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Shifts and widths of magnetic Feshbach resonances in atomic traps

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We have developed and analyzed in application to experimentally interesting cases a theoretical approach to study magnetic Feshbach resonances in atomic traps [1,2]. The program was realized by extending (to confined geometry of the traps) the two-channel model of Lange et al [3] suggested for parametrization of resonances in free-space. In our approach, the experimentally known parameters of Feshbach resonances in free-space are used as an input. We have calculated the shifts and widths of s- and p-wave magnetic Feshbach resonances of ^{133}Cs and ^{40}K atoms emerging in harmonic waveguides as s- and p-wave confinement induced resonances (CIRs)[4,5]. Particularly, we show a possibility to control the width and shift of the s- and p-wave CIRs by the trap frequency and the applied magnetic field which could potentially be used in corresponding experiments. For example, it is shown that in a harmonic waveguide there is a possibility to decrease dramatically the width of the Feshbach resonances by decreasing the trap frequency.

We have also found the importance of including the effective range terms in the computational schemes for the description of the p-wave CIRs contrary to the case of s-wave CIRs where the impact of the effective range is negligible [4,6]. In previous investigations of the p-wave CIRs in harmonic waveguides [2,5,7] the effects due to the effective range have been neglected. Thus, our model permits to extract the precise information about low-energy atom-atom interaction, such as s- and p-wave scattering lengths and effective ranges, from the width and shifts of magnetic Feshbach resonances in atomic traps.

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