Bachelors defense

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Plan

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- Flying focus in PIConGPU
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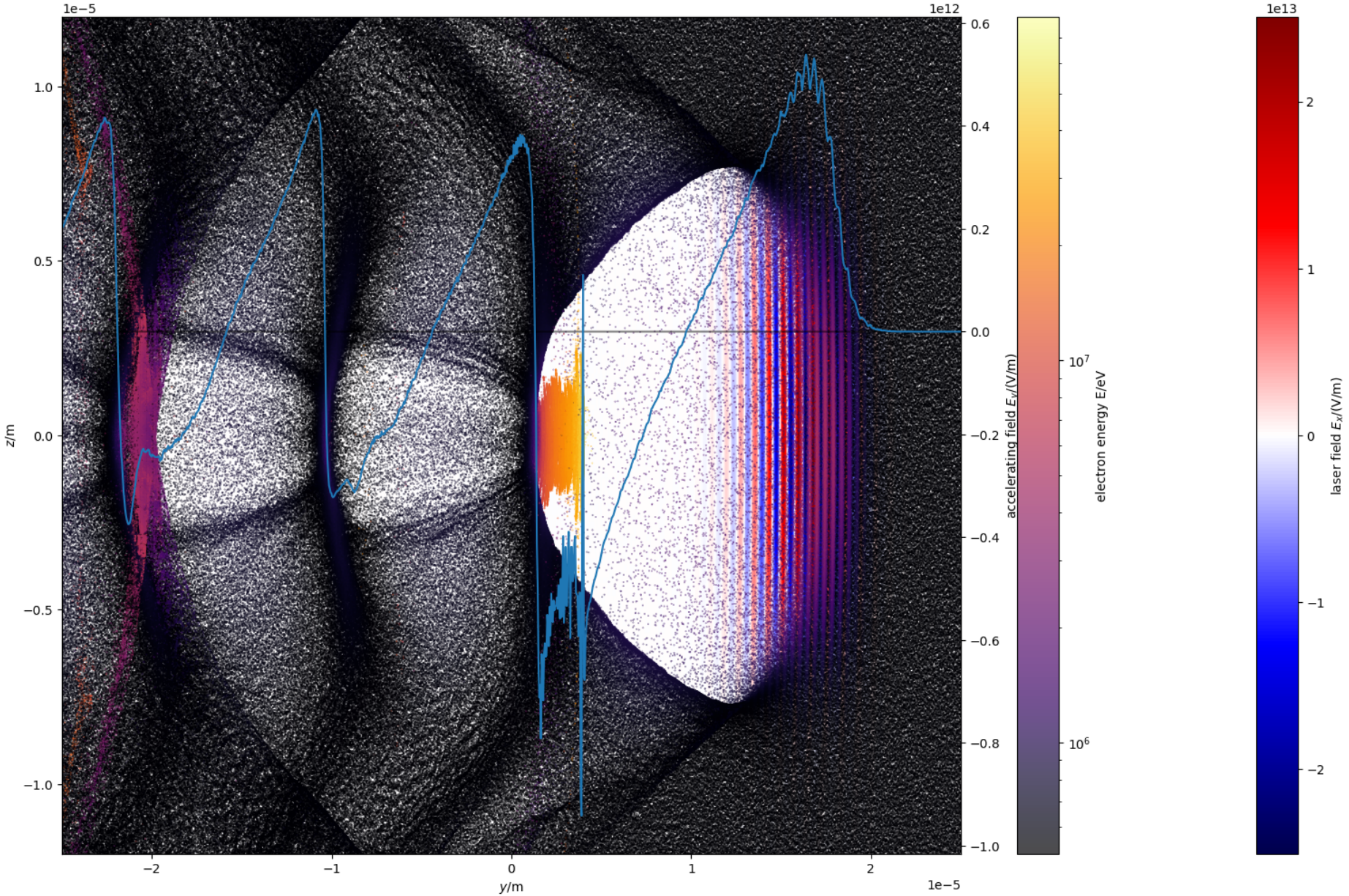
  - why doesnt it work
  - Now Lasy lasers available in PIConGPU
  - back to LWFA

LWFA [5]



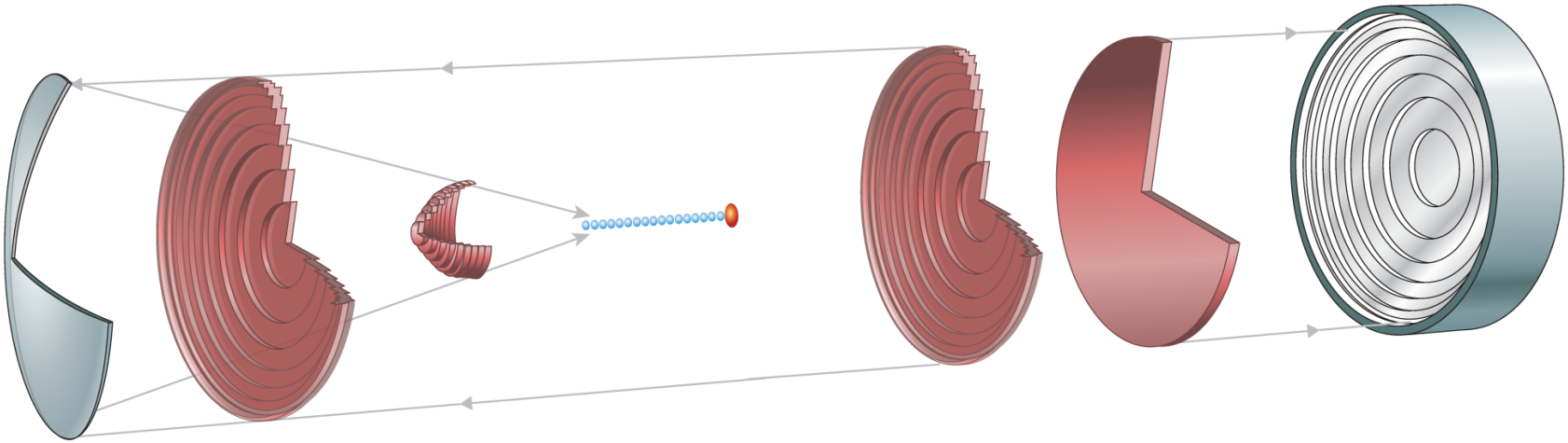
Electric field and electrons in an LWFA simulation.

Properties of flying focus lasers

- tweac
- axiparabola

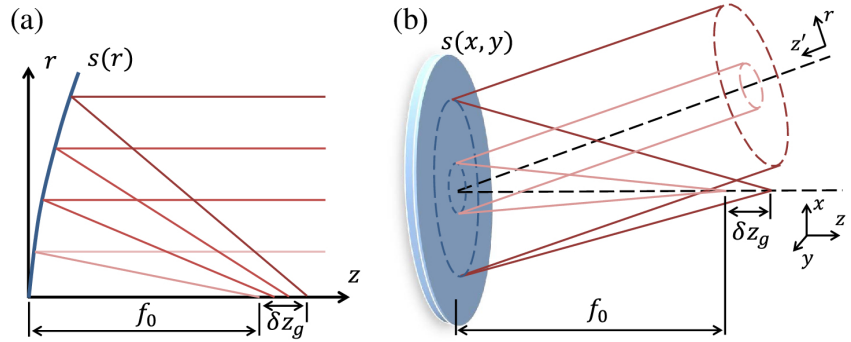
Images:

Flying focus lasers



The flying focus setup. Image taken from Palastro et al [3].

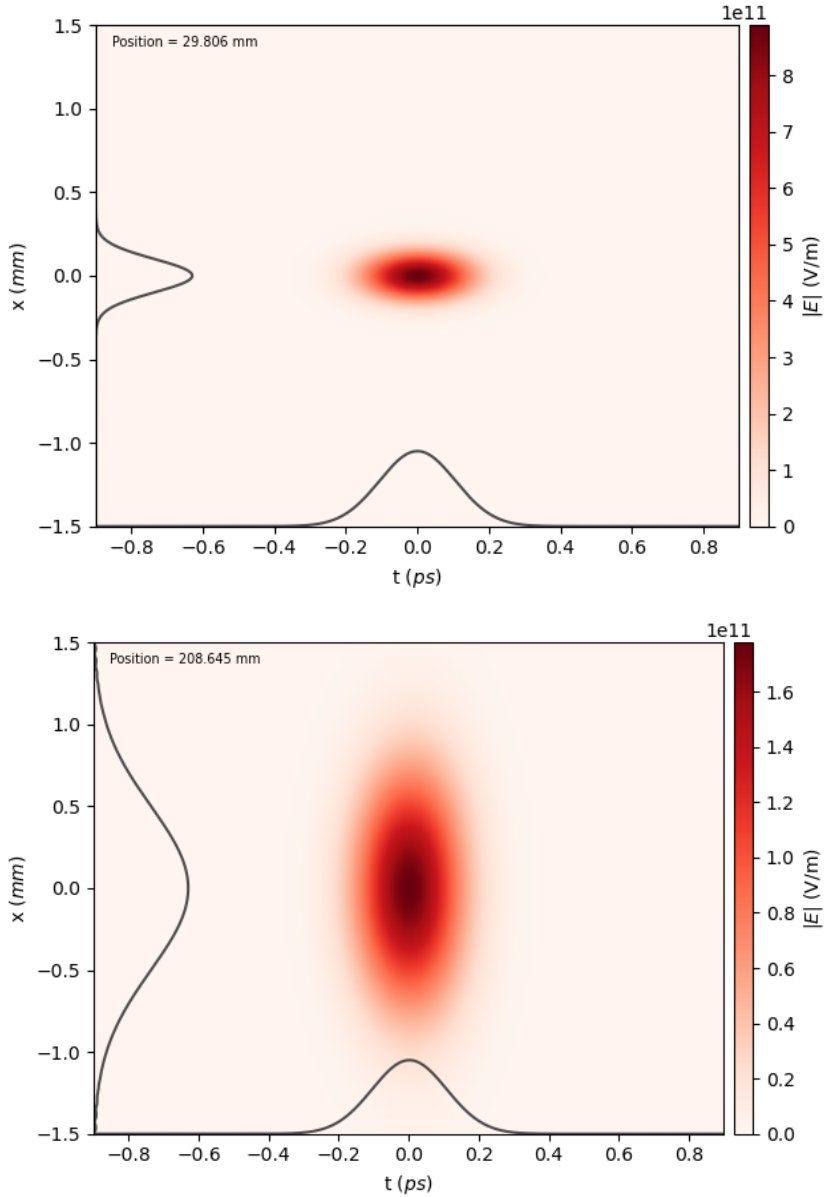
- Built from an axiparabola and a radial group delay echelon (RGD)
- Axiparabola:
  - Focuses light onto a line
  - ?
- RGD:
  - ?



Axiparabola functionality. Image taken from Smartsev et al [4].

Lasy [1]

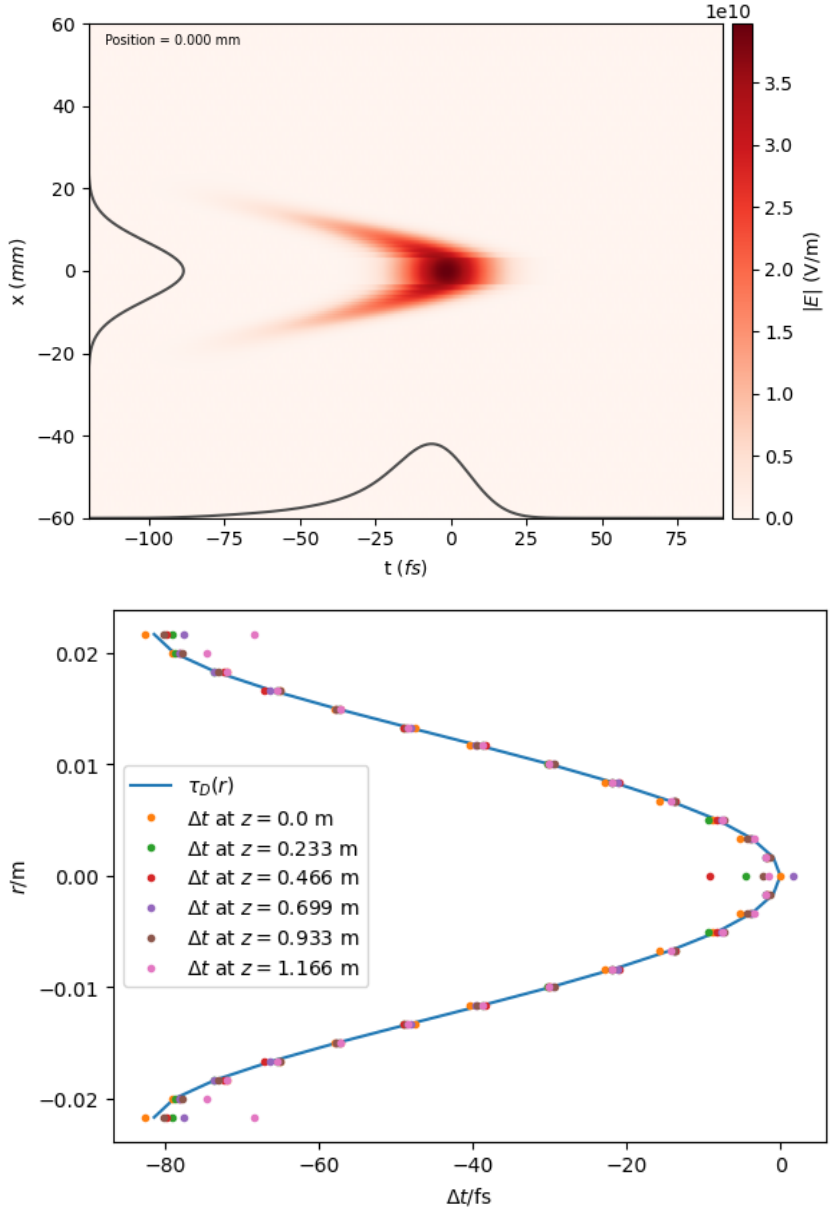
- A python library for simulating Laser pulses in a vacuum
- Uses complex envelope of the laser field
- angular spectrum propagation



Images: Example of a Gaussian pulse being propagated by Lasy. Top: generated at the focus, Bottom: 6 z_R after the focus.

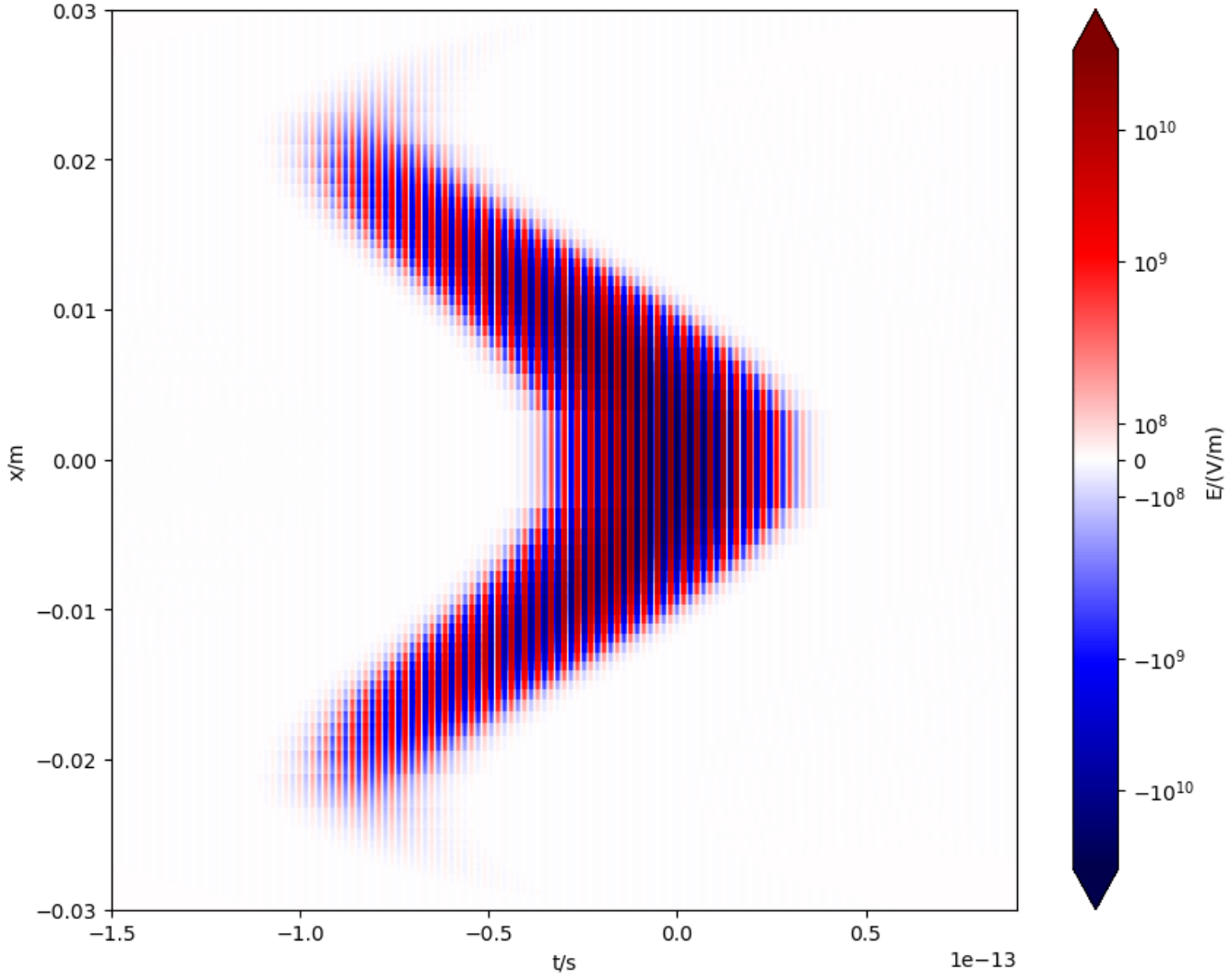
Implementing the flying focus: RGD

- Implemented from scratch as Lasy optical element
- Following the description by Ambat et al [2]
- Shapes the pulse temporally without focusing or defocussing



Images: A Gaussian pulse after interacting with the RGD. Top: field envelope, Bottom: Test results. even after long distances the shape still holds.

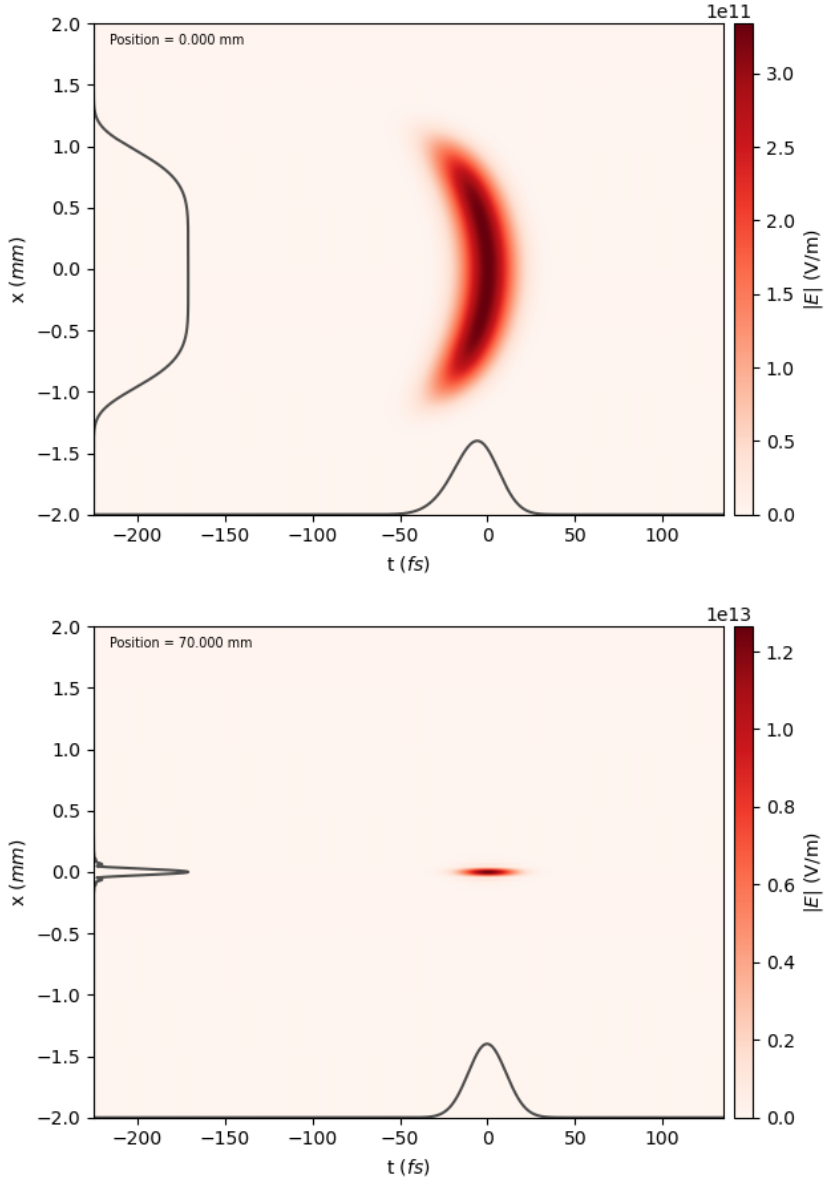
Implementing the flying focus: RGD



The electric field of the laser after interacting with the RGD.

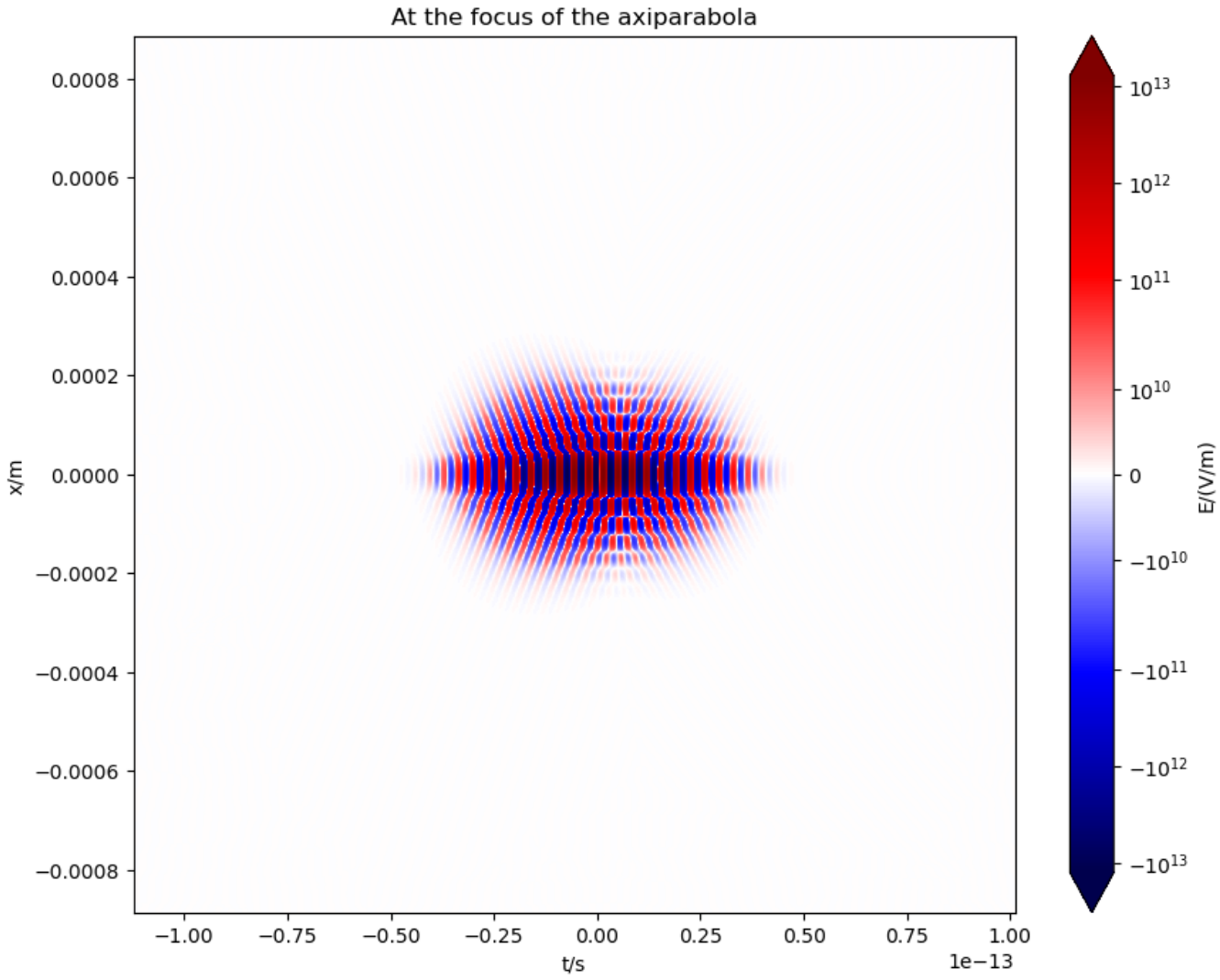
Implementing the flying focus: Axiparabola

- Included in Lasy
- Following Smartsev et al [4]
- ?



Images: A super-Gaussian laser pulse after reflecting off the axiparabola. Top: in the near field, Bottom: in the far field at the beginning of the focus region.

Implementing the flying focus: Axiparabola



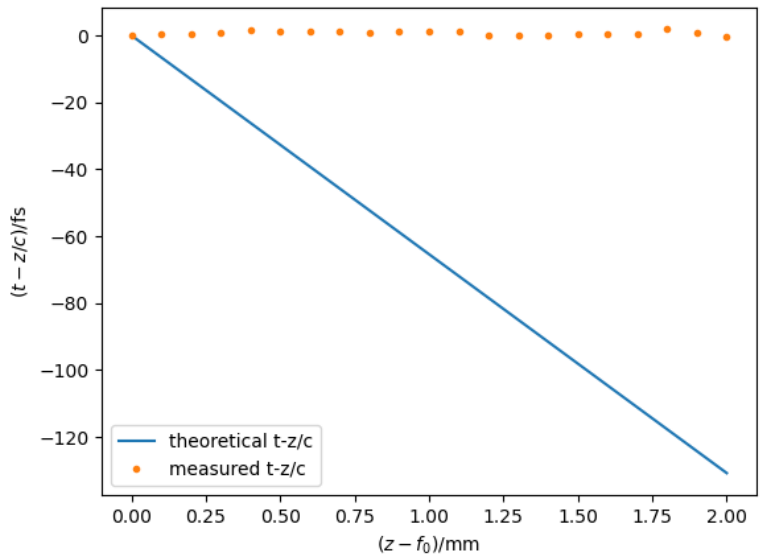
The electric field of the laser at the beginning of the focus region of the axiparabola.

Importing to PIConGPU

- New module `full_field`
- Generates full electric field and saves it using `openPMD-api`
-

Images:

Testing the flying focus laser: First results



Testing the flying focus laser:

Remaining Possible reasons for failure

- The Axiparabola
- The Propagation
- The Findings in the other papers

Outlook

- Lasy lasers available in PIConGPU

$\rightarrow$ ...

- LWFA with new laser setups possible

References I


Lasy 0.6.2 documentation.
`https://lasydoc.readthedocs.io/en/latest`.
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M. V. Ambat, J. L. Shaw, J. J. Pigeon, K. G. Miller, T. T. Simpson, D. H. Froula, and J. P. Palastro.
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Optics Express, 31(19), 2023.


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Dephasingless laser wakefield acceleration.
Phys. Rew. Letters, 124, 2020.

References II

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