

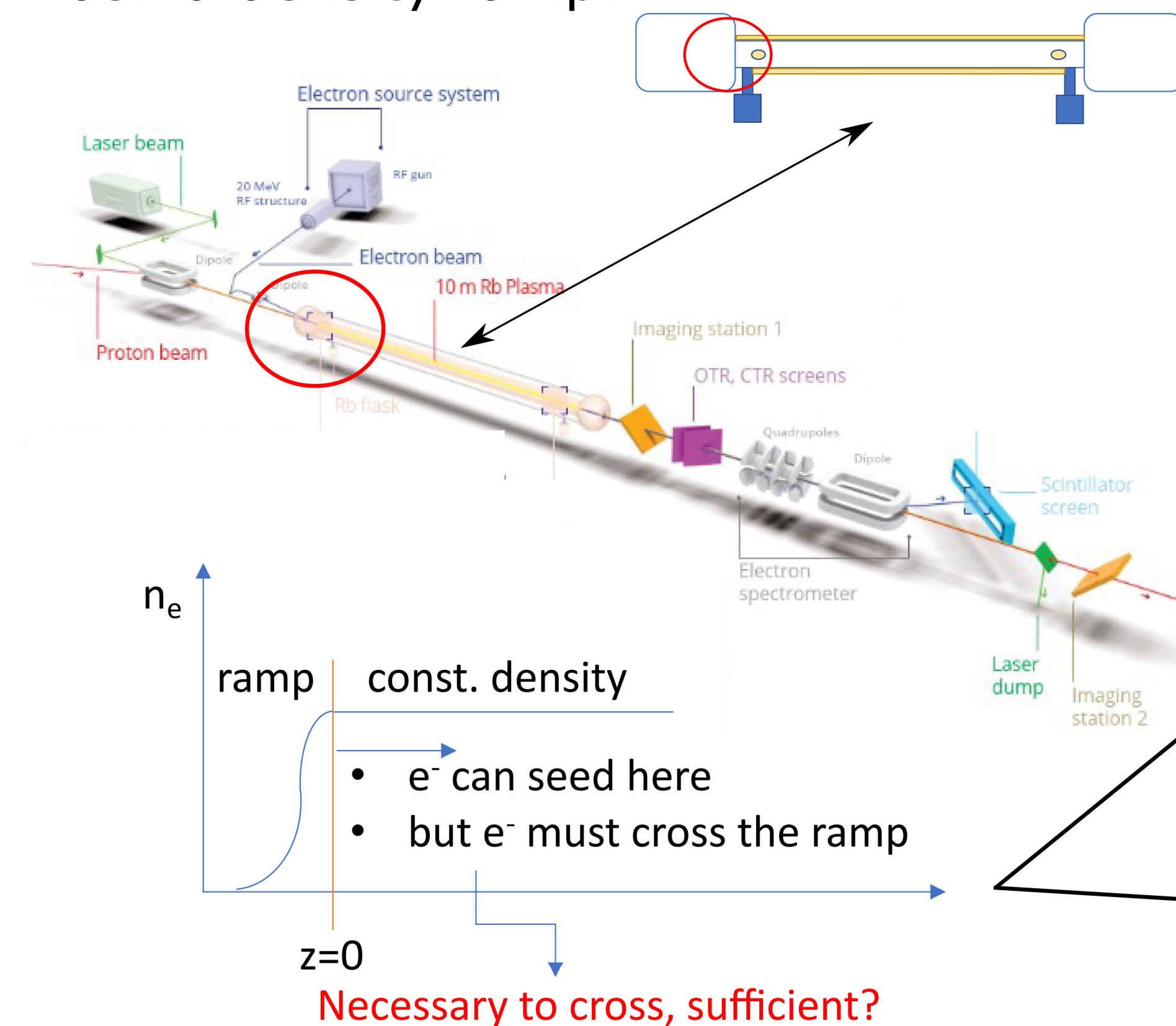
Effects of plasma density ramp measured in AWAKE

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Giovanni Zevi Della Porta², Patric Muggli¹ and AWAKE collaboration**

Abstract:

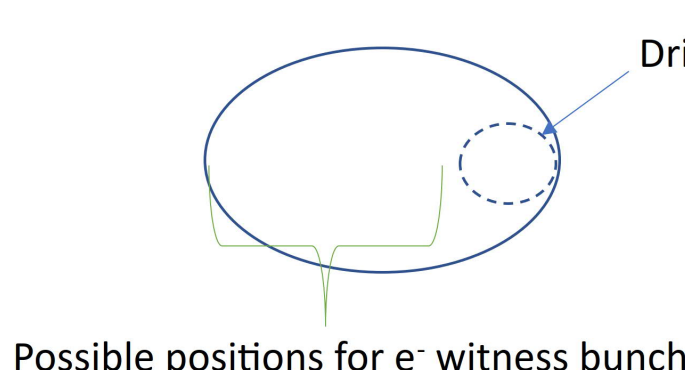
We study the propagation of an electron bunch travelling within a proton bunch through a plasma density ramp. Because the proton bunch density in the ramp is higher than the plasma density, the bunch generates a high density, on-axis plasma electron filament. This filament is defocusing for the electron witness bunch that can therefore be lost along the ramp. At AWAKE we have measured this effect by changing the relative timing of the electron bunch with respect to the proton bunch. When the electron bunch propagates in front of the proton bunch (i.e. seeding the self-modulation), the electrons travel until the electron spectrometer, downstream of the plasma column. A position of the electrons within the proton bunch, where seeding stops, exists. Beyond this position electrons are lost and do not reach the spectrometer. We will present latest experimental data obtained during Run 2.

Plasma density ramp:



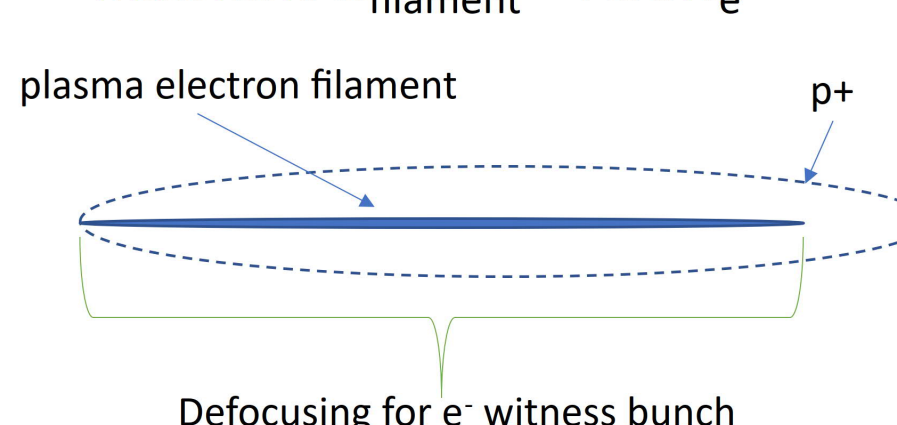
Electron/laser driver

- Focusing position for witness (e^-) within first wakefield bucket

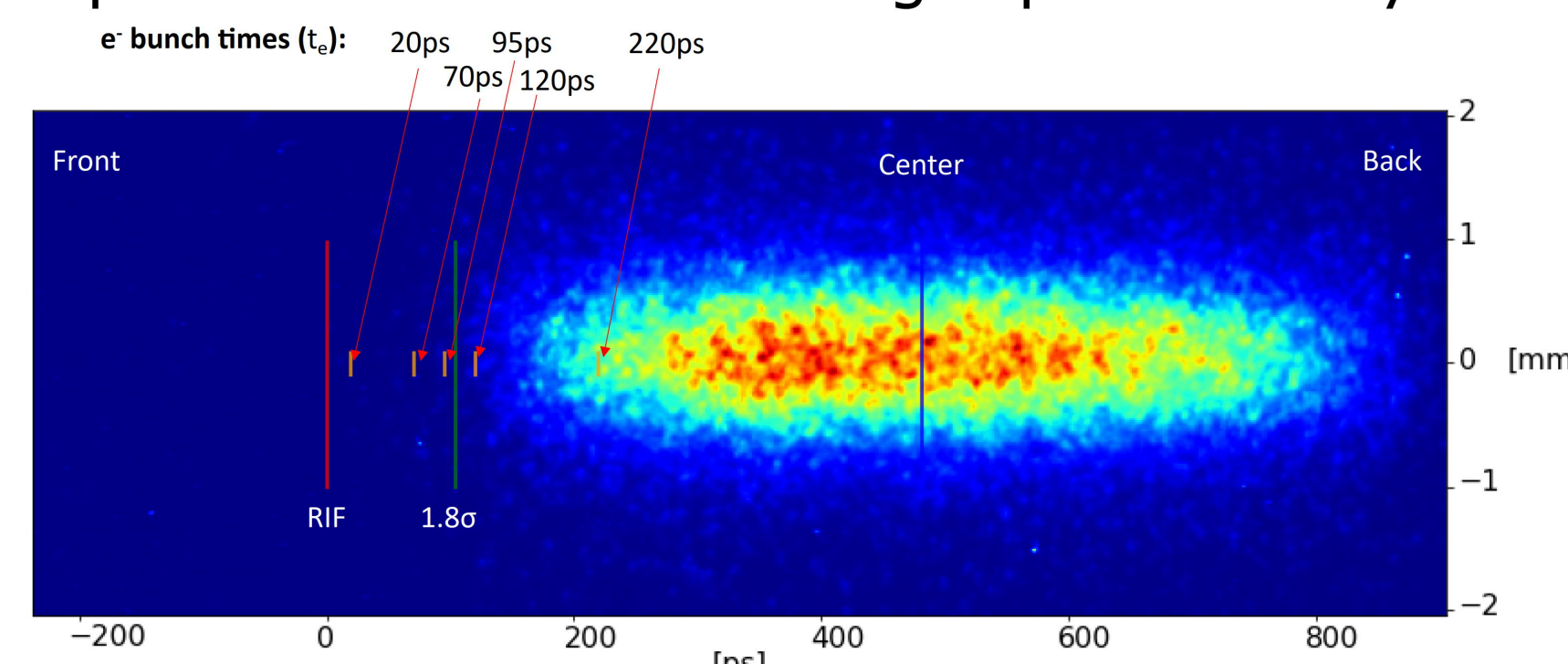


Proton driver

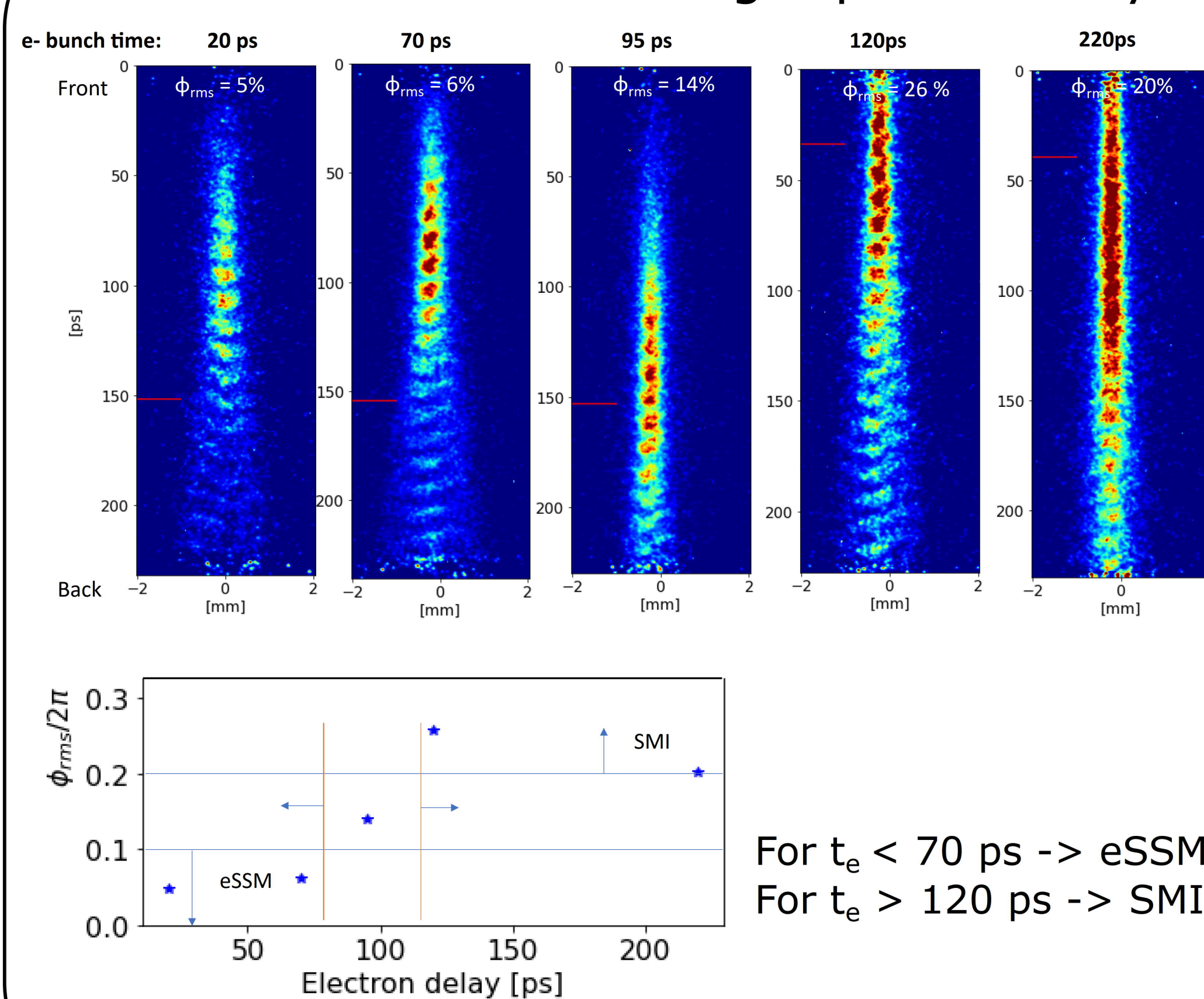
- Formation of plasma electron filament $n_{\text{filament}} > 100n_e$



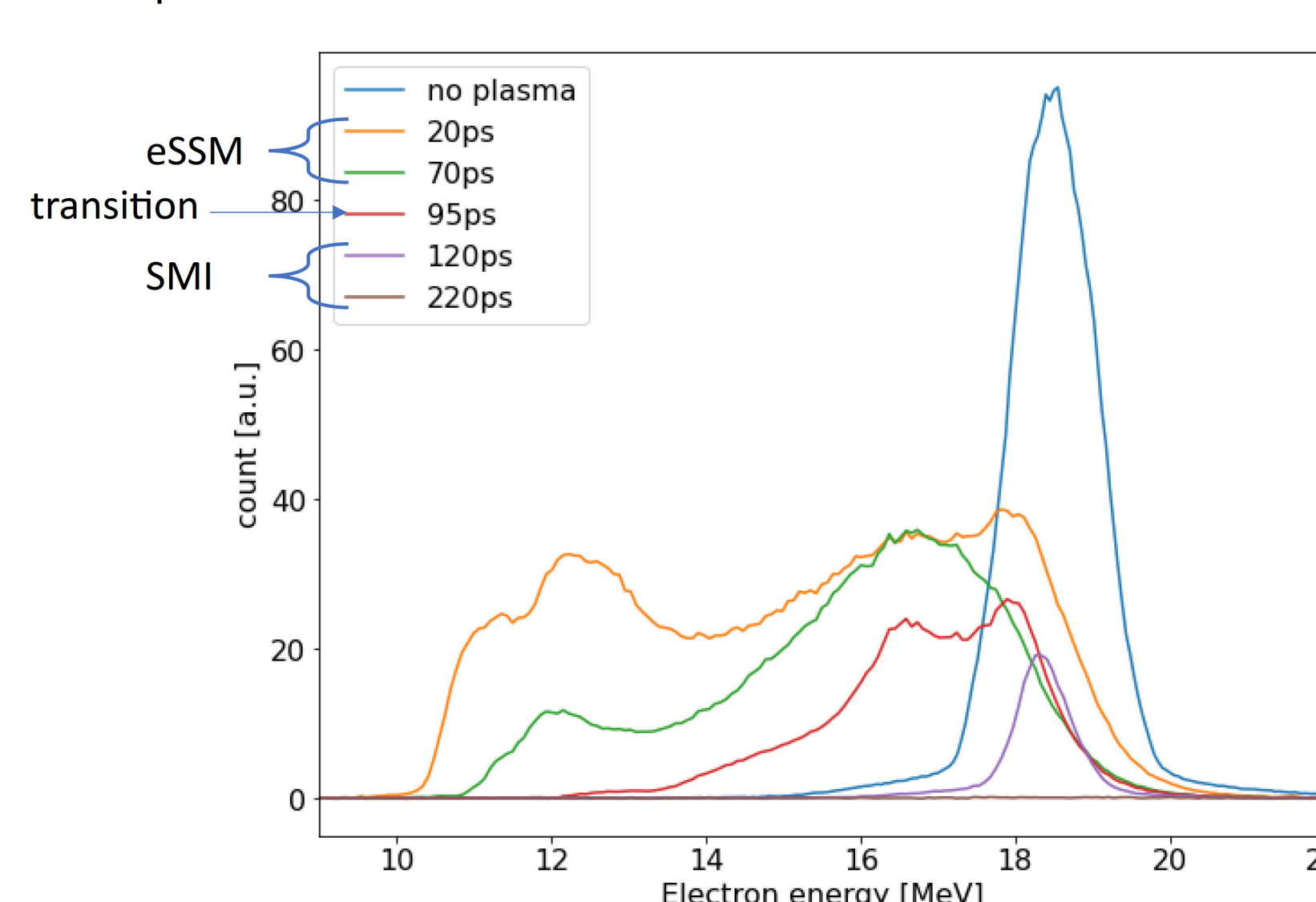
Measure electron energy spectrum + charge
Measure proton microbunch timing reproducibility



Proton microbunch timing reproducibility:



Electron energy spectrum: after plasma



Q_e decreases as t_e increases
 $Q_e > 0$ but $\Phi_{rms} > 20\%$

Charge at initial energy survives, but does not seed, also when no charge seen -> SMI

Summary:

Plasma electron filament disturbs the electron bunch, inhibiting seeding for $t_e > 70$ ps

Impossible to accelerate electron bunch -> RUN2 issue?

Measurement consistent with numerical simulations (see Pablo's poster)

Explanation of the charge seen at spectrometer pending