Structure and Formation of the Deeply Bound $\bar{p}$ atoms via $\bar{p}$ beam

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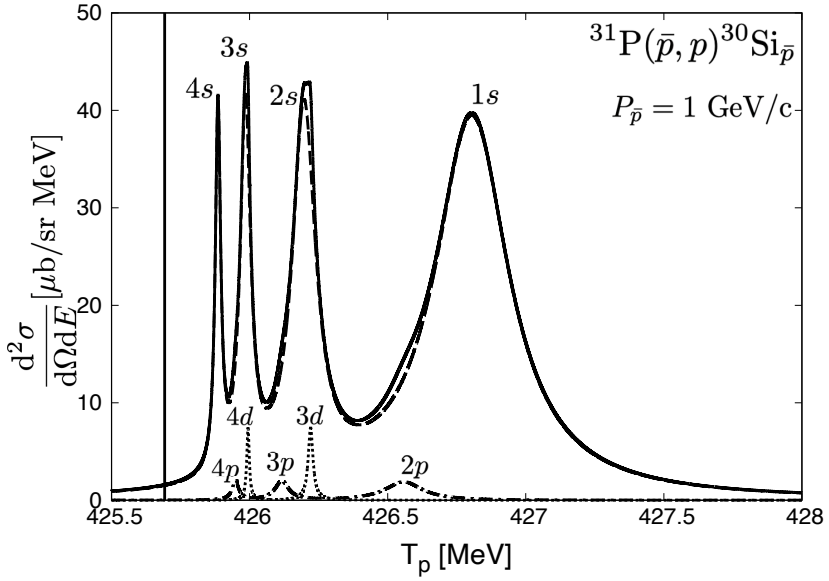
Content

We study the structure and formation of the antiprotonic atoms including the deeply bound states which cannot be observed by the X-ray spectroscopy. The recent studies of the antiprotonic atom were reported in Ref. [1] and the several phenomenological antiproton-nucleus interactions are known. We theoretically study the $(\bar{p}, p)$ reactions for the formation of antiprotonic atoms to extend the spectroscopic study to new frontier of deeply bound antiprotonic states. The forward $(\bar{p}, p)$ reactions are almost recoilless for any initial energies and are very suited for the formation of the so-called quasi-substitutional atomic states which have the same angular momentum as the proton in the target nucleus.

We find that the widths of the atomic states are narrower than the level spacing even for deeply bound atomic states so that the well-isolated deeply bound antiprotonic atoms are expected to exist. We also find the existence of the antiproton nuclear states with huge widths. For the observation of the deep atomic states, we investigate the $(\bar{p}, p)$ reactions for ^{12}C, ^{16}O, and ^{31}P target nuclei. We conclude that the $(\bar{p}, p)$ reactions are very much suited for the antiprotonic atom formation and are strongly expected to provide new information on antiproton - nucleus systems.

We show in figure the formation spectra of antiproton-^{30}Si bound systems as a function of the emitted proton kinetic energy. Here, we use the effective number approach and the phenomenological optical potential obtained in fit to the experimental data in Ref. [2]. The vertical line indicates the threshold energy. The spectroscopic factors reported in Ref. [3] are not taken into account in this figure.



Reference

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Field of Research: Production, structure and decay of hypernuclei / Interactions of mesons and baryons with strangeness / Strange mesons in nuclei

Experiment / Theory: Theory

Contribution Type: Contribution talk