Entangling the lattice clock: Towards Heisenberg-limited time-keeping

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scheme for entangling the atoms of an optical lattice to reduce the quantum projec-
tion noise of a clock measurement. The divalent clock atoms are held in a lattice at a
“magic” wavelength that does not perturb the clock frequency – to maintain clock ac-
curacy – while an open-shell $J = 1/2$ “head” atom is coherently transported between
lattice sites via the lattice polarization. This polarization- dependent “Archimedes’
screw” transport at magic wavelength takes advantage of the vanishing vector po-
larizability of the scalar, $J = 0$, clock states of bosonic isotopes of divalent atoms.
The on-site interactions between the clock atoms and the head atom are used to
engineer entanglement and for clock readout.