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Exploring the states of light: from photon counting to quantum information

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Forty years ago, the seminal papers of Roy Glauber have given a complete analysis of photon counting and light coherence, combining in a single theoretical framework a description of the granular and wave-like features of radiation. Glauber's theory has since then explained countless landmark experiments in quantum optics and has become an essential tool to understand the role played by photons in the physics of quantum information. We will describe a few experiments which illustrate the importance of Glauber's work in modern quantum optics. In addition, we will stress that complementary wave and particle behaviors are not restricted to light. They are also exhibited by atomic matter in Bose Einstein condensates. As we will see, Glauber's formalism of coherent states and particle counting has also found a remarkable testing ground in this new domain of research at the boundary between atomic and condensed matter physics.