



The CERN Accelerator School

Introduction to Accelerator Physics

18 September – 1 October 2022

Victoria Hotel, Kaunas, Lithuania

WELCOME!

The CERN Accelerator School - CAS

- Established at the beginning of 1983
 - To preserve and transmit knowledge accumulated, at CERN and elsewhere, on particle accelerators and colliders of all kinds
- This provided a framework for a series of courses
 - General accelerator physics
 - [Introduction to Accelerator Physics](#)
 - [Advanced Accelerator Physics](#)
 - Specialized topics in the field (RF, BI, magnets, vacuum, colliders, beam dynamics, plasma,...)
 - 50 to 70 hours teaching in **~2 week intensive residential courses**
- About 90 courses held so far
- Occasional courses in the framework of the US-CERN-Japan-Russia Joint Accelerator School (JAS), from 2022: IAS (International Accelerator School)
 - 14 schools held so far (since 1985), Superconductivity course upcoming in July 2023

Scope

Accelerator Physics

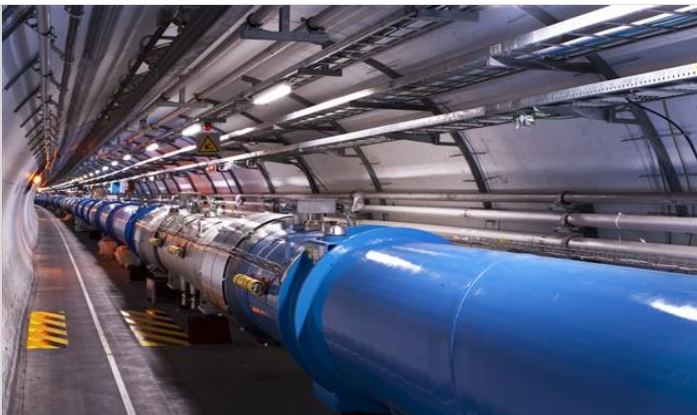
Relativity / Electro-Magnetic Theory /
Transverse Beam Dynamics /
Longitudinal Beam Dynamics / Linear
Imperfections and Resonances /
Synchrotron Radiation / Electron
Beam Dynamics / Multi-Particle
Effects / Non-Linear Dynamics Beam
Instabilities / Landau Damping /
Beam-Beam Effects

Accelerator Systems

Particle Sources / RFQ / LEPT
RF Systems / Beam Measurement /
Feedback Systems / Beam Injection
and Extraction / Beam Transfer Power
Convertors / Warm Magnets /
Superconducting Magnets / Vacuum
Systems Machine Protection Systems
Radiation and Radioprotection

Accelerators

Linear Accelerators
Synchrotron Light Machines
FELs
FFAGs
Cyclotrons
Synchrotrons
Colliders



Applications

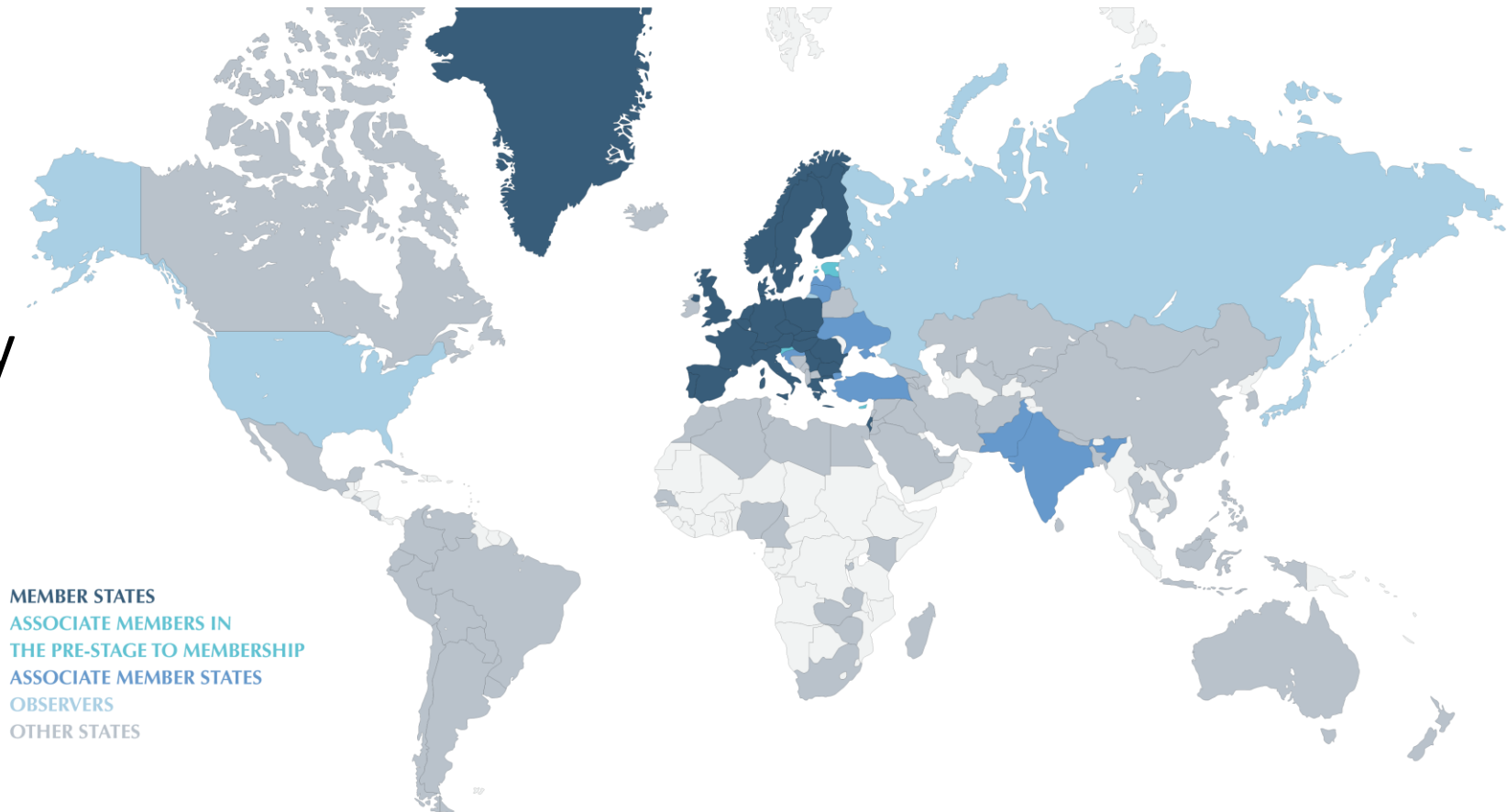
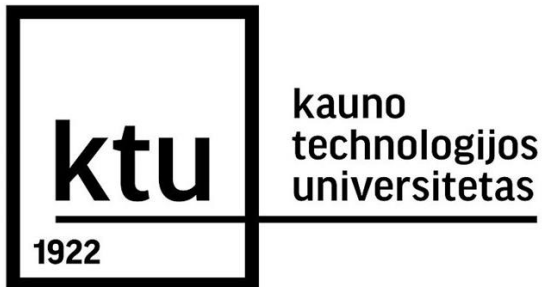
High Energy Physics
Nuclear Physics
Industrial Applications
Medical Applications
Cancer Therapy



Why are we in Lithuania now?

- CERN is financed by 23 member states and 10 associated member states
- CAS visits all CERN member states and associated member states in turn
- Lithuania became associated CERN member in 2018
- School organized with the Technical University of Kaunas

Many thanks!



Residential CAS Courses

- Networking is an essential part of each CAS course!
- Introduction to Accelerator Physics (yearly – in September)
 - 18 Sep – 1 Oct 2022 (in Kaunas)
 - Hands-on in transverse and longitudinal beam dynamics
- Advanced Accelerator Physics
 - 6 – 18 Nov 2022 in Sévrier (near Annecy), France
 - Hands-on in RF, Beam Instrumentation and Beam Dynamics
- 2023+: Radiofrequency, Magnets, Mechanical and Material Engineering, ...
- Basic course (non-residential) near CERN – open for external participants

Program for the 2022 CAS - Introduction to Accelerator Physics

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat				
18/09	19/09	20/09	21/09	22/09	23/09	24/09	25/09	26/09	27/09	28/09	29/09	30/09	01/10				
08:30	Arrival day and registration	Opening	Kinematics of Particle Beams - Relativity	Transverse Linear Beam Dynamics V	Free	Beam Instrumentation	Electron Beam Dynamics I	Excursion	Cyclotrons I	Vacuum	Free	A first taste of Non-Linear Beam Dynamics I	Advanced accelerator concepts II	Departure day			
		Tecker	Shreyber	Hillert		Forck	Rivkin		Seidel	Seidel		Bartosik	Ferrario				
09:30																	
09:45		Electromagnetic Theory I	Transverse Linear Beam Dynamics III	Longitudinal BD in Circular Machines I		Computational tools II	Electron Beam Dynamics II		RF systems I	Collective Effects I		Injection and Extraction	Particle motion in Hamiltonian Formalism II				
		Shreyber	Hillert	Tecker		Latina	Rivkin		Völlinger	Li		Tecker	Papaphilippou				
10:45		Coffee				Coffee			Coffee			Coffee					
11:15		Electromagnetic Theory II	Linear Accelerators I	Linear Imperfections I		Beam Diagnostics	Discussion electron beam dynamics		Cyclotrons II/FFAs	Introduction to Non-Linear longitudinal Beam Dymanics	A first taste of Non-Linear Beam Dynamics II	Synchrotron light circular machines					
		Shreyber	Alesini	Ziemann		Forck	Rivkin		Seidel	Lasheen	Bartosik	Prat					
12:15		Lunch							Lunch								
13:45		Transverse Linear Beam Dynamics I	Superconducting Magnets	Longitudinal BD in Circular Machines II		History of particle acceleration	Linear Imperfections - corrections		Machine & People Protection Issues	RF systems II	Collective Effects II	Collective Effects III	Advanced accelerator concepts I		FELs		
		Hillert	de Rijk	Tecker		Sheehy	Ziemann		Forck	Völlinger	Li	Li	Ferrario		Prat		
14:45																	
15:00		Warm Magnets	Linear Accelerators II	Time and Frequency domain signals I	Time and Frequency domain signals II	Sources	Secondary beams and targets		Hands-ON calculations (longitudinal) - Intro	Hands-ON calculations (longitudinal) - III	Colliders and luminosity	Particle motion in Hamiltonian Formalism I	Designing a synchrotron - a real life example				
		de Rijk	Alesini	Schmickler	Schmickler	Faircloth	Faircloth		Lasheen et al.	Lasheen et al.	Schmickler	Papaphilippou	Papaphilippou				
16:00	Coffee							Coffee									
16:30	Transverse Linear Beam Dynamics II	Transverse Linear Beam Dynamics IV	Hands-ON Lattice calulations I	Accelerator Applications	Hands-ON Lattice calulations III	Hands-ON Lattice calulations V	Hands-ON calculations (longitudinal) - I	Hands-ON calculations (longitudinal) - IV	Collective Effects IV	Q&A/study time	Closing						
	Hillert	Hillert	Gamba et al.	Sheehy	Gamba et al.	Gamba et al.	Lasheen et al.	Lasheen et al.	Li		Tecker						
17:30																	
17:45	1 slide 1 minute	Computational tools I	Hands-ON Lattice calulations II	Linear Imperfections II	Hands-ON Lattice calulations IV	Hands-ON Lattice calulations VI	Hands-ON calculations (longitudinal) - II	Hands-ON calculations (longitudinal) - V	Discussion collective effects								
		Latina	Gamba et al.	Ziemann	Gamba et al.	Gamba et al.	Lasheen et al.	Lasheen et al.	Li	all							
18:45	Welcome reception				Discussion session			Seminar - Ultrasonic measurements		Poster session	Seminar - Nonlinear dynamical systems						
20:00	Dinner at Hotel											Banquet					
21:00									Cinema event								

This course

- 77 participants (26 CERN, 38 external, 10 local) – 25 nationalities!
- Lectures 45-50 minutes + discussion
- Discussion sessions with lecturers
- Hands-on courses for transverse and longitudinal optics
- Lunch and coffee breaks between the lectures
- use them for networking
- 1 slide – 1 minute today followed by Welcome drink
- Excursion to Trakai on Sunday
- Cinema evening next week on Tuesday
- 2 entertaining seminars by local professors

COVID-19

- We want to hold the course in safe conditions
- No particular measures presently imposed
- In case of symptoms
 - Don't come to the course
 - Please test yourself first

Hands-on courses

- Transverse Optics
 - Choice of MatLab/Octave – Python => list with Python participants
- Longitudinal Optics
 - Python
- Tandems
 - optional !
 - idea: in case you get stuck, you can ask your tandem partner for help
 - don't just make the more experienced person do the exercises
 - subscribe in lists for '**persons wanting help**' and '**helpers**' for MatLab and Python

The CAS Team

Anastasiya Safronava

Web pages



Noemi Caraban Gonzalez

CASopedia

Christine Völlinger

Deputy Director

Michela Lancellotti

Social media

Frank Tecker

Director

Delphine Rivoiron

Administrative Manager

Hermann Schmickler

previous Director

Ron Suykerbuyk

Filming

Online Evaluation Form

- Important to maintain / improve the high quality of teaching
- <https://cas.web.cern.ch/evaluation/kaunas-2022>
- Log in with CERN account or many other ways (Google, LinkedIn, ...)

Sign in with a CERN account


Username


Password

[Forgot Password?](#)


Sign In


Or use another login method

 Two-factor authentication

 Kerberos


Sign in with your email or organisation


 Home organisation - eduGAIN


 External email - Guest access


Or sign in with a social account

By clicking on the buttons below, you consent to CERN's transfer of your login request to the social provider and to receive your account name, name and e-mail for authenticating you. Click [here](#) for more details.

 Google

 LinkedIn

 GitHub

 Facebook

Online Evaluation Form

Level	Content	Presentation	Relevance
<input type="radio"/> Much too low	<input type="radio"/> Completely uninteresting	<input type="radio"/> Very poor	<input type="radio"/> Should not be in this CAS course
<input type="radio"/> Low	<input type="radio"/> Uninteresting	<input type="radio"/> Poor	<input type="radio"/> Specialist information - good, but not for me
<input type="radio"/> Just right	<input type="radio"/> Of some interest	<input type="radio"/> Fair	<input type="radio"/> Contributes to the general accelerator education
<input type="radio"/> Too high	<input type="radio"/> Interesting	<input type="radio"/> Good	<input type="radio"/> Important general information
<input type="radio"/> Much too high	<input type="radio"/> Very interesting	<input type="radio"/> Very good	<input type="radio"/> Directly relevant for my present studies

Other comments on this lecture...

☒ SAVE DRAFT

SUBMIT

- Please **fill it in** ideally **daily** during the course, when your memory is fresh
- You can **save it** and come back to it later at any time
- Just **DON'T submit it until** you have completed your evaluation at **the end**



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Introduction to Accelerator Physics

Enjoy the course!

<http://cern.ch/cas>

