



Creating Ultracold Dipolar NaCs Molecules

Sebastian Will

Assistant Professor of Physics, Columbia University

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<https://purdue-edu.zoom.us/j/97714977974>

Host: Mahdi Hosseini

Ultracold dipolar molecules combine features of ultracold atoms and trapped ions. They promise new research avenues in quantum simulation, quantum computing, and quantum chemistry. But creating and taming ultracold systems of dipolar molecules is not a routine task. For example, Bose-Einstein condensates of dipolar molecules have not been created, yet.

In this talk, I will discuss the creation of dipolar NaCs molecules in their absolute ground state. NaCs molecules have a large dipole moment of 4.6 Debye, which will lead to strong long-range dipole-dipole interactions. Over the past year, we have created overlapping Bose-Einstein condensates of Na and Cs [1], located Feshbach resonances of the quantum gas mixture, and created high phase-space density gases of NaCs Feshbach molecules [2]. Most recently, we have created the first ultracold gases of NaCs ground state molecules. With this system, we plan to explore new strongly interacting quantum phases, such as dipolar crystals and Mott insulators with fractional filling. At the end of the talk, I will briefly discuss a new effort in my group. Using programmable arrays of Sr atoms, we are working towards demonstrating collective effects, such as subradiance, which may help enhancing coherence in many-body quantum systems.

[1] “Overlapping Bose-Einstein Condensates of Na and Cs,” C. Warner et al., Phys. Rev. A 104, 033302 (2021) (Editors’ Suggestion)

[2] “A High Phase-Space Density Gas of NaCs Feshbach Molecules,” A. Lam et al., arXiv:2202.03355 (2022)



Sebastian Will investigates quantum systems of ultracold atoms and molecules. Since 2017, he is an Assistant Professor at Columbia University, where he and his team use ultracold atoms and molecules to create novel many-body quantum systems, perform quantum simulations of strongly interacting matter, and work towards single atom and single molecule control. He is a recipient of the NSF Career award and a Fellow of the Alfred P. Sloan Foundation.

