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Kaonic nuclei – dense and cold nuclear systems

YOSHINORI AKAISHI, Nihon University & RIKEN

We have predicted strongly bound kaonic states in few-body nuclei, the bindings of which are on the order of 100 MeV: the separation energies of a K^- in ^{3}He and ^{4}He are calculated to be 108 and 86 MeV with widths of 20 and 34 MeV, respectively. Substantial contraction of the system is induced due to the strong KN attraction, thus forming an unusually-dense nuclear object. Since these kaonic nuclei have large densities more than 3-times the normal density, they provide a unique playground for studying possible QCD structure in dense and cold nuclear medium. We discuss the implication of recently discovered strange tri-baryons in ^{4}He(stopped-K^-, p)S^0(3115) and ^{4}He(stopped-K^-, n) S$^+$ (3140) within the framework of deeply bound Kaonic states formed on shrunk nuclear cores. The S$^+$ (3140) corresponds to T=0 $ppnK^-$, whereas the S^0(3115) to T=1 $pnnK^-$, which is an isobaric analog state of $pppK^-$. The observed binding energies can be accounted for by including the relativistic effect and by invoking a medium-enhanced KN interaction by 15%. A new paradigm is discussed, which would be closely related to important issues of "chiral symmetry restoration," "kaon condensation" and "strange matter."