Corpuscular Explanation of the Interference Patterns Between Field Modes

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In this talk I would like to discuss an explanation of the patterns of interference between two or more field modes based on the corpuscular character of electromagnetic radiation (or mechanical waves) and the use of entangled states [1]. Based on R Glauber's photodetection theory, we show that this is possible when we analyze the interference patterns from a microscopic view of the interaction between multiple modes of the field and the screen (or detector, which can be described by a two-level system). We then show that, at the points where we identify as destructive interference (and usually interpreted as points of absence of light), there is actually light but in collective states that do not couple with the detector, which we call dark states of the field. As a consequence of this new explanation, we show that in double-slit experiments with a single photon, the photon can always go to the dark regions, even in the absence of an observer (detector) who tells us which slit the photon passed through. In other words, with or without an observer, the photon never changes its trajectory towards the dark spots, it only changes the state it is in, going from an undetectable state to a detectable one when an observer is introduced.

References

[1] C J Villas-Boas, C E Máximo, P P de Souza, R Bachelard and G Rempe, arXiv:2112.05512v2 (2024)