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Quantum simulation of frustrated magnetism in a triangular optical lattice JULIAN STRUCK, CHRISTOPH ÖLSCHLÄGER, CHRISTINA STAARMANN, PARVIS SOLTAN-PANAHI, DIRK-SÖREN LÜHMANN, RODOLPHE LE TARGAT, PATRICK WINDPASSINGER, KLAUS SENGSTOCK, Institute of Laser Physics, University of Hamburg, Luruper Chaussee 149, D-22761 Hamburg, Germany — We present the experimental realization of a quantum simulator for magnetism with ultracold quantum gases in optical lattices. It is possible to emulate magnetic interactions of a xy-model - with spinless bosons - by identifying the local superfluid phase on each lattice site with a classical spin. Applying a time periodic acceleration to the lattice allows for tuning independently the tunneling matrix elements between neighboring lattice sites in magnitude and sign. We have mapped out all relevant parts of the phase diagram and could observe several different phases, ranging from ferromagnetic via parallel- and staggered-spin-chains to fully antiferromagnetic systems. In the latter case, we observed spin frustration which leads to a two-fold degenerate ground-state. Here we observe the symmetry breaking spontaneous occupation of one ground-state. Furthermore we will discuss the possibility to study quenching dynamics between different phases and to explore the quantum xy-model which should exhibit spin-liquid phases in case of the triangular lattice.

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