Experimental Study to Search for Kaonic Nuclear States

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A recent hot topic concerns the possible existence of deeply bound kaonic nuclear states. After the so called "kaonic hydrogen puzzle" was resolved [1], the attractive nature of the $\overline{K}N$ interaction is undeniable. This fact allows to assume the $\Lambda(1405)$ to be a K^-p bound state due to the strong interaction. Based on this assumption, Akaishi and Yamazaki predicted meta-stable kaon bound state formation in light nuclei [2], using their coupled channel calculation.

This prediction triggered many extensive studies both in experimental and theoretical manners. It is quite important to search such states, because the chiral order parameter $\langle\overline{q}q\rangle$ is the function of the temperature and density, and the nucleus is the highest density object one can study at the laboratory. If the interaction is strong enough to form higher density beyond normal nuclear-matter density, one may study the in-medeum mass modification effect as a function of matter density. If it exist, one may study more direct information of the $\overline{K}N$ interaction than the study by the atomic level shift and width, and also one may study the property change of K-mesons in nuclei.

There are several reports of the possible candidates of the deeply bound kaonic states at present, but very conclusive data is still missing. In a sense, existence of deep and narrow kaonic state seems to be negative, both experimental and theoretical ways, and at least the width of the state would be much larger than the original prediction. This could be understood because the multi-nucleon absorption process is quite large. However, the importance of the experimental study is unchanged. Many experimental studies are planned to be sensitive even for the wide state. The experimental data will provide rich information of the $\overline{K}N$ interaction, and will help to understand the nature of $\Lambda(1405)$ in the sub-threshold region.

The paper will cover present experimental results and future studies to search for the kaonic bound state in a selective way.

[1] M. Iwasaki et al: Phys. Rev. Lett. **78**. 3067 (1997).
[2] Y. Akaishi and T. Yamazaki, Phys. Rev. C **65**, 044005 (2002).

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