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Quantize clocks, not gravity

Time is not an observable in quantum gravity. What, then, do clocks measure? If you pose this question to researchers at the National Institute of Standards and Technology (NIST), they will tell you, 'Our clocks do not measure time. Our clocks define time.' That is, time is defined by the observed phases of quantum clocks. Similarly, in quantum field theory, space is not an observable. Distances in space are derived, e.g., from the observables associated with times of departure and arrival of signals in the global positioning system (GPS). This talk proposes a quantum theory of gravity based on GPS observables.

In this theory, intervals of time and distances in space are defined by clocks and signals. The spacetime metric is not quantized in itself: rather, it obtains its quantum nature from the quantum nature of those clocks and signals.

Quantum fluctuations in times of departure and arrival give rise to quantum fluctuations in the spacetime metric. The 'quantized-GPS' theory of gravity predicts the absence of fluctuations from source-free quantized gravitons in the early universe, an effect that might be observed in the next generation of cosmic microwave background satellites.