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Traveling-wave Decelerator Principle and Results

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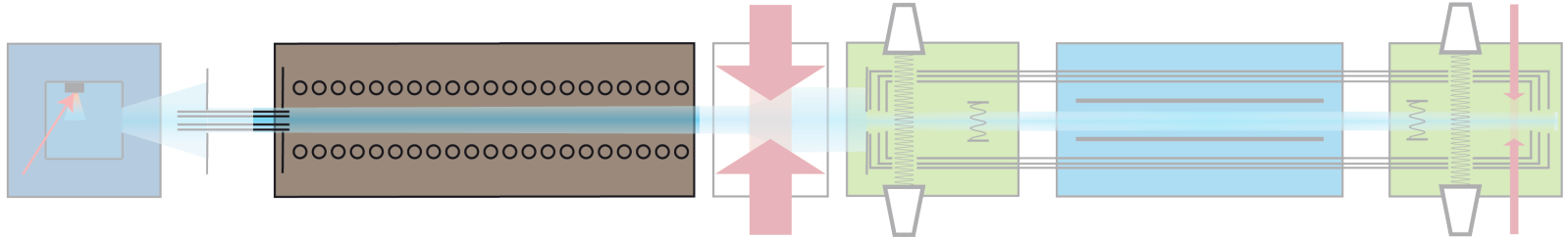
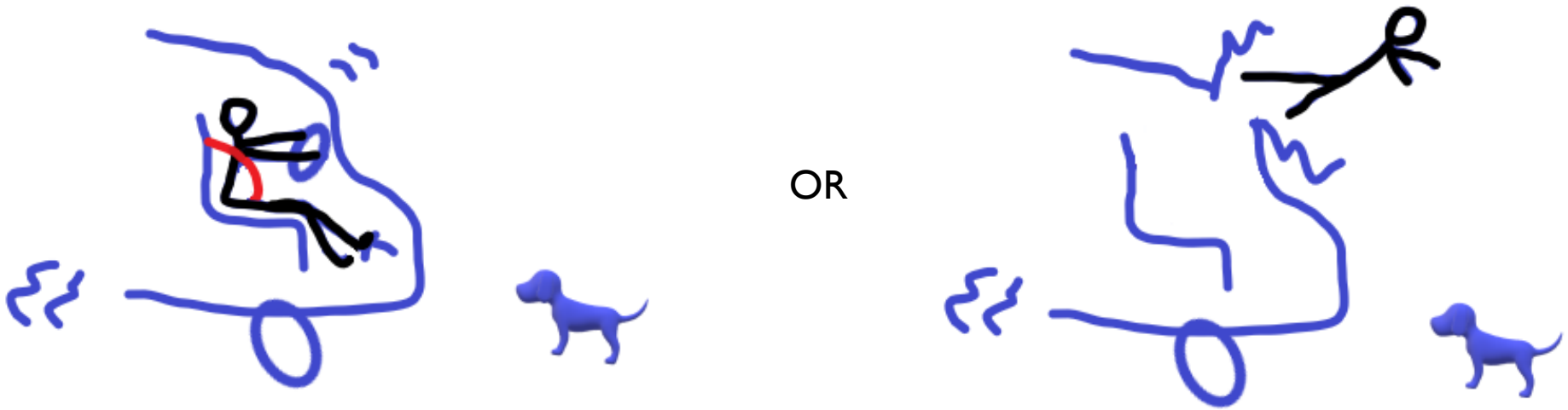
for the NL-*e*EDM collaboration



Experimental setup

Deceleration principles



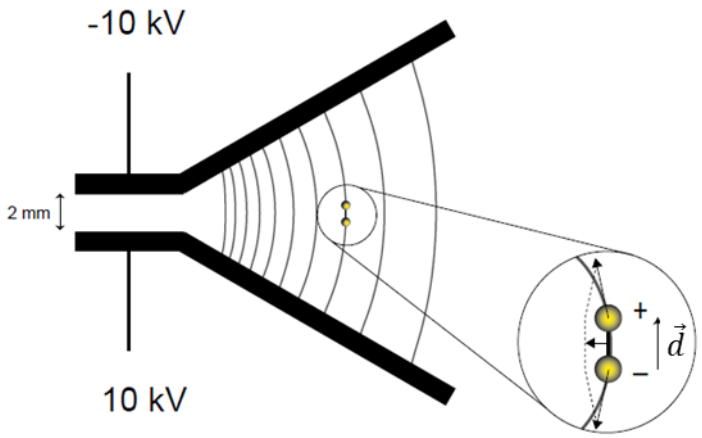
Car----------Traveling-wave electric field

Seat belt---------- Electric trap due to Stark effect

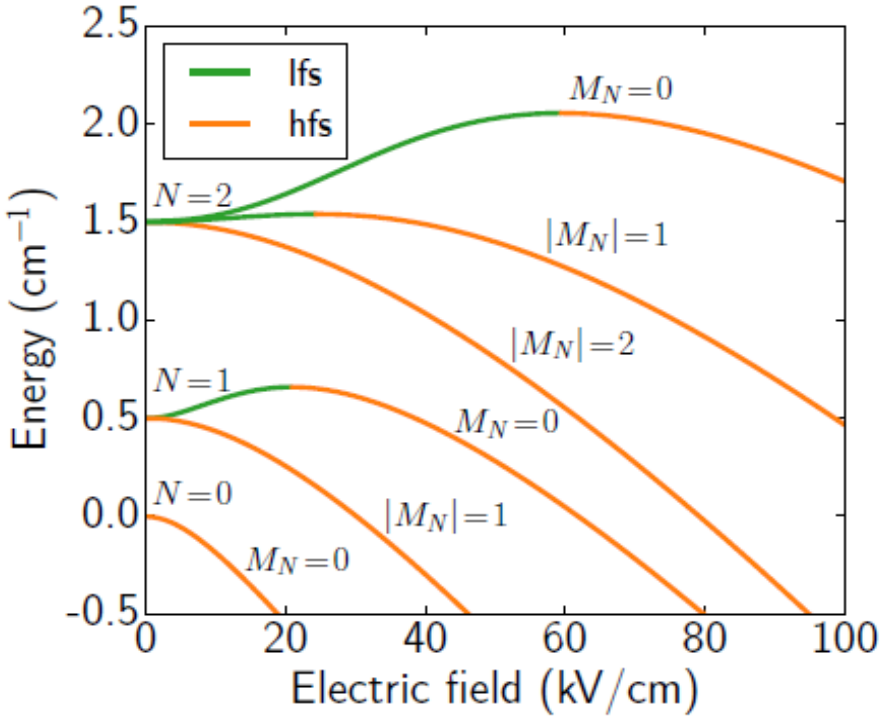
Stark effect of polar molecules

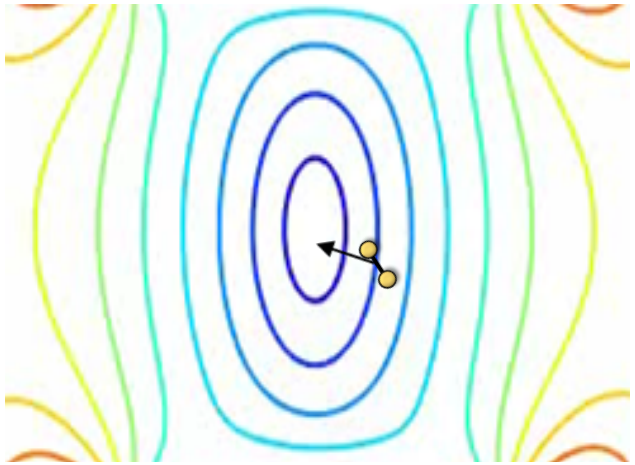
Energy shift due to electric field:

$$\hat{H}_{Stark} = -\boldsymbol{d} \cdot \boldsymbol{E}$$



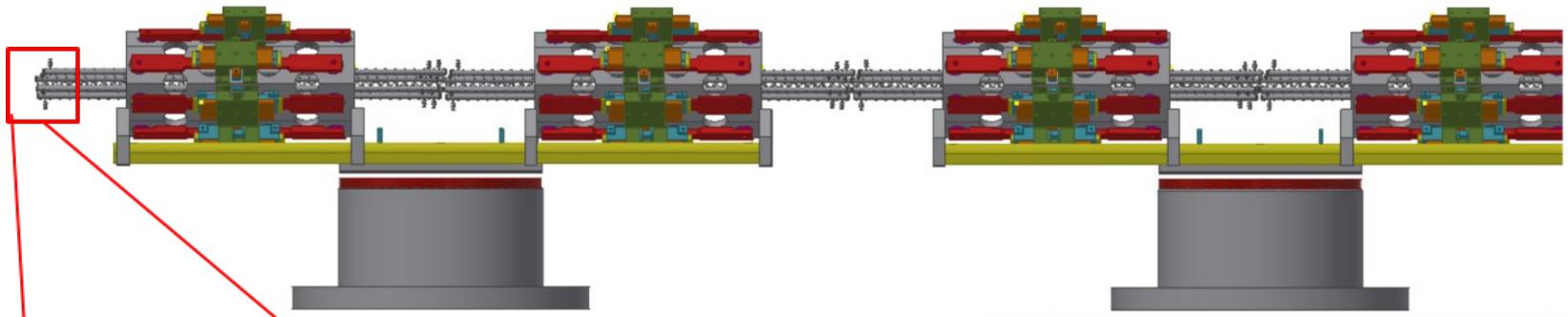
Stark shift of SrF molecule



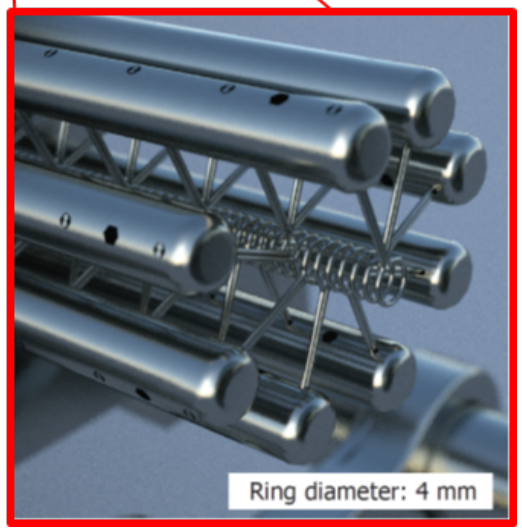


Molecules at low-field seeking state are attracted to the minima of electric field

Inhomogeneous electric field



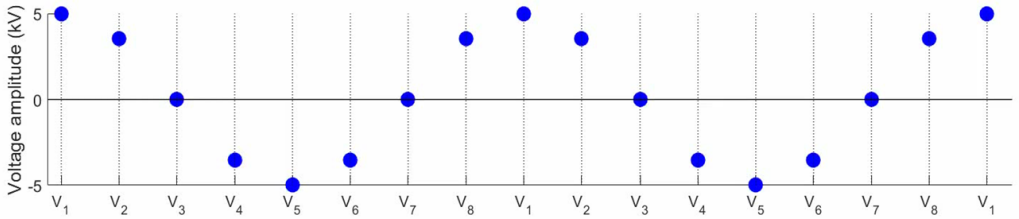
8 modules

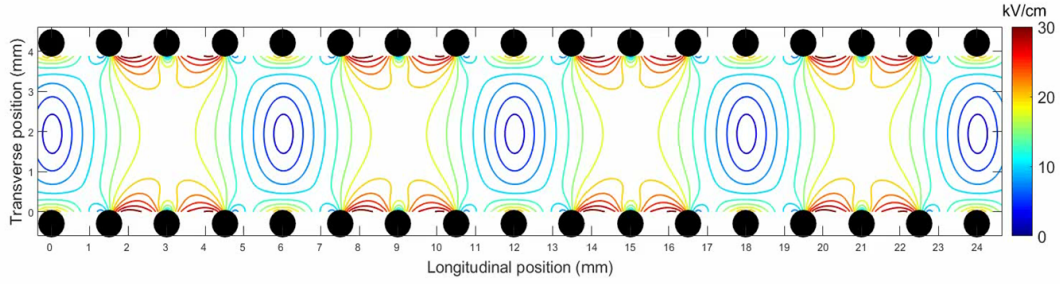


8 electrodes

Voltage up to 5 kV

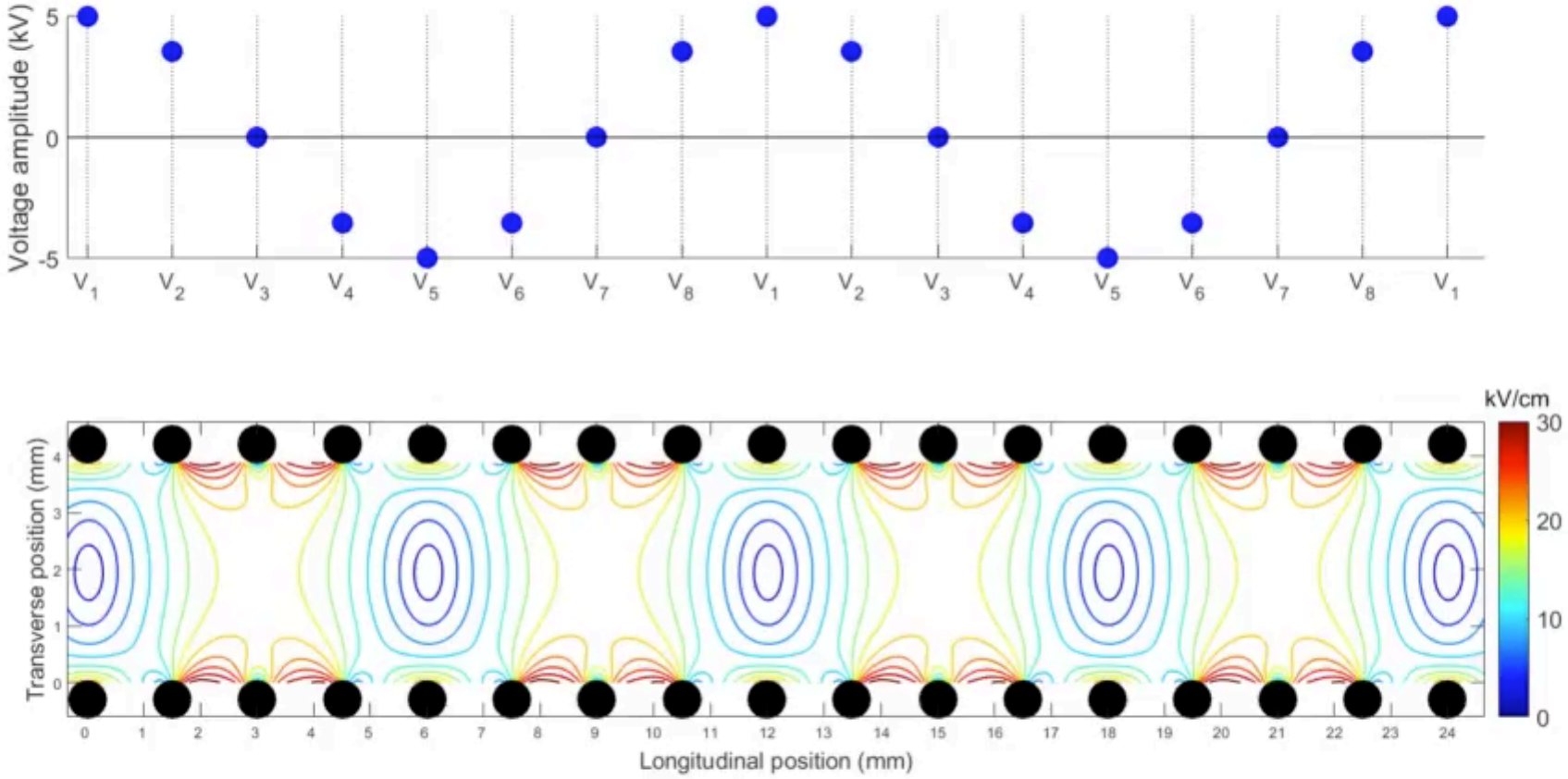
Period: every 8 rings





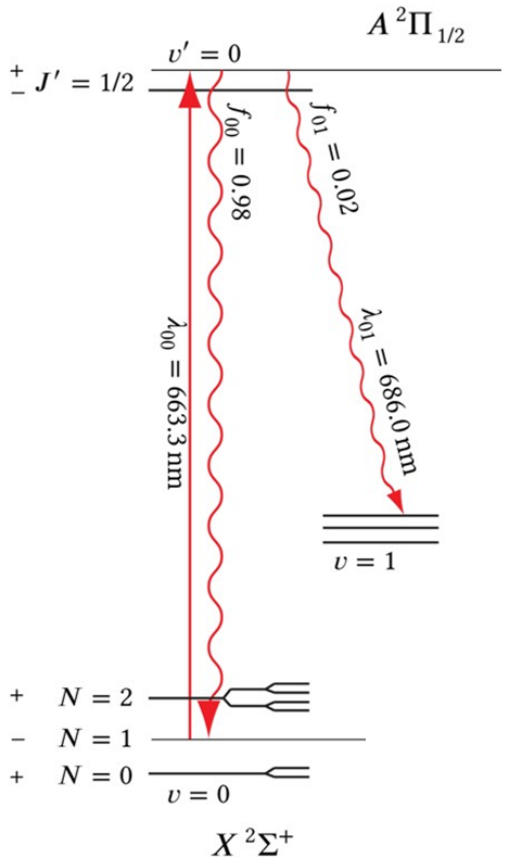
Travelling minima with a periodicity of 6 mm

3-D traps inside the decelerator

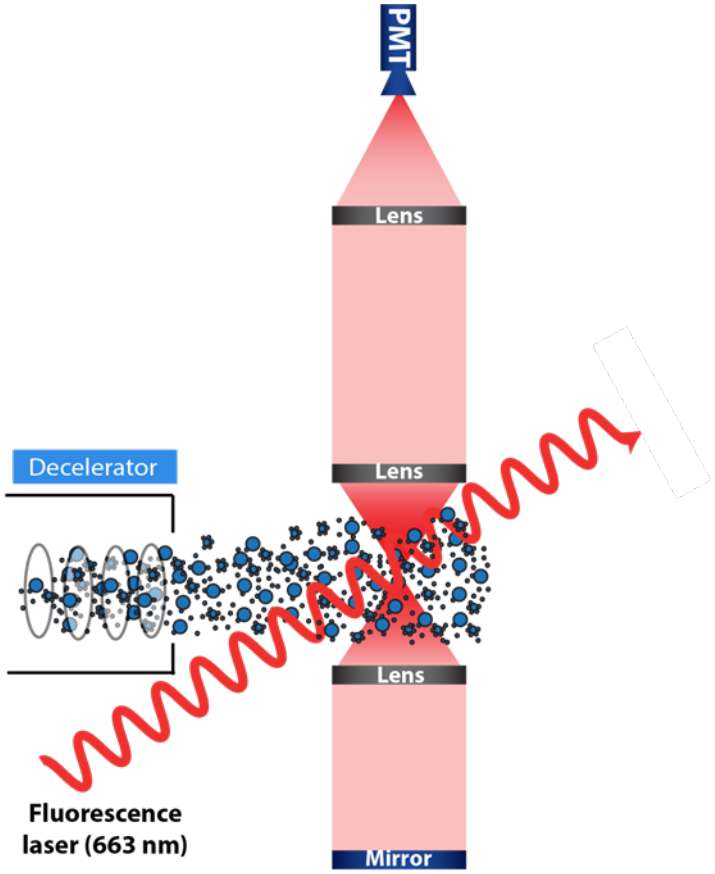


Speed of the trap is determined by the frequency of the sinusoidal voltage: guiding or deceleration

Laser induced fluorescence detection

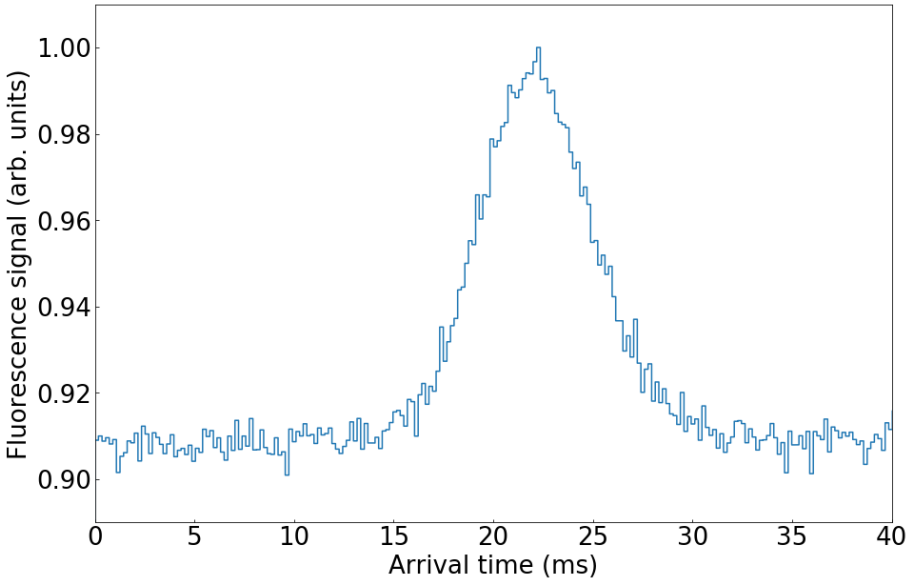


SrF energy levels and laser pumping scheme



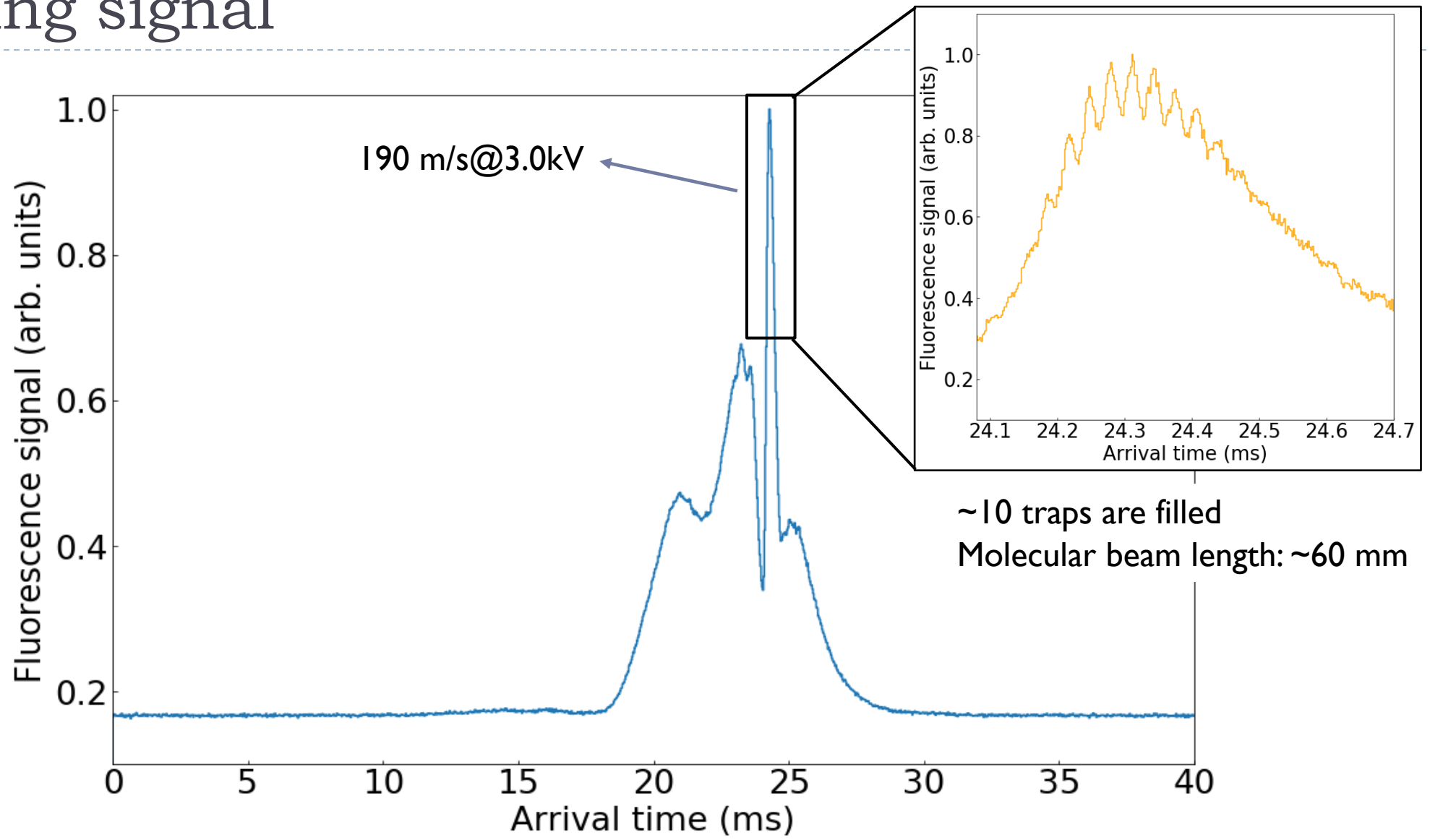
Pulsed molecular beam (10 Hz)

Continuous-wave detection laser



Time of flight signal
(free flight)

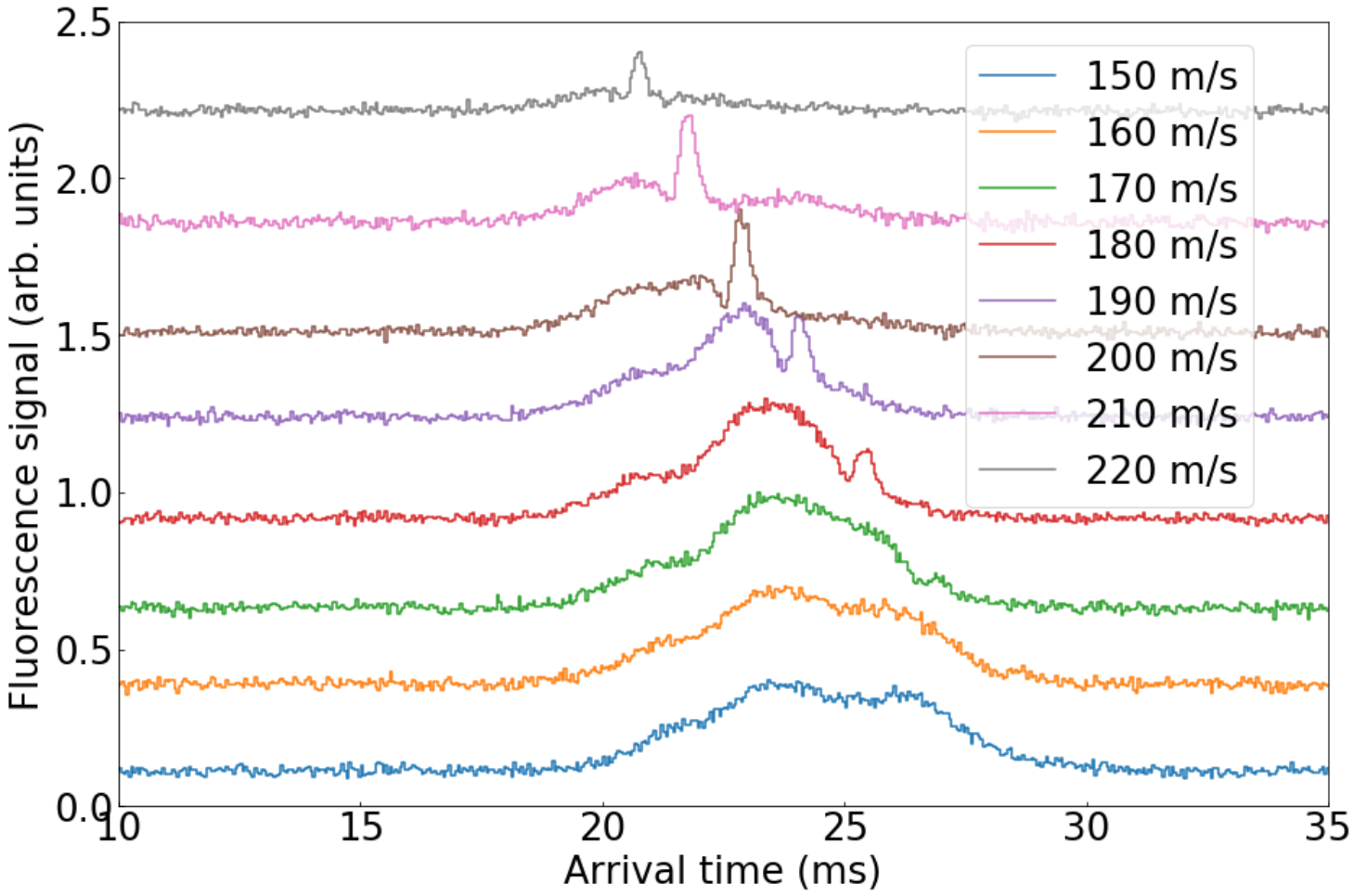
Guiding signal



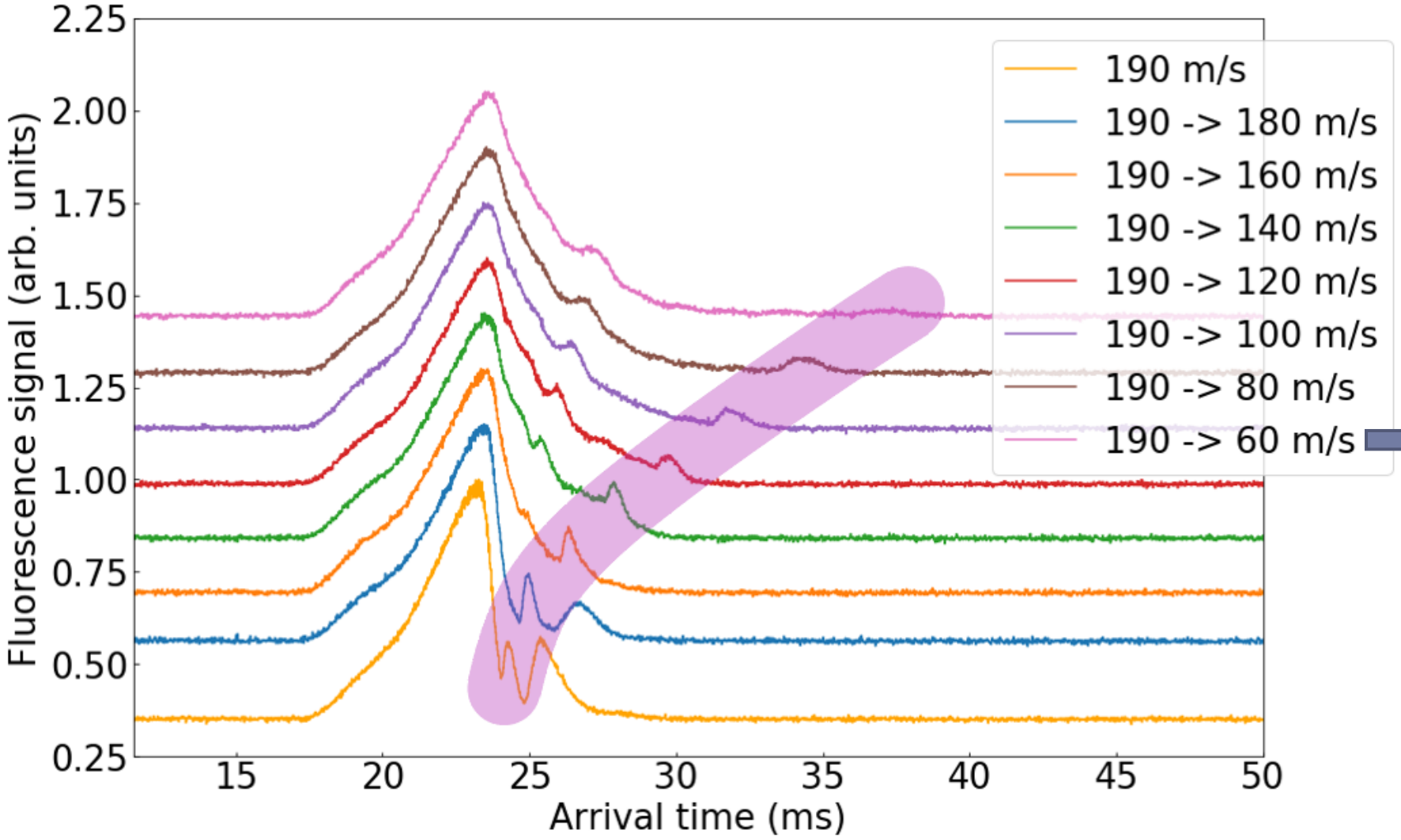
~10 traps are filled

Molecular beam length: ~60 mm

Guiding at different velocities



Deceleration to different velocities



90% of the initial kinetic energy is removed

Conclusion & Outlook

- ☑ Cryogenic source has been coupled to decelerator
- ☑ Decelerator is working in either guiding or deceleration mode

- ☐ Decelerating molecules to lower speed are in progress
- ☐ Transformers capable of higher voltages are in construction
- ☐ Molecules will be switched from SrF to BaF in the near future

NL-*e*EDM collaboration

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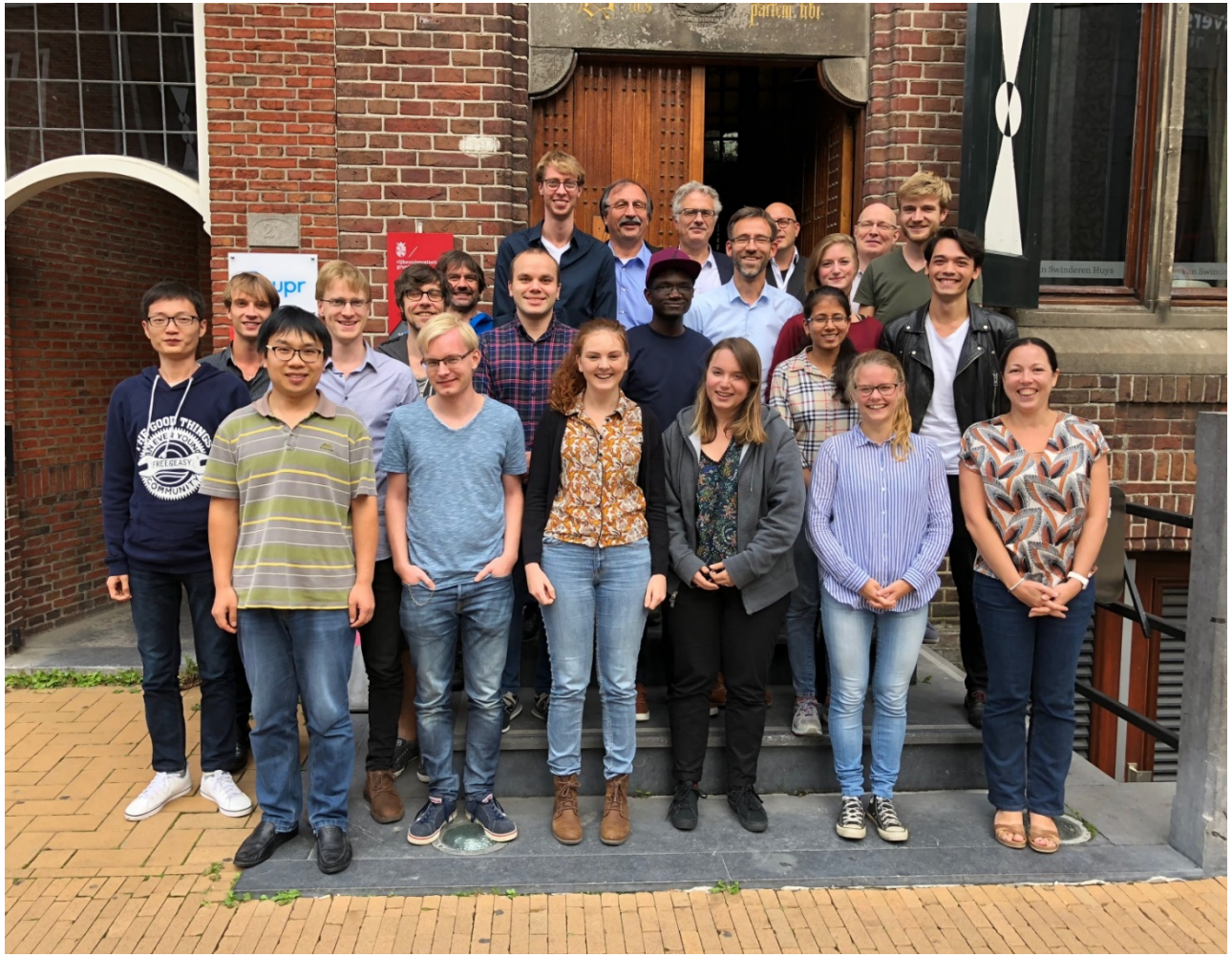

Thanks for your attention

Trajectory of molecules going through the decelerator