PHILLIPS LINES FOR WEAKLY BOUND TRIATOMIC He_2Li MOLECULES

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There are two observations that were made in the very end of 1960-s and have been atrracting the few-body community's attention for a long time: the Phillips line [1] and the Efimov effect [2]. The Phillips line -- the linear correlation between the neutron-deuteron scattering length and the triton bound state energy -- constitutes a phenomenological observation for a very particular three-body system, whereas the Efimov effect is a universal theoretical prediction: it emerges for any three-body system which holds at least two subsystems with the two-body scattering lengths larger than all the other length scales. The latter case is often called ``the universal interaction regime'' in which only the leading orders of the two-body effective range expansions govern the three-body dynamics. The both observations can serve as an indication of the universal interaction regime.

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, [3] and refs. therein). The close proximity of this system to the modified dimensionless Phillips line has been demonstrated in [4], which confirms the universal interaction regime for this system.

Another set of Efimov system examples that are not yet confirmed experimentally could be taken from He_2 – alkali-atom van-der-Waals trimers. The dimensionless Phillips plots for these systems differ, however, from the fully symmetric Helium trimer due to the dependence of the plot on the mass ratio of the constituent particles.

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. The proximity of these systems to the universal Efimov regime is demonstrated on the base of analyzing the modified Phillips line for non-symmetrical systems.

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