



Ballistic Bunch Compression in Single Mode Structure

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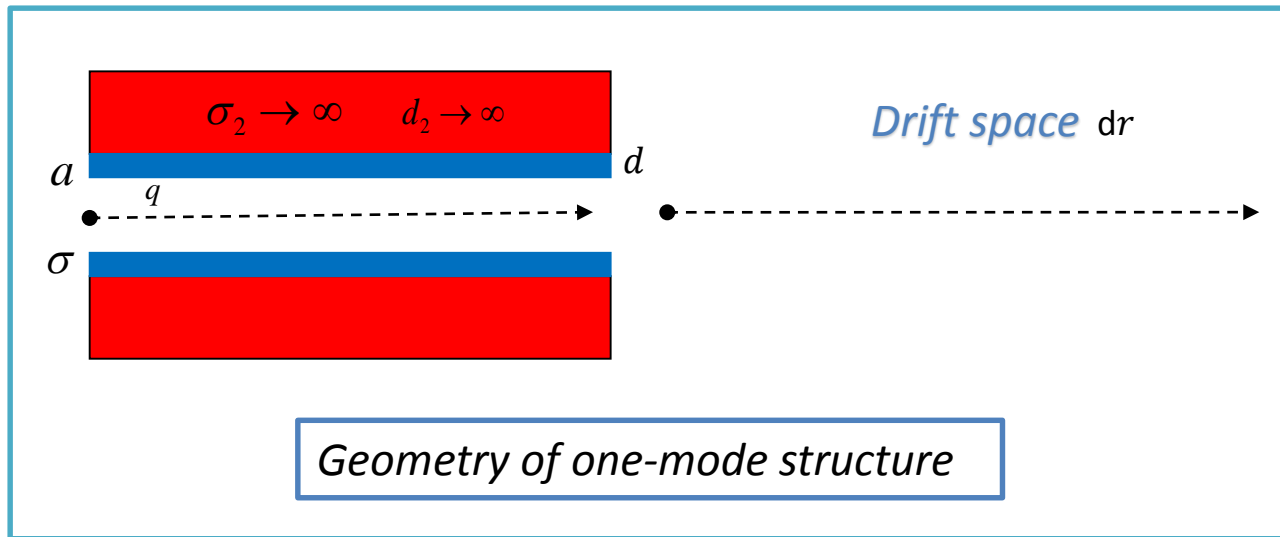
Outline

- Problem definition
- Structure description
- Micro-bunching of uniform and parabolic bunches
- Gaussian bunch compression
- Summary

Problem definition

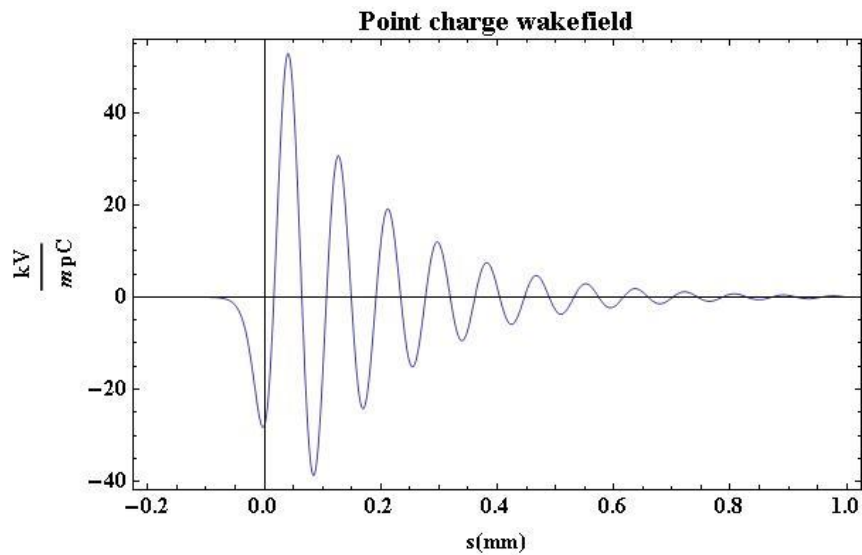
Study of micro-bunching and compression of a bunch after passing through a single-mode waveguide.

Scheme of the structure

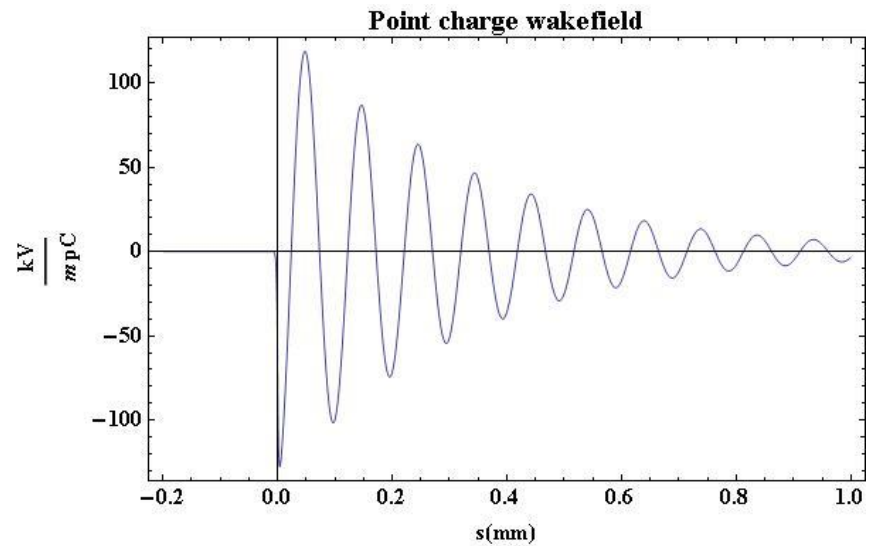


Point charge wake function

$$a = 0.5\text{mm}, d = 1\mu\text{m}, \sigma = 10^4 \frac{\text{S}}{\text{m}}$$



E=10MeV



E=40MeV

Parabolic bunch

Structure and bunch parameters

$$E = 10\text{MeV}$$

$$q = 100\text{pC}$$

$$a = 0.5\text{mm}$$

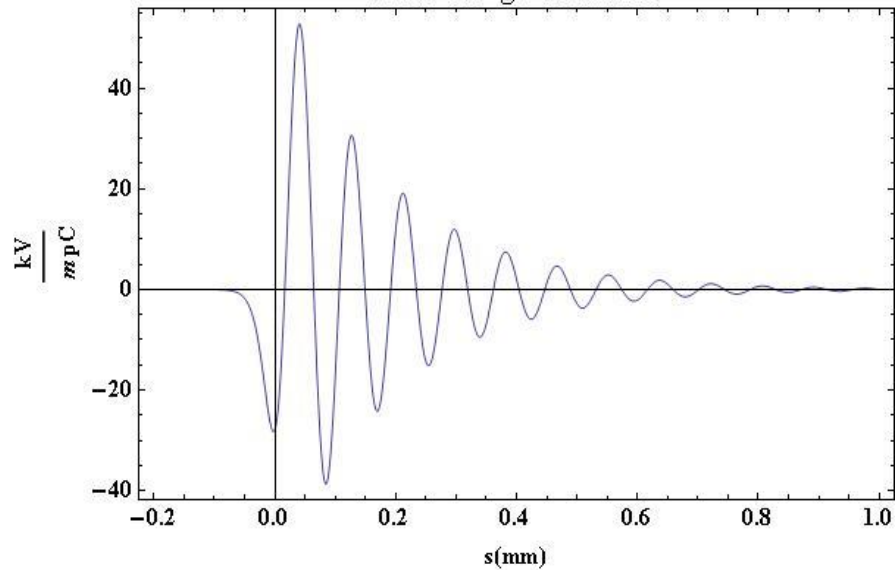
$$d = 1\mu\text{m}$$

$$\sigma = 10^4 \frac{\text{S}}{\text{m}}$$

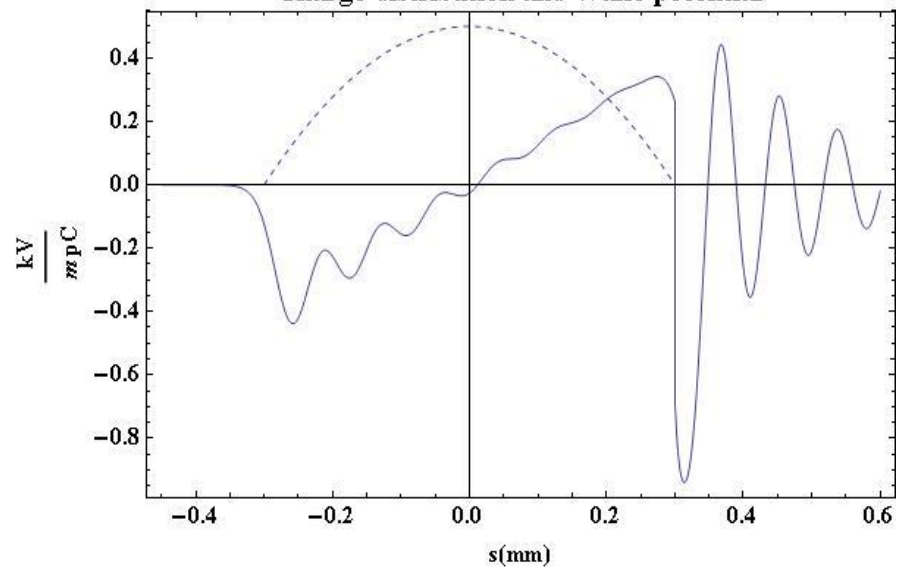
$$L = 0.5\text{m}$$

$$a_{\text{bunch}} = 300\mu\text{m}$$

Point charge wakefield

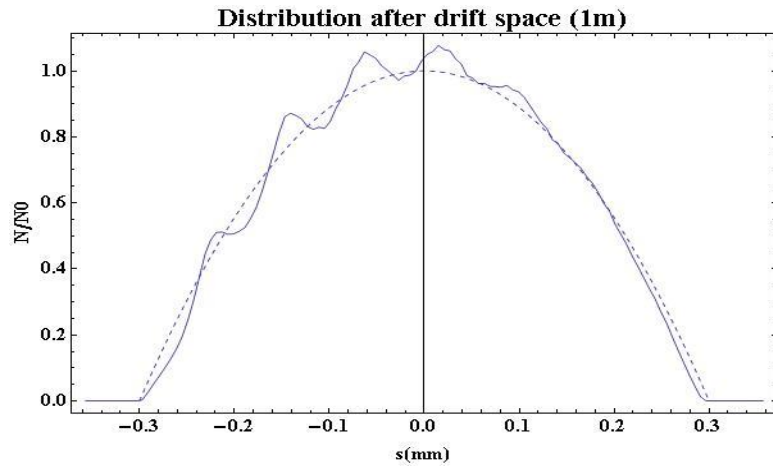


Charge distribution and Wake potential

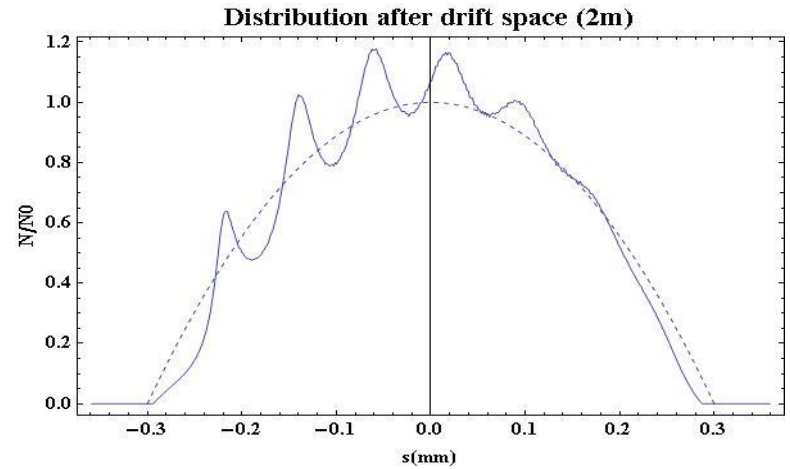


Parabolic bunch

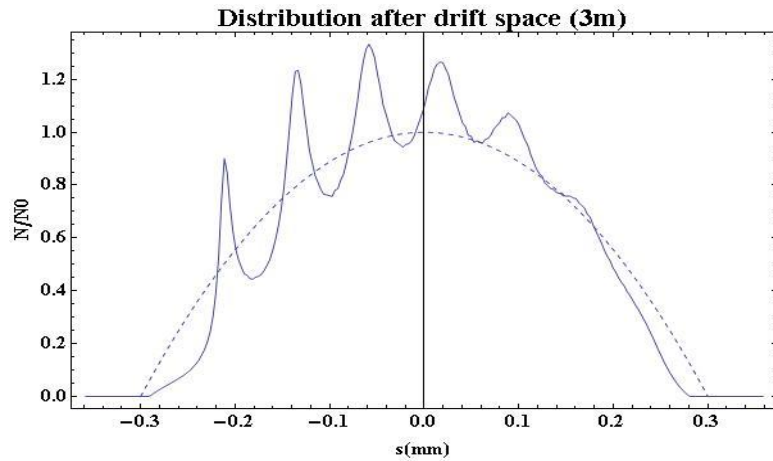
dr = 1m



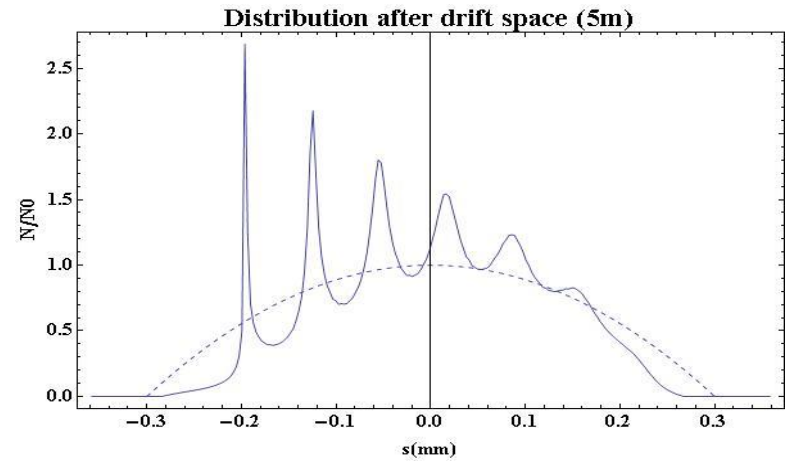
dr = 2m



dr = 3m



dr = 5m



Uniform bunch

Structure and bunch parameters

$$E = 10\text{MeV}$$

$$q = 100\text{pC}$$

$$a = 0.5\text{mm}$$

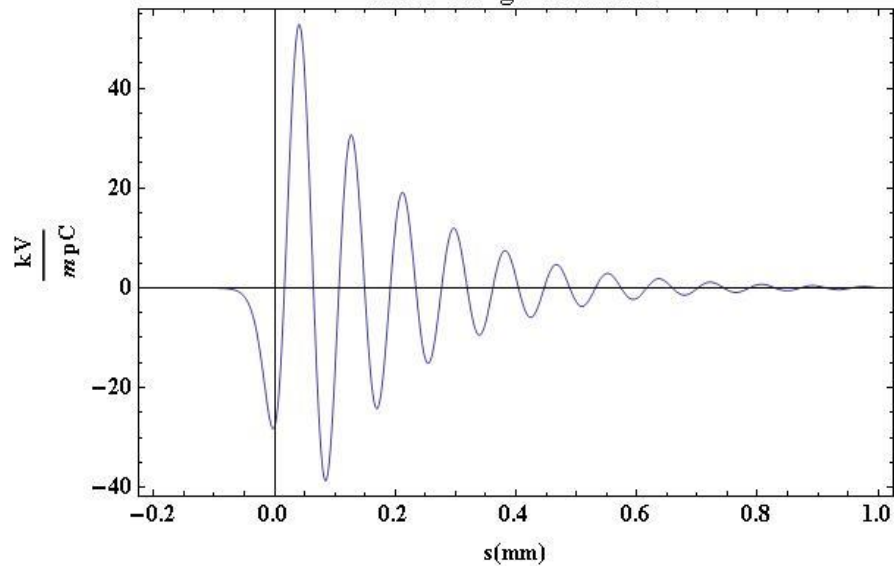
$$d = 1\mu\text{m}$$

$$\sigma = 10^4 \frac{\text{S}}{\text{m}}$$

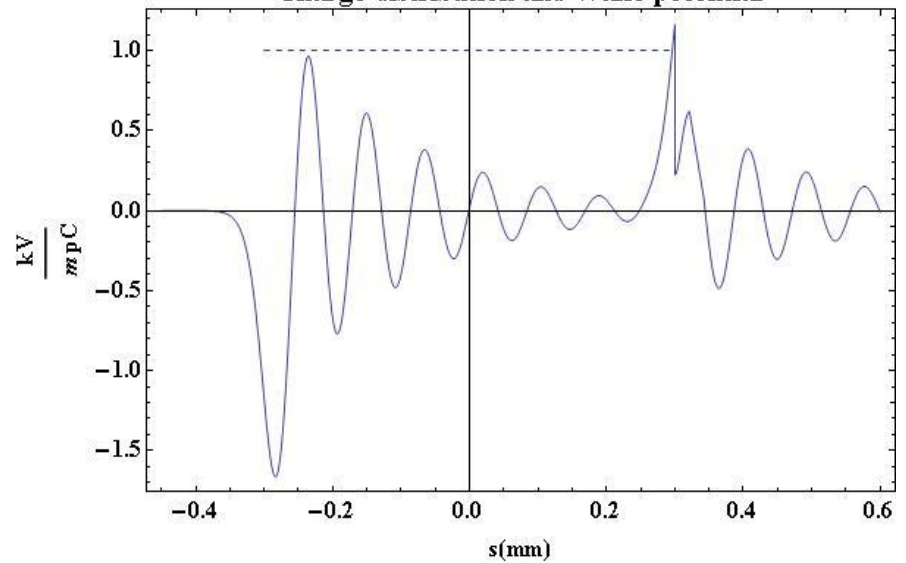
$$L = 0.5\text{m}$$

$$a_{\text{bunch}} = 300\mu\text{m}$$

Point charge wakefield

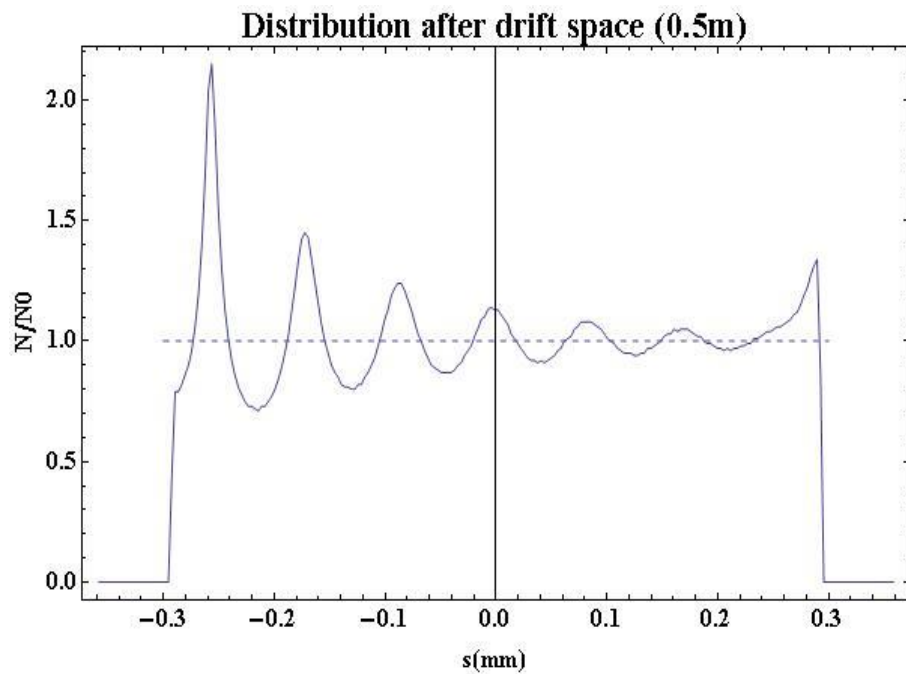


Charge distribution and Wake potential

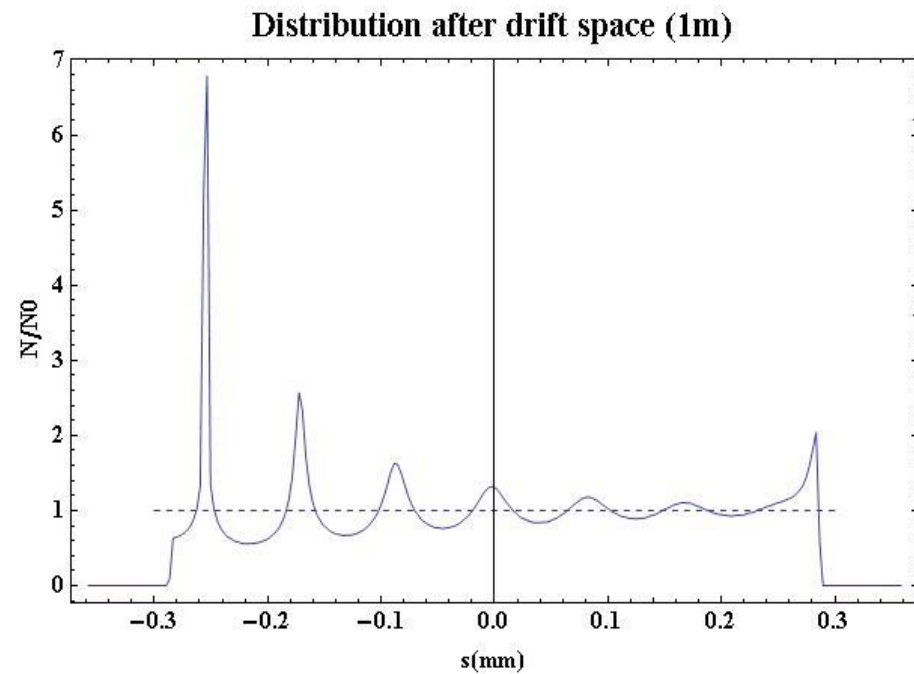


Uniform bunch

$$dr = 0.5m, \sigma = 21\mu m$$



$$dr = 1m, \sigma = 8.36\mu m$$



Gaussian bunch

Structure and bunch parameters

$$E = 10\text{MeV}$$

$$q = 100\text{pC}$$

$$a = 0.5\text{mm}$$

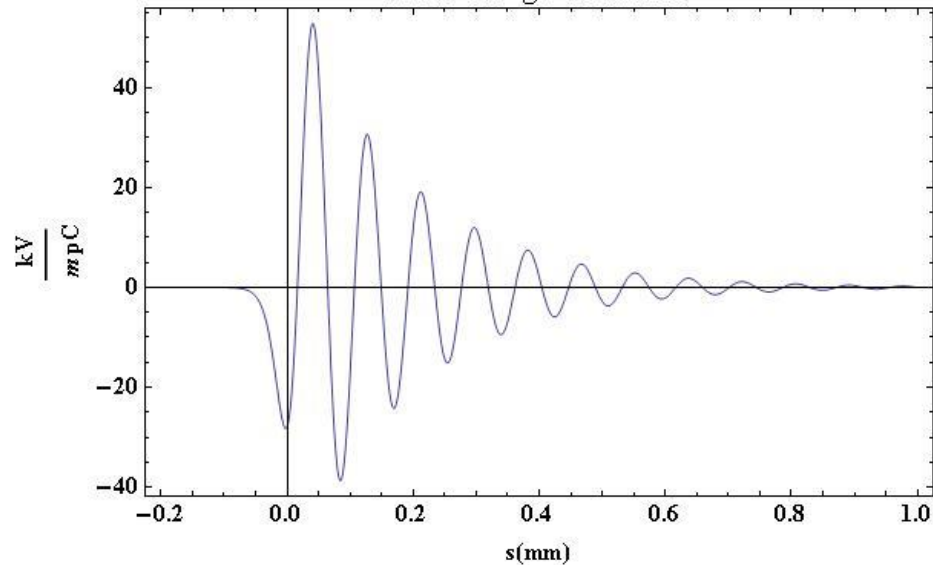
$$d = 1\mu\text{m}$$

$$\sigma = 10^4 \frac{\text{S}}{\text{m}}$$

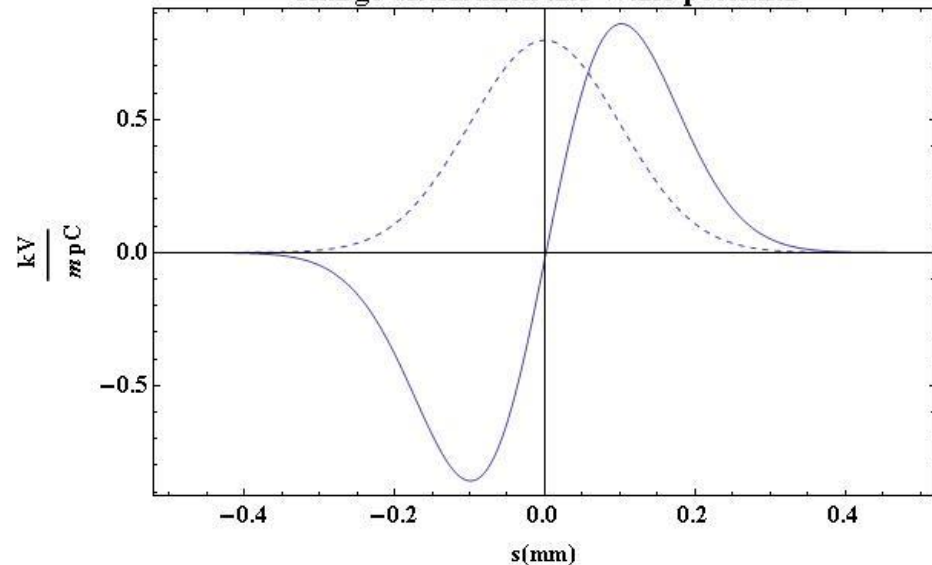
$$L = 1\text{m}$$

$$\text{rms} = 100\mu\text{m}$$

Point charge wakefield

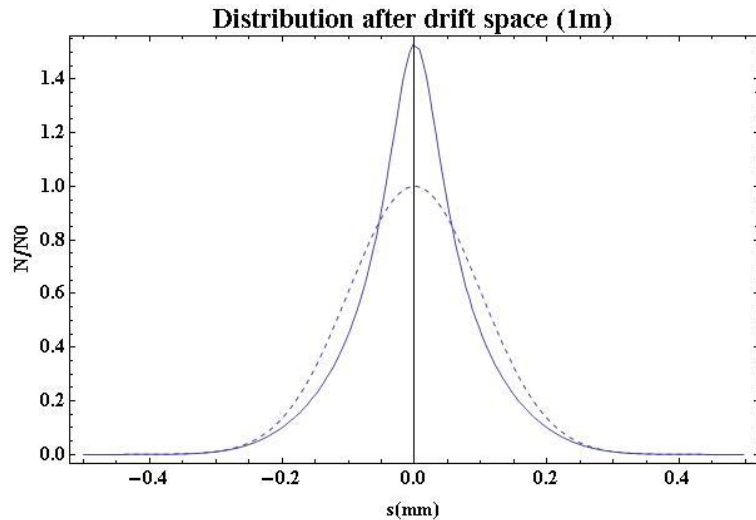


Charge distribution and Wake potential

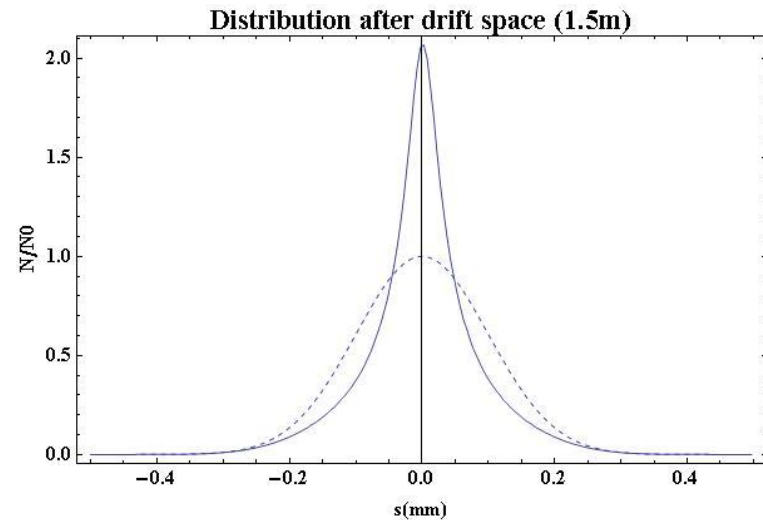


Gaussian bunch

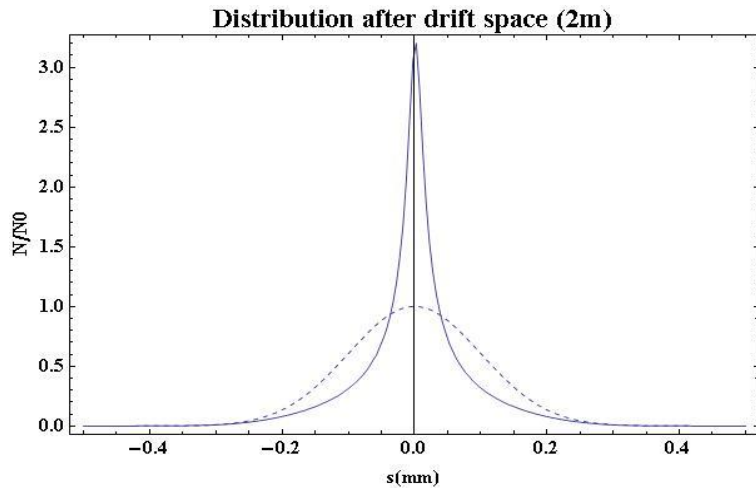
$$dr = 1m, \sigma = 46.2\mu m$$



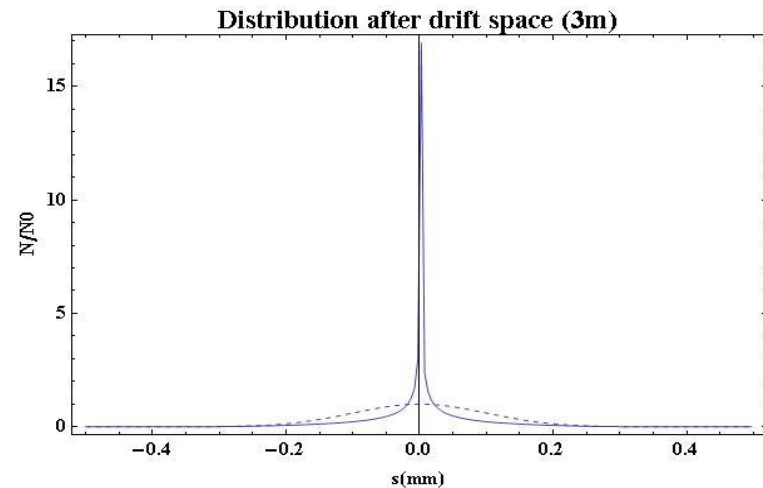
$$dr = 1.5m, \sigma = 38.1\mu m$$



$$dr = 2m, \sigma = 32\mu m$$



$$dr = 3m, \sigma = 18.7\mu m$$



Summary

- Bunch compression is shown for $300\mu m$ Uniform bunch up to $8.36\mu m$
- Bunch compression is shown for a $100\mu m$ Gaussian bunch up to $18.7\mu m$