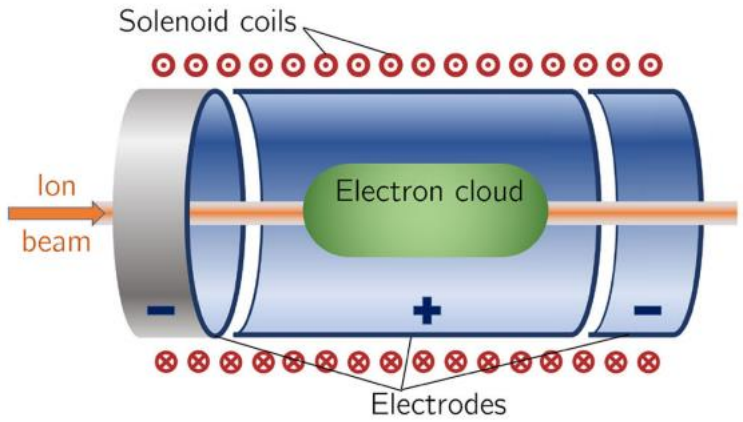
Work Package 3: Proton and ion capture

Poram Ruksasakchai
(On behalf of WP3)

Gabor lens

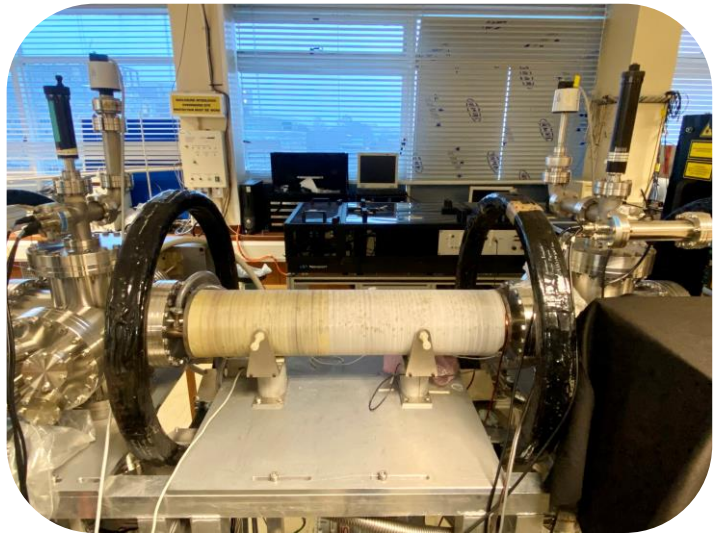
Using the electron plasma to produce a lens. It reduces the focal length to 1% of that produced by a magnetic field alone.

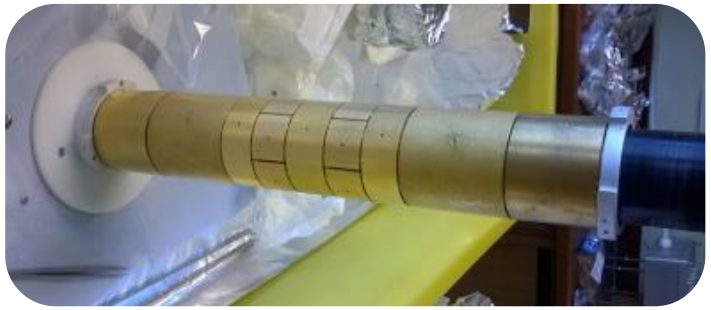


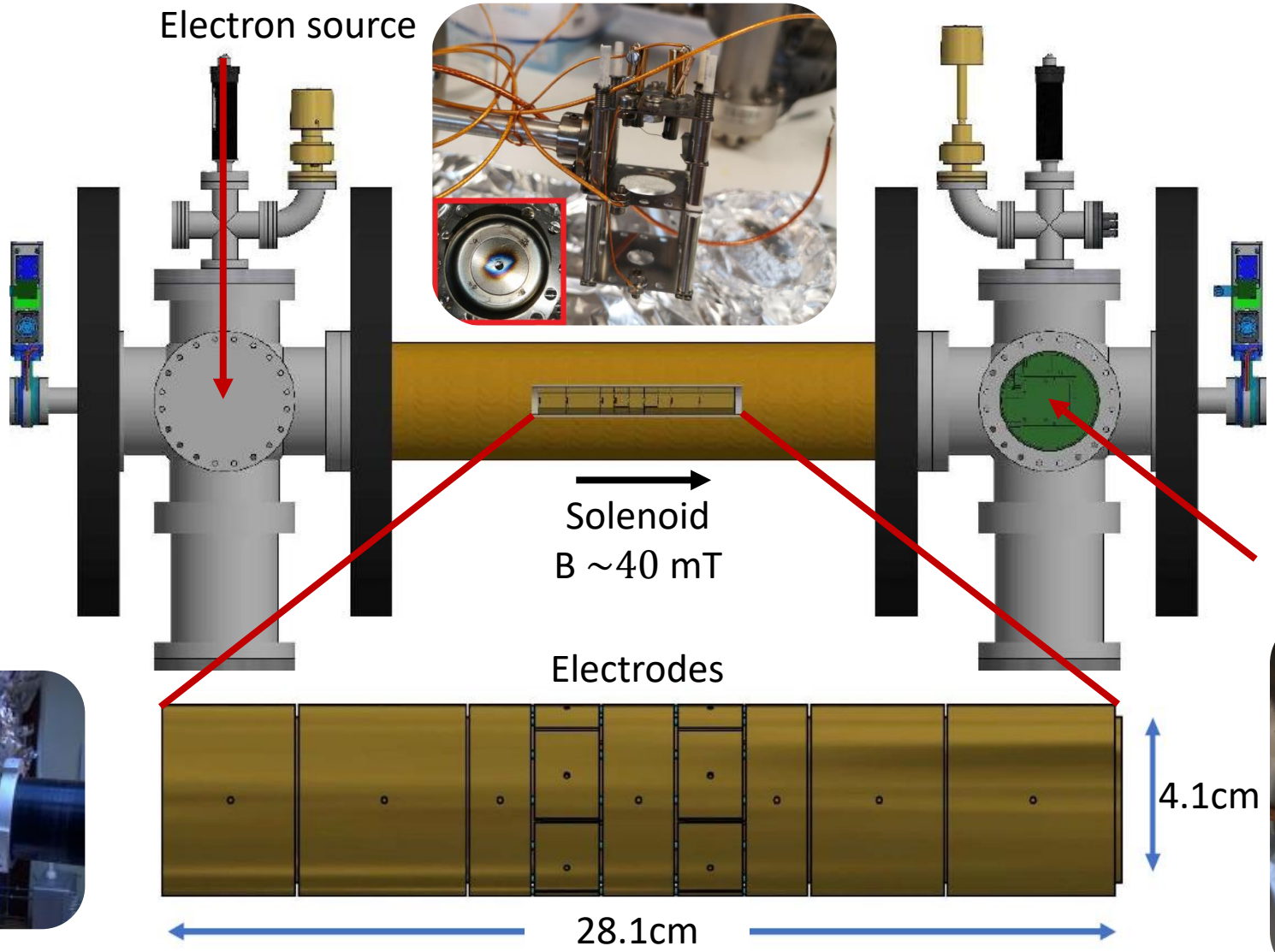
Aymar, G., Becker, T., Boogert, S., Borghesi, M., Bingham, R., Brenner, C., ... & Xiao, R. (2020). LhARA: the laser-hybrid accelerator for radiobiological applications. Frontiers in Physics, 8, 567738.

Using the Penning-Malmberg trap, a linear array of electrically biased cylinders arranged along the axis of a uniform magnetic field.

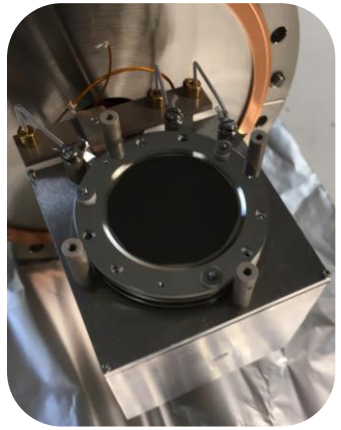
Current Apparatus (preliminary activity)



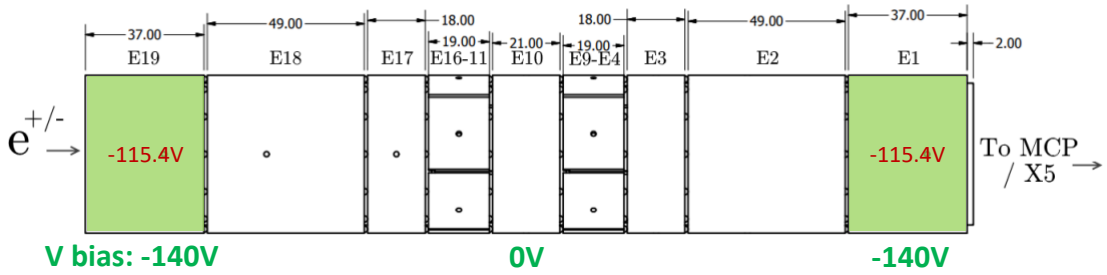


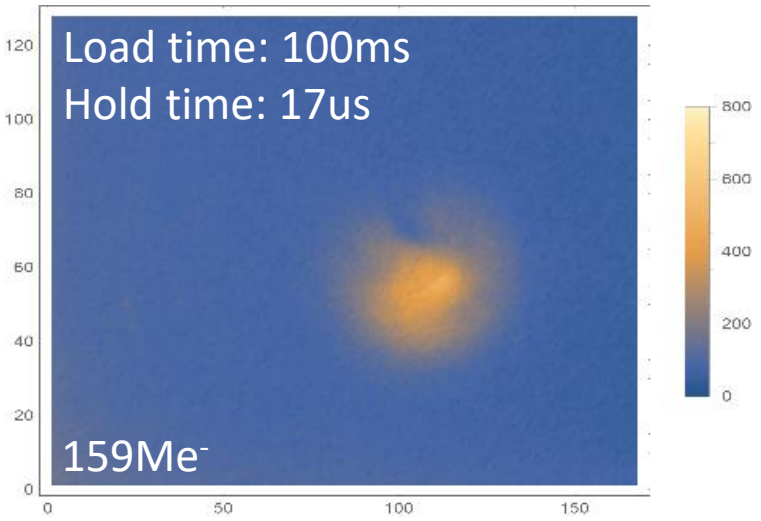


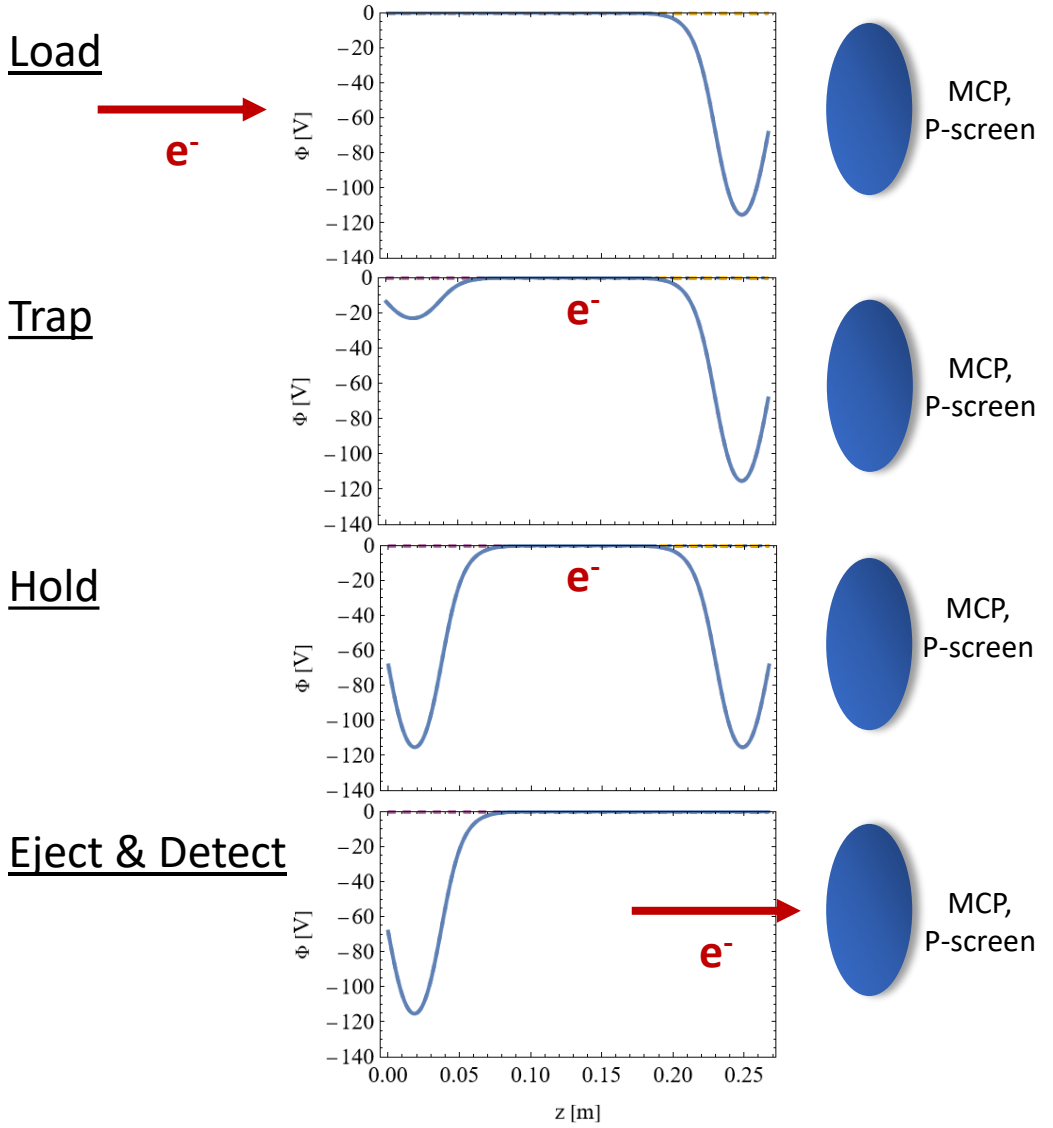
Microchannel plate (MCP)/ Phosphor screen



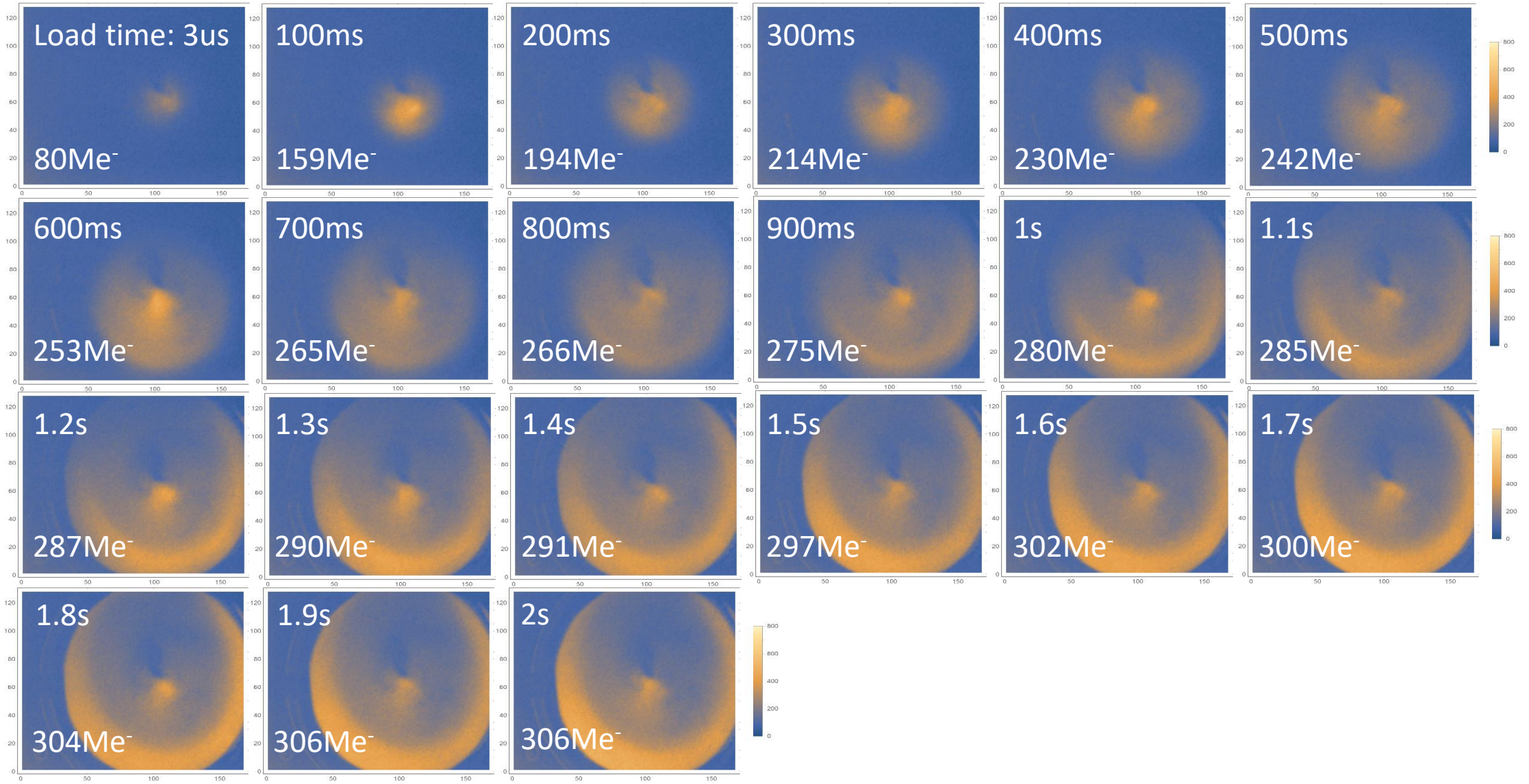
Preliminary results (October 2023)





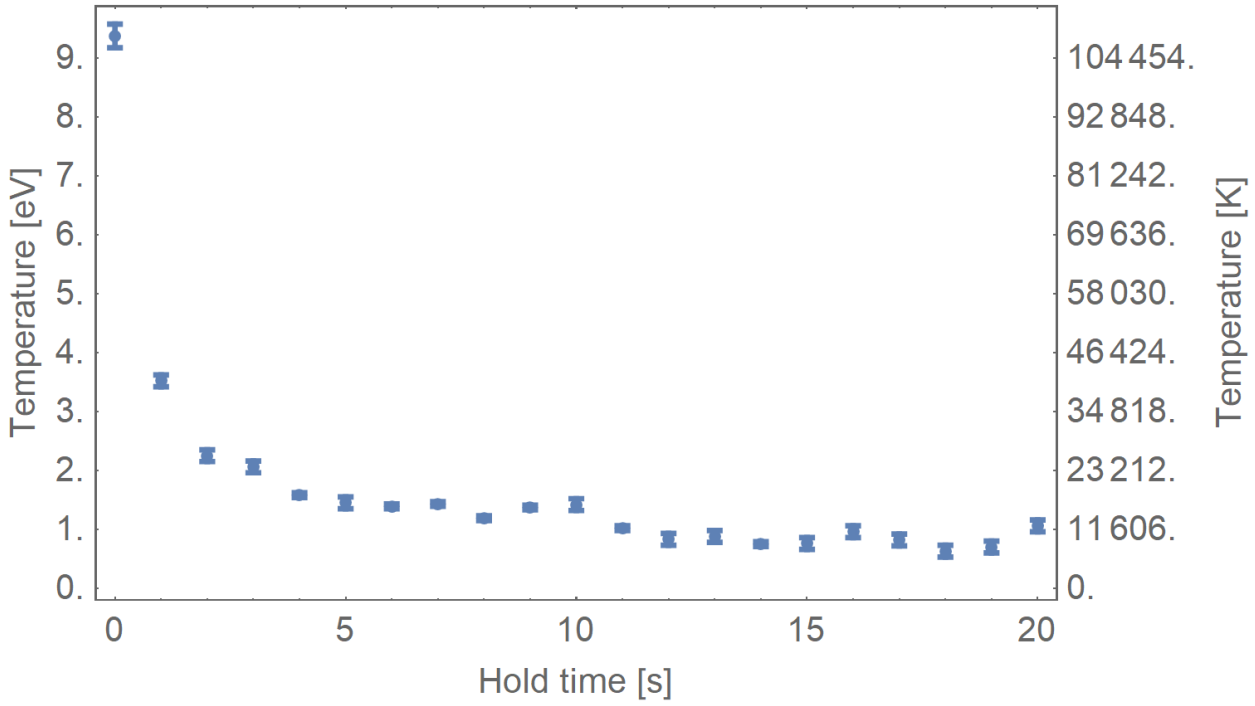


Vary the load time



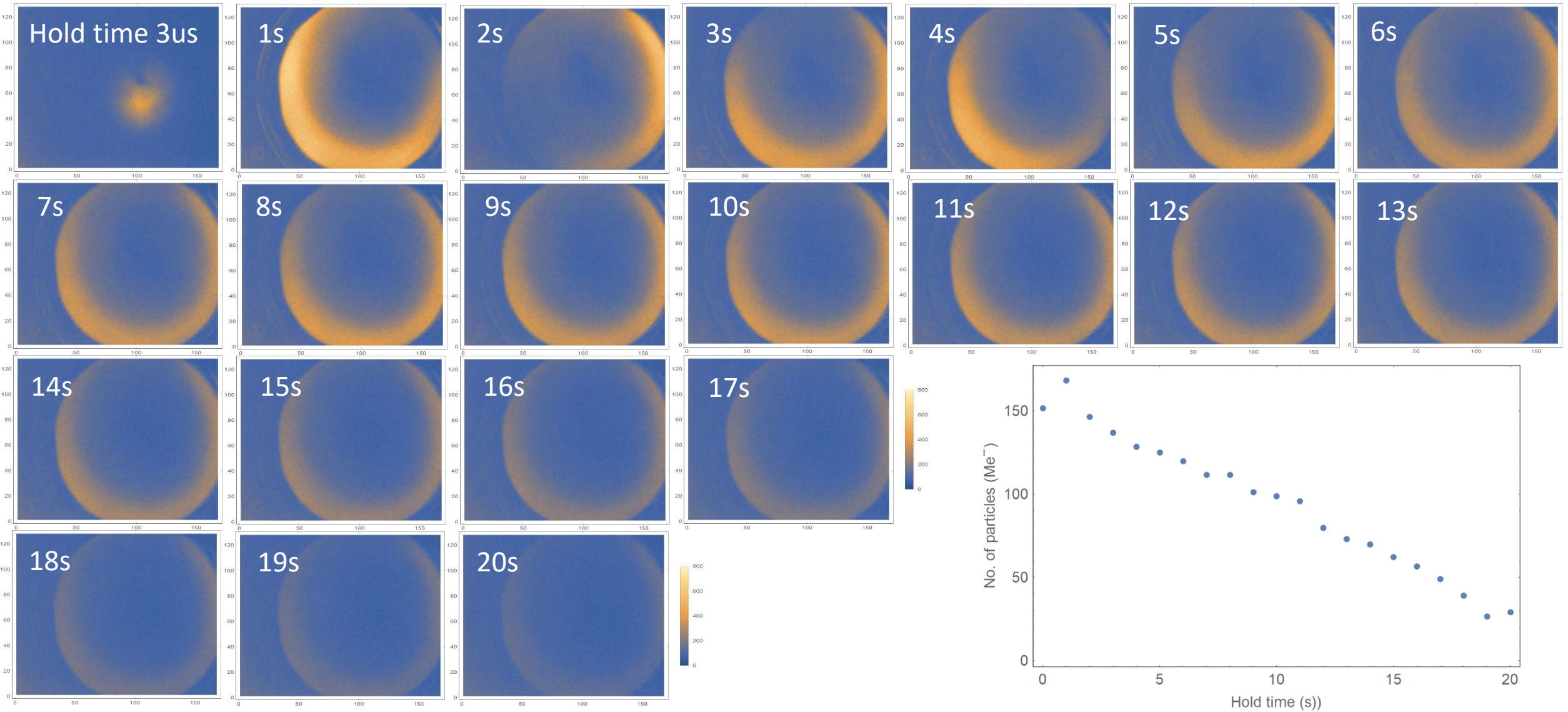
Temperature of the trapped e^-

Measuring the temperature by detecting the number of electrons escaping from the trap when reducing the trap potential.
Load time: 100ms

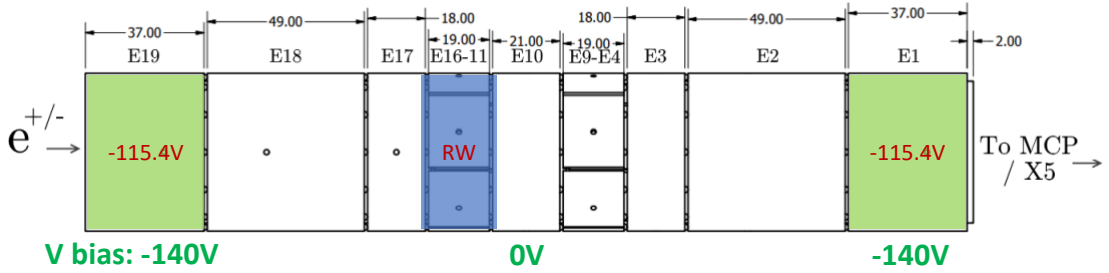


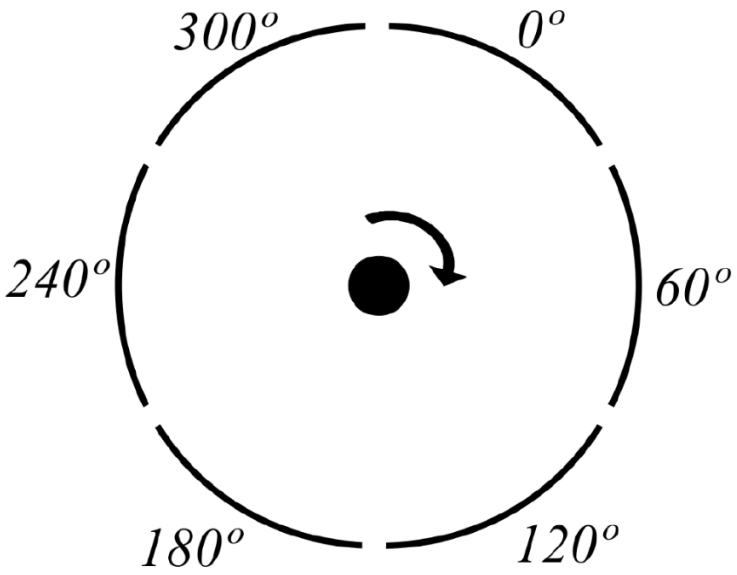
Temperature ~1eV at equilibrium

Vary hold time



Rotating Electric fields / Rotating wall





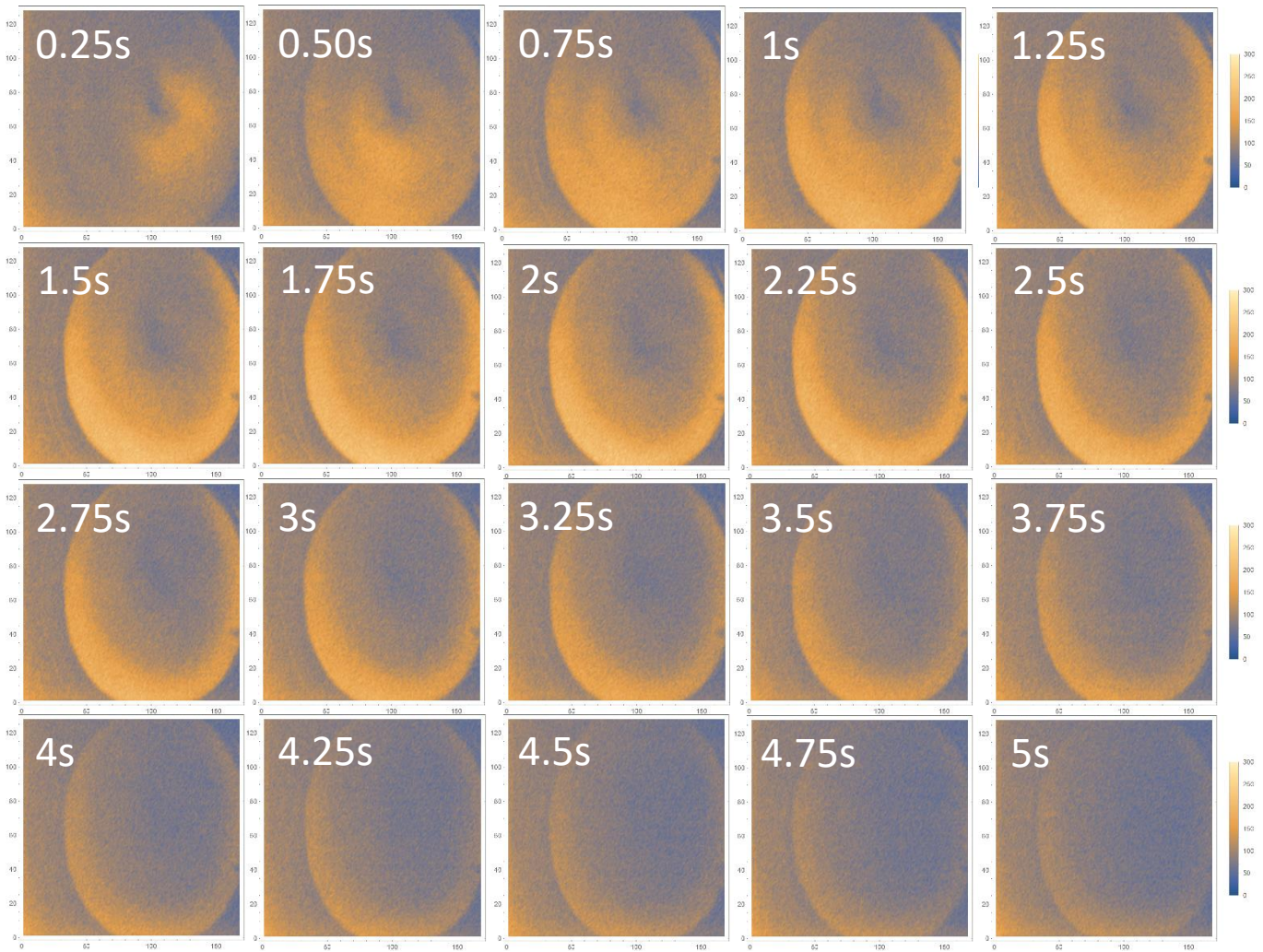
https://alpha.web.cern.ch/science/rotating-wall

A six-segment rotating wall electrode is used to control plasma radii. The relative phase of the signal applied to each sector of the electrode is labelled.

This gives a rotating electric field perpendicular to the axis of symmetry of the plasma.

↳ The electric field induces an electric dipole moment in the plasma, leading to plasma compression.

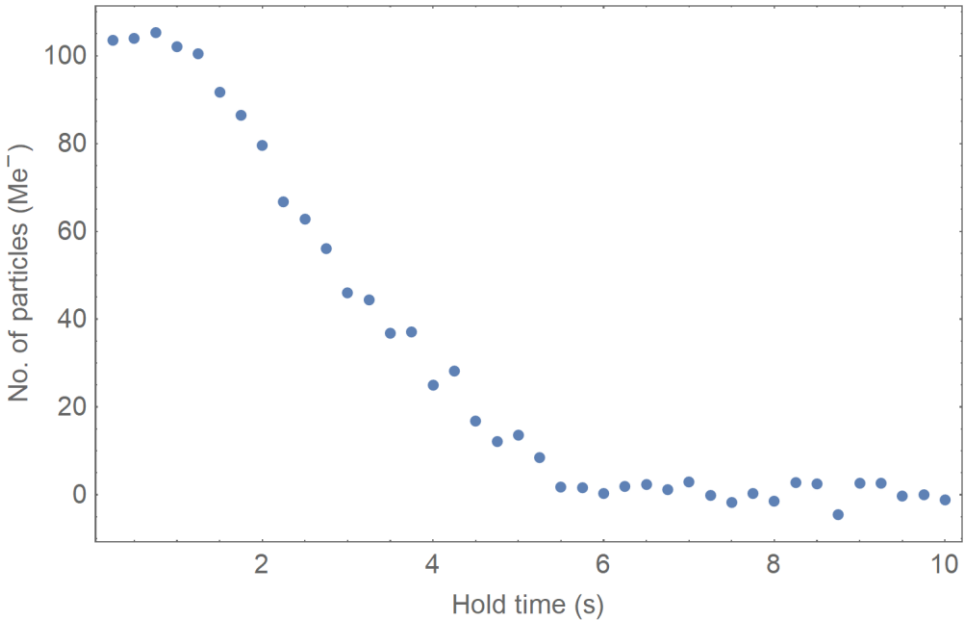
Rotating wall



Load time: 200ms

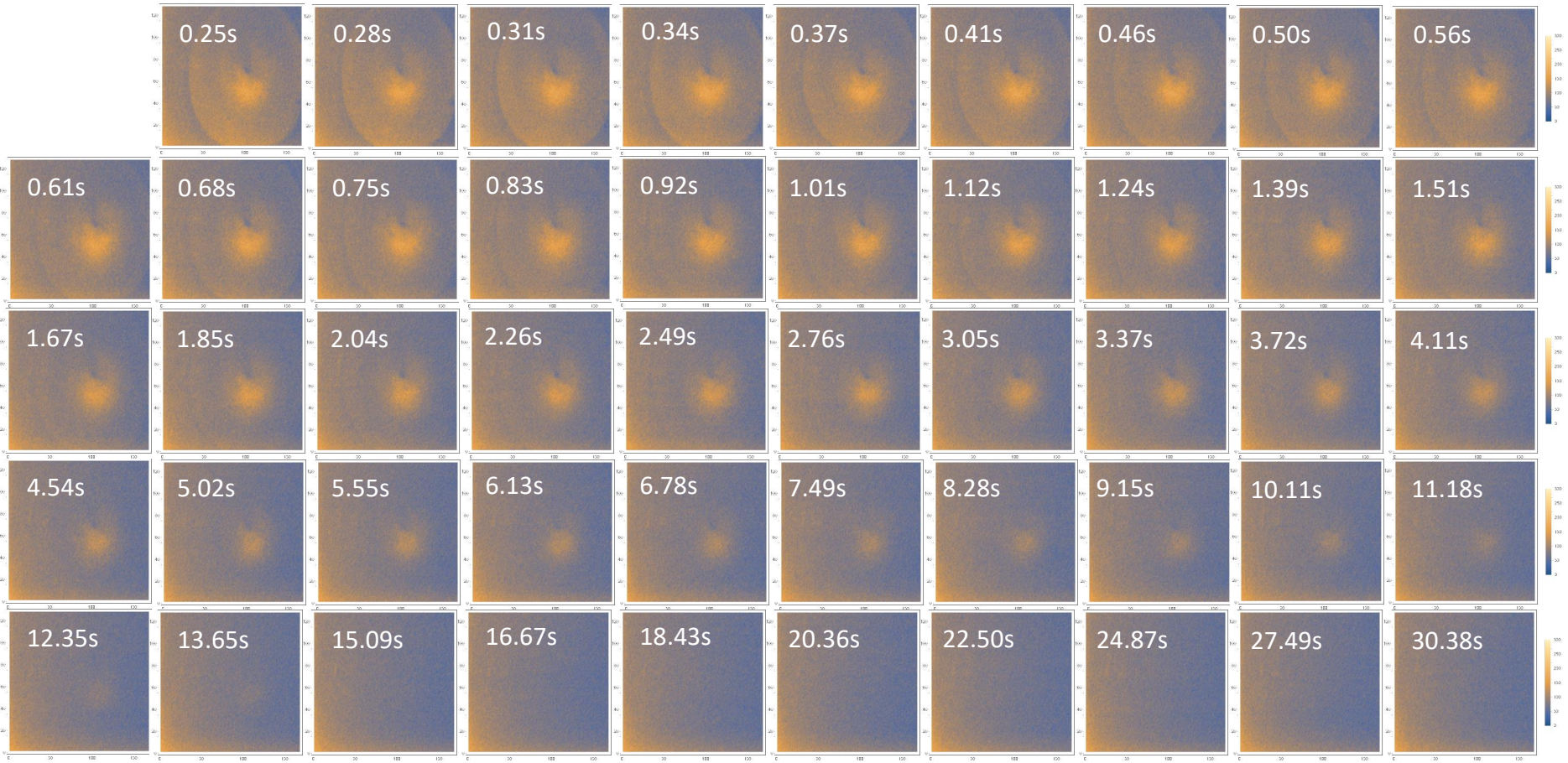
RW frequency: 1MHz, amplitude: 0.33V

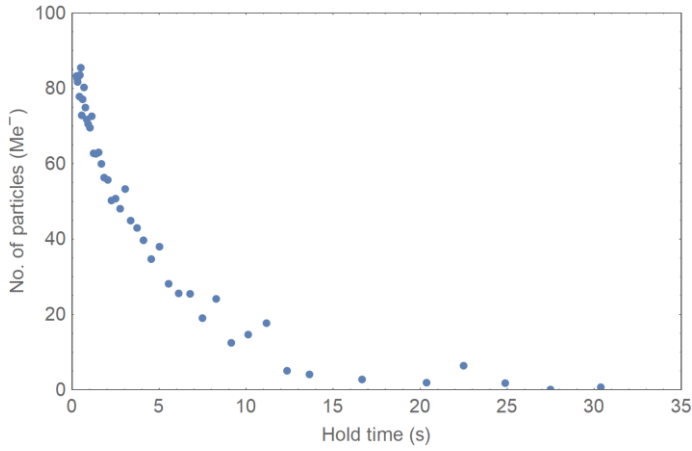
Hold+RW time: 250ms-10s



RW + Cooling of electrons with CF_4

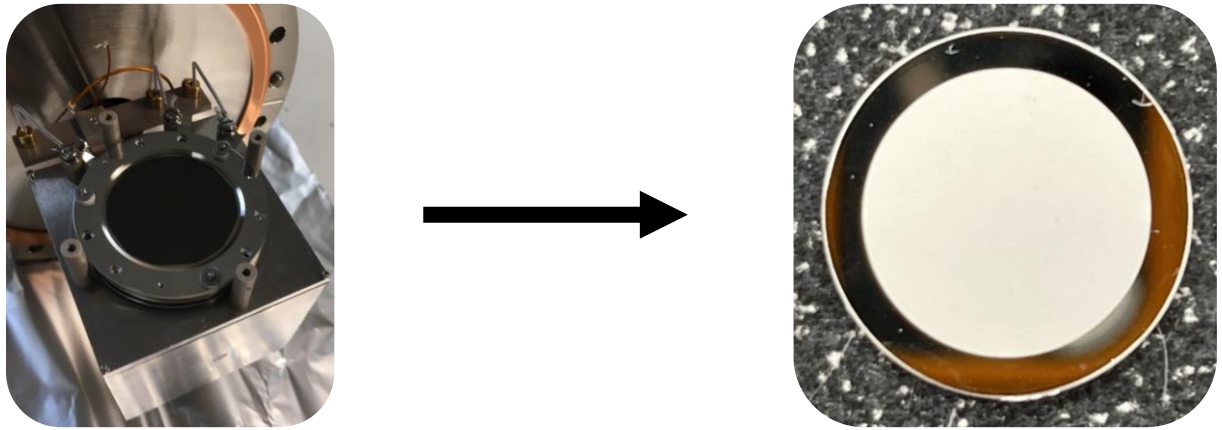
RW frequency: 4MHz, RW amplitude: 0.33V, Vary Hold+RW time: 17us-30.38s



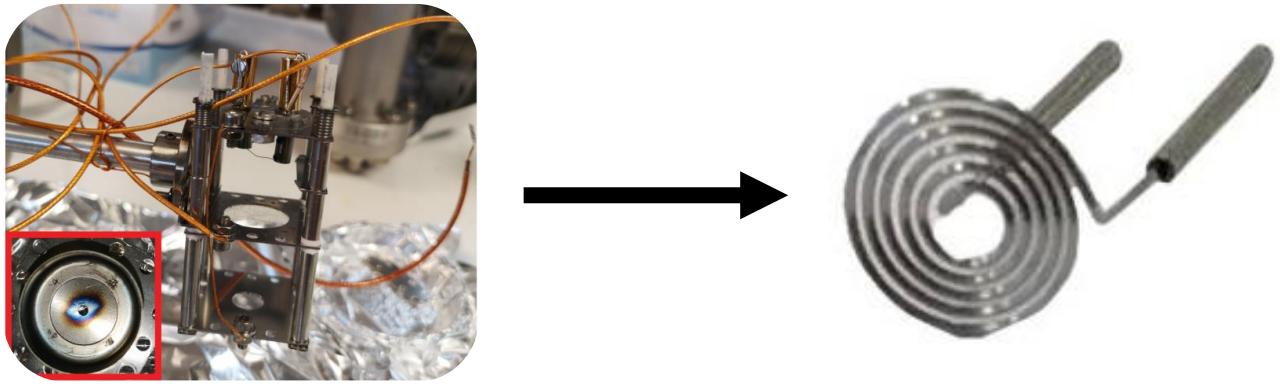


Next step …

- Replacing MCP with Phosphor screen.



- Replacing E-gun linear filament with a spiral filament to obtain more symmetric plasma.



- Optimizing experimental parameters to obtain higher number of the electron with longer lifetime.

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