Vibrational molecular lattice clock for fundamental physics
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Columbia University — A molecular clock operating on rovibrational transitions is
a promising instrument in the search for variations of the electron-to-proton mass
ratio, presence of gravity-like forces at the nanometer-scale, and QED corrections
to long-range interatomic interactions. I report the realization of a lattice clock
with ultracold diatomic strontium, enabled by state-insensitive trapping of elec-
tronic ground-state molecules in an optical lattice tuned close to a narrow vibronic
resonance belonging to the potential correlating to the atomic spin-forbidden inter-
combination line. At this magic wavelength, we observe more than a thousand-fold
improvement in light-molecule coherence, achieving a $Q$ factor of almost $10^{12}$. I
also discuss the ongoing systematic evaluation and conclude with an outlook for
high-precision measurements with the molecular clock.