Kicker Simulations

Jun Ma

Department of Physics and Astronomy
Stony Brook University

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Peak current

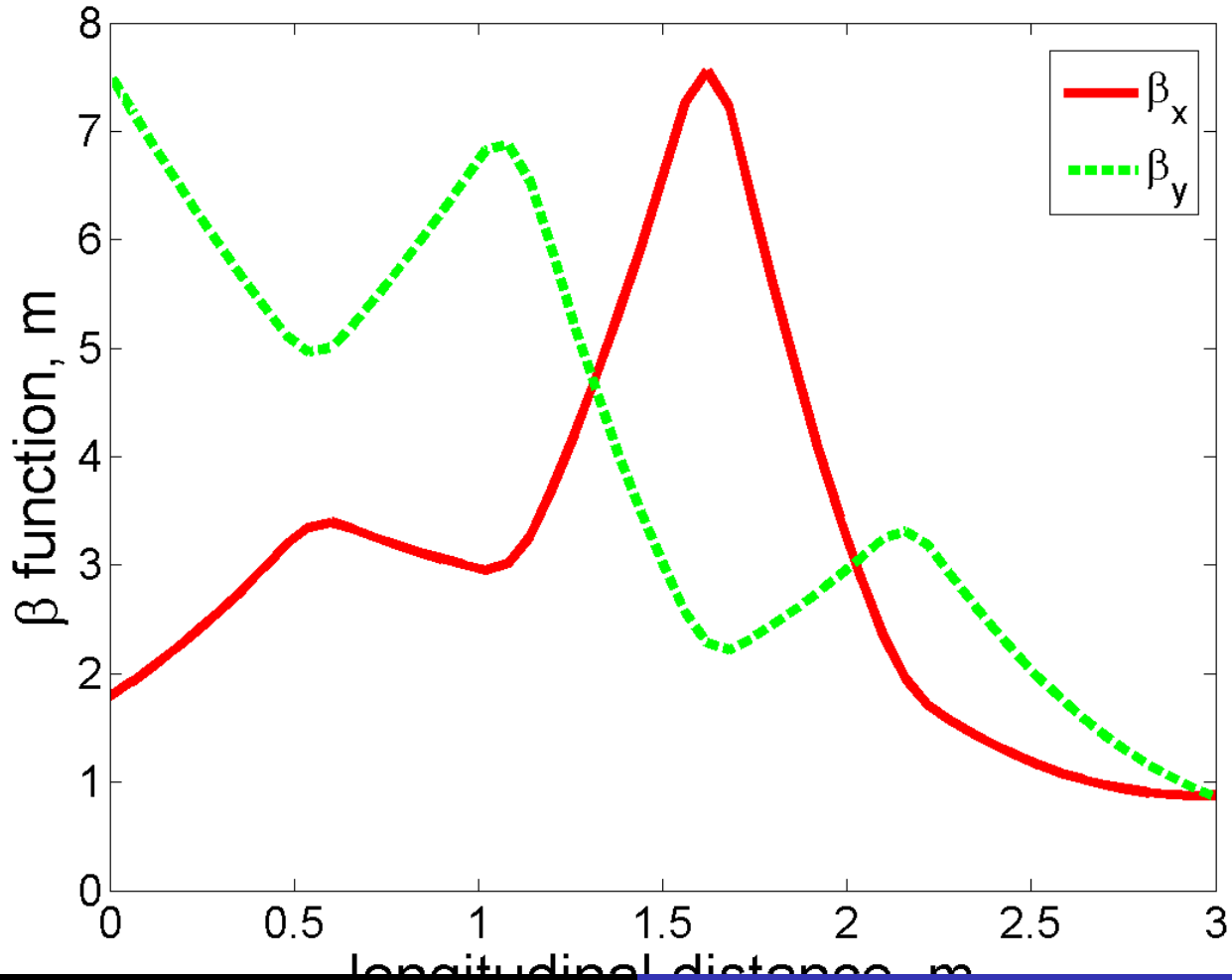
31A

- Slightly higher modulation
- FEL max gain is 300, gain at 237th slice is 140
- May be too close to saturation, which affects kicker section

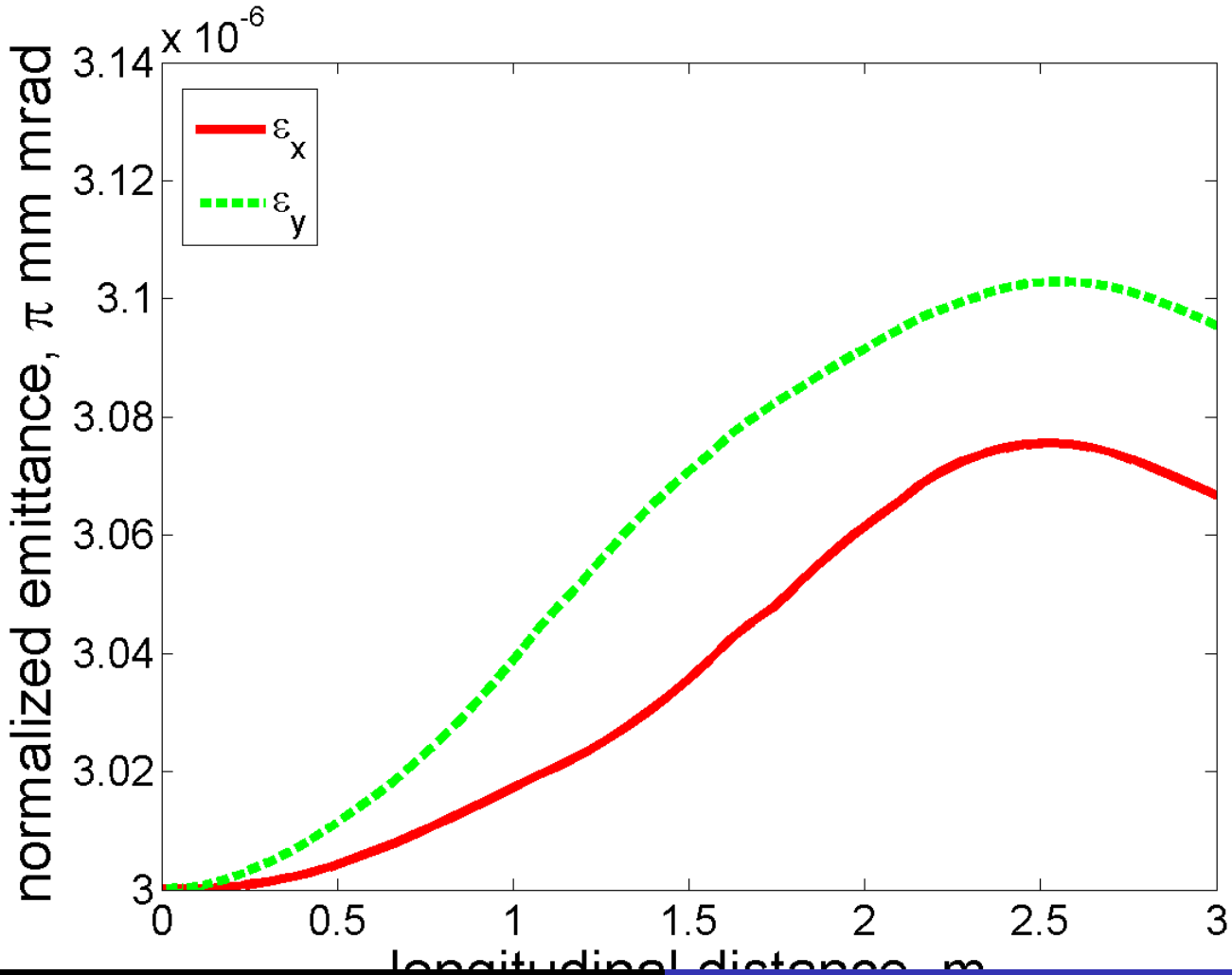
23A

- Slightly lower modulation
- FEL max gain is 100, gain at 237th slice is 40
- Normal behavior in kicker section

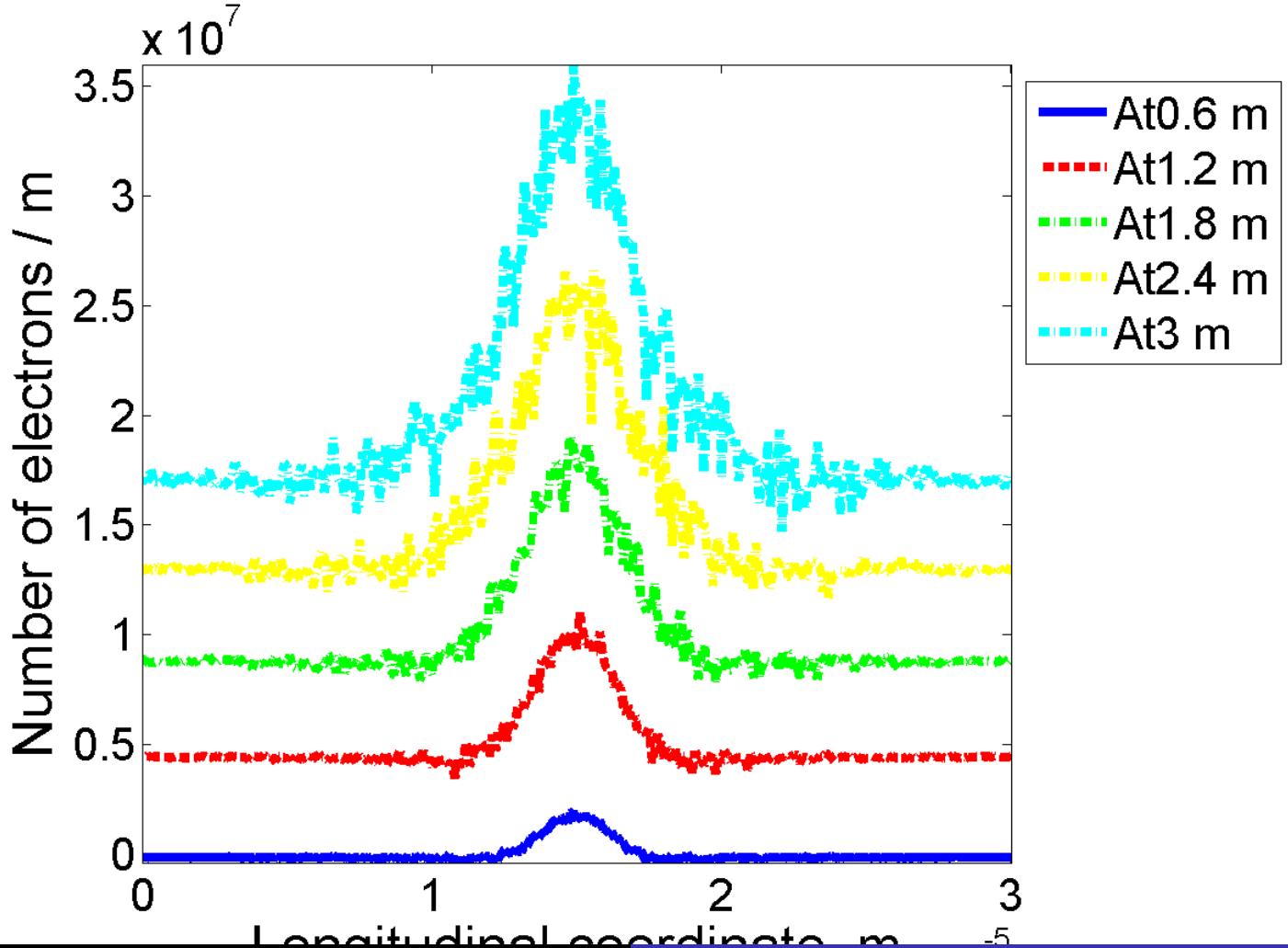
β function in modulator



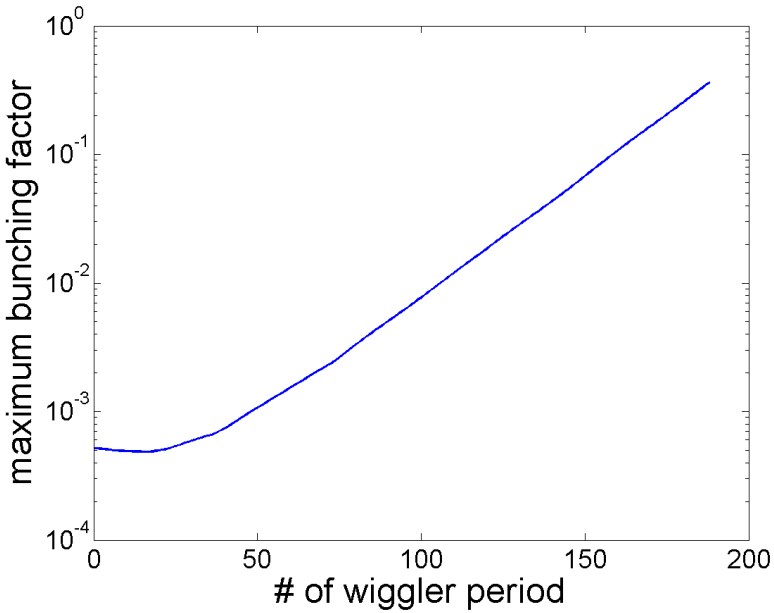
Emittance in modulator



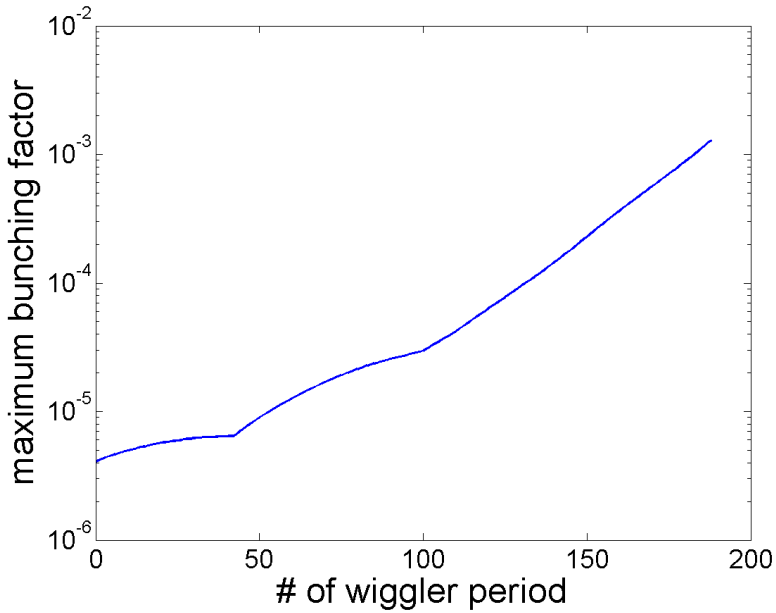
Longitudinal density modulation



Bunching factor in FEL

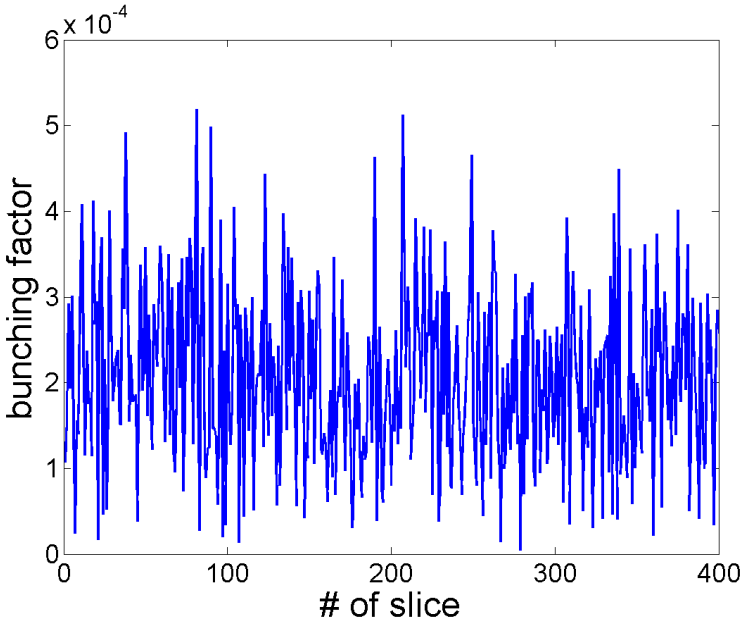


(a) Background

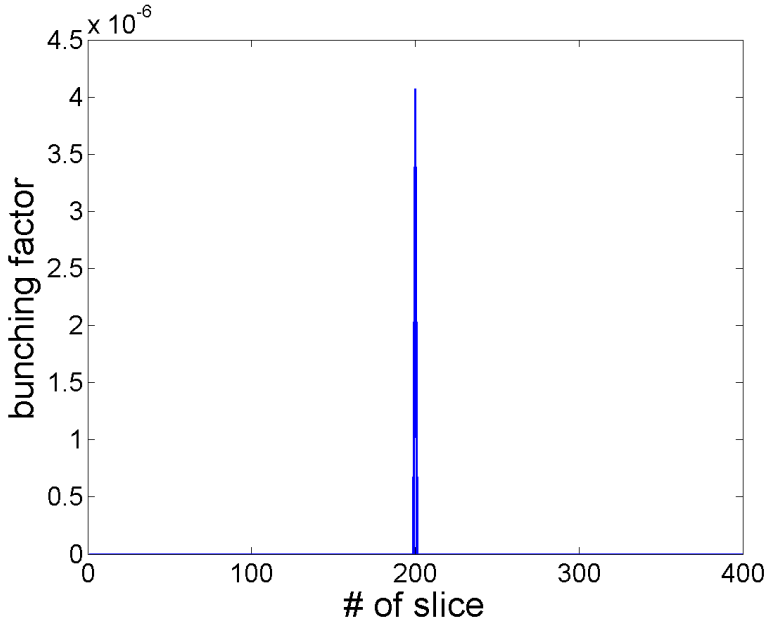


(b) Signal

Bunching factor in FEL at beginning

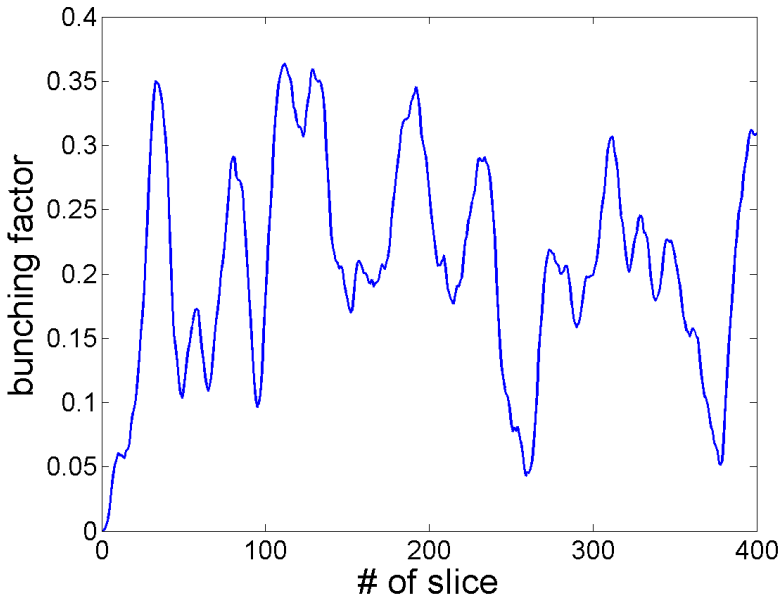


(a) Background

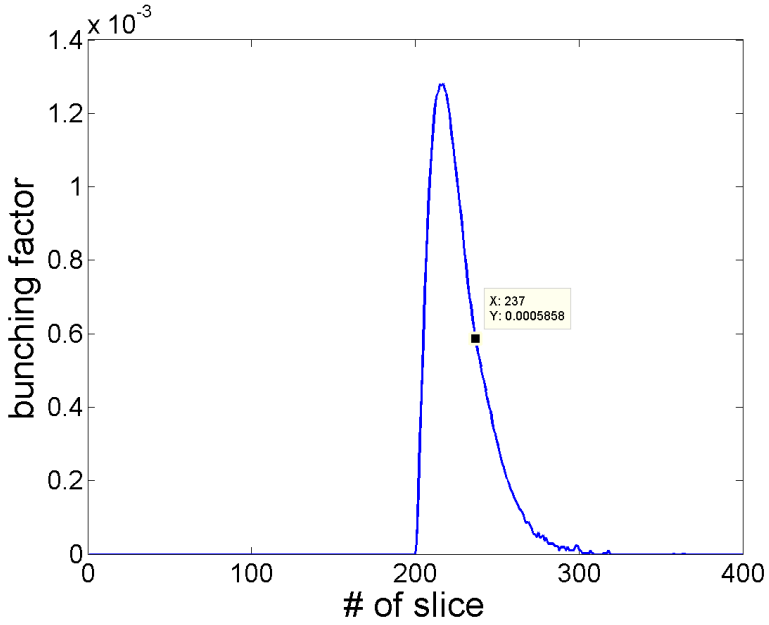


(b) Signal

Bunching factor in FEL at end

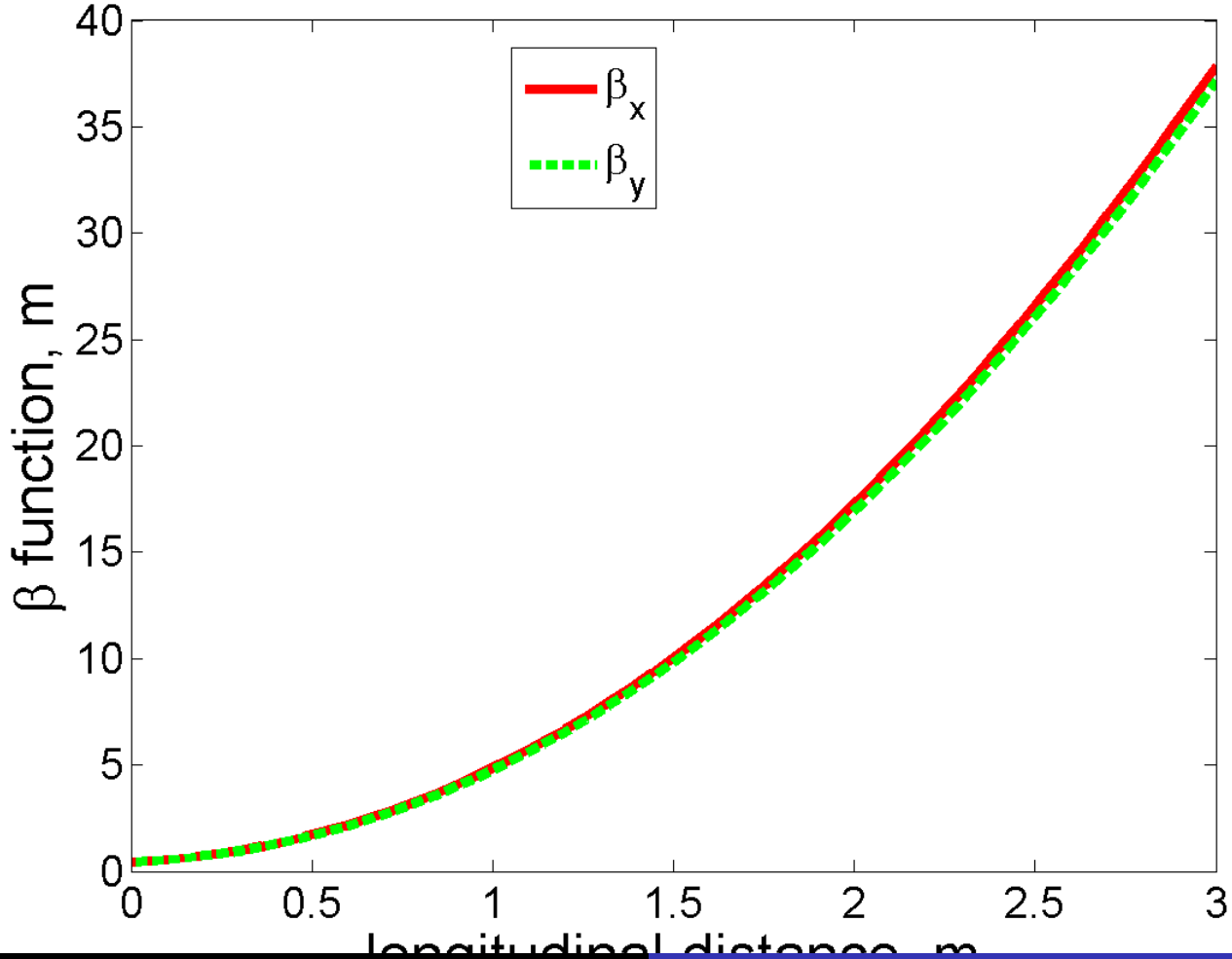


(a) Background

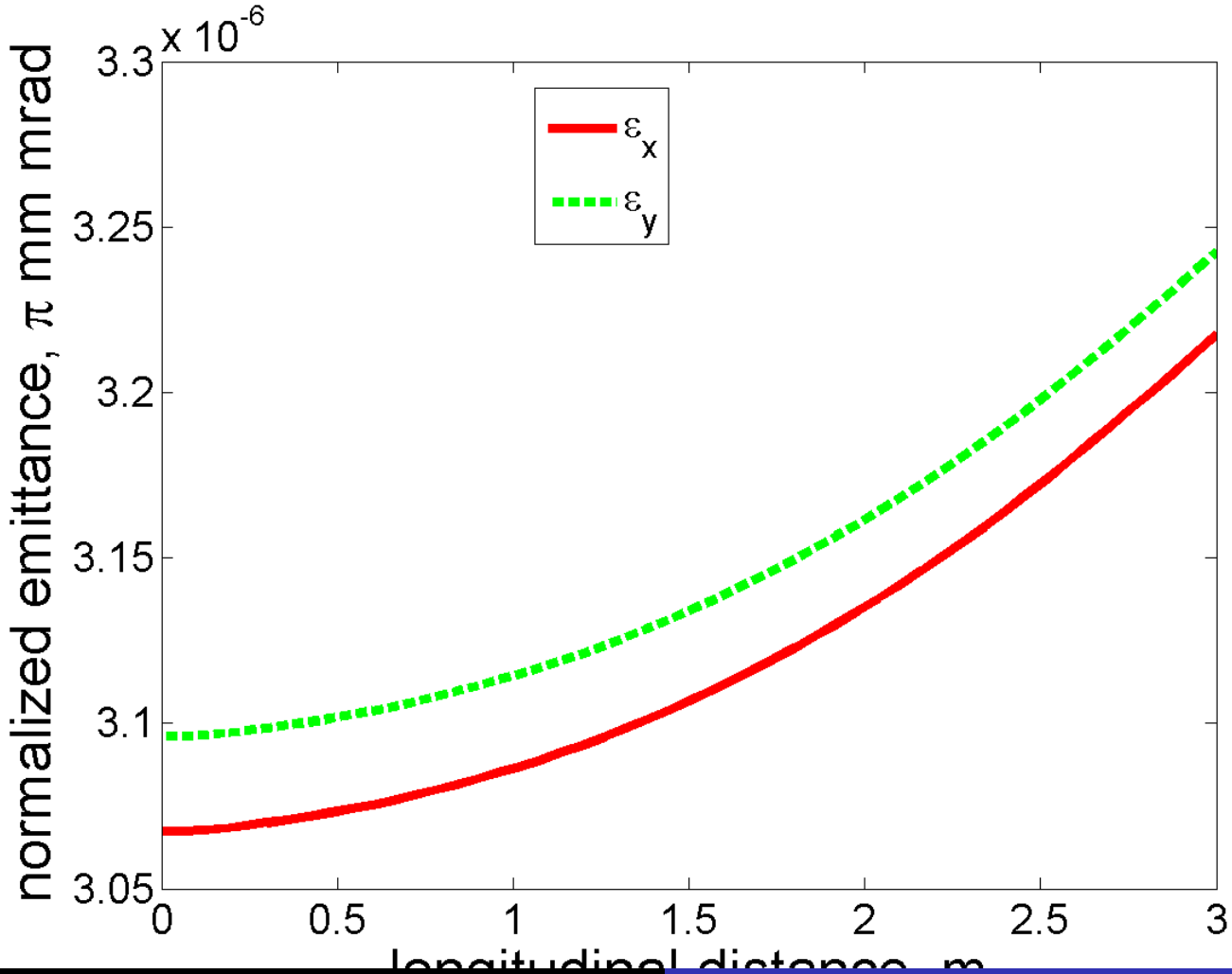


(b) Signal

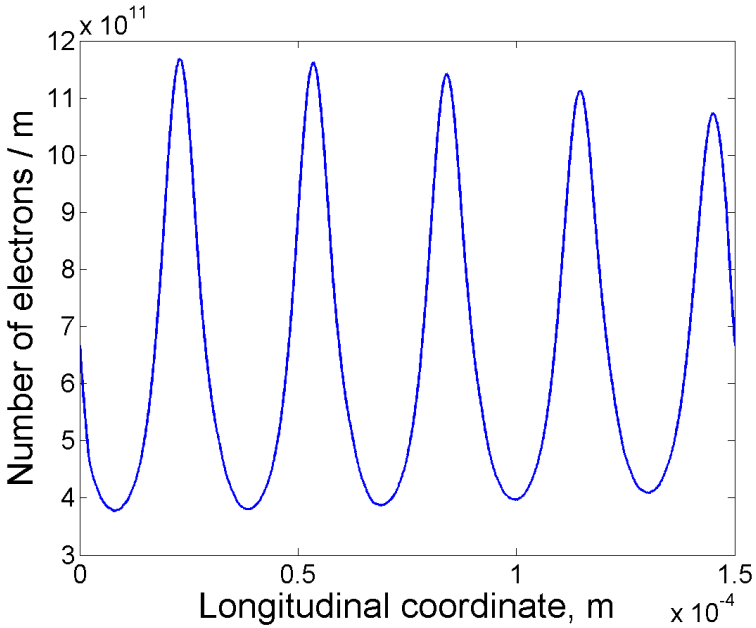
β function in kicker



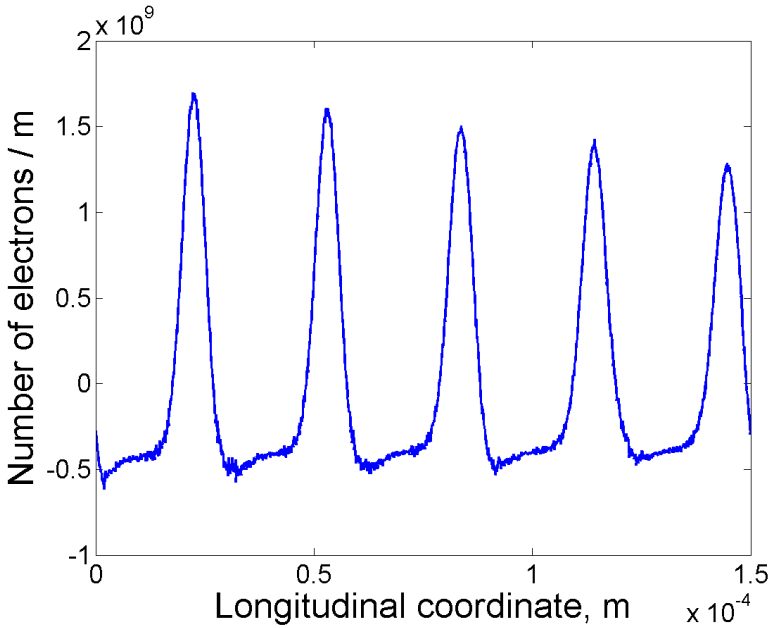
Emittance in kicker



Longitudinal density distribution in kicker, 0 m

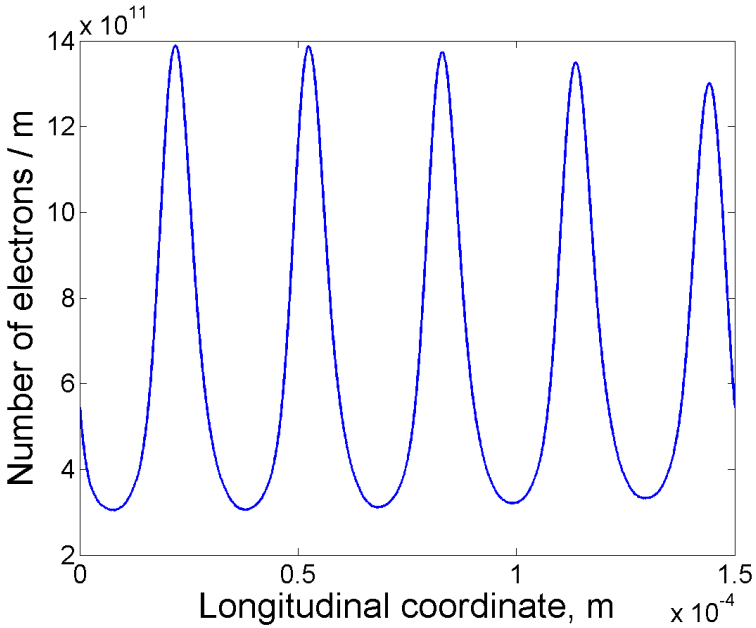


(a) Background

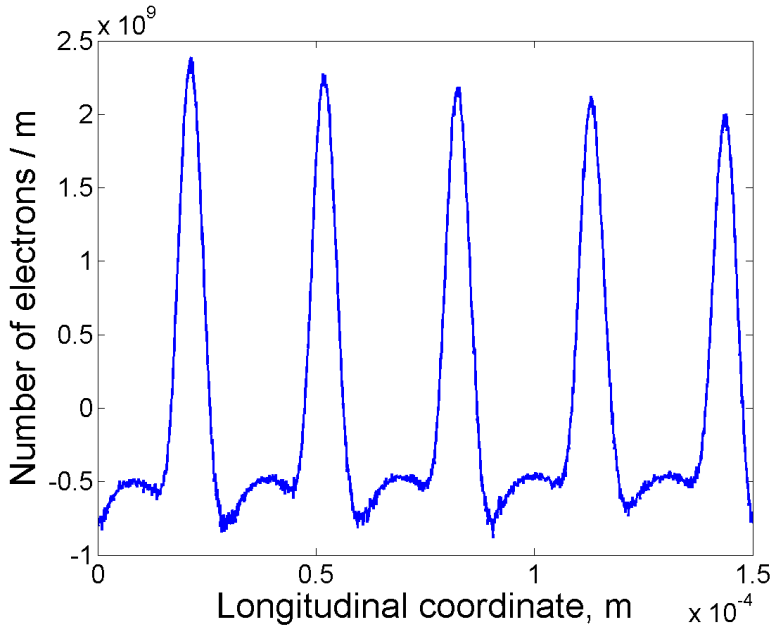


(b) Signal

Longitudinal density distribution in kicker, 0.6 m

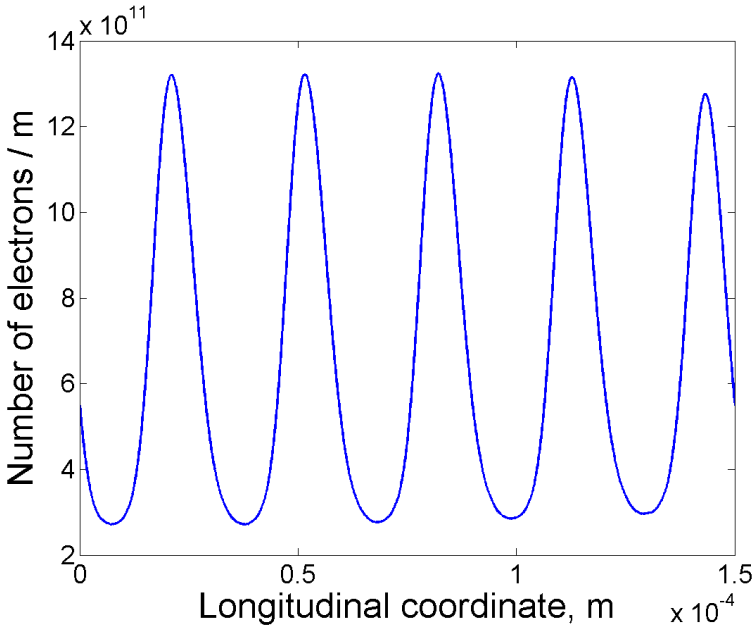


(a) Background

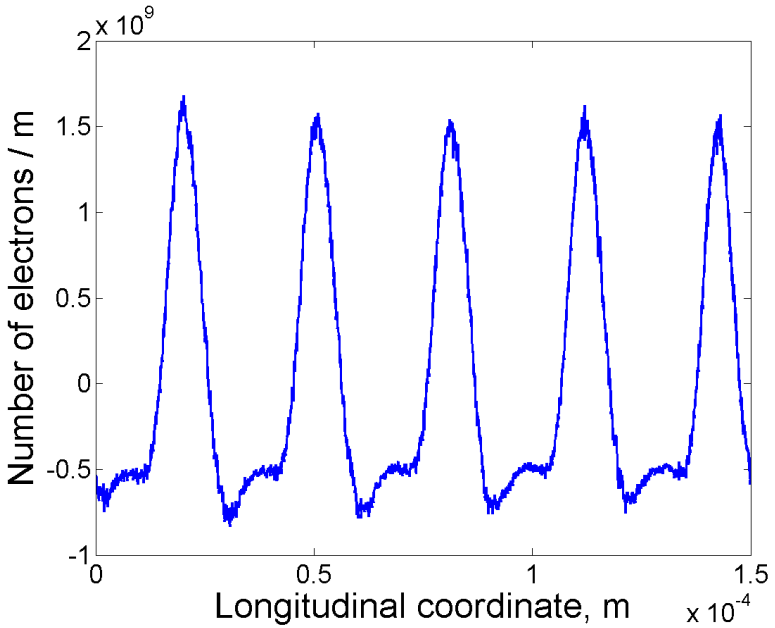


(b) Signal

Longitudinal density distribution in kicker, 1.2 m

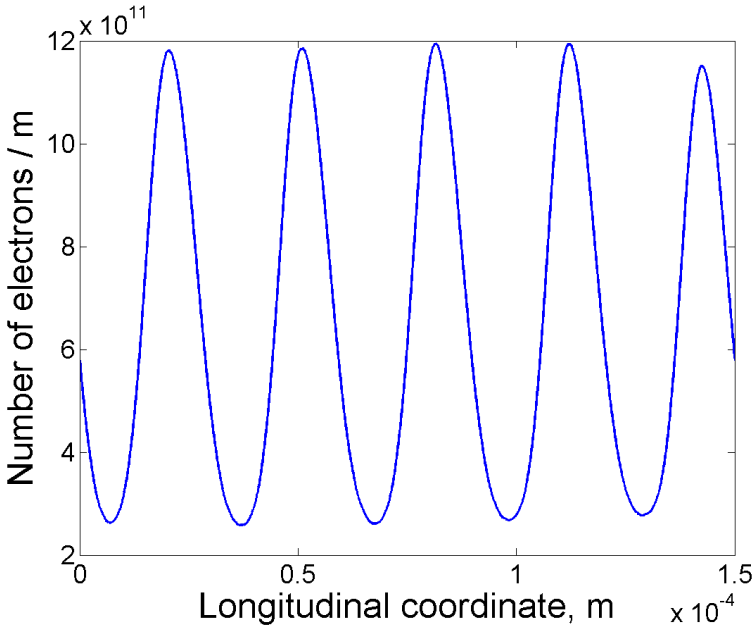


(a) Background

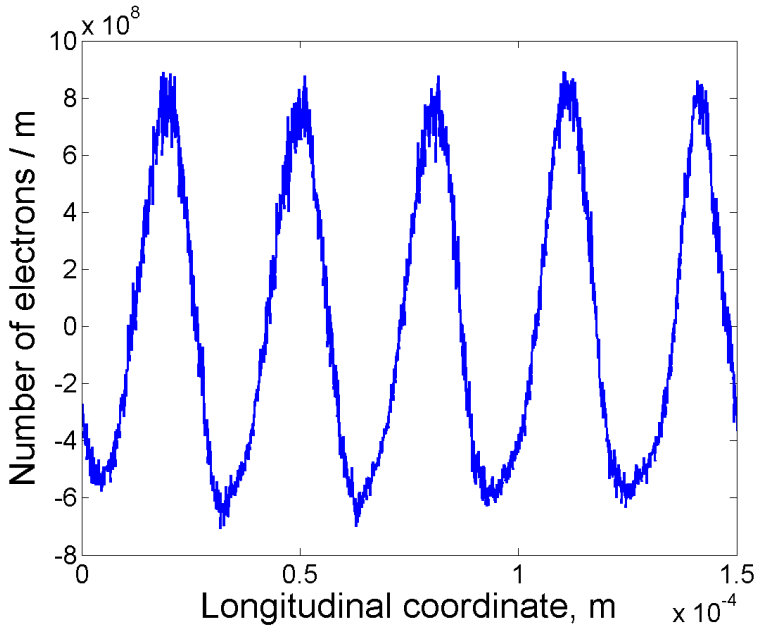


(b) Signal

Longitudinal density distribution in kicker, 1.8 m

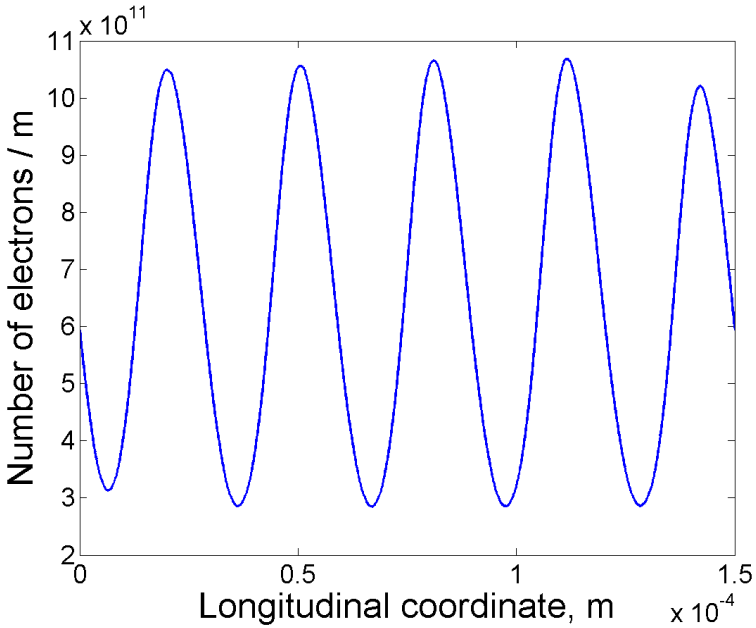


(a) Background

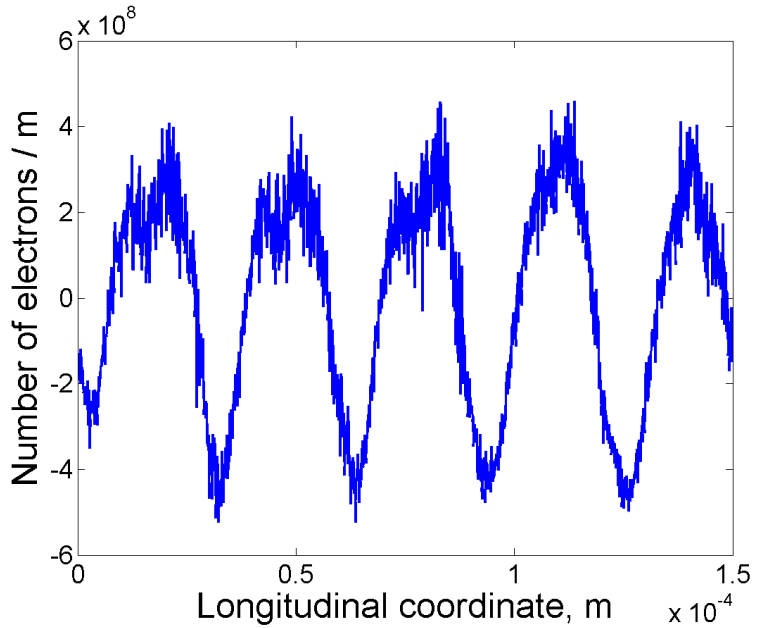


(b) Signal

Longitudinal density distribution in kicker, 2.4 m

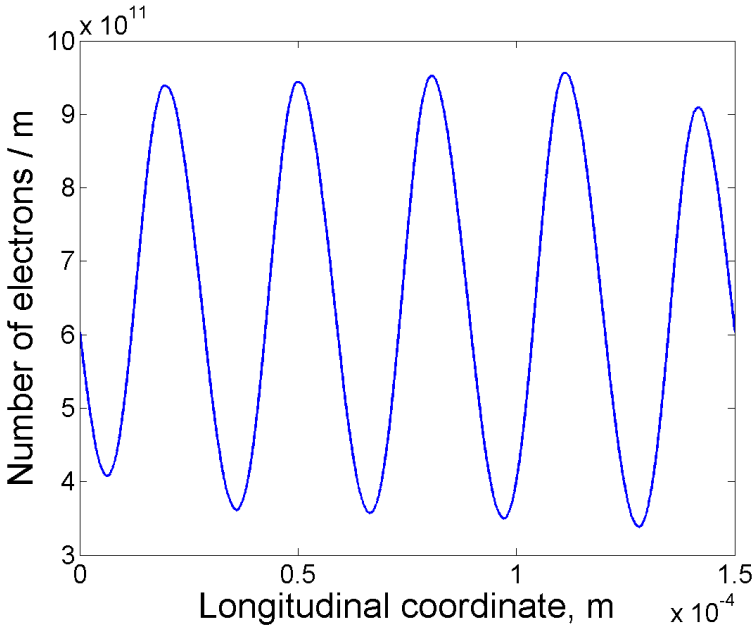


(a) Background

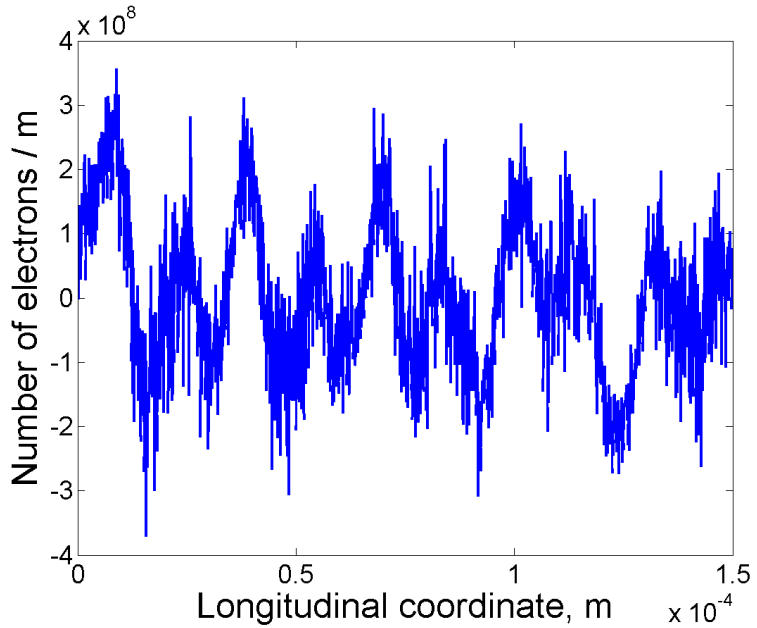


(b) Signal

Longitudinal density distribution in kicker, 3 m

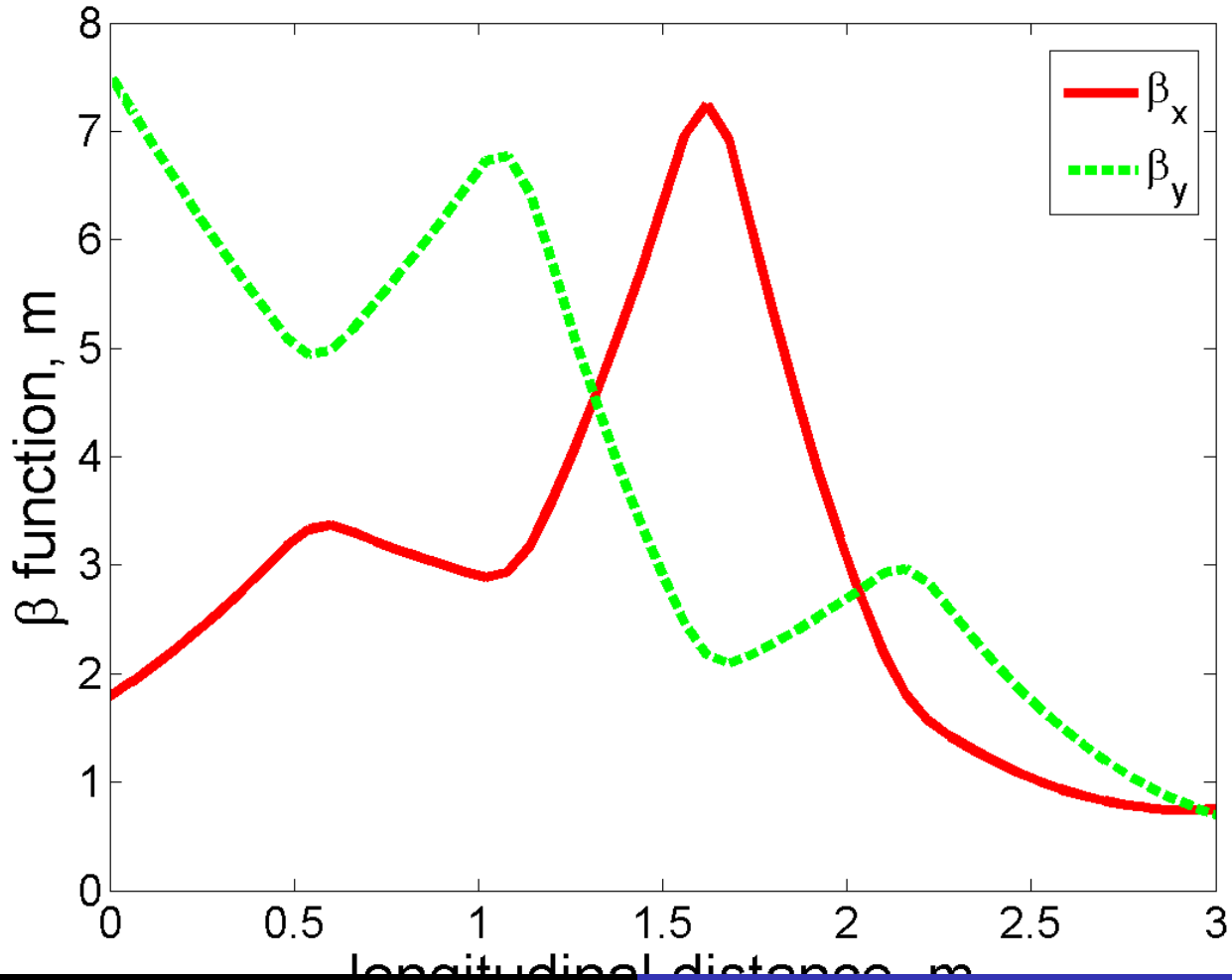


(a) Background

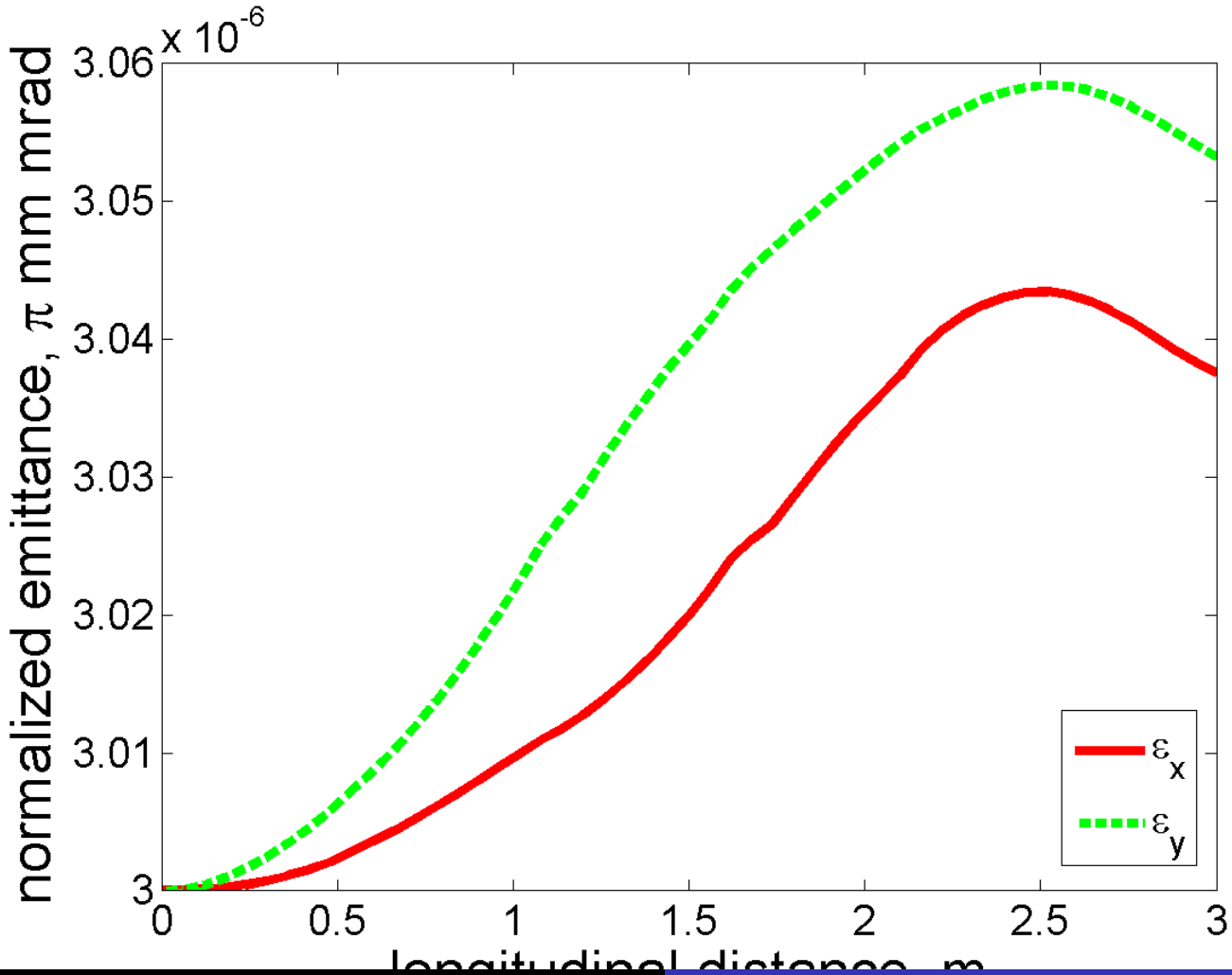


(b) Signal

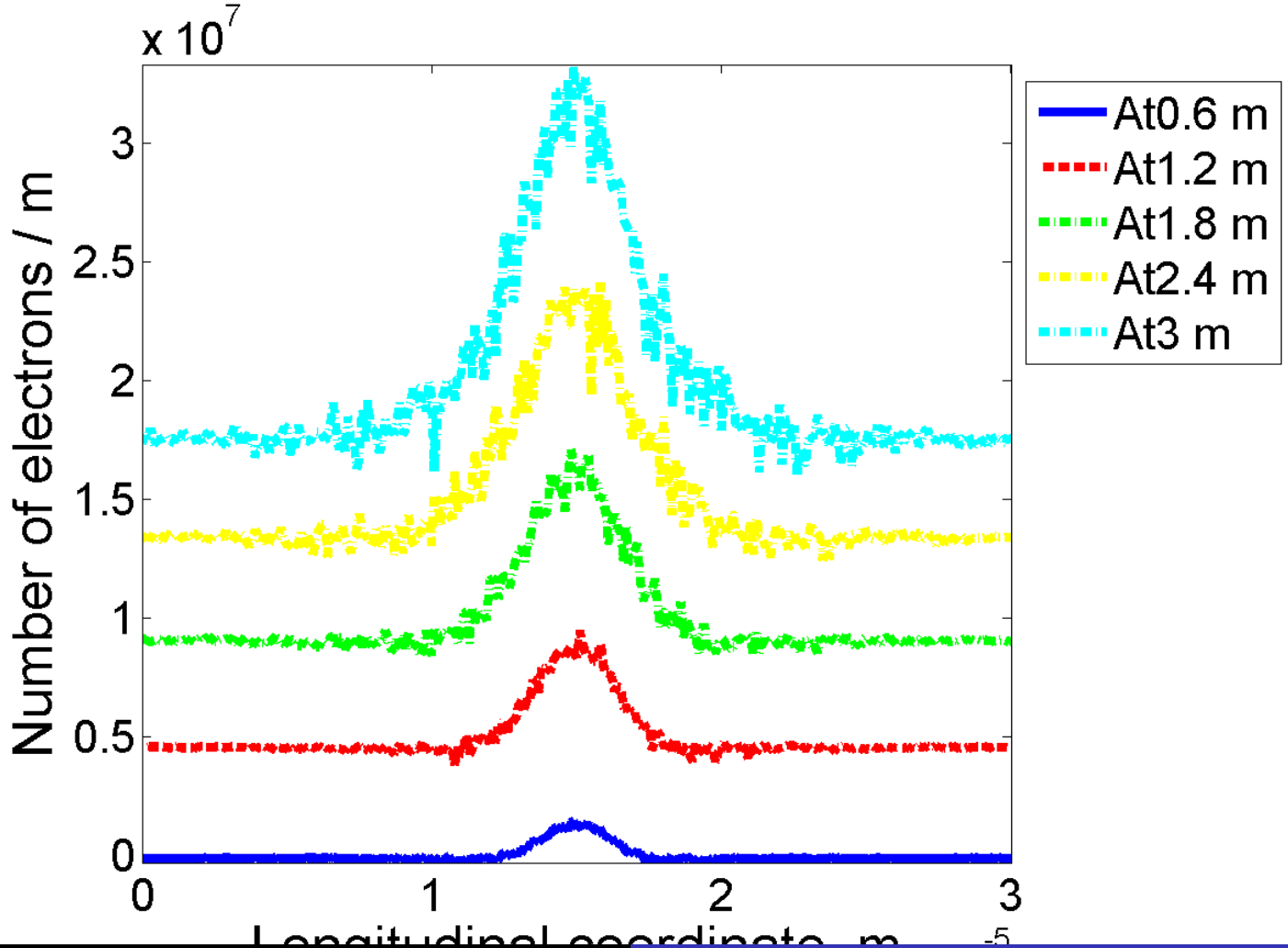
β function in modulator



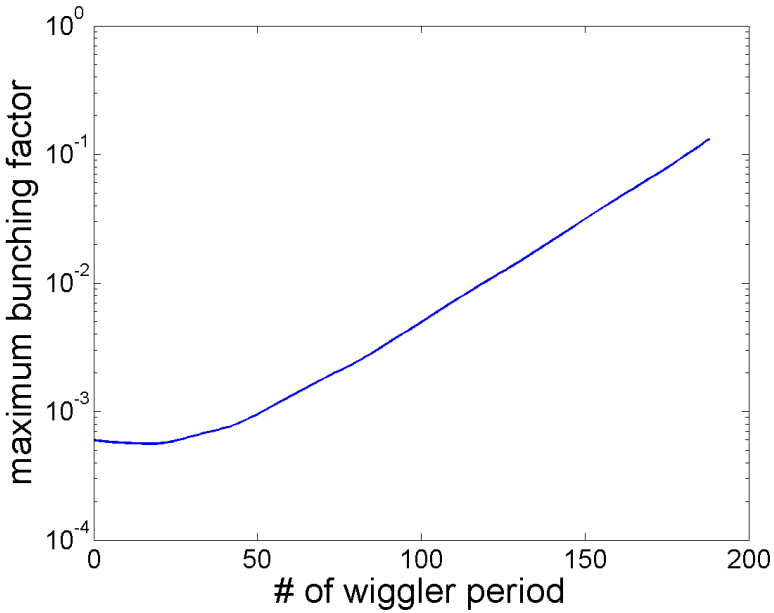
Emittance in modulator



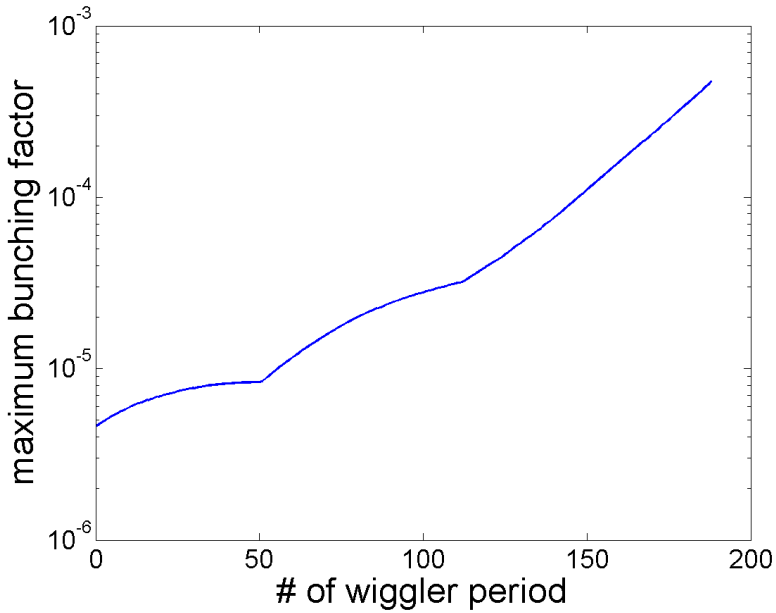
Longitudinal density modulation



Bunching factor in FEL

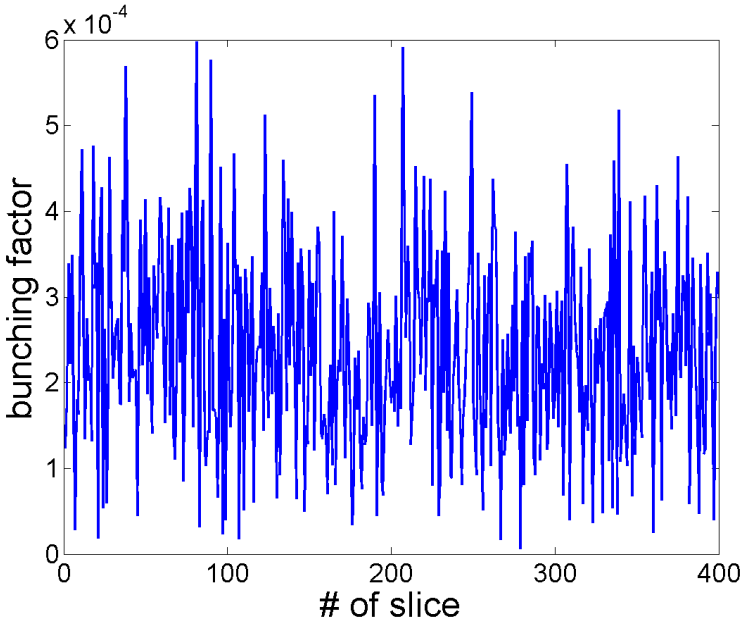


(a) Background

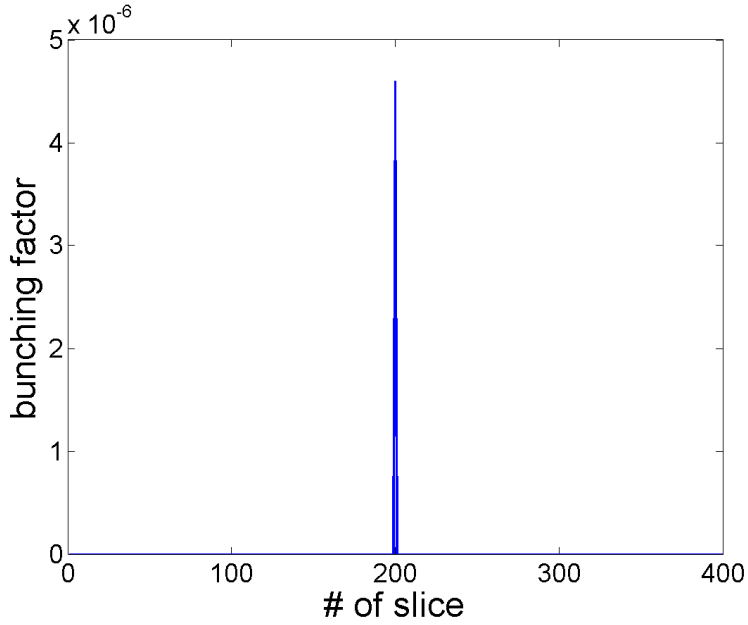


(b) Signal

Bunching factor in FEL at beginning

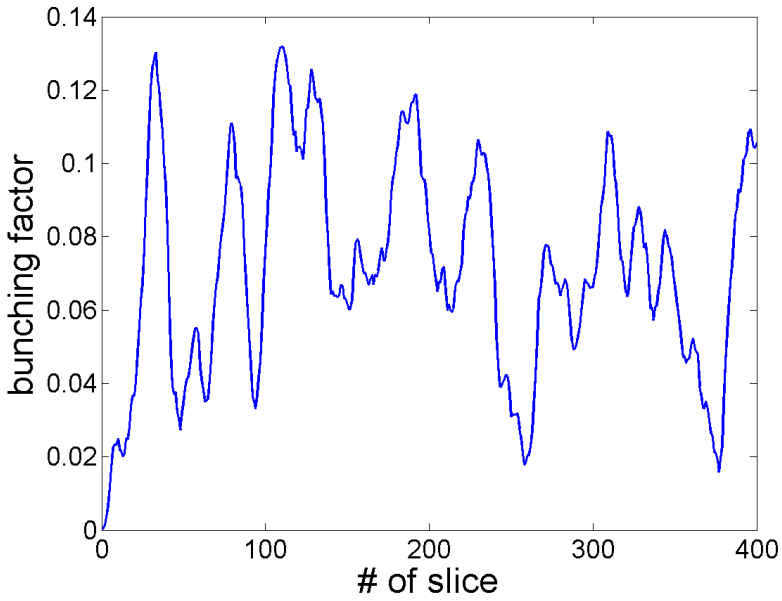


(a) Background

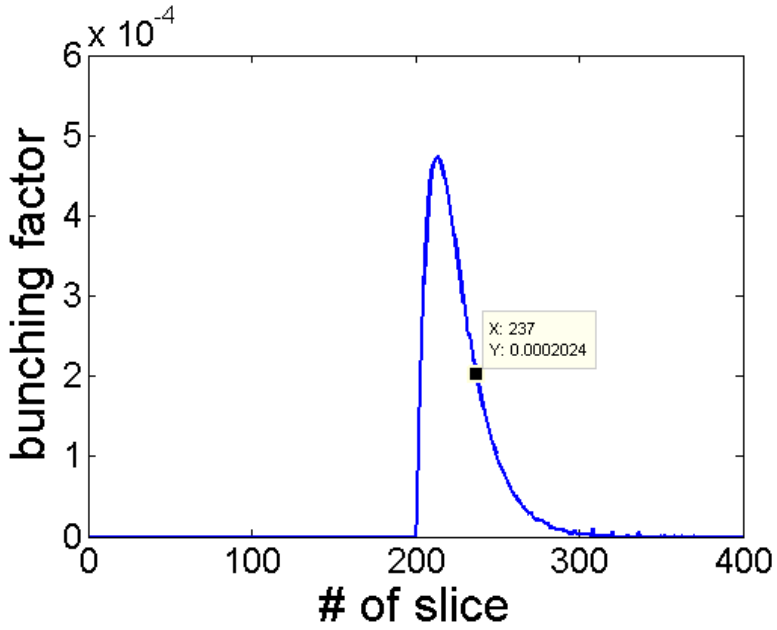


(b) Signal

Bunching factor in FEL at end

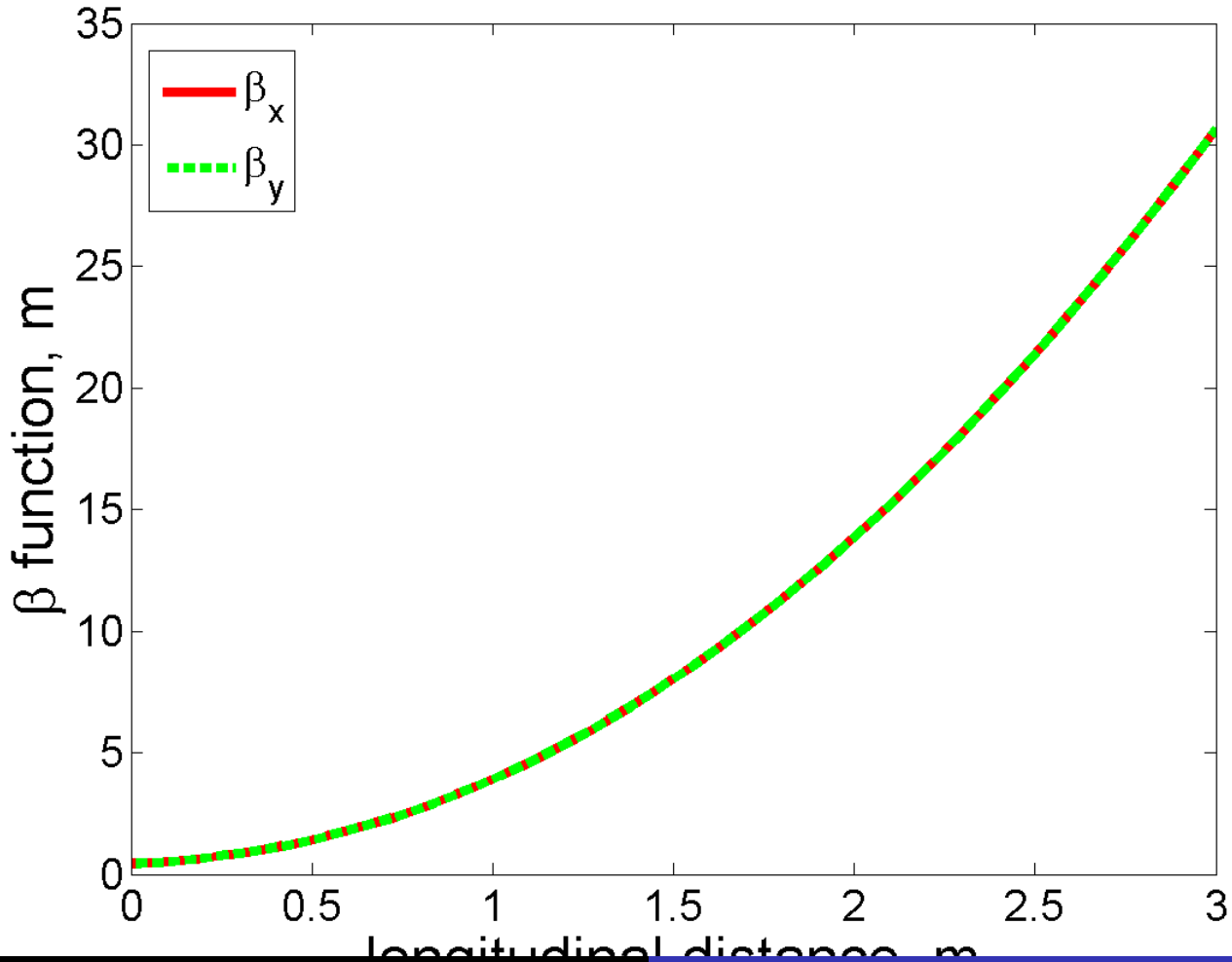


(a) Background

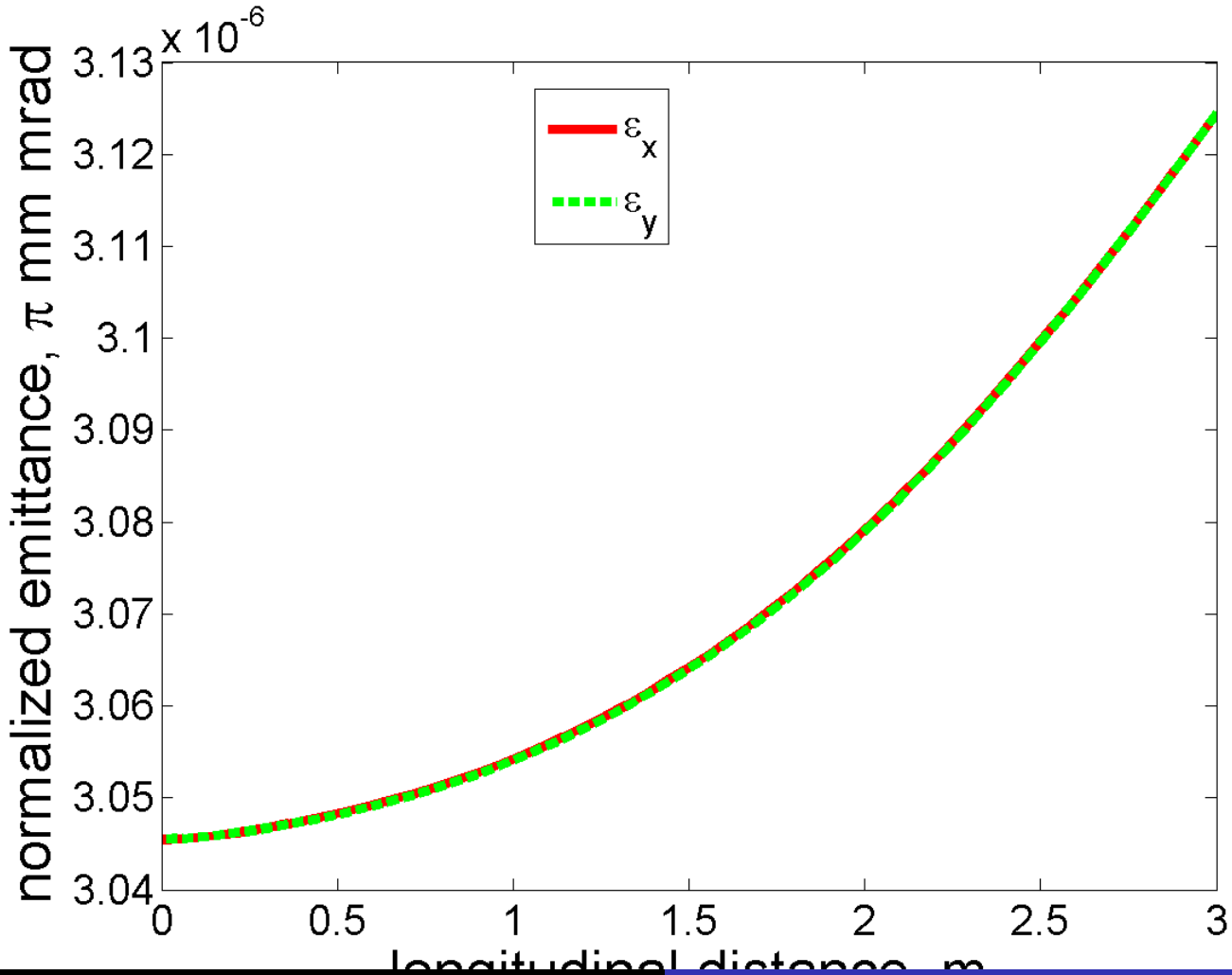


(b) Signal

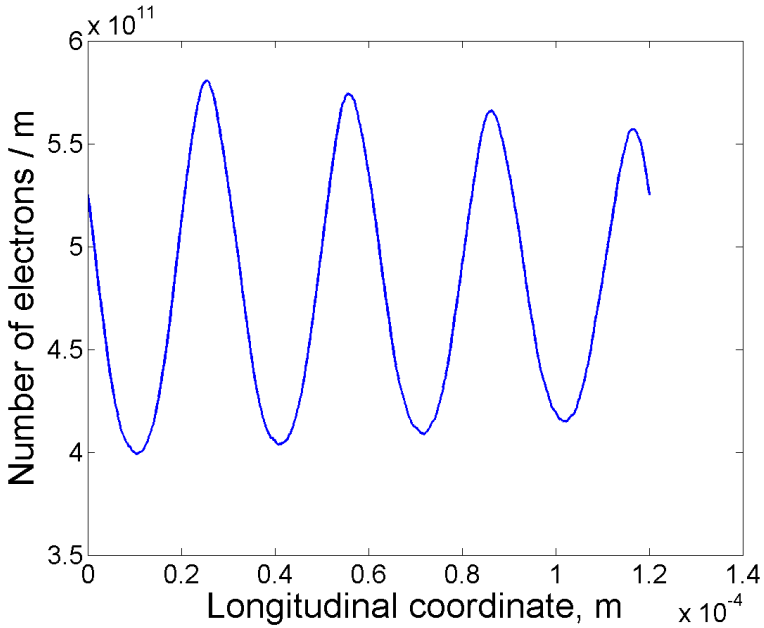
β function in kicker



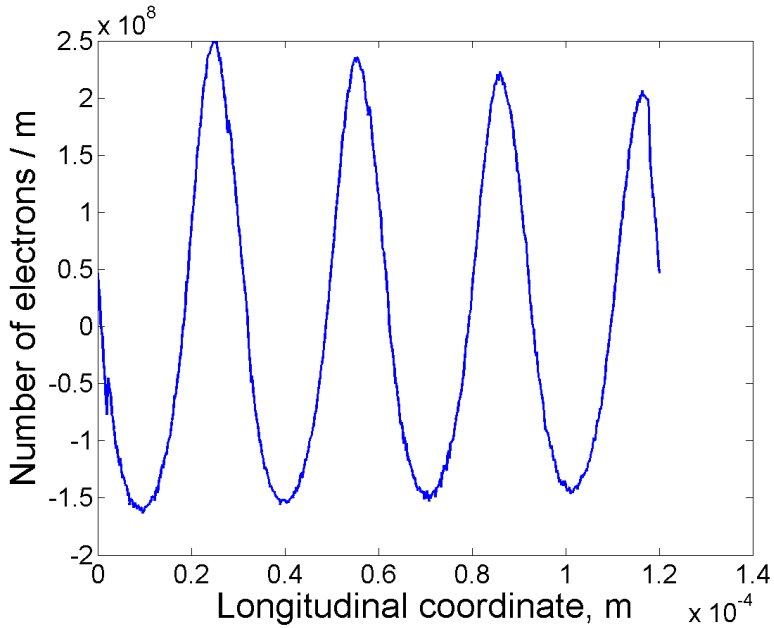
Emittance in kicker



Longitudinal density distribution in kicker, 0 m

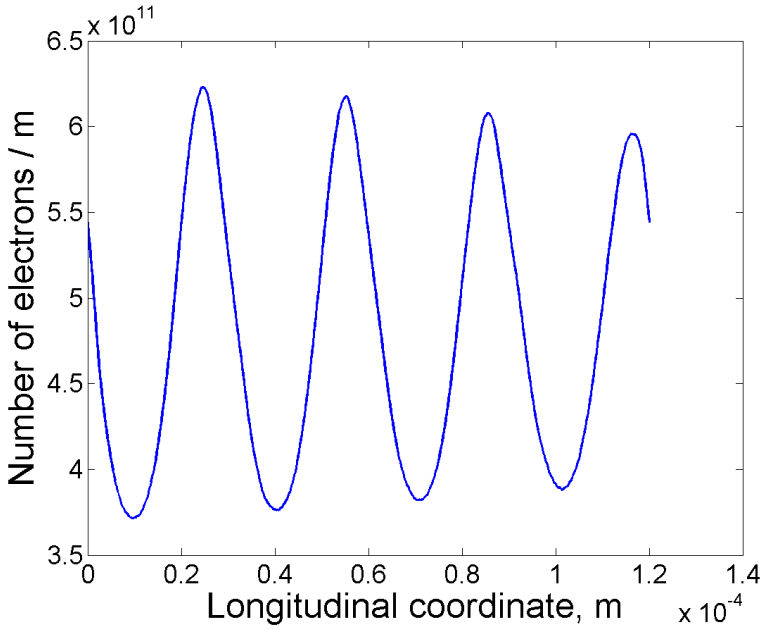


(a) Background

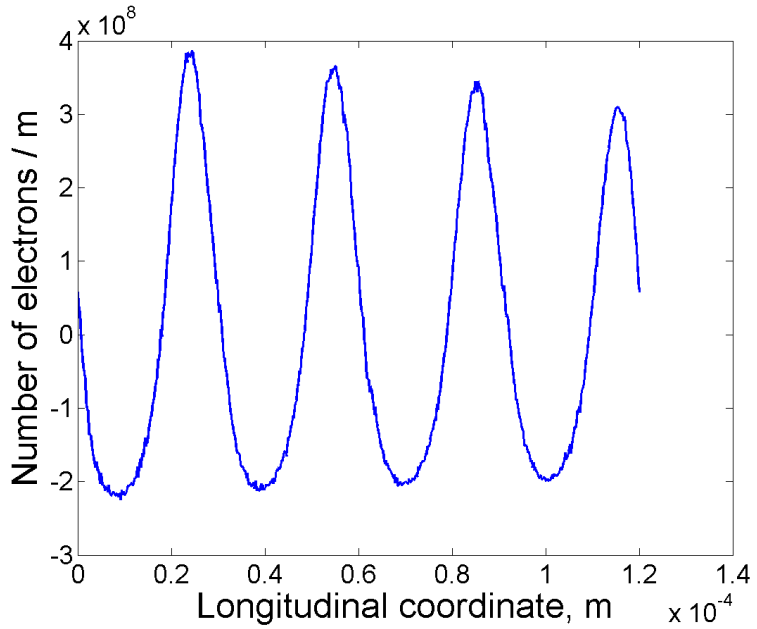


(b) Signal

Longitudinal density distribution in kicker, 0.6 m

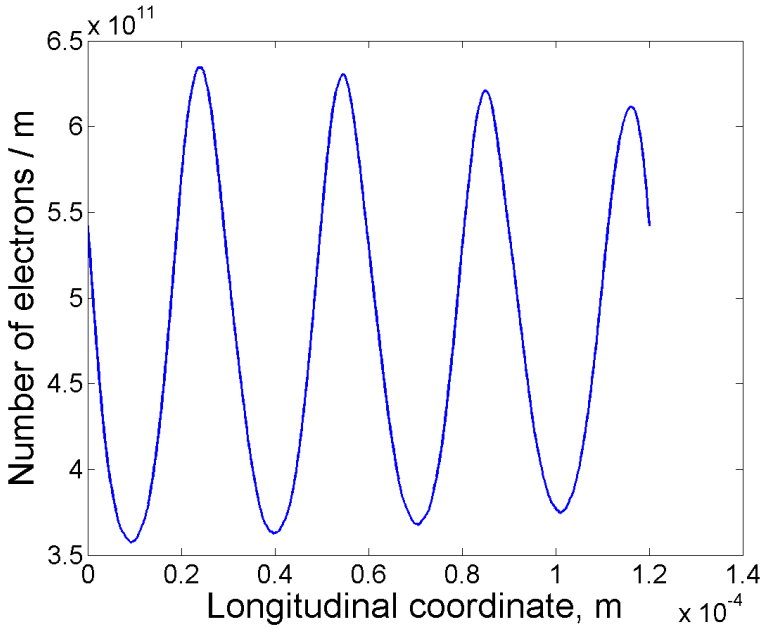


(a) Background

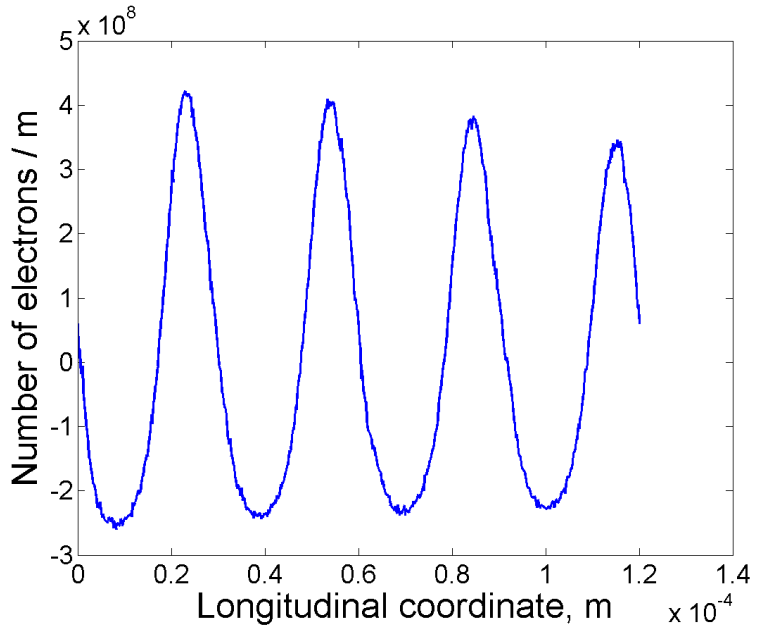


(b) Signal

Longitudinal density distribution in kicker, 1.2 m

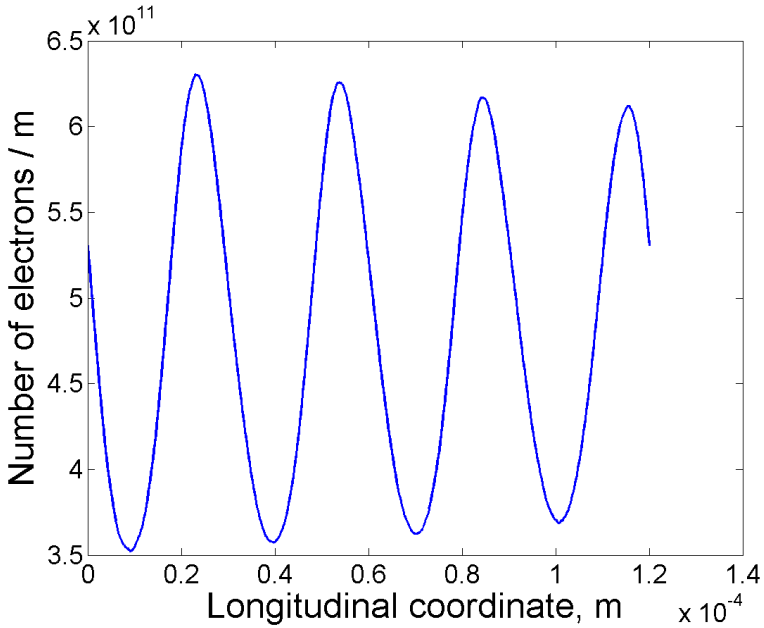


(a) Background

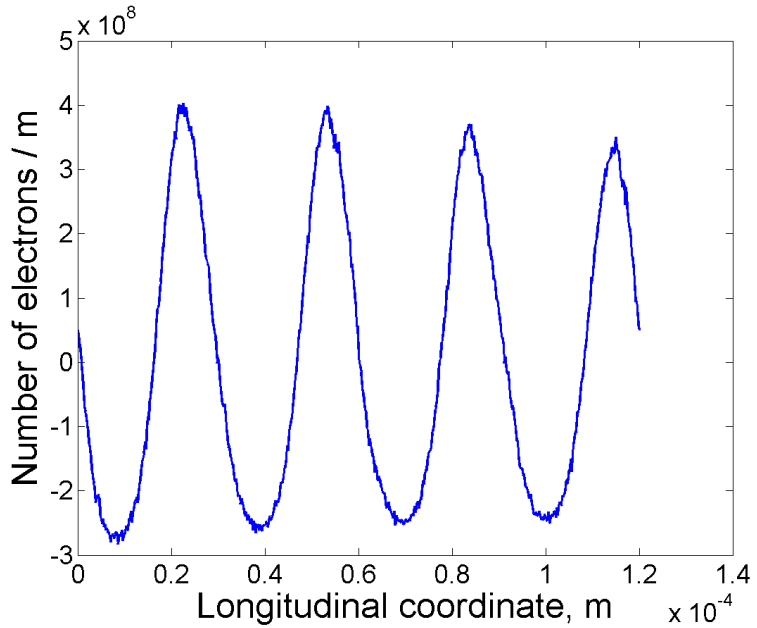


(b) Signal

Longitudinal density distribution in kicker, 1.8 m

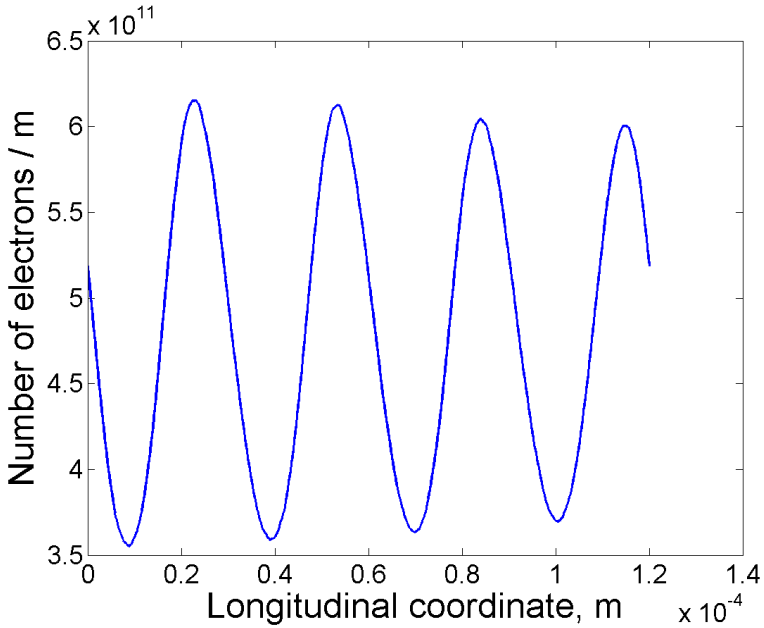


(a) Background

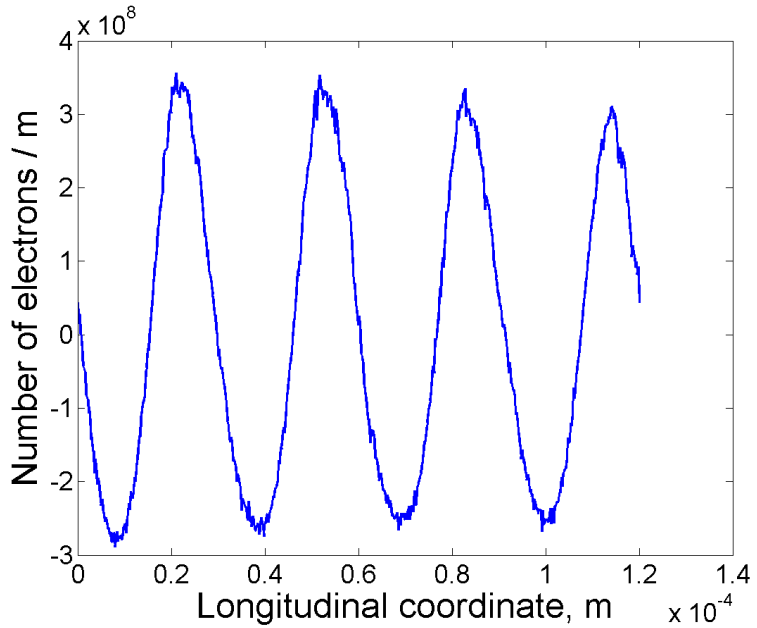


(b) Signal

Longitudinal density distribution in kicker, 2.4 m

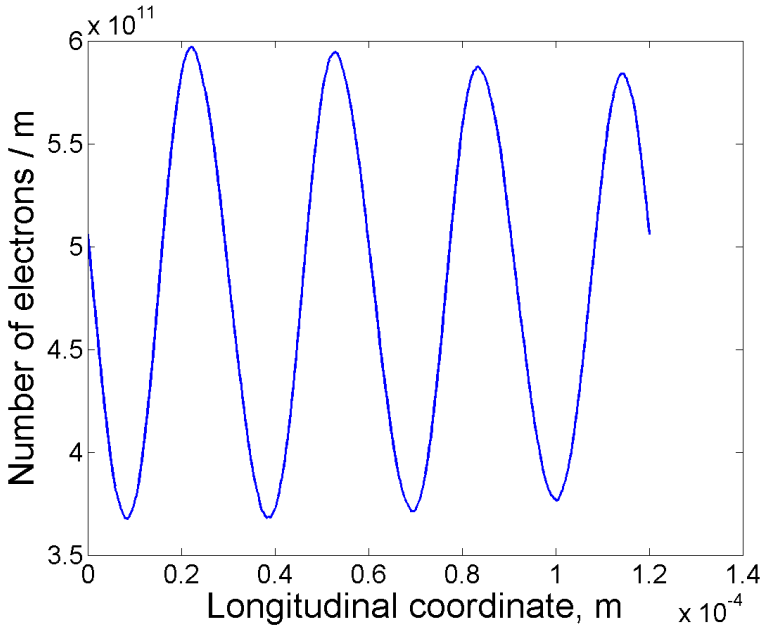


(a) Background

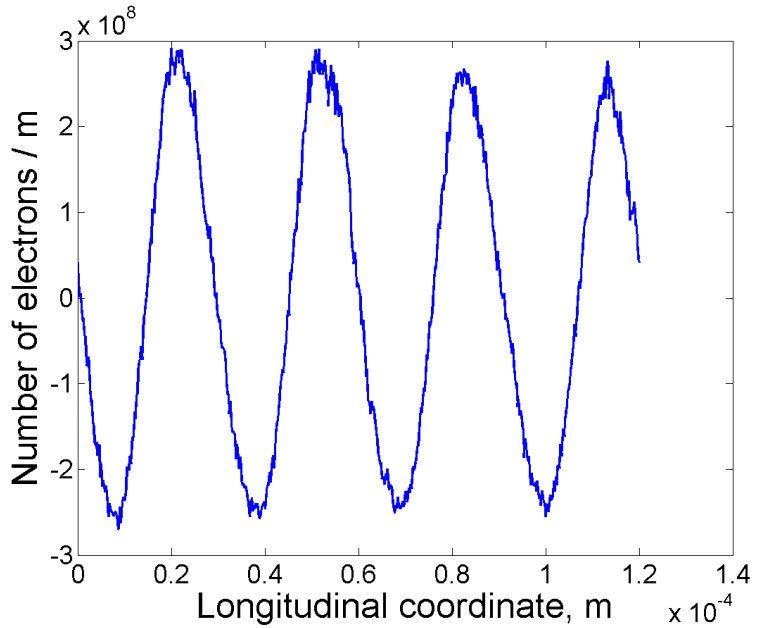


(b) Signal

Longitudinal density distribution in kicker, 3 m



(a) Background

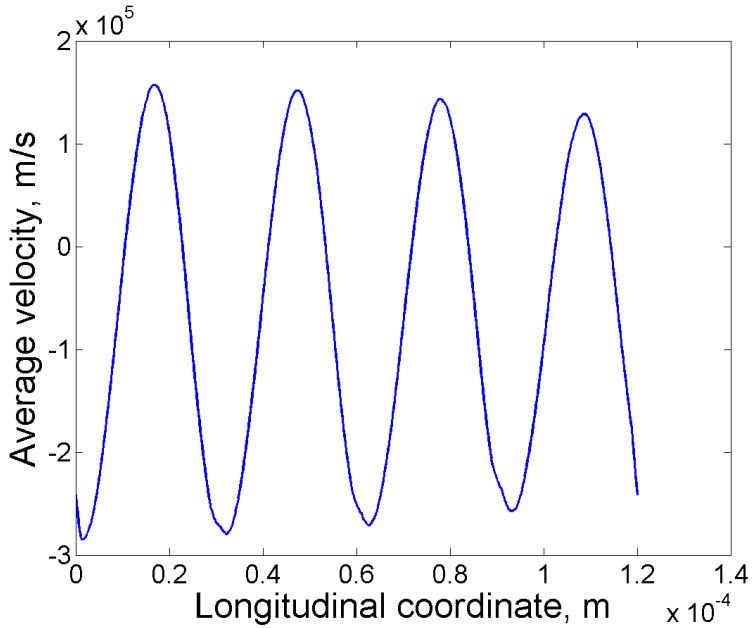


(b) Signal

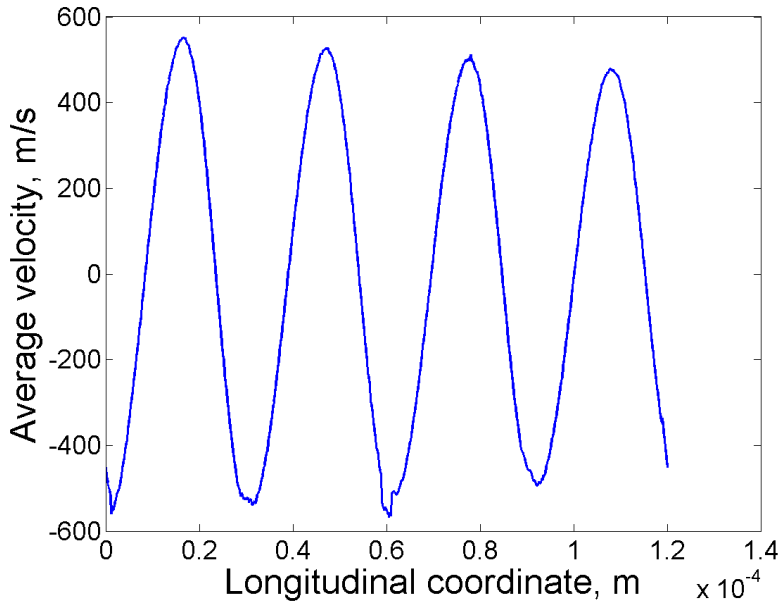
Shift

Electron beam slips 2.8e-6 m backwards, 33.6 degree.

Longitudinal velocity distribution in kicker, 0 m

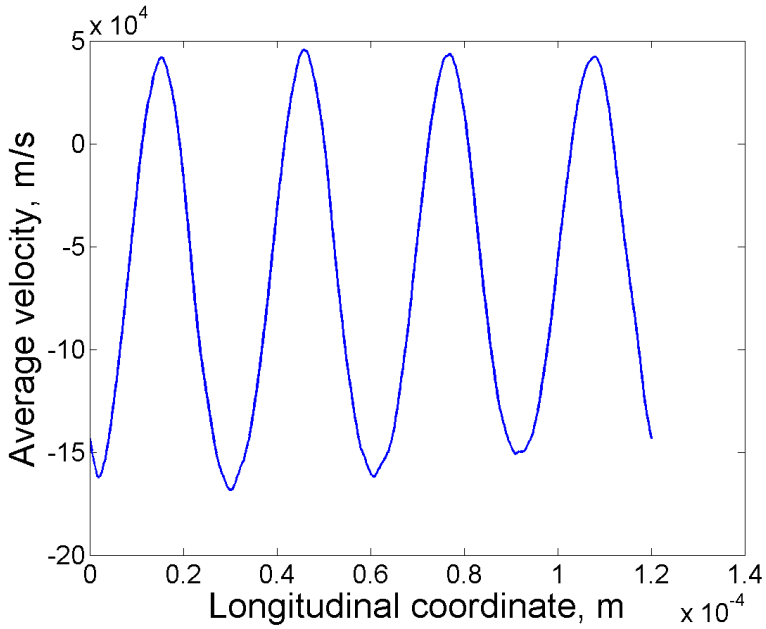


(a) Background

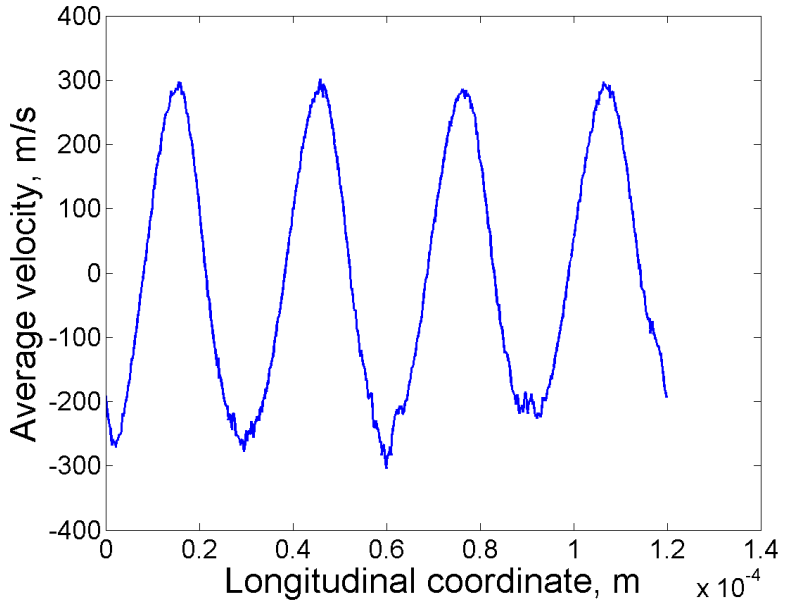


(b) Signal

Longitudinal velocity distribution in kicker, 0.6 m

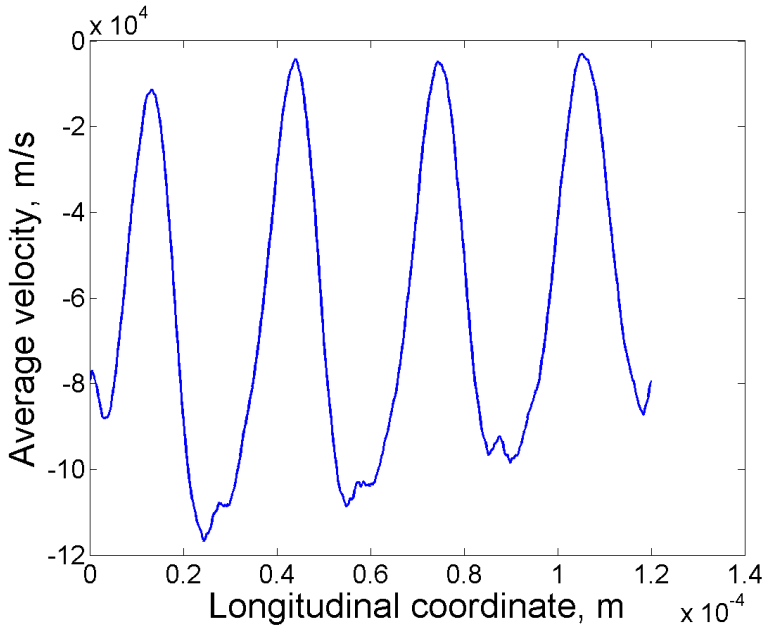


(a) Background

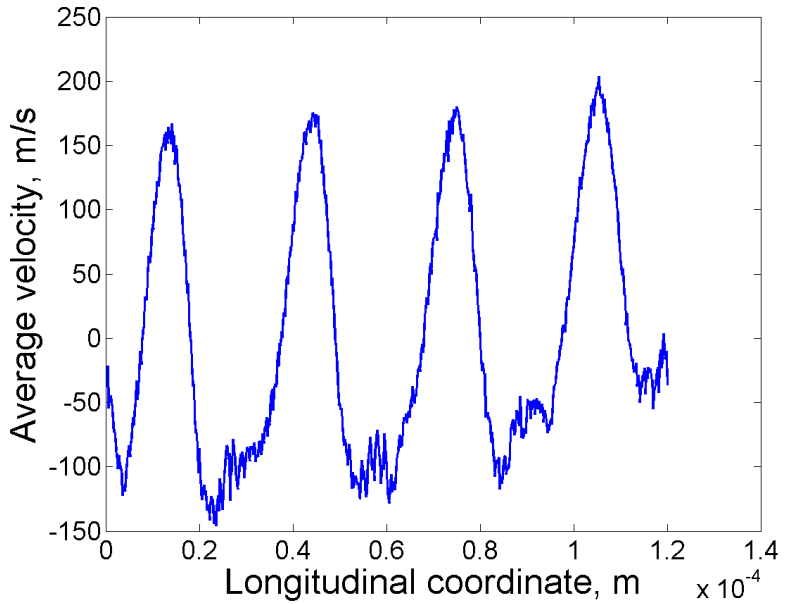


(b) Signal

Longitudinal velocity distribution in kicker, 1.2 m

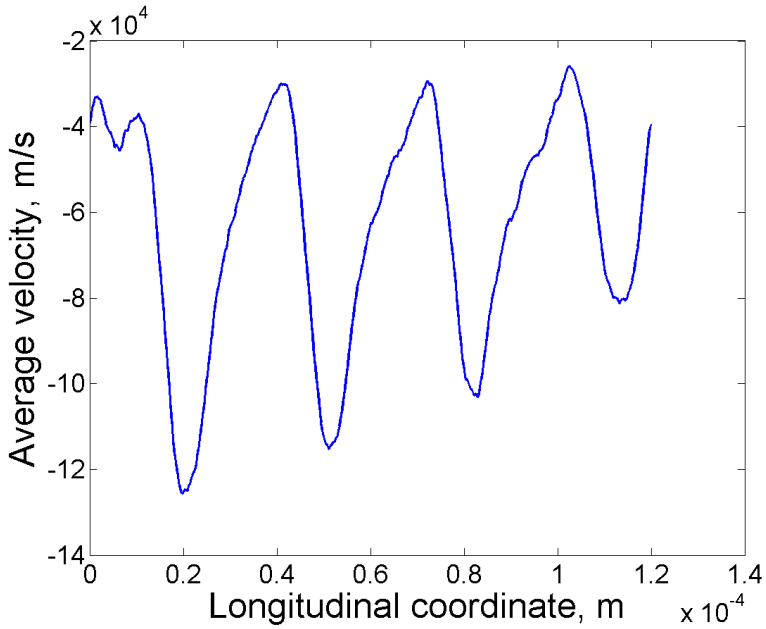


(a) Background

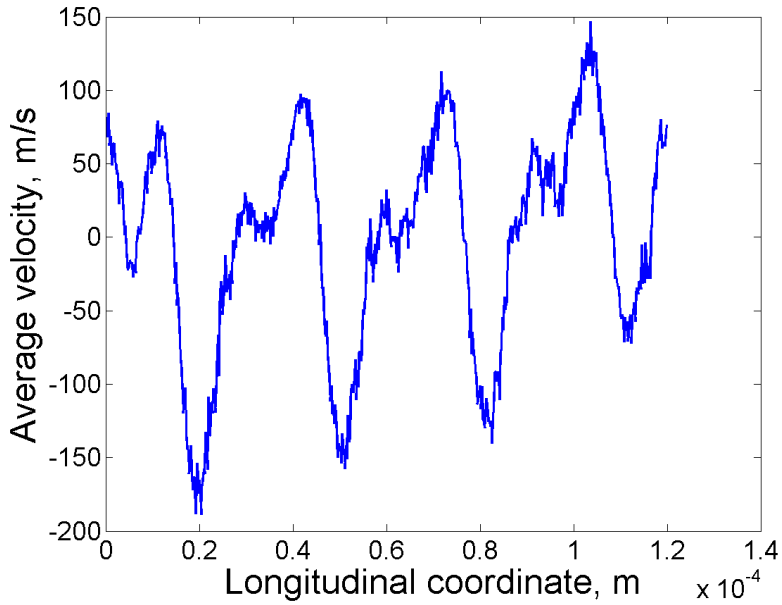


(b) Signal

Longitudinal velocity distribution in kicker, 1.8 m

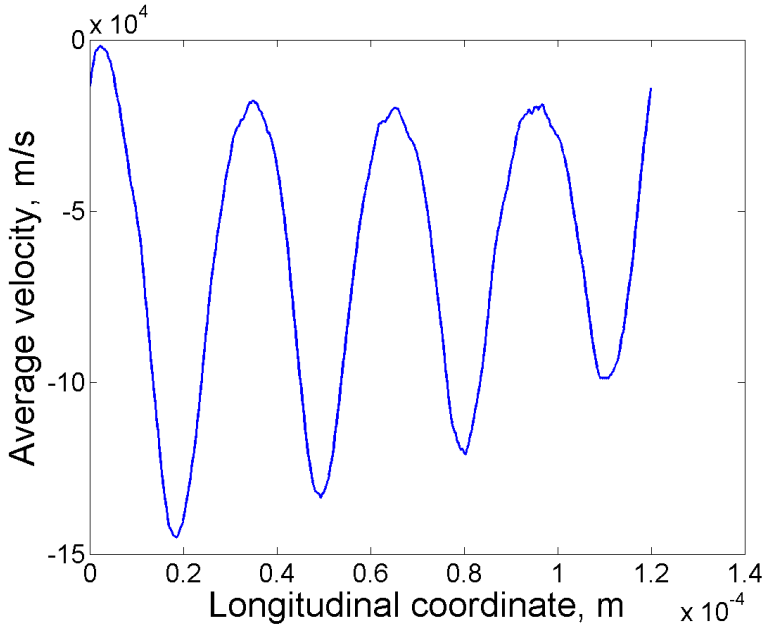


(a) Background

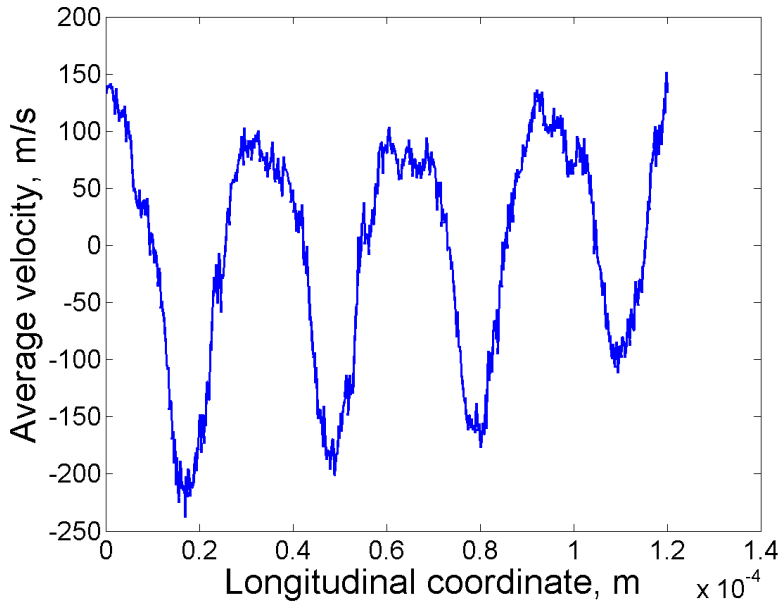


(b) Signal

Longitudinal velocity distribution in kicker, 2.4 m

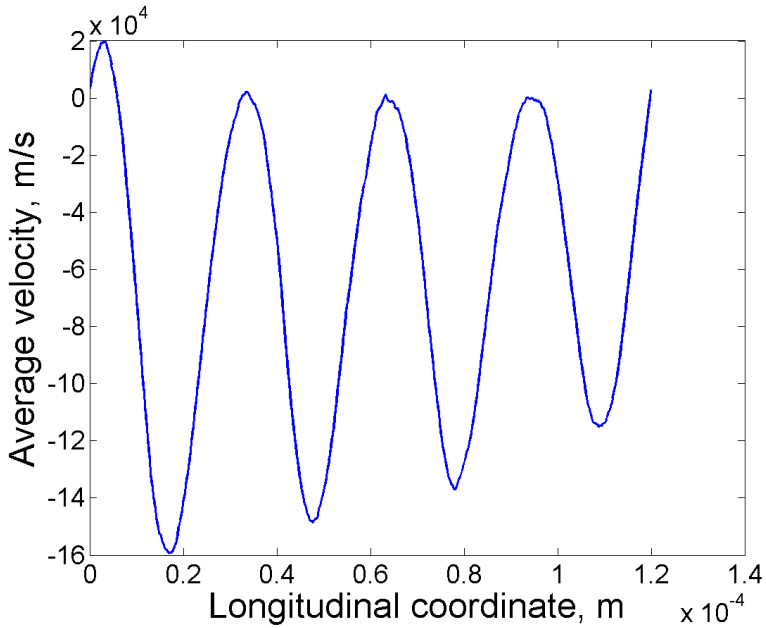


(a) Background

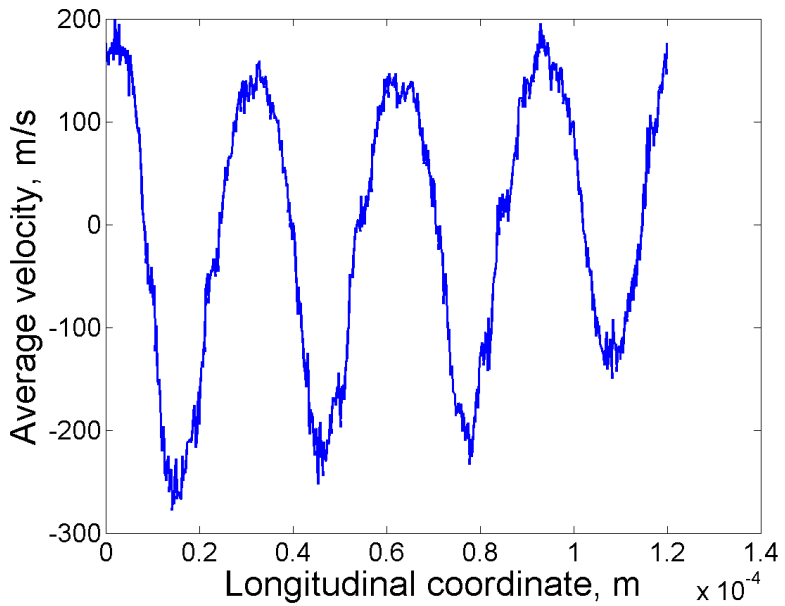


(b) Signal

Longitudinal velocity distribution in kicker, 3 m



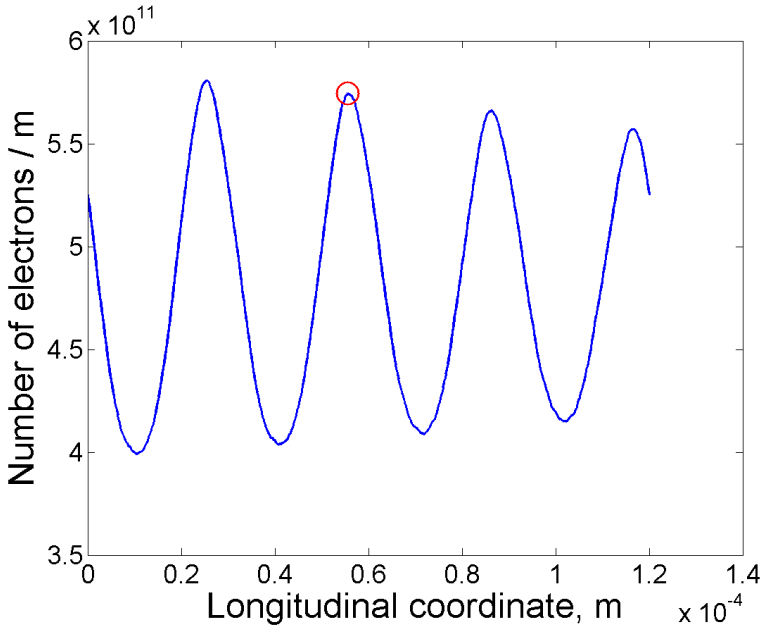
(a) Background



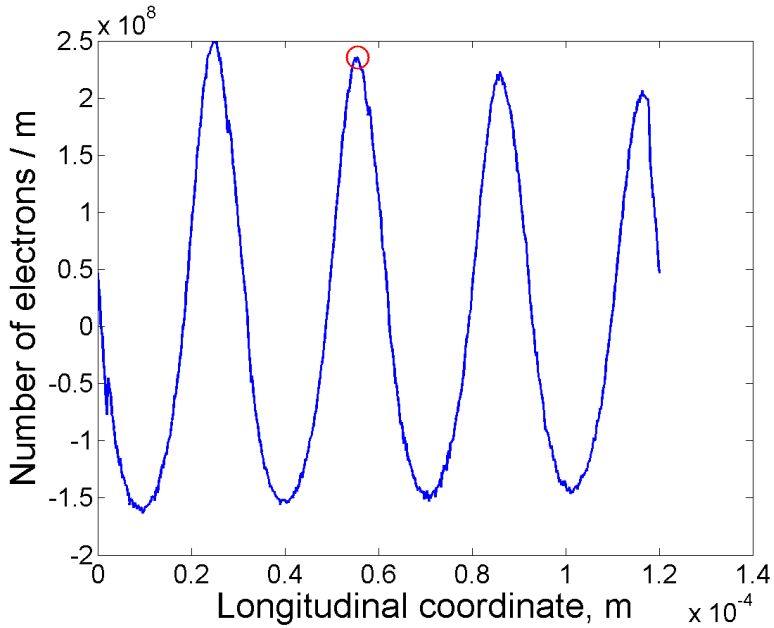
(b) Signal

Trace an ion with reference energy in kicker, v_z=0 m/s in beam frame.

Longitudinal density distribution in kicker, 0 m

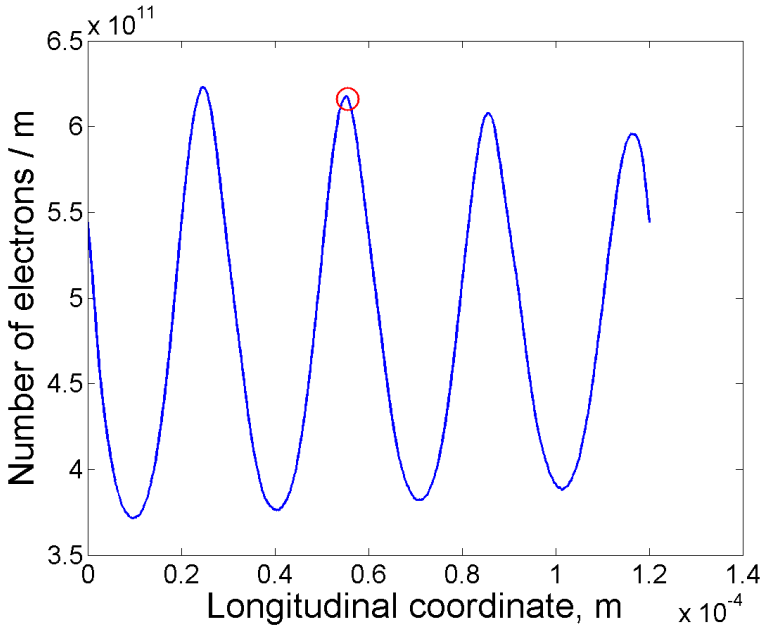


(a) Background

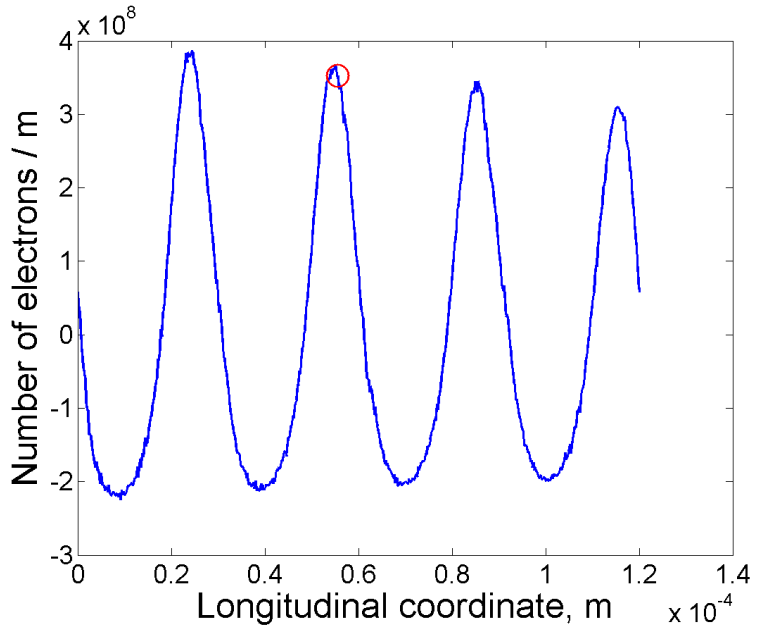


(b) Signal

Longitudinal density distribution in kicker, 0.6 m

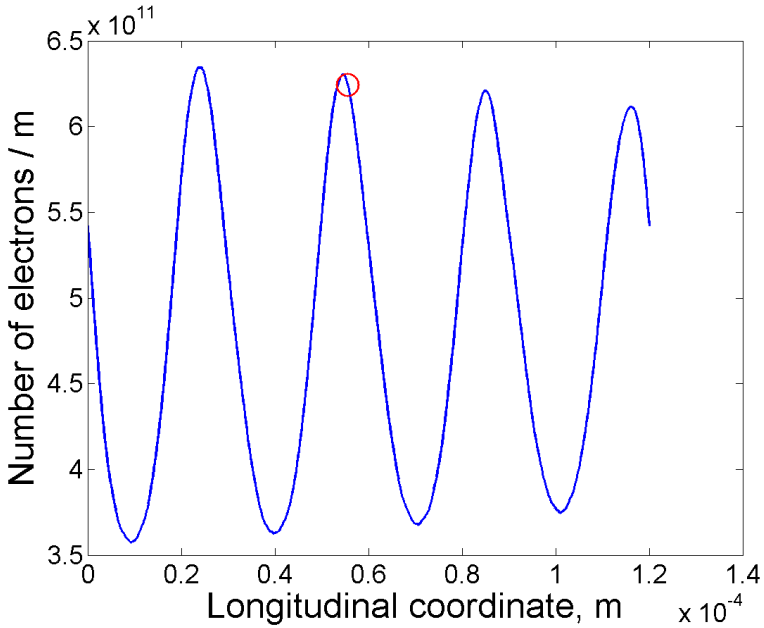


(a) Background

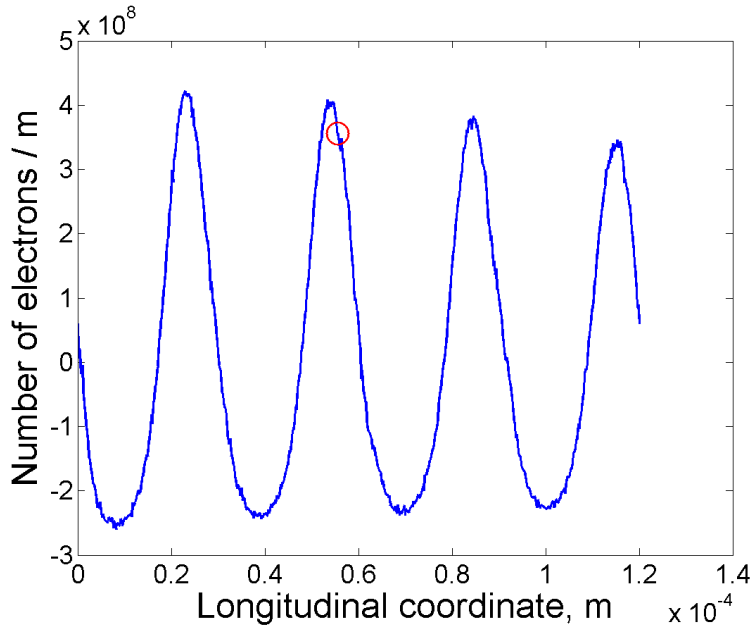


(b) Signal

Longitudinal density distribution in kicker, 1.2 m

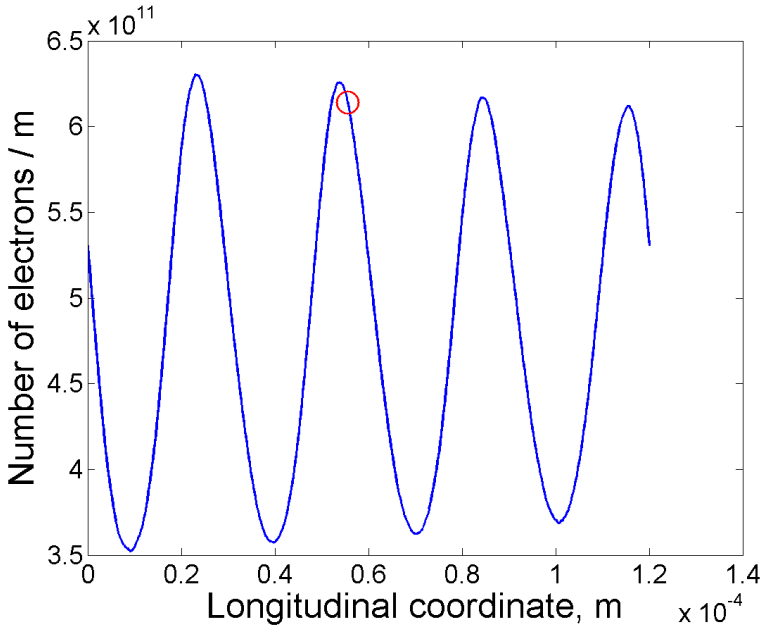


(a) Background

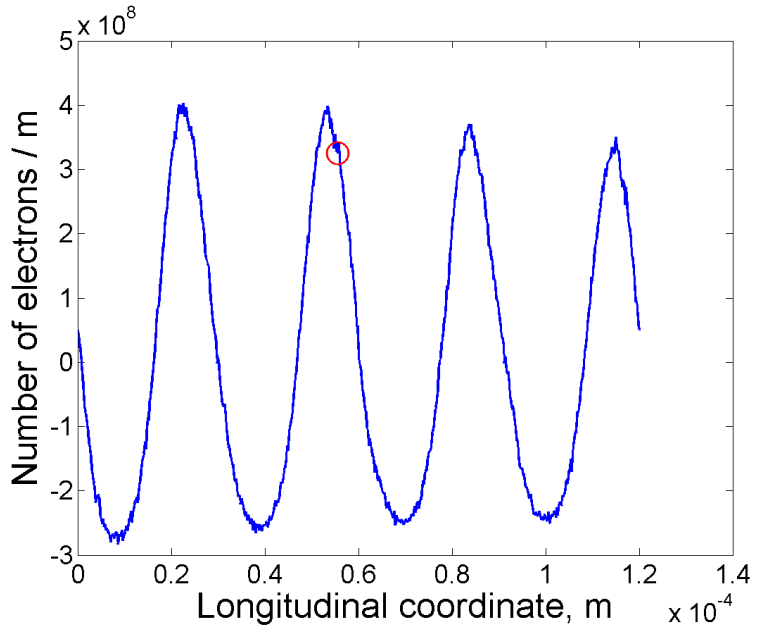


(b) Signal

Longitudinal density distribution in kicker, 1.8 m

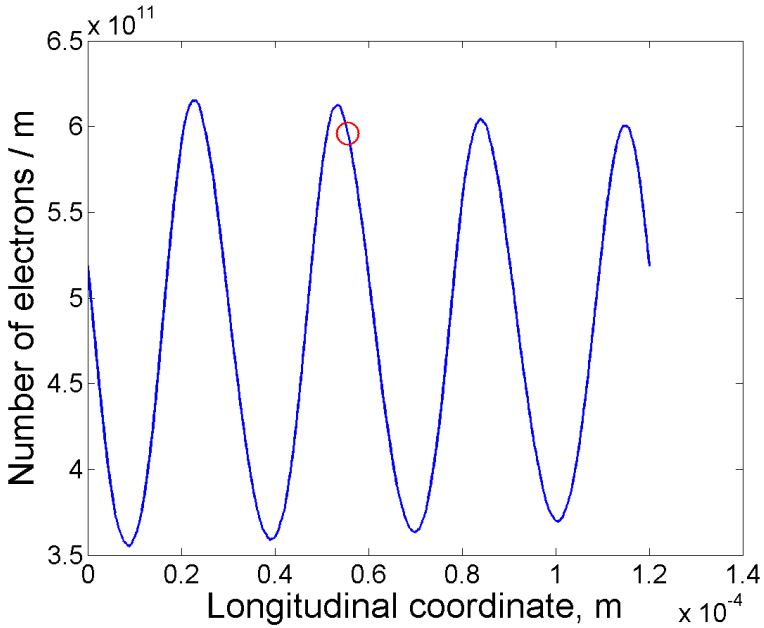


(a) Background

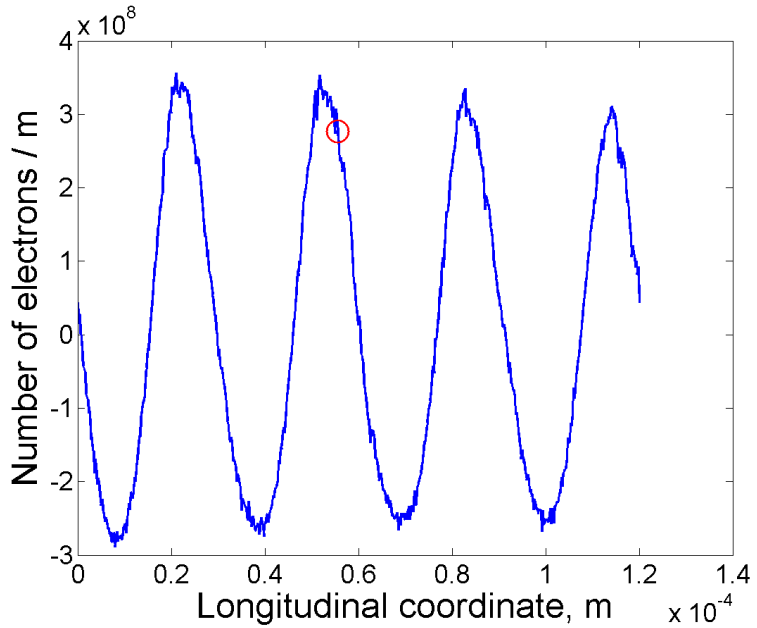


(b) Signal

Longitudinal density distribution in kicker, 2.4 m

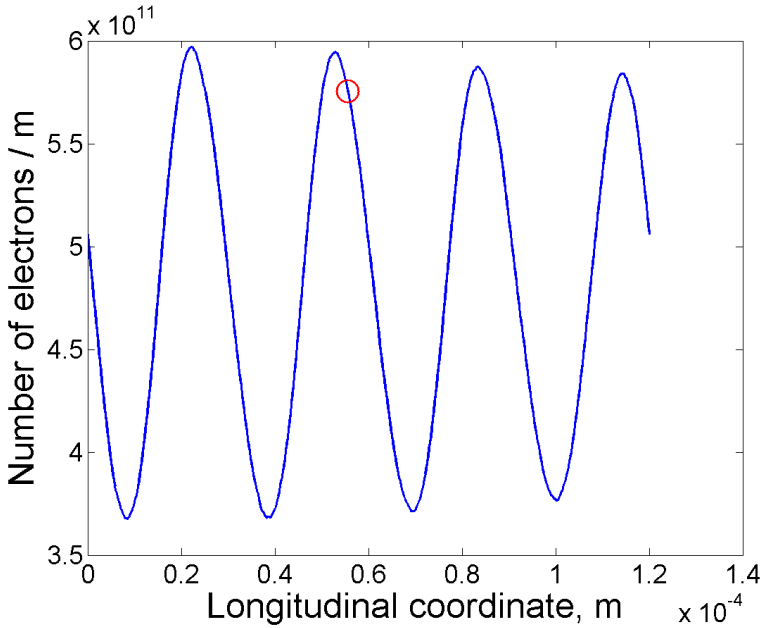


(a) Background

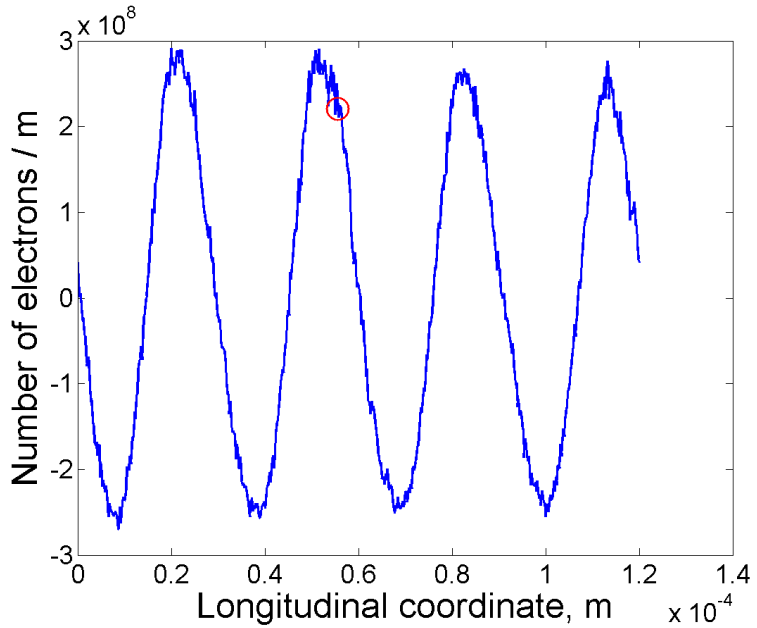


(b) Signal

Longitudinal density distribution in kicker, 3 m

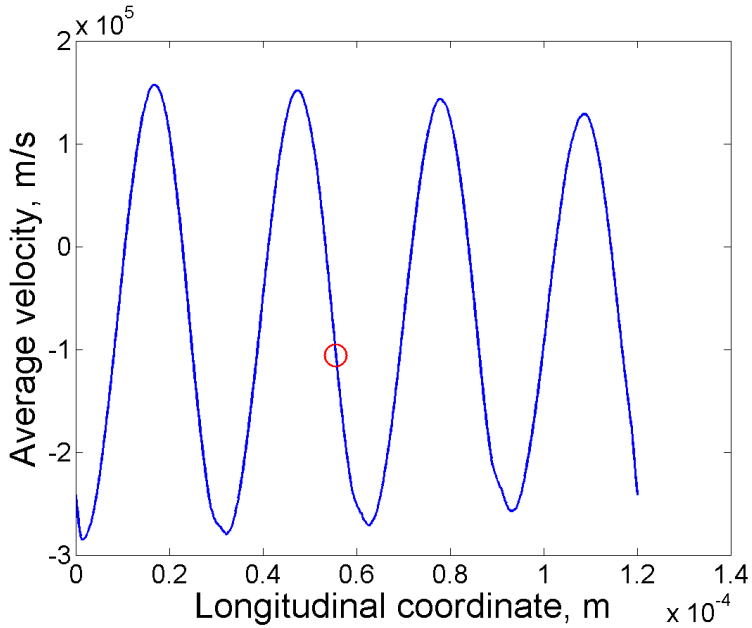


(a) Background

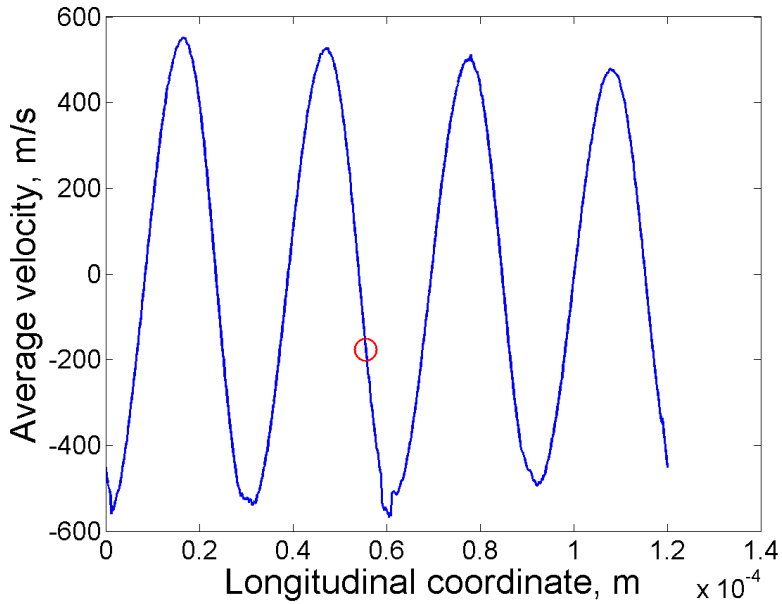


(b) Signal

Longitudinal velocity distribution in kicker, 0 m

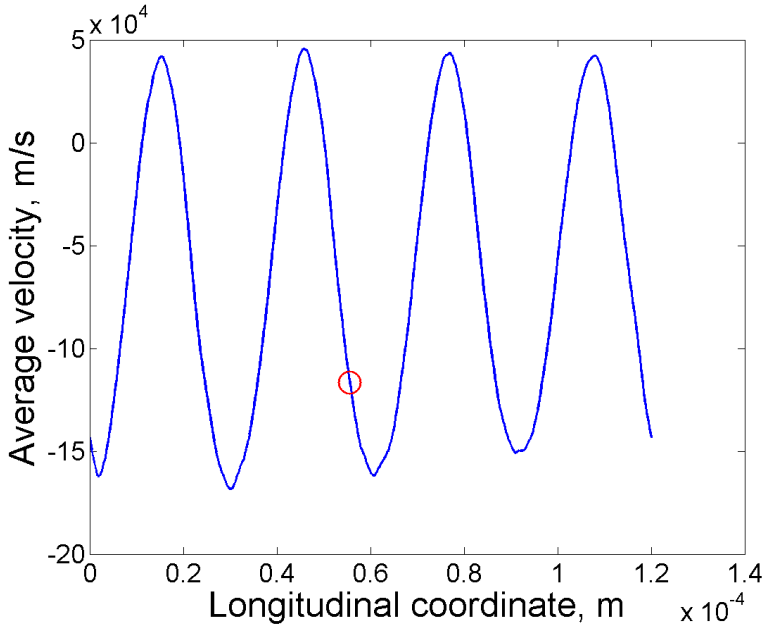


(a) Background

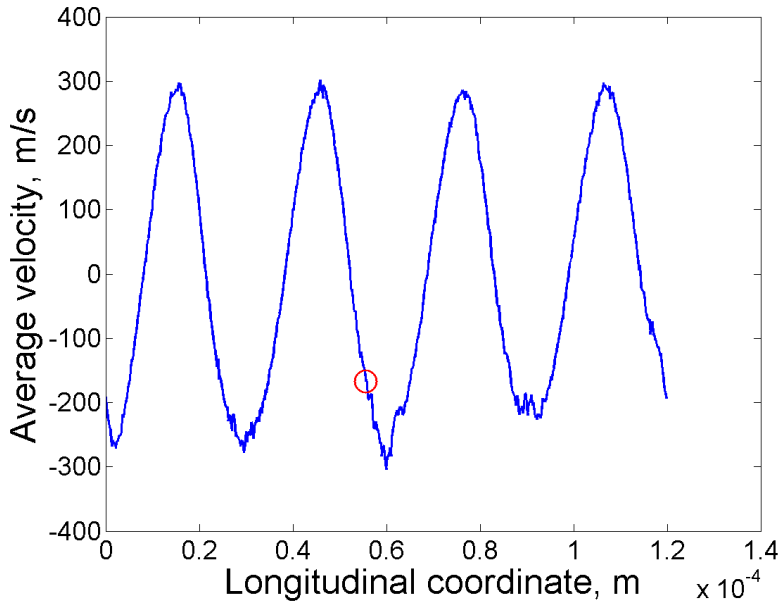


(b) Signal

Longitudinal velocity distribution in kicker, 0.6 m

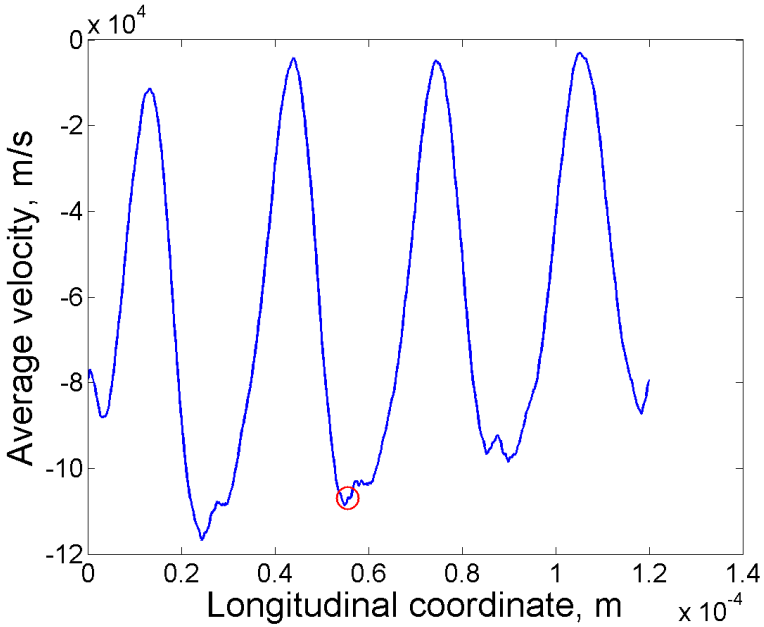


(a) Background

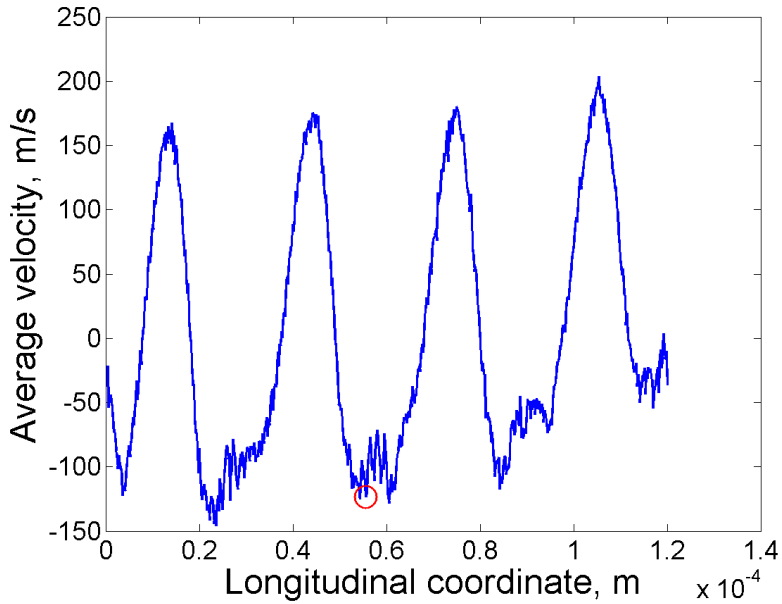


(b) Signal

Longitudinal velocity distribution in kicker, 1.2 m

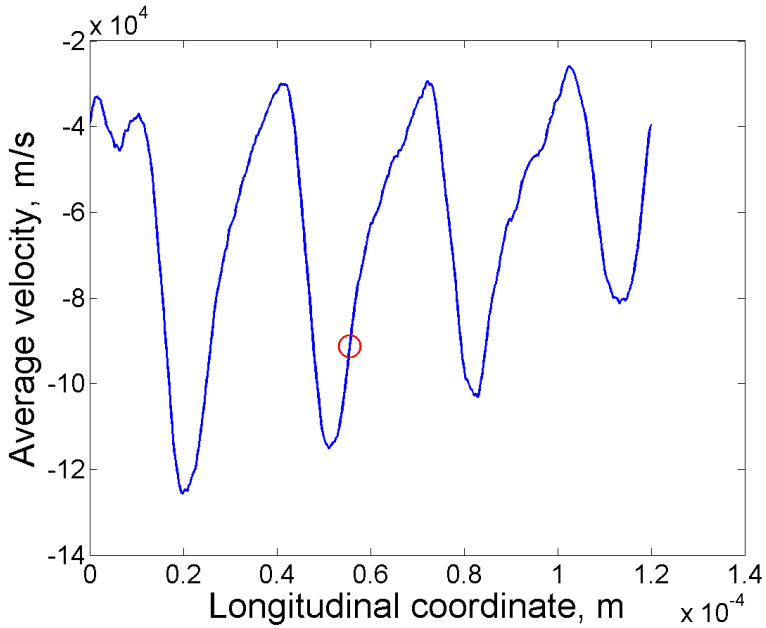


(a) Background

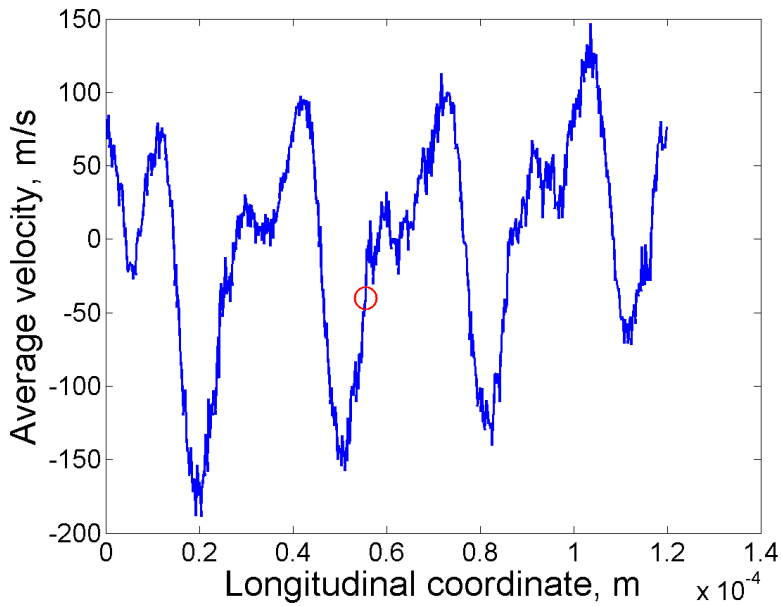


(b) Signal

Longitudinal velocity distribution in kicker, 1.8 m

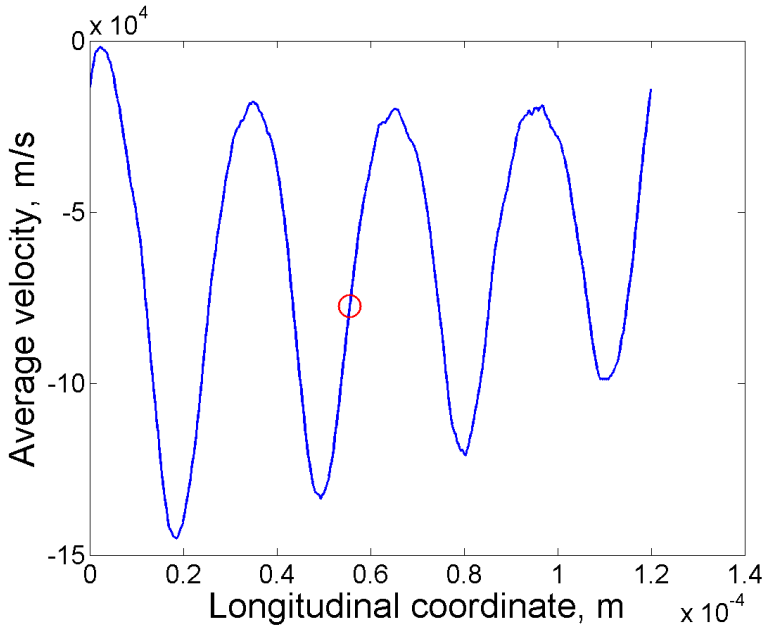


(a) Background

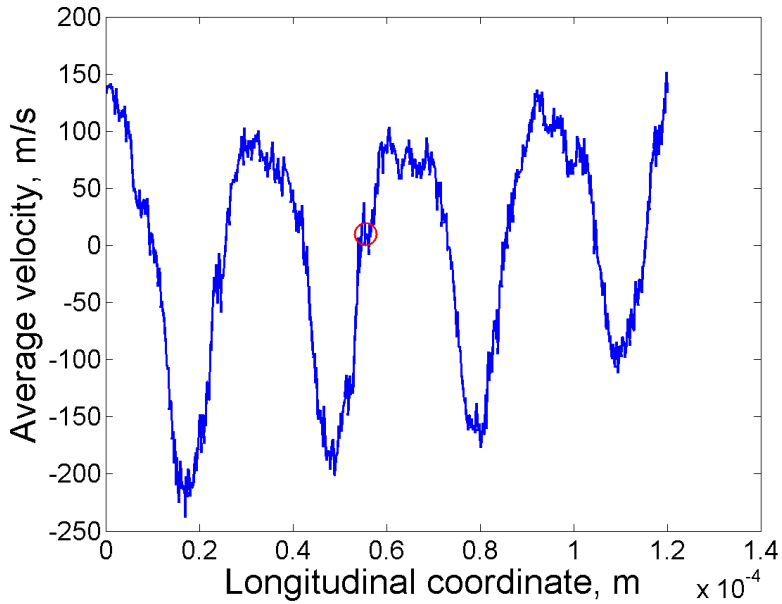


(b) Signal

Longitudinal velocity distribution in kicker, 2.4 m

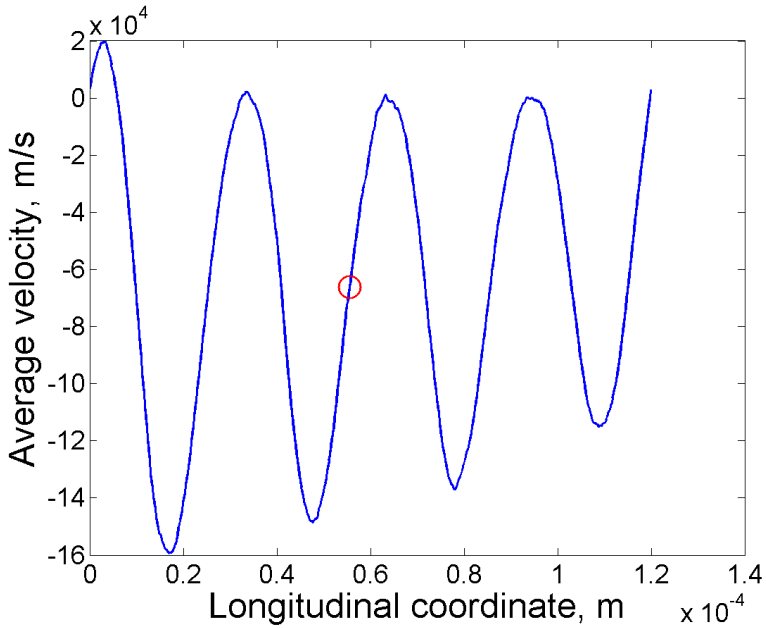


(a) Background

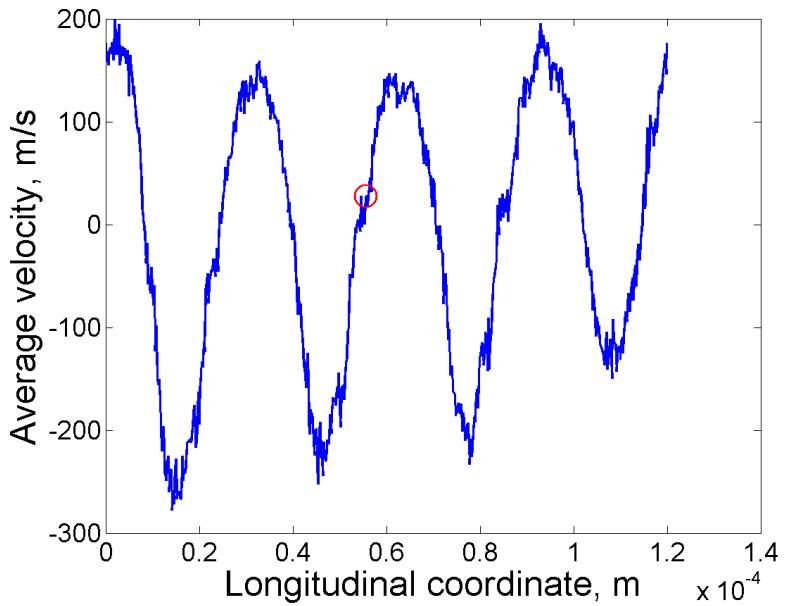


(b) Signal

Longitudinal velocity distribution in kicker, 3 m

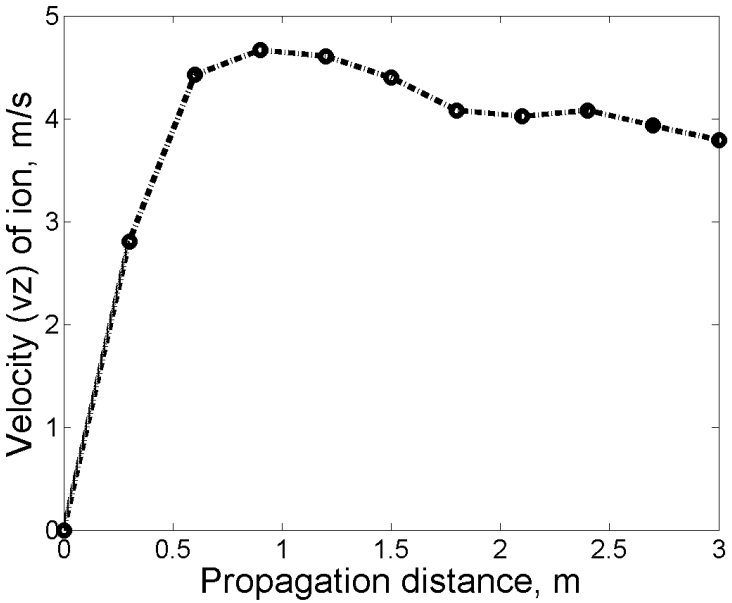


(a) Background

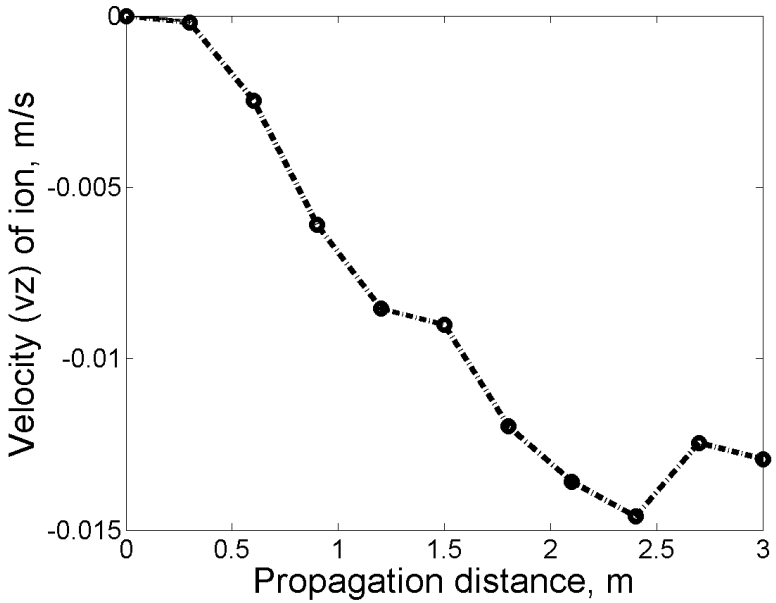


(b) Signal

Ion's velocity



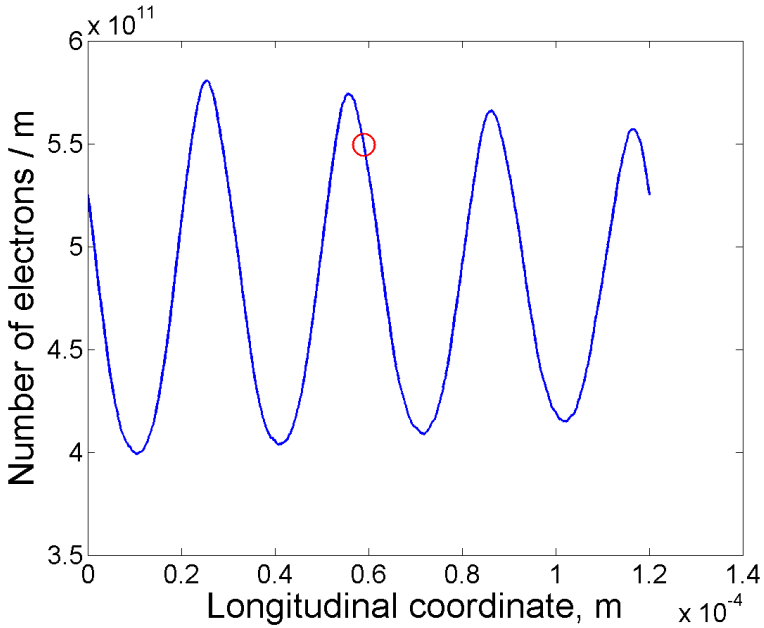
(a) Background



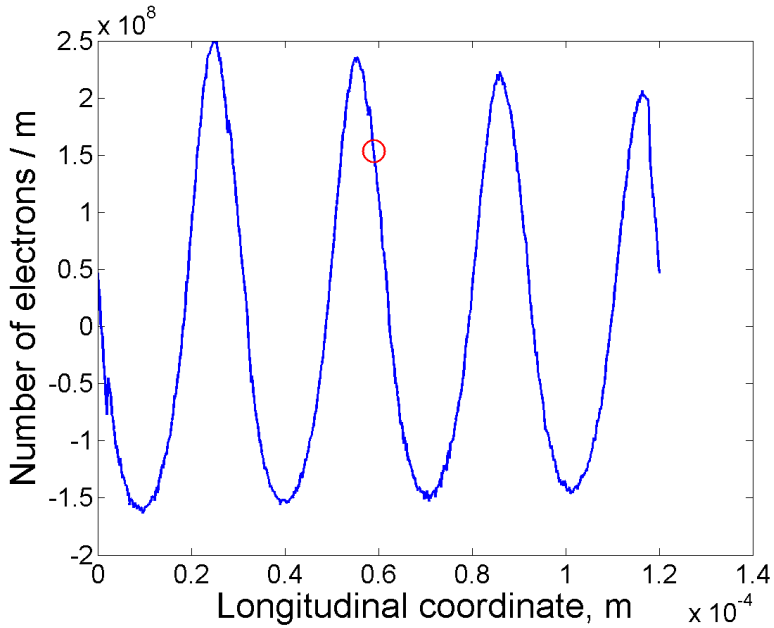
(b) Signal

Trace an ion with off-reference energy in kicker, v_z=3e+5 m/s in beam frame.

Longitudinal density distribution in kicker, 0 m

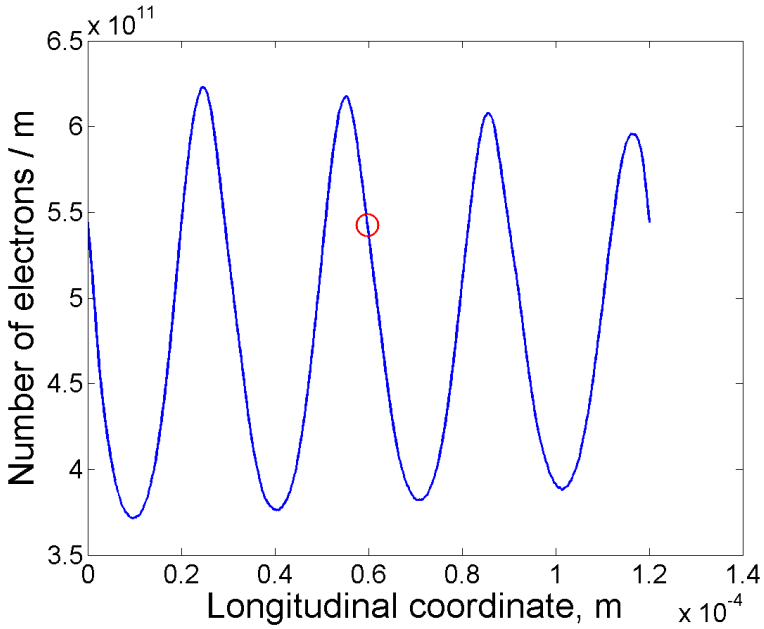


(a) Background

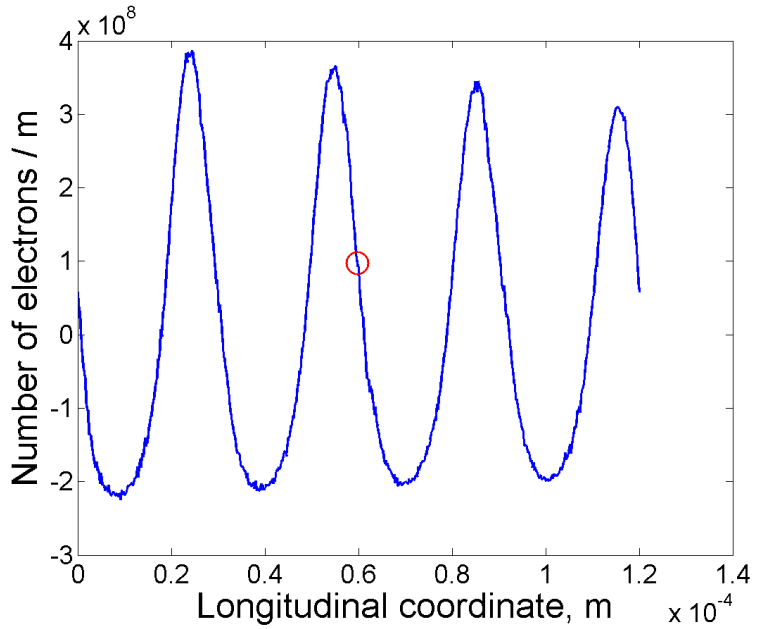


(b) Signal

Longitudinal density distribution in kicker, 0.6 m

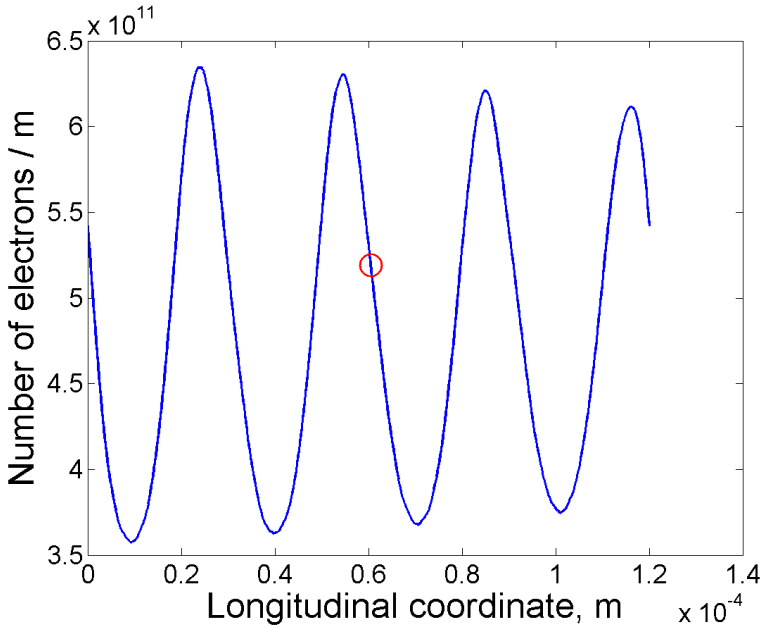


(a) Background

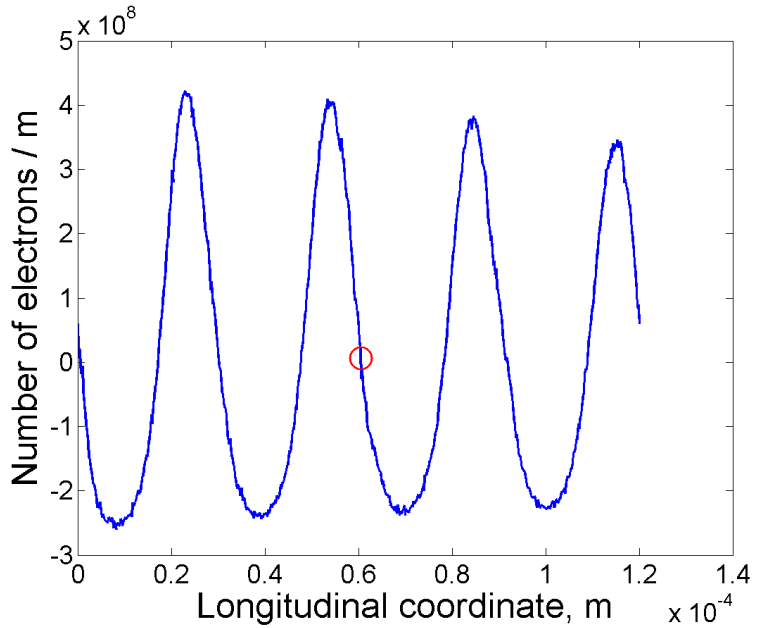


(b) Signal

Longitudinal density distribution in kicker, 1.2 m

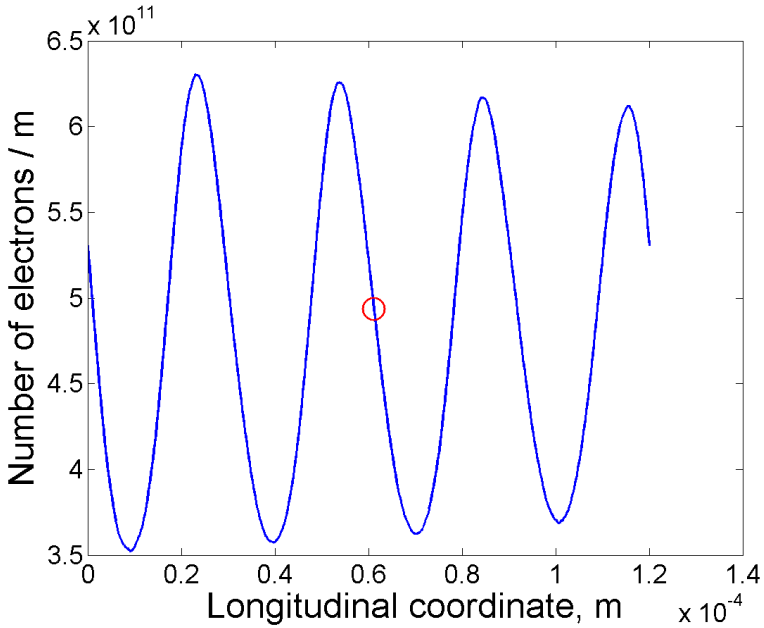


(a) Background

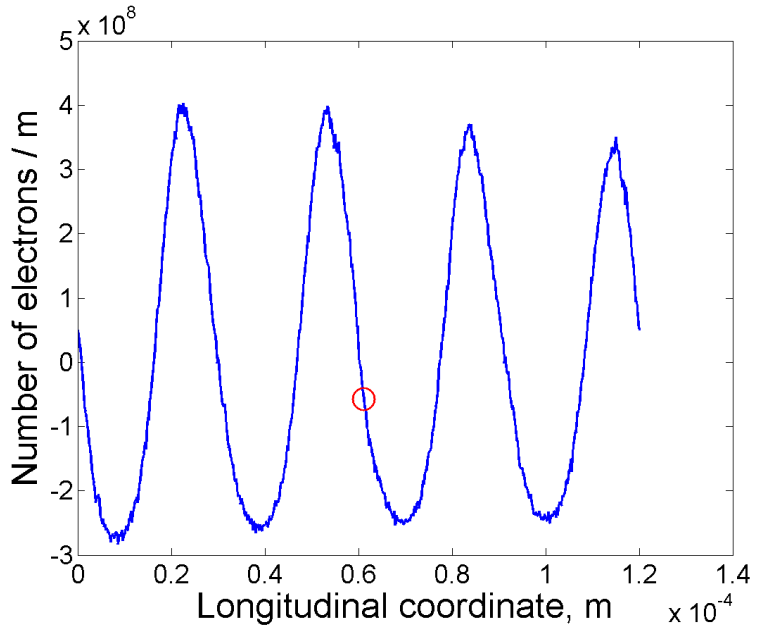


(b) Signal

Longitudinal density distribution in kicker, 1.8 m

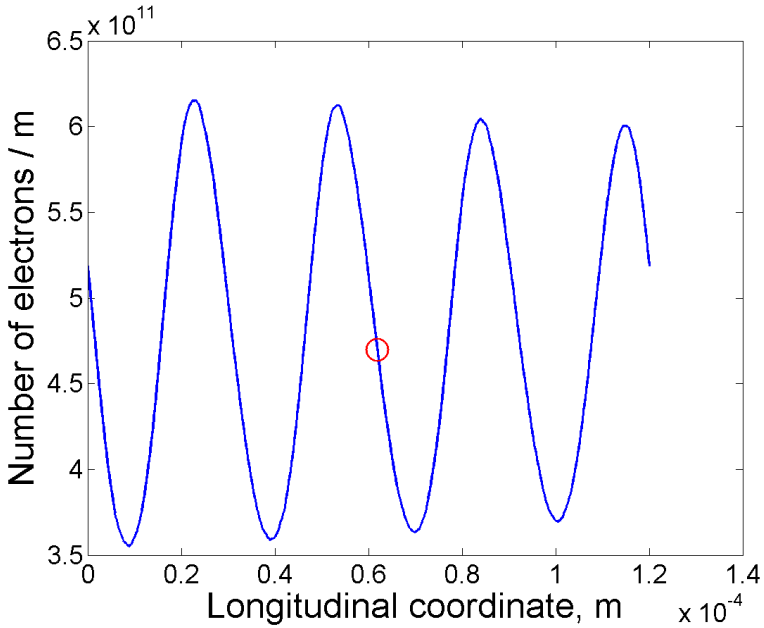


(a) Background

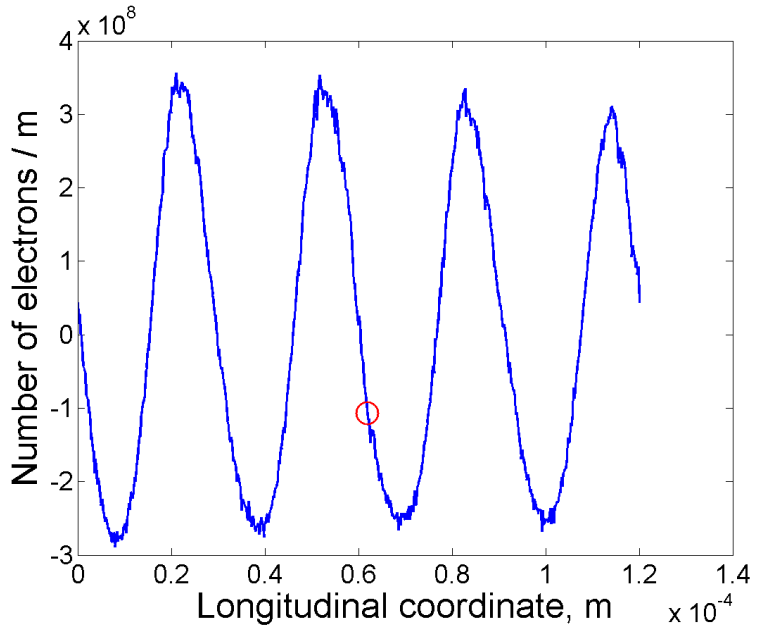


(b) Signal

Longitudinal density distribution in kicker, 2.4 m

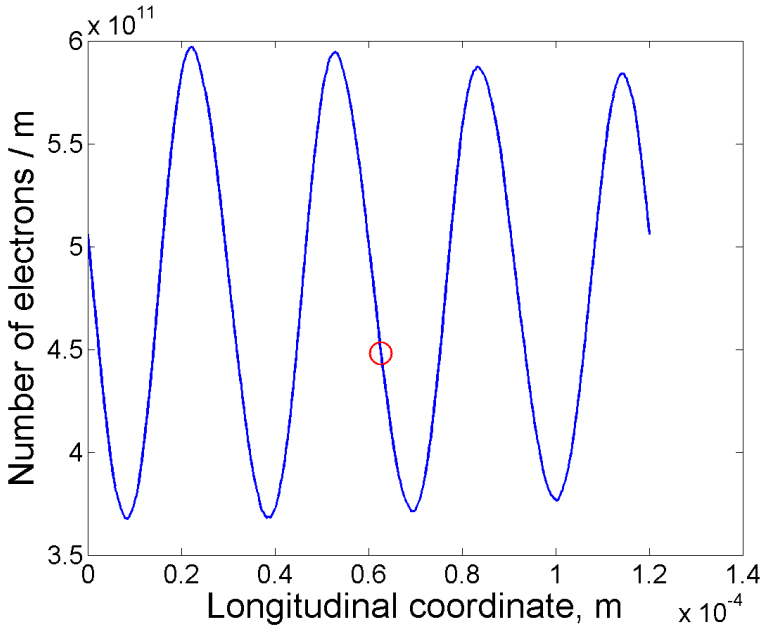


(a) Background

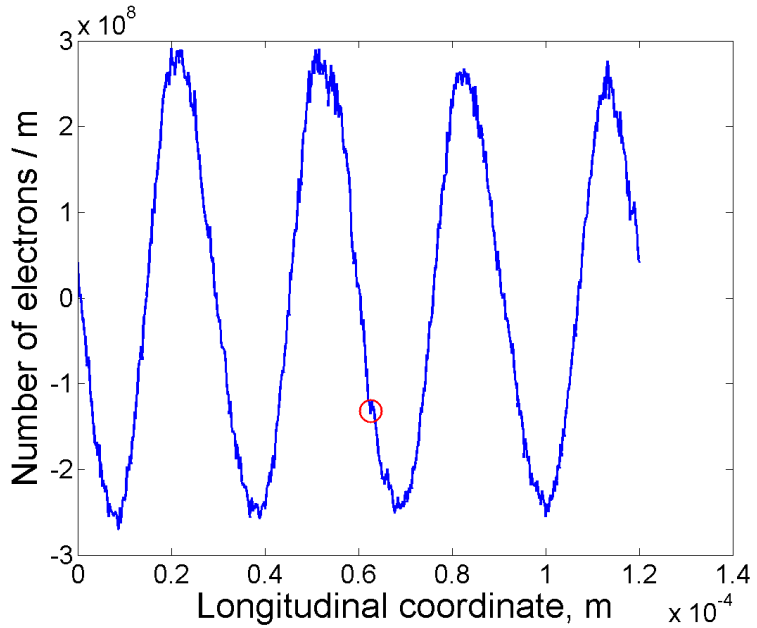


(b) Signal

Longitudinal density distribution in kicker, 3 m

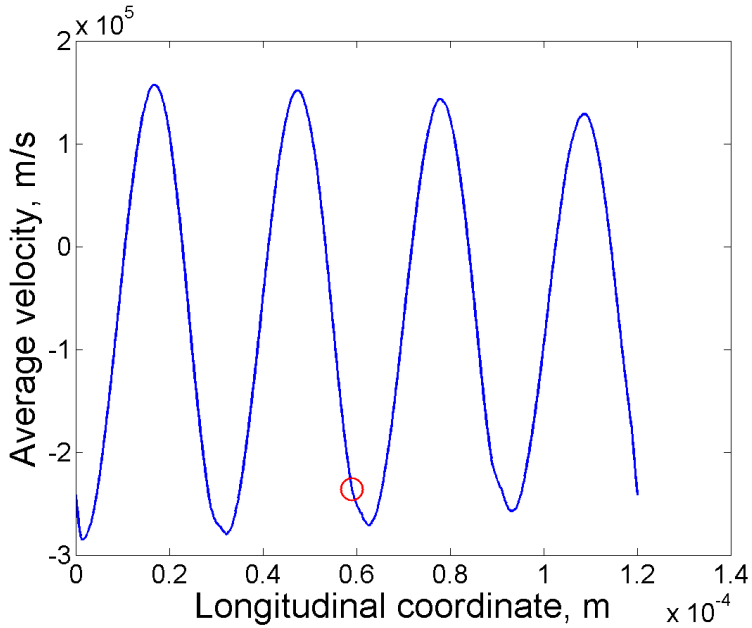


(a) Background

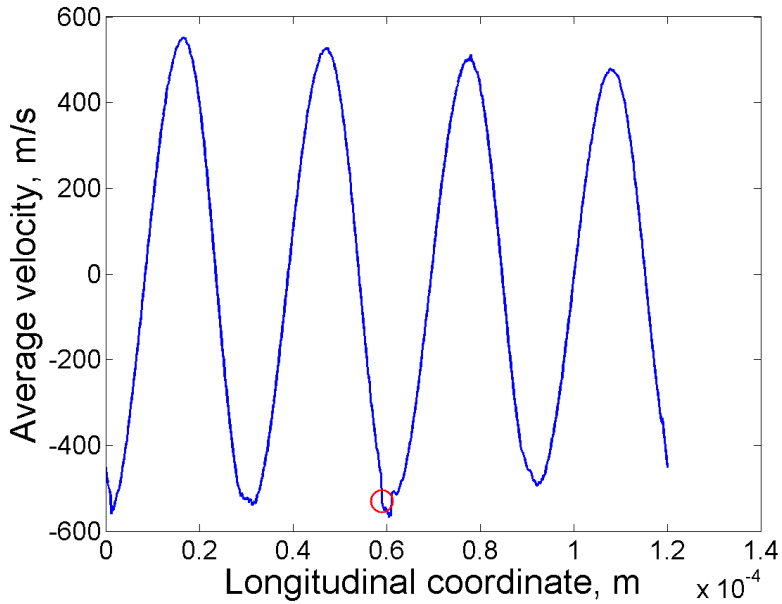


(b) Signal

Longitudinal velocity distribution in kicker, 0 m

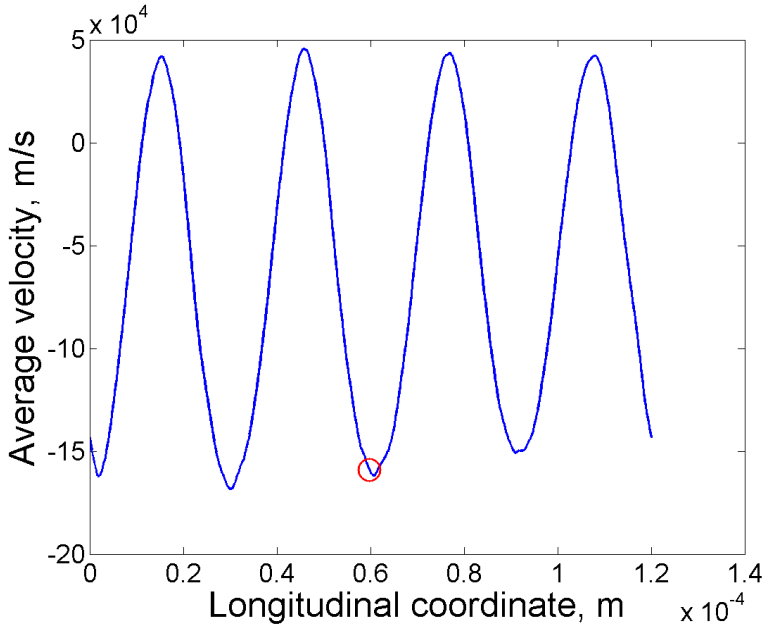


(a) Background

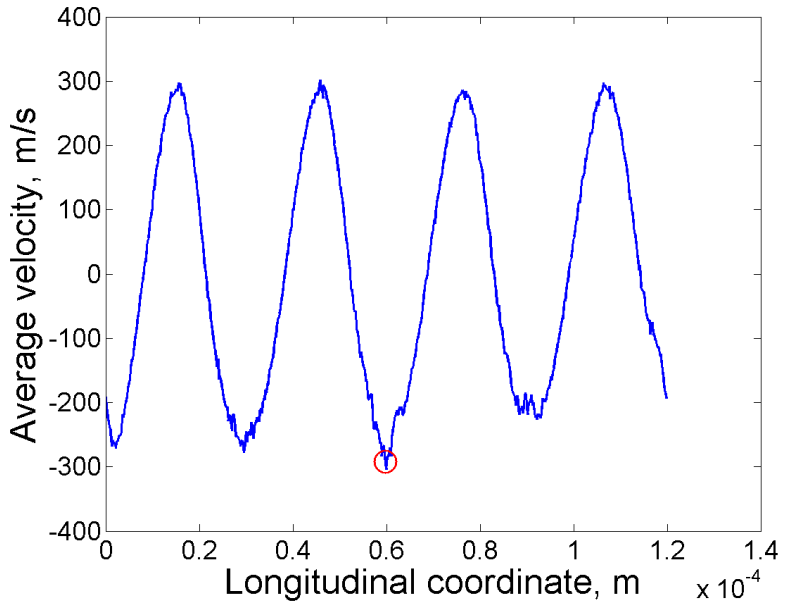


(b) Signal

Longitudinal velocity distribution in kicker, 0.6 m

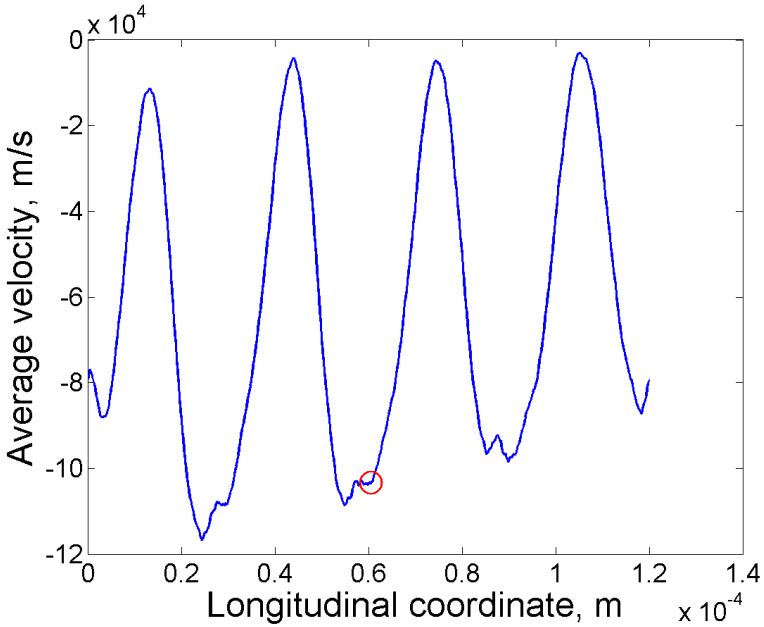


(a) Background

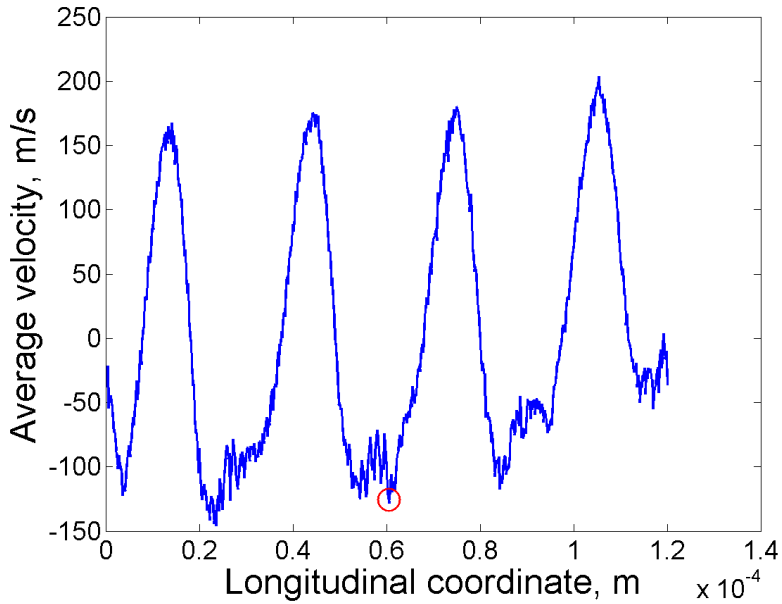


(b) Signal

Longitudinal velocity distribution in kicker, 1.2 m

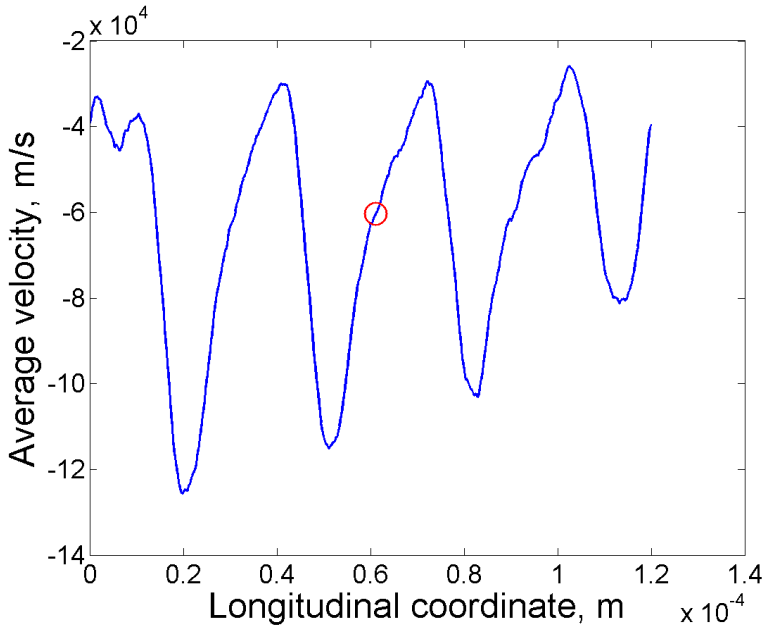


(a) Background

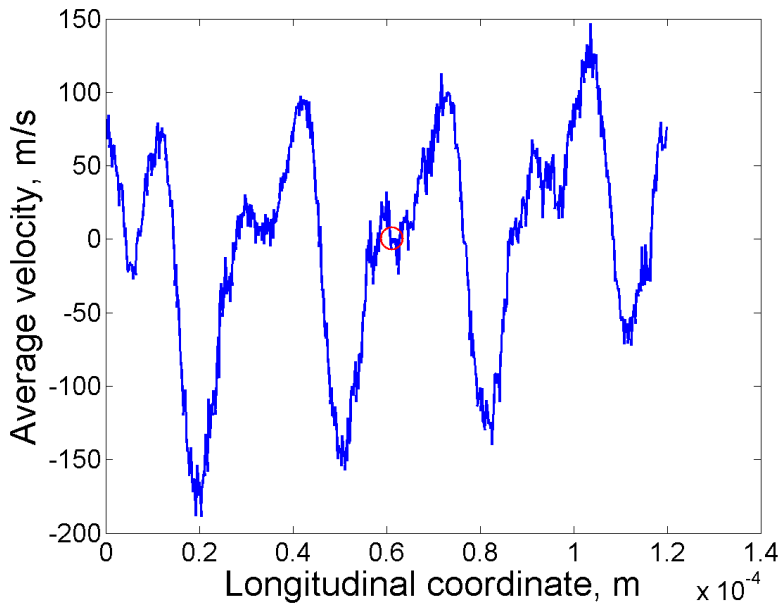


(b) Signal

Longitudinal velocity distribution in kicker, 1.8 m

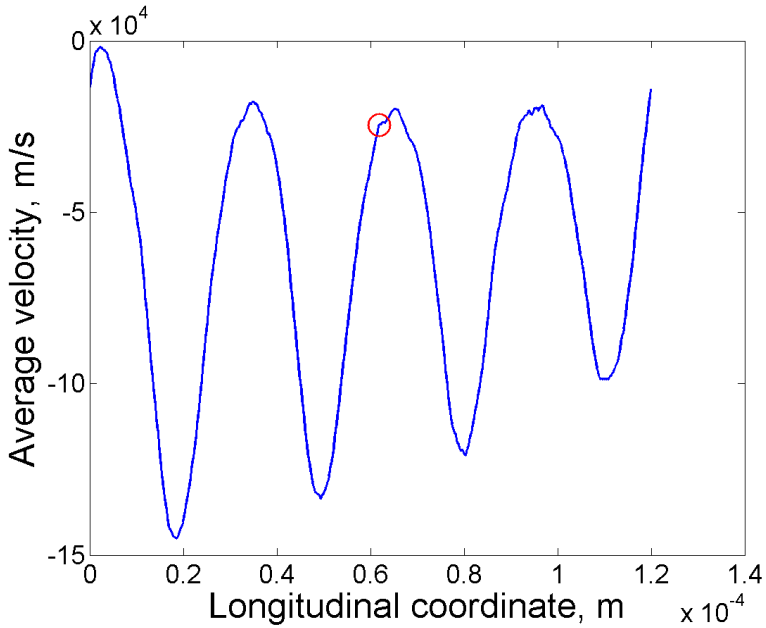


(a) Background

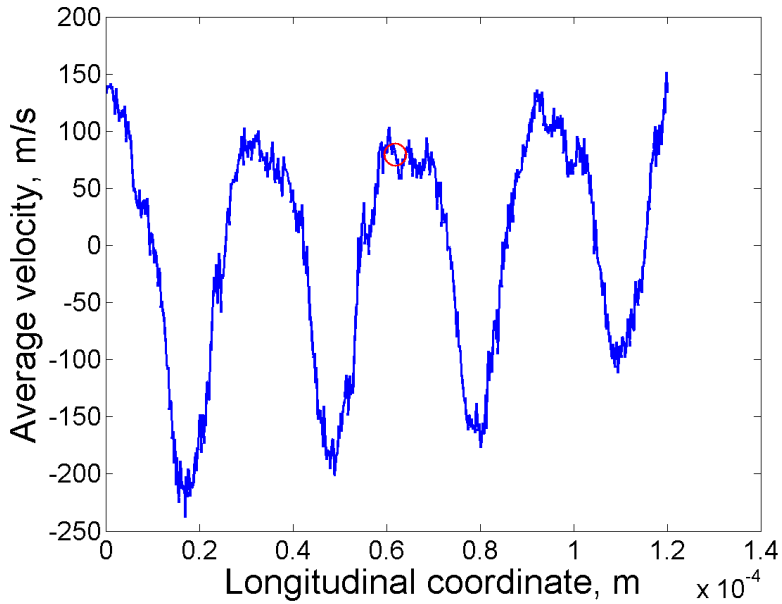


(b) Signal

Longitudinal velocity distribution in kicker, 2.4 m

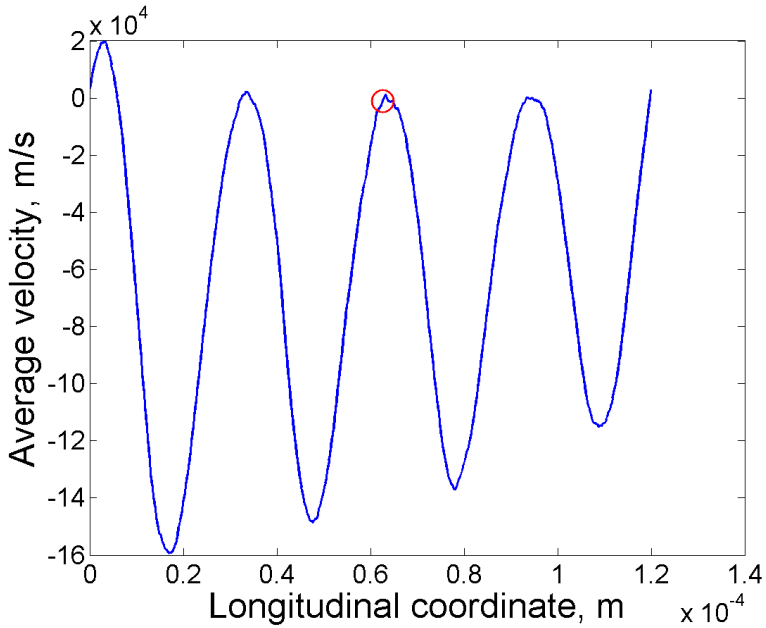


(a) Background

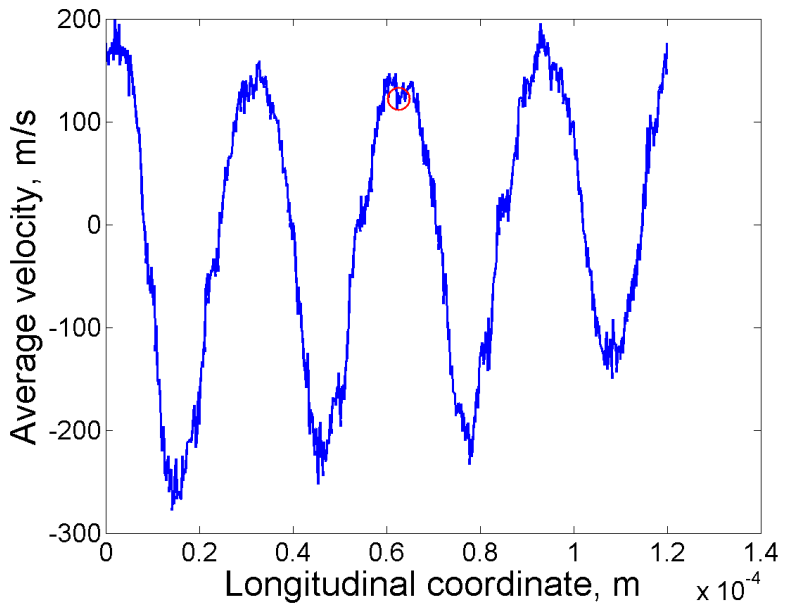


(b) Signal

Longitudinal velocity distribution in kicker, 3 m

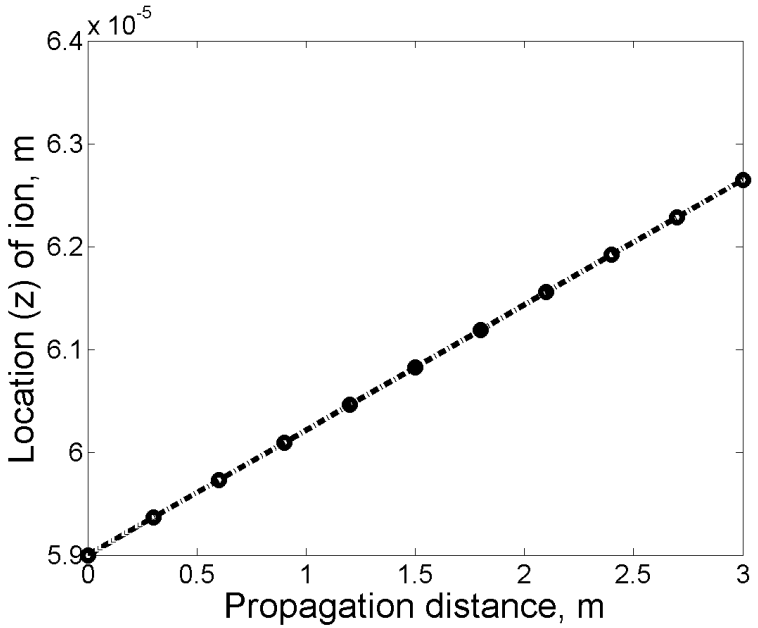


(a) Background

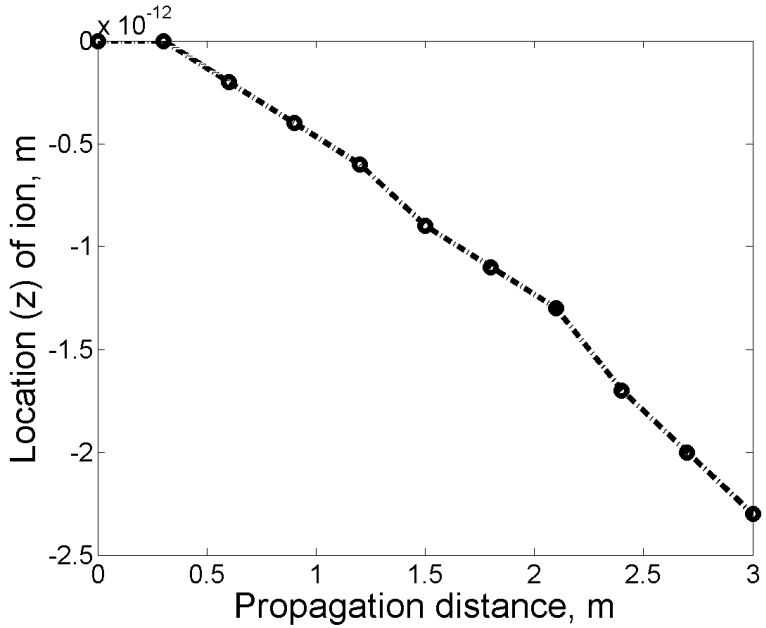


(b) Signal

Ion's position

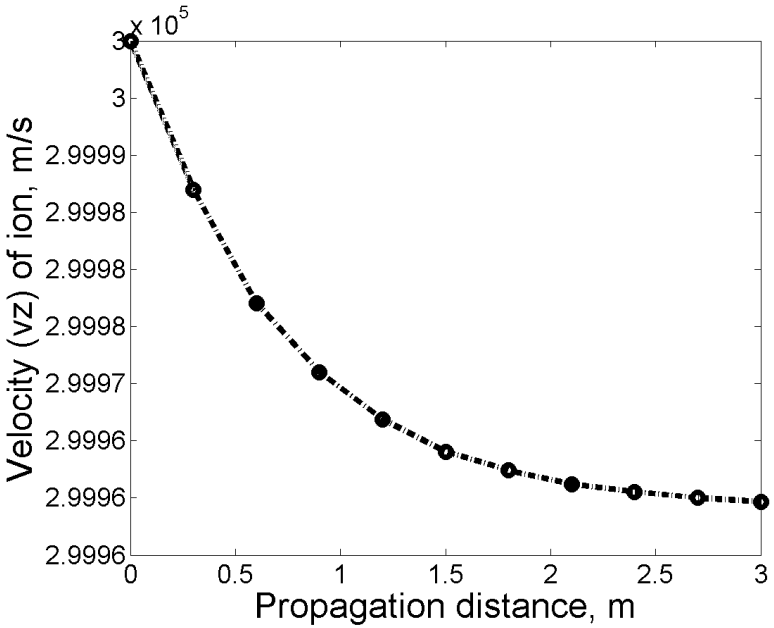


(a) Background

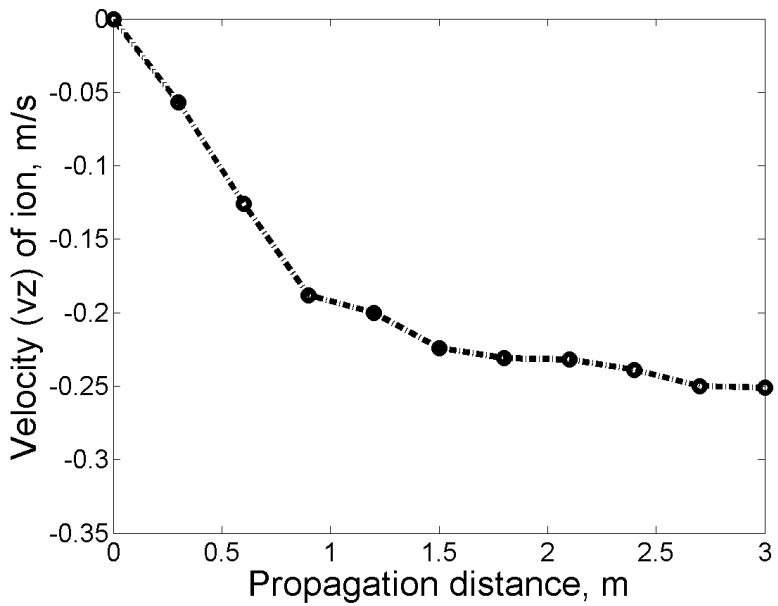


(b) Signal

Ion's velocity



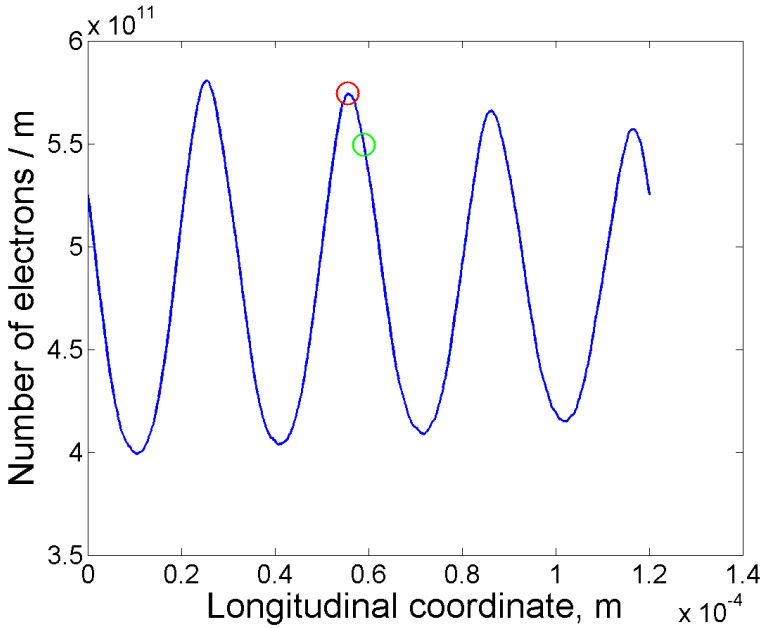
(a) Background



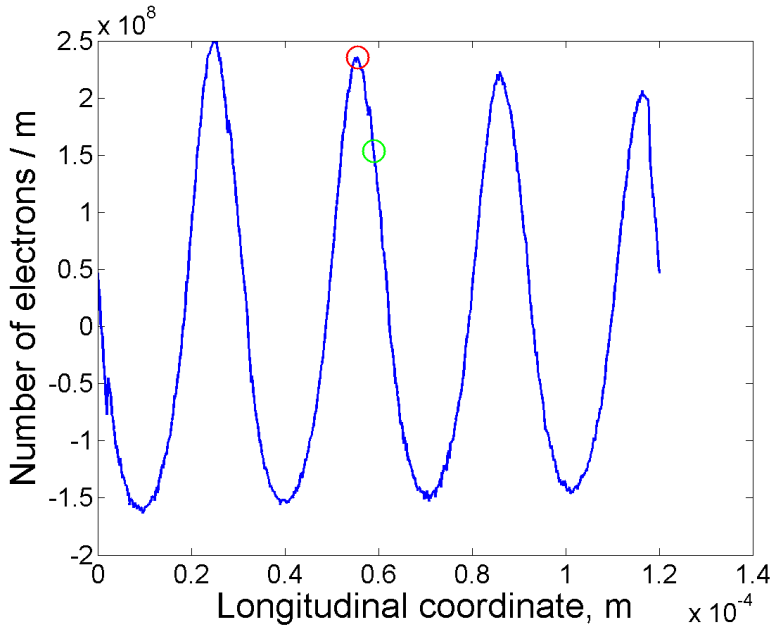
(b) Signal

- Instead of putting real ions in the kicker, set several detecting points, given initial positions and velocities.
- These points are ghost particles with zero charge, and are stationary (with zero initial velocity) or follow straight motion (with non-zero initial velocities).
- Read the field forces on these points at each step and make time integral.

Longitudinal density distribution in kicker, 0 m

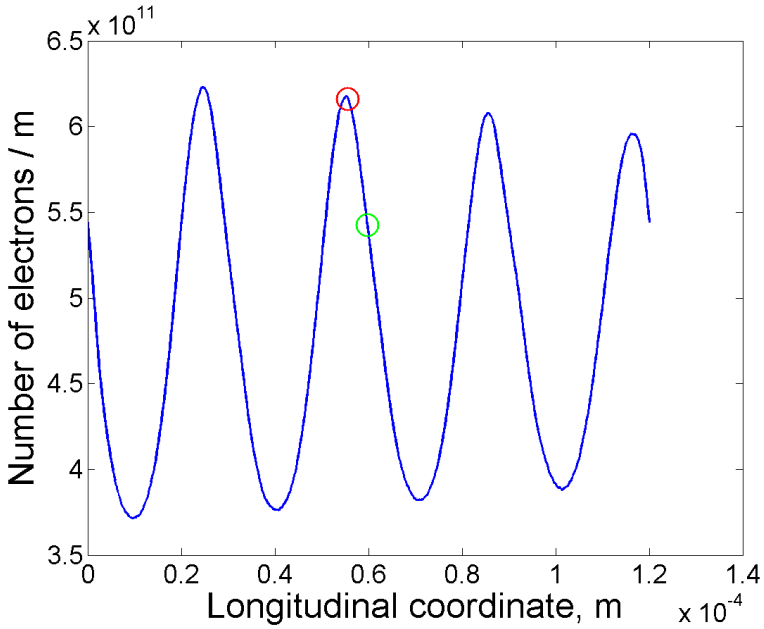


(a) Background

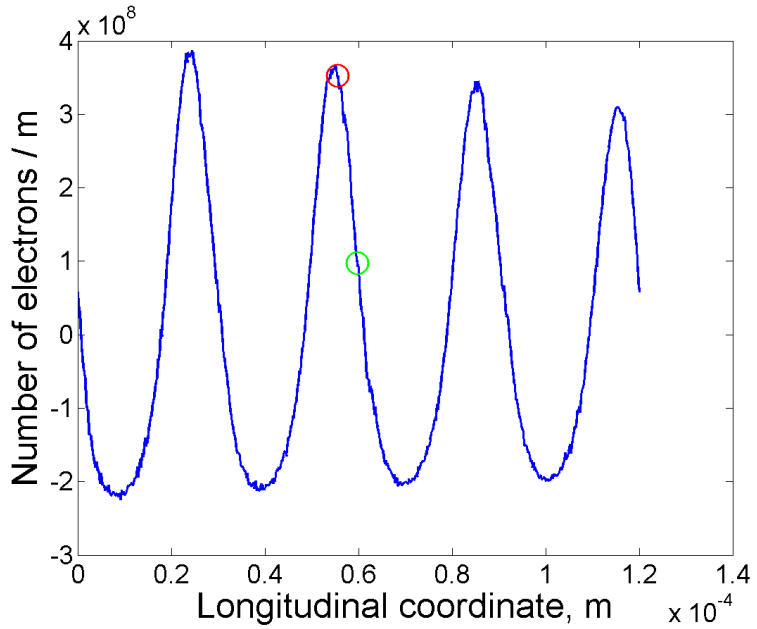


(b) Signal

Longitudinal density distribution in kicker, 0.6 m

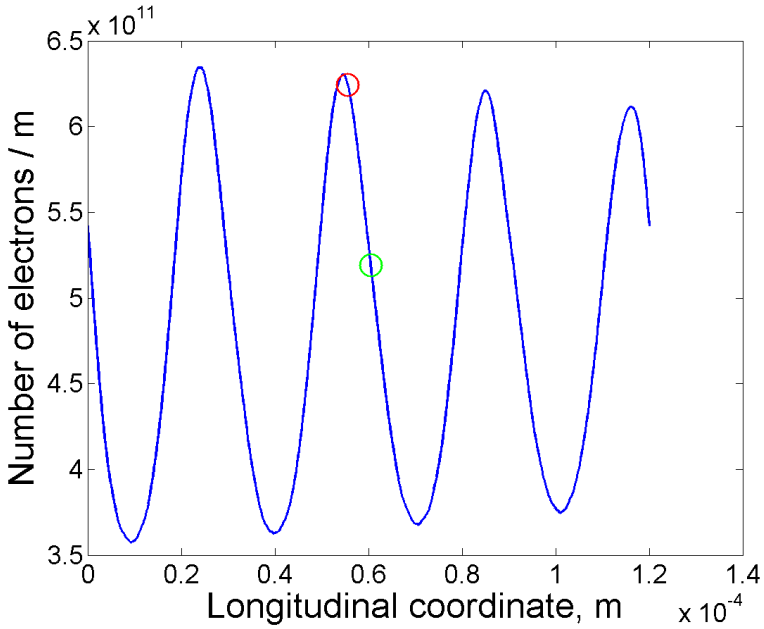


(a) Background

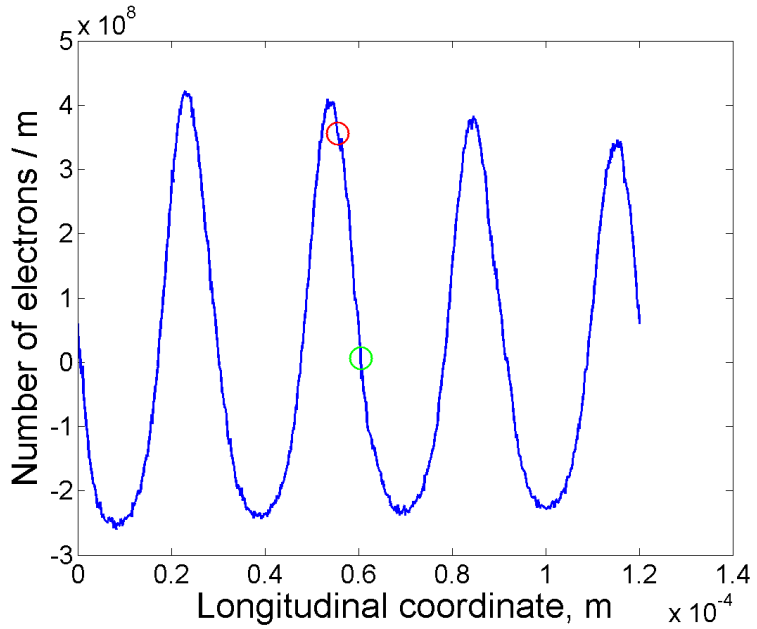


(b) Signal

Longitudinal density distribution in kicker, 1.2 m

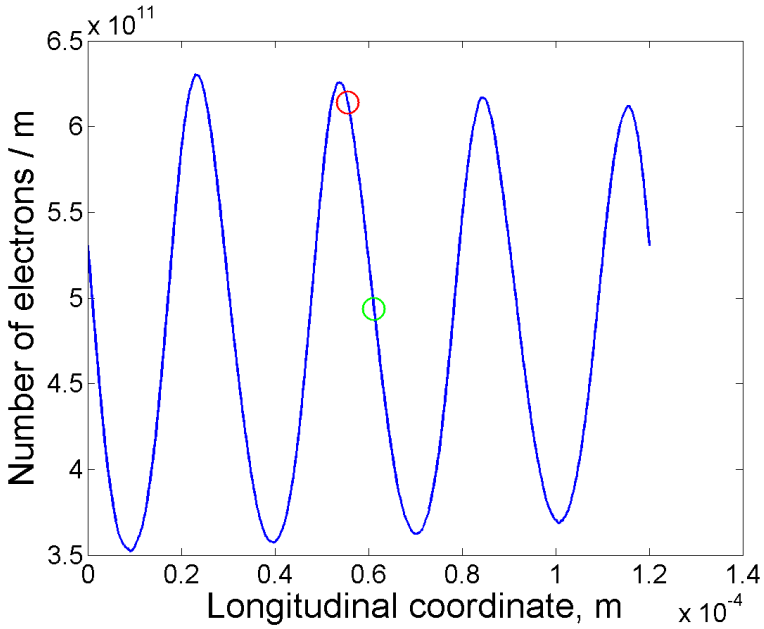


(a) Background

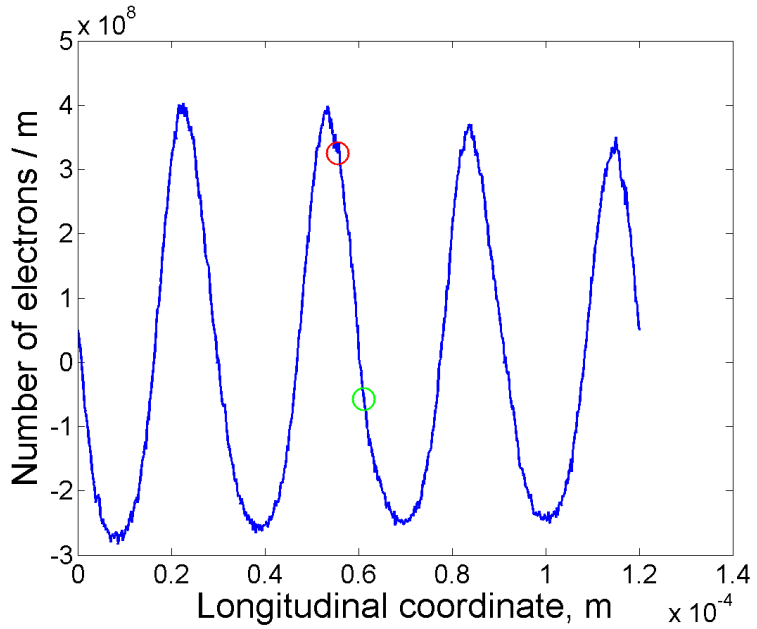


(b) Signal

Longitudinal density distribution in kicker, 1.8 m

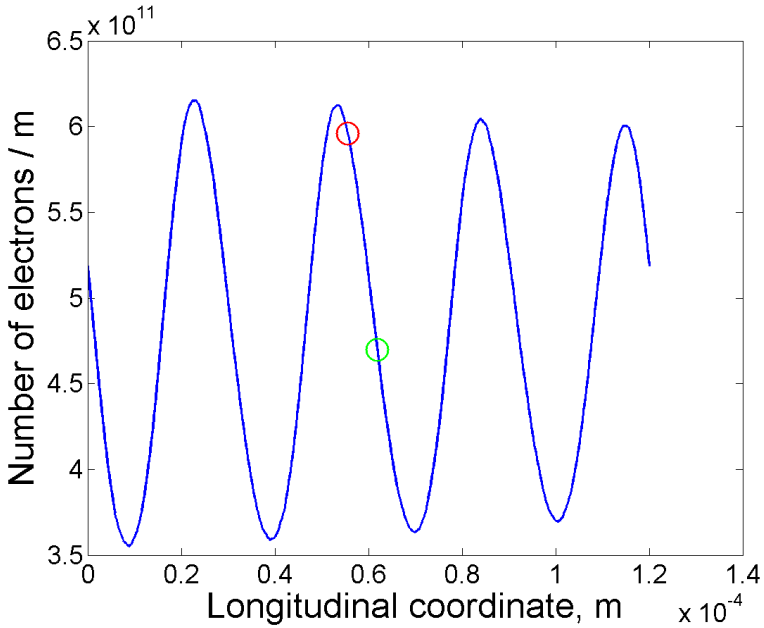


(a) Background

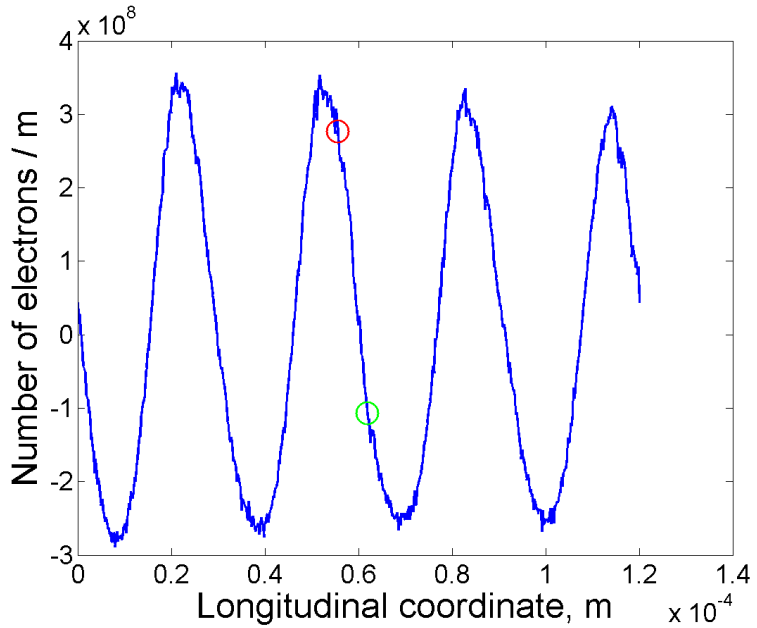


(b) Signal

Longitudinal density distribution in kicker, 2.4 m

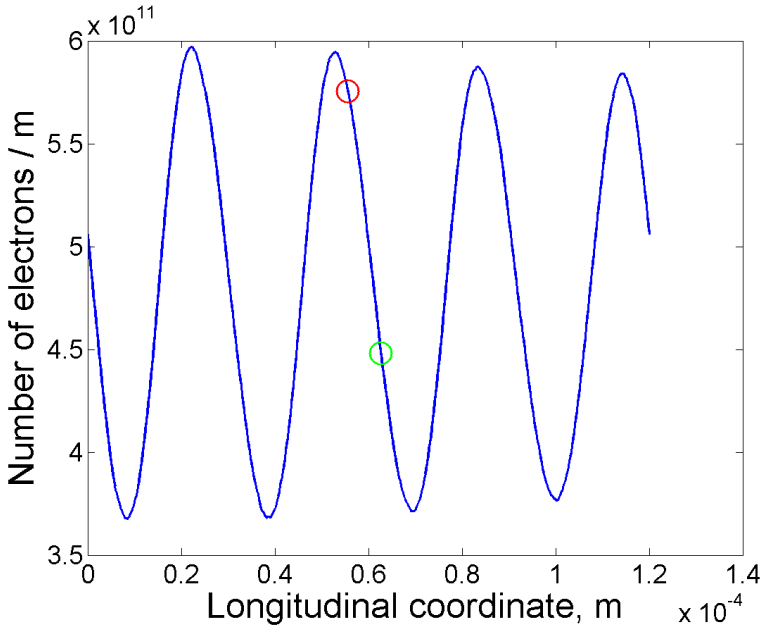


(a) Background

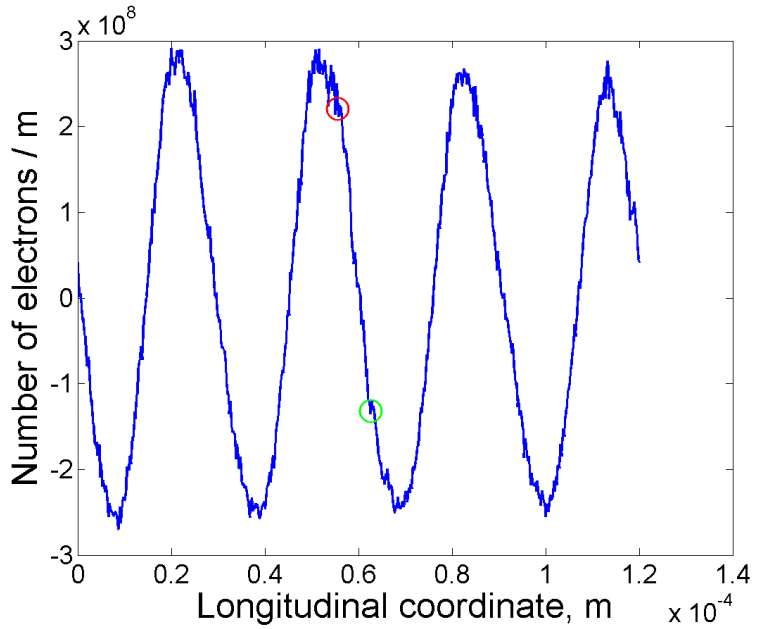


(b) Signal

Longitudinal density distribution in kicker, 3 m



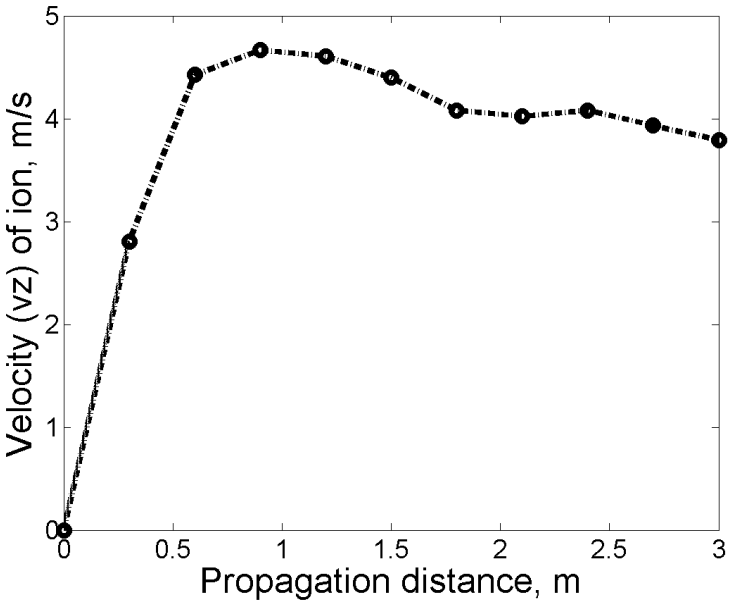
(a) Background



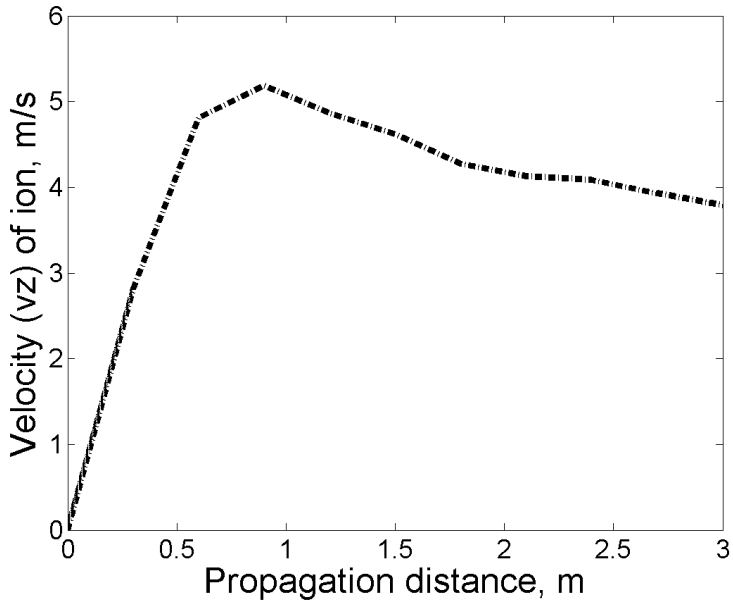
(b) Signal

- Assuming that the kick forces from the background and signal are relatively small, which do not change the ion's trajectory dramatically.
- Measurements using real ions and ghost ions give almost identical kick force from background and slightly different kick force from signal.

Background kick on stationary ion

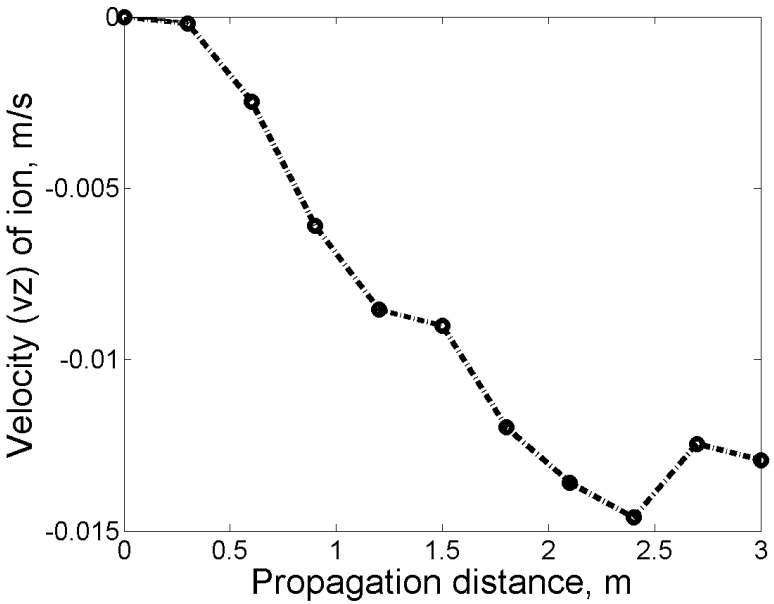


(a) Real ion

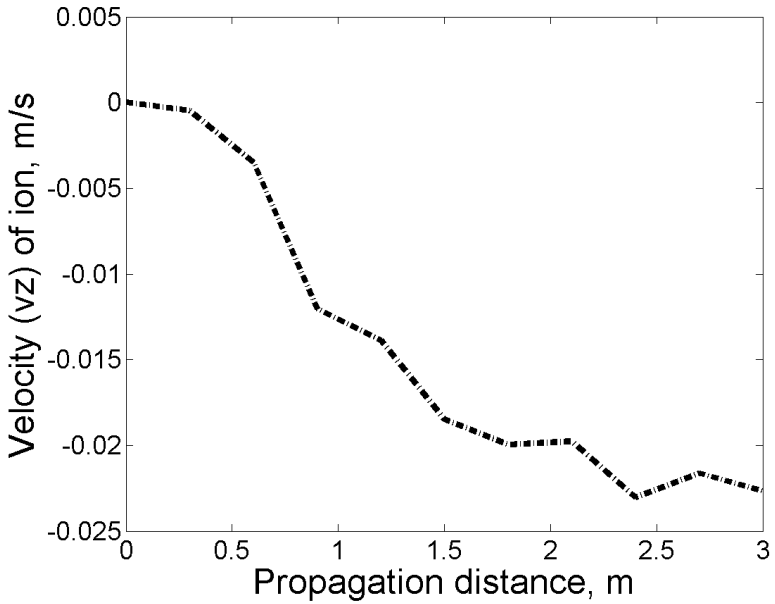


(b) Ghost ion

Signal kick on stationary ion

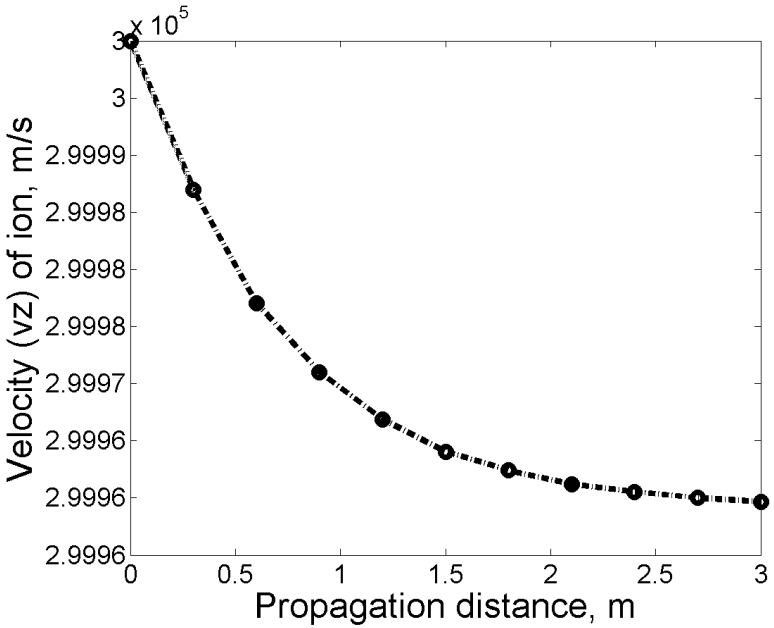


(a) Real ion

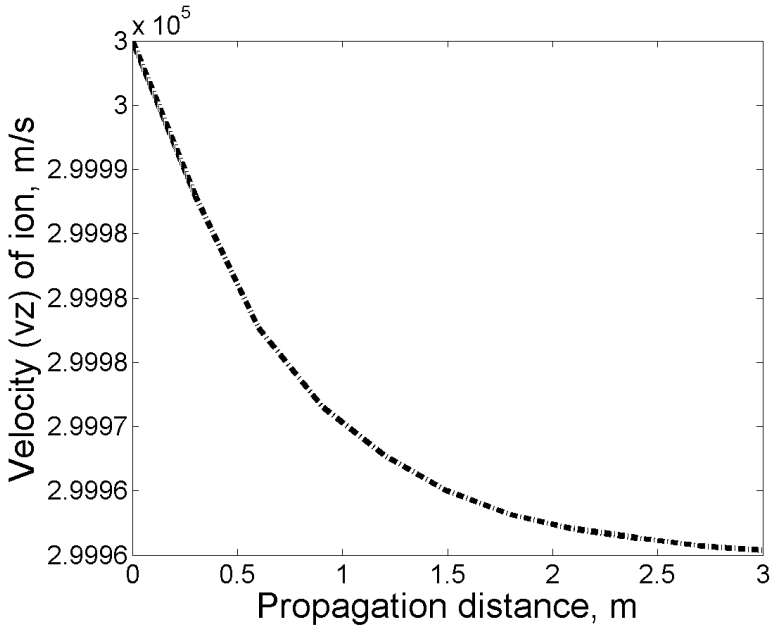


(b) Ghost ion

Background kick on moving ion

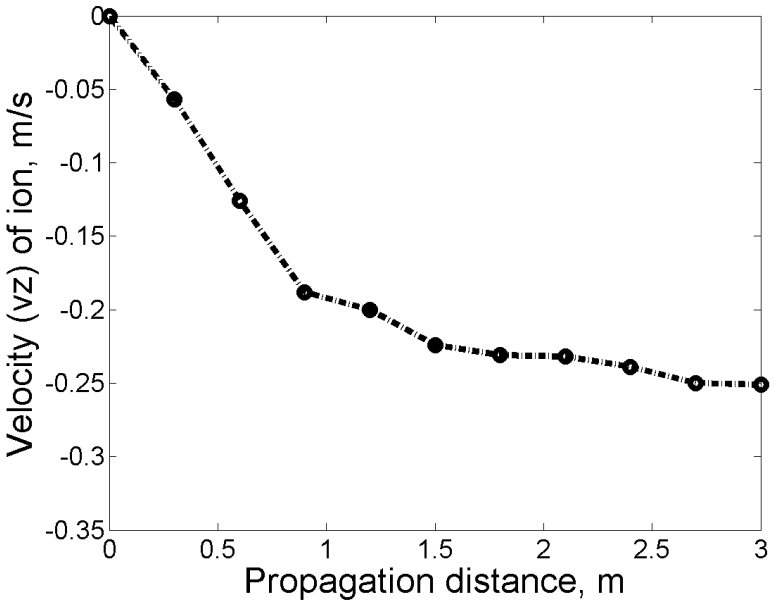


(a) Real ion

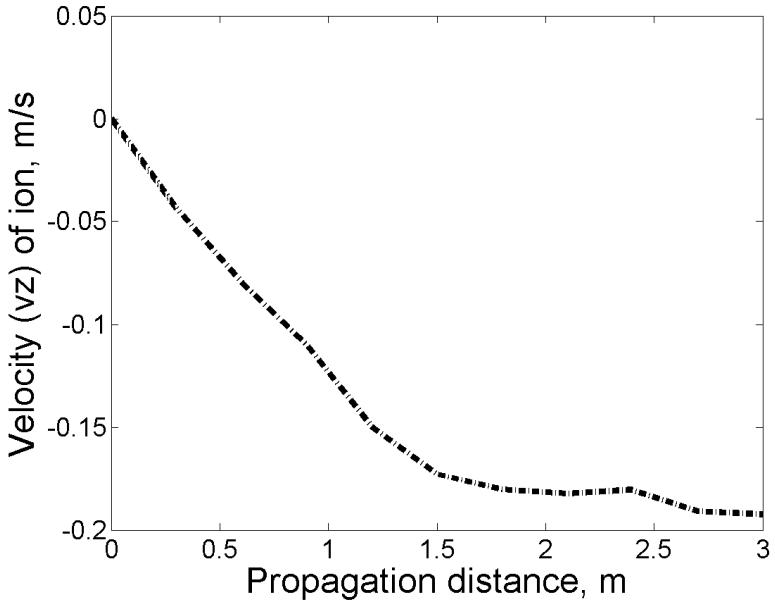


(b) Ghost ion

Signal kick on moving ion



(a) Real ion



(b) Ghost ion