

Deeply bound pionic 1s states in Sn isotopes

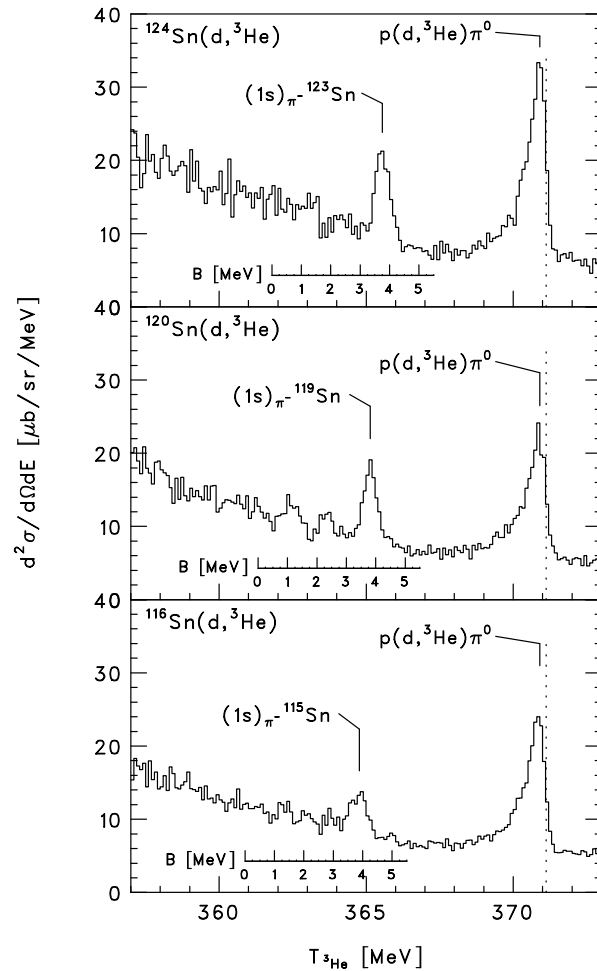
M. Fujita^a, H. Geissel^b, H. Gilg^c, A. Gillitzer^d, R.S. Hayano^e, S. Hirenzaki^a, K. Itahashi^f, M. Iwasaki^f, P. Kienle^c, M. Matos^b, G. Münzenberg^b, T. Ohtsubo^g, M. Sato^h, M. Shindo^e, K. Suzuki^e, T. Suzuki^e, H. Weick^b, M. Winkler^b, T. Yamazakiⁱ, T. Yoneyama^h

^a Department of Physics, Nara Women's University, ^b GSI Darmstadt, ^c Physik-Department, Technische Universität München, ^d Institut für Kernphysik, Forschungszentrum Juelich, ^e Department of Physics, University of Tokyo, ^f Muon Science Laboratory, RIKEN, ^g Department of Physics, Niigata University, ^h Department of Physics, Tokyo Institute of technology, ⁱ RI Beam Science Laboratory, RIKEN

A recently established technique - ($d, {}^3\text{He}$) reaction at the recoilless kinematical condition - led to a break-through for studying deeply bound pionic states in heavy nuclei [1,2,3]. Such states, 1s-states in particular, which were discovered by this method, are dominated by the s-wave part of the pion-nucleus potential. The s-wave strength in heavy nuclei is not only translated into a pion mass excess in the nuclear medium, but also provides well separated isoscalar (b_0) and isovector (b_1) potential parameters.

In continuation of our former experiments at GSI using ${}^{208,206}\text{Pb}(d, {}^3\text{He})$ reactions at $T_d=600\text{MeV}$, we carried out series of measurements on a long chain of Sn isotopes at $T_d=500\text{MeV}$ to populate the 1s π^- states in ${}^{115,119,123}\text{Sn}$. From this experiment we obtained three spectra with a well-improved energy resolution of $\sim 370\text{keV}$, as shown in the figure. They show distinct 1s π^- peaks in ${}^{115,119,123}\text{Sn}$, in accordance with a theoretical prediction by Umemoto *et al.* [4]. The absolute energy scale was obtained from the $\text{Sn}(d, {}^3\text{He})\text{In}$ reactions as well as from the edge positions of the $p(d, {}^3\text{He})\pi^0$ peak, which originates from a thin mylar layer put downstreams on the targets, as shown by vertical broken lines in the figure.

Thus, we determined the 1s binding energies within an accuracy of $\sim 25\text{keV}$. These data provide precise information on the isovector parameter b_1 of the s-wave part of the pion-nucleus interaction, which is a unique indicator of chiral symmetry restoration in the nuclear medium.



References

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