

- PHY691 - Spring 2023 -

ACCELERATOR

**YOUR NEXT 6-D FLIGHT
SIMULATOR**

Across a Speed-of-Light Universe

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THE AGENDA TODAY

- **Getting introduced to each other**
- **This introduction**
- **A brief review of particle accelerators in history, and where we are today**
- **Introduction to our flight-simulator engine, the ray-tracing code Zgoubi. And to alternate cross-check means.**

• This course is an introduction to the physics and technology of particle accelerators,

◇ based on computer laboratory work

◇ during which we will

- construct and run virtual accelerators, of all sorts

- accelerate charged particle beams

- generate synchrotron light

- watch the relativistic death of short-lived particles

- polarize and shake particle spins

- play with Siberian snakes

- and much more

● **This course introduces to most types of existing particle accelerators, and to the basic**

- technological components of charged particle beam optics,

- principles of charged particle beam dynamics:

. beam steering, focusing, acceleration, ...

. collateral aspects: spin dynamics, synchrotron radiation, in-flight decay, ...

◇ **All this, via numerical simulations on computer.**

● **These computer simulations are taken from real-life laboratory activities, they constitute the backbone of the course.**

● **Computer code developments - and debugging ! - will be part of the game.**

● This course is also

◇ a forum for discussions to foster deeper

- insight,

- understanding,

- on whatever topic, whenever desired,

- including further (better?) ideas you may have of accelerator

simulations and code developments

◇ an opportunity to get contacts with world reknown accelerator

laboratories and people, if you wish to explore further a possible

future in the field

- “Numerical simulations”, or numerical experiments, means what?
 - ◇ we will run beam dynamics computer programs
 - ◇ manage/process the data they produce,
 - ◇ we will keep confronting beam dynamics findings from numerical simulations with theoretical expectations,
 - ◇ in an interactive play between both : “numerical experiments” regarding particle beams in accelerators, and the underlying theory.

Organization of a 1h20m session

(i) On my side (15~40 minutes) :

◇ **When we start a new topic : a short historical overview**

Cyclotron, synchrotron, synchrotron light, decay-in-flight, spin,

etc.

◇ **As needed: accelerator theory.**

◇ **Simulation exercise assignments, including guidance**

(ii) On your side:

- ◇ **proceed with computer simulations as per latest assignments.**

This is the bulk of the sessions.

- ◇ **when done with a set of simulations, you present it: a few slides, to be presented to the group.**

I want to see theory, theoretical explanations, in your slides!

These slide presentations may take time: discussions, questions...

- ◇ **At times, I may request a written report as part of your home work.**