

# Study of the excited ${}^9\text{Li}$ core in ${}^{11}\text{Li}$

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${}^{11}\text{Li}$  nucleus is one of the flagship drip-line nuclei in the field of nuclear physics. A spatially extended structure of neutrons in  ${}^{11}\text{Li}$ , which is now widely known as “halo” structure, opened the very active field of research with unstable nuclear beams.  ${}^{11}\text{Li}$  have the nature of Borromean.[1] In many cases,  ${}^{11}\text{Li}$  is considered as a 3-body system of  ${}^9\text{Li} + 2$  neutrons. However, recent theoretical studies pointed out that contribution of the excited  ${}^9\text{Li}$  core can be significant. According to the interpretation of [2], the ground state of  ${}^{11}\text{Li}$  has components which contain excited state of the core. In Ref [3], they showed that the E1 cluster sum rule value should be reduced by about 15% due to the  ${}^9\text{Li}$  core excitation. Currently no experiment has succeeded in providing a direct information of the excited  ${}^9\text{Li}$  core in  ${}^{11}\text{Li}$ .

In this work, with the data of SAMURAI18 experiment, the quasi-free  ${}^{11}\text{Li}(p,pn){}^9\text{Li}^*$  reaction was employed to study the excited  ${}^9\text{Li}$  core. Because of spin-parity constraints, the first bound excited state of  ${}^9\text{Li}$  cannot contribute much and the 2nd state, which is unbound, can give the major contribution. Therefore, the  ${}^9\text{Li}$  excited core will decay into the  ${}^8\text{Li} + \text{neutron}$ . Using the invariant mass spectrum and dalitz plot of  ${}^8\text{Li} + 2$  neutrons, we could get the direct information of the excited  ${}^9\text{Li}$  core in  ${}^{11}\text{Li}$ .

[1] M. V. Zhukov, et al., Phys. Rep. 231, 151 (1993).

[2] G. Potel, F. Barranco, E. Vigezzi, and R. A. Broglia, Phys. Rev. Lett. 105, 172502 (2010)

[3] Y. Kikuchi, et al., Phys. Rev. C 87, 034606 (2013).

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