LhARA Fortnightly meeting
WP3
VSim tests
with previously validated model

Christopher Baker

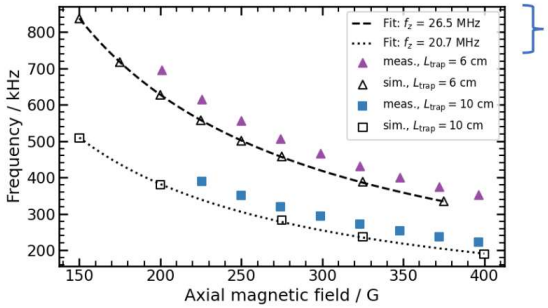
LhARA Fortnightly meeting

31st Jan 2023

Recall

- Titus' Jan 2022 presentations:

Magnetron freq. vs. B-field

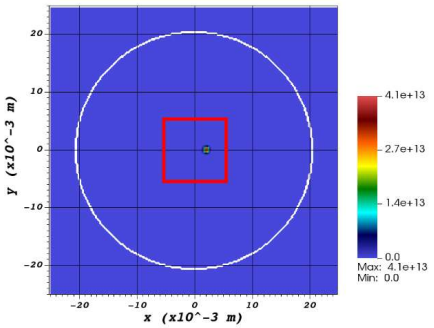


$$\omega_m = \omega_c / 2 - \sqrt{(\omega_c / 2)^2 - \omega_z^2 / 2}$$

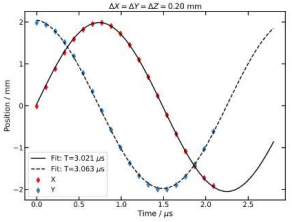
$$\omega_c = \frac{eB}{m_e}$$

$$\omega_z = \omega_z(V_{gate};\ \text{electrode geometry})$$

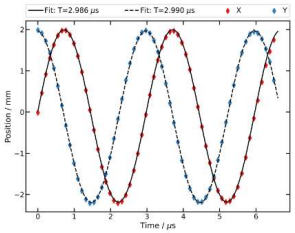
Speed up single simulation



- Fields are kept constant throughout the simulation (no effect of the charges induced in anode wall, ~1 kHz for rigid plasma column)

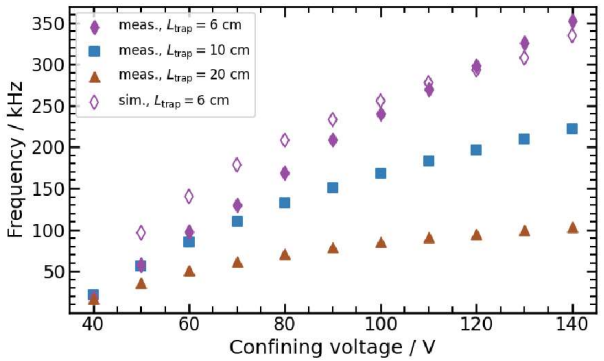


~48 hours
(16 CPUs)



~24 hours
(16 CPUs)

Update on the results of simulations



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    - Courant limit (number)
      - Determined by velocity & grid size
      - Can’t skip cells
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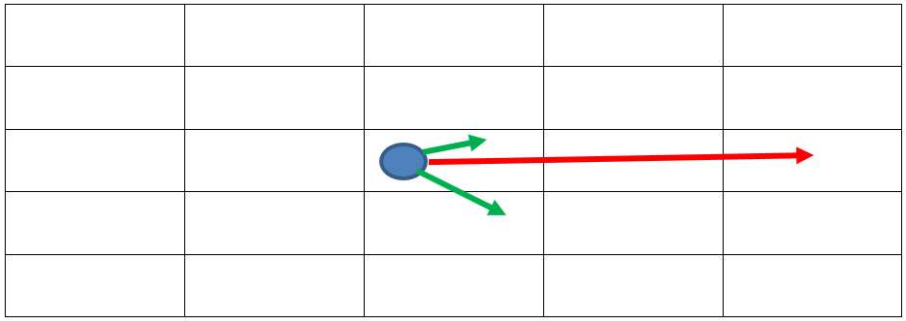

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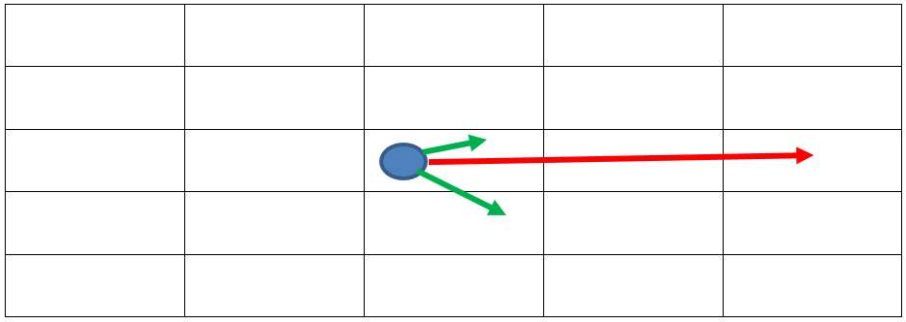
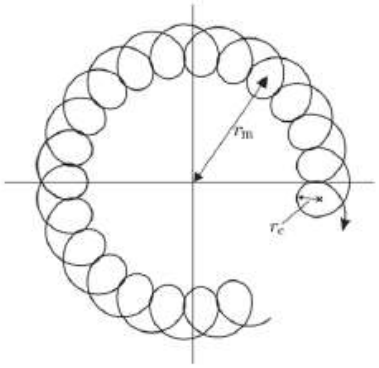
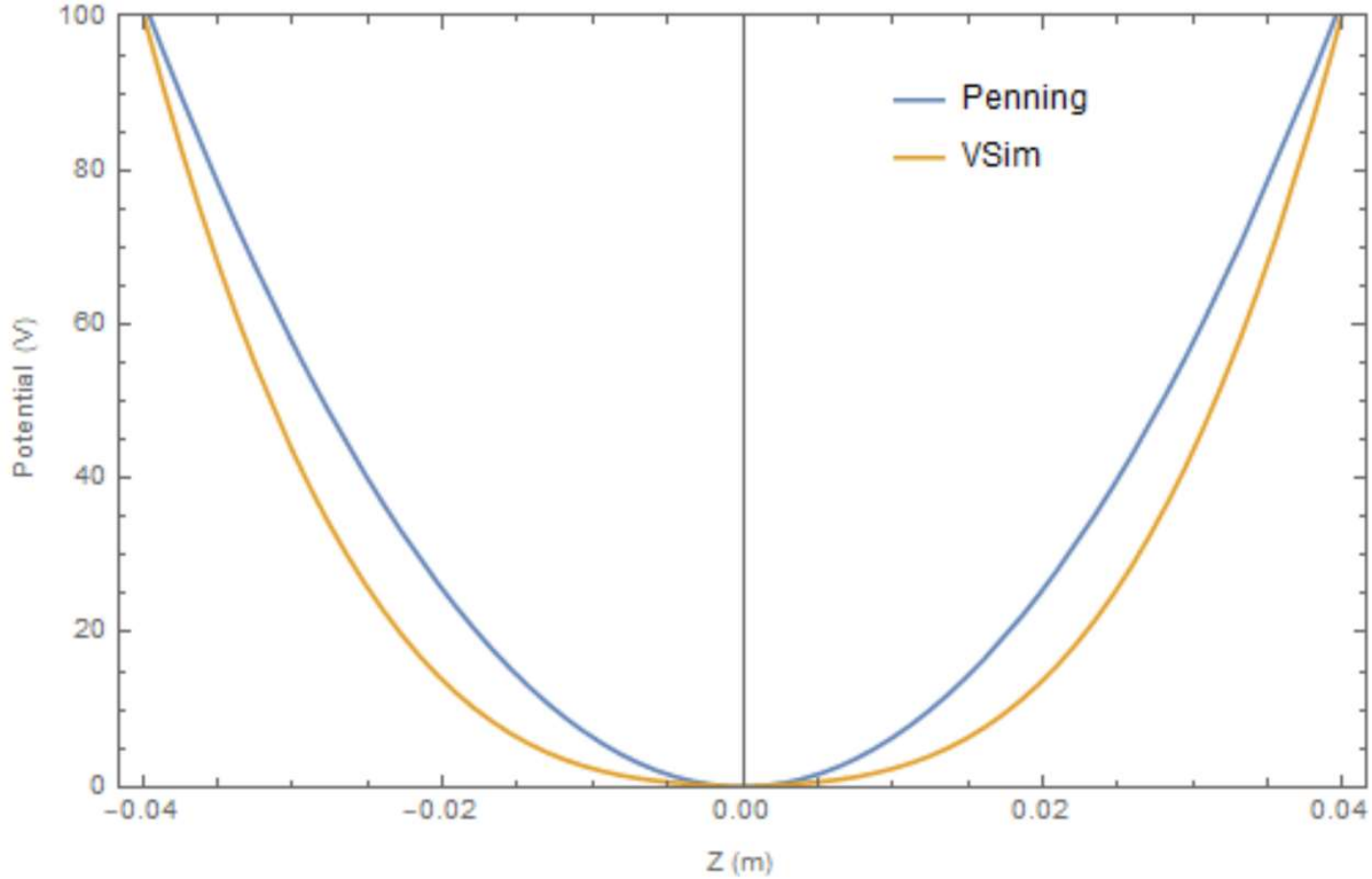




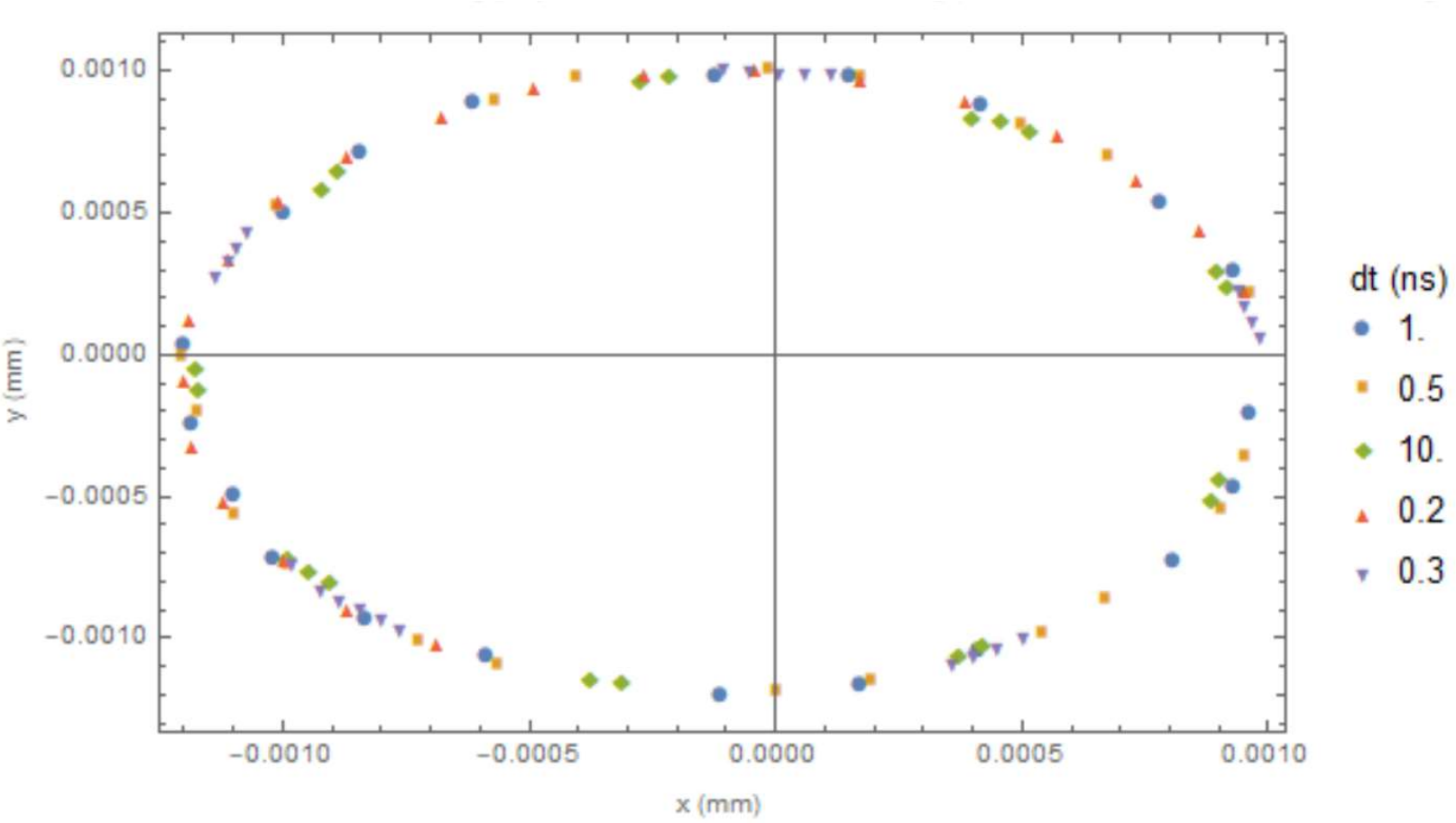
Test conditions

- Spacial
  - Courant limit
    - T_σ=15eV
    - Cell size 0.25 x 0.25 x 0.25 mm^3
    - Max. dt ~ 100 ps
- Temporal
  - Cyclotron period at 0.04T ~ 0.9ns
  - Max dt < ns
- VSim suggested dt ~ 240 ps
- Run parameters
  - Sampled distributions, r_σ~0.3 mm, z~3.5 cm, ρ=5x10^{13} m^{-3}, B=0.04T

Trap potentials

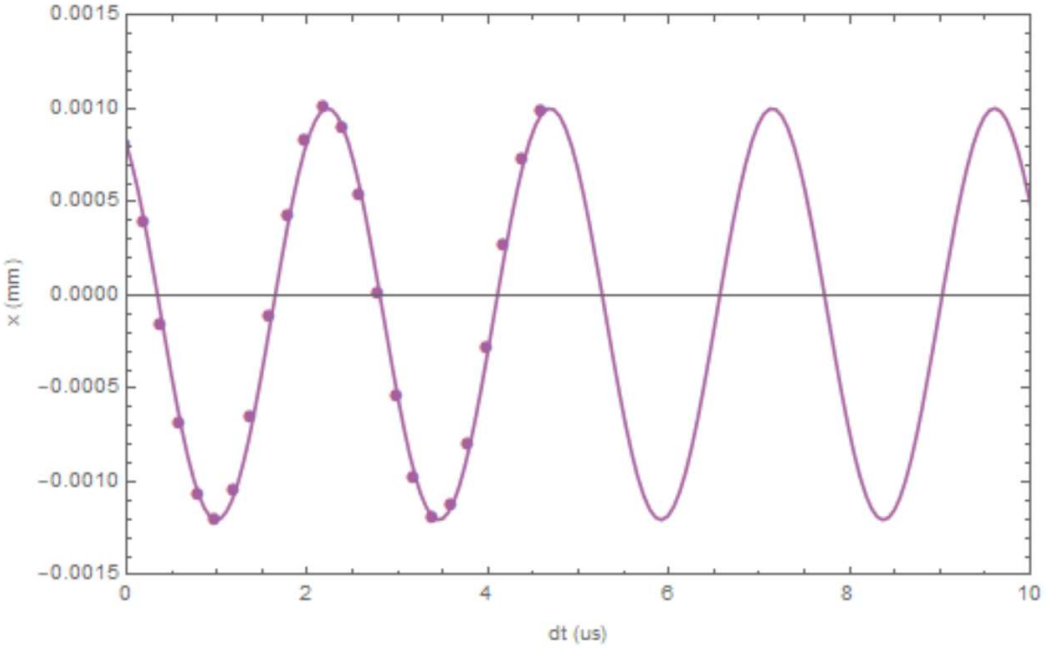


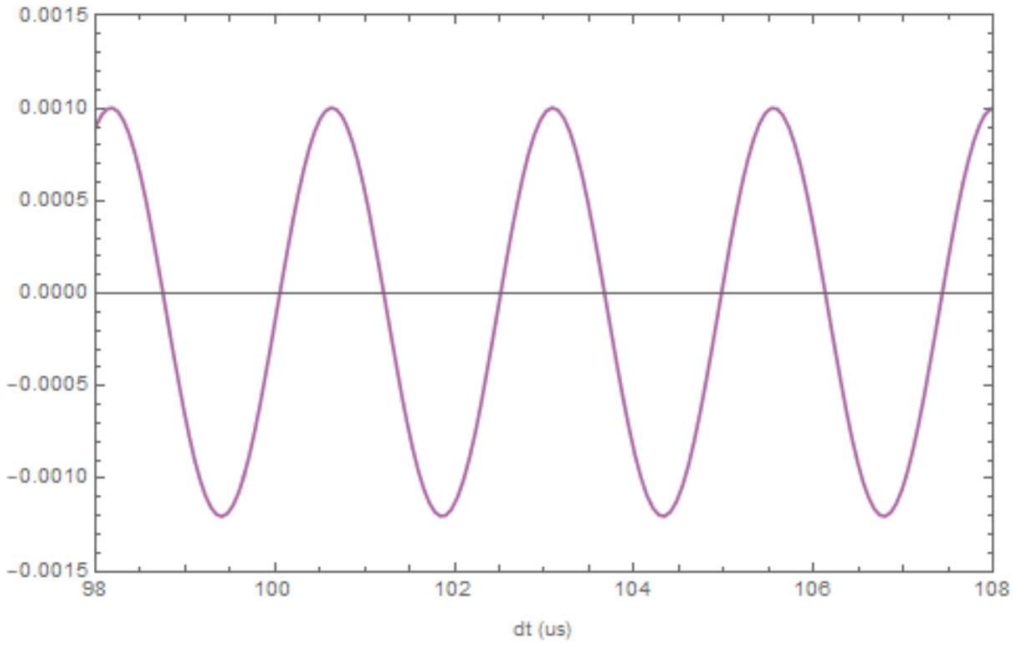
Magnetron Orbit



- Runtime 100 us

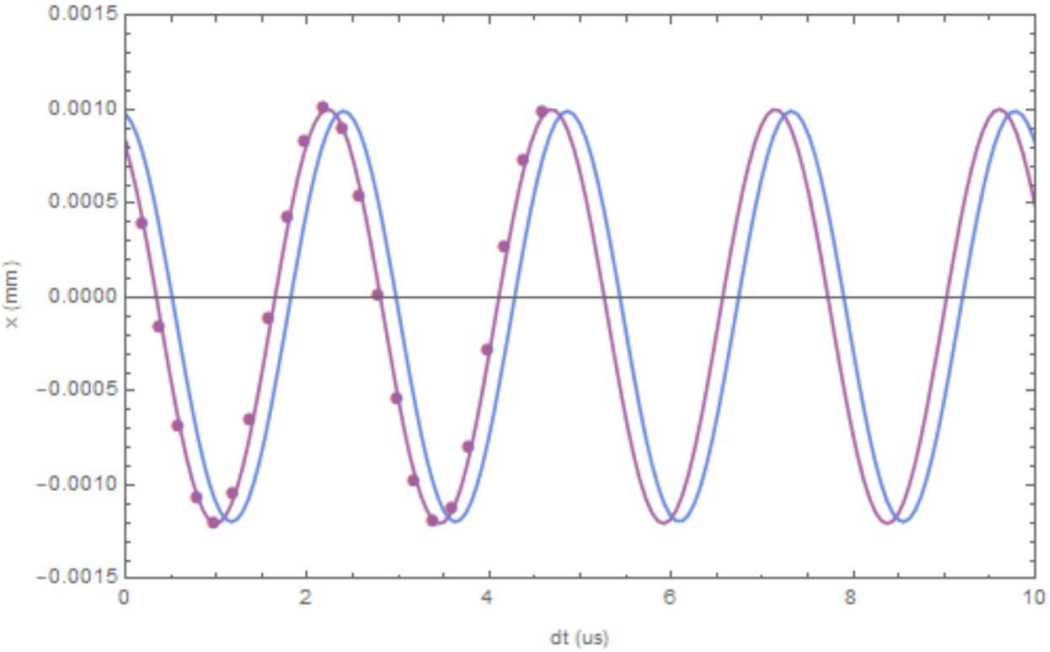
Magnetron Frequency

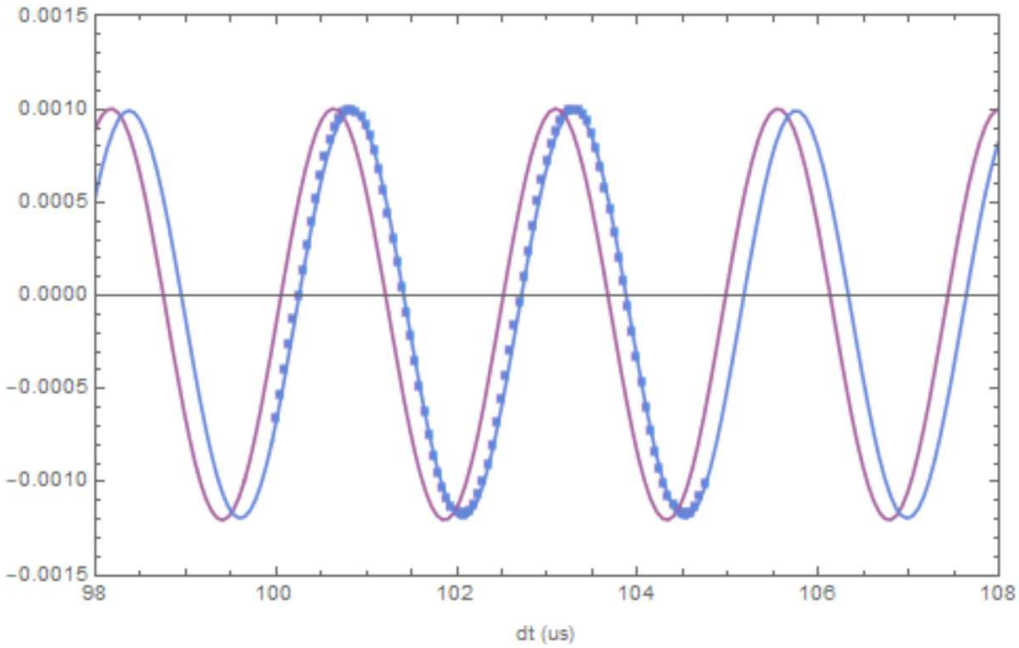




- 0 - 5 us, dt = 0.2ns – f=406.47(3) kHz

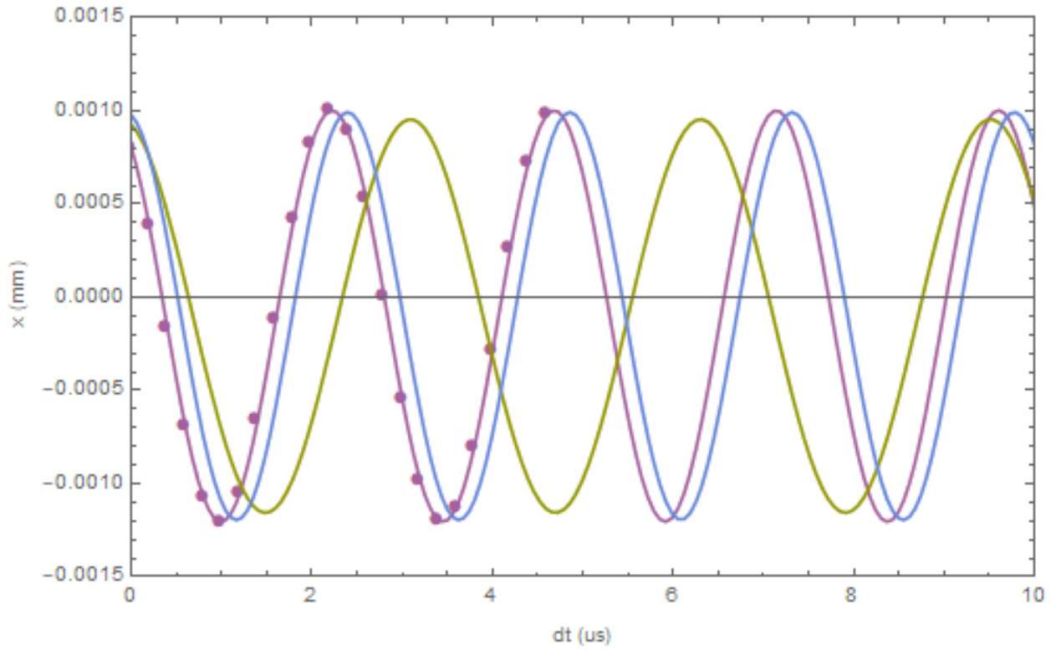
Magnetron Frequency

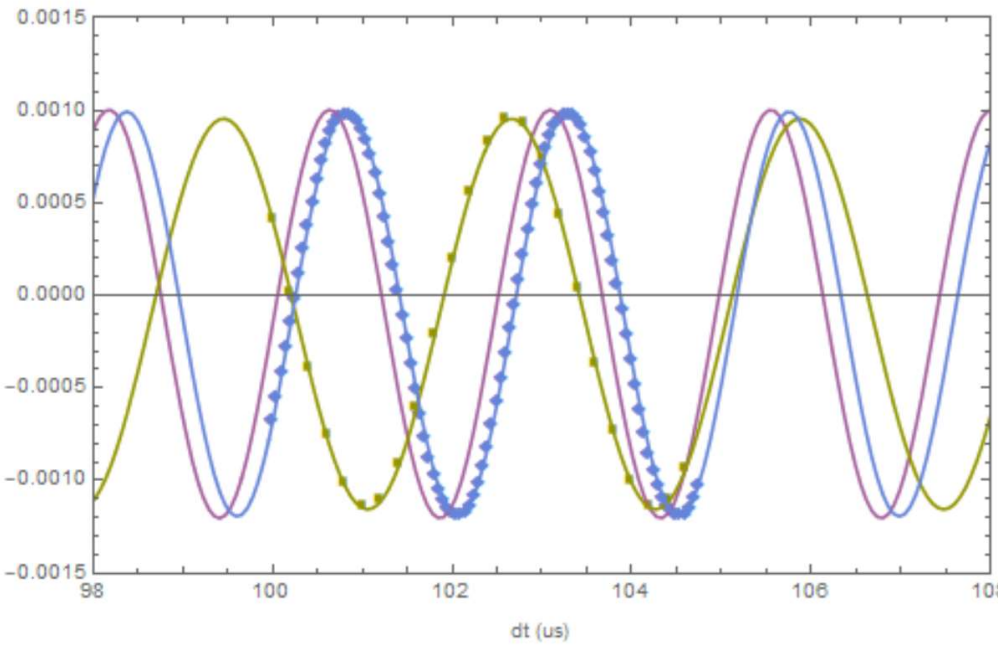




- 0 - 5 us, dt = 0.2ns – f=406.47(3) kHz
- 0 – 100 us, dt = 0.2ns -> 100 – 105 us, dt = 0.2ns – f=406.4(1) kHz

Magnetron Frequency





- 0 - 5 us, dt = 0.2ns – f=406.47(3) kHz
- 0 – 100 us, dt = 10ns -> 100 – 105 us, dt = 0.2ns – f=311.34(2) kHz
- 0 – 100 us, dt = 0.2ns -> 100 – 102 us, dt = 0.2ns – f=406.4(1) kHz

Preliminary conclusions

- Evidence VSim has ‘guiding centre’ capabilities
- Micro-motion (cyclotron motion) doesn’t necessarily need to be resolved
  - Magnetron amplitude ‘stable’
  - Frequency ~25% change over 100 us
    - Appears a computational artefact