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Wave-particle duality of states of partially distinguishable particles

The dynamics of systems of identical particles is characterised by many-particle interference effects which vanish if the constituents are rendered distinguishable by assigning them a label. We consider the intermediate situation of partially distinguishable particles and establish a connection between the crossover from wave- to particle-like behaviour and Bohr‚Äôs complementarity principle as illustrated by the double-slit experiment with which-way detectors. The wave character of the state is related to its coherence after tracing out the label degree of freedom, while the particle character is measured by the ability to discriminate between labels. These two properties are shown to obey complementarity relations which constrain the results of general interference experiments.

References

Christoph Dittel, Gabriel Dufour, Gregor Weihs, Andreas Buchleitner, arXiv:1901.02810