

Patterns of interfering massive particles

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Two-particle interference has been the focus of many studies, specifically in quantum optics with photons. However, interference between two massive, identical particles is not so well understood. In a study published in *European Physical Journal D*, Pedro Sancho from the CLPU (Centre for Pulsed Lasers) in Salamanca, Spain, uncovers a counterintuitive result whereby particles called bosons do not behave as expected—they are overlapping, and not interfering—due to the combination of interference and so-called exchange interaction. The latter is a quantum mechanical effect that alters their symmetry when identical particles are exchanged.

The paper studies [interference patterns](#) of [massive particles](#); namely bosons and fermions. The author uses two massive particle beams directed towards two slits to perform a quantum interference experiment.

The trouble is that it is very difficult to evaluate the diffraction patterns of particles endowed with a mass, unlike the interference of massless photons. Indeed, only highly complex analytical equations can describe such phenomenon. Instead, simpler, numerical methods or analytical approximations, such as those based on the Gaussian slit approximation introduced by Feynman, are better suited to tackling this problem. Using such an approach, Sancho found that the sometimes large overlapping occurring between two bosons does not lead to strong interference associated with exchange effects.

Instead, the author obtains a pattern typical of distinguishable bosons,

corresponding to a negligible degree of overlapping and no interference. This contrasts with findings in [quantum optics](#) experiments where the photons must be completely undistinguishable, or fully overlapping, to obtain the maximum visibility in the interference patterns.

Ultimately, this type of [interference](#) experiment, once tested with multiple slits, could be used to provide a source of identical particles in precision tests in the quantum realm.

More information: P. Sancho (2014), The two-particle two-slit experiment, *European Physical Journal D*, [DOI: 10.1140/epjd/e2013-40743-7](#)

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