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Spin-Orbit Coupling for a Neutral Atom inside a Ring Cavity FAROKH MIVEHVAR, DAVID FEDER, IQST, University of Calgary — The spin-orbit (SO) interaction in solids, the coupling of an electron's center-of-mass momentum to its spin degrees of freedom, can give rise to fascinating new quantum states. These include topological insulator (TI) states, which are similar to quantum Hall states but require no external magnetic fields. Very recently, artificial SO interactions have been induced in ultracold neutral atomic gases through resonant Raman couplings. We build on these methods to show how to induce a SO interaction for a neutral atom confined inside a ring cavity. This is effected by coupling three internal states of the atom to two counter-propagating ring-cavity modes in the Λ scheme. Unlike a linear cavity, ring cavities support traveling modes which allow momentum transfer between a photon and an atom. The scheme is able to simultaneously generate an adjustable artificial magnetic vector potential. Combined with strong cavity-mediated atom-atom interactions, this approach could readily yield strongly-correlated TI states in cavity QED.

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