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Three-body calculation of the 1s level shift in kaonic deuterium

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For the first time a dynamically exact calculation was performed for a hadronic atom with more than two particles. The main difficulty in the description of these systems is the simultaneous correct treatment of the strong and Coulomb interactions. To solve this problem for three-body systems Z. Papp proposed a method (see e.g. [1]), based on the expansion of the 3 Faddeev components of the wave function on Coulomb-Sturmian basis. The discrete and complete set of these functions has the main advantage, that the matrix elements of the Coulomb Green's function can be calculated analytically. The method was successfully applied to nuclear few-body systems with repulsive Coulomb force and for purely atomic systems. However, the case of attractive Coulomb force combined with the strong interaction was not considered. With suitable modifications we used it to perform a dynamically exact calculation of the 1s level shift of kaonic deuterium. This first calculation was done with simple complex KbarN I=0 and I=1 interactions, reproducing the SIDDHARTA kaonic hydrogen 1s level shift (accurately) and the elastic K^-p cross section (approximately). Calculations with more realistic KbarN interactions will follow. Apart from yielding a value for the 1s level shift, these calculations have the important advantage, that they provide a reliable control of the different commonly used approximations for obtaining a theoretical value of this quantity.

[1] Z. Papp, W. Plessas, Phys.Rev. C 54,50(1996)

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