Binding energy of the ^{3}He^{4}He$_2$ trimer within the hard-core Faddeev approach

E. Kolganova[a,b], Y. K. Ho[a], and A. K. Motovilov[b]

[a] *Institute of Atomic and Molecular Sciences, Academia Sinica, P.O.Box 23-166, Taipei, Taiwan 10764, ROC*

[b] *Joint Institute for Nuclear Research, 141980 Dubna, Moscow region, Russia*

There is a great number of experimental and theoretical studies of the ^{4}He three-atomic system. The non-symmetric system ^{3}He^{4}He$_2$ found comparatively little attention. We can only mention the recent works [1]–[3] where the ^{3}He^{4}He$_2$ trimers were treated alongside with small ^{4}He clusters. Until now only the bound states of the ^{3}He^{4}He$_2$ system have been studied numerically. There are still no scattering calculations reported for this system.

Being a more light particle than ^{4}He, the ^{3}He atom supports no bound state with the ^{4}He counterpart and no ^{3}He dimer exists. Thus, the ^{3}He^{4}He$_2$ is even a more loosely bound system than the ^{4}He trimer. According to the hyperspherical adiabatic calculations of [1, 2] and Monte-Carlo investigation of [3] the realistic He-He potentials such as LM2M2 [4] and TTY [5] support only one bound state of the ^{3}He^{4}He$_2$ trimer with the energy of the order of 10–15 mK.

The present work [6] represents rather a first step in an extension of our numerical approach [7]–[9] to the case of three-body systems including particles with different masses. Like in [7]–[9] we use a hard-core version of the Faddeev differential equations and apply it to the ^{3}He^{4}He$_2$ three-atomic system. Using these equations we calculate the binding energy of the ^{3}He^{4}He$_2$ trimer with the LM2M2 and TTY potentials. In the nearest future we plan not only to continue our study of the ^{3}He^{4}He$_2$ bound state but also to perform calculations of the scattering of a ^{3}He atom off a ^{4}He$_2$ dimer. In [6] we only outline the method employed and report our first results for the binding energy of the ^{3}He^{4}He$_2$ system.

References

[1] B. D. Esry, C. D. Lin, and C. H. Greene, Phys. Rev. A **54** (1996) 394.
[2] E. Nielsen, D. V. Fedorov, and A. S. Jensen, J. Phys. B **31** (1998) 4085.
[3] D. Bressani, M. Zavaglia, M. Mella, and G. Moros, J. Chem. Phys. bf 112 (2001) 717.
[4] R. A. Aziz and M. J. Slaman, J. Chem. Phys. **94** (1991) 8047.
[5] K. T. Tang, J. P. Toennies, and C. L. Yiu, Phys. Rev. Lett. **74** (1995) 1546.
[6] E. A.Kolganova and A. K. Motovilov, Czech. J. Phys. **52** (2002), C649.
[7] E. A.Kolganova and A. K. Motovilov, Phys. Atom. Nucl. **62** (1999) 1179.
[8] E. A. Kolganova, A. K. Motovilov, and S. A. Sofianos, J. Phys. B **31** (1998) 1279.
[9] A. K. Motovilov, W. Sandhas, S. A. Sofianos, and E. A. Kolganova, Eur. Phys. J. D **13** (2001) 33.