LhARA Capture Meeting

2nd December 2021

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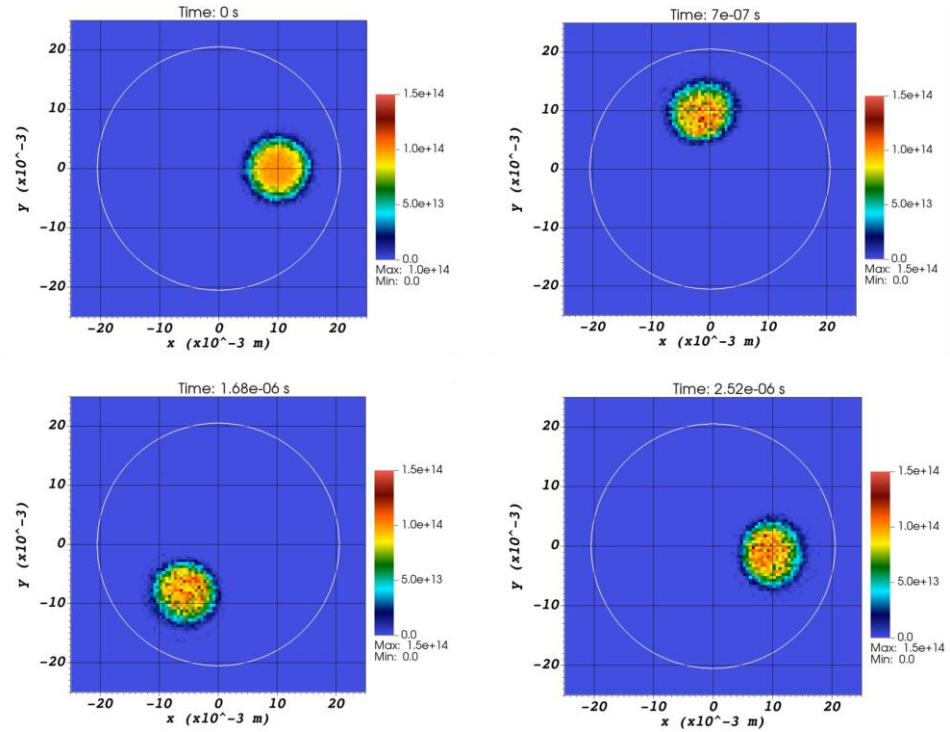
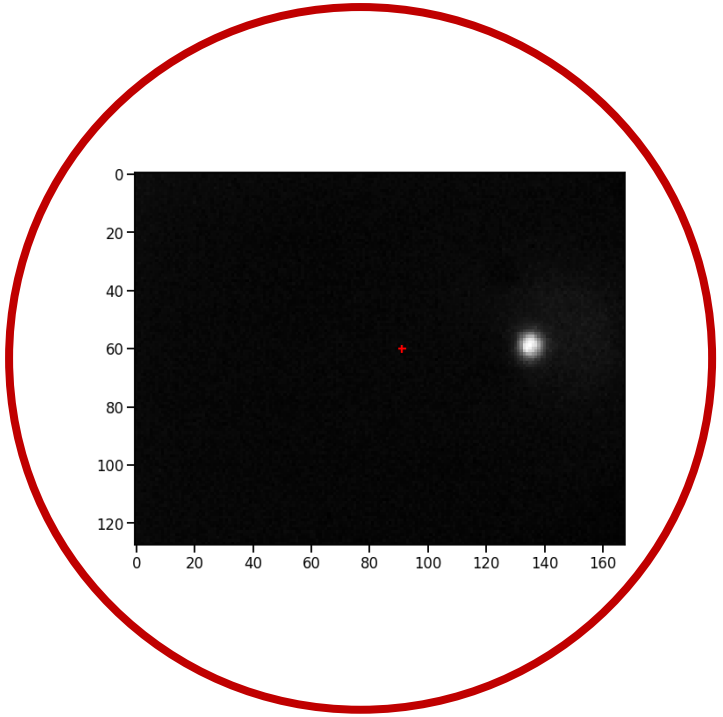
Previous simulations vs. experiment





Previous simulation, $r_p = 1$ cm

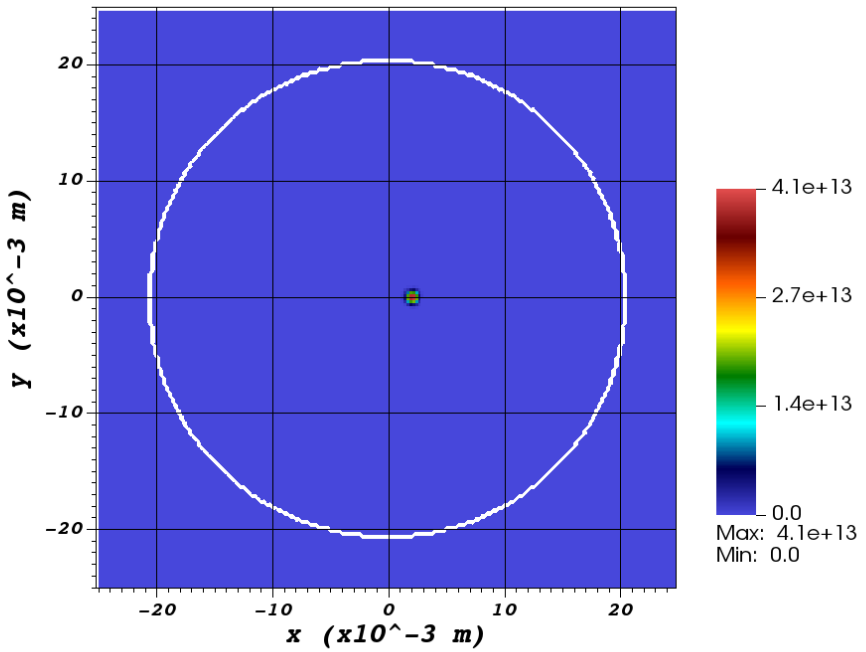
- Grid size 100x100x250 (limited by the Poisson solver)
- Cell size $\Delta x = \Delta z = 0.5$ mm
  - Limited spatial resolution in the trap E-field

Approx. size comparison between the anode and the electron column $\sigma_p \approx 0.3$ mm

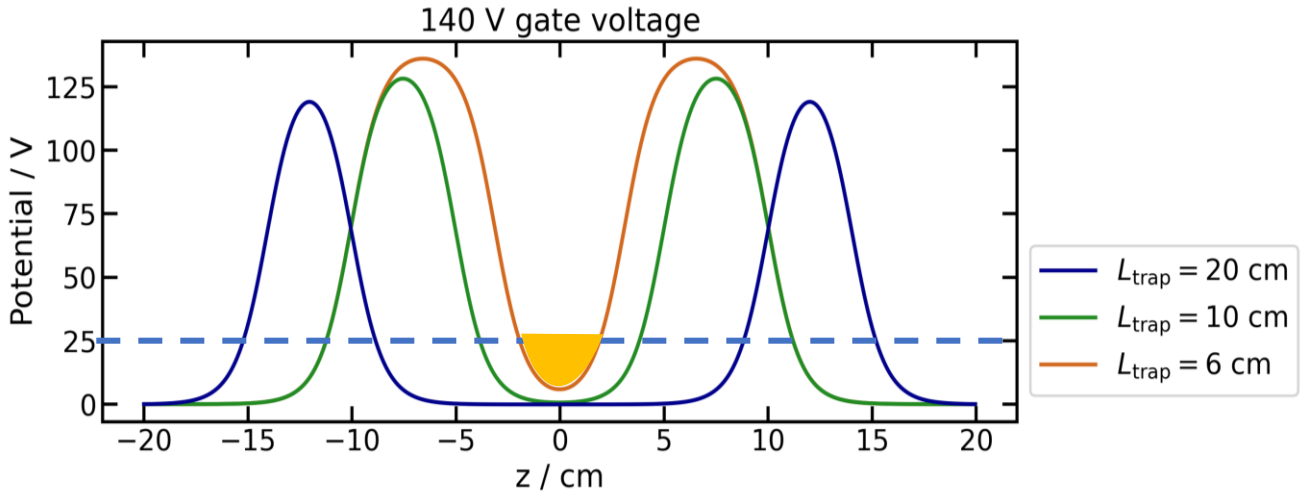
Change of solver

- Use different solver
  - Poisson ⟶ “prescribed fields”
    - Calculate the trapping fields at the start of the simulation
    - Advance particles at each time-step through the fields calculated at the start

- Advantage
  - 3D Poisson solver is applied only once
    - Grid can be increased to 250x250x655
    - Cell size $\Delta x = \Delta z = 0.25\ \mathrm{mm}$
      - Requires higher time-resolution
    - Total CPU time remains similar

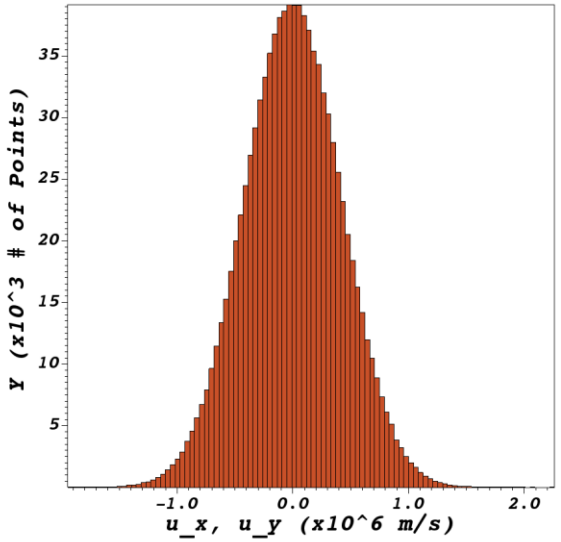


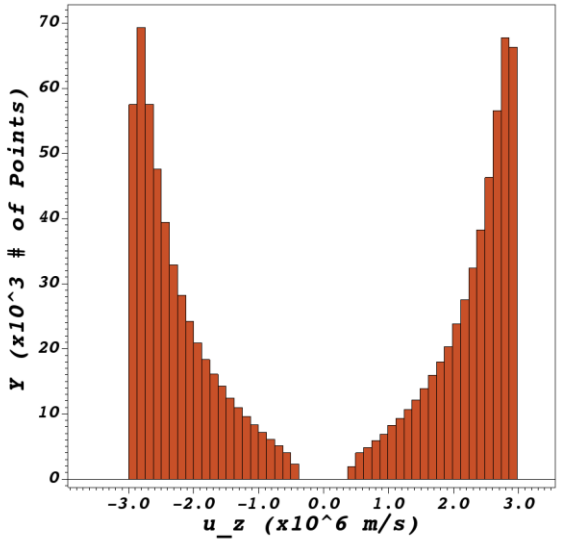
Particle loading

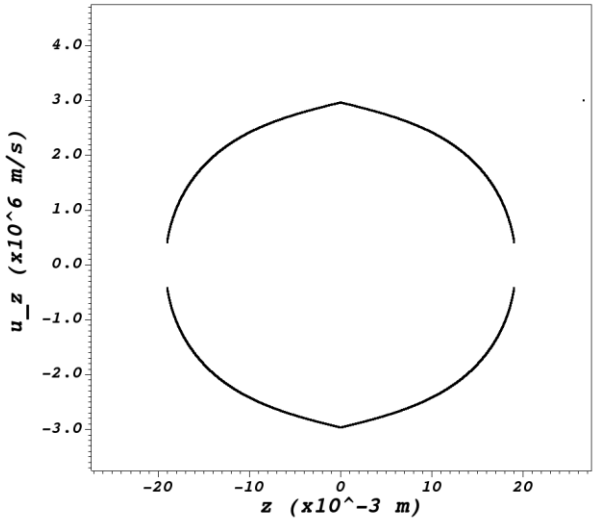


- Number of electrons: $10^5 – 10^6$
  - Macroparticle weight = 1

- Thin electron column at the start of the simulation
  - Initial length occupied by the electrons inferred from calculation of the trap potential
  - 2 counter-propagating beams
  - Energy adjusted according to the trap potential at the specific position of each electron

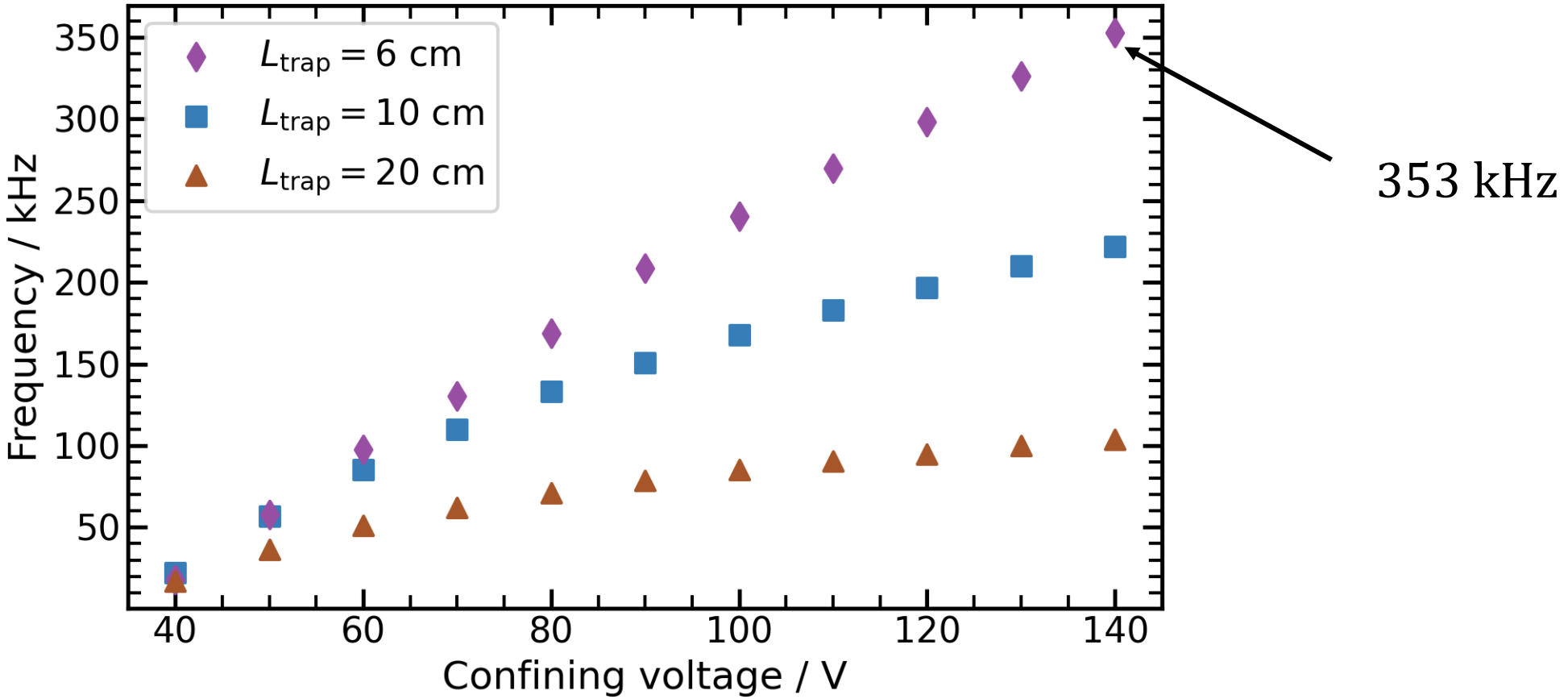






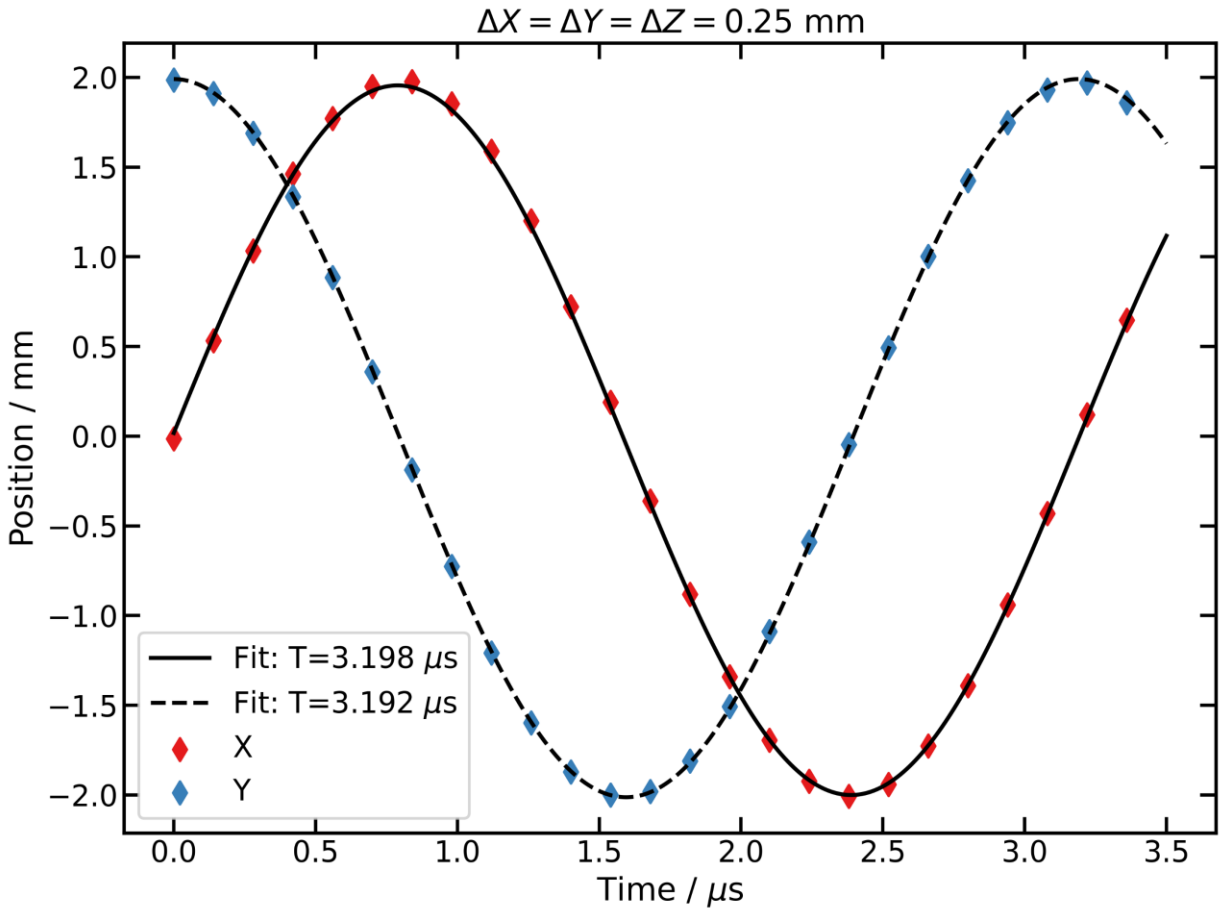
Measurements

- Magnetron frequencies measured in Swansea



Simulation

- 1st run



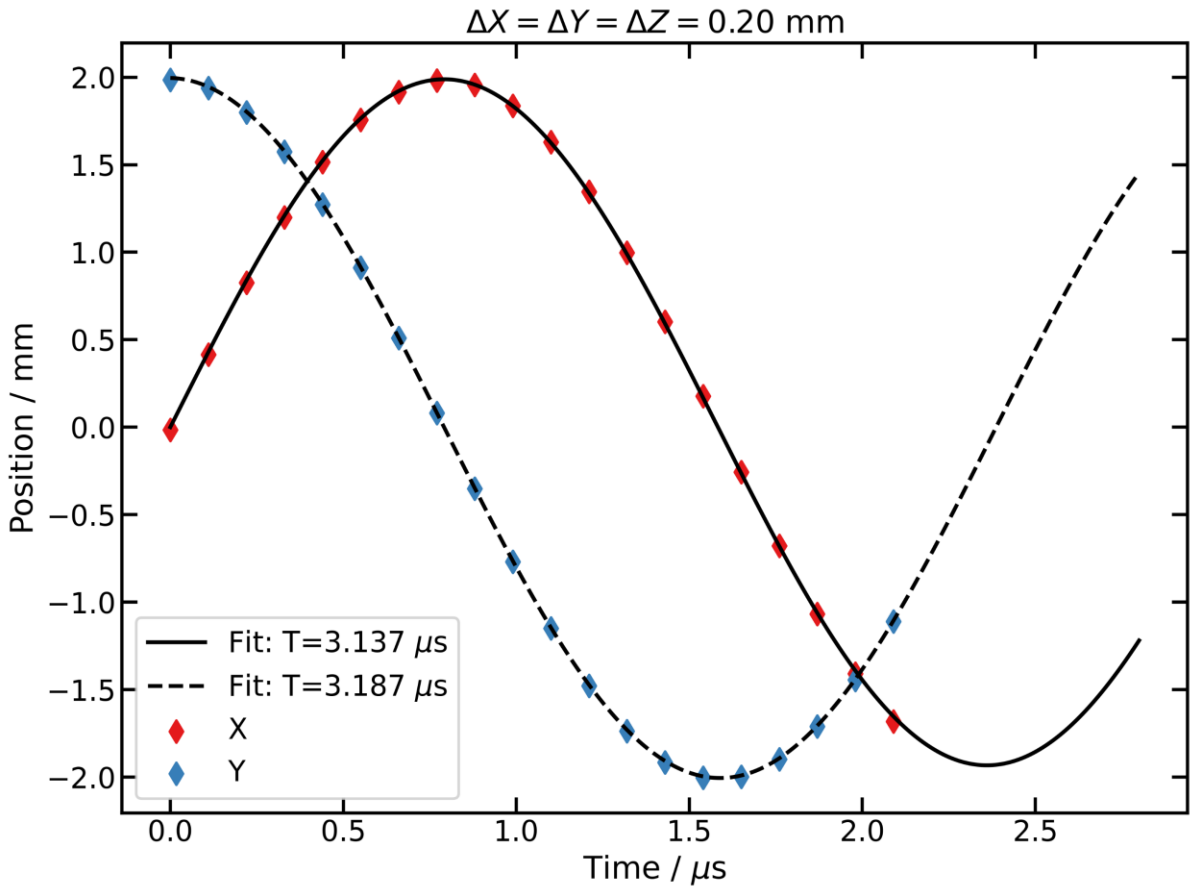
Simulation: 313 kHz

Measurement: 353 kHz

- ~1% difference expected from charges induced in the anode wall ("diocotron" contribution) (infinite length)
  - ~6% with corrections for finite length/temperature ~0.1 eV

Simulation

- 2nd run (smaller cell size)



Simulation: 313–318 kHz

Measurement: 353 kHz

- ~1% difference expected from charges induced in the anode wall ("diocotron" contribution)