Title:	NONINERTIAL EFFECTS IN QUANTUM SYSTEMS
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Abstract:	The essence of many of the phenomena at the interface of quantum theory and general relativ- ity can be studied under the much simpler setting of quantum physics in noninertial reference frames. But, as their gravitational counterparts, the noninertial effects in quantum systems are usually feeble, requiring large accelerations to be observable in traditional settings. In the first part of this thesis we address the question of how to isolate and desirably enhance noninertial effects in quantum systems so that they can be probed with current or near-future technology. We deploy theoretical techniques from quantum optics, cavity-QED, open quantum system dynamics, and the response of correlated quantum systems to tap into the latest experimental advances in quantum measurement techniques and determine optimal setups in which weak effects such as the ones mentioned can be detected. To this end, we study quantum effects such as the geometric phase and radiative shifts in atomic spectra in noninertial setups inside an electromagnetic cavity. The geometric phase is an observable of interest due to its sensi- tive and accumulative nature. At the same time, radiative shifts hold interest due to intense experimental activity surrounding atomic spectroscopy and the resultant high-precision mea- surements of the spectral lines. We show that both the geometric phase and radiative shifts lend themselves to the detection of noninertial effects in laboratory settings. In the second part of this thesis, we study an atom interacting with a general quantum electromagnetic field state in flat spacetime. We show that atomic emission and absorption profiles, and momentum transferred to or from the atom can be written in terms of the initial state expectation value of a real, positive operator. Further, using the atomic emission and absorption profiles, we characterize field states which lead to a non-zero force on the atom. We study the absorption and emission processes for the pulsed Fock and Coherent states of the field in detail. This study forms a stepping stone for a more general study of atom-field interaction in curved spacetime, which becomes essential with the growing interest in space- based quantum communications and technologies
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