100 Years of Complementarity

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Einstein in 1905, in his explanation of the photoelectric effect, postulated that light, the quintessential wave, had to possess particle-like properties. In the course of 1923-24, de Broglie, analyzing electron scattering from metal surfaces, postulated that electrons, the quintessential particles, must possess wave-like properties. In 1928, Bohr made the first attempt to reconcile the two viewpoints and introduced the concept of complementarity (or, in a more restricted sense, wave-particle duality), and thus the by now nearly 100 years history of complementarity has started. We will overview the history [1-5] and present recent results [6-12], highlighting that to complete complementarity, besides wave and particle features (which have classical counterparts), a third, truly quantum, reality, entanglement, must be included.

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