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Interference of distinguishable photon states

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Intensity fringes are characteristic features of optical interference between spatially coherent fields. At the quantum level, interference expresses the distinguishability of a given observable. A classic illustration is Young's double slit experiment; the two slits are indistinguishable, causing the two paths taken by a single photon to interfere on a screen. However, the ability to measure interference is determined by the uncertainty of the detector. In the case of Young's double slit, Heisenberg position-momentum uncertainty determines the bounds of interference visibility, and thus the photon distinguishability. Here, we exploit a variant of Heisenberg uncertainty principle, a time-energy uncertainty, to demonstrate a quantum in energy and time, using distinguishable photons. The identity of photons as quanta of energy is generally encapsulated in the photon energy . However, a coherent superposition of distinguishable frequency states leads to interference in time which, manifests itself as a frequency beat that can only be observed, so long as it occurs within the detector's time uncertainty. We show that by marking the frequencies with polarisation, we can erase or unravel the frequency information, controlling the visibility of the frequency beating.

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Level for award
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PhD

Main supervisor (name and email)
and his / her institution

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No

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