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Atomic clock based on quantum matter

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Quantum state engineering of ultracold matter and precise control of laser coherence have revolutionized a new generation of atomic clocks with accuracy at the 18th digit. This progress has benefited greatly from microscopic understandings of atomic interactions in the quantum regime. In return, the unified front of precision metrology and quantum physics has enabled exploration of many-body spin systems. Our next clock will have at its core a Sr Fermi degenerate gas configured as a band insulator in a three-dimensional optical lattice. The correlated, high-density atomic system provides a clear path for improving the clock performance to the next decimal point, and sets the stage to advance measurement precision beyond the standard quantum limit. These emerging quantum technologies will allow us to test the fundamental laws of nature and search for new physics.

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