Service de Physique Nucléaire

Séminaire

le vendredi 13 octobre 2006 à 11H

CEA Saclay, Orme des Merisiers, Bât. 703, Salle 135

Search for the kaonic nuclear cluster K^-pp in the $p + p \rightarrow K^+ + K^-pp$ reaction with FOPI

Ken Suzuki

(Technische Universität München)

Recently exotic nuclear systems involving antikaon, $\bar{K}$ (K^- or $\bar{K^0}$), as a constituent have been predicted based on phenomenologically constructed $\bar{K}N$ interaction, which reproduce low-energy $\bar{K}N$ scattering data, kaonic hydrogen atom data and the binding energy and width of $\lambda(1405)$ under assumption that $\lambda(1405)$ is a $\bar{K}N$ bound system. A few nucleon systems with $\bar{K}$ considered with the $\bar{K}N$ interaction are found to have very large total binding energy of 100MeV (E=118MeV and 97MeV for $ppnK^-$ and $pppK^-$, respectively) strong enough to close the main decay channel of $\bar{K}N \rightarrow \Sigma\pi$ and therefore the states appear narrow and discrete. Consequently it is found that the strong attraction makes these systems very compact and dense. Antisymmetrized Molecular Dynamics (AMD) method, a fully-microscopic, ab initio calculation showed that such deeply-bound kaonic bound systems may have enormously high density ($> 3\rho_0$) beyond the well-known incompressibility of the nucleus. In addition to its exoticness, having an access experimentally to such cold and dense bound system will allow us a great possibility to explore QCD phase diagram, and to study many unresolved questions of low energy QCD in SU(3), namely chiral symmetry restoration, dynamical generation of hadron masses, kaon condensation, or the structure of neutron stars.

We are planning to investigate the $p + p \rightarrow K^+ + X$ reaction with FOPI detector in GSI, where $X \equiv K^-pp$ is the most fundamental unit of kaonic nuclear bound states (kaonic nuclear clusters, KNC). With a proton beam energy of 3 GeV from SIS we measure protons, K^+'s and π^-'s at large angles by the Central Drift Chamber of FOPI and forward going particles by installing an additional magnetic tracking device (TPC or GEM layers) to reconstruct a missing-mass spectrum of K^+, $MM(pp-K^+)$, and invariant-mass spectrum of $\Lambda - p$, $M_{\rm inv}(\Lambda p)$. The signature for K^-pp, whose mass is expected to lie between $M = 2250-2300$ MeV/c^2 will be obtained jointly from both $MM(pp-K^+)$ and $M_{\rm inv}(\Lambda p)$. We performed a first test experiment of about one week in November 2005 to evaluate the whole research program and for developing improved measurement, acceleration, beam transport and target techniques. In the talk, a result of the first test experiment, and the prospects of the main production run which will take place in early 2008 will be presented.

Le café sera servi 10 minutes avant