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Manipulating nuclear transition on demand

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One of the uncharted territories in nuclear physics concerns a thrilling frontier in the study of systems where particles interact with relatively low-energy (< 20 MeV) yet extraordinarily high-intensity fields. In such environments, multi-particle processes rival and surpass traditional one-to-one interactions, opening the door to groundbreaking discoveries.

Here, we focus on a new scheme that enables the control of nuclear transitions on demand. The high-power laser systems are exploited as a driver to generate energetic (gamma-ray) photons. Together with additional low-energy photons provided by a second, less intense laser, a multi-photon absorption scheme enables a very attainable manipulation of nuclear transitions including isomer pumping and depletion. Furthermore, the technique can potentially be utilized to uncover hidden states and rare transitions in the nuclei as well as to realize stimulated amplification of γ -rays (graser). Realistic calculations suggest that the aforementioned sensational events could be realized already on those sites equipped with PW-class high-power laser systems.

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