

Abstract Submitted
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Matter Waves and Clock Comparisons MICHAEL HOHENSEE, HOLGER MÜLLER, University of California, Berkeley — The gravitational redshift and the universality of free fall have been known to be closely related to one another since the 1960s, when Schiff demonstrated that conservation of energy required any anomalies in one to be balanced by a matching violation of the other, and conjectured that this must be true in any consistent theory of gravity. It is thus no surprise that clock comparisons and matter wave interferometer tests of the effects of gravity set bounds on the same kinds of anomalous terms when considered at leading order in the context of the Standard Model Extension. Surprisingly, these seemingly distinct classes of experiment can be shown to be formally identical to one another in every way at leading order. We demonstrate this explicitly for the Mach-Zehnder matter-wave interferometer, and in the process correct a conceptual error common to many non-relativistic treatments of atom-photon interactions. This suggests that Schiff's conjecture might be proven trivially true if no test of the universality of free fall can be distinguished from a test of the gravitational redshift. Higher order deviations from general relativity are also considered.

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