

# **Ultracold atoms as quantum simulators for new materials – optical lattices and synthetic gauge fields**

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When atoms are cooled to nanokelvin temperatures, they can easily be confined and manipulated with laser beams, and new Hamiltonians can be engineered. Crystalline materials are simulated by placing the atoms into an optical lattice, a periodic interference pattern of laser beams. With the help of laser beams, neutral atoms can move around in the same way as charged particles subject to the magnetic Lorentz force. This has been used to realize synthetic magnetic fields and spin-orbit coupling. These and other tools are now applied towards various spin Hamiltonians and topological physics.