Ultralong-range Ytterbium Rydberg Molecules

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Long-range Rydberg molecules form when the electron of a Rydberg atom encounters a ground-state atom: depending on the scattering phase shifts of the electron with the neutral atom, attractive potential energy curves form which support a rich vibrational spectrum. This concrete link between the low-energy scattering phase shifts of a free electron off of a neutral atom and the binding energies of a Rydberg molecule allows for extracting the low-energy scattering properties from spectra of Rydberg molecules [1,2]. We utilize this premise of comparison of measured and theoretical spectra to determine the *S*-wave scattering length and position and width of the $P_{3/2}$-shape resonance of ^{174}Yb. These quantities are in qualitative agreement with sparse existing theoretical predictions [3].

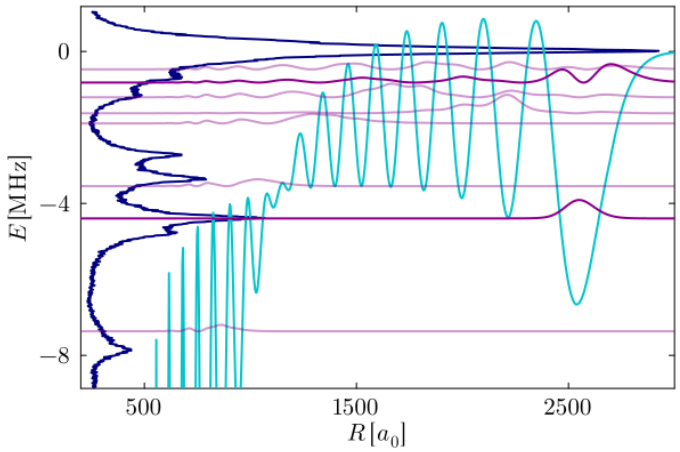

Figure 1: Electronic potential energy curve (in turquoise) of ^{174}Yb(6*s*)+^{174}Yb(41*s* ^{1}S$_0$) Rydberg molecule, with calculated vibrational states (in purple) and measured spectrum (in navy).

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References

[1] V. Bendkowsky, *et. al. Nature* **458**, 1005-1008 (2009).

[2] H. Saßmannshausen, F. Merkt and Johannes Deiglmayr, *Phys. Rev. Lett.* **114**, 133201 (2015)

[3] V.A. Dzuba and G.F. Gribakin, *Phys. Rev. A* **49**, 2483 (1994).