C. Wiesner

PE Mini Lectures: Further planning

01.10.2020

Mini Lectures: Next topics (tentative plan)

Plan: mini lecture ~every 4 weeks (shifted by 2 weeks from the section meeting) on **Thursdays, 10.30h.**

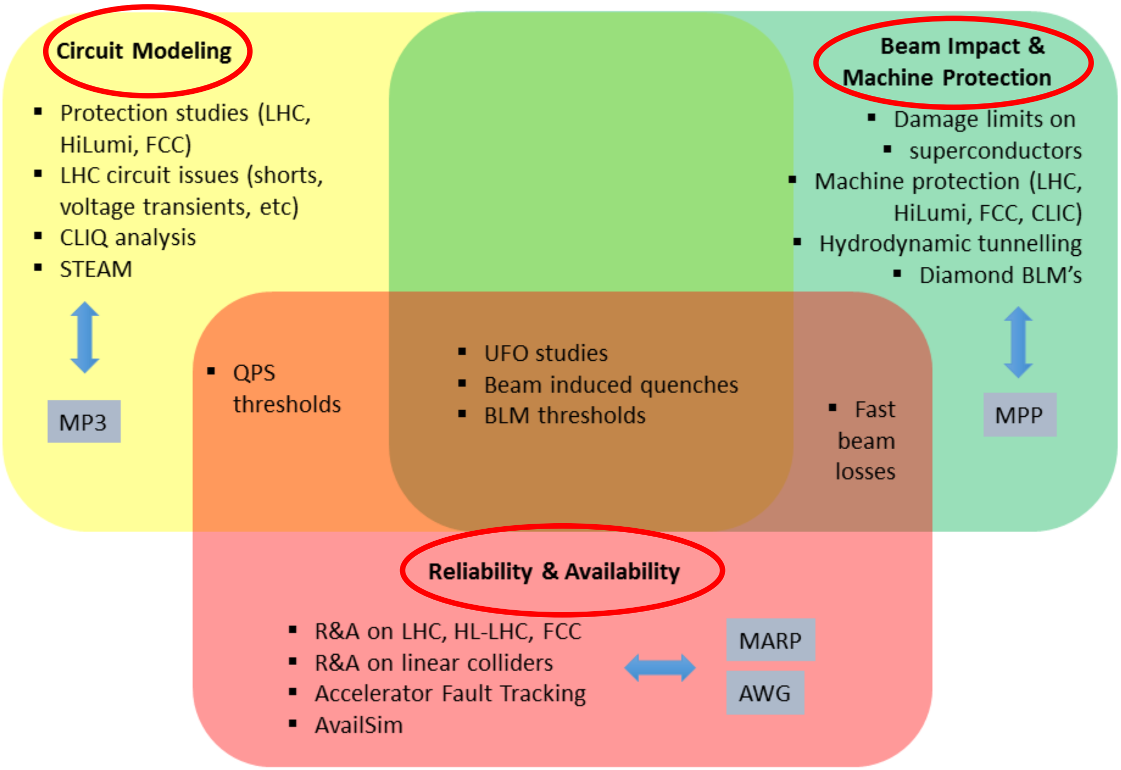
Scientific computing: numpy	Cedric	1.10.2020	Computational methods
Data processing: pandas	Michal	8.10.2020	Computational methods
Introduction to reliability and availability studies for accelerators	Thomas	29.10.2020	Availability
Introduction to superconductivity and s.c. magnets	Lorenzo	26.11.2020	Magnets
How to build a s.c. magnet?	Arjan	Jan 2021 (TBC)	Magnets
How to protect a s.c. magnet?	Emmanuele	Feb 2021 (TBC)	Magnets
….Restart and extend beam physics topics		> Feb 2021	Beam & Accelerator Physics

Ideas and volunteers always welcome! ☺

Backup

MPE-PE Section

MPE-PE section consists of 3 main branches:



https://twiki.cern.ch/twiki/bin/viewauth/TEMPEPE/

Most studies require numerical and computational tools and methods

Section meetings:

- Present and discuss ongoing studies and topics
- Often there is not enough time to present underlying concepts and used tools

Mini lectures:

- Learn and share (basic) knowledge and technical tools useful for our work
- More efficient communication and collaboration between the section members and, thus, increase synergies

Mini Lectures: So far…

1) Coding convention and good practice	✓	Computational Methods
2) How to describe a particle beam? • Concept of phase space/Liouville theorem • Emittance • Beta function and Twiss parameters	✓	Beam & Accelerator Physics
3) How to produce a particle beam? • Ion sources • Space charge	✓	Beam & Accelerator Physics
4) How to accelerate a particle beam? • RF acceleration (Linacs and RF cavities)	✓	Beam & Accelerator Physics
5) SWAN Notebooks • Using SWAN for scripting and documentation	✓	Computational Methods
6/7) Python: Advanced Programming in python	✓	Computational Methods

You can find the presentation on the indico pages for 2019 and 2020.

Mini Lectures: Proposed Topics (May 2019)

Beam & Accelerator physics

How to describe a particle beam?
- Phase-space, Liouville theorem, emittance, optical functions (α, β, γ), σ

How do accelerators work?
- Beams production: ion sources
- Beam transport, FODO lattice
- Beam acceleration: linacs and acc. cavities
- Beam collision: synchrotron, collider, luminosity, β^*
- Acc. hardware: beam dump, cavities, …

What types of magnets do we need? And how do we get them?
- Dipoles, quadrupoles, and more: beam-dynamics and hardware realization
- Kicker and septa

Magnets

How do superconducting acc. magnets work?
- Basics of superconductivity
- Basics of superconducting magnet
- Superconducting cable design
- Why use superfluid helium?

Why and how to protect a s.c. magnet?
- How to quench a s.c. magnet?
- How to protect a s.c. magnet?
- Quench/damage limits

Machine Protection

What can go wrong? Beam-related failures
- Failure classification (risk, slow/fast/ultrafast failures)
- Failure examples: magnet powering, injection/extraction failures, UFOs, QH firing
- Failure criticality for different machines

What happens if the beam is lost?
- Beam-matter interaction
- Hydrodynamic tunnelling

MP Systems
- Main MP systems at LHC (BIS, PIC, WIC, QPS, LBDS, COLL)
- Electronics for MP

How does the CERN accelerator complex work?
- Injectors: LINACs, PSB, PS, SPS
- LHC operation and cycle
- LHC availability and faults

Reliability & Availability

Reliability and availability
- Basic definitions (for CERN and other accelerators)
- Introduction to risk assessment
- Lifetime distributions and bathtub curve

Special Topics…
Visits…

Computational Methods

- Coding conventions and good practice / Object-oriented programming
- Basics of co-simulation
- Introduction to machine learning
- How to simulate a particle beam? How to simulate a magnetic field?

python