Deeply Bound Kaonic Nuclear States

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The status of experiments and future searches for antikaon mediated nuclear bound states are reviewed. Akaishi and Yamazaki [1] predicted the existence of deeply bound kaonic nuclear states on basis of the strong I=0 K^-p interaction below the $\Lambda(1405)$ resonance, considered as a K^-p quasi bound state. The expected binding energies may exceed the $\Sigma\pi$ threshold, which leads to narrow states because the main decay channel is energetically closed.

First experimental searches, KEK E471, using the K^-(stopped) (^{4}He, n/p) reactions gave indications of strange tribaryon $S^+(3140)$, B= -169 MeV, $\Gamma < 21.6$ MeV and $S^0(3115)$, B= -194 MeV, $\Gamma < 21.6$ MeV states [2,3]. These experiments we have recently repeated, KEK E549/570, with an improved set up and higher statistics. The analysis is in progress. Recently FINUDA at DAPHNE in LNF reported the discovery of the strange dibaryon state ppK^- with a binding energy of B= -115 MeV and a width of $\Gamma = 67$ MeV [4]. We also report on first results of searches for light kaonic nuclear clusters as remnants of heavy ion collisions, such as 1.9A GeV Ni-Ni and 2.0A GeV Al-Al collisions using invariant mass spectroscopy of correlated Λp and Λd pairs as decay products of strange dibaryon and tribaryon, respectively [5] detected in the 4π-system FOPI at GSI, Darmstadt. In a pilot experiment using a 3.5 GeV proton beam and liquid deuterium, $(CH_2)n$ and $(CD_2)n$ targets and detecting K^0, K^-, Λ and protons, thus combining missing mass and invariant mass spectroscopy, we searched for strange dibaryon.

In an outlook we point out further opportunities of this new field using Dalitz type correlation studies of 3-body decays of strange nuclear clusters for measuring their sizes and density distributions and angular momentum transfers [6]. Further more ideas are discussed to produce double kaonic nuclear clusters with high densities using double strangeness transfer, antiproton annihilation and high energy heavy ion reactions.

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