Laboratory Cosmology with Free Spinorial Wave Packets

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The electron quantum dynamics at crossing the black hole horizon is investigated. Exploiting the equivalence principle, we show a way to emulate the electron's dynamics via an appropriately chirped free electron wave packet, where the dynamical characteristics is encoded in the interference fringes of the wave packet. Apart from creating an analog of the gravitational effect, we deduce the electron's explicit wave function at the horizon of a black hole and provide quantitative predictions on the quantum properties of the electron crossing the horizon. These findings potentially pave the way for a new research avenue in laboratory cosmology based on the use of specially designed free electron wave packets.