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Quantum-quasiclassical model for resonant and cooling/heating processes in atom-ion traps (CANCELLED)

In recent years, there has been a rapidly growing interest in ultracold hybrid atomic-ion systems. It is caused by new opportunities opening here for modeling various quantum system and processes with controllable properties. Particularly, in the paper of Melezhik and Negretti [1] the confinement-induced resonances (CIRs) in ultracold hybrid atom-ion systems were predicted. The prediction was done in the "static approximation" for the ion. This approximation was also used in recent paper [2] where CIRs in two-center problem were analyzed in pseudopotential approach. However, going beyond the "static approximation"is a hot problem due to principally unavoidable effect of the ion "micromotion"in the Paul trap [3].
To adequately describe the atom-ion dynamics in the hybrid atom-ion trap we have developed a quantum-quasiclassical approach. In this computational scheme, the time-dependent Schrödinger equation, describing collisional atom dynamics in a waveguide-like trap, is integrated simultaneously with the classical Hamilton equations for the ion motion in a linear Paul trap. At that, the three-dimensional Schrödinger equation is coupled with the six classical Hamilton equations during the confined atom-ion collision. The computations were performed for two kinds of the ion confining trap. First, we have considered the effective trap with the time independent frequencies. Afterward, we have evaluated the effect of the ion "micromotion"on the CIRs by including oscillating term in the Paul trap. It was shown that the confined motion (and "micromotion") of the ion does not destroy the CIR. The shift of the CIR position as a function of the mean transversal and longitudinal ion energy were calculated. We also suppose to discuss an extension of the developed approach for heading/cooling process in the confined atom-ion systems. It is important problem for planning controllable and precision experiments with such systems [3].

References

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