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**Josephson effect and $SU(N)$ superfluidity in an optical lattice clock**[1] LEONID ISAEV, JILA, University of Colorado Boulder, ANA MARIA REY, JILA, NIST and Department of Physics, University of Colorado Boulder — Josephson effect is a quantum interference phenomenon that results from weak coupling (junction) of two superfluid systems. It offers an invaluable tool to perform phase-sensitive measurements of condensate wavefunctions. In this work, we propose a protocol to realize a Josephson junction with $SU(N)$-symmetric [$N$ is the number of populated nuclear-spin states] fermionic $^{87}$Sr atoms in a quasi-1D optical lattice that consists of weakly-coupled 2D harmonically-trapped clouds (pancakes). Within each pancake, the axial confinement couples a two-atom scattering channel and their molecular channel, leading to an $s$-wave superfluid state. These superfluid correlations can be enhanced by using a photo-association laser that drives the formation of bound pairs and effectively reduces the molecular-channel detuning. A weak inter-pancake single-atom tunneling gives rise to a Josephson current along the system, which can be detected thanks to the ultra-high spectral resolution and exquisite controllability of the Sr optical lattice clock transition. We also describe ways of exploiting this Josephson effect to probe the $SU(N)$ structure of the emergent superfluid state.

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