



The CERN Accelerator School

RF for Accelerators

18 June – 1 July 2023

Seminaris CampusHotel, Berlin, Germany

WELCOME!

Roger Bailey (1954-2023)

- We share the news of Roger Bailey's passing with heartfelt sorrow.
- Roger was the Head of the CERN Accelerator School from 2011 to 2017 and had dedicated more than 30 years to working at CERN. He was also the head of LHC Operations and my supervisor.
Roger's remarkable contributions to the accelerator physics community will forever be remembered.
- Our heartfelt sympathies go out to his loved ones, colleagues and friends during this tough time.



19/3/1954 – 1/6/2023

The CERN Accelerator School - CAS

- Established at the beginning of 1983 => 40 years this year!
 - 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

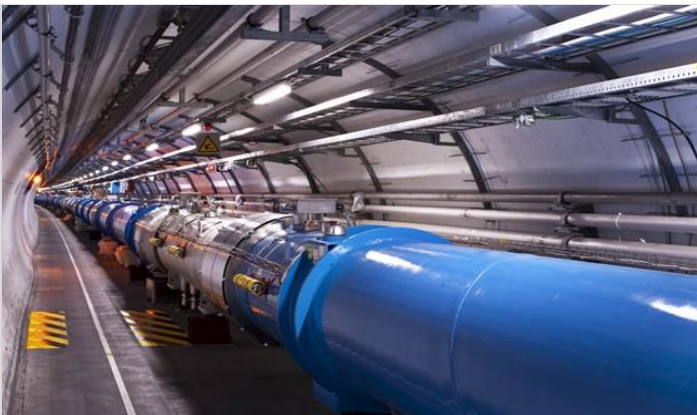
Relativity / Electro-Magnetic Theory /
Transverse Beam Dynamics /
Longitudinal Beam Dynamics / Linear
Imperfections and Resonances /
Synchrotron Radiation / Electron
Beam Dynamics / Multi-Particle
Effects / Non-Linear Dynamics Beam
Instabilities / Landau Damping /
Beam-Beam Effects

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

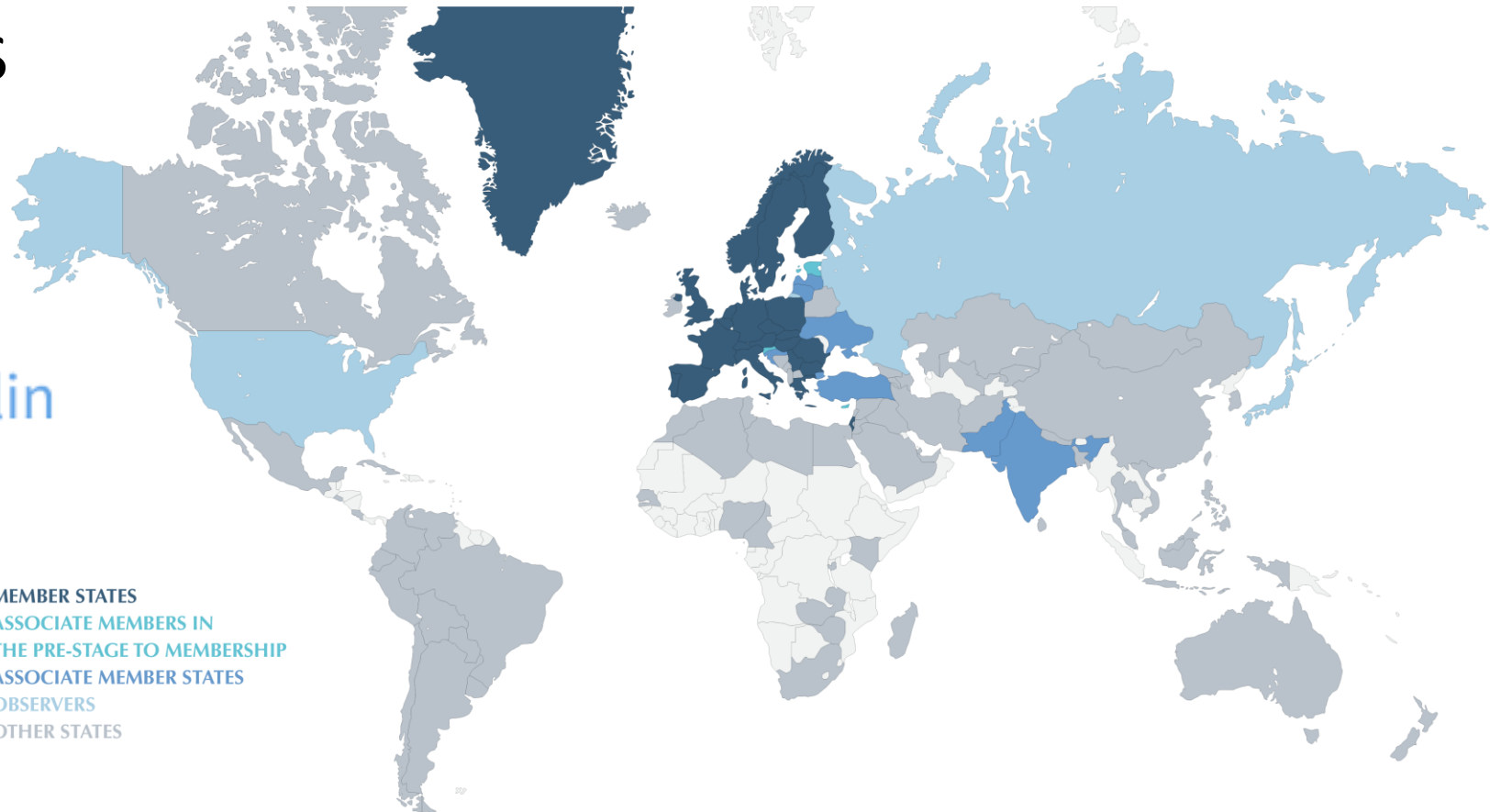


Why are we in Germany now?

- CERN is financed by 23 member states and 10 associated member states
- CAS visits all CERN member states and associated member states in turn
- Previous residential CAS in Germany in 2016
- In collaboration with

HZB Helmholtz
Zentrum Berlin

- Many thanks to
Axel Neumann
Roswitha Schabardin
Jens Knobloch





Residential CAS Courses

- Typically 2 weeks duration
- Networking is an essential part of each CAS course!
- Introduction to Accelerator Physics (yearly – in September)
 - 25 Sep – 8 Oct 2023 (in Santa Susanna, Spain)
 - 2024 in Serbia
 - Hands-on in transverse and longitudinal beam dynamics
- Advanced Accelerator Physics
 - next in Nov 2024
 - Hands-on in RF, Beam Instrumentation and Beam Optics
- 2023+: Magnets, Mechanical and Material Engineering, ...
- Basic course (non-residential, 5 days) near CERN – open for external participants

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

This course

- **107 participants** (25 CERN, 77 external, ~~6~~ 5 grants)
- **34 (!) colleagues for lectures and hands-on**, 3 more for the CAS team
- Lectures 45-50 minutes + discussion
- Discussion sessions with lecturers and hands-on colleagues
- Hands-on courses for
 - RF measurements (I + II), RF simulations, Longitudinal Tracking
- Special lecture **“Electromagnetic simulations with CST”** tomorrow by Frank Demming-Janssen (SIMUSERV GmbH)
- entertaining **seminar:**
“Quantum Entanglement – Spooky Action at a Distance”
on Wednesday by Prof. Oliver Benson and Julian Rypalla

This course

- Lunch and coffee breaks between the lectures
- arrival at dinner buffet 19:30 – 20:30, buffet until 21:30, beer, wine, soft drinks
- use this for networking

- 1 slide – 1 minute today followed by Welcome drink
- Poster session this Friday after hands-on
- **HZB visits**
 - Thu 22/6: **Bus leaves at 14:00**, please let participants eat first
 - Wed 28/6: **Bus leaves at 8:30**
- **Excursion** by boat on **Sunday**, followed by free time - **buses leave at 9:00!**
- Cinema evening next week on Tuesday

Hands-on courses

- **4 different topics, 4 groups** rotate through every 2 days
 - Group assignment shown this afternoon
- **RF measurements 1 (1st floor: Harvard 1 and 2)**
- **RF measurements 2 (2nd floor: Oxford 1 and 2)**
 - 12 experiments about 1 hour each, rotate through them
- **RF simulations**
 - CST Microwave Studio (on your own computer, we have a few laptops)
 - in this auditorium (in the back)
- **Longitudinal Tracking**
 - in this auditorium
 - in Python (on your own computers, we have a few laptops)

Networking

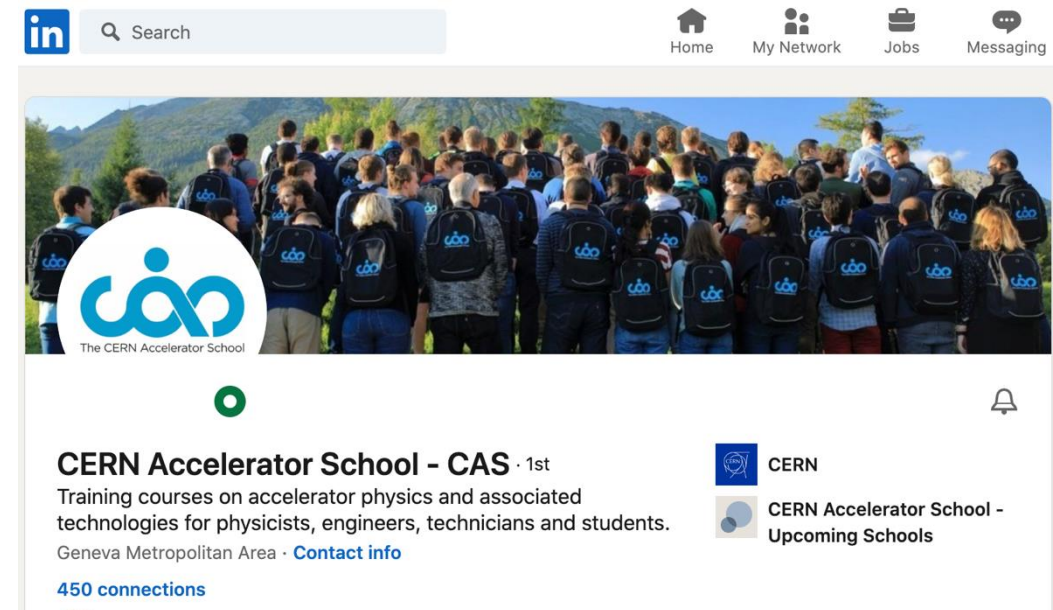
- Next to the course teaching the most important aspect of the school
“ digital training cannot replace CAS courses”

- people socialising (and even working)
up to late in the evenings
- lots of interactions students <-> teachers
- cinema evening
- excursion

- LinkedIn

- From the CAS web page

- CAS profile: <https://www.linkedin.com/in/cern-accelerator-school-a61367233>



COVID-19

- We want to hold the course in safe conditions
- No particular measures imposed

- In case of symptoms
 - Don't come to the course
 - Please test yourself first

The CAS Team

Anastasiya Safronava

Web pages



Noemi Caraban Gonzalez

CASopedia, Social media

Christine Völlinger

Deputy Director

Maria Filippova

Administrative Assistant

Frank Tecker

Director

Delphine Rivoiron

Administrative Manager

Ron Suykerbuyk

Filming

Frank Tecker, Opening CAS 2023

Online Evaluation Form

- Important to maintain / improve the high quality of teaching
- <https://cas.web.cern.ch/evaluation/berlin-2023>
- 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**



The CERN Accelerator School

RF for Accelerator

Enjoy the course!

<http://cern.ch/cas>

