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Detecting Gravitational Wave Time Dilation Using Space-Based Atomic Clocks NICHOLAS LANGELLIER, SHIMON KOLKOWITZ, AVI LOEB, MIKHAIL LUKIN, Harvard University, DANI MAOZ, Tel Aviv University, JUN YE, Joint Institute for Laboratory Astrophysics, RONALD WALSWORTH, Harvard University — Recently, atomic clocks have reached a fractional frequency instability of about $10^{-16}/\sqrt{\tau}$. With such precision it may be possible to measure differences in the ticking rates of a spaced-based network of atomic clocks due to time dilation induced by passing gravitational waves. Supermassive black hole binaries arising from galaxy mergers at cosmological distances are predicted to produce gravitational waves at mHz frequencies. The largest variations in clock ticking will occur on the scale of half a wavelength, which for mHz waves is on the 1 AU scale. We assess the sensitivity and feasibility of such a space clock network detector, and compare it to existing means of mHz gravitational wave detection.

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