Analyses of excited states in ^{4}He with complex scaling method

Shigeyoshi Aoyama [(a)]

[(a)] Center for Academic Information Service, Niigata University,
Niigata 950-2181, Japan

Many "*ab-initio*" studies have been carried out for the ground state of ^{4}He. However, for excited states of ^{4}He, theoretical analyses have not been sufficient mainly because the treatment of unbound states are difficult. One of useful methods for analyzing unbound states is the Microscopic R-matrix Method (MRM) [1]. Recently, we have studied the importance of the tensor force in the d+d scattering and the $d(d,\gamma)^4$He radiative capture with the MRM [2]. The flat behavior of the astrophysical S-factor in low energy region is originating from the d-wave component in the deuteron wave function and the ^{4}He wave function.

Another useful method is the Complex Scaling Method (CSM) [3]. The CSM can directly treat three-body and four-body continuums in the excited region of ^{4}He, while the MRM can approximately treat them. In Figure 1, we can clearly see two-body continuum, three-body continuum and four-body continuum solutions on the so-called 2θ-liene in addition to the ground state solution. However, the computational time with the CSM is very slower than that with the MRM. Thus, the comparative analyses with both method are important. In the present presentation, I will show the latest studies for excited states of ^{4}He with the CSM, comparing some results with the MRM.

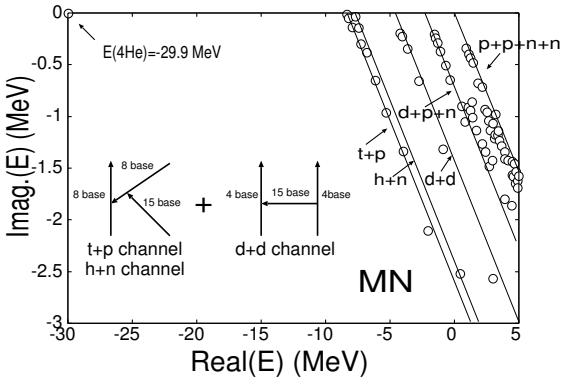

Figure 1: Complex eigenvalue distributions of the p+p+n+n system

References

[1] D.Baye, P.H.Heenen, M.Libert-Heinemann, Nucl.Phys.A291(1977)230.

[2] K.Arai, S.Aoyama, Y.Suzuki, P.Descouvemont, D.Baye, Phys.Rev.Lett.107(2011) 132502.
S.Aoyama, K.Arai, Y.Suzuki, P.Descouvemont, D.Baye, Few-Body Syst.52(2012)97.

[3] S. Aoyama, T. Myo, K. Katō, K. Ikeda, Prog.Theor.Phys.116(2006)1.

E-mail: aoyama@cc.niigata-u.ac.jp