Application of the few-body quantum theory of scattering for guided control of chemical reaction and creation of the new molecular structures

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Guided control of molecular processes and creation of the new molecular structure is a subject of active research in molecular and chemical physics. One of the most natural and general approaches in this area is a quantum few-body theory based on the Faddeev-Yakubovsky equations [1,2]. It is based on the idea, that the possible mechanisms of occurrence of chemical reactions based on a specific multiparticle interaction under condition of low coupling energy between clasters of the system [3,4].

In addition to the quantum approaches classical control theory based on the classical mechanics have also been developed [5]. However phase effects as essential [2-5], and classical treatment cannot be good enough.

Investigation of the methods and tools for creation of the new molecular structures with new properties and control of chemical reaction on the base quantum theory of few-body system are presented.

A general method for study three-body recombination reactions base on Faddeev-Yakubovsky equations is developed. Calculations of the three-body recombination rate of the reactions [2-5] $H + H + H \to H_2 + H, He + He + He \to He_2 + He, Cs^+ + Dr^- R \to CsBr + R$ for low energies are compere with clssical results and ather approxamations.

References

[1] L.D. Faddeev, S.P Merkuriev Quantum scattering theory for several particles systems, Kluwer, London, 1993.

[2] Pozdneev S.Application of quantum theory of scattiring to the calculations of different processes in nuclear, atomic and molecular physics, Moscow, Janus-K, 2001; Dynamics of Elementary Atomic-Molecular Processes in Gas and Plasma, Nova Sci. Publ., v.212, 1996.

[3] Efimov V. Nucl.Phys., A362, 45, 1981; A378, 581, 1982; Phys.Rev., C47, 1876, 1993; Vugalter S.A., Zislin G.M. Dokl AN USSR, 1982, v.267, p.784.

[4] Pozdneev S. JETP, v.99, N 5, 2004, p.915-933; J.Rus.Las.Res.,v.22, 2001, p.175; Bull. Lebedev Phys.Inst., N5, 2003, p.1.

[5] Ostrovsky V.N. J.Phys.B:At.Mol.Opt.Phys.,v.B28, 1995, p.3901; Solov'ev E.A. Sov.Phys.-Uspekhi, v.32, 1989, p.228; Vriens L. Case stadies in Atomic Physics, Noth-Holland, v.1,1969,p.335.

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