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A spin dependent hexagonal optical lattice with complex valued tunneling MALTE WEINBERG, JULIAN STRUCK, CHRISTOPH OELSCHLAEGER, JULIETTE SIMONET, PATRICK WINDPASSINGER, KLAUS SENGSTOCK, Institute of Laser Physics, University of Hamburg, Germany — The realization of ultracold quantum gases in hexagonal optical lattices allows for the investigation of unique topological properties especially in connection to Dirac cones. Here we report on prospects of engineering artificial gauge potentials for bosons in a tunable hexagonal optical lattice. An intrinsic spin-dependency offers a versatile method to lift the degeneracy of this bipartite lattice via the orientation of the quantization axis. It is thus possible to tailor gaps at the Dirac points in the dispersion relation. Moreover, complex tunneling parameters can be experimentally realized by applying an external periodic force which breaks time reversal symmetry. As the resulting Peierls phases range from 0 to 2π it is possible to emulate artificial gauge potentials in such a system. With these tools at hand, we discuss the feasibility of the emulation of strong field physics with ultracold quantum gases in the honeycomb lattice as a step towards the realization of complex quantum systems, i.e. quantum Hall states and topological insulators.

Malte Weinberg
Institute of Laser Physics, University of Hamburg, Germany

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