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EMERSON SADURNÍ: Extended quantum particles in free fall: Analytical treatment of their diffraction

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The diffraction of atomic and molecular beams is typically described by non-trivial solutions of the stationary Schroedinger equation. This has been done for structureless particles in the absence of external fields. In this contribution, the techniques that incorporate both internal composition and a gravitational field are presented. A derivation of the corresponding propagator is provided without approximations, identifying the center-of-mass propagation coordinate with a pseudo-time. In the paraxial regime –borrowed from optics– it is shown that a superposition of Moshinsky functions with internal molecular states gives rise to corrected diffraction patterns in the far, intermediate and near field regions along the optical axis. The limit of small molecular radii in diatomic harmonic models is discussed. Single and multiple slit diffraction patterns are studied, displaying corrections to the emergent Talbot carpets. Implications on quantum tests of the equivalence principle are briefly reviewed in this light, showing that modified probability densities arise when small deviations from unity of the inertial-to-gravitational mass ratio are considered.

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