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Effective Long-Range Interactions for Charged Particles in Confined Curved Dimensions PETER SCHMELCHER, ALEXANDRA ZAMPETAKI, SVEN KROENKE, JAN STOCKHOFE, Centre for Optical Quantum Technologies, University of Hamburg, Luruper Chaussee 149, 22761 Hamburg —
We explore the effective long-range interaction of charged particles confined to a curved low-dimensional manifold using the example of a helical geometry. Opposite to the Coulomb interaction in free space the confined particles experience a force which is oscillating with the distance between the particles. This leads to stable equilibrium configurations and correspondingly induced bound states whose number is tunable with the parameters of the helix. We demonstrate the existence of a plethora of equilibria of few-body chains with different symmetry character that are allowed to freely move. An outline concerning the implications on many-body helical chains is provided. We explore the effects arising due to the coupling of the center of mass and relative motion of two charged particles confined on an inhomogeneous helix with a locally modified radius. For an inhomogeneous helix, the coupling of the center of mass and relative motion induces an energy transfer between the collective and relative motion, leading to dissociation ofinitially bound states in a scattering process. Due to the time reversal symmetry, a binding of the particles out of the scattering continuum is thus equally possible. We identify the regimes of dissociation for different initial conditions.

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