Deeply bound pionic $1s$ states in Sn isotopes

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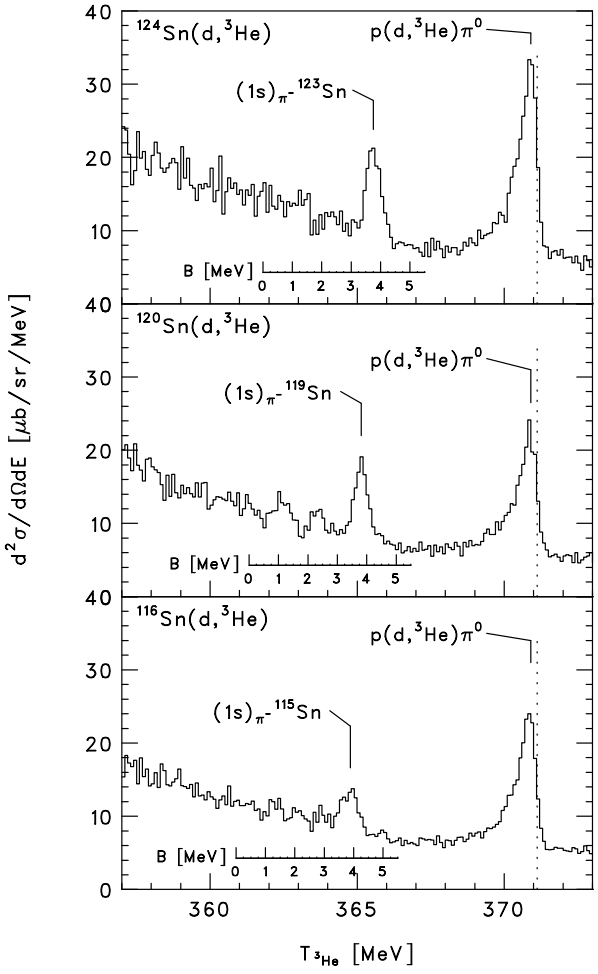
A recently established technique - (d,^{3}He) reaction at the recoilless kinematical condition - led to a break-through for studying deeply bound pionic states in heavy nuclei [1,2,3]. Such states, $1s$-states in paticular, which were discoverd by this method, are dominated by the s-wave part of the 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}Pb(d,^{3}He) reactions at T_d=600MeV, we carried out series of measurements on a long chain of Sn isotopes at T_d=500MeV to populate the $1s$ π^- states in ^{115,119,123}Sn. From this experiment we obtained three spectra with a well-improved energy resolution of $\sim$ 370keV, as shown in the figure. They show distinct $1s$ π^- peaks in ^{115,119,123}Sn, in accordance with a theoretical prediction by Umemoto *et al.* [4]. The absolute energy scale was obtained from the Sn(d,^{3}He)In reactions as well as from the edge positions of the p(d,^{3}He)π^0 peak, which originates from a thin mylar layer put downsteams on the targets, as shown by vertical broken lines in the figure.

Thus, we determined the $1s$ binding energies within an accuracy of $\sim$ 25keV. 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.



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