Hadron-Nucleus Bound-State Spectroscopy

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Deeply Bound π^- States as an Indicator of Chiral Symmetry Restoration

A new type of nuclear spectroscopy to produce deeply bound 1s states of π^- in heavy nuclei has been developed since the first success at GSI [1,2] based on theoretical predictions [3]. They provide a unique information on the isovector s-wave πN interaction in the nuclear medium, which is connected to the question of chiral symmetry restoration [4,5]. A detailed analysis of the new data in ^{205}Pb has indicated an enhancement of the isovector parameter, $b_1/b_1^{\rm free}$, or equivalently, a decreased chiral order parameter, $R = (f_\pi^*/f_\pi^{\rm free})^2 = 0.78^{+0.13}_{-0.09}$ [6]. A further high-precision experiment on series of Sn isotopes provides a more decisive indication [7].

$\bar{\rm K}$ Bound States as Cold and Dense Nuclear Systems

In the strange meson sector a new paradigm is being pursued, as narrow nuclear $\bar{\rm K}$ bound states in few-body systems are predicted to exist [8]. Very deeply bound states lying below the $\Sigma\pi$ emission threshold are accommodated by the strong attraction of the $I = 0$ $\overline{\rm K}$N interaction. The most spectacular aspect is that they are expected to form enormously dense nuclear systems. The exotic structure involving a $\bar{\rm K}$ has also been studied by the Antisymmetrized Molecular Dynamics method [9]. Currently, an experiment on ^{4}He (stopped $\rm K^-$, n) to search for $\rm K^-$ppn is under way at KEK [10]. A new possibility using $(\rm K^-, \pi^-)$ to populate exotic systems such as $\rm K^-$pp, $\rm K^-$ppp, etc. has also been pointed out [11], and its first experimental trial is proposed [12].

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