Neutron capture research offers insight into astrophysics and detector design

December 4 2023

Photograph of the C_6D_6 detector system in the Back-n facility of the CSNS. A gold sample is placed in the aluminum sample holder. Credit: *Nuclear Science and Techniques* (2023). DOI: 10.1007/s41365-023-01337-6

In a study published in the journal *Nuclear Science and Techniques*, researchers from Sun Yat-sen University have conducted a novel study on neutron capture by bromine at the China Spallation Neutron Source, providing invaluable insights into both astrophysics and cutting-edge detector design.

At the China Spallation Neutron Source's Back-n facility, researchers harnessed four specialized C_6D_6 detectors to observe prompt γ-rays from neutron-induced capture events. Leveraging advanced data analysis techniques, such as pulse-height weighting and double bunch unfolding methods based on Bayesian theory, they ensured meticulous background deductions, normalization, and corrections.

The SAMMY code, a multilevel R-matrix Bayesian tool, was central to analyzing the capture yields in the observed energy spectrum, enabling the extraction of resonance parameters. While their results aligned with prior studies, notable discrepancies with certain databases emerged.

The TALYS code, grounded in the Hauser–Feshbach statistical emission model, was vital in describing average cross-sections in unresolved resonance regions. The study's pinnacle was calculating the Maxwell average cross sections (MACSs) for bromine isotopes and contrasting them with extant databases and recommended values.

Through a combination of precision and advanced methodologies, the team not only deepened the comprehension of neutron capture by bromine but also illuminated broader implications for astrophysics and detector design.

Moreover, these findings are set to shape the design and enhancement of upcoming neutron and γ-ray detectors, advancing the boundaries of nuclear experimentation. This study lays a solid foundation for subsequent investigations, poised to uncover more cosmic mysteries.

More information: Gao-Le Yang et al, Measurement of Br(n,γ) cross sections up to stellar s-process temperatures at the CSNS Back-n, *Nuclear Science and Techniques* (2023). DOI: 10.1007/s41365-023-01337-6

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