Modulator Simulations and Prelim Dipole Simulations

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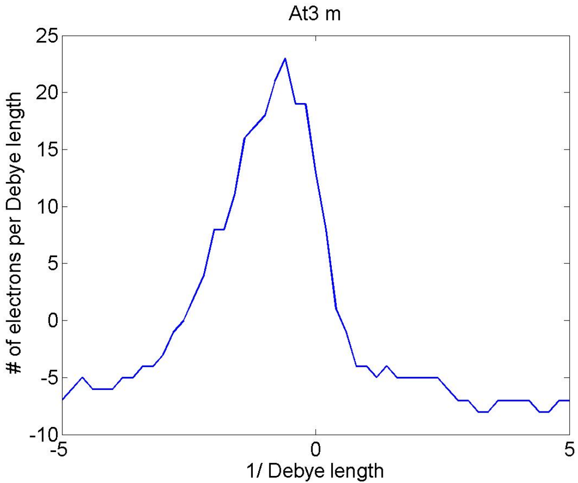
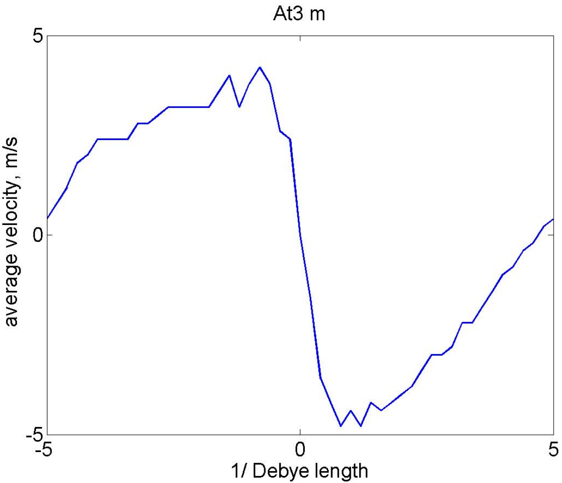
- Ion moves with 1 or 2 β_z along longitudinal direction
- In the code, ion stays and electron bunch moves instead

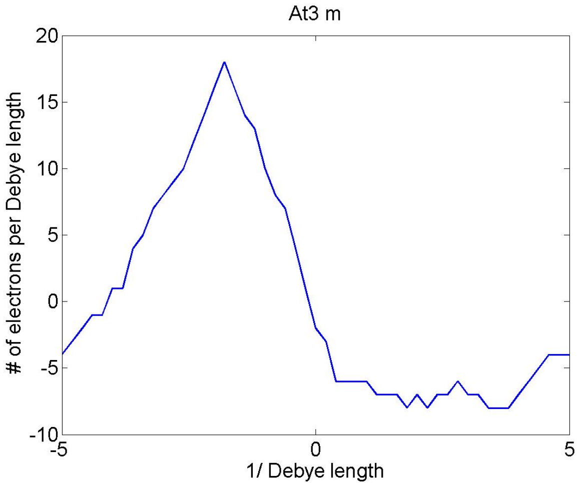
$v_{ion} = 1\beta_z$, longitudinal number distribution



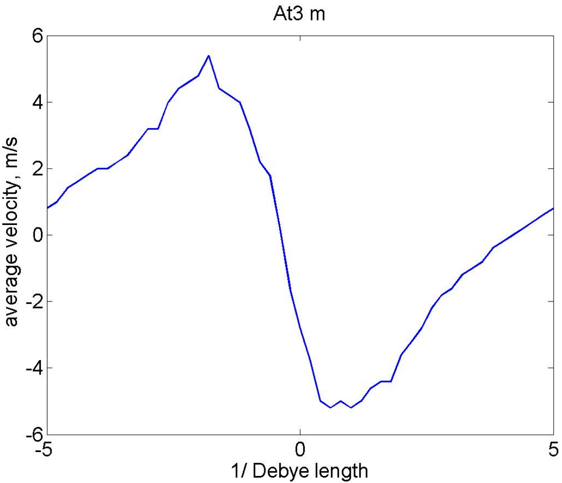
$v_{ion} = 1\beta_z$, longitudinal velocity distribution



$v_{ion} = 2\beta_z$, longitudinal number distribution



$v_{ion} = 2\beta_z$, longitudinal velocity distribution



Magnetic field of quadrupole

$$\begin{pmatrix} B_x \\ B_y \\ B_z \end{pmatrix} = -\frac{\mathsf{G}}{\mathbf{b1}} \cdot \begin{pmatrix} B_{\text{fringe,x}}\left(\mathbf{b1}\ x, \mathbf{b1}\ y, \mathbf{b1}\ (z - \frac{1}{2}L)\right) + B_{\text{fringe,x}}\left(\mathbf{b1}\ x, \mathbf{b1}\ y, \mathbf{b1}\ (-z - \frac{1}{2}L)\right) \\ B_{\text{fringe,y}}\left(\mathbf{b1}\ x, \mathbf{b1}\ y, \mathbf{b1}\ (z - \frac{1}{2}L)\right) + B_{\text{fringe,y}}\left(\mathbf{b1}\ x, \mathbf{b1}\ y, \mathbf{b1}\ (-z - \frac{1}{2}L)\right) \\ B_{\text{fringe,z}}\left(\mathbf{b1}\ x, \mathbf{b1}\ y, \mathbf{b1}\ (z - \frac{1}{2}L)\right) - B_{\text{fringe,z}}\left(\mathbf{b1}\ x, \mathbf{b1}\ y, \mathbf{b1}\ (-z - \frac{1}{2}L)\right) \end{pmatrix}$$

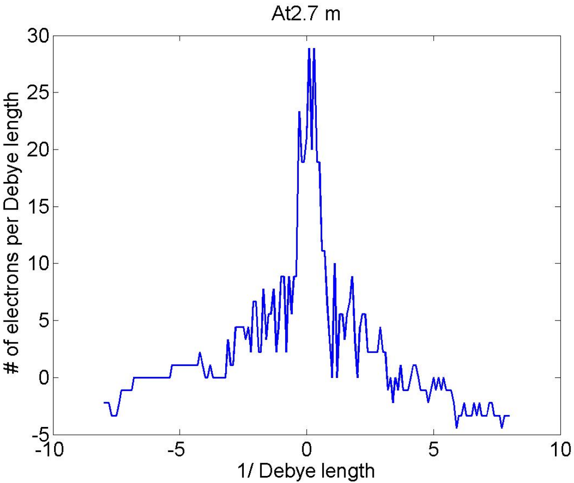
Magnetic field of quadrupole (continue)

$$\mathbf{B}_{\text{fringe}}(x,y,z)=\frac{1}{4}\begin{pmatrix} -y-2\arctan\left(-\dfrac{\sin(y)}{e^{-z}+\cos(y)}\right)+\dfrac{y\sinh(z)}{\cos(x)+\cosh(z)} \\ -x-2\arctan\left(-\dfrac{\sin(x)}{e^{-z}+\cos(x)}\right)+\dfrac{x\sinh(z)}{\cos(y)+\cosh(z)} \\ \dfrac{y\sin(x)}{\cos(x)+\cosh(z)}+\dfrac{x\sin(y)}{\cos(y)+\cosh(z)} \end{pmatrix}$$

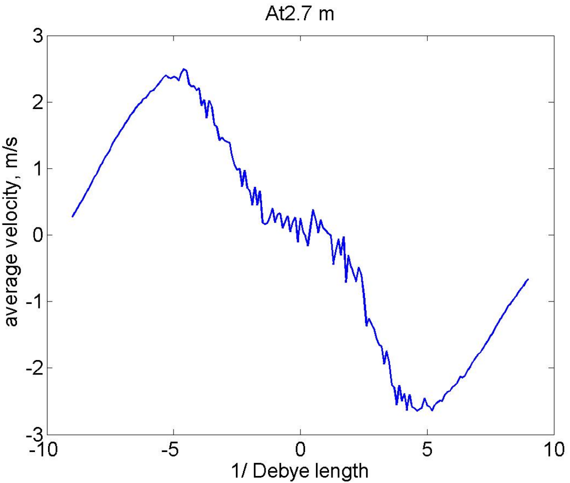
Magnetic field of quadrupole (continue)

- $G = K = K_1 \cdot B\rho$
- $b_1 = \pi / r_{bore}$
- r_{bore} =3cm or 12cm

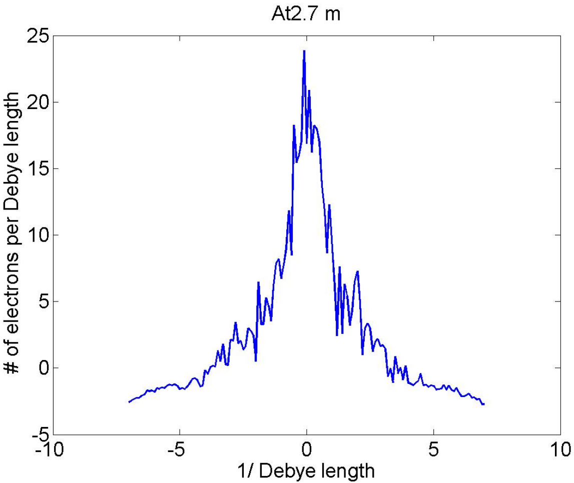
$r_{bore} = 3cm$, longitudinal number distribution



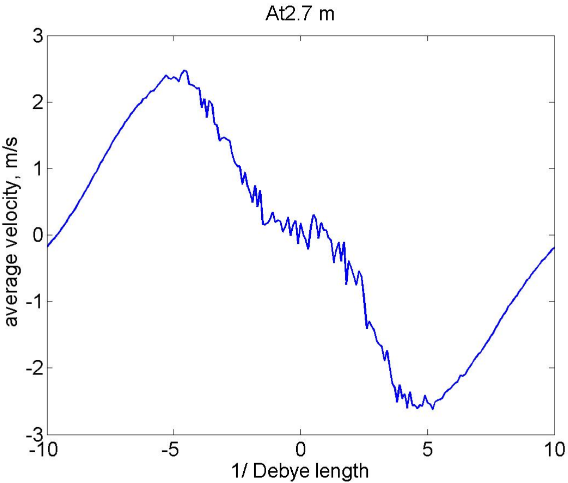
$r_{bore} = 3cm$, longitudinal velocity distribution



$r_{bore} = 12cm$, longitudinal number distribution



$r_{bore} = 12cm$, longitudinal velocity distribution



Magnetic field of dipoles

- $B(s) = B_0 \sin(k_w \cdot s)$
- $k_w = 2\pi/\lambda_w$
- $\lambda_w = 4cm$
- $B_0 = 0.2T$

Motion of electron bunch

- Length of dipoles is 7 m.
- Dipoles' magnetic field makes electron bunch move along negative z direction, which requires even larger computational domain than 3-pole wiggler simulations.
- Use coarse mesh for prelim dipoles simulations

Dipoles effect at 1 m