Modulator and Wiggler simulations

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Numerical setting

- Domain
  - Transversal : 4e-3m ($14 \times$ *Debyelength*) open boundary
  - Longitudinal : 2e-5m ($20 \times$ *Debyelength*) periodic boundary
- Grid number : 20 per Debye length
- Electron
  - Gaussian in x, y
  - Uniform in z
- Ion
  - At center
  - At one σ

Linear focusing field

$$\vec{E_0}(x) = \frac{m_e}{e}\frac{\sigma^2}{r_0^2}(x - x_0)$$

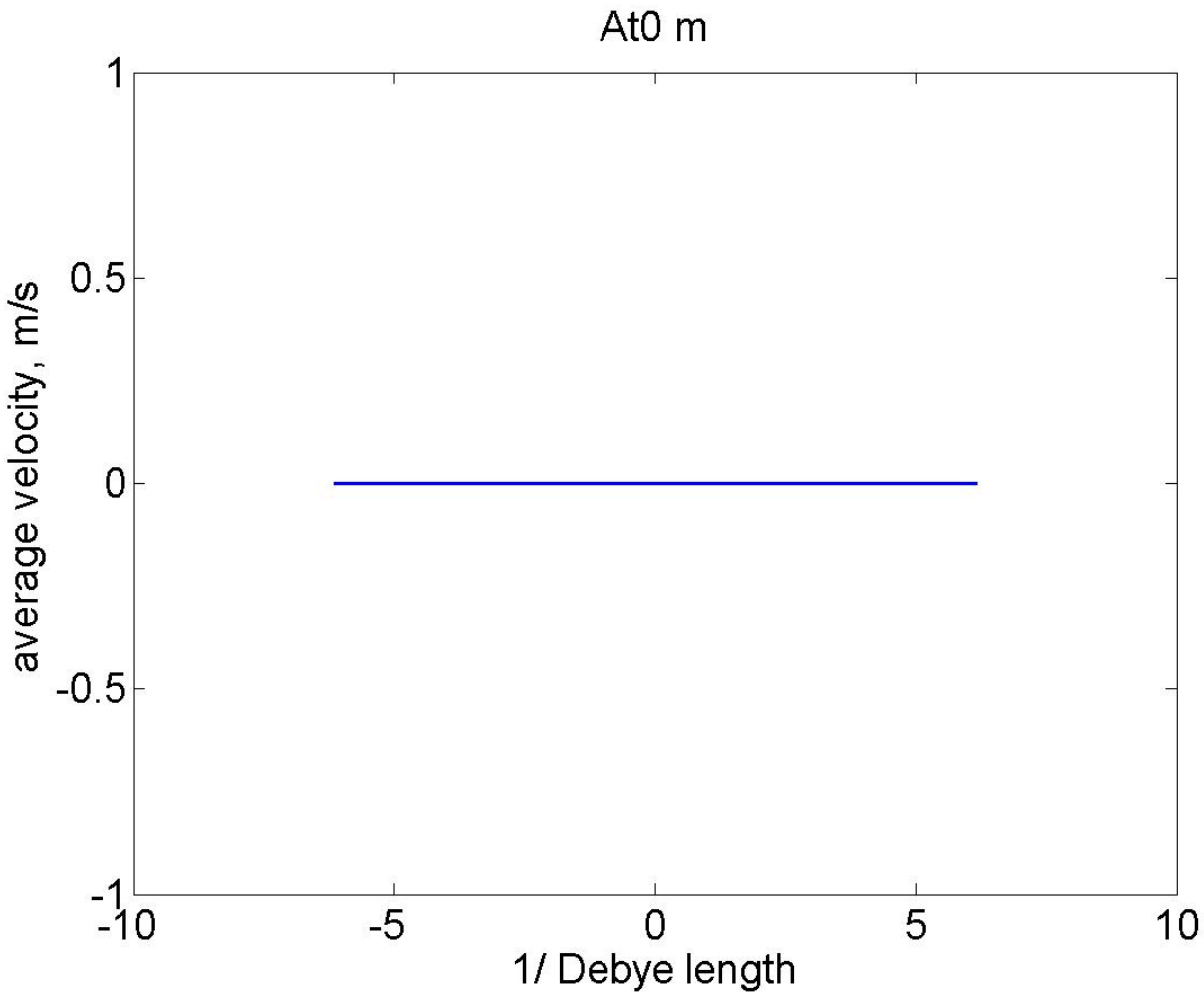
G. Bell et al., VLASOV AND PIC SIMULATIONS OF A MODULATOR SECTION FOR COHERENT ELECTRON COOLING, Proceedings of 2011 Particle Accelerator Conference, New York, NY, USA, MOP067.

Implemented as

$$\vec{E} = k\vec{x}$$

- Expansion by space charge
- Expansion by thermal velocity

Transversal velocity distribution



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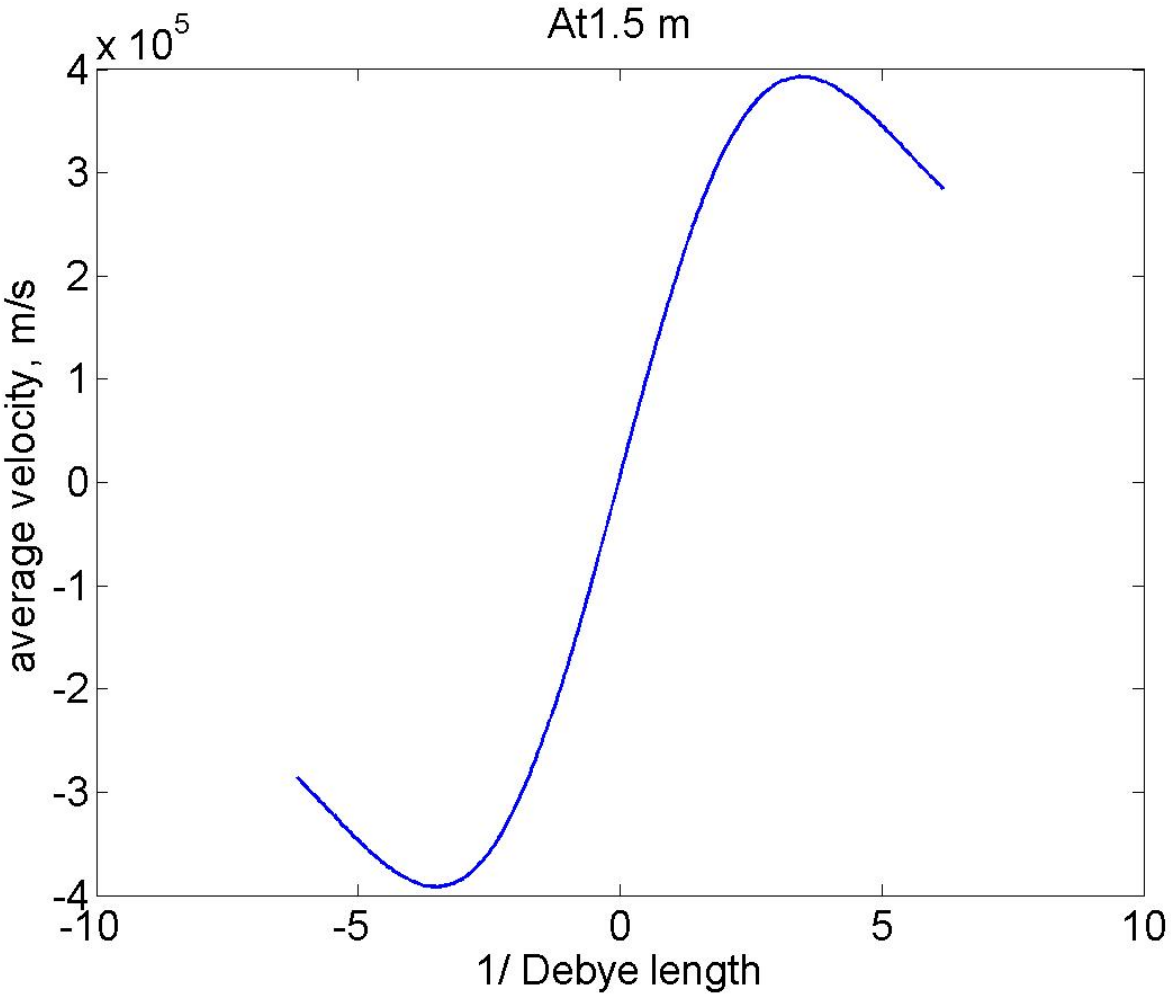

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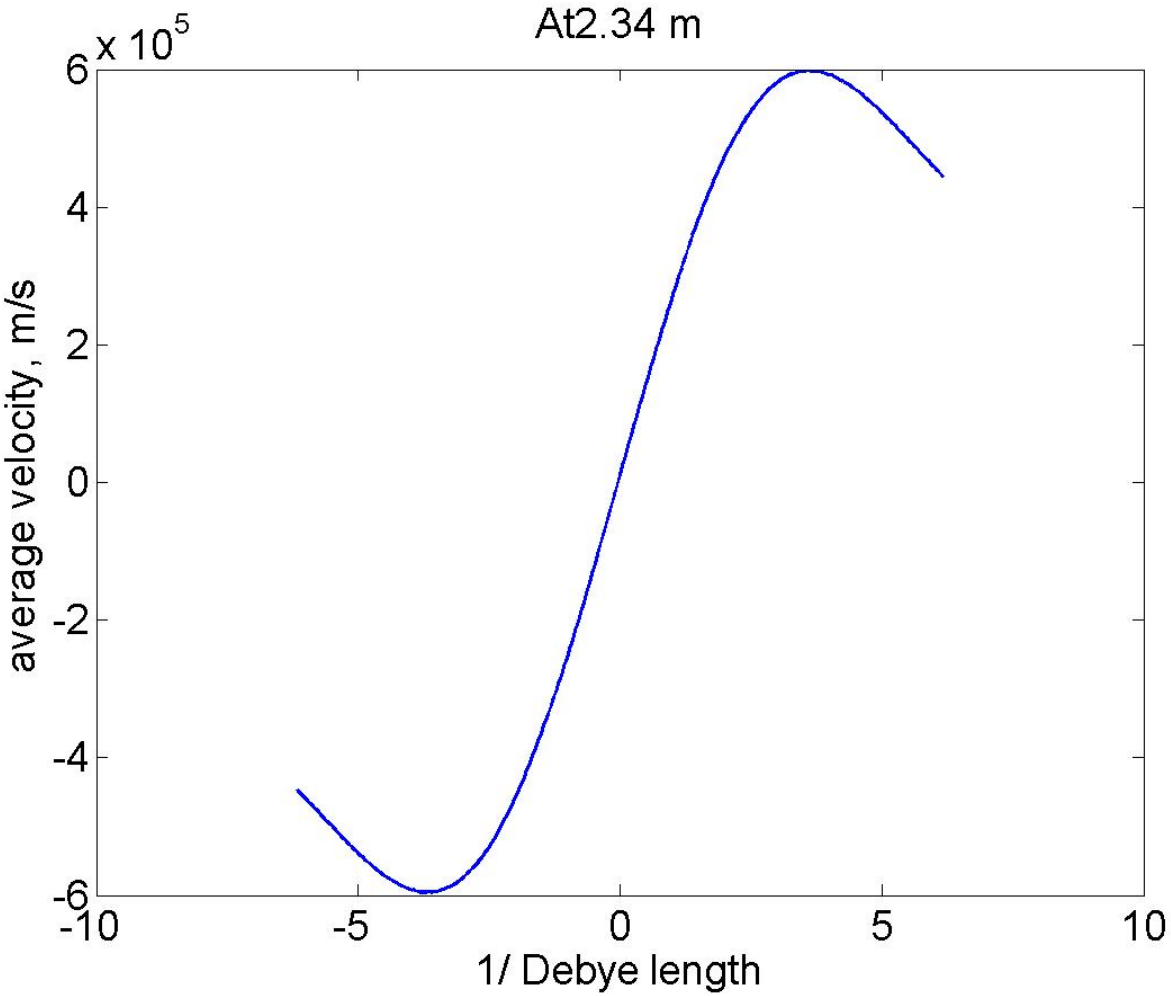
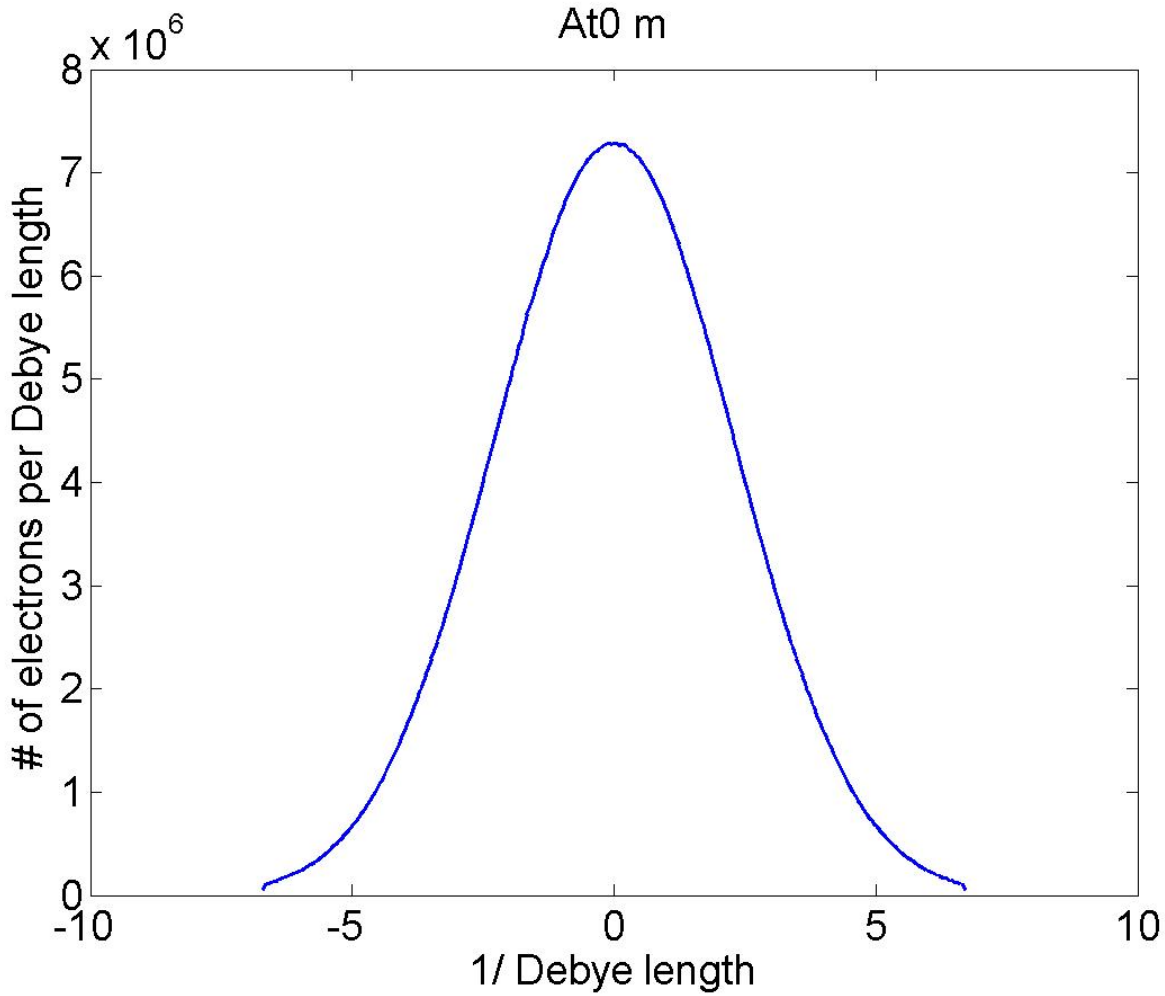


Transversal number distribution



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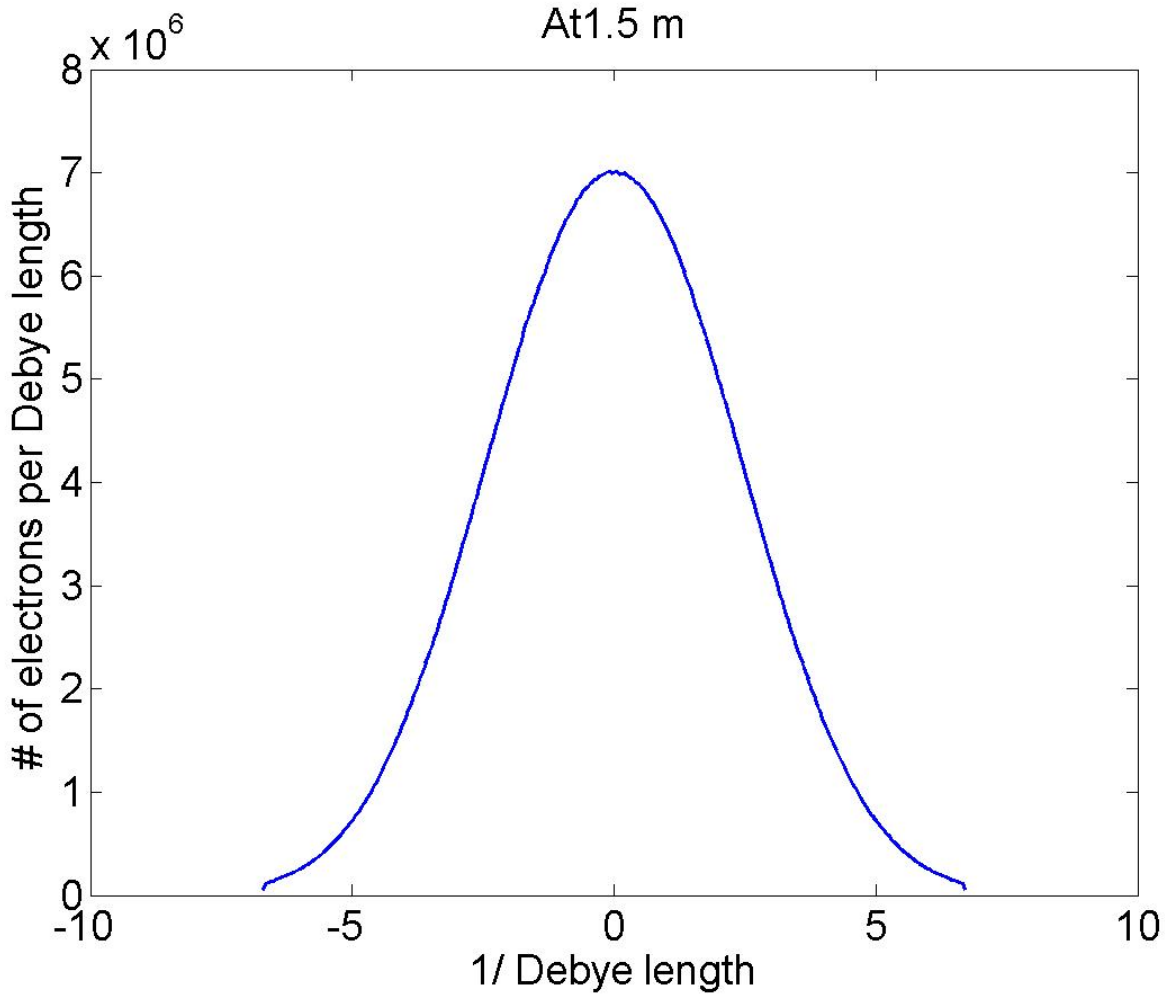

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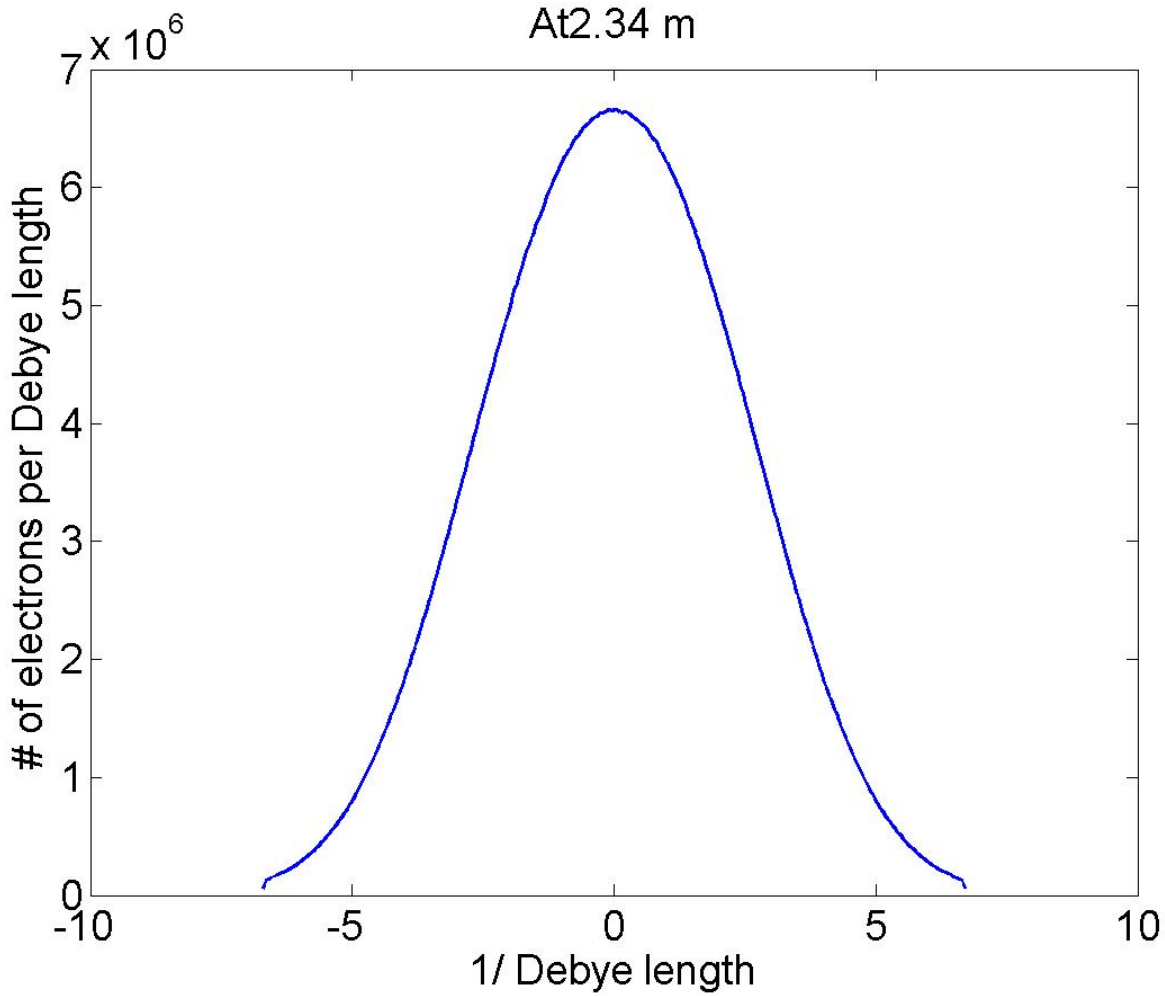
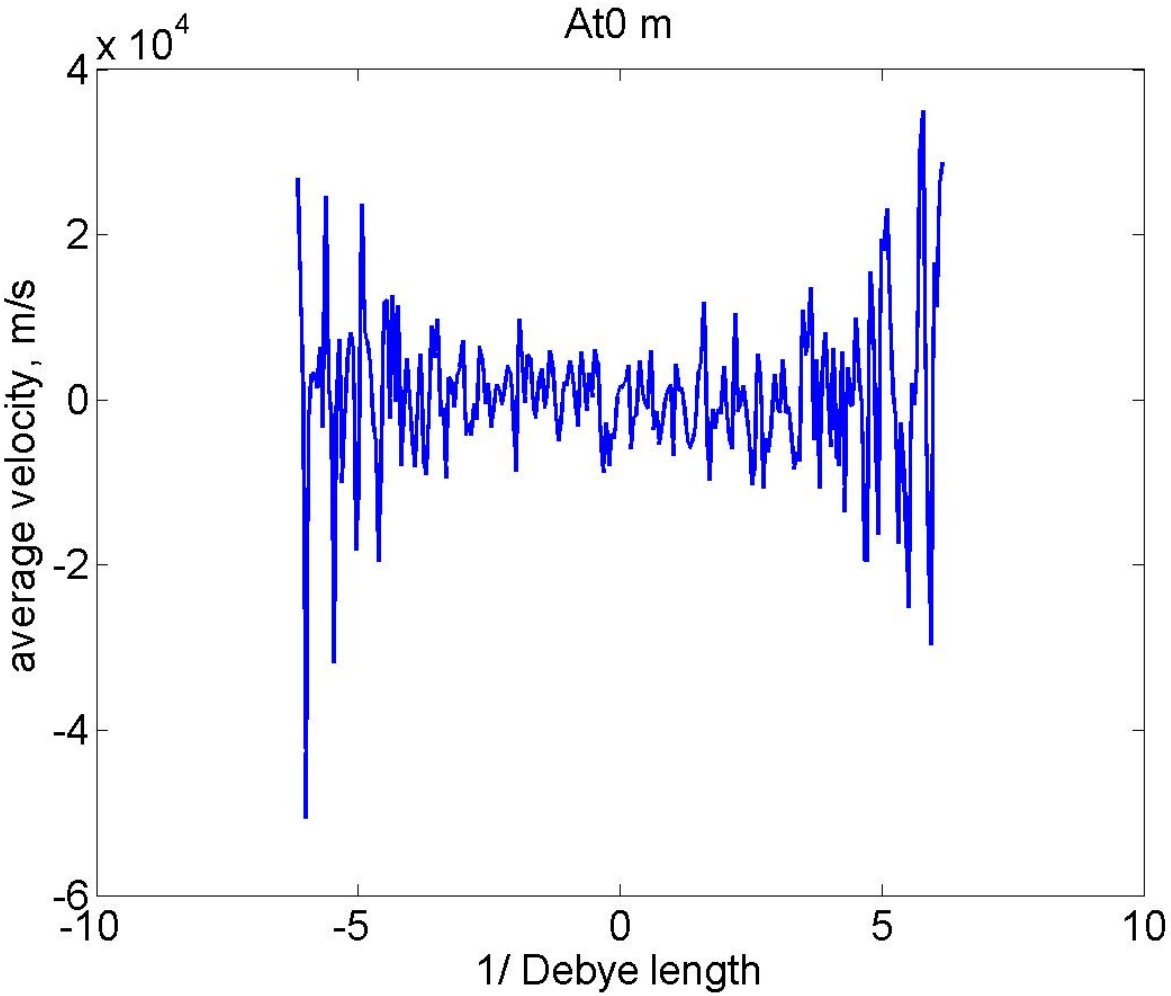


Initial Velocity Distribution

- Kappa2 velocity distribution in beam frame

  $\beta_x = \beta_y = 2e + 6m/s, \beta_z = 3e + 5m/s$

Transversal velocity distribution



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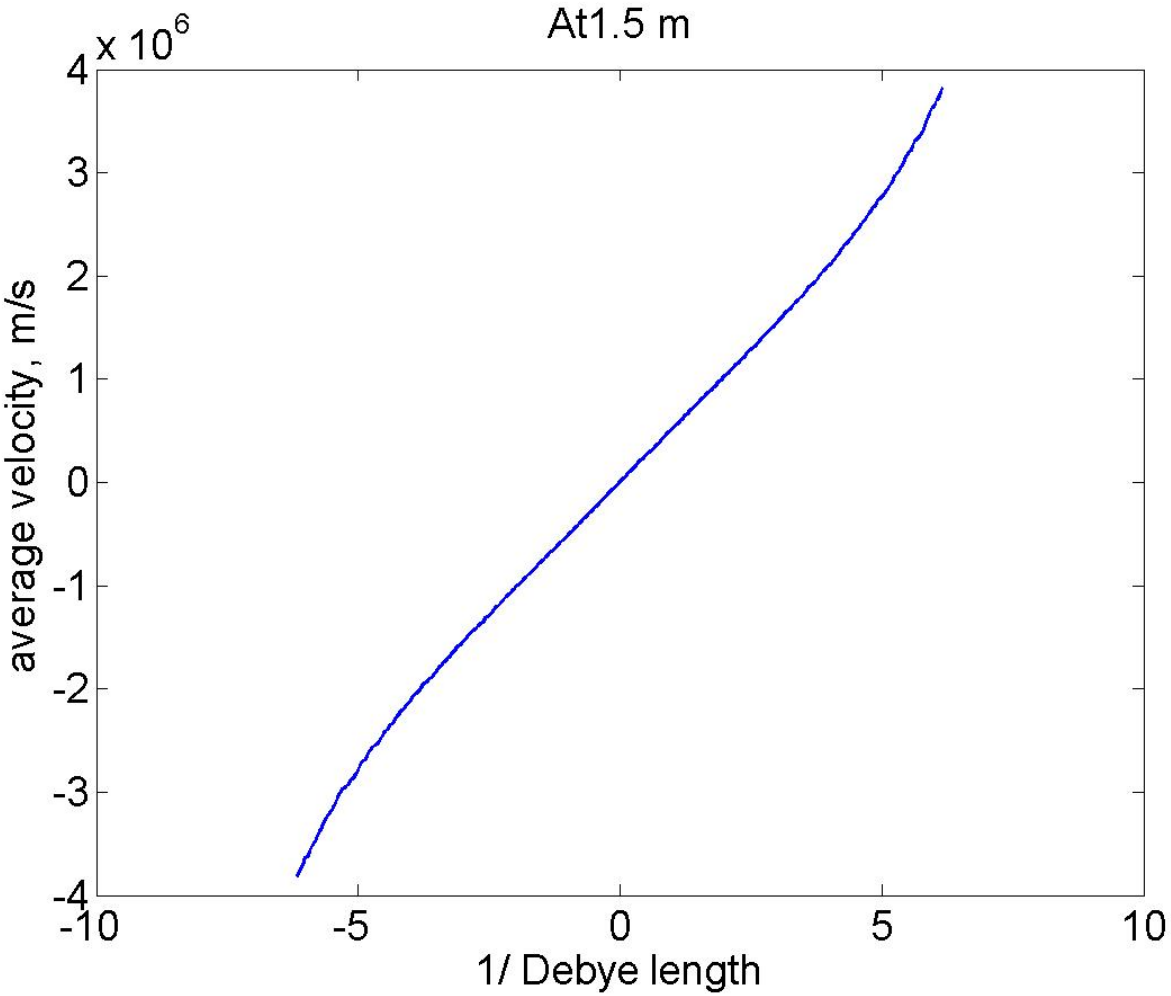

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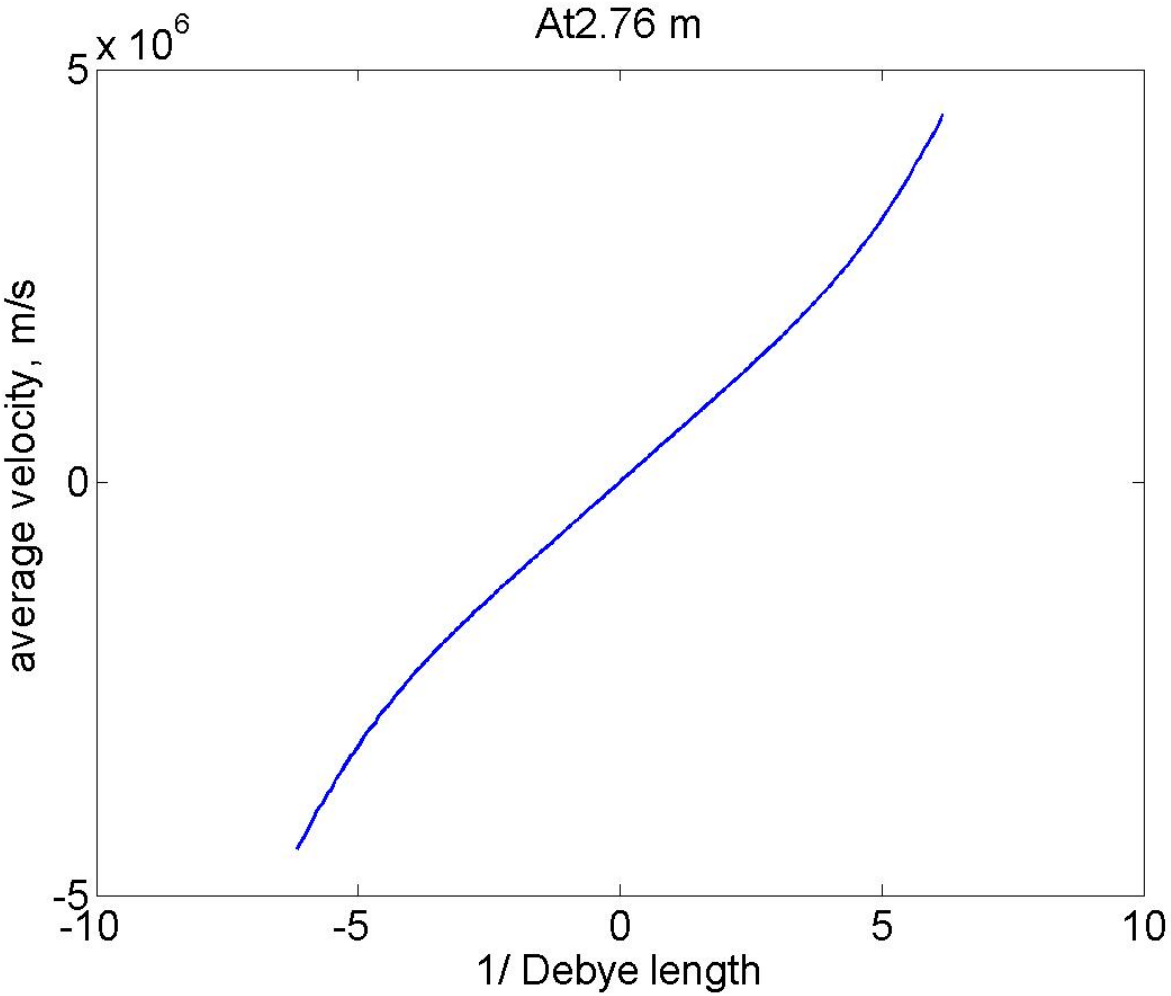
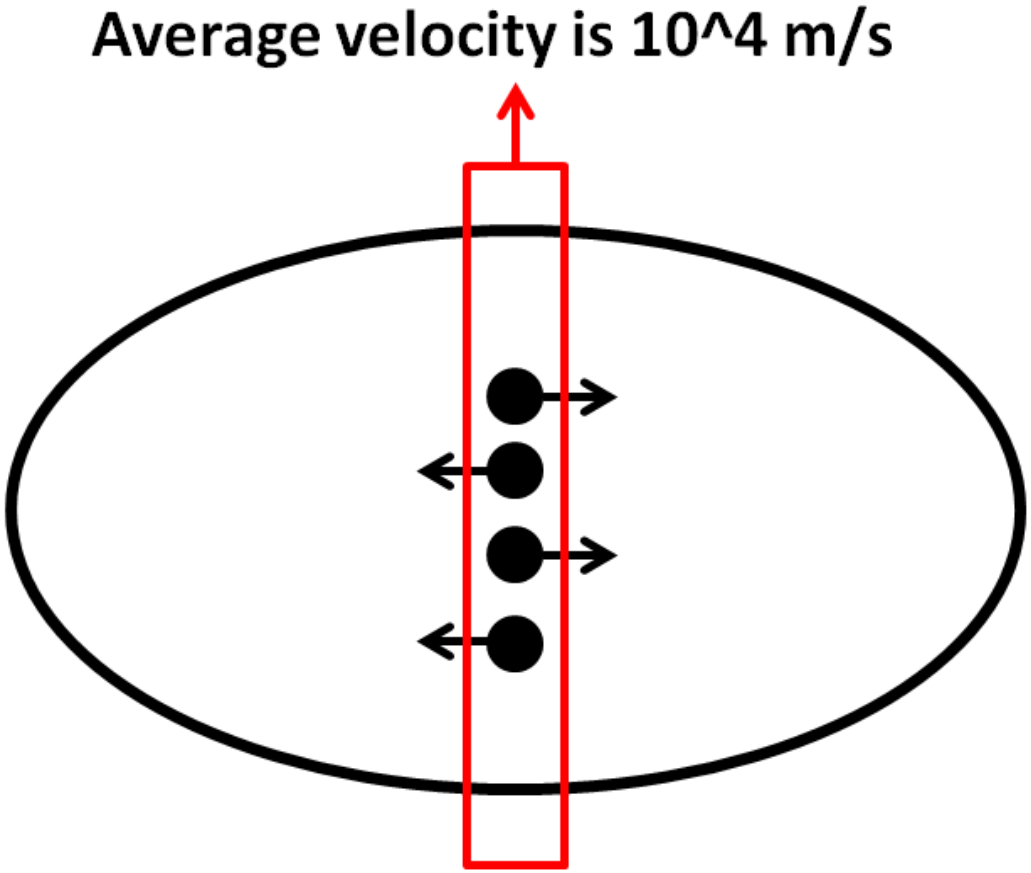
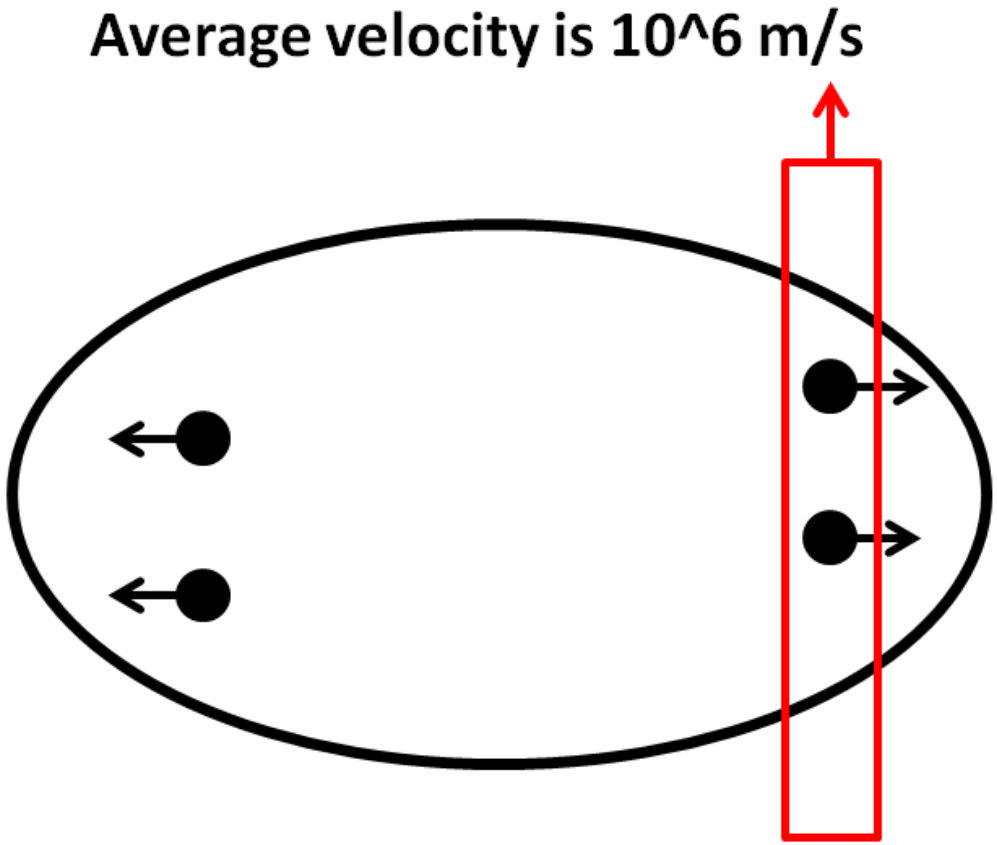


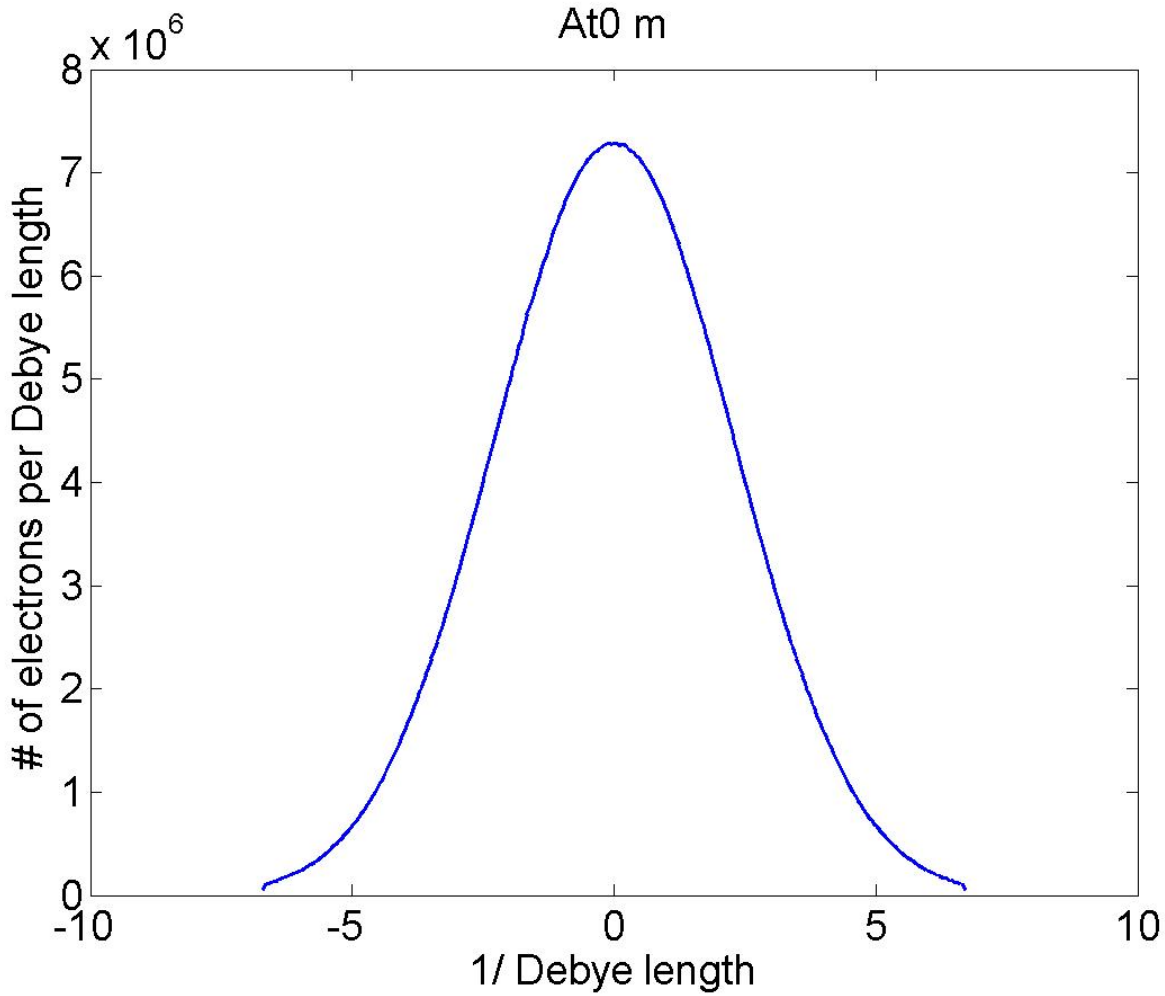
Transversal velocity (initial)



Transversal velocity (later)



Transversal number distribution



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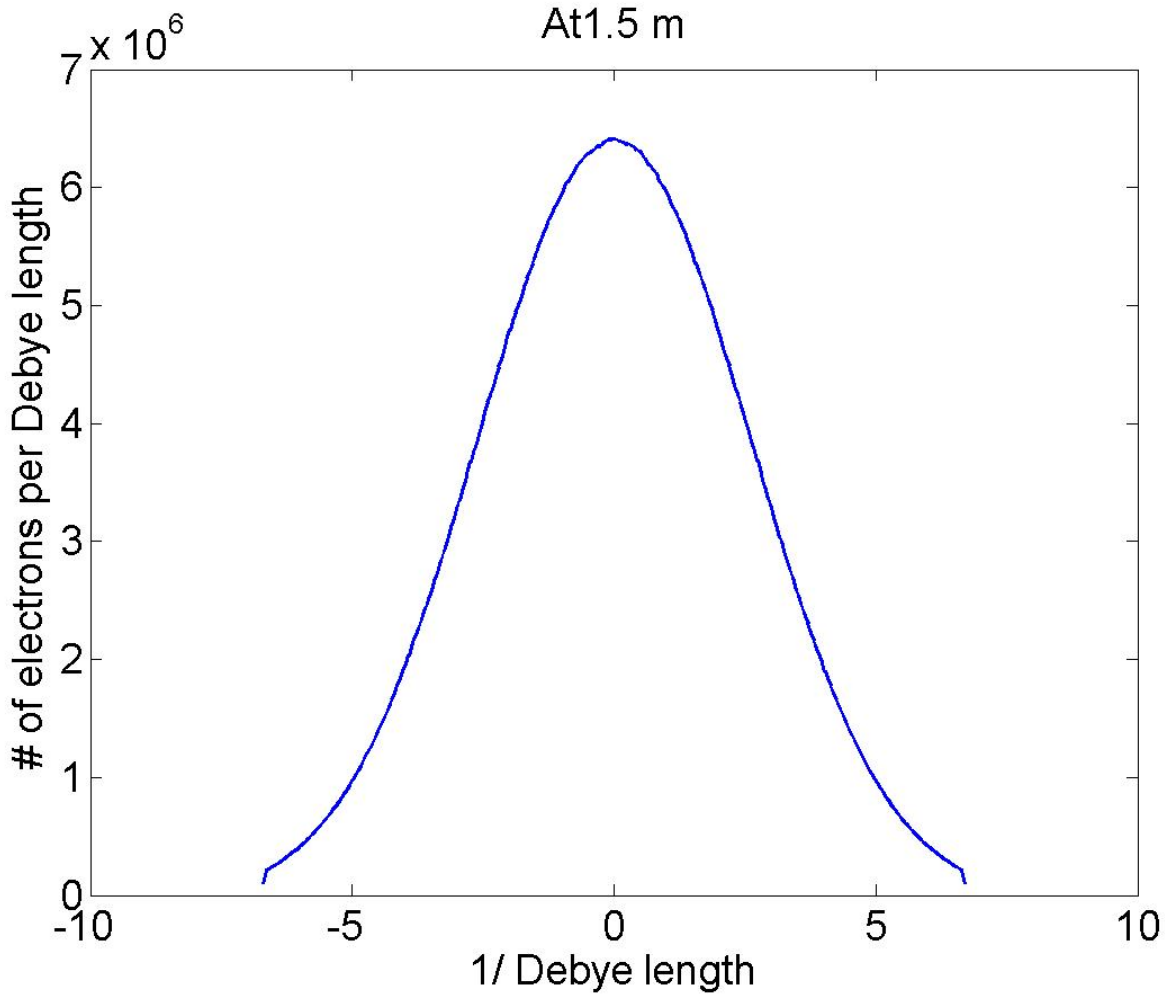

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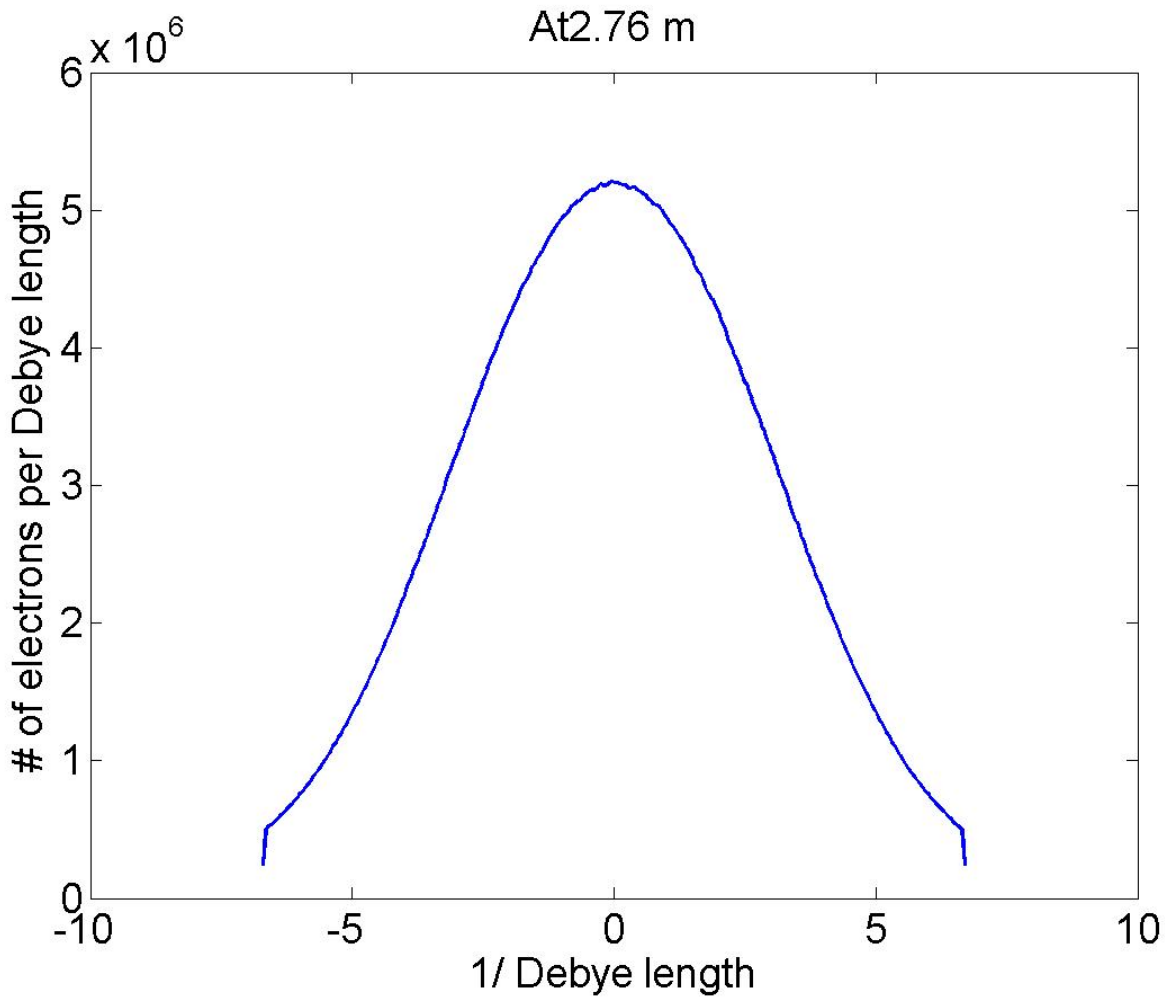

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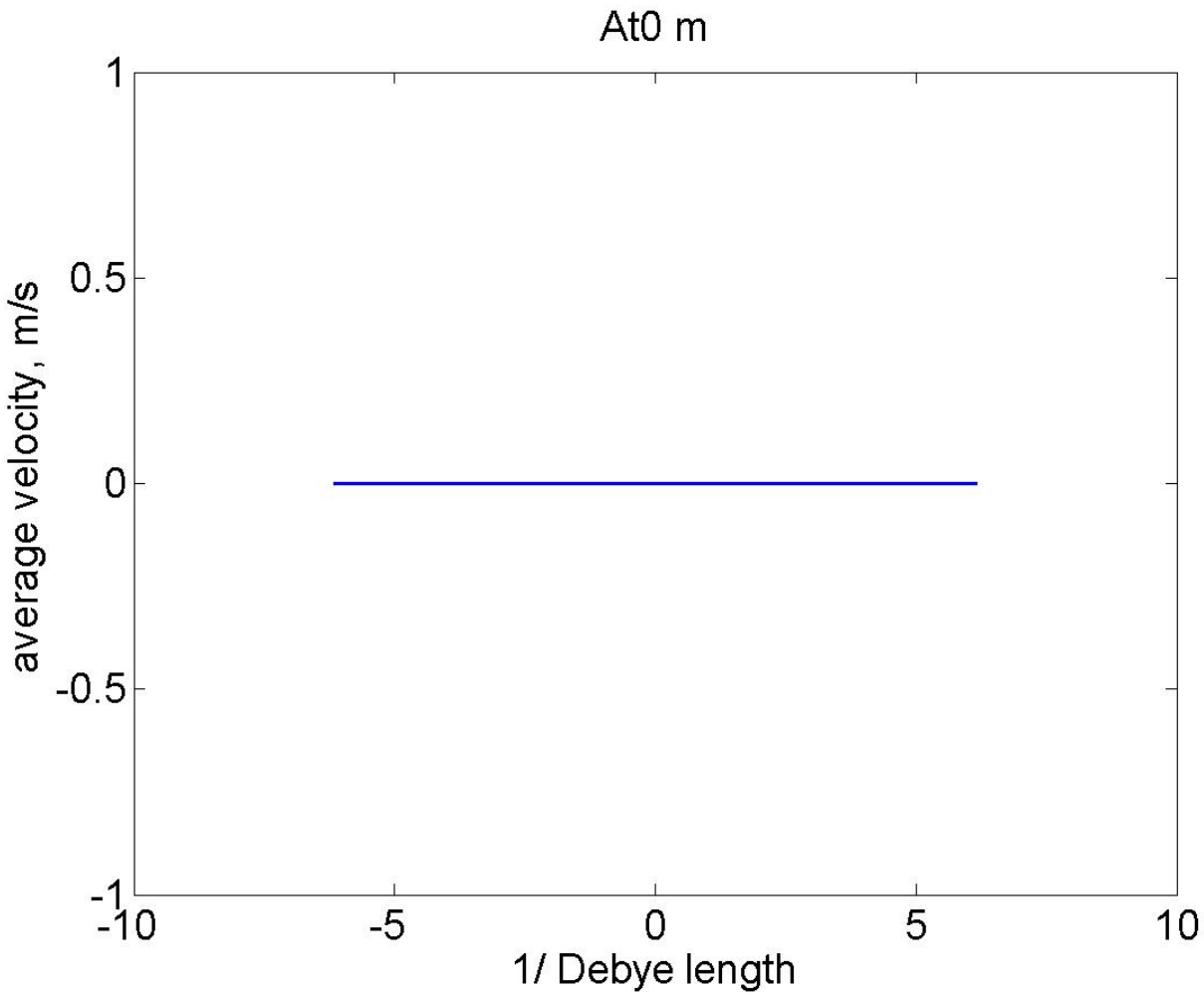

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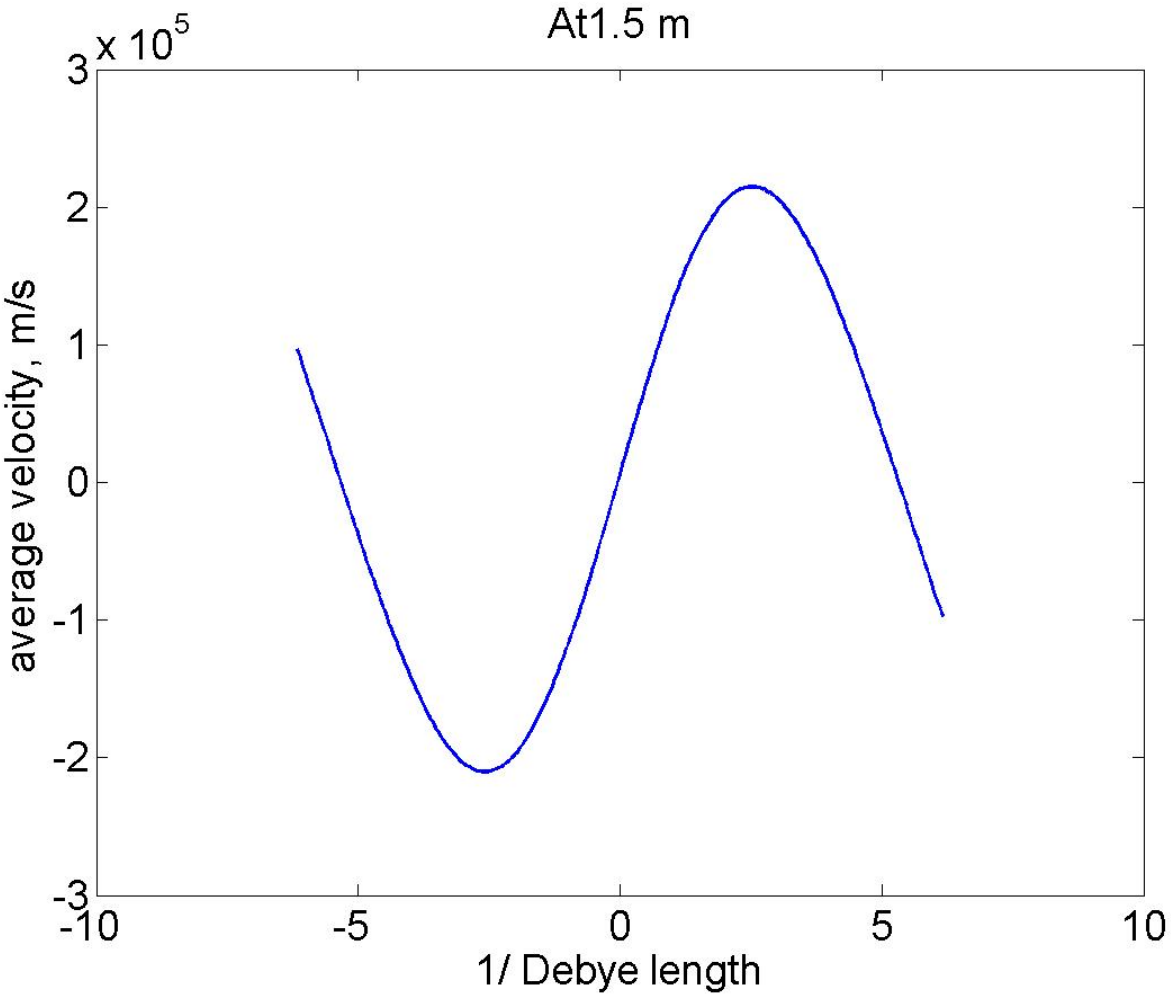

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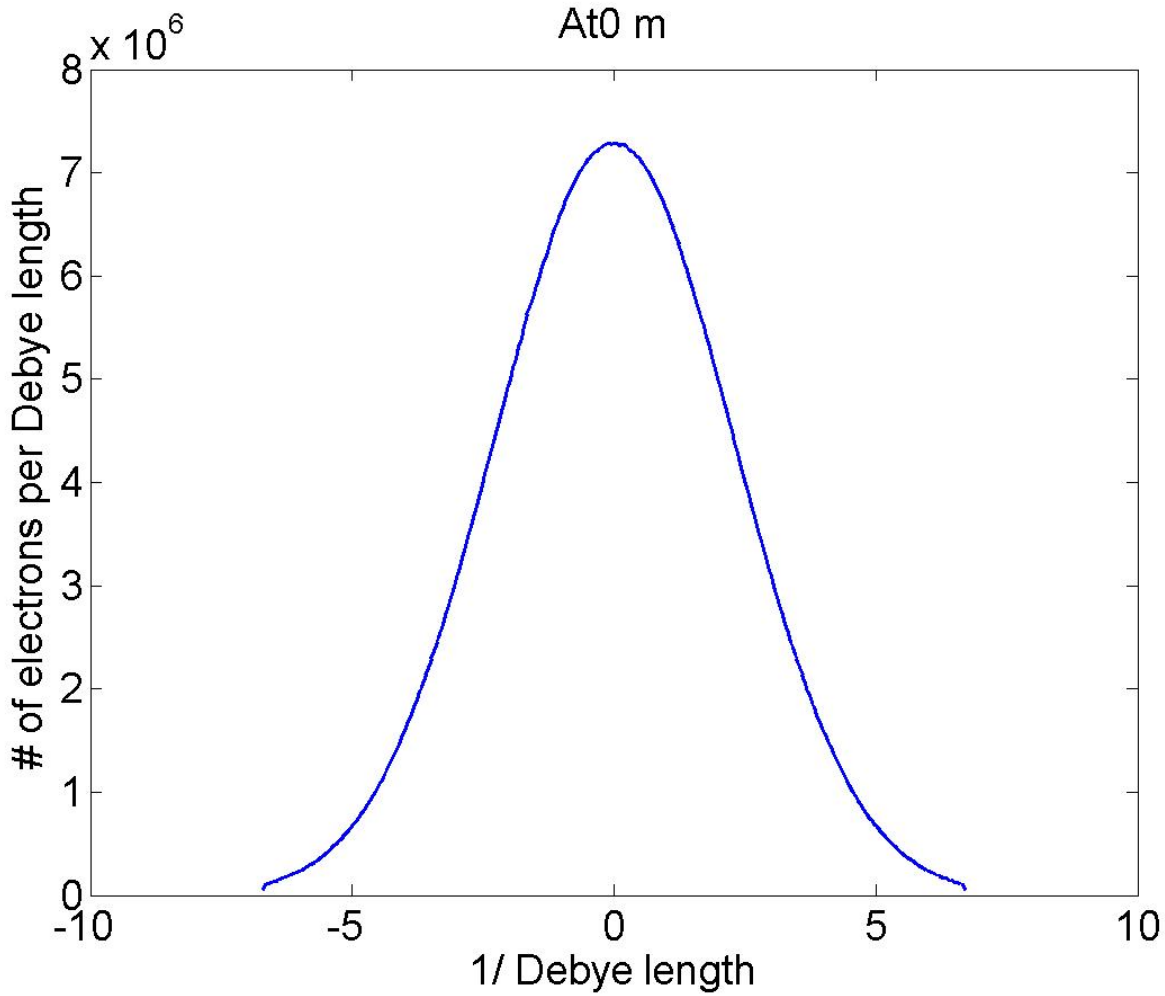

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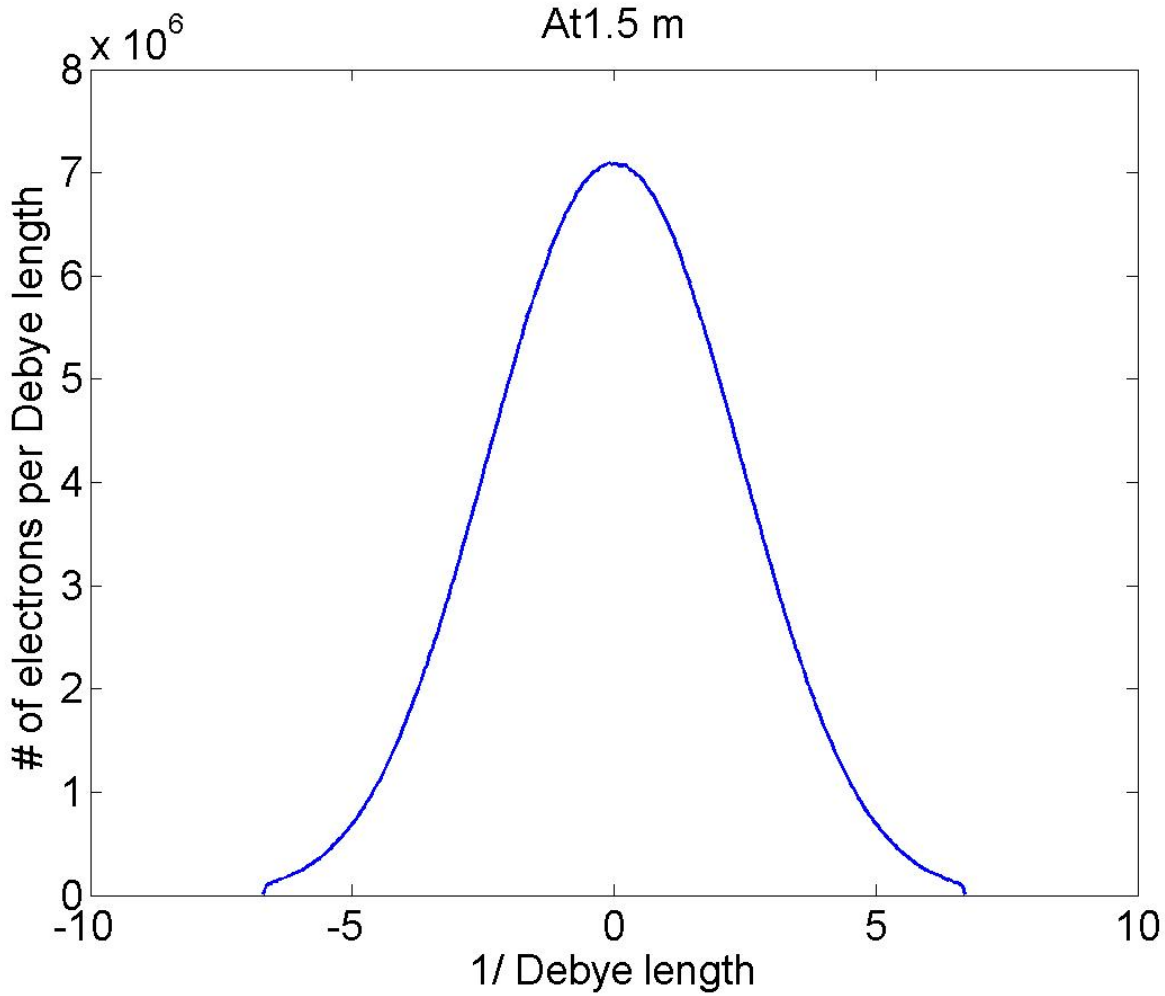

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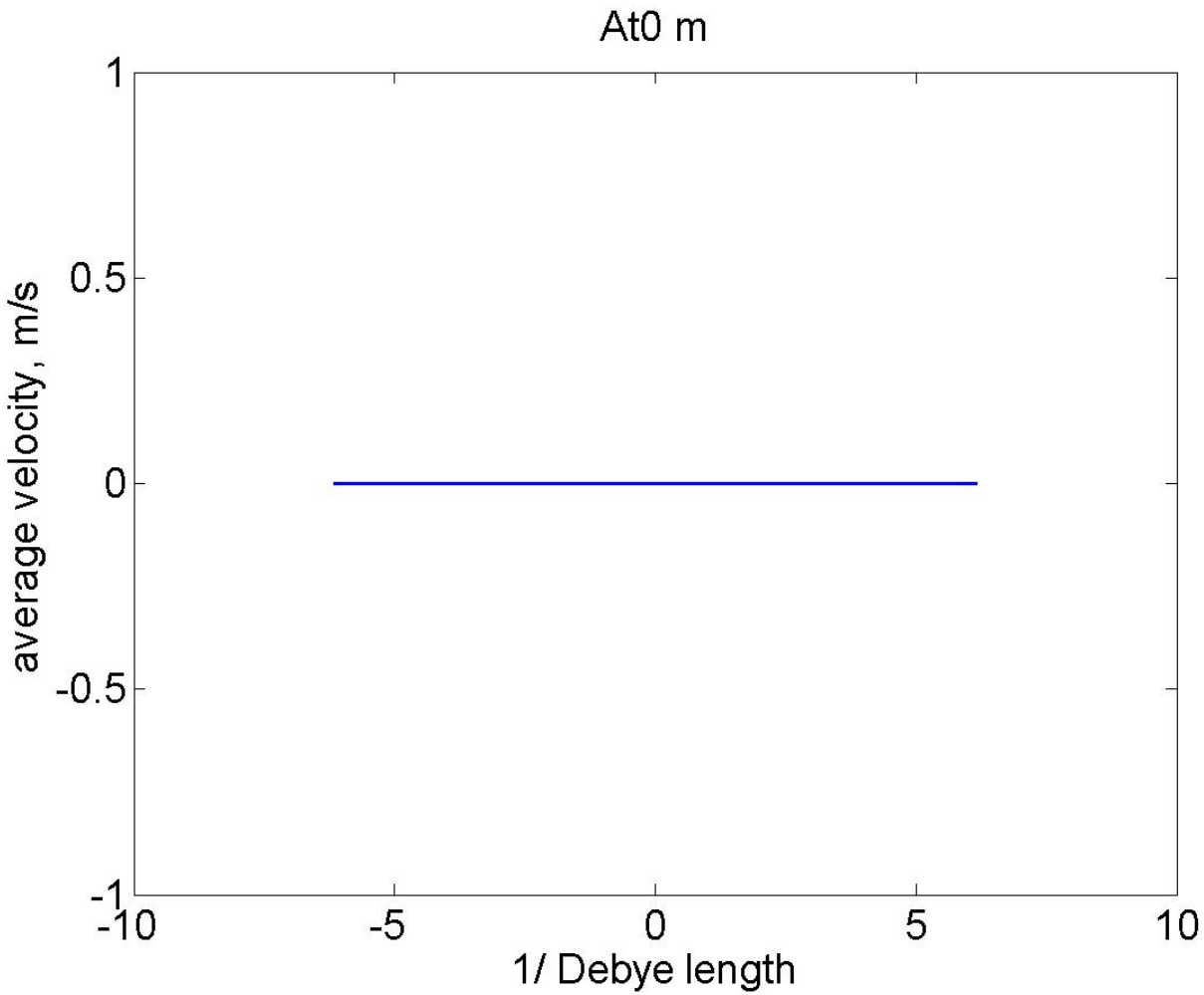

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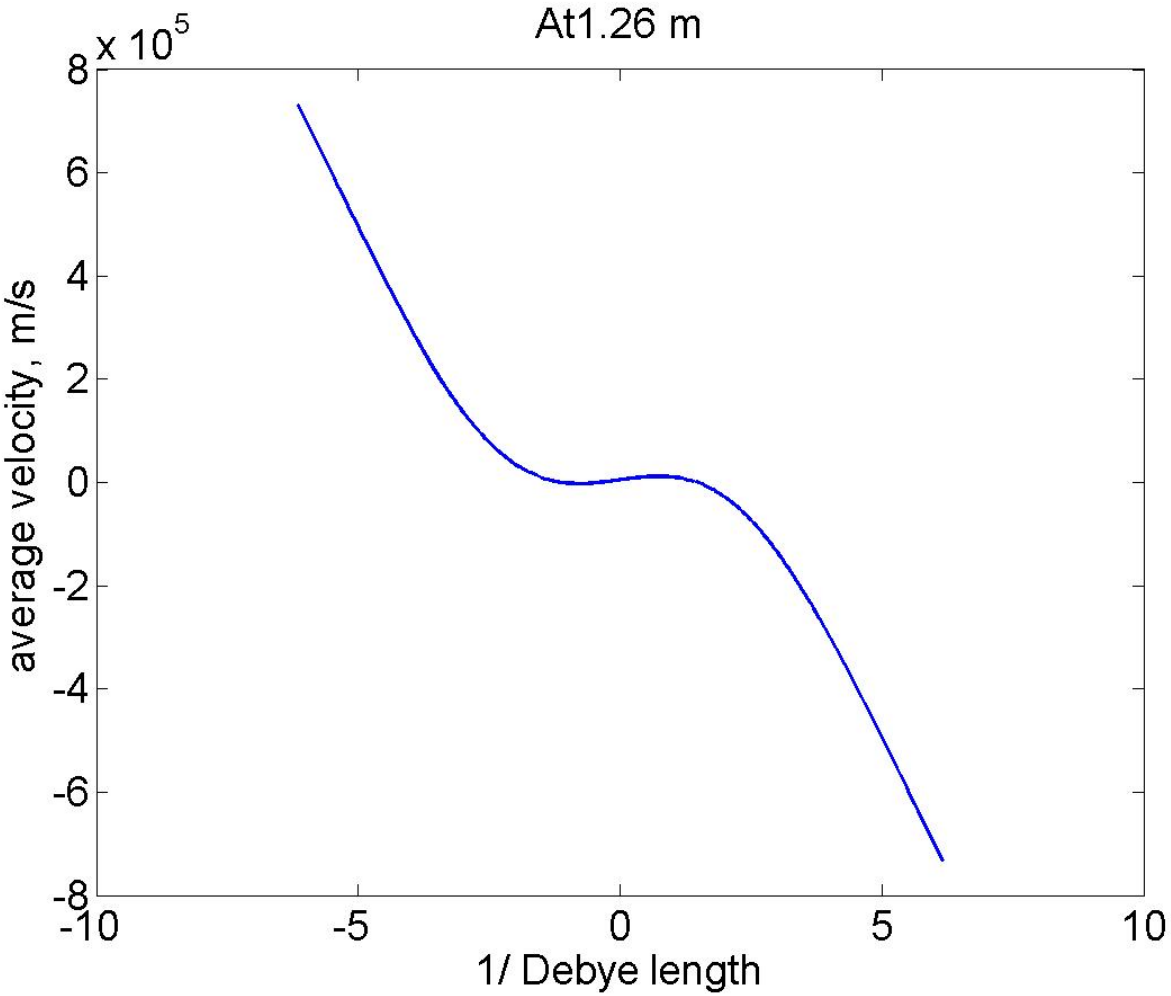

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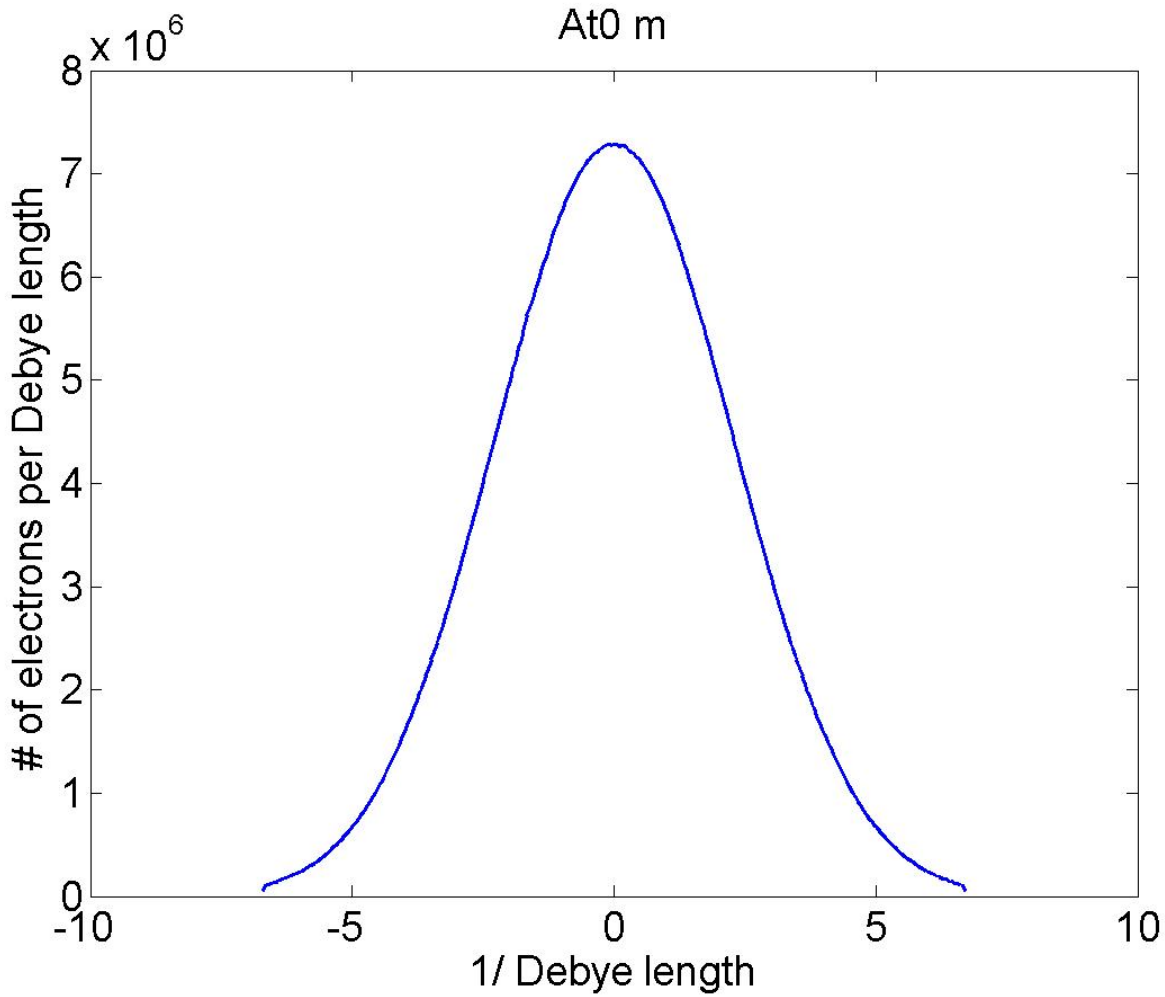

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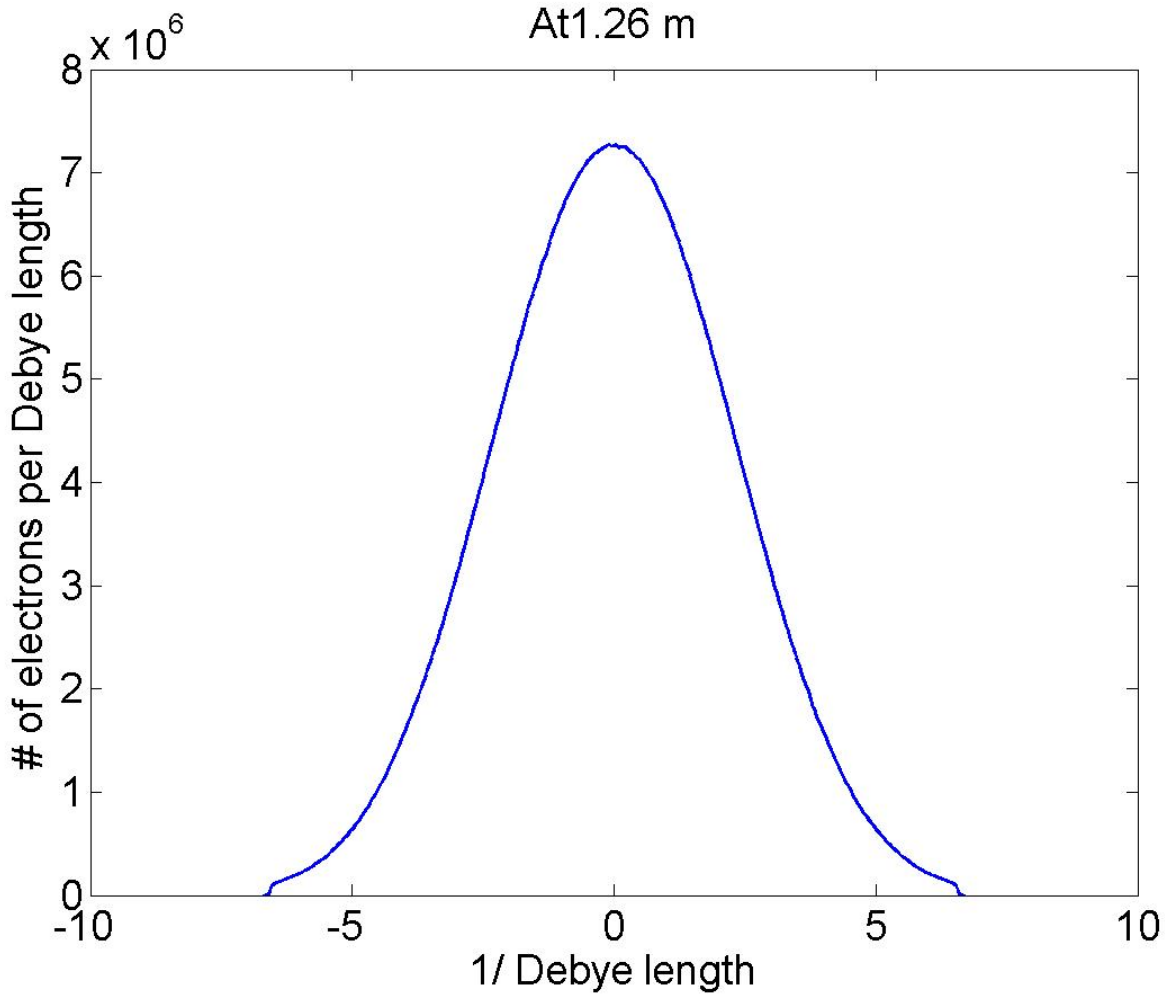

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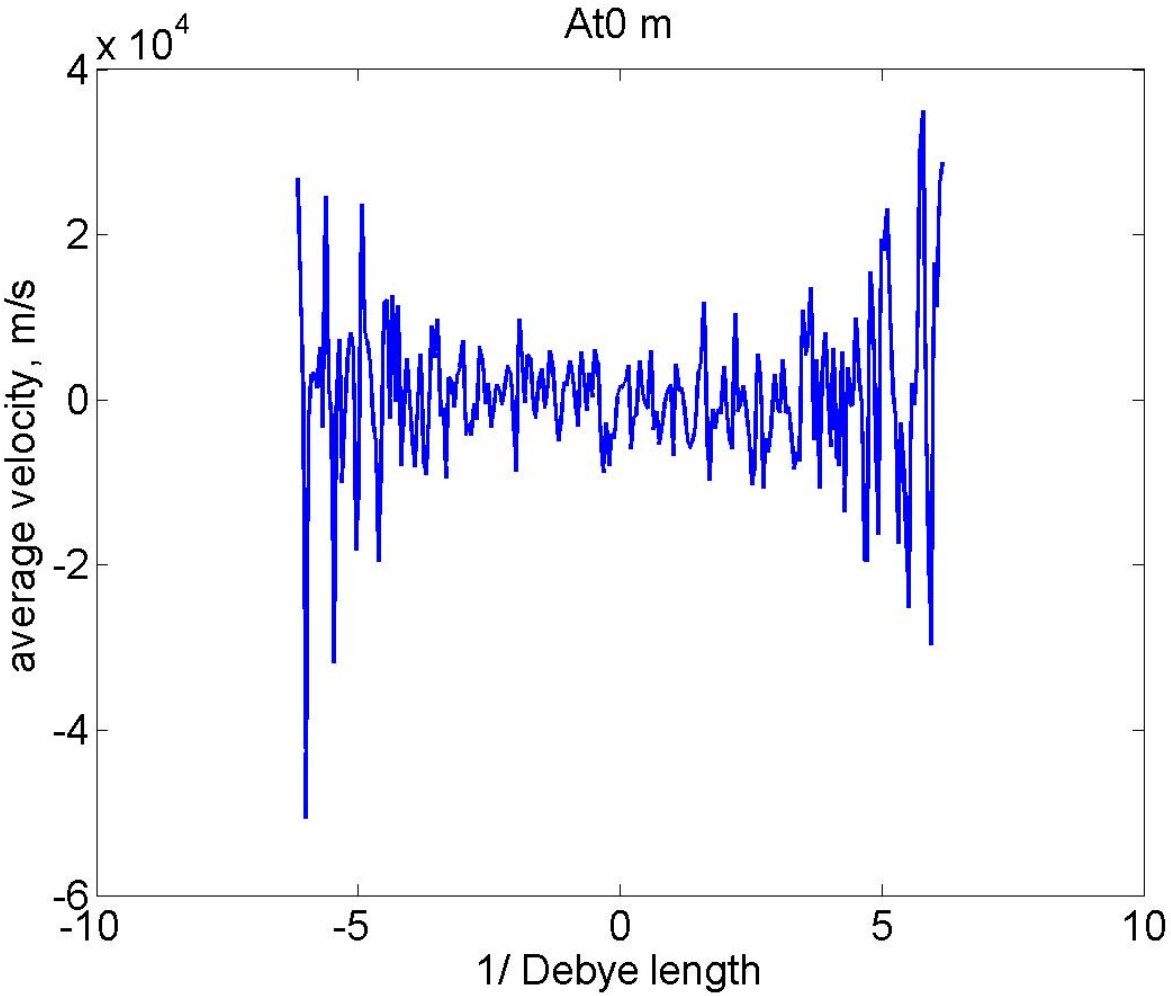

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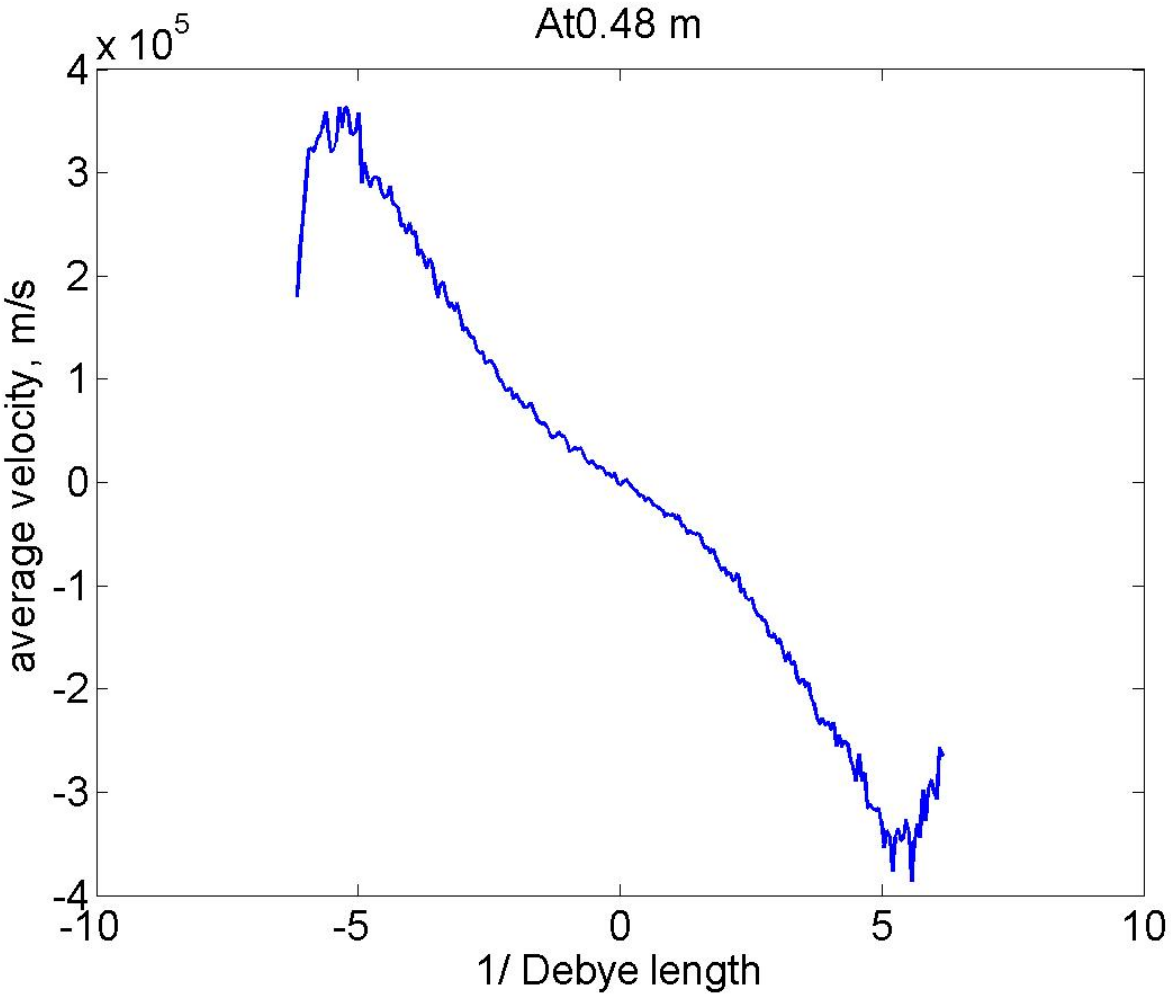

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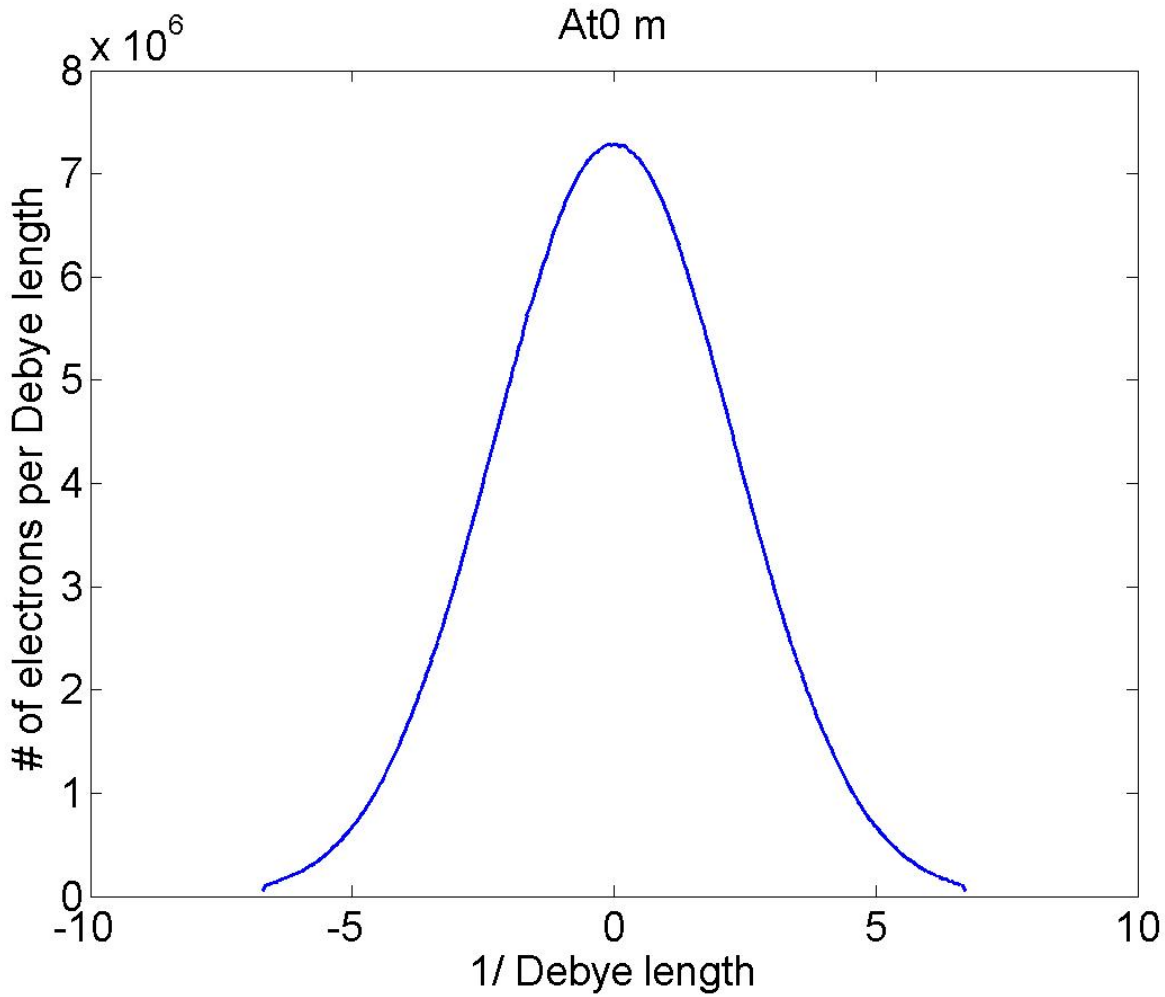

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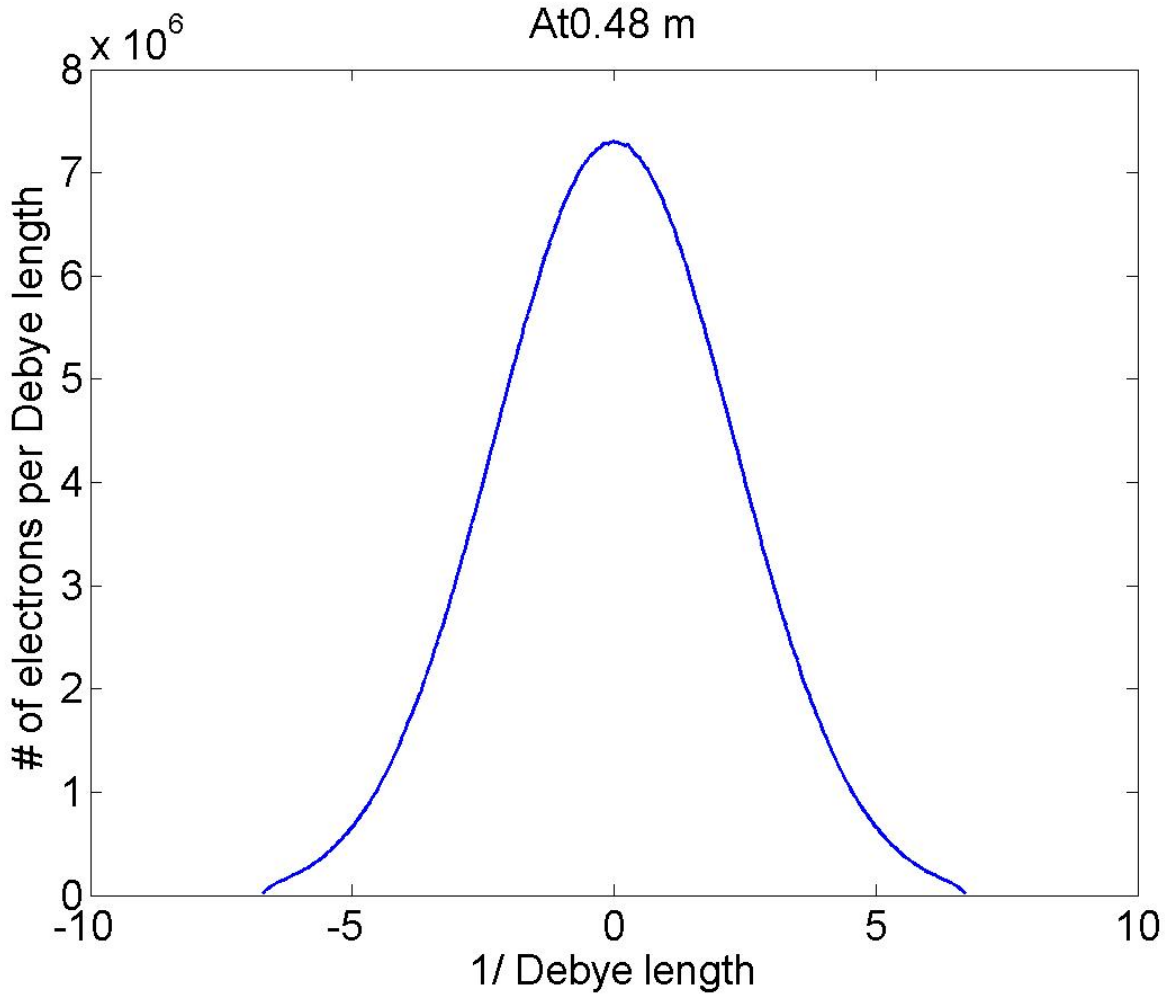

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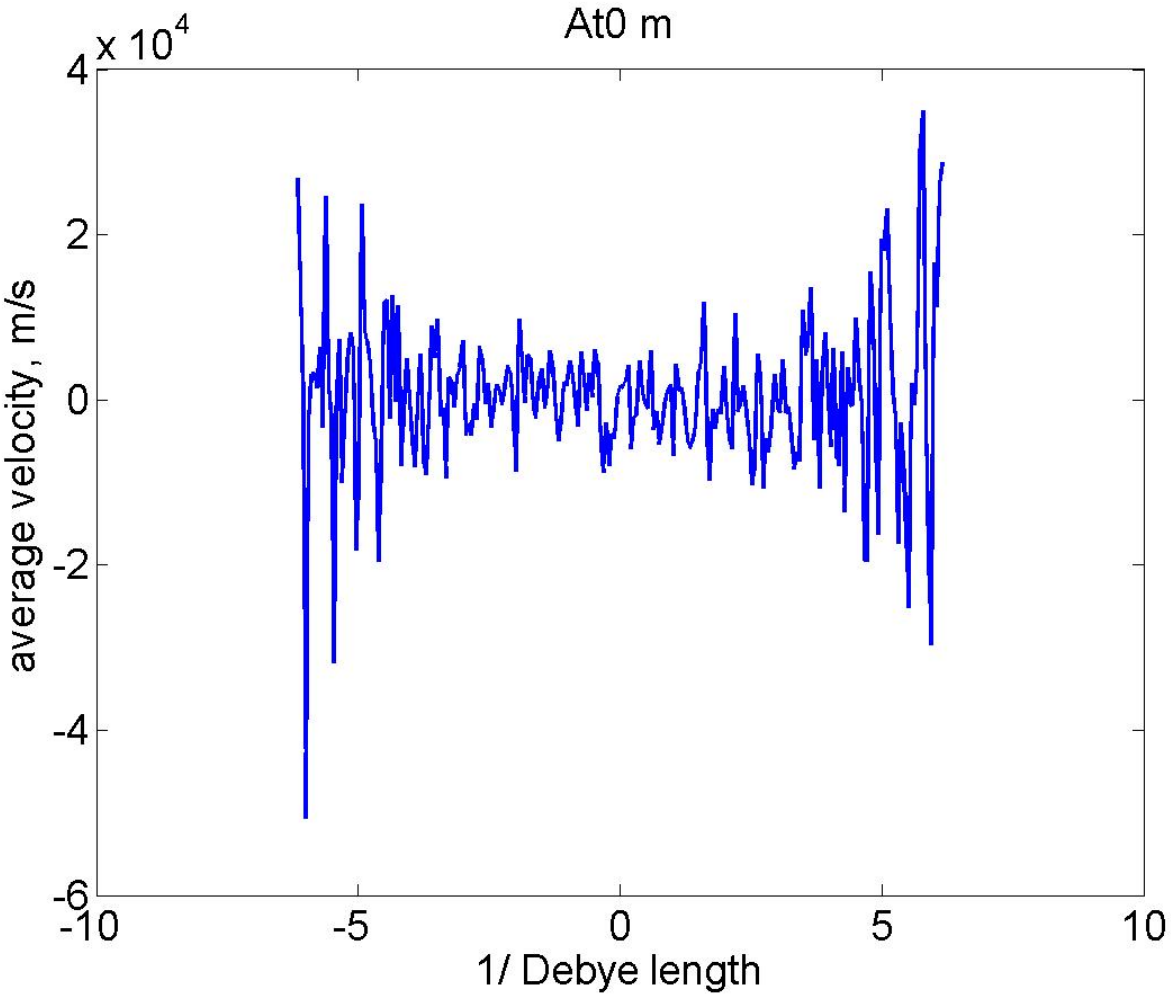

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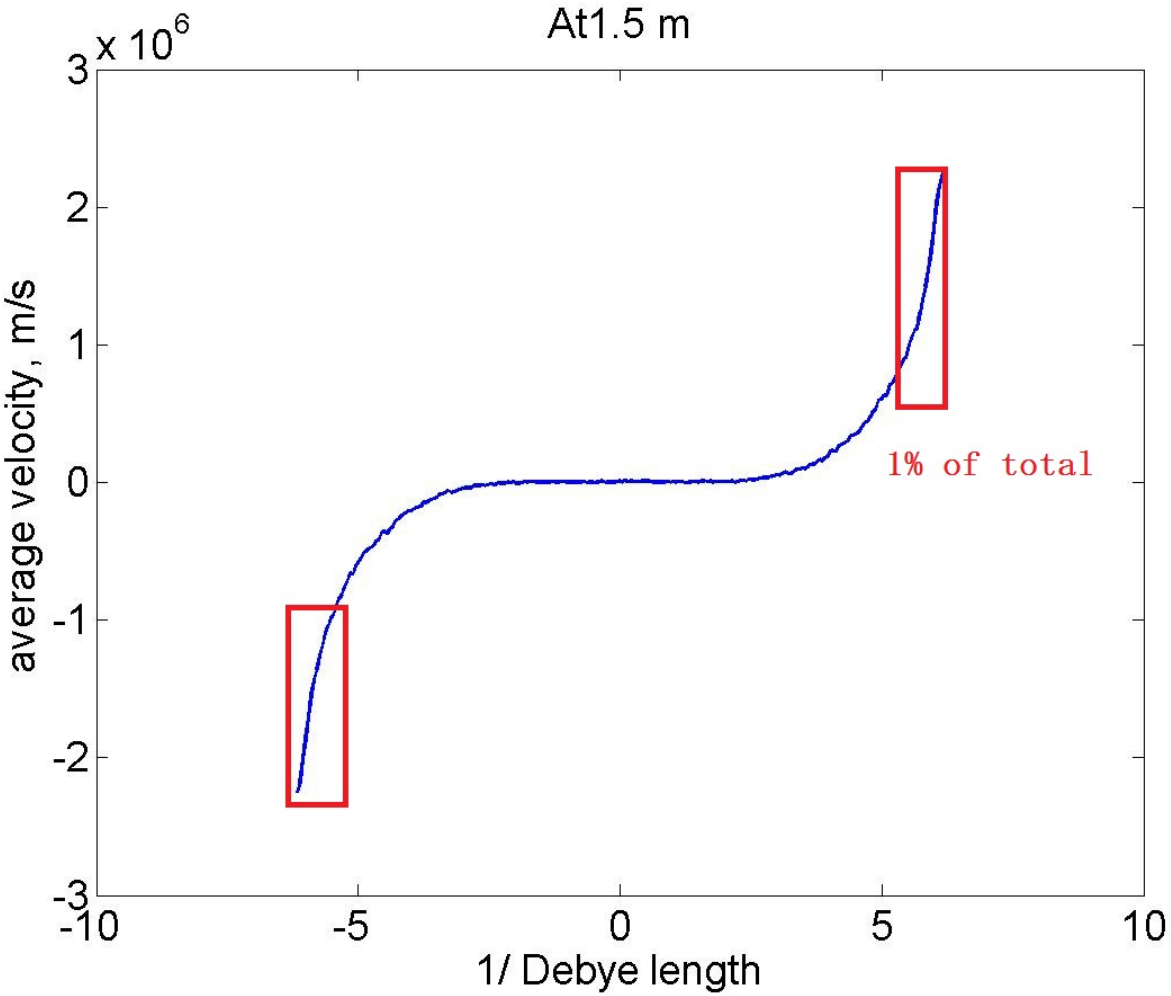

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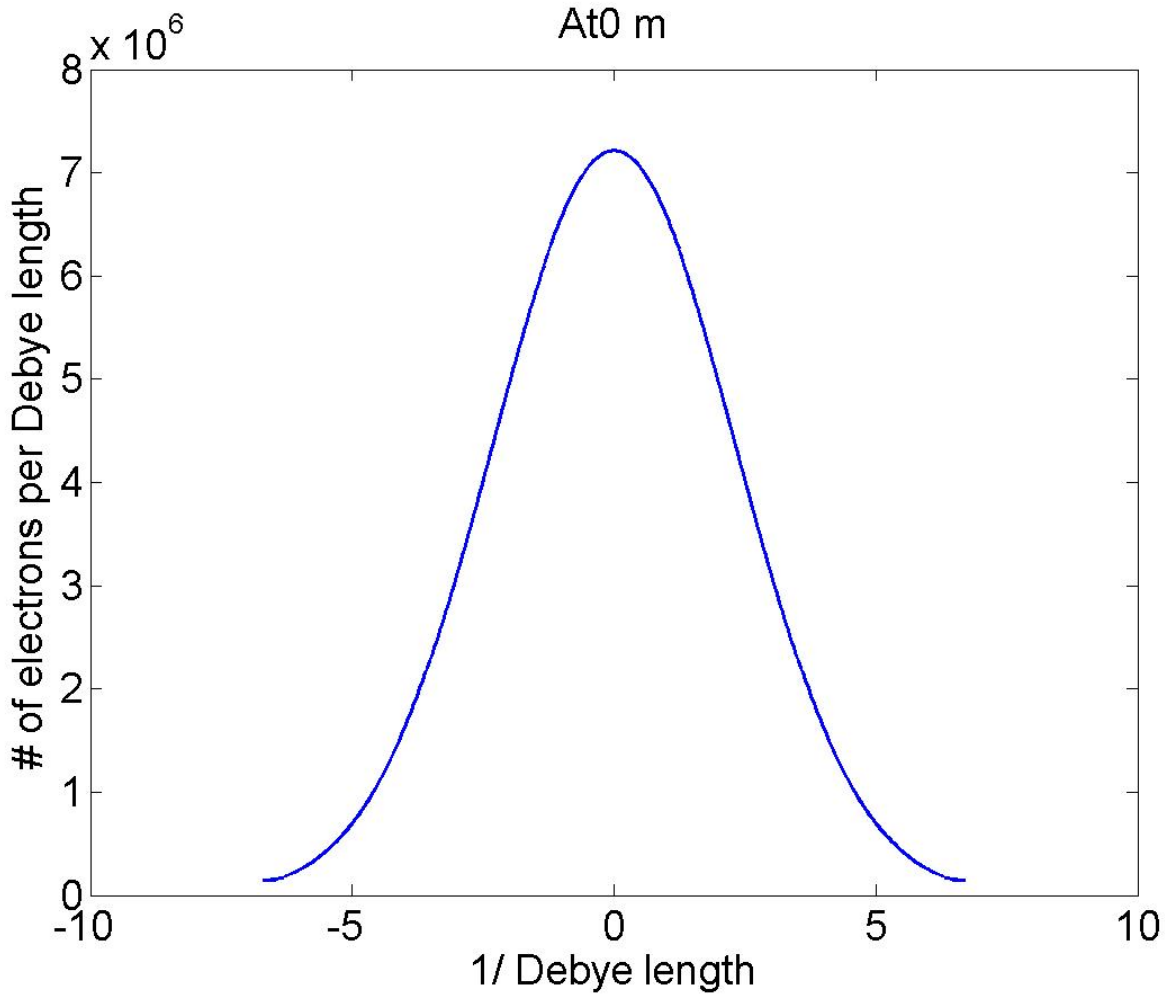

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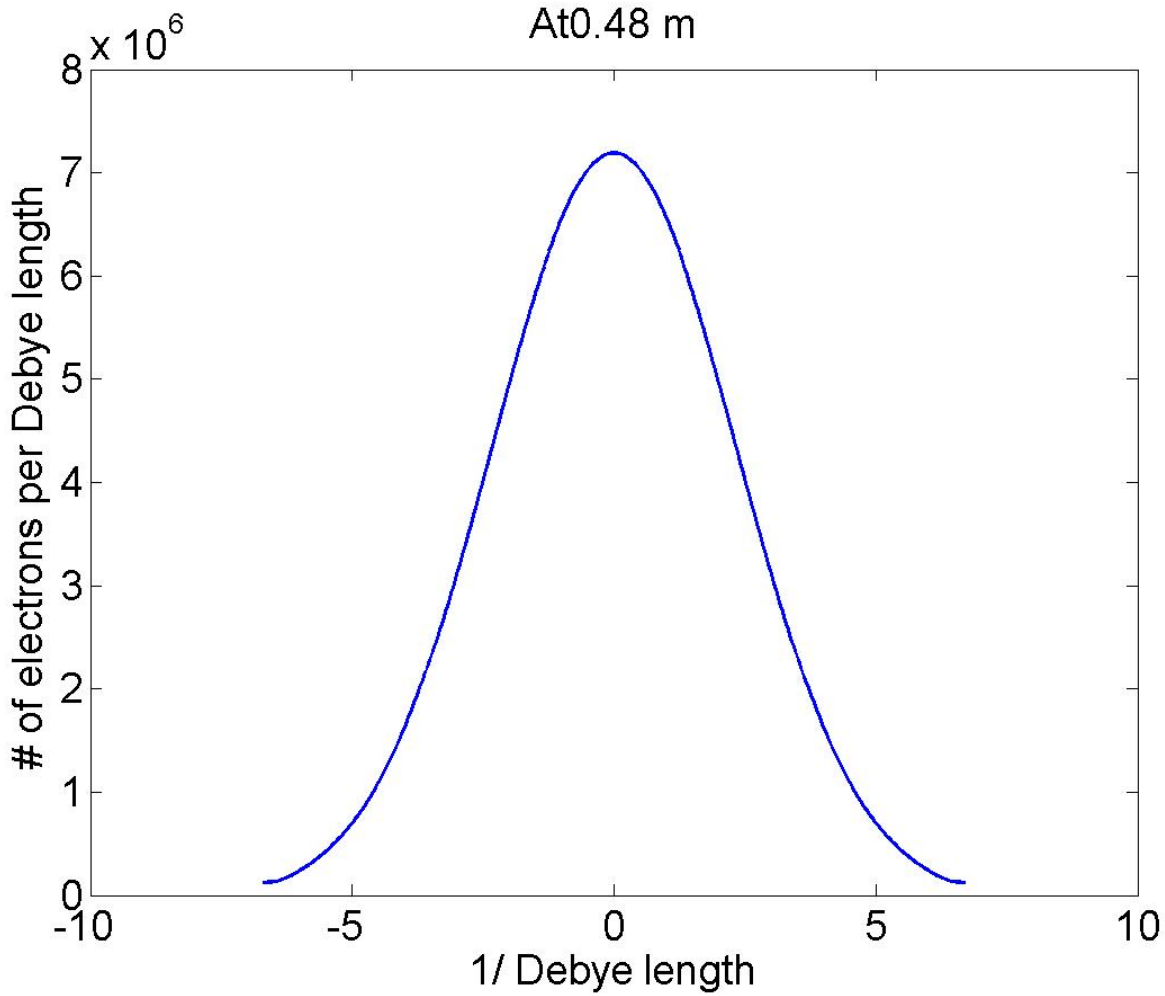
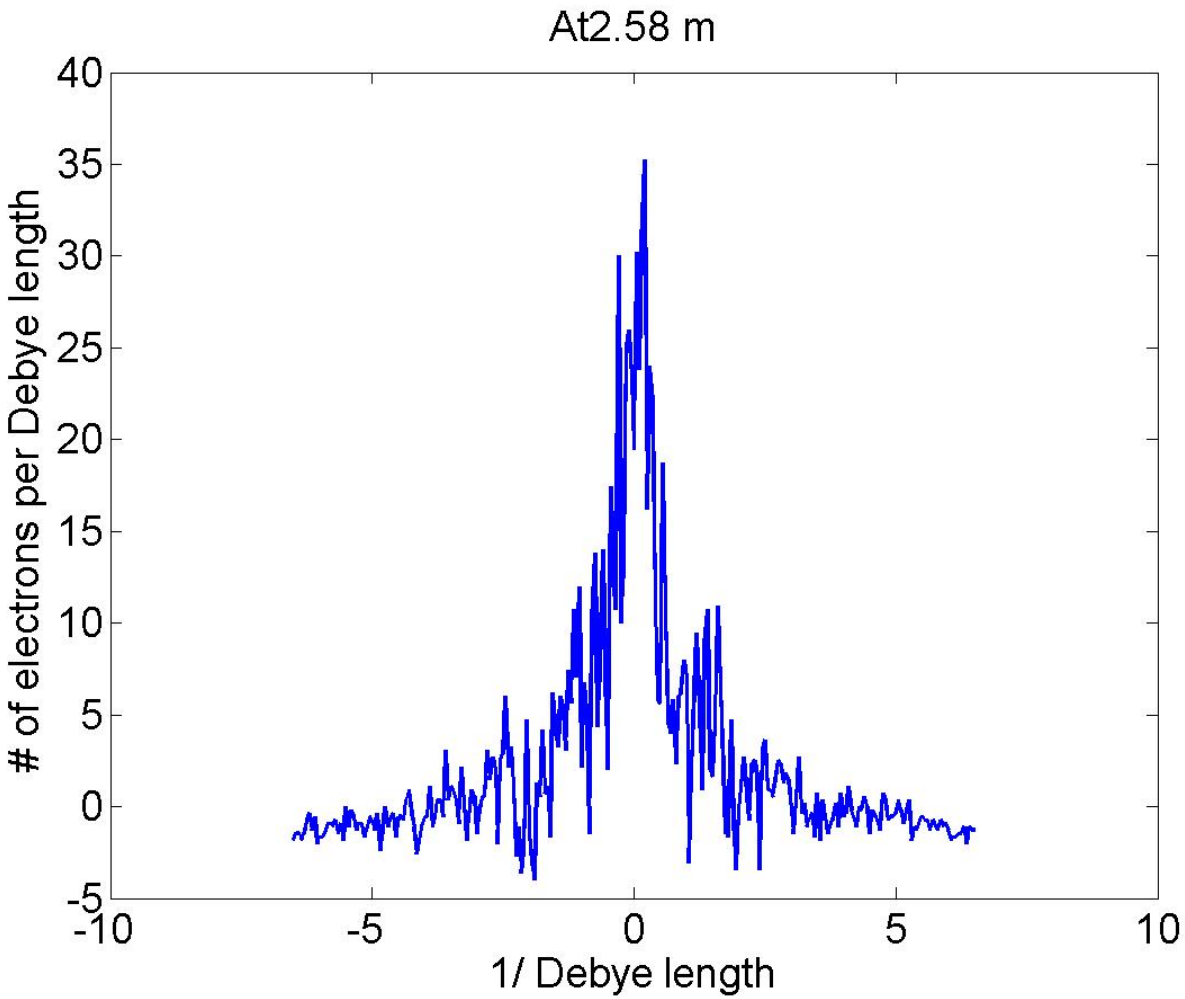


Longitudinal number distribution



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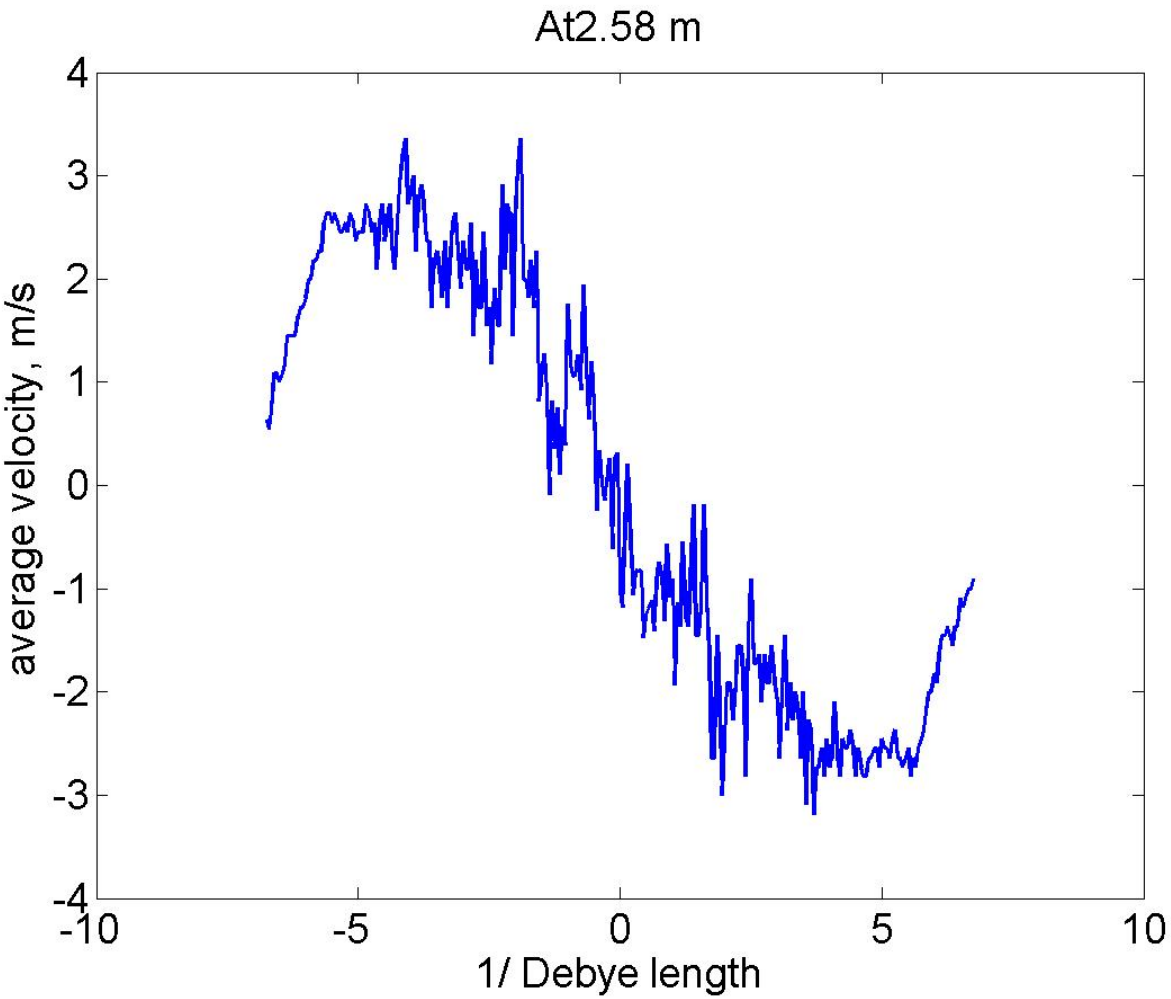

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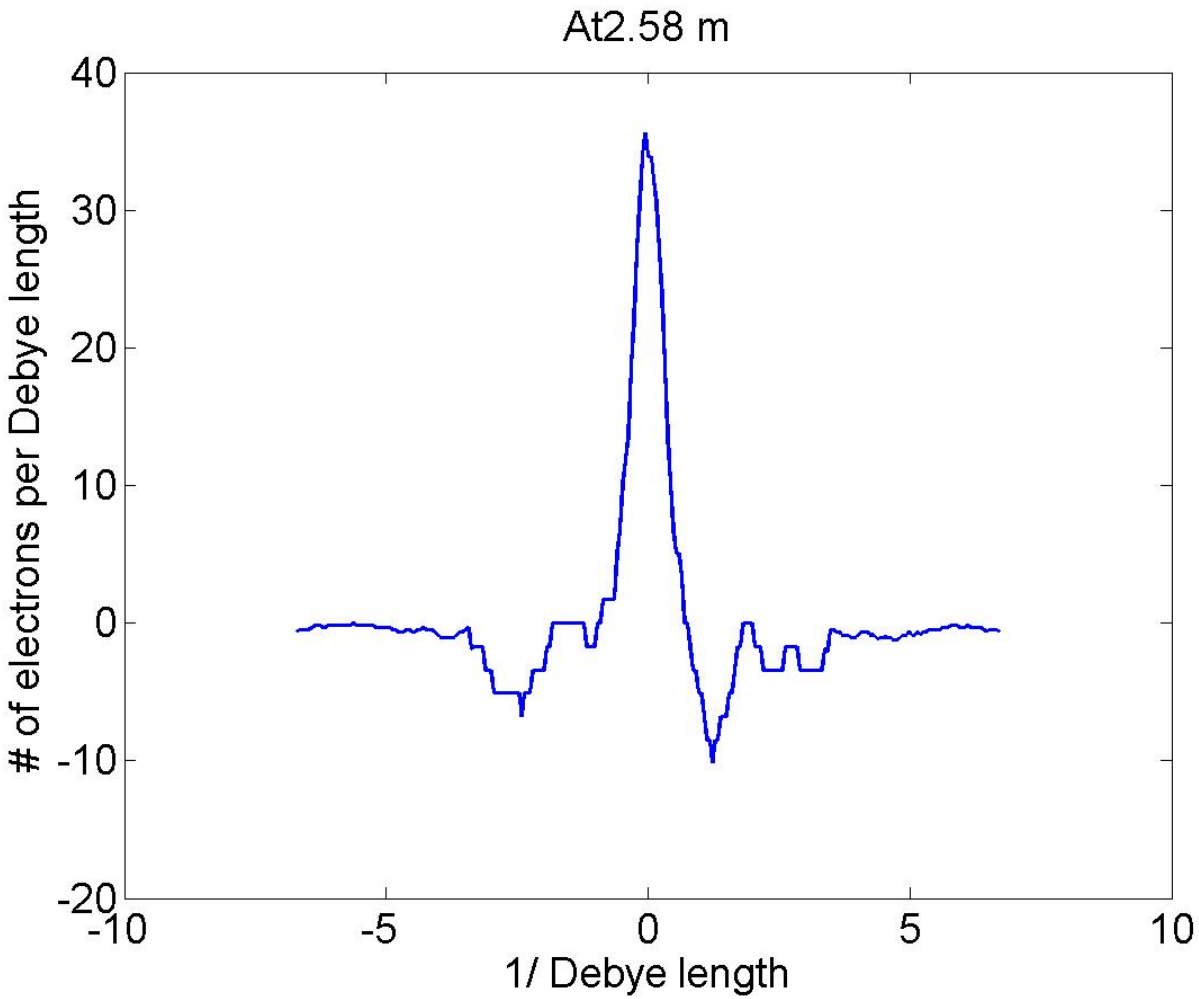

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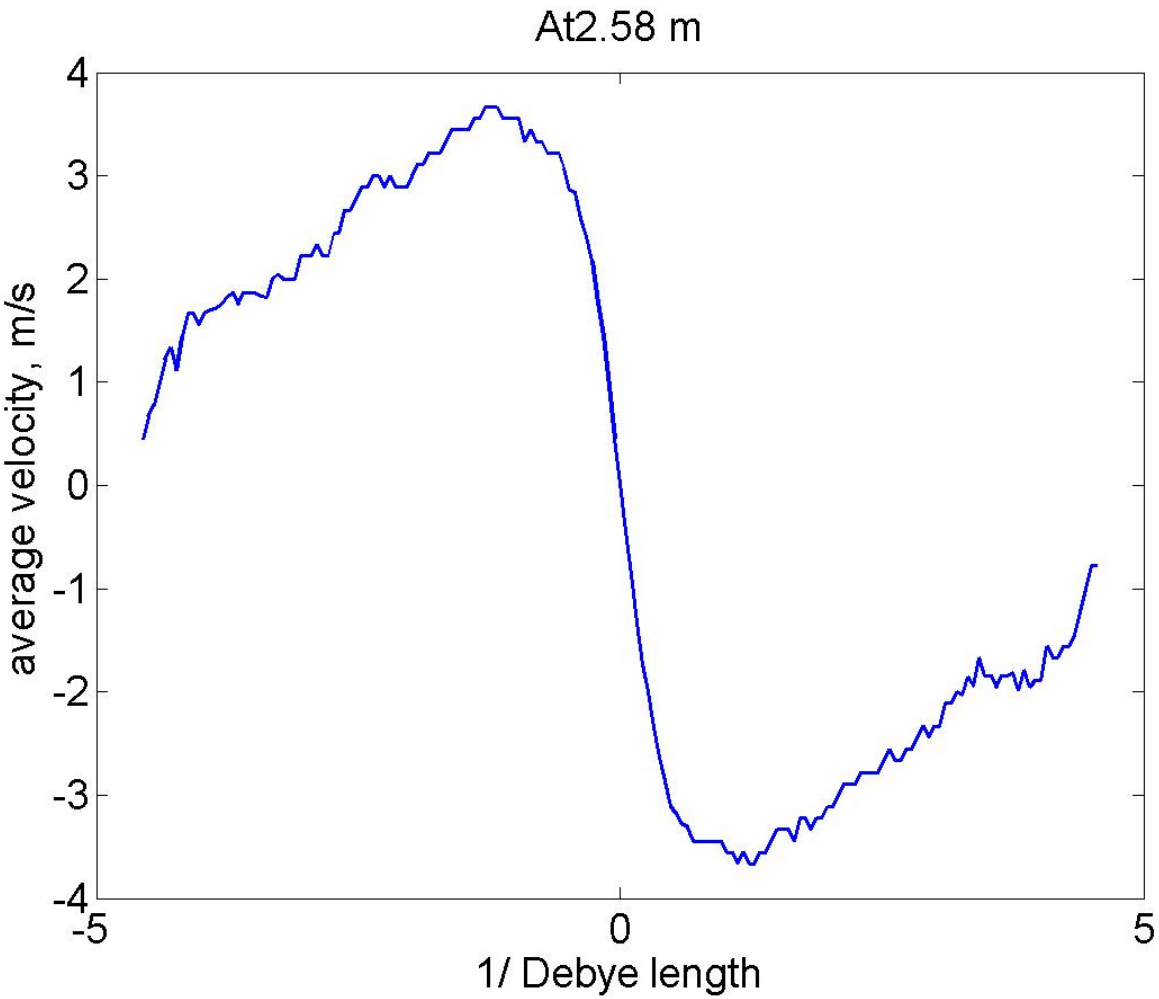

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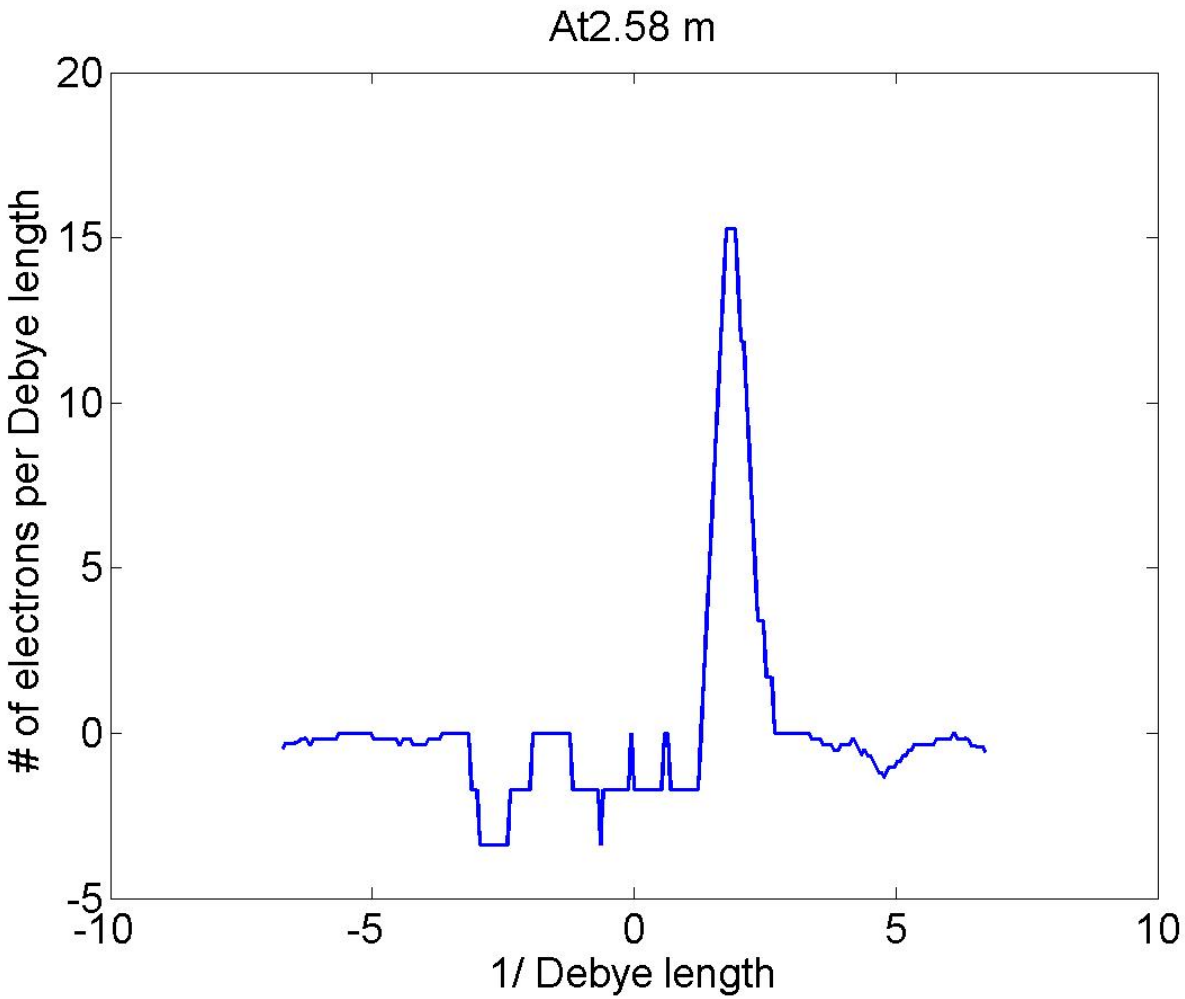

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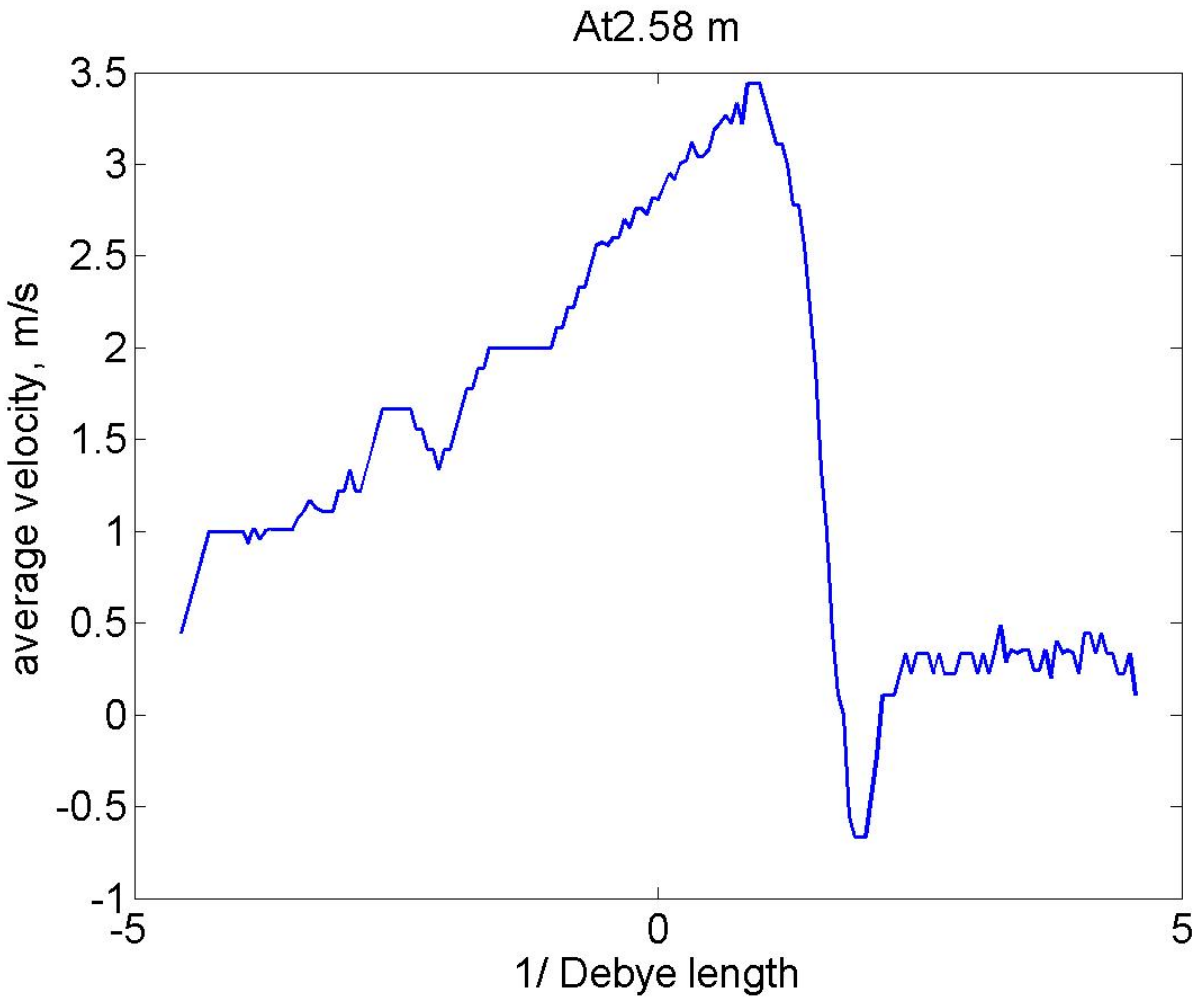
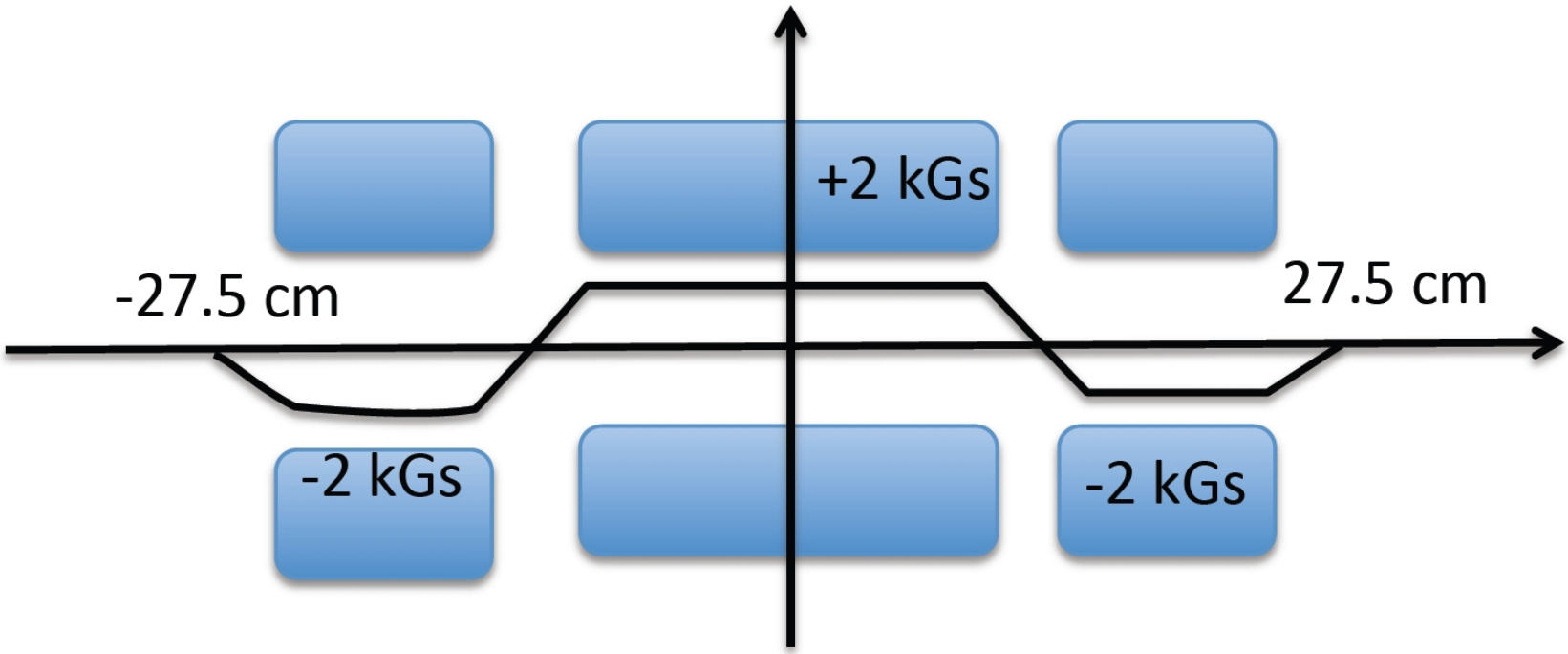
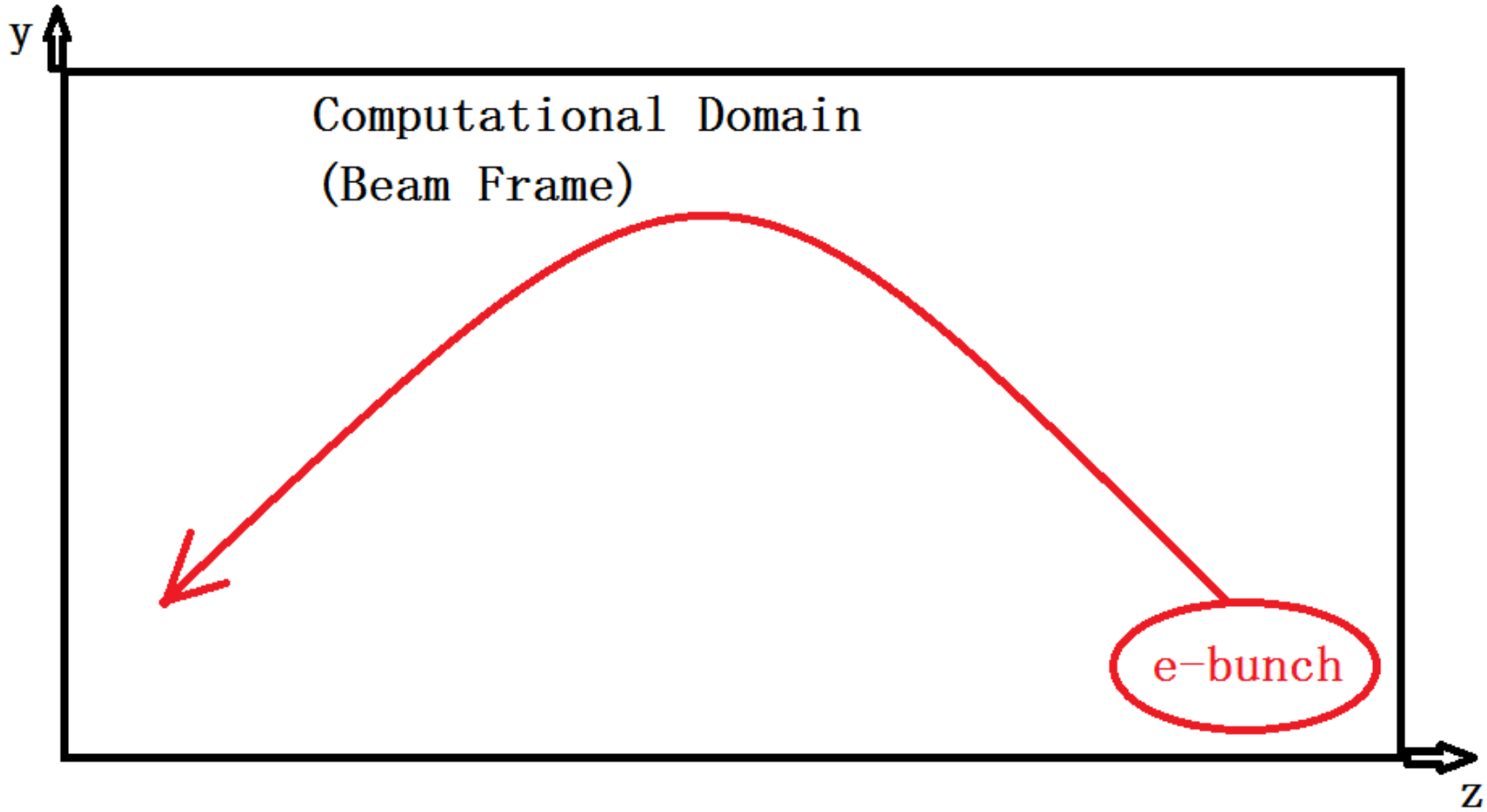


- Beam frame
- Take output of modulator as input of wiggler
- Take difference
  - Background electron bunch through wiggler
  - Modulated electron bunch through wiggler

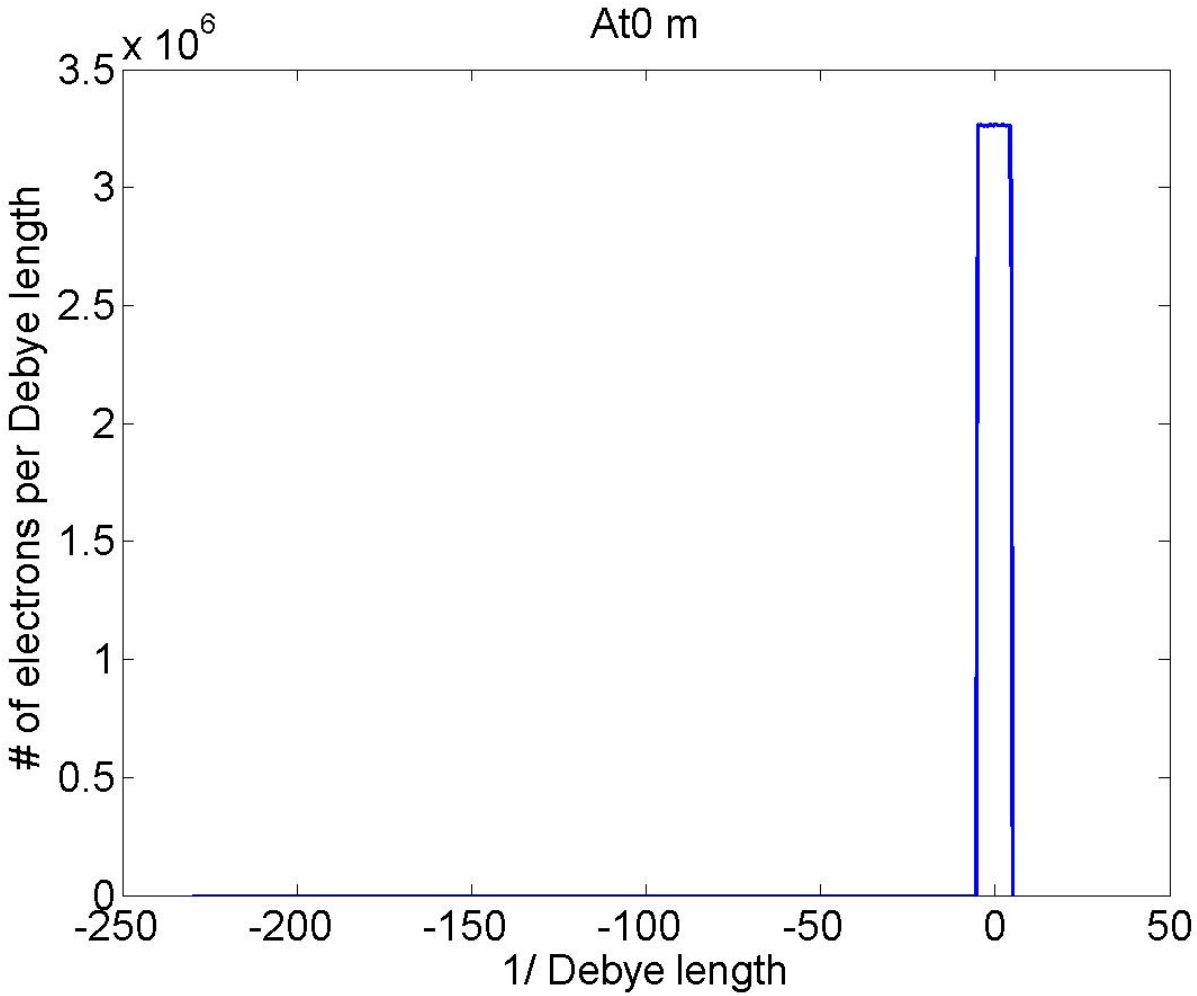
Wiggler structure



Motion of electron bunch



Longitudinal number distribution



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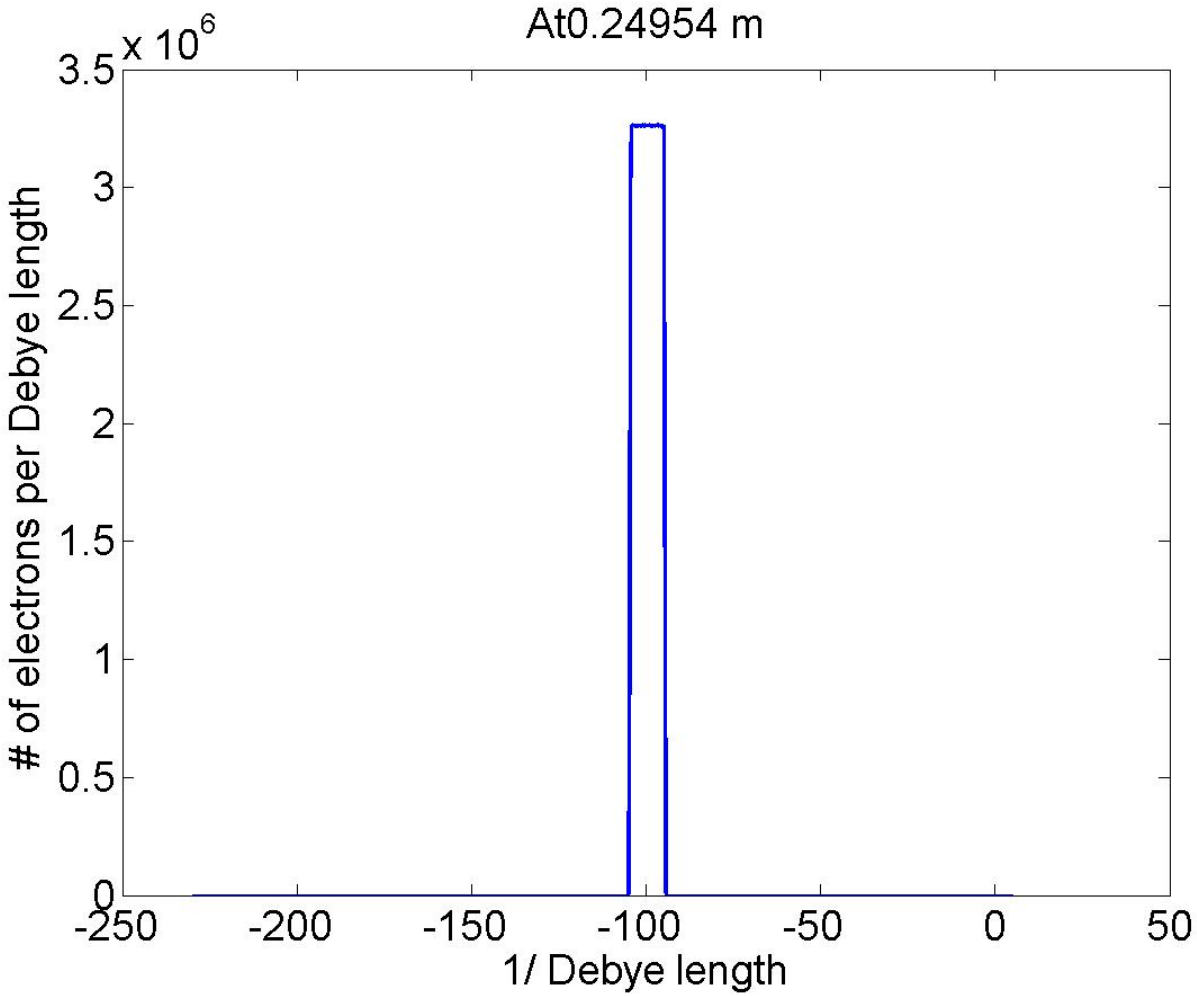

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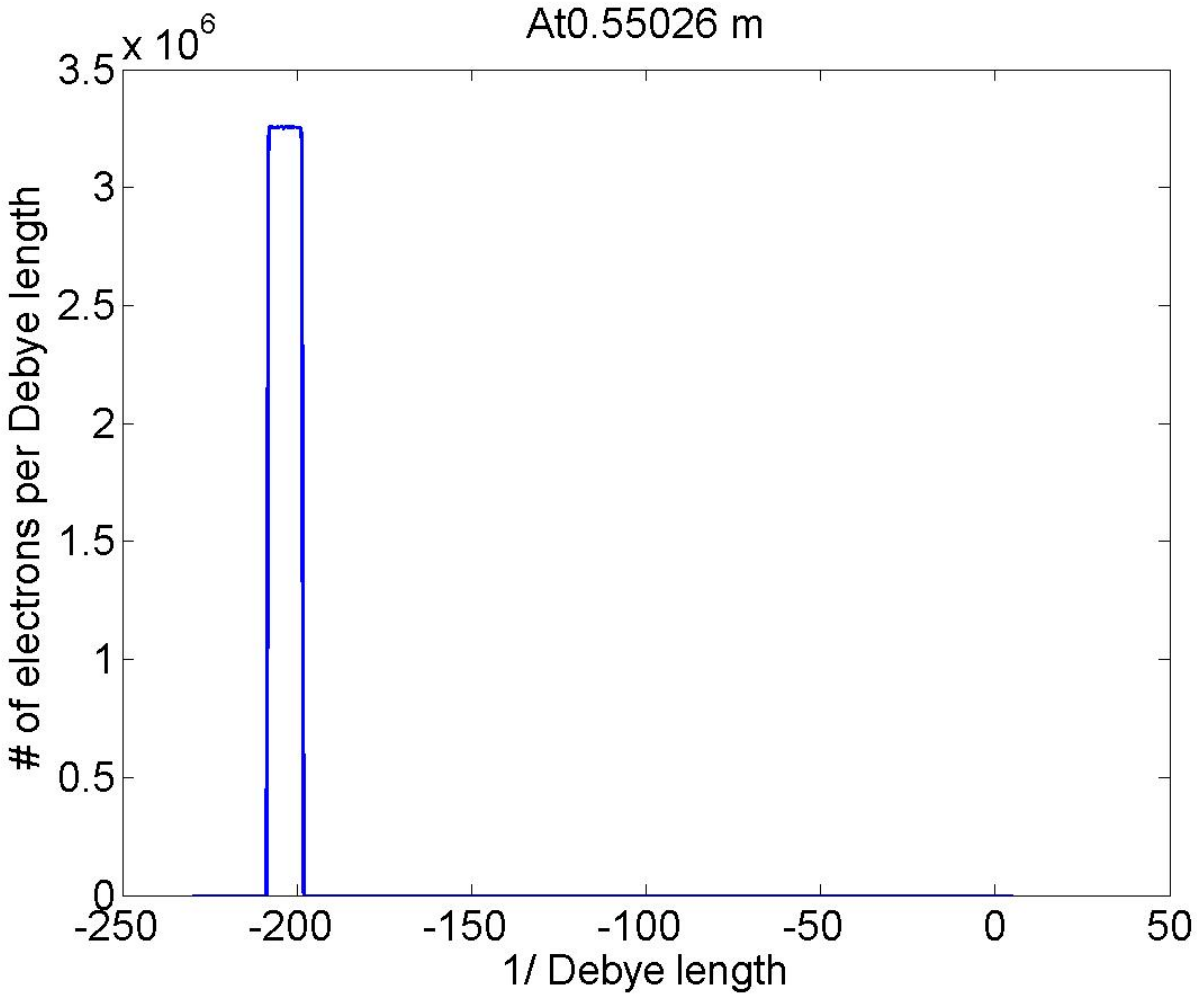
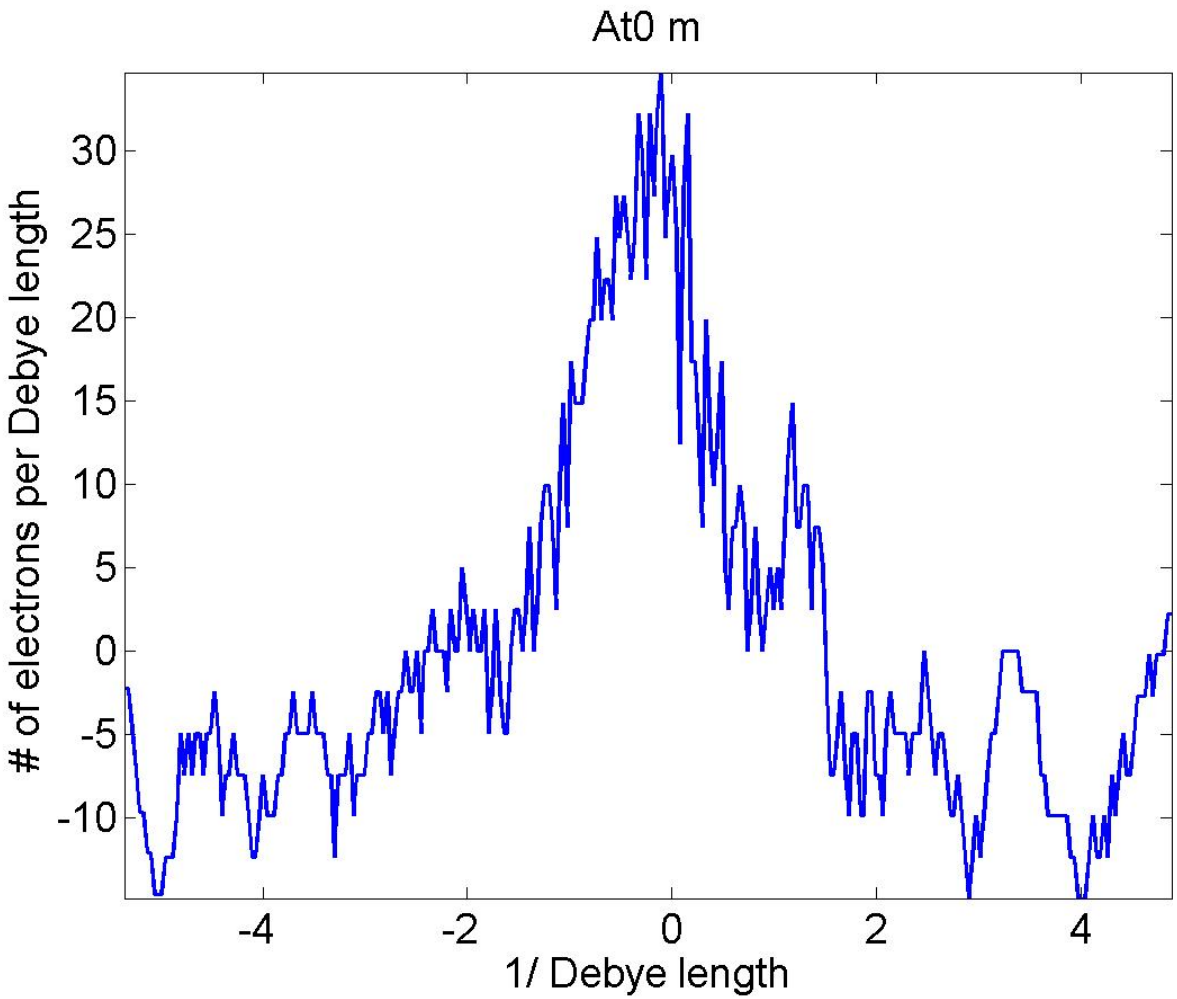


Longitudinal number distribution (difference and zoom)



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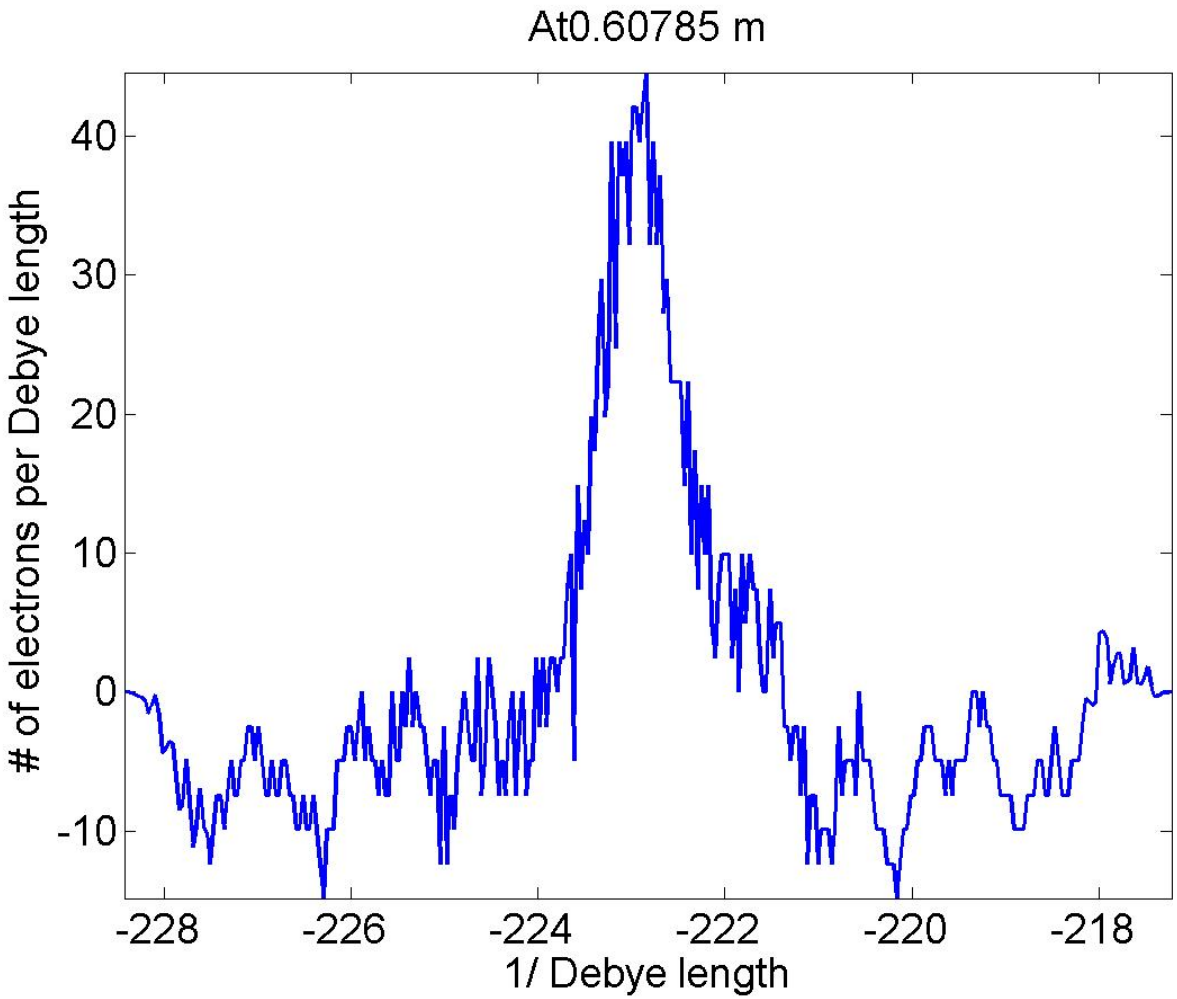
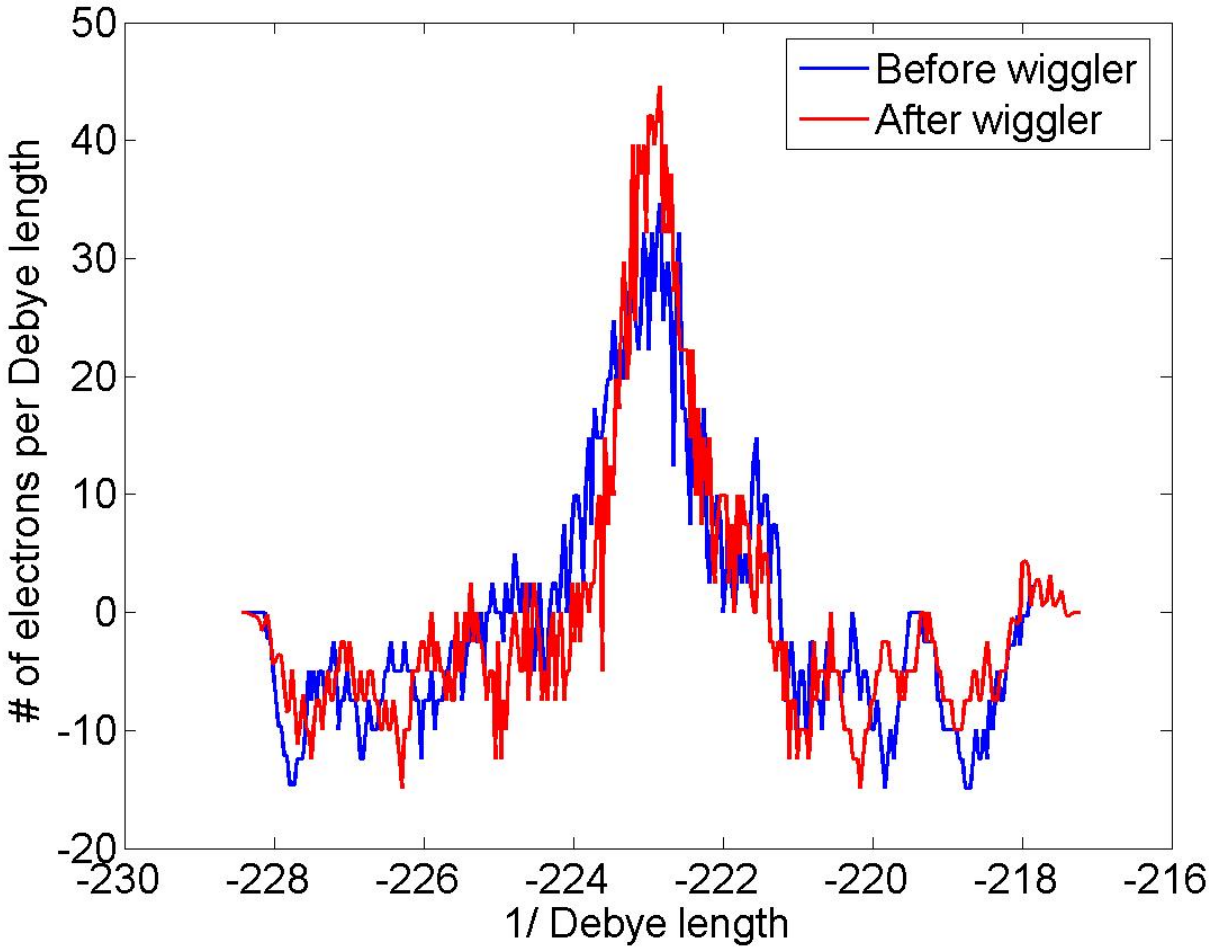
Longitudinal number distribution (comparison)