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Search for Deeply Bound Kaonic Nuclear States in AMADEUS experiment

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Deeply Bound Kaonic Nuclear States are currently one of the hottest topics in nuclear and hadronic strangeness physics, both from experimental and theoretical points of view. The existence of bound kaonic nuclear states of K−, also called kaonic nuclear clusters, was firstly predicted in 1986 [1]. The phenomenological investigations, resulted in deeply bound nuclear states with narrow widths and large binding energies which can reach 100 MeV in kaon-nucleon-nucleon system (K−pp), being a consequence of the strongly attractive K− - proton interaction. Recent theoretical studies, based on different methods are giving a wide range of possible values for the binding energies of the kaonic nuclear states, ranging from few MeV up to about 100 MeV [2-5]. Therefore, in order to clarify this issue, experimental data are needed. The research would be very important in understanding the fundamental laws of the Nature and Universe. It can have important consequences in various sectors of physics, like nuclear and particle physics as well as astrophysics. The binding of the kaon in nuclear medium may impact on models describing the structure of neutron stars (Equation of State of neutron stars) [6,7] including binaries which are expected to be sources of the gravitational waves. Investigation of stable forms of strange matter like DBKNS in extreme conditions would be helpful for a better understanding of elementary kaon - nucleon interaction for low energies in the non-perturbative quantum chromodynamics (QCD) and in consequence, would contribute to solve one of the crucial problems in hadron physics: hadron masses (related to the chiral symmetry breaking), hadron interactions in nuclear medium and the structure of the dense nuclear matter.
The AMADEUS group has developed a method having a high chance for discovery of DBKNS corresponding to K−pp, K−ppn and K−ppnn kaonic nuclear clusters and their decay to Λp, Λd and Λt, respectively. The method is based on the exclusive measurement of the momentum, angular and invariant mass spectra for correlated Λp, Λd, Λt [8]. Possible DBKNS may be produced with K− stopped in helium or carbon and then decay into considered decay channels. The experiment was carried out with very high precision and high acceptance by AMADEUS using the KLOE detector itself as an active target (2004-2005) as well as with dedicated high purity graphite target (2012) and using low-energetic negatively charged kaon beam provided by DAΦNE collider located in National Laboratory in Frascati (Italy). The poster will present status of the data analysis.

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