Incident-energy Dependent Quenching of the Analyzing Power in Pre-equilibrium Composite Particle Emission*

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The analyzing power experimental observable proves to be a very sensitive quantity to investigate the multi-step character of the reaction process of proton-induced pre-equilibrium composite ejectile emission.

Recently we have shown [1-3] that the $(p,^3\text{He})$ reaction in the incident energy range of 100 to 160 MeV on two representative target nuclei, ^{59}Co and ^{93}Nb, can be understood reasonably well in terms of a multistep reaction process. The initial nucleon-nucleon collisions appear to be followed by a final step in which a proton-neutron pair is picked up from the target system. Of particular interest is the reproduction of the evolution of the characteristic features of the analyzing power distributions as a function of incident energy. A general trend is that the average magnitude of the analyzing power decreases towards higher incident energy. Unfortunately, due to the convoluted nature of the theoretical calculations, it is not obvious whether the observed incident energy-dependent quenching of the analyzing power is a consequence of fortuitous conspiracy of pickup from the various states available to the reaction process, or something more fundamental.

A similar study of the (p,α) reaction at the same incident energies and target nuclei suggests an analogous mechanism, with perhaps, based on dynamical considerations, knockout of pre-formed or induced α-clusters from the target more likely for the final step in the multistep chain.

We will discuss calculations for the (p,α) reaction in a kinematic range which should preferentially favour a one-step knockout of pre-formed cluster. Results will be evaluated in terms of consistency with the known small a-cluster occupation available in the ground state of targets in the same mass range.

[1] A. A. Cowley, J. Bezuidenhout, S. S. Dimitrova, P. E. Hodgson, S. V. Förtsch, G. C. Hillhouse, N. M. Jacobs, R. Neveling, F. D. Smit, J. A. Stander, G. F. Steyn, and J. J. van Zyl. Phys. Rev. C **75** (2007) 054617.

[2] A. A. Cowley, J. Bezuidenhout, E. Z. Buthelezi, S. S. Dimitrova, S. V. Förtsch, G. C. Hillhouse, P. E. Hodgson, N. M. Jacobs, R. Neveling, F. D. Smit, J. A. Stander, G. F. Steyn, and J. J.   van Zyl. Proceedings of the 23rd International Nuclear Physics Conference INPC2007 (Tokyo, Japan) 3-8 June 2007. (Editors: S. Nagamiya, T. Motobayashi, M. Oka, R. S. Ηαψανο ανδ T. N agae, Publisher: Elsevier, Amsterdam (2008)   Volume 2, p. 473 − 475.

[3] J. J. van Zyl. MSc thesis, University of Stellenbosch, 2008 (unpublished).