Production of a cold beam of BaOH using water seeded neon gas

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Ultracold polyatomic molecules have gained a lot of attention recently for their utility in precision tests on fundamental physics, specifically for searches of a non-zero permanent electric electron dipole moment (*e*EDM) [1]. Linear triatomics in particular possess structure that afford them both laser coolability and internal comagnetometry with closely lying states of opposite parity. Barium monohydroxide (BaOH) is interesting owing to its sensitivity to the *e*EDM [2], alongside its role as a pathfinder for triatomic molecules more sensitive to the *e*EDM such as RaOH.

To this end, we report the production of BaOH in a cryogenic buffer gas beam source. The molecules are produced by laser ablating a barium target in the presence of neon as buffer gas and neon seeded with water as reactant. We observe an elevenfold increase in yield by exciting the $^1S_0 - ^3P_1$ transition in the ablated barium atoms. The enhanced beam produces a molecular flux of $\sim 10^{10}$ molecules per shot. Using a gas reactant with a metal target instead of a ceramic salt target minimizes fluctuations in molecular yield over long timescales. This provides opportunities to perform precision spectroscopy on BaOH to characterize the *e*EDM science state and developing a viable laser cooling scheme.

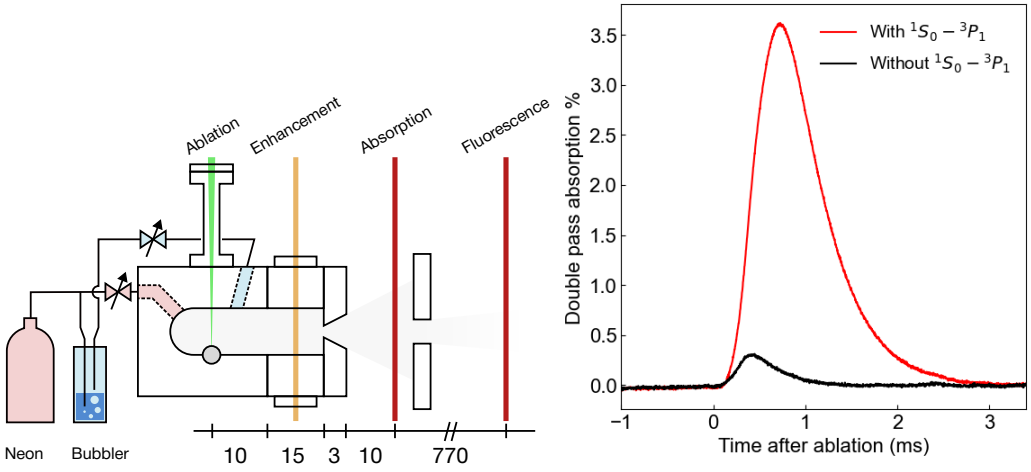

Figure 1: **Left** : Cryogenic buffer gas source setup. **Right** : Enhanced yield seen in the time-of-flight profile.

References

[1] N. R. Hutzler, *Quantum Science and Technology* **5**, 044011 (2020).

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