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A molecular lattice clock to probe short-range gravity HENDRIK BEKKER, KON H. LEUNG, EMILY TIBERI, CHIH-HSI LEE, TANYA ZELEVINSKY, Columbia University, ZLAB TEAM — Precision frequency metrology is a powerful tool to set stringent limits on physics beyond the Standard Model such as a possible mass-dependent fifth force. Thanks to rapid advances on both the experimental and theoretical fronts, ultracold diatomic molecules are promising systems to probe short-range gravity. In this work, we study $^{88}Sr_2$ molecules, which we produce by photoassociation and trap in an optical lattice. Using several quantum-optical techniques such as Autler-Townes spectroscopy, we have mapped out parts of the molecular potentials. This allowed us to find magic wavelengths for the optical lattice, where the dynamic polarizabilities of two vibrational states are equalized. Thereby, inhomogeneous line broadening was reduced so that our molecular clock achieved a Q-value of $\nu/\delta\nu = 8 \cdot 10^{11}$. Currently, we are working on improving the setup to achieve even lower linewidths, toward a goal of probing the full ground state molecular potential of several isotopologues of Sr_2. These measurements should allow us to set new limits on the existence of a mass-dependent fifth force.

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