eli nuclear physics

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Photonuclear reactions and nucleosynthesis - ongoing work and experimental ideas for the future

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Nuclear cross sections and reaction rates for astrophysical temperatures are crucial for modelling nucleosynthesis of elements heavier than iron. Many nuclear reaction cross sections needed to understand nucleosynthesis, in particular for the r-process production, cannot be determined through direct measurement and cross sections are usually calculated within the statistical framework of Hauser-Feshbach. The photonuclear response is, among others, of theoretical importance as key parameters of theoretical models of the γ-strength function are adjusted to the experimental data of stable isotopes. The γ-strength function is a key ingredient in Hauser-Feshbach cross section calculations.

Of the photonuclear reactions, the (γ,n) reactions are the better studied and several campaigns during the 70's and 80's aimed at mapping out the photoneutron cross sections on stable isotopes. Nevertheless, many stable isotopes have not been investigated at all. Furthermore, there are significant discrepancies in data sets from different research groups in most of the cases where the same isotope has been studied by more than one group. The PHOENIX Collaboration, where ELI-NP is a part, aims at rectifying this situation by measuring the photonuclear response of most of the previously studied isotopes in addition to isotopes where no (γ,n)-cross sections have been reported previously. This work is part of the IAEA Coordinated Research Project on Photonuclear Data and Photon Strength Functions. I will shortly present our current progress on (γ,n)-cross section measurements.

The (γ,n) reaction cross sections on most stable isotopes can be well determined at existing photon beam facilities. There are however other important photonuclear reactions, such as the (γ,n) reaction that would require novel instrumentation and more intense photon beams. The final part of the talk will be dedicated to ideas for future experiments that ELI-NP would be the ideal host.