

Bachelors defense

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DLWFA

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Testing the flying focus laser

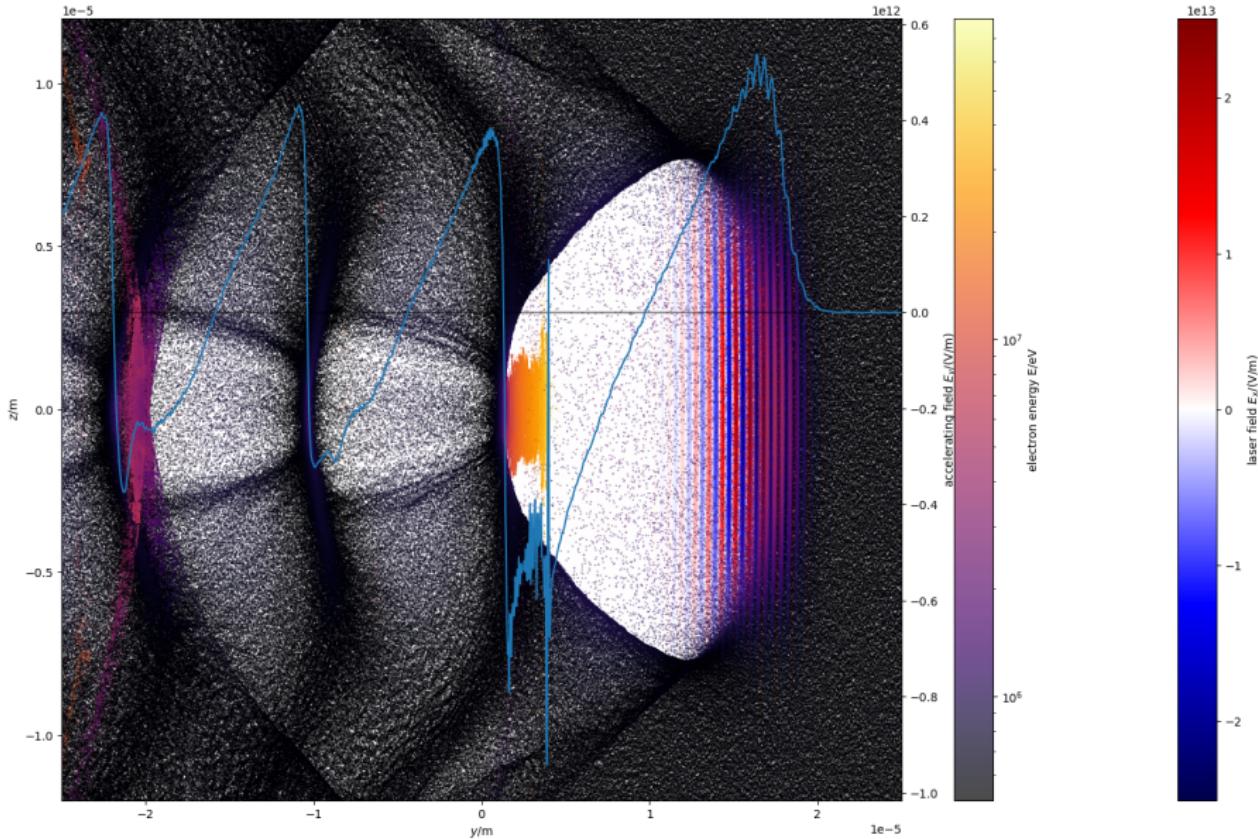
Conclusion and Outlook

References

Plan

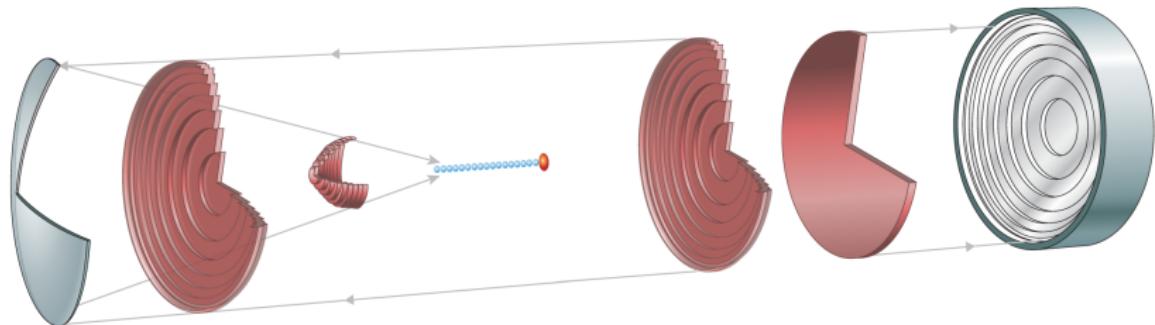
- ▶ Why? DLWFA
- ▶ Flying focus in PICoGPU
- ▶ Lasy + implementation
- ▶ Flying focus doesn't work - why?
 - ▶ tests
 - ▶ tests
- ▶ Conclusion
 - ▶ why doesn't it work
 - ▶ Now Lasy lasers available in PICoGPU
 - ▶ back to LWFA

LWFA [5]



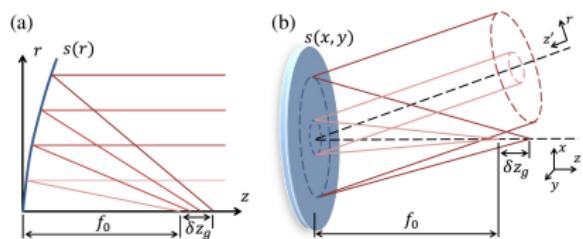
Electric field and electrons in an LWFA simulation.

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].

Properties of flying focus lasers

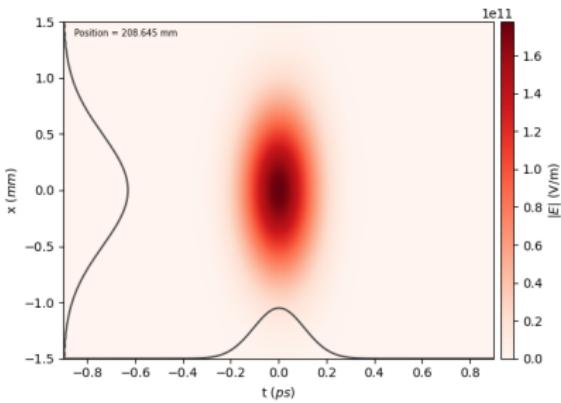
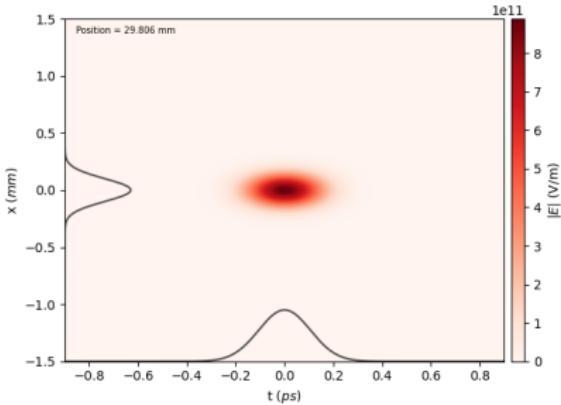


Images:

Lasy [1]

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

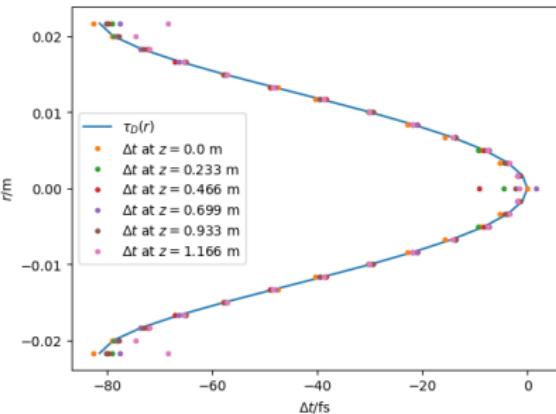
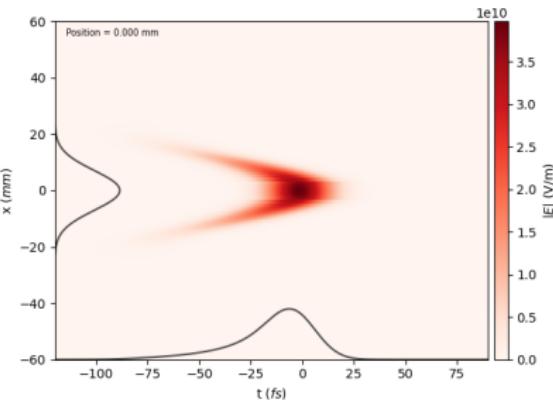
Images: Example of a Gaussian pulse being propagated by Lasy. Top: generated at the focus, Bottom: 6 z_R after the focus.



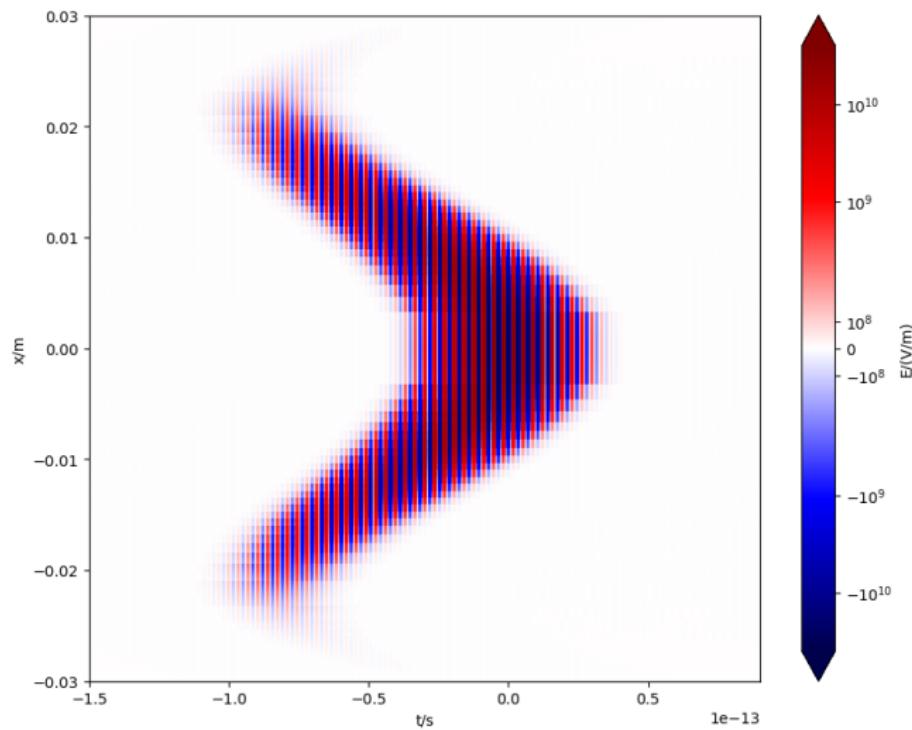
Implementing the flying focus: RGD

- ▶ 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

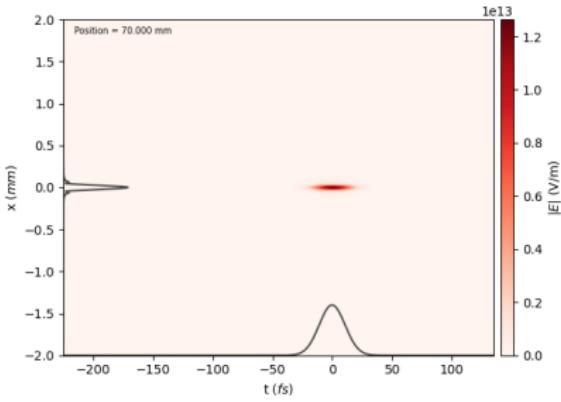
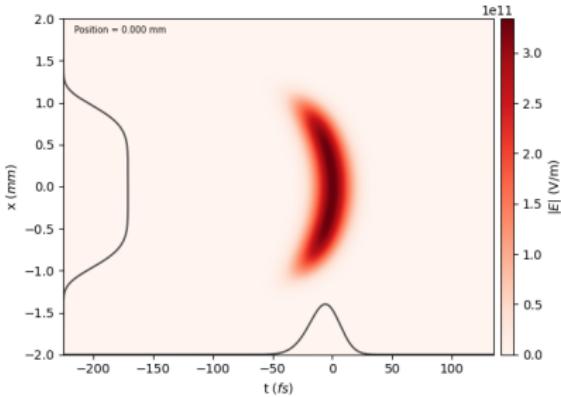


The electric field of the laser after interacting with the RGD.

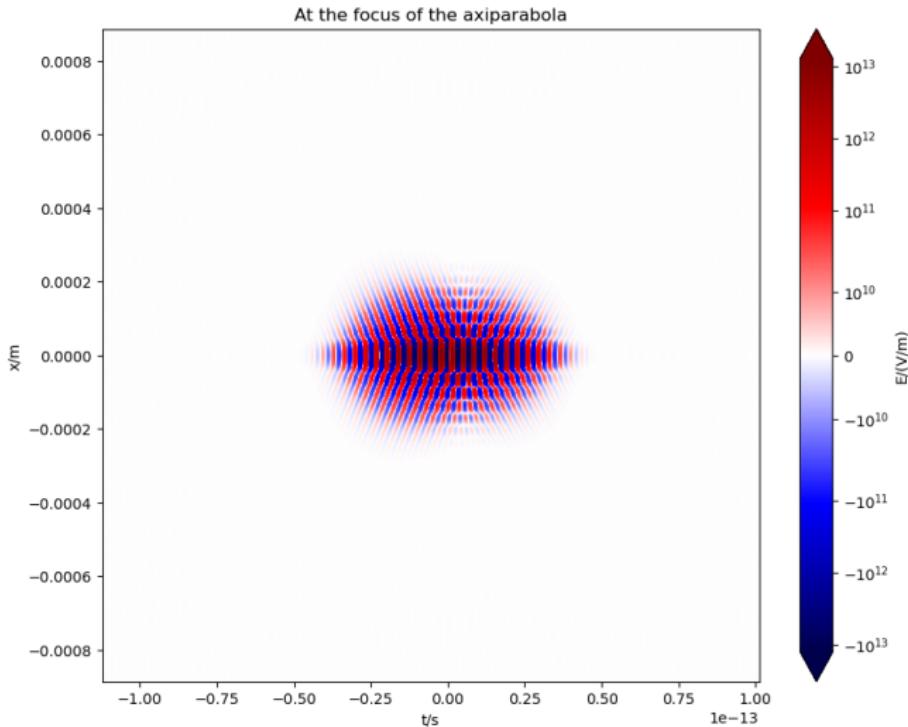
Implementing the flying focus: Axiparabola

- ▶ 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



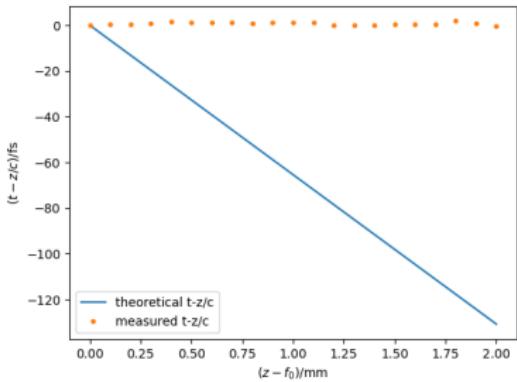
The electric field of the laser at the beginning of the focus region of the axiparabola.

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

- ▶ Easy lasers available in PIConGPU
 - ...
- ▶ LWFA with new laser setups possible

References I

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Phys. Rev. Letters, 124, 2020.

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-  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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