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Nuclear isomers at the interface

Nuclear isomers –excited states of atomic nuclei with half-lives ranging from less than a nanoseconds to many years [1] –have a variety of actual and potential applications beyond the domain of nuclear physics [2]. There are, for example, opportunities to study novel physics at the nuclear-atomic interface, including high-intensity, low-energy photon-nucleus interactions. One promising avenue is focused on the low-energy photo-deexcitation of isomers. By selecting a suitable isomer, the deexcitation is able to liberate at least one photon of much higher energy, which provides a unique signal of the interaction. Also, with the large span of possible isomer half-lives, a range of timing and physical-separation techniques can be used to enhance the experimental sensitivity to isomer interactions. Meanwhile, the underlying consideration is the need to understand the basic atomic and nuclear processes involved.

This presentation will discuss the different types of nuclear isomer, and consider a selection of isomer-inspired experiments aimed at shedding light on the interactions at the nuclear-atomic interface.

[1] P.M. Walker and G.D. Dracoulis, Energy traps in atomic nuclei, Nature 399 (1999) 35.
[2] P.M. Walker and Zs. Podolyák, Nuclear isomers, Chapter 12 in “Handbook of Nuclear Physics”, Eds. I. Tanihata, H. Toki and T. Kajino (Springer Nature Singapore 2023) 487.

Primary author: Prof. WALKER, Philip (University of Surrey)

Presenter: Prof. WALKER, Philip (University of Surrey)