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Distinguishing time-reversible from time-irreversible processes with Interference patterns.[1] ZILIN CHEN, PETER BEIERLE, HERMAN BATELAAN, University of Nebraska - Lincoln — In interference experiments, coherence is often incomplete. Coherence can be lost by dephasing or decoherence processes. The former is associated with time-reversible processes, while the latter is associated with time-irreversible processes. Even though there is a significant difference, the interference patterns appear similar; the pattern are more or less washed out. Entropy is a convenient measure of time reversibility. However, to determine the entropy, the coherence terms, i.e., the off-diagonal elements of the density matrix, need to be known. At first glance, it seems not possible to determine the reversibility from an interference pattern that provides only knowledge of the diagonal elements of the density matrix. Inspired by the lens-less imaging experiments by Gao et al.[1], we show by theoretical analysis that the spatial correlation function of repeated measurements of the interference pattern allows one to assess the reversibility. The second-order correlation function is proportional to the Fourier transformation of the spatial pattern of the double slits, but only if a dephasing process disturbs the wave. For a decoherence process the interference pattern is not recovered. This provides a method to establish time-reversibility, or the absence thereof, in matter-wave experiments. [1] Rui-Feng L, Xin-Xing Y, Yi-Zhen F, et al. Subwavelength Fourier-transform imaging without a lens or a beamsplitter[J]. Chinese Physics B, 2014, 23(5): 054202.

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