LUDWIG-
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MÜNCHEN

Centre for Advanced Laser Applications

FEW-CYCLE SHADOWGRAPHY OF PLASMA WAVE TRAINS

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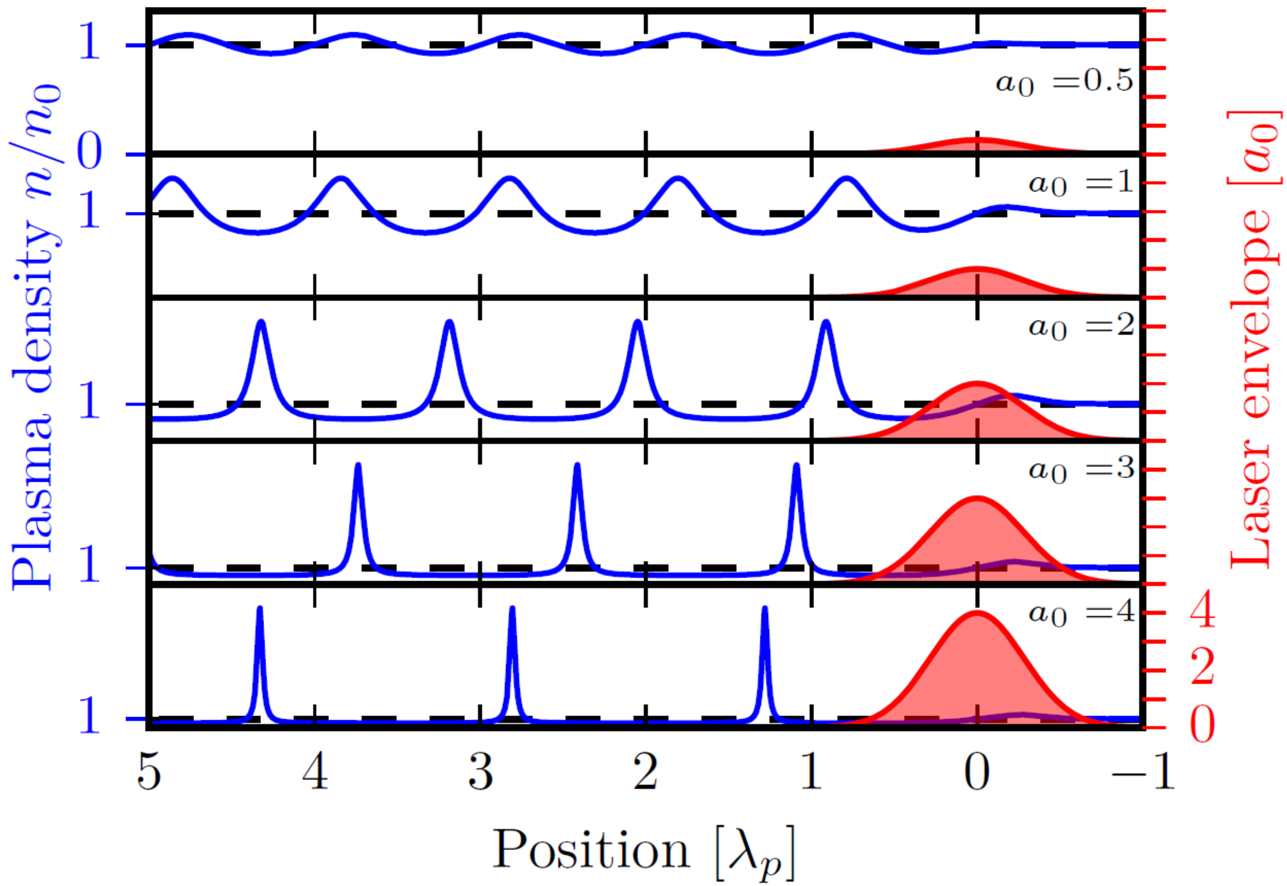
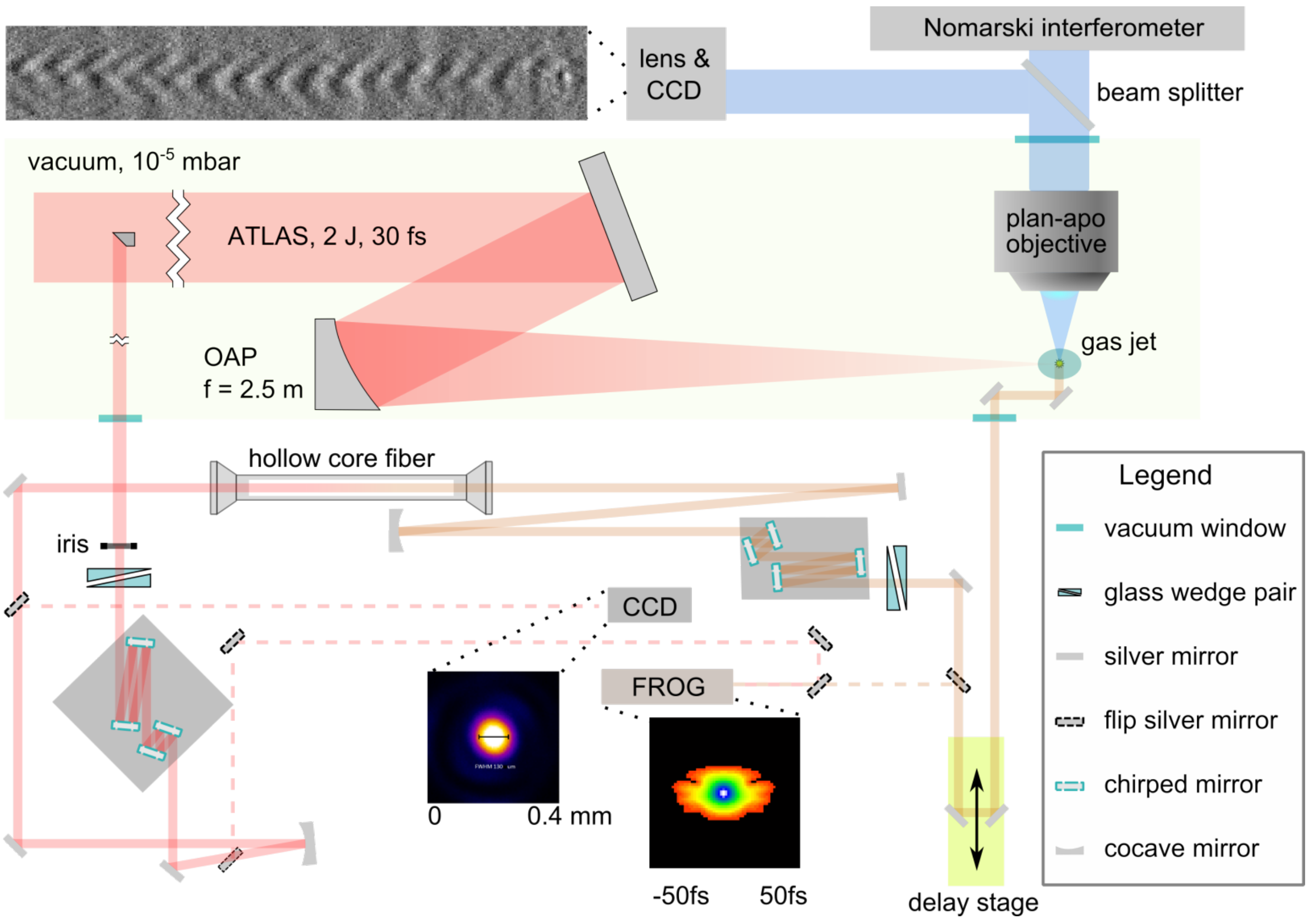
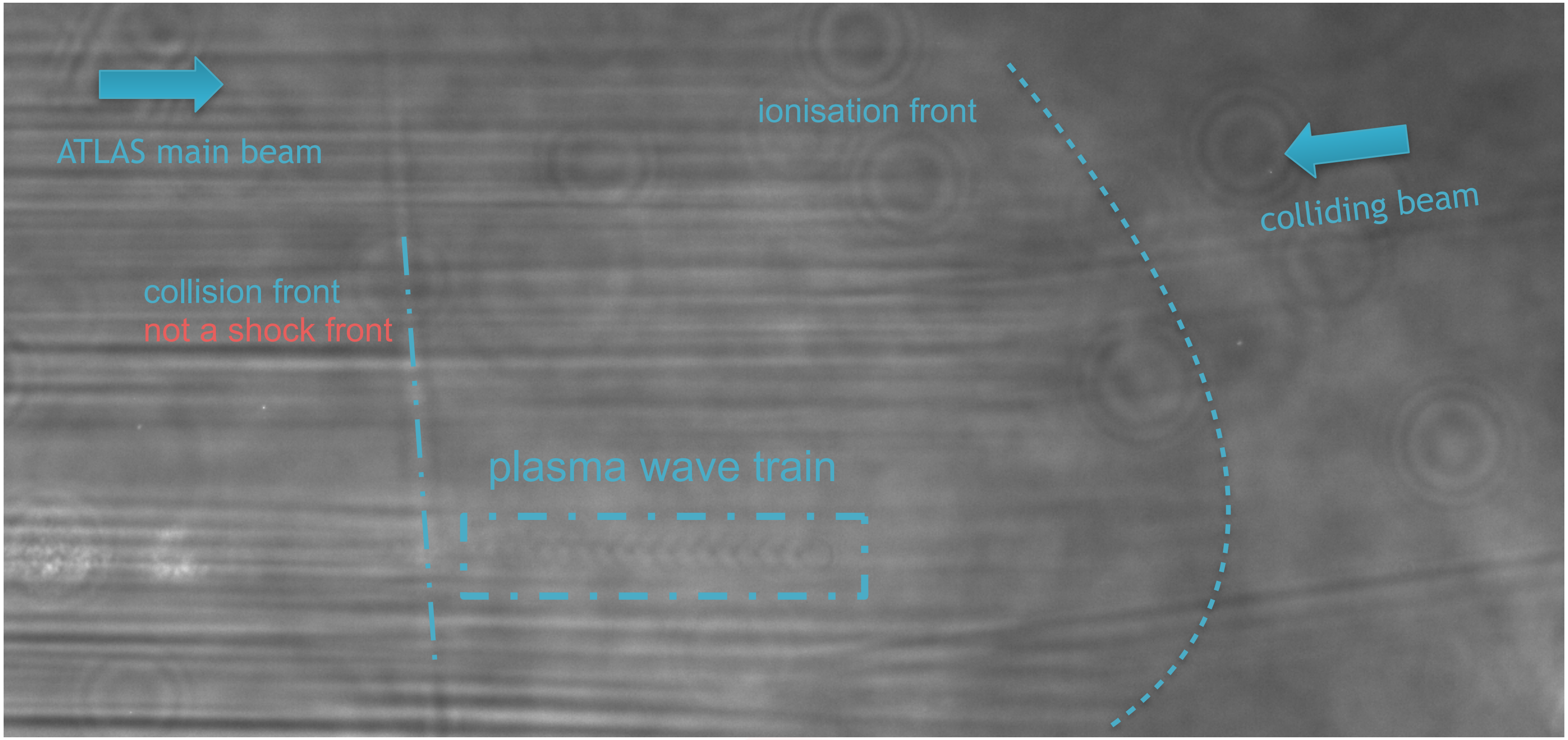
Laser Plasma Accelerator Workshop
5-10 May 2019, MedILS, Split

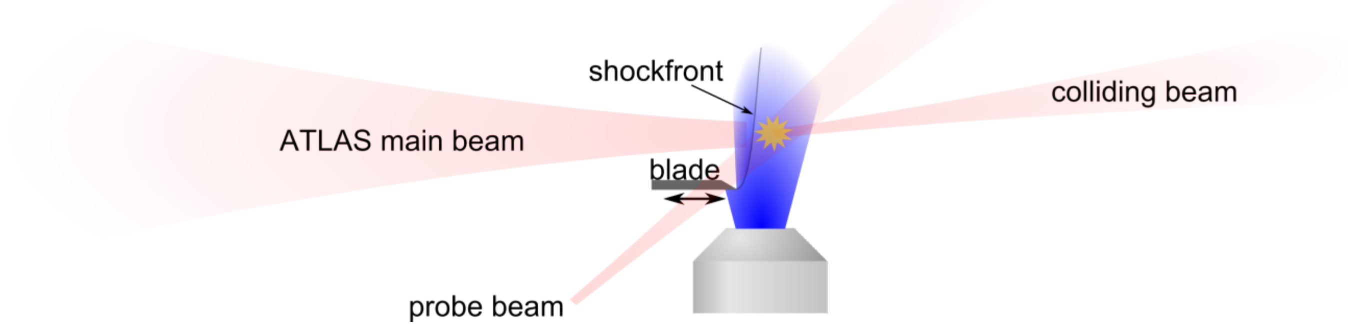
Wakefield excitation in 1D fluid theory



Experimental setup

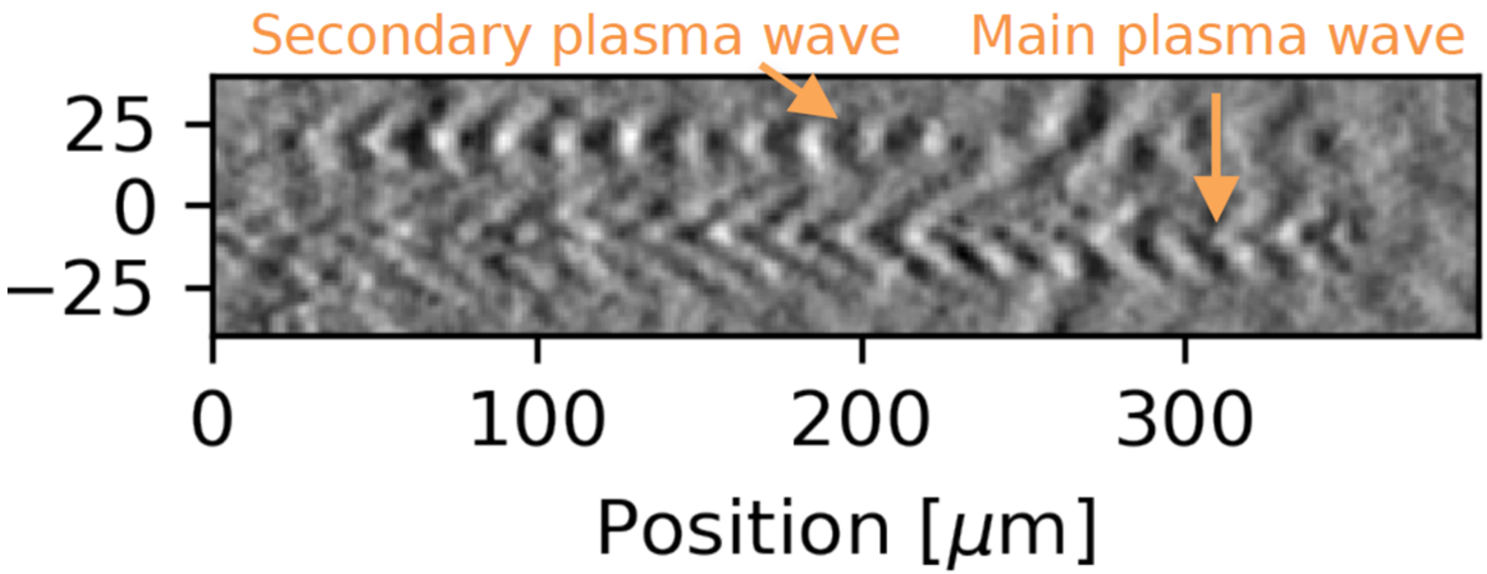






S. Schindler's poster
M. Förster's poster

Multiple plasma waves in a single shot



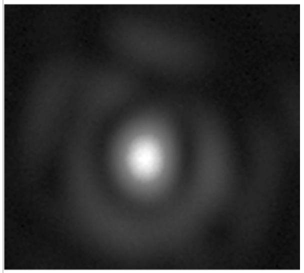
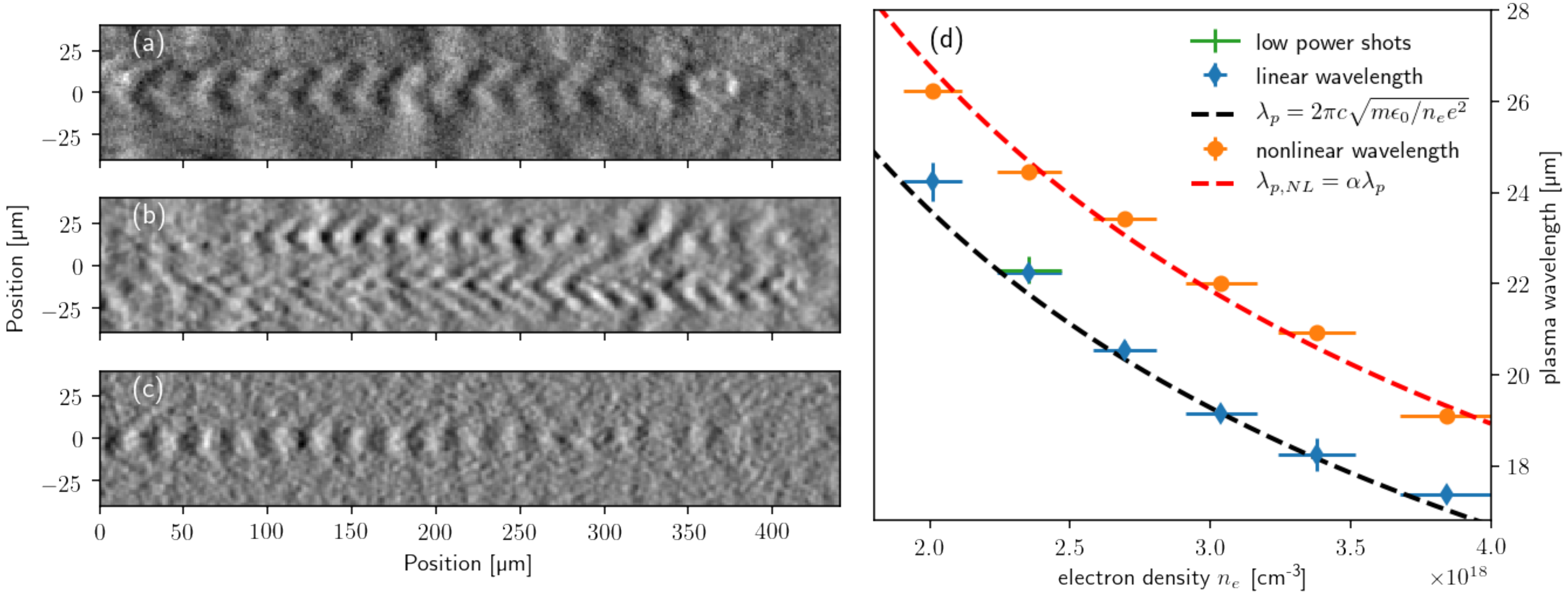


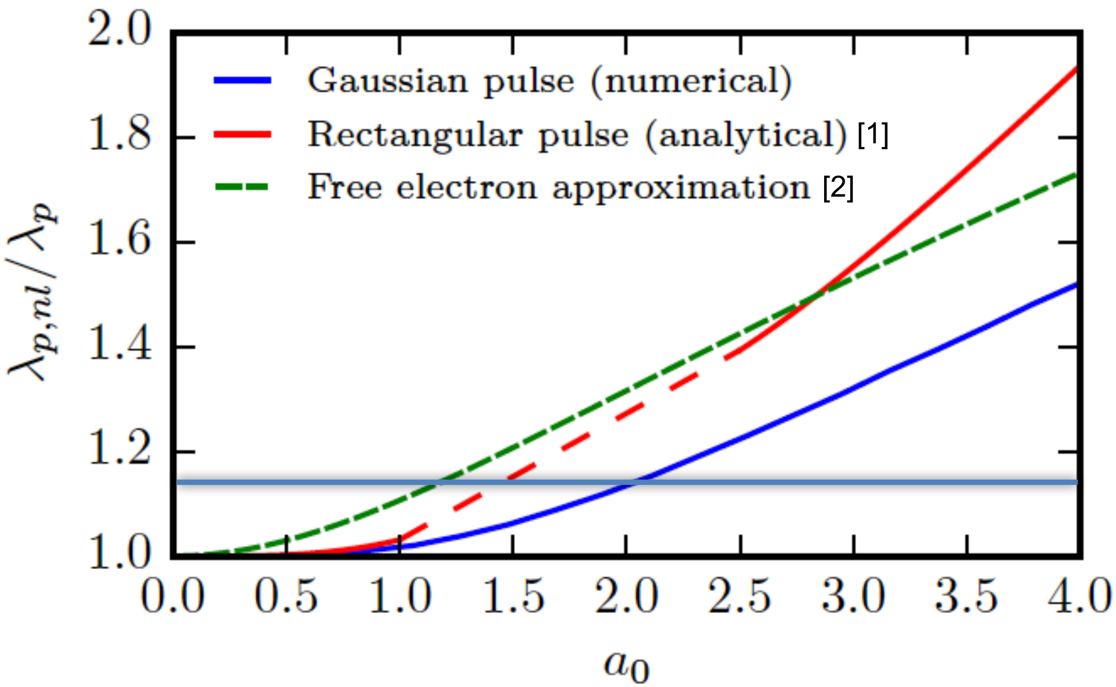
Image of the focus is saturated to show the low intensity satellites.

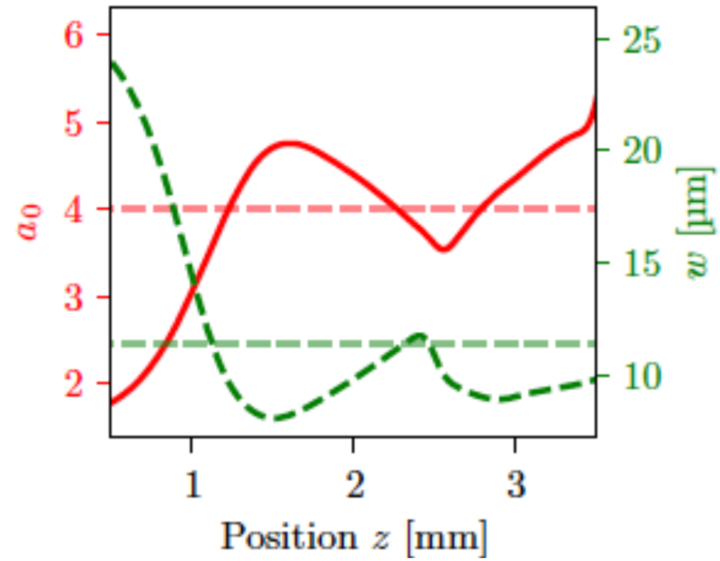
Laser driven nonlinear plasma wave train



- in-situ density measurement with Nomarski interferometer
- 13% elongation of the main wave train, compared with cold plasma wavelength
- the secondary waves, or low power shots have the cold plasma wavelength

Laser intensity estimate?





- 1D models seem not able to explain the observed wave lengthening
- PIC simulation suggests $a_0 \sim 4$

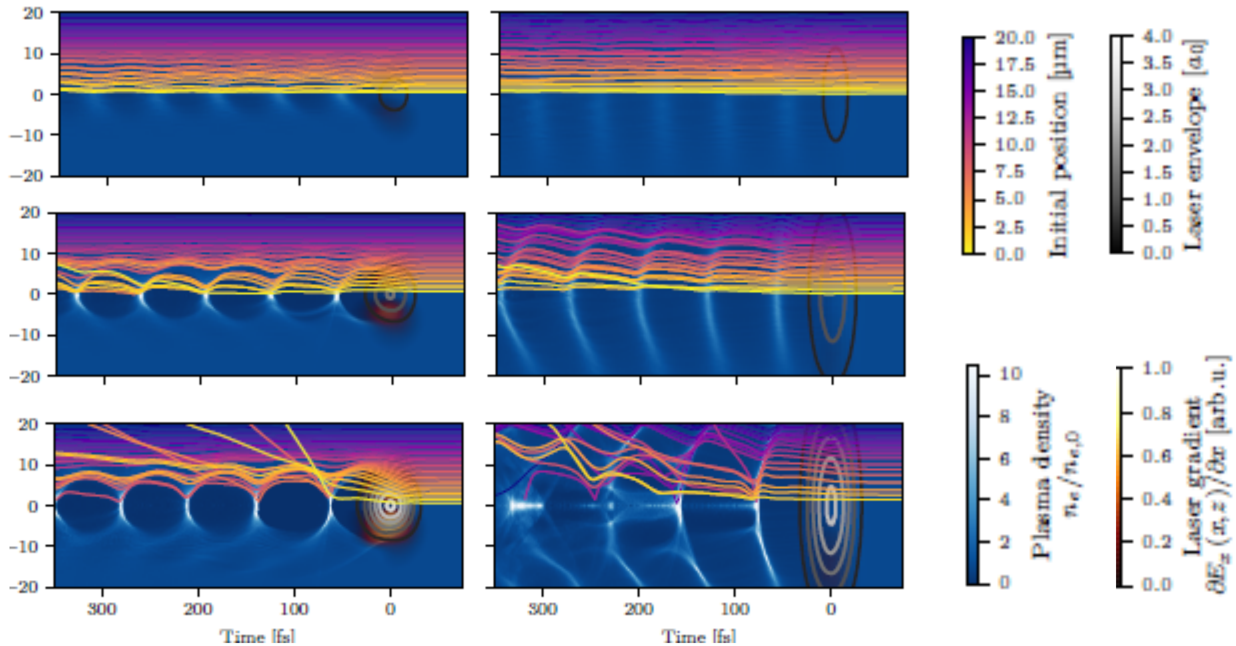
[1] Esarey, E., et al., Reviews of Modern Physics 81, 1229 (2009)
[2] Matsuoka, T., et al., Physical Review Letters 105, 034801 (2010)

Influence of the transverse intensity gradient

a_0 = 1

a_0 = 2

a_0 = 4



- a tightly focused spot -> strong transverse ponderomotive force ->
- full cavitation behind the driver
- electrons do not see the intensity peak of the laser pulse

Summary

- we measure lengthening of a nonlinear plasma wave train
- qualitative estimate of the laser intensity
- not only the peak intensity, but also the aspect ratio of the pulse plays an important role

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Thanks !