- PHY691 - Spring 2021 -

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**
- **Discuss the project list and how we get organized, by teams, for a 14 week project**
- **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 will introduce to most types of existing particle accelerators**

◇ **it will introduce**

- the basic principles of beam dynamics in these machines

- their main beam steering, focussing and acceleration components

◇ **Most of that, *via* numerical simulations using powerful computer tools.**

• **Computer simulations taken from real-life laboratory activities constitute the backbone of the course.**

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

- **This course also includes**

  - **conducting a project, from start to end, by teams, over the semester.**

  - **Project topics will be discussed and chosen early, during the first two course sessions.**

    - **I will come back on that**

• This course is also

◇ a forum for discussions and deeper

- insight,

- understanding,

- on whatever topic, whenever desired,

- including further ideas 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

- **During this semester,**

  - **we will run beam dynamics computer programs**

  - **manage the data they produce,**

  - **we will keep confronting beam dynamics findings from numerical simulations with theoretical expectations,**

  - **in an interactive play between both : experimentation regarding particle beams in accelerators and in accelerator components, and the underlying theory.**

Organization of a 2h50 session

- **In these times of COVID19,**

  - the classes will be on remote, using Zoom,

  - a weekly 2h50 session will be split in 2×1h25 weekly meetings

- **A 2h50 session is organized as follows:**

(i) On my side (up to 15∼30 minutes) :

◇ **a short historical overview - when starting a new accelerator chapter** ($10 \sim 15$ **minutes) : cyclotron, synchrotron, synchrotron light, decay-in-flight, or whatever else depending on our progress**

◇ **the next simulation exercise assignments:** (10 $\sim$ 15 **minutes**)

That's the real work of yours : your accelerator problems and the numerical simulations home work.

http://case.physics.stonybrook.edu/index.php/PHY691_spring_2021

◇ **Dedicated written notes will be made available in due time, on the web site.**

(ii) On your side: returning your home work

◇ **as a matter of fact,**

- finishing the computer simulations undertaken during the previous session is part (the essential) of the home work.

- the home work is returned under the form of 2-3 slides, to be presented to the group (5 minutes per team)

(iii) At times - as needed - still on your side, starting on week 3: status of the projects,

◇ **this is under the form of 2 slides presented to the group (2 minutes per team)**

ACCELERATOR PROJECT

- **Goal : conducting your own accelerator project, just like in real life, from start to end, over the semester.**

- **The plan is the following:**

◇ **We will go through the list of projects and discuss it, next to this introduction.**

◇ **You'll have 2 weeks to make your choice.**

Questions are welcome of course:

- any time

- by e-mail (fmeot@bnl.gov), or during the class.

• **Time is tight : during your project, don't waste time staying stuck, instead ask/discuss amongst us, ask me, just as we do in professional life, and proceed !**

• **At the end of the semester, this project will be concluded by**

  - a presentation to the group, under the form of slides

  - a written report, laboratory technical note style

• **For each project, the following is expected :**

(i) Start with a bibliographical research. An extended bibliography: history and present status, technical aspects, interest of the technology, future developments, etc.

This should represent about 25% of the work, of the time spent on the project.

The goal of the bibliography is to

- understand the motivations for the development of a particular line of accelerator, how it evolved in a particular historical context, what it has become today, its applications

- provide a technical documentation relevant to your present accelerator project and to the applications of this particular type of accelerator you choose to study, including parameter lists, possibly details regarding particular scientific or technological aspects

◇ For each project a bibliographical document is provided. That can be the starting point for your bibliography.

(ii) The bulk of the work: producing the requested computer simulations, or program developments, or whatever the project is about.

(ii) Reporting :

- slides for a 10 minute presentation to the class,

- a written "lab. tech. note" style of report, up to 10 pages

- **My advice, here :**

*** Do not wait until the end of the course to start writing. You'd be too late and lack time.**

*** Instead, start writing as you start the project, which is, from the moment you start working on the bibliography !**

*** Hint : the bibliographical documents you are going to discover and consult can be a source of inspiration regarding the presentation/organization of your written technical note.**