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Validation and Evaluation Uses for Quasi-Differential High Energy Scattering Data

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Natural lead evaluations have been performed at RPI [1] to address concerns in deficient cross sections for fast spectrum applications [2]. As lead is a primarily scattering material, the quasi-differential scattering measurements done at RPI providea great basis for validating natural lead [3]. MCNP [4]simulations of the experiment with current lead evaluations[5] [6] [7] alluded to the understanding that elastic scattering angular distributions (ESAD) were a major problem in lead. Using the Blatt-Biedenharn formalism [8] implemented into NJOY[9], ESAD from resonance parameters were calculated and showed great promise in addressing the current problems with replicating natural lead. A novel method, encompassing SAMMY [10], NJOY, and MCNP connected with Python, proved useful in extending the resolved resonance region of 208Pb when coupled with differential transmission data [11]. This method relies on the premise of the domination of the scattering data to isolated resonances, the spin of which, should produce radically different signals in scattering calculations. Further studies into the ESAD derived for 208Pb highlighted potential for constraining the P1 moment uncertainty of evaluated nuclear data angular distributions (MF-34). The outcome of updating the elastic scattering distributions of lead isotopes greatly increased the agreement between MCNP simulations and experimental data. Long held as a tool for validation, with the ESAD fitting methodologies developed here, quasi-differential scattering data can be used as part of the evaluation tool set to adjust model parameters and provide uncertainties.

REFERENCES

1. P. BRAIN, et al, "Isotopic Lead Neutron Evaluations for Future Fast Spectrum Systems", Transactions of the American Nuclear Society, Vol. 128, pgs. 724-727. June 2023.
2. T. K. KIM, C. GRANDY, K. NATESAN, J. SIENICKI, R. HILL, "Research and Development Roadmaps for Liquid Metal Cooled Fast Reactors", ANL/ART-88, 2017.
3. A. E. YOUMANS, J. BROWN,et al, "Fast Neutron Scattering Measurements with Lead", AccApp 15, Washington, DC, pp. 355-360, November 10-13 2015.
4. C.J. WERNER, J.S. BULL, C.J. SOLOMON, et al.,"MCNP6.2 Release Notes", LA-UR-18-20808 (2018).
5. D. A. BROWN et al., "ENDF/B-VIII.0: The 8th Major Release of the Nuclear Reaction Data Library with Cielo-Project Cross Sections, New Standards and Thermal Scattering Data,"Nucl. Data Sheets, 148, 1 (2018).
6. A.J.M. PLOMPEN, O. CABELLOS, C. DE SAINT JEAN, et al. The joint evaluated fission and fusion nuclear data library, JEFF-3.3", Eur. Phys. J. A56(2020)181.
7. O. IWAMOTO, N. IWAMOTO, K. SHIBATA, eta al, "Japanese Evaluated Nuclear Data Library Version 5: JENDL-5", Journal of Nuclear Science and Technology, 60:1, 1-60, DOI: 10.1080/00223131.2022.2141903
8. J. BLATT and L. C. BIEDENHARN, "The Angular Distribution of Scattering and Reaction Cross Sections". Rev. Mod. Phys. v24,4 258–272. Oct. 1952 https://link. aps.org/doi/10.1103/RevModPhys.24.258
9. J. CONLIN, A.C. Kahler, et al, "NJOY16: Next generation nuclear data processing capabilities", EPJ Web of Conferences 146, 09040 2017.
10. N. M. LARSON, "Updated User's Guide for SAMMY: Multilevel R-Matrix Fits to Neutron Data Using Bayes Equations,"ORNL/TM-9179/R8 ENDF-364/R2, Oak Ridge National Laboratory Oct, 2008.
11. R.F. CARLTON et al. "R-Matrix analysis of an ORELA measurement of n+208Pb total cross section from 78 to 1700 keV".Bulletin of the American Physical Society Ser.II, volume 36, page 1349, paper J10-10, 1991/04. 1991

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