SFB/TRR 21 - Seminar

15. November 2012, Stuttgart

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Theoretical and experimental investigation of quantum Hall physics in photonic systems

Topological properties of physical systems can lead to natural protection against perturbations. In the electronic systems, this robustness is exemplified by quantized conductance and edge state transport in the quantum Hall effects. Here we demonstrate how various quantum spin Hall Hamiltonians can be simulated with linear optical elements using a two dimensional network of coupled optical resonators. We experimentally investigate the implementation of such ideas in silicon-on-insulator technology. Such systems allow the presence of photonic edge states in direct analogy to integer quantum Hall edge states.

Furthermore, the addition of optical non-linearity to our proposed system leads to the possibility of implementing fractional quantum Hall states of photons such as Laughlin states. In particular, we develop a theoretical framework which is experimentally relevant for actual, i.e., driven, optical systems, and also computationally accessible.

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