Non-separable two-body scattering as wave-packets collisions: applications to μCF and other exotic systems

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We develop a wave-packet propagation method for the quantum two-body problem with non-separable interactions. It was successfully applied for sticking[1] and stripping[2, 3] problems of μCF .

Recently, with this approach we have found[4, 5] that the atom-atom interaction or the scattering of an electron off a fixed impurity can be virtually switched off by the impact of a geometrical confinement. By tuning the width $a_\perp = \sqrt{\hbar/\mu\omega}$ of optical or magnetic trap $U(\rho) = \frac{1}{2}\mu\omega^2\rho^2$ one can turn off the ultracold atom-atom scattering in the cylindrical confinement.

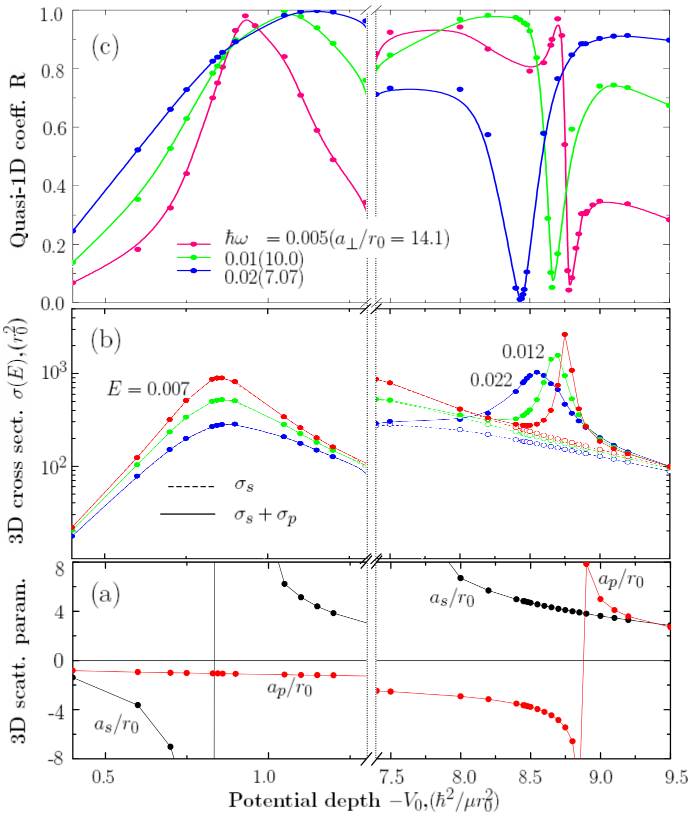

Figure illustrates this effect (by using the screened Coulomb $V(r) = V_0\frac{r_0}{r}\exp\{-\frac{r}{r_0}\}$ as an interatomic potential): how the harmonic trap can transform the pure p-wave resonance in the 3D free space (Fig.(b)) to the free particles flow in a quasi-1D geometry (Fig.(c)).

At that, the maximum in the 3D scattering cross section $\sigma(E)$ (at the point $a_p \to \mp\infty$) (Fig.(b)) is transforming into the minimum of the reflection coefficient R, describing the particles flow in a quasi-1D trap(Fig.(c)), if $a_\perp = 1.45a_s$ and $a_s \sim -a_p$.

This effect might be useful for improving the sensitivity of guided atom interferometers, for controlling properties of quasi-1D quantum gases and decreasing the heat dissipation in tiny electronic devices.

The approach opens new possibilities for analyzing the laser-stimulated formation of antihydrogen atoms:

$$\overline{p} + e^+\hbar\omega \to \overline{\mathrm{H}}_n + 2\hbar\omega$$

which we suppose to discuss in the talk.

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[2] V.S. Melezhik and P. Schmelcher, *Phys. Rev.* **59**, *4264 (1999).*

[3] V.S. Melezhik, *Hyp. Interac.* **138**, *351 (1996).*

[4] J.I. Kim, V.S. Melezhik, and P. Schmelcher, *Phys. Rev. Lett.* **97**, *193203 (2006).*

[5] J.I. Kim, V.S. Melezhik, and P. Schmelcher, *Rep. Progr. Theor. Phys.* (in press).