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Spin-orbit coupling in a strontium optical lattice clock TOBIAS BOTHWELL, SARAH BROMLEY, SHIMON KOLKOWITZ, XIBO ZHANG, MICHAEL WALL, ANA MARIA REY, JUN YE, JILA — Synthetic gauge fields are a promising tool for creating complex Hamiltonians with ultracold neutral atoms that may mimic the fractional Quantum Hall effect and other topological states. A promising approach is to use spin-orbit coupling to treat an internal degree of freedom as an effective 'synthetic' spatial dimension. Here, this synthetic dimension is comprised by the internal ground and excited states used for high-precision clock spectroscopy in a fermionic strontium optical lattice clock. We report on our progress towards this goal in a system where atoms tunnel through a 1D optical lattice during clock interrogation. We present measurements of the lattice band structure under varying Lamb-Dicke parameters and in a regime where s-wave collisions are expected to contribute density dependent frequency shifts.

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