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Are Quantum Objects Born with Duality?[1] XIAOFENG QIAN, Stevens Inst of Tech, GIRISH AGARWAL, Texas AM University — Single-particle two-path interference has been the dominant scenario employed for analyzing and testing quantum wave-particle duality. It can be regarded as a process of regenerating the quantum object (e.g., a photon, an electron, an atom, etc.) with a two-center source. A natural question arises: will this regeneration process affect the wave and particle natures of the quantum object? To address this question, we analyze the duality property of a photon in relation to the properties of its actual two-point source, i.e., a pair of non-locally entangled two-level atoms. Surprisingly, the photon's duality is found to be solely controlled by the state coherence of the atomic source through an exact Pythagorean relation, $V^2 + D^2 = \mu_S^2$, where V and D are the single photon's interference visibility and which-way distinguishability respectively and μ_S is the source state purity. Our analysis opens a new perspective of investigating and understanding quantum duality.

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