WEAKLY BOUND TRIATOMIC He_2Li MOLECULES

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The Efimov effect is a remarkable phenomenon, which is an excellent illustration of the variety of possibilities arising when we transit from the two-body to the three-body problem. In 1970 V.Efimov [1] proposed that three-body systems with short range interaction can have an infinite number of bound states when none of the two-particle subsystems has bound states but at least two of them have infinite scattering lengths. In such a case the scattering length is much larger than the range of the interaction.

One of the best theoretically predicted three-body system with an excited state of the Efimov type is a naturally existing molecule of the helium trimer $^4He_3$ (see, [2] and refs. therein). The interaction between two helium atoms is quite weak and supports only one bound state with the energy about 1mK and a rather large scattering length about 100 A. Only recently the long predicted weakly-bound excited state of the helium trimer was observed for the first time using a combination of Coulomb explosion imaging and cluster mass selection by matter wave diffraction [3].

There is a growing interest in the investigation of He_2 – alkali-atom van-der-Waals systems that are expected to be of Efimov nature. In addition to the Helium dimer, the He – alkali-atom interactions are even shallower and also support weakly bound states. In triatomic $^4He_2$-alkali-atom systems presence of Efimov levels can be expected. Three-body recombination and atom-molecular collision in Helium-Helium-alkali-metal systems at ultracold temperatures have been studied using adiabatic hyperspherical representation in [4]. Here we use the Faddeev equations in total angular momentum representation to calculate the $^4He_2{}^{6;7}Li$ binding energies and a scattering length, which has not been studied before.

Our results for $^4He_2{}^7Li$ and $^4He_2{}^6Li$ trimers binding energies show that different potential models support two bound states in both trimers. The energy of the excited state is very close to the energy of the lowest two-body threshold. In case of the $He_2{}^6Li$ system the lowest threshold is different for different potentials but the relative energy with respect to the lowest two-body threshold is practically the same.

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