated:
"*If one wishes to calculate the probabilities of excitation and ionization of then one must introduce the coordinates of the atomic electrons as variables on an equal footing with those of the colliding electron. The waves then propagate no longer in three-dimensional space but in multi-dimensional configuration space. From this one sees that the quantum mechanical waves are indeed something quite different from the light waves of the classical theory atoms*."

References

[1] Louis de Broglie "The Reinterpretation of Wave Mechanics" Foundations of Physics, Vol. 1 No. 1 (1970).
[2] M. Born, *Zur Quantenmechanik der Stossvorgange, Z. f. Phys*., 37 (1926) 863; [*Quantenmechanik der Stossvorgange*], ibid., 38 (1926), 803.