The trouble with 20 μm emittance

john

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Matching

The a bunch macthed for the blowout regime must satisfy

$$\sigma_x = \frac{\sqrt{2\gamma}c}{\omega_p}\sigma_{x'}, \tag{1}$$

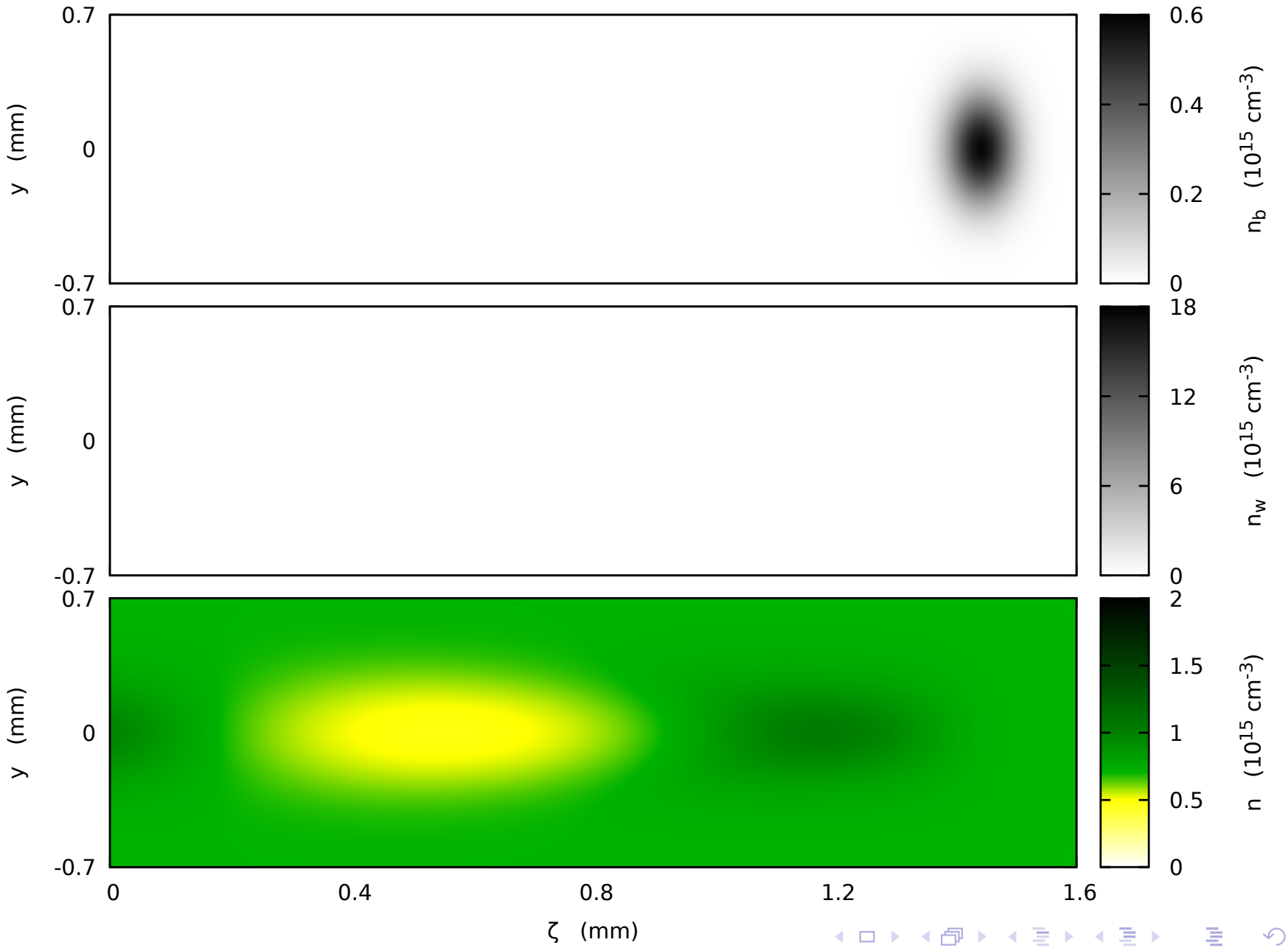
$$= \left(\frac{2c^2\epsilon_x^{*2}}{\gamma\omega_p^2}\right)^{1/4}, \tag{2}$$

and

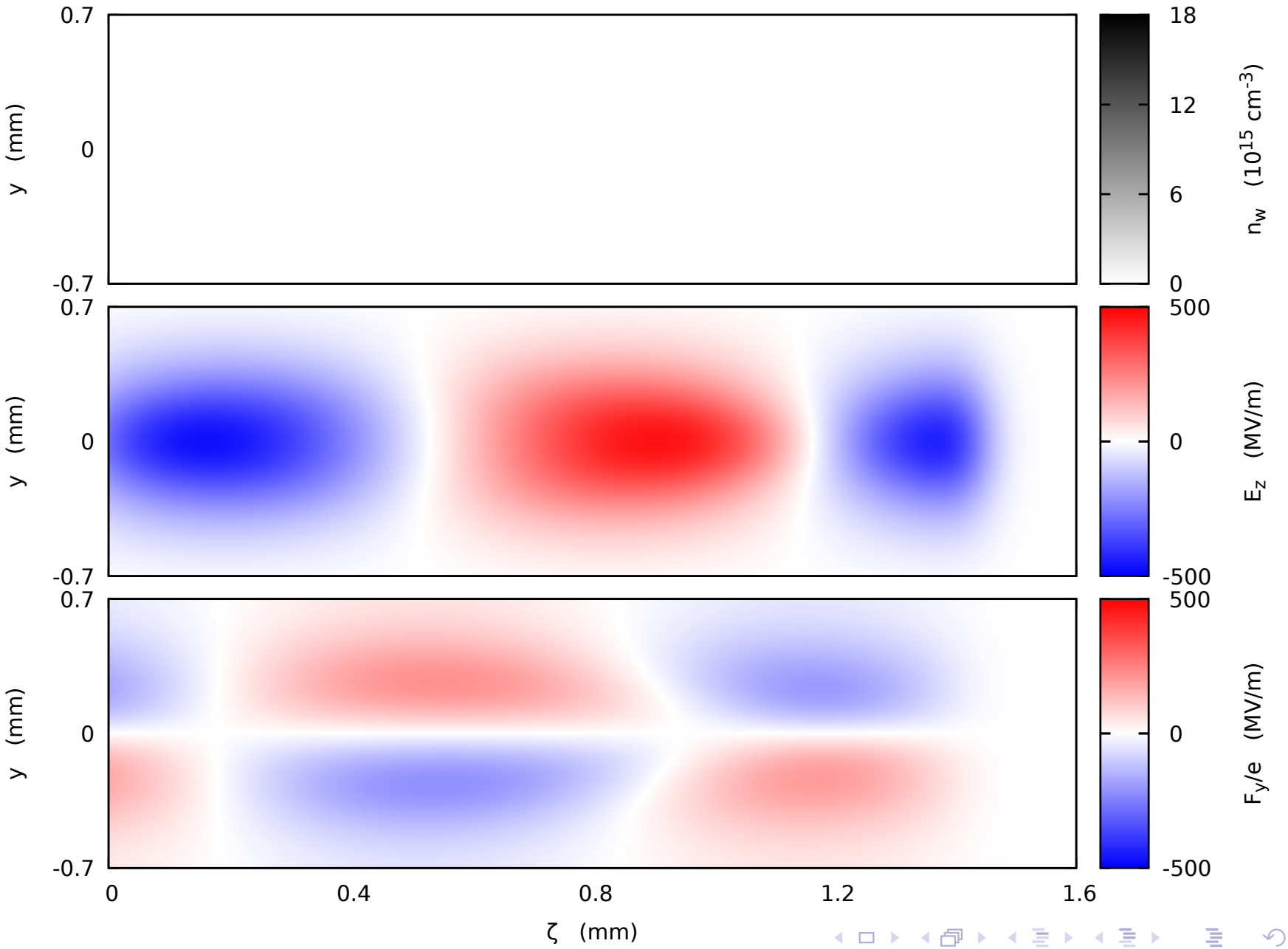
$$\beta = \frac{\sigma_x}{\sigma_{x'}} = \frac{\sqrt{2\gamma}c}{\omega_p} = \frac{1}{k_\beta}. \tag{3}$$

where $\epsilon^* = \gamma\sigma_x\sigma_{x'}$ is the normalised emittance.

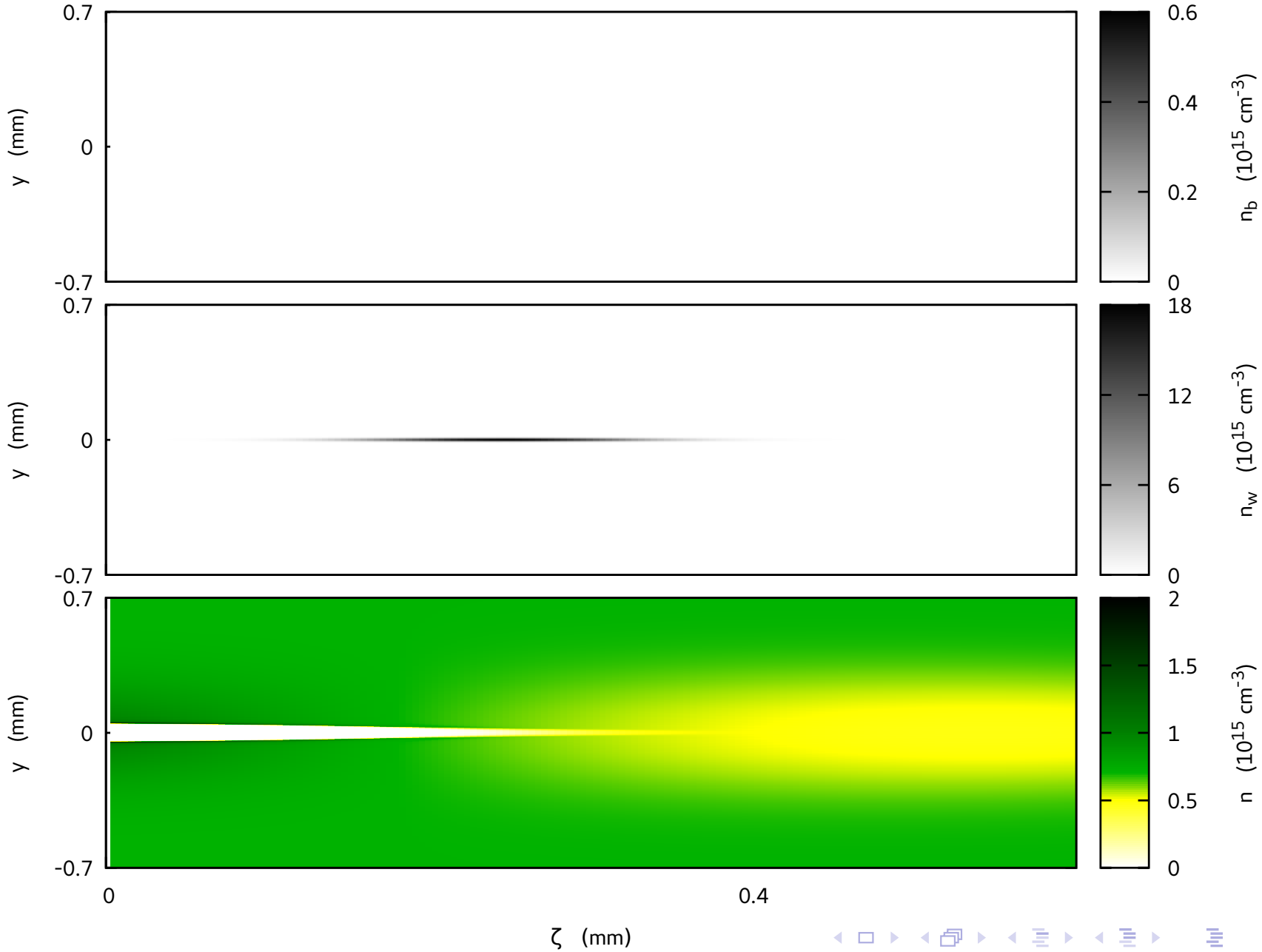
Veronica


0.7
0
-0.7
y (mm)
0.6
0.4
0.2
0
n_b (10^{15} cm^{-3})
18
12
6
n_w (10^{15} cm^{-3})
2
1.5
1
0.5
n (10^{15} cm^{-3})
0
0.4
0.8
1.2
1.6
ζ (mm)

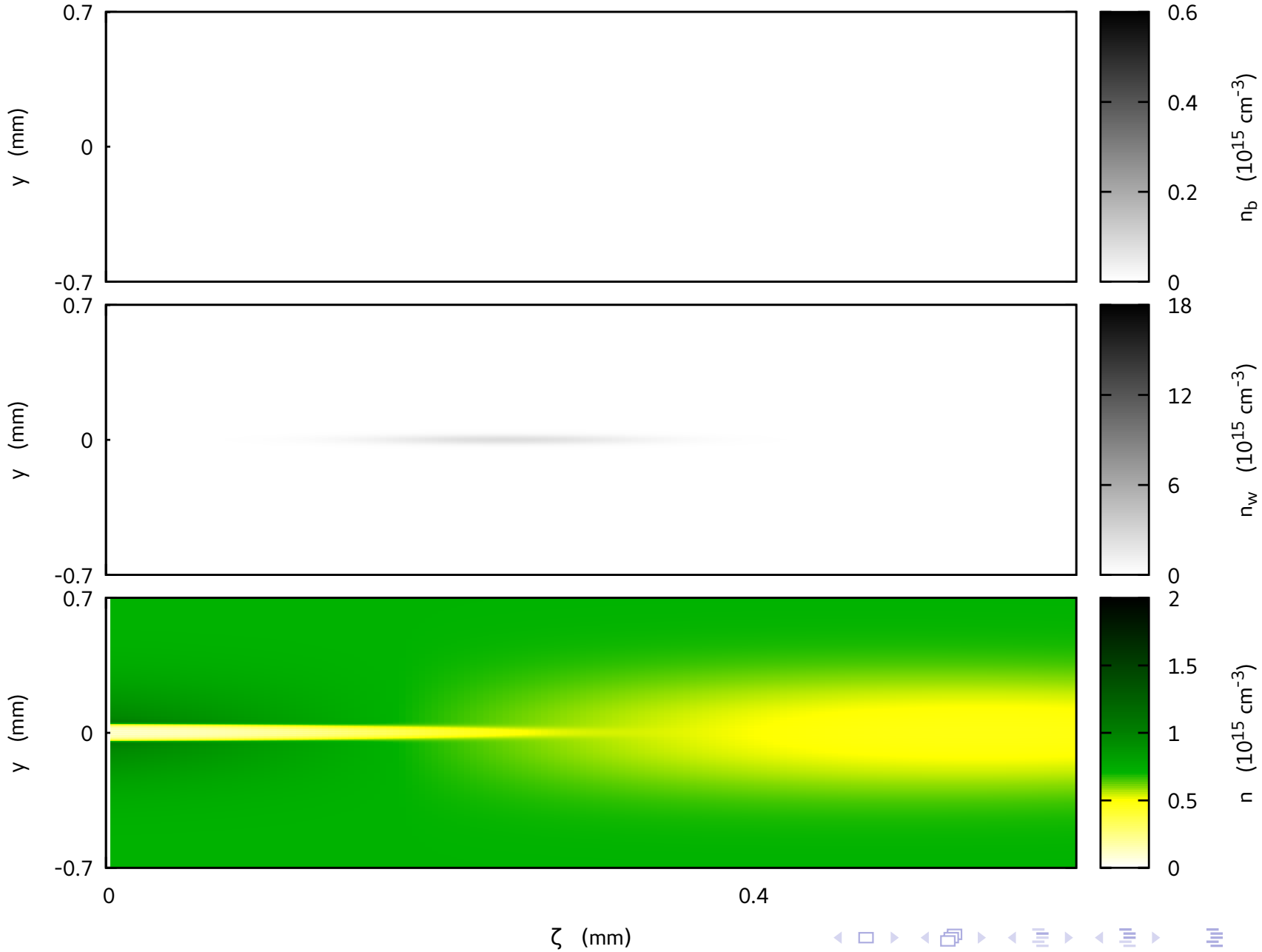
Veronica


0.7
0
-0.7
y (mm)
18
12
6
0
n_w (10^{15} cm^{-3})
500
0
-500
E_z (MV/m)
F_y/e (MV/m)
0
0.4
0.8
1.2
1.6
ζ (mm)

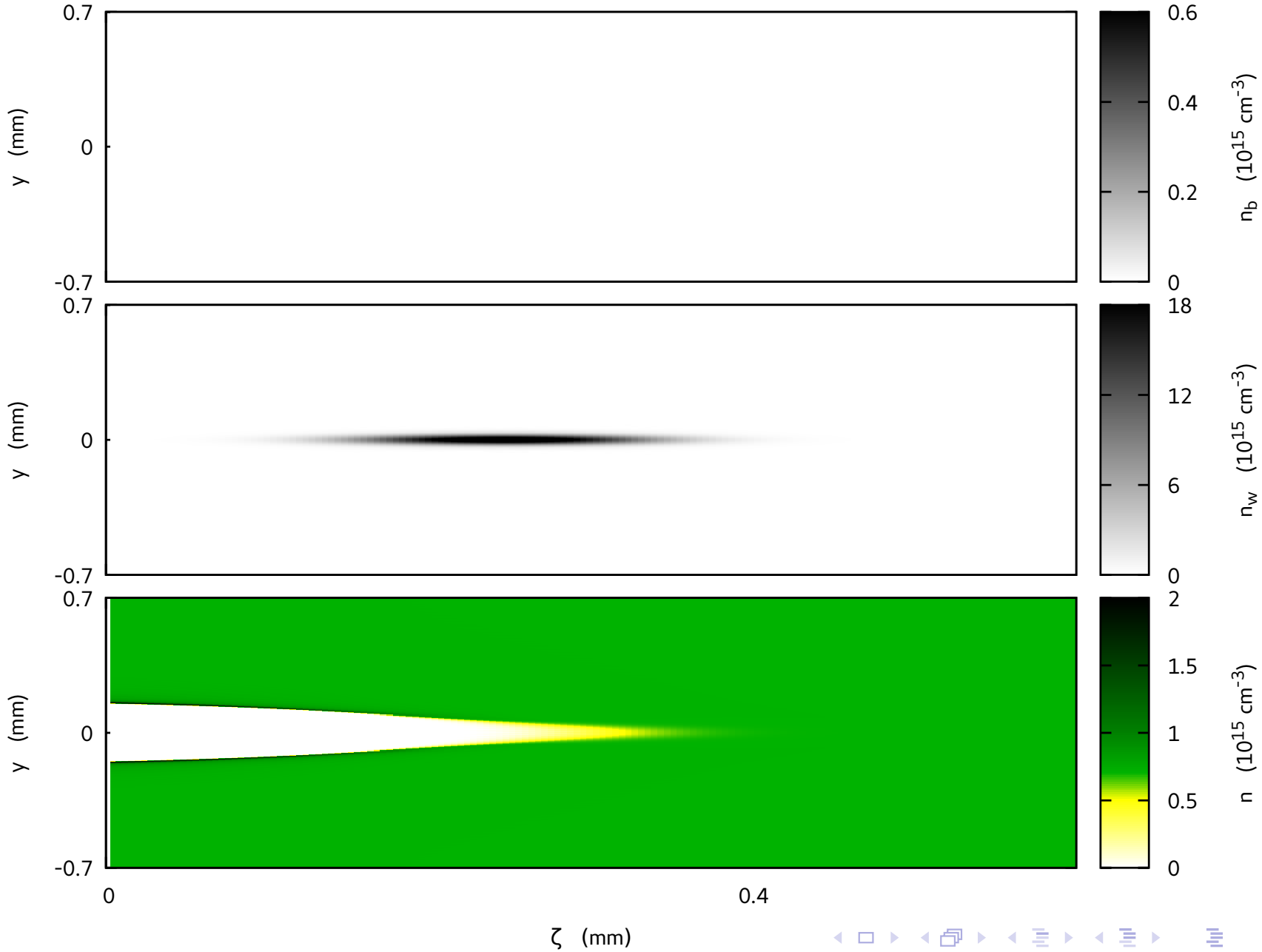
Veronica


0.7
0
-0.7
y (mm)
0.6
0.4
0.2
0
n_b (10^{15} cm^{-3})
18
12
6
n_w (10^{15} cm^{-3})
2
1.5
1
0.5
n (10^{15} cm^{-3})
0
0.4
ζ (mm)

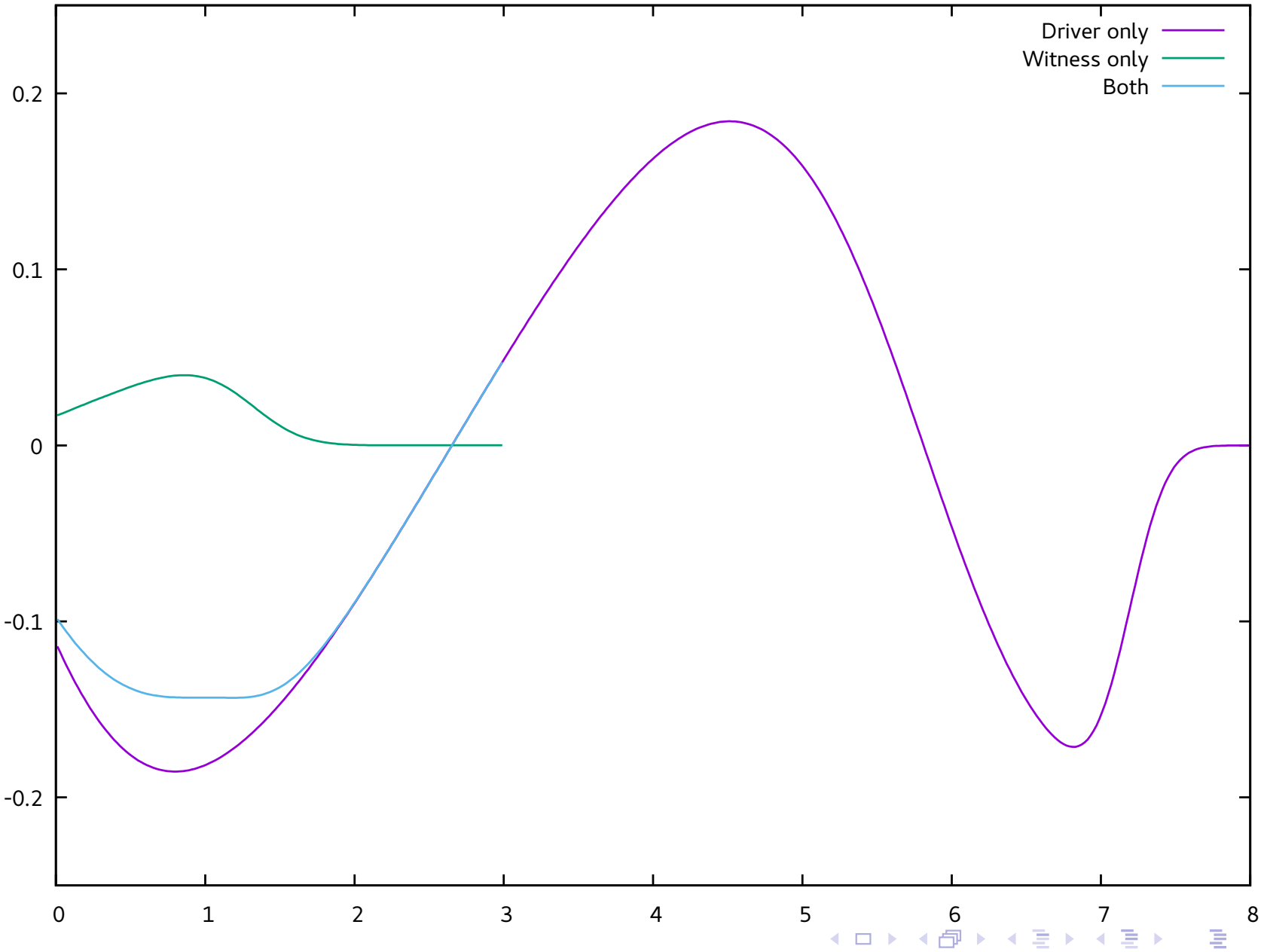
Veronica - 20 μm



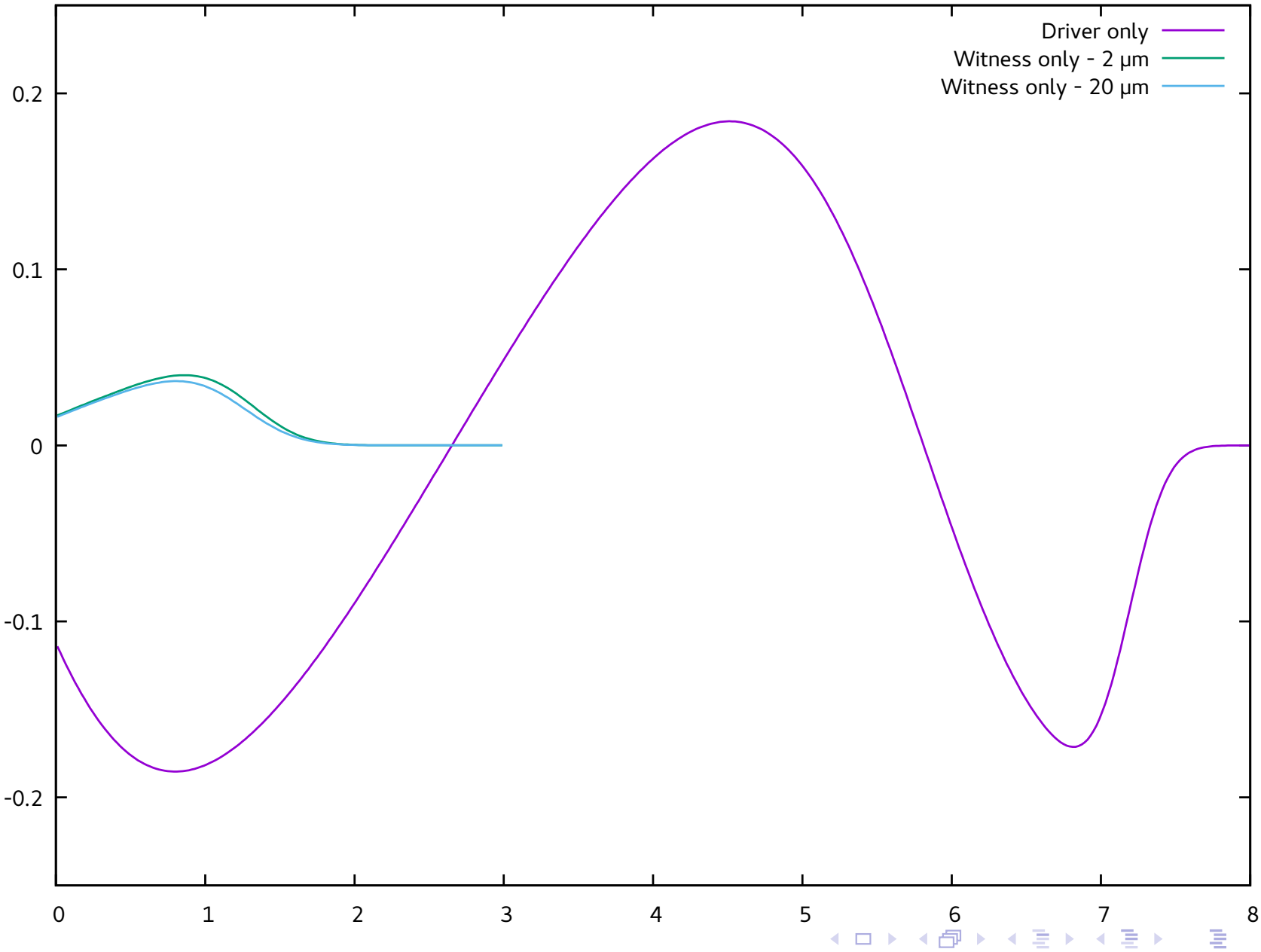
Veronica - 20 μm, 1 nC (witness only)



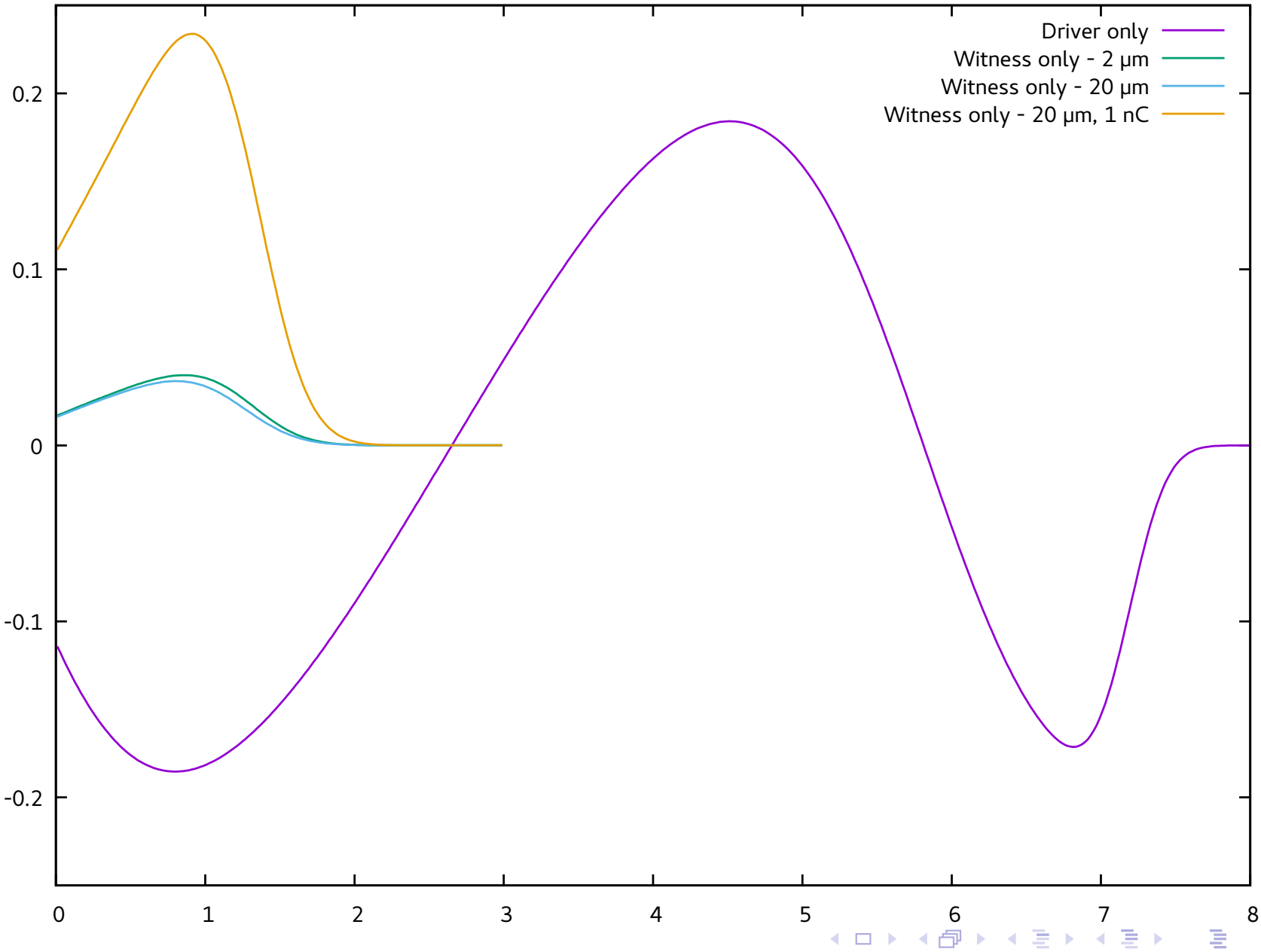
Beamloading



Beamloading



Beamloading



Conclusions

Beamloading involves the driver and witness wakes "cancelling out" to make a flat accelerating field

The scaled witness (keeping on-axis density the same) would have a charge of 1 nC

The decelerating field due to the witness is larger than the accelerating field from the driver! Not even possible to accelerate the whole witness