SPAGINS: A novel approach to predicting nuclear fragmentation in gamma-induced spallation

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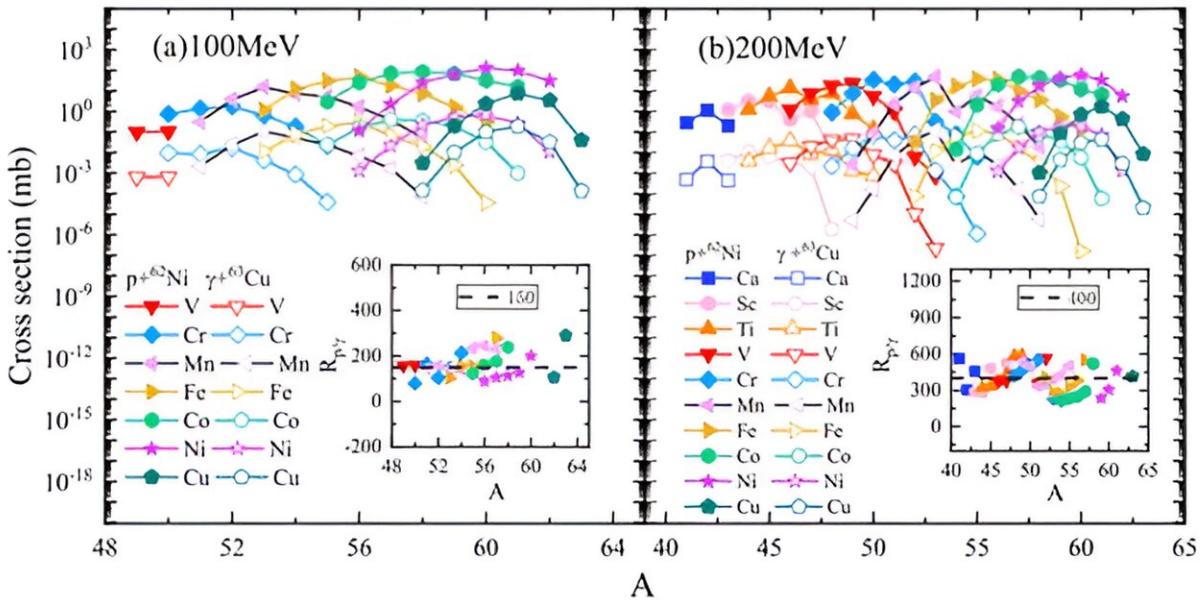

The calculated isotopic cross section for fragments by TALYS-1.96 in the $^{\gamma+63}$Cu and $^{p+62}$Ni reactions at Eγ = 100MeV [in (a)] and 200 MeV [in (b)], respectively. The ratio of the isotopic cross sections in the $^{p+62}$Ni and $^{\gamma+63}$Cu reactions are plotted in the inserted figure. Credit: *Nuclear Science and Techniques* (2023). DOI: 10.1007/s41365-023-01342-9

In a study published in *Nuclear Science and Techniques*, researchers from Henan Normal University report a significant advancement in nuclear

physics. The study showcases the effectiveness of the SPAGINS model, a novel approach to accurately predicting fragment production in gamma-induced nuclear spallation reactions.

This breakthrough not only surpasses the capabilities of existing models but also paves the way for significant progress in fields such as nuclear astrophysics, medicine, and various industrial applications, due to its enhanced precision in predicting nuclear fragmentation.

The development of the SPAGINS formulas represents a sophisticated integration of theoretical models and empirical data, utilizing key components such as the TALYS toolkit, EPAX and SPACS formulas, and the Rudstam formula.

This innovative approach began with an analysis of the similarities in fragment production between gamma- and proton-induced nuclear spallation reactions, with a particular emphasis on isotopic cross-sectional distributions. Special adjustments were incorporated to cater to the unique characteristics of gamma-induced nuclear spallation reactions (PNSR), including the dependency on incident energy and the charge distribution of the fragments.

The culmination of this research is evident in the SPAGINS formulas' ability to accurately reproduce measured data across a wide range of gamma energies (100 to 1000 MeV). This performance, when compared to existing models and empirical formulas, highlights the SPAGINS' superior predictive capabilities, offering a more comprehensive and accurate representation of fragment production in PNSR than any model currently available.

The SPAGINS formulas, with their precise predictions of fragment production in gamma-induced nuclear spallation reactions, have far-reaching implications beyond academia. They are poised to revolutionize

nuclear astrophysics, medicine, and high-energy gamma ray industries, enhancing our understanding of complex reactions, driving technological advancements, and improving safety in nuclear facilities. As high-energy gamma-ray facilities advance rapidly, SPAGINS emerges as a crucial tool for nuclear research and safety.

More information: Hui-Ling Wei et al, SPAGINS: semiempirical parameterization for fragments in gamma-induced nuclear spallation, *Nuclear Science and Techniques* (2023). DOI: 10.1007/s41365-023-01342-9