Towards ultracold CsAg molecules

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We are reporting the initial progress on the development of our experimental setup able to produce ultracold CsAg molecules. This molecule can achieve electric dipole moments nearing 10 D in the absolute roto-vibrational ground state [1], making it an excellent platform for quantum simulations of systems in which long-range dipole-dipole interactions dominate.

In order to produce CsAg molecules, samples of Cs and Ag will be laser-cooled and then associated by magnetic Feshbach association. In our laboratory, we already possess the expertise and equipment required to cool down and manipulate ultracold Cs and K . Thus, the only ingredient left is the production of ultracold Ag samples.

To cool down Ag, we will use the D_2 line located at 328 nm. To produce this light, we use a doubling cavity pumped by a high-power 656 nm laser. Similarly to experiments with Cd [2], we are using the 656 nm light to study the hyperfine spectrum of different X to B transitions of molecular iodine to locate a transition that can be used as a frequency reference to lock the frequency of the 656 nm in the vicinity of the silver cooling frequency. We will use a frequency comb to precisely determine the frequency of these transitions. The expertise gained along these measurements will be used in future spectroscopy measurements, including the study of the clock state of Ag.

Future (or almost current) efforts will be directed toward the development of a Ag 2D magneto-optical trap (MOT). This Ag 2D MOT will provide a high-flux atomic beam to feed a dual-species (Cs and Ag) 3D MOT, where further cooling and manipulation will take place.

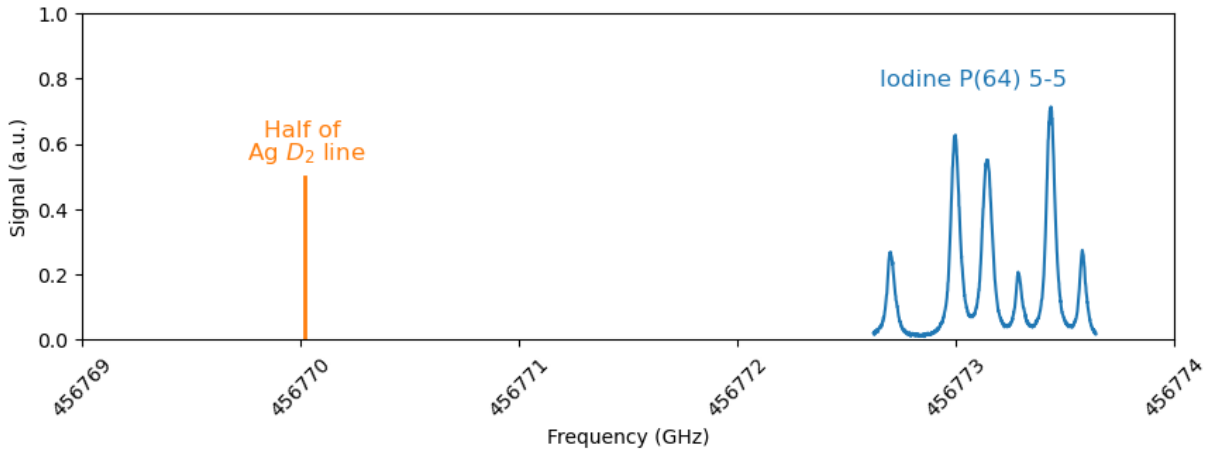

Figure 1: Preliminary results of the hyperfine spectroscopy of the iodine X to B transition in the vicinity of the Ag D_2 line.

References

[1] M. Smiałkowski and M. Tomza, *Physical Review A* **103**, 022802 (2021).
[2] S. Manzoor, M. Chiarotti, S.A. Meek, G. Santambrogio, and N. Poli , *Optics Express* **32**, 44683-44693 (2024).