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Laser-nucleus reactions at the upcoming extreme light infrastructure

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Recent experimental developments in laser physics promise to open the new field of laser-induced nuclear reactions in a so-far unexplored domain. Efforts are under way to generate a multi-MeV laser beam at the Nuclear Physics Pillar of the Extreme Light Infrastructure (ELI). Bound by the strong force, nuclei typically do not show any response even to extremely intense optical fields, which can only induce nuclear reactions indirectly, as they are very efficient in transferring kinetic energy to charged particles. Laser-driven nuclear accelerators using intense optical fields are thus one candidate for nuclear physics experiments with strong external fields. In this context, we would like to report on our study of laser-driven recollisions of alpha particles immediately following alpha decay. With the new laser beam envisaged at ELI that would attain photon energies comparable to typical nuclear excitation energies, strong nuclear excitation is rendered possible. We could show that laser-nucleus reactions with such a beam leads to multiple photon absorption and may produce compound nuclei in the so-far unexplored regime of several hundred MeV excitation energies. We have investigated semi quantitatively the competition between photon absorption, photon-induced nucleon emission, fission and neutron evaporation. With neutron evaporation becoming dominant before the excitation is saturated, proton-rich nuclei far off the line of stability are produced. Stronger excitation in the sudden regime where equilibration cannot compensate photon absorption may offer for the first time the possibility to study the transition from a bound system of strongly correlated nucleons to single independent particles.

Biography

Adriana Palffy has studied Physics in Bucharest, Romania, and received her PhD in Theoretical Physics at the Justus Liebig University in Giessen, Germany. Since 2011 she is the Leading Scientist of the group Nuclear and Atomic Quantum Dynamics at the Max Planck Institute for Nuclear Physics in Heidelberg, Germany. She is an expert in the field of Laser-Matter Interaction, with more than 40 papers published in peer-reviewed journals.

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