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Coherent matter-wave manipulation techniques

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Abstract:

Modern quantum nanotechnology relies on the coherent manipulation of matter-waves in numerous different applications. From diffraction experiments with electrons to neutrons, atoms and molecules different types of coherent beam splitters are used. In this work an important method for coherent manipulation of massive molecular matter-waves is discussed that is the diffraction at a single grating. Such diffraction masks are made from purely absorptive nano mechanical gratings as well as from standing light-waves. For both techniques I discuss the relevance of the internal molecular properties for the matter-wave dynamics. For material gratings a detailed analysis of dispersive forces and the resulting phase shift on the matter-wave is given. Additionally, different methods to realize optical gratings are examined with regard to new molecular diffraction mechanisms. Possible challenges on the way to power enhanced UV-gratings in high vacuum are identified. This technology may allow for conformer changing gratings in the future.