MAR13-2012-020386

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Quantum Hall physics with light

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Quantum Hall physics provides a variety of novel phenomena in both the integer and fractional domain, with applications in metrology, technology, and quantum computation. I will discuss implementing quantum Hall physics with optical systems by means of synthetic gauge fields and photon-photon interactions. First, in the integer quantum Hall regime, I consider our theoretical and experimental efforts using established photonics technology to see expected phenomena, such as edge states of light. I will then consider the nonlinear regime, where photon-photon interactions via optical or microwave nonlinearities enable the potential realization of fractional quantum Hall states, and indicate challenges and solutions for examining pumped, non-equilibrium systems that do not admit a mean-field description. Finally, potential applications of these ideas in passive and active photonics will be examined.