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Calibration of a Larmor Clock for Tunneling Time Experiments

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How much time does it take for a particle to tunnel? This has been a controversial question for nearly a century because of the inability to make a direct measurement of time. One operational definition for the tunnelling time is the Larmor clock, in which the spin degree of freedom of a tunneling particle is used as a clock that ticks only inside the forbidden region due to the presence of a magnetic field localized to within the barrier. Here, we report the calibration of a Larmor clock to measure tunneling times. Our system is a 87 Rb Bose Einstein condensate in the F=2 ground state manifold, traversing an optical waveguide. We use the Zeeman sublevels (a spin-2 system) and Raman beams for the implementation of the Larmor clock. Experimental progress towards measuring the tunneling time and the challenges involved in this measurement will also be discussed.

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