

# Gravitational Photon Echo

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A gravitationally induced photon echo based on the 8.4 eV Thorium-229 nuclear clock transition on Earth is theoretically investigated. With an exceptionally narrow linewidth of approximately 1 mHz and a high quality factor in the order of  $10^{19}$ , the Thorium-229 clock transition enables the exploitation of gravitational redshift effects at millimeter-scale altitude variations. A height difference between two Thorium-229-doped targets results in a mode spacing between their respective nuclear absorption lines. Based on this picture, we explore the generation of a coherent photon echo driven by the gravitational frequency shift, either within a single extended target or across multiple remote samples. Furthermore, we will discuss strategies for the control and storage of the gravitationally induced photon echo.