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Quantum Detection of Inertial Frame Dragging

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A relativistic theory of gravity like general relativity produces phenomena differing fundamentally from Newton's theory. An example, analogous to electromagnetic induction, is gravitomagnetism, or the dragging of inertial frames by mass-energy currents. These effects have recently been confirmed by classical observations. Here we show, for the first time, that they can be observed by a quantum detector. We study the response function of Unruh De-Witt detectors placed in a slowly rotating shell. We show that the response function picks up the presence of rotation even though the spacetime inside the shell is flat and the detector is locally inertial. The detector can distinguish between the static situation when the shell is nonrotating and the stationary case when the shell rotates and the dragging of inertial frames, i.e., gravitomagnetic effects, arise. Moreover, it can do so when the detector is switched on for a finite time interval within which a light signal cannot travel to the shell and back to convey the presence of rotation.

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