



TECHNISCHE
UNIVERSITÄT
DRESDEN

BACHELORS DEFENSE

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Dresden, January 9, 2026

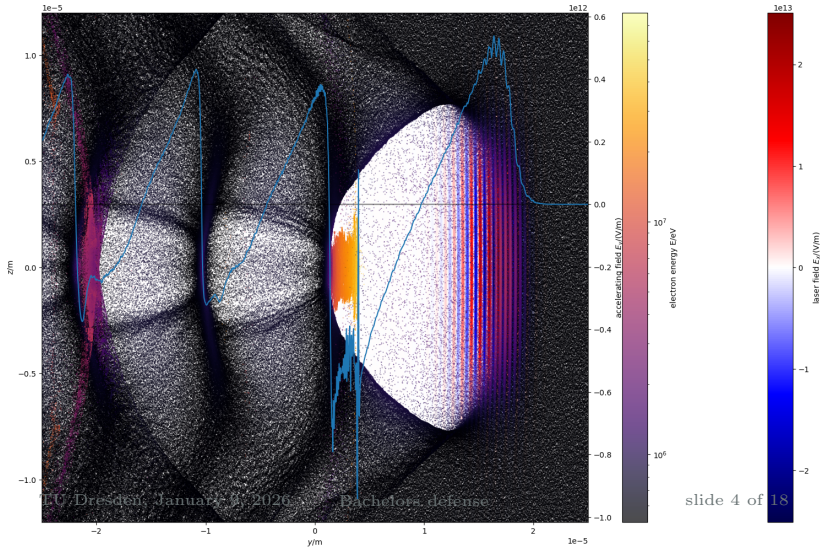
00 Contents

- 1 DLWFA
- 2 Flying focus lasers in PConGPU
- 3 Testing the flying focus laser
- 4 Conclusion and Outlook
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00 Plan

- Why? DLWFA (mention tweac)
- Flying focus in PIconGPU
- Lasy + implementation
- Flying focus doesnt work - why?
 - tests
 - tests
- Conclusion
 - why doesnt it work
 - Now Lasy lasers available in PIconGPU
 - back to LWFA

01 LWFA [5]



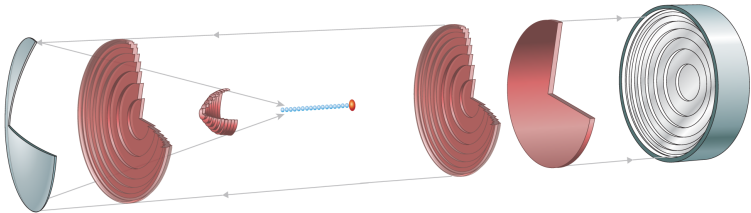


01 Properties of flying focus lasers

- tweac
- axiparabola

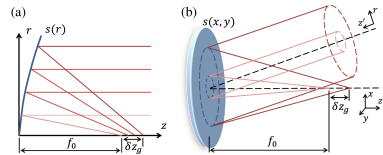
Images:

01 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:

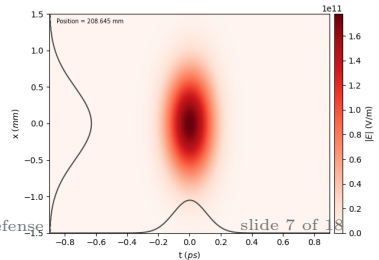
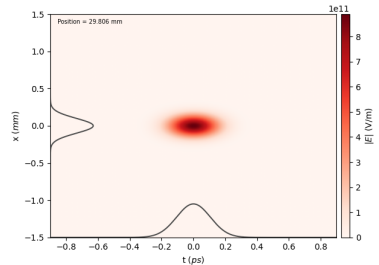


Axiparabola functionality. Image taken from Smartsev et al [4].

02 Lasy [1]

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

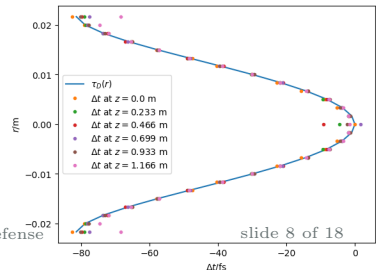
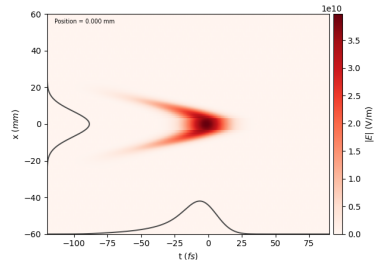
Images: Example of a Gaussian pulse being propagated by Lasy. Top: generated at the focus, Bottom: 6 z_R after the focus.



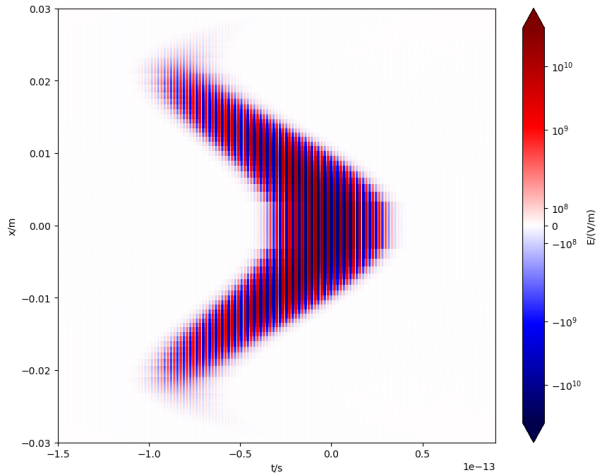
02 Implementing the flying focus: RGD

- 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.



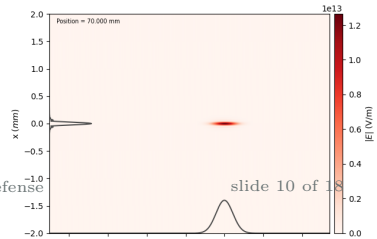
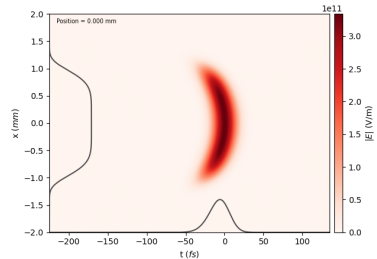
02 Implementing the flying focus: RGD



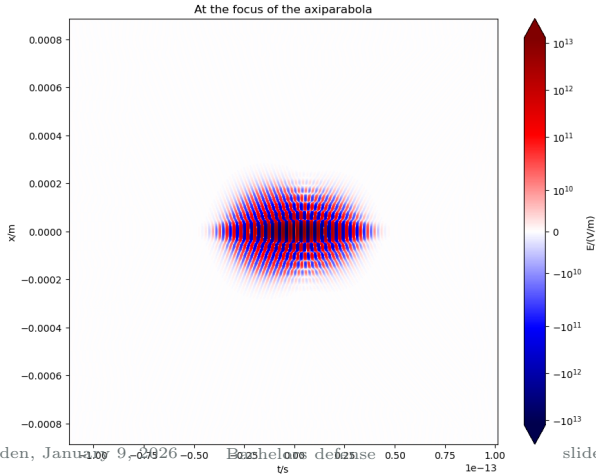
02 Implementing the flying focus: Axiparabola

- 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.



02 Implementing the flying focus: Axiparabola



The electric field of the laser at the beginning of the focus

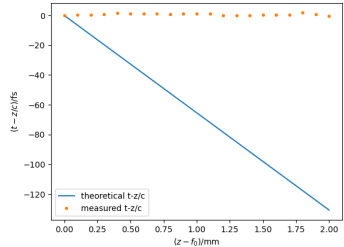


02 Importing to PIConGPU

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

Images:

03 Testing the flying focus laser: First results





03 Testing the flying focus laser:



04 Remaining Possible reasons for failure

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

04 Outlook

- Lasy lasers available in
PConGPU

→ ...

- LWFA with new laser setups
possible

05 References I



Lasy 0.6.2 documentation.

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M. V. Ambat, J. L. Shaw, J. J. Pigeon, K. G. Miller, T. T. Simpson,
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Programmable-trajectory ultrafast flying focus pulses.

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Dephasingless laser wakefield acceleration.

Phys. Rev. Letters, 124, 2020.

05 References II



Slava Smartsev, Clement Caizergues, Kosta Oubrerie, Julien Gautier, Jean-Philippe Goddet, Amar Tafzi, Kim Ta Phuoc, Victor Malka, and Cedric Thaury.

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