LONGITUDINAL TRACKING HANDS-ON

FOREWORD

RF CAS 2023

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ELENA, FRANK AND HEIKO FOR SHAPING THE CONTENT OF LONGITUDINAL BEAM DYNAMICS COURSES FOR THE CAS!

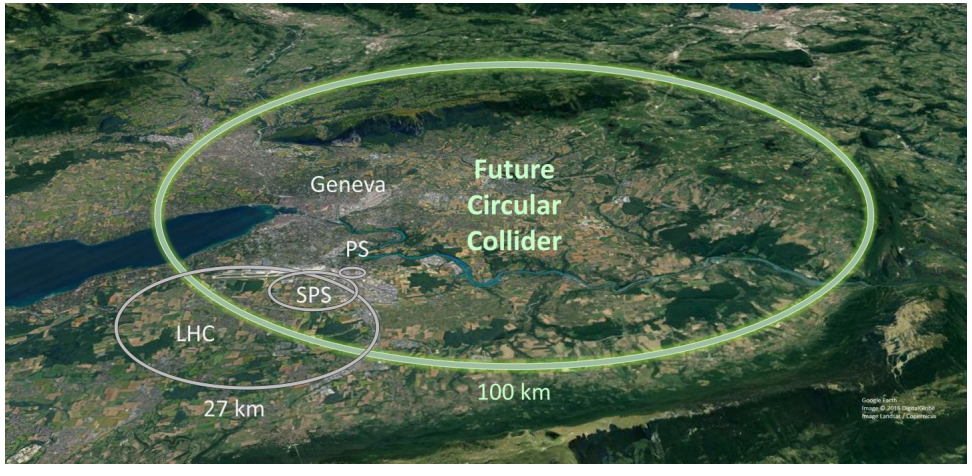
COLLEAGUES FROM THE RF GROUP AT CERN

AND YOU!

SCENARIO

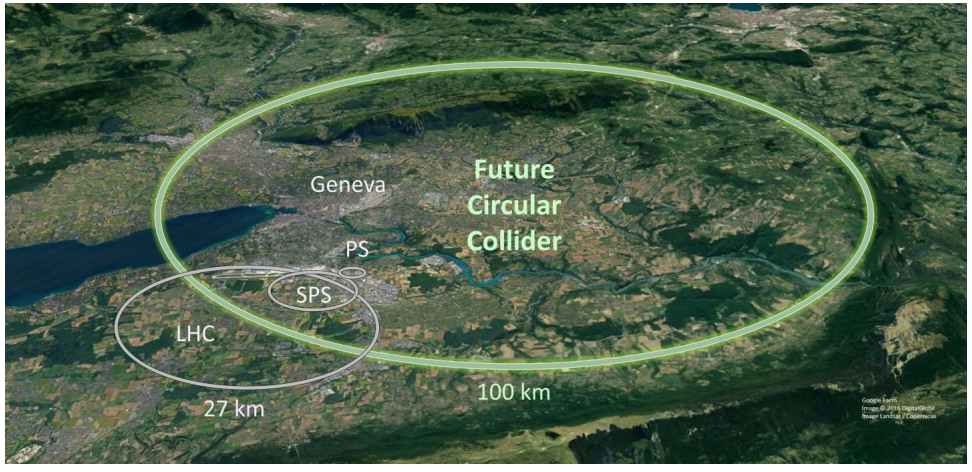
You've been enrolled to work for the FCC-hh project, and more specifically on its injector complex...

We need to decide whether we use the LHC as a High Energy Booster, or upgrade the SPS into a superconducting machine at 1.3 TeV: the scSPS...



FCC-hh Conceptual Design Report, Section 6, p.940

SCENARIO



You are part of the team working on the scSPS. Your colleague from beam transfer says there are many benefits in terms of transfer line design...

One question remains: what about longitudinal beam stability due to wakefields?...

The task is complex, so are the RF system and the impedance model, the analytical approach difficult... How can we evaluate beam stability?

ONE TOOL YOU SHOULD TRY: BEAM TRACKING!

PURPOSE OF THE HANDS-ON

The purpose of the hands-on, together with the courses, is to give you insights on the following questions.

WHAT IS LONGITUDINAL TRACKING?

WHY DO WE USE TRACKING?

HOW DO WE EFFECTIVELY DEVELOP AND USE A TRACKING CODE?

WHAT FEATURES CAN WE INCLUDE IN TRACKING SIMULATIONS?

COURSE OBJECTIVES

WHAT YOU SHOULD KNOW AT THE END OF THE COURSE

- How the longitudinal dynamics of particles in a synchrotron is simulated in a tracking code.
- What is synchrotron motion, using numerical method to visualize it.
- What are the benefits (and limitations) of tracking.
- How to input wakefield/impedance in a tracking code, whether you come from beam dynamics or RF background.

WHAT YOU SHOULD BE ABLE TO DO AT THE END OF THE COURSE

- Use the BLonD code for your own simulations.
- Use tracking as a mean to compare to analytical longitudinal beam dynamics models.

OUTLINE OF THE HANDS-ON

FOR EACH HANDS-ON BLOCK

FIRST AFTERNOON: INTRODUCTION TO TRACKING

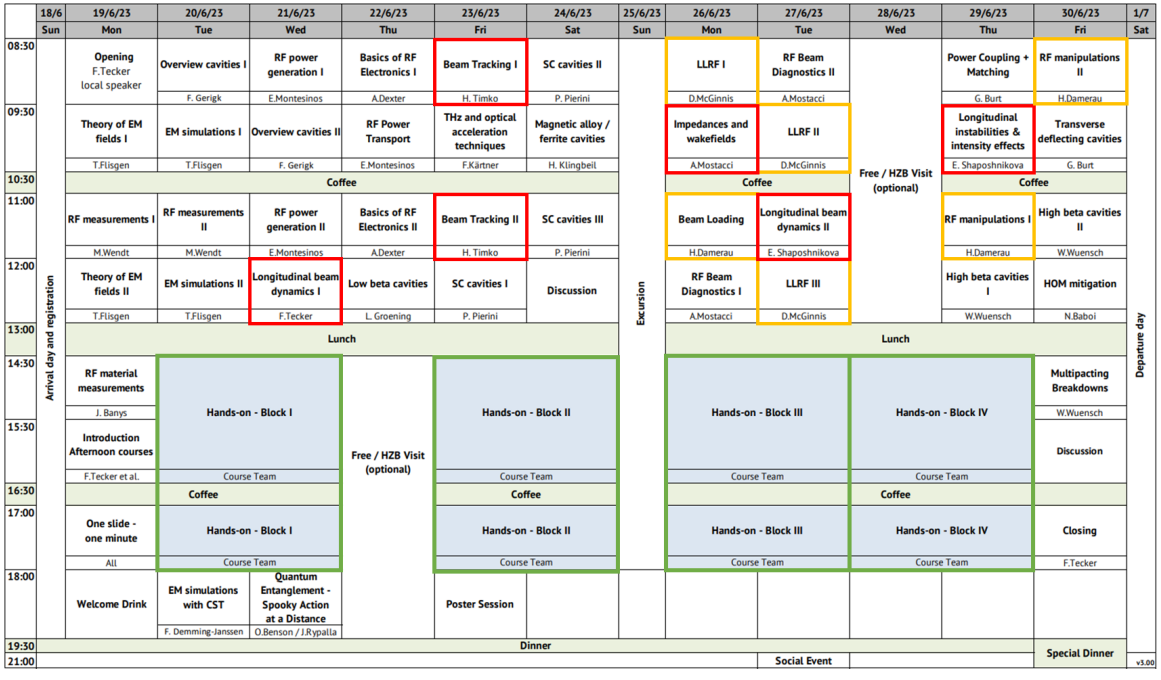
- Develop a multiparticle tracking code, without intensity effects
- Two options are offered:
  - Make your own tracker!
  - Use the BLonD simulation code

SECOND AFTERNOON: ADVANCED TRACKING

- Learn how to include intensity effects (wakefields) using BLonD
- Check if instabilities are a limitation for scSPS
- Get insights on advanced topics like potential well distortion, as you would measure it in a real accelerator

SCHEDULE

WHERE DO WE STAND?



	18/6 Sun	19/6/23 Mon	20/6/23 Tue	21/6/23 Wed	22/6/23 Thu	23/6/23 Fri	24/6/23 Sat	25/6/23 Sun	26/6/23 Mon	27/6/23 Tue	28/6/23 Wed	29/6/23 Thu	30/6/23 Fri	1/7 Sat
08:30	Arrival day and registration	Opening F.Tecker local speaker	Overview cavities I F. Gerigk	RF power generation I E.Montesinos	Basics of RF Electronics I A.Dexter	Beam Tracking I H. Timko	SC cavities II P. Pierini	Excursion	LLRF I D.McGinnis	RF Beam Diagnostics II A.Mostacci	Free / HZB Visit (optional)	Power Coupling + Matching G. Burt	RF manipulations II H.Damerau	Departure day
09:30		Theory of EM fields I T.Flisgen	EM simulations I T.Flisgen	Overview cavities II F. Gerigk	RF Power Transport E.Montesinos	THz and optical acceleration techniques F.Kärtner	Magnetic alloy / ferrite cavities H. Klingbeil		Impedances and wakefields A.Mostacci	LLRF II D.McGinnis		Longitudinal instabilities & intensity effects E. Shaposhnikova	Transverse deflecting cavities G. Burt	
10:30		Coffee							Coffee			Coffee		
11:00		RF measurements I M.Wendt	RF measurements II M.Wendt	RF power generation II E.Montesinos	Basics of RF Electronics II A.Dexter	Beam Tracking II H. Timko	SC cavities III P. Pierini		Beam Loading H.Damerau	Longitudinal beam dynamics II E. Shaposhnikova		RF manipulations I H.Damerau	High beta cavities II W.Wuensch	
12:00		Theory of EM fields II T.Flisgen	EM simulations II T.Flisgen	Longitudinal beam dynamics I F.Tecker	Low beta cavities L. Groening	SC cavities I P. Pierini	Discussion		RF Beam Diagnostics I A.Mostacci	LLRF III D.McGinnis		High beta cavities I W.Wuensch	HOM mitigation N.Baboi	
13:00		Lunch							Lunch					
14:30		RF material measurements J. Banys	Hands-on - Block I		Free / HZB Visit (optional)	Hands-on - Block II			Hands-on - Block III		Hands-on - Block IV		Multipacting Breakdowns W.Wuensch	
15:30		Introduction Afternoon courses F.Tecker et al.	Course Team			Course Team			Course Team		Course Team		Discussion	
16:30			Coffee			Coffee					Coffee			
17:00		One slide - one minute All	Hands-on - Block I Course Team			Hands-on - Block II Course Team			Hands-on - Block III Course Team		Hands-on - Block IV Course Team		Closing F.Tecker	
18:00		Welcome Drink	EM simulations with CST F. Demming-Janssen	Quantum Entanglement - Spooky Action at a Distance O.Benson / J.Rypalla		Poster Session								
19:30		Dinner											Special Dinner	
21:00										Social Event				v3.00

- Core courses for the hands-on.
- Courses to go beyond, where tracking is an important tool.
- All courses have relevant implications for the design of an accelerator!

INSTALLATION

ALL YOU NEED TO GET STARTED

Live version of instructions on the codimd

USEFUL LINKS

- RF CAS website: https://indico.cern.ch/event/1212689/
- Programme of the CAS: https://cas.web.cern.ch/sites/default/files/RF_timetable_2023_v3_1.pdf
- Longitudinal hands-on, link to content and cheat sheets: https://indico.cern.ch/event/1212689/contributions/5377007/
- Python software installation: https://codimd.web.cern.ch/s/eg2t11z3T
- BLonD source code: https://gitlab.cern.ch/blond/BLonD

QUESTIONS?