Deceleration, cooling and trapping of SrF molecules for precision spectroscopy

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Heavy diatomic molecules can have hugely enhanced sensitivity for the study of fundamental symmetries and interactions, such as the search for an electron-EDM or parity violation. We work on the development of methods to cool and trap selected molecules suited for such precision measurements, since the ultimate sensitivity could be reached in an experiment exploiting the long coherence time offered by cold, trapped molecules.

We present the first results on the deceleration of SrF molecules [1, 3] in a traveling-wave Stark decelerator (Figure 1). Traditional Stark decelerators suffer from overfocusing, leading to losses. This makes it very inefficient to use such a device for the deceleration of heavy diatomics, such as SrF. A long traveling-wave decelerator, which is inherently stable, is therefore built in our lab. Using arbitrary waveform generators and high voltage amplifiers we can create true 3D moving electric traps inside the decelerator, that can be brought to a complete standstill in the laboratory [2]. After deceleration, we will laser cool the molecules to prepare them for a parity violation measurement. We report the status of the experiment and present our plans for cooling and precision spectroscopy using cold and/or trapped molecules.

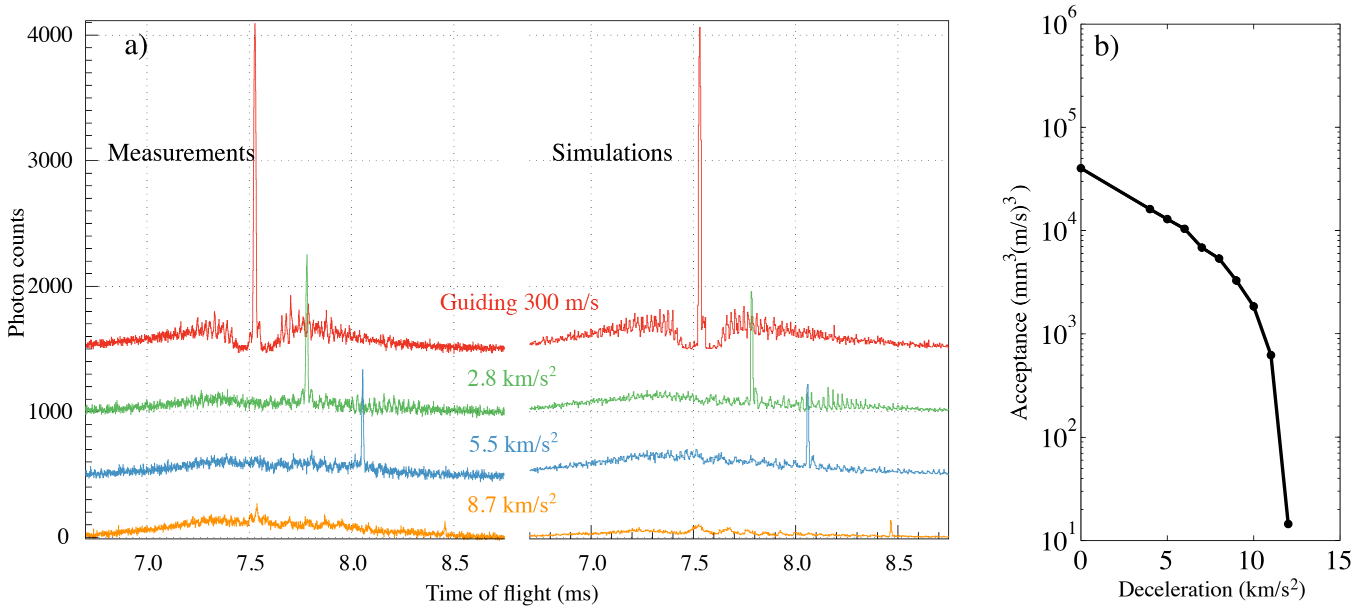

Figure 1: *a) A time-of-flight measurement (left) compared with trajectory simulations (right) showing the deceleration of SrF molecules. b) Simulation results that illustrate the unavoidable decrease of acceptance with increasing deceleration strength. The observed deceleration matches the design efficiency.*

References

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