Towards Ultracold Dy_2 Molecules via STIRAP

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Ultracold molecules composed of lanthanide atoms offer a unique platform for exploring strongly anisotropic interactions, quantum magnetism, and precision-controlled chemistry. Here, we propose a method to create ground-state dysprosium dimers (Dy_2) from ultracold Dy atoms using the Stimulated Raman Adiabatic Passage (STIRAP) technique. To identify an optimized STIRAP scheme, we systematically explore the intermediate state by numerically solving the coupled-channel Schrödinger equation and subsequently calculating the Franck–Condon factors. The interatomic interaction is modeled using an anisotropic long-range van der Waals potential combined with a short-range repulsive term, which can be refined based on our ongoing spectroscopic measurements. While this study is still in progress, our preliminary simulations offer promising insights into experimentally viable pathways for producing ground-state Dy_2 molecules. We also outline the roadmap for the experimental platform under construction, aimed at enabling the realization and control of complex magnetic molecules at ultracold temperatures.

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References

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