

# Case Studies

## Introduction



Andreas Walker, DESY  
Sesimbra, Portugal, 13.3.2019



# Case Studies

## What is it?

- Chance to do some work based on current questions within PWFA and LWFA community
- Lecturers provided input for these case studies over the last few months
- Basically: you will be designing your own plasma accelerator machine as a team
- The case studies will be handed out in 15 min and students were distributed to groups randomly



# Case Studies

## Contact persons

- **Andreas Walker** ([andreas.walker@desy.de](mailto:andreas.walker@desy.de)):  
any questions regarding case studies (science & organizational).
- **All lecturers:** regarding any science questions. They are invited to join us during the case study period.
- In additional we have 5 student tutors who know all about the simulation code:
  - **Thales Silva**
  - **Miguel Pardal**
  - **Bernardo Malaca**
  - **Anton Helm**
  - **Mariana Moreira**



# Case Studies

When is it?

When to work?

- 6 h of real core work time

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Introduction to plasma physics II <i>P. Gibbon</i>	Plasma sources I <i>J. Osterhoff</i>	Plasma sources II <i>J. Osterhoff</i>	Plasma wake generation (non-linear) <i>L. Silva</i>	E X C U R S I O N	Blow out regime <i>L. Silva</i>	Particle beam diagnostics <i>B. Marchetti</i>	electron sources from plasma I <i>B. Cros</i>	staging (incl. Synchr. & tolerances) <i>C. Lindstrom</i>	
Laser beam physics <i>L. Corner</i>	Plasma wake generation (linear) <i>Z. Najmudin</i>	Modelling and simulation I <i>J.L. Vay</i>	Modelling and simulation II <i>J.L. Vay</i>		laser driver propag. in plasmas <i>S. Mangles</i>	Plasma diagnostics <i>J. Osterhoff</i>	Dielectrical Acc Structures (Theory) <i>N. Schoenenberger</i>	positron acc. in plasmas <i>S. Corde</i>	
Coffee	Coffee	Coffee	Coffee		Coffee	Coffee	Coffee	Coffee	
laser diagnostics <i>L. Corner</i>	Acceleration of e- in a plasma II <i>A. Thomas</i>	Injection extraction and matching I <i>M. Ferrario</i>	Modelling and simulation III <i>J.L. Vay</i>		Beam driven (experiment) <i>E. Gschwendtner</i>	Beam driver propogation (beams) <i>R. Assmann</i>	electron sources from plasma II <i>B. Cros</i>	case study <i>A. Walker</i>	
Lunch	Lunch	Lunch	Lunch		Lunch	Lunch	Lunch	Lunch	
Laser driven wakefields I <i>S. Karsch</i>	Free Afternoon	Injection extraction and matching II <i>M. Ferrario</i>	Mod & simul hands on II <i>J. Vieira, R. Fonseca</i>		Laser driven (experiment) <i>S. Mangles</i>	Beam driven systems (PWFA) I <i>P. Muggli</i>	Dielectrical Acc Structures (Exp) <i>N. Schoenenberger</i>	Radiation generation <i>F. Albert</i>	
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Tea		Tea	Tea		Tea	Tea	Tea	Tea	Tea
Laser driven wakefields II <i>S. Karsch</i>		Discussion 1 <i>B. Holzer</i>	Seminar I <i>IST</i>		Seminar: Acceleration of protons & ions <i>L. Willingale</i>	case study <i>A. Walker</i>	case study <i>A. Walker</i>	case study <i>A. Walker</i>	case study presentations <i>A. Walker</i>
case study Introduction <i>A. Walker</i>		Mod & simul hands on I <i>J. Vieira, R. Fonseca</i>	case study <i>A. Walker</i>		case study <i>A. Walker</i>	case study <i>A. Walker</i>	Departure Gala Dinner: 19:00h	case study <i>A. Walker</i>	Coherent X-rays and applications <i>M. Fajardo</i>
Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Gala_Dinner	Dinner	Dinner	



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## When is it?

### When to work?

- 6 h of real core work time
- **1 h of presentation preparation**
- **2 h of presentation (strict time keeping)**  
=> 6 hours (& nights and weekends...)

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=> 6 hours (& nights and weekends...)
- 3 h of **“Mod & Sim”** important for cases

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- 2 h of presentation (strict time keeping)  
=> 6 hours (& nights and weekends...)
- 3 h of **“Mod & Sim”** important for cases
- **3 prizes, one each for:**
  - Best overall/realistic work of the study
  - Most innovative solution
  - Most entertaining presentation & performance (including content, group name & logo, outfit)

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# Case Studies

4 experimental case studies with small simulation work and 1 simulation case study

## 4 experimental case studies

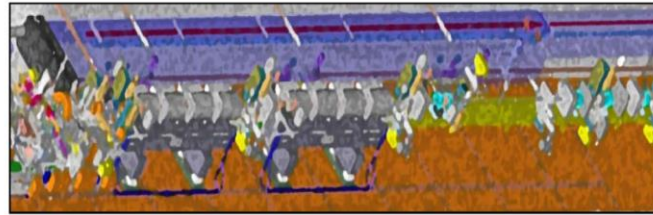
- 2 on LWFA
- 2 on PWFA

## 1 simulations case study

- 2D LWFA

*Each person is assigned to one case study.*

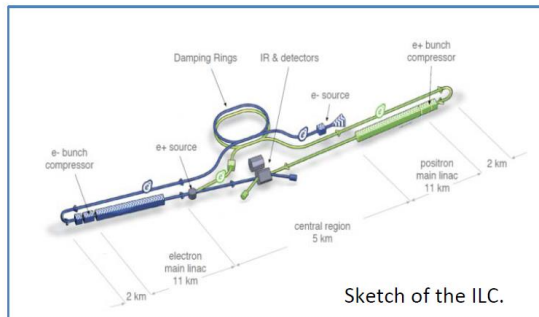
Case Study 1: LWFA with external injection



Case Study 2: Applications of Laser Plasma Accelerators



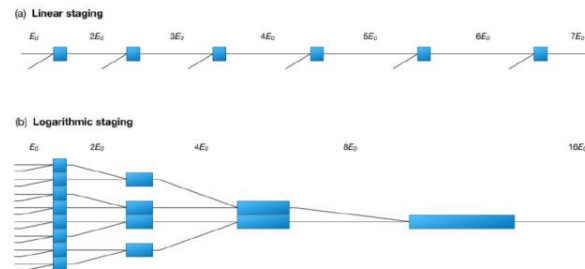
Case Study 3: plasma booster module for ILC



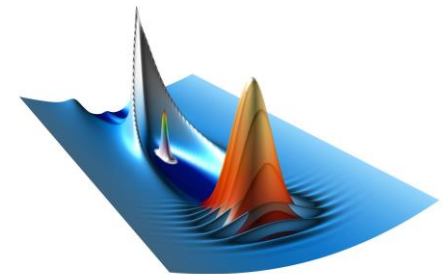
Case Study 4: Staging plasma accelerators

### Introduction

Beam-driven plasma wakefield accelerators can significantly shrink the size of a future linear electron-positron collider. However, unless all the energy is carried by a single driver, many acceleration stages are required—a likely case for electron/positron drivers. However, staging may require complex optics to preserve beam emittance, which can take up significant space between stages. Moreover, the staging length will get longer for higher energies—likely scaling as  $\gamma$ , where  $\gamma$  is the Lorentz factor. To limit the accelerator length and keep the effective accelerating gradient high, the total staging length must be minimized.



Case Study 5: LWFA simulation





# Case Studies

## Some hints how to organize

- During the 6 core hours tutors, lecturers and me will be here in the lecture hall for you to ask questions
- Case studies will be challenging: apply what you learn(ed) in these two weeks
- You can work anywhere in the hotel (e.g. bar, pool side, lobby, beach, outside the lecture hall ...)
- There are also 2 extra seminar rooms just outside the lecture hall for you to use during case study hours
- Work as a *group* and organize yourselves within the group. (Not everybody needs to do everything, but everybody needs to do something.)



# Case Studies

## Some hints how to organize

- Use the simulation code to validate your chosen plasma and driver parameters.
- Your group has to present the results in a 5 min presentation at the end of the school. Choose a speaker of your group.
- Your group's final presentation (PowerPoint/Keynote/...) should include (but is not limited to):
  - Overview of your machine (e.g. layout/size/parts included/cost)
  - Table of your chosen plasma and driver parameters. Explain why these were chosen
  - At least one simulation result
- Send finished presentation to me (andreas.walker@desy.de) by 2 pm on 21.3.2019

# Case Studies

ANY QUESTIONS?

