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Quantum chaos in ultracold collisions between Yb (1S0) and Yb (3P2)

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Dense Feshbach spectra in ultracold collisions that are chaotic cannot be analyzed in the same way as has been done for alkali metals. In particular, good quantum numbers cannot be assigned to individual resonances in chaotic systems, such as ultracold Er+Er and Dy+Dy. Instead, a statistical approach must be taken.

We have calculated and statistically analyzed the Feshbach spectrum of ultracold collisions between Yb($^1S_0$) and Yb($^3P_2$) atoms. The strongly anisotropic potential of this system leads to chaotic signatures when a magnetic field is applied. We probe these chaotic signatures by examining Feshbach resonances as functions of both external magnetic field and an interatomic potential scaling factor λ. We find that the statistics of the Feshbach resonances with respect to λ show a transition from random behaviour at zero magnetic field to chaotic behaviour at finite field. Feshbach resonances as a function of magnetic field also show strong signs of chaos.

The results are a step towards characterizing the conditions required for the emergence of chaos, and demonstrate that a complicated electronic structure is not a prerequisite for chaos.

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