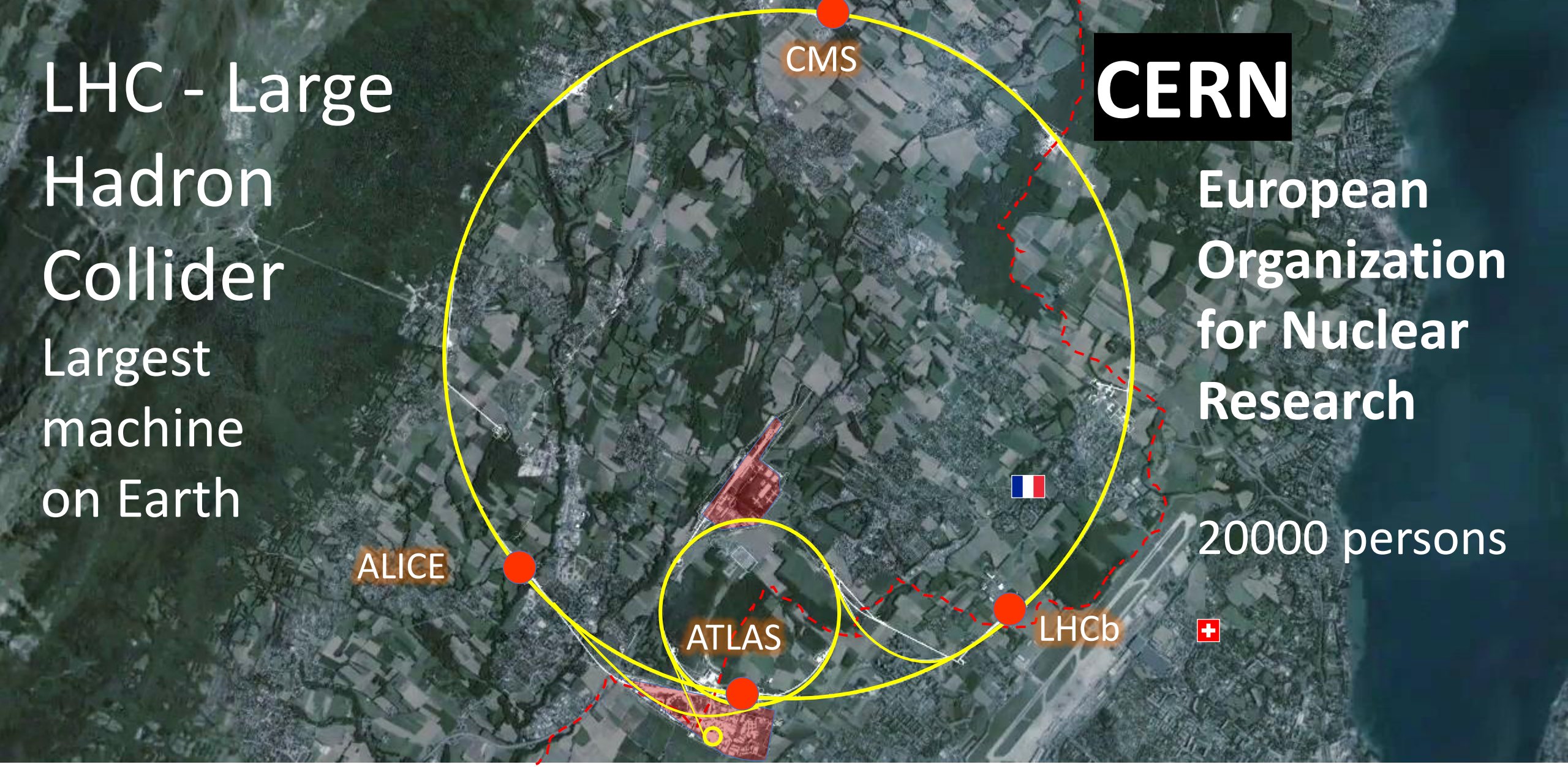
The CERN Accelerator School

Normal- and Superconducting Magnets

19 November – 2 December 2023

CityHotel, Sankt Pölten, Austria

WELCOME!



Credit: François Briard

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)
  - 15 schools held so far (since 1985), lately Superconductivity course July 2023

Residential CAS Courses

- **Introduction to Accelerator Physics** (yearly – in September)
  - 25 Sep – 8 Oct 2023 (in Santa Susanna, Spain) – next year to be fixed
  - Hands-on exercises in transverse and longitudinal beam dynamics

- **Advanced Accelerator Physics** (every two years)
  - 6 – 18 Nov 2022 (in Sévrier (near Annecy), France) – next in 2024
  - Hands-on in RF, Beam Instrumentation and Beam Dynamics

- 2023: Radiofrequency, Magnets
- 2024: Mechanical and Material Engineering, …
- **Basic course** (5 days, non-residential) near CERN – open for external participants

- Networking is an essential part of each CAS course!

The CERN Accelerator School

Scope

Accelerator Physics

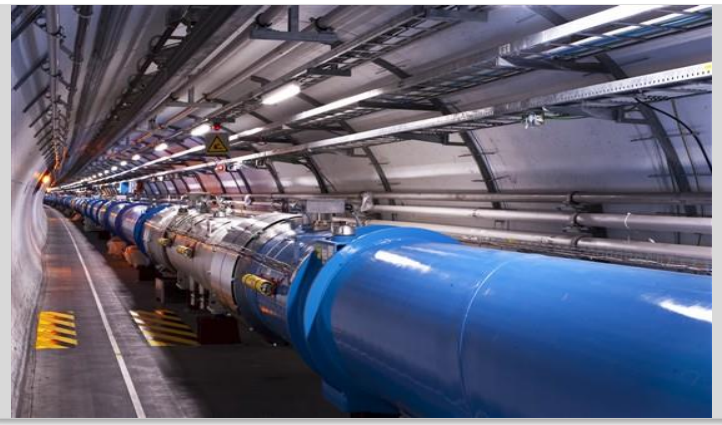
Relativity / Electro-Magnetic Theory / Transverse Beam Dynamics / Longitudinal Beam Dynamics / Linear Imperfections and Resonances / Synchrotron Radiation / Electron Beam Dynamics / Multi-Particle Effects / Non-Linear Dynamics Beam Instabilities / Landau Damping / Beam-Beam Effects

Accelerator Systems

Particle Sources / RFQ / LEBT
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
FFAs
Cyclotrons
Synchrotrons
Colliders

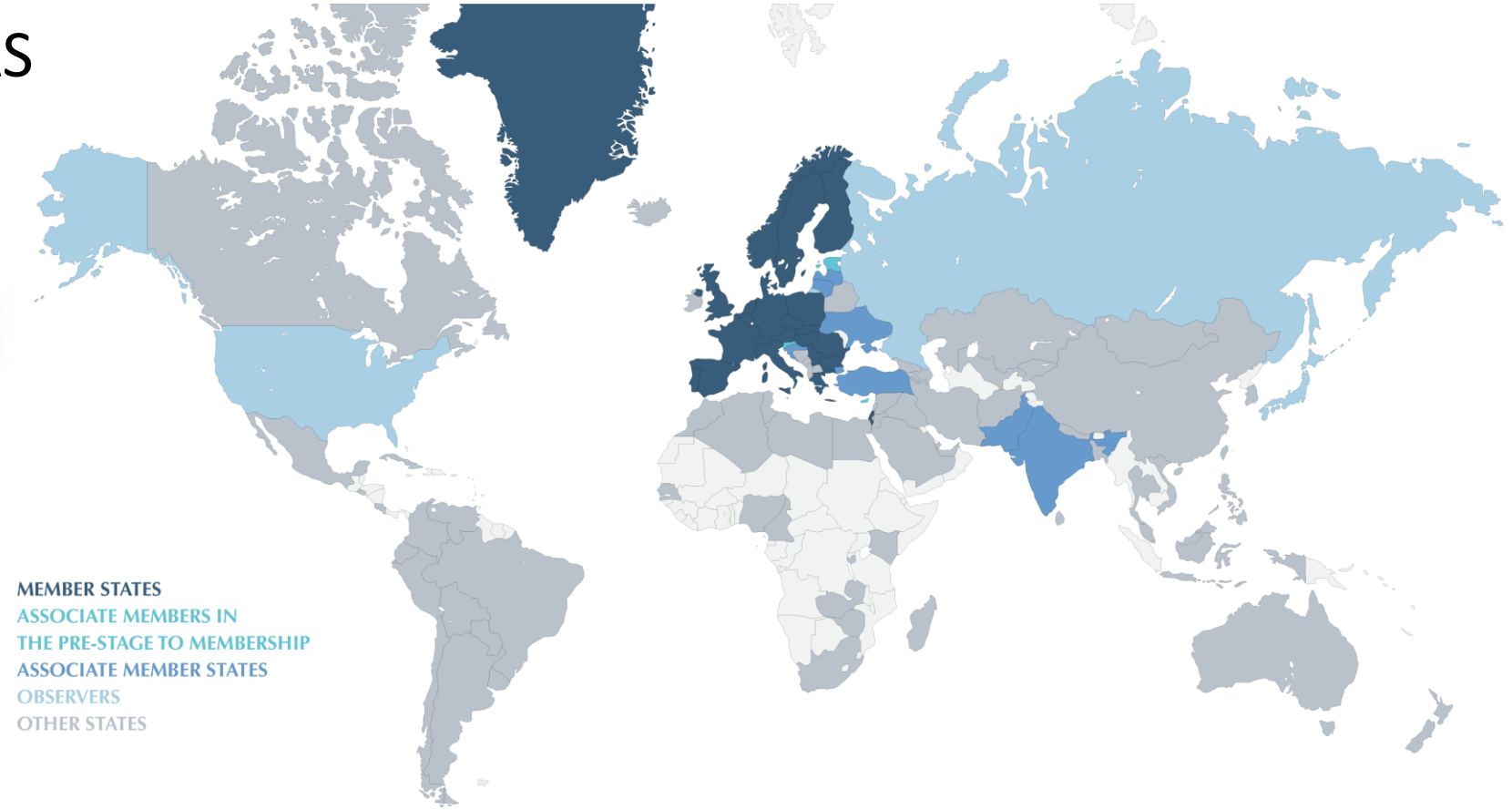


Applications

High Energy Physics
Nuclear Physics
Industrial Applications
Medical Applications
Cancer Therapy

Why are we in Austria 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 Austria in 2015
- In collaboration with MedAustron
- Many thanks to
  Petra Wurzer
  Victoria Lipp
  Claus Schmitzer



The CERN Accelerator School

Normal- and Superconducting Magnets

Organization of the Course

Program for the CAS course 'Normal- and Superconducting Magnets' - 2023 - Sankt Pölten, Austria

	19/11	20/11/23	21/11/23	22/11/23	23/11/23	24/11/23	25/11/23	26/11/23	27/11/23	28/11/23	29/11/23	30/11/23	1/12/23	2/12
	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat
08:30	Arrival day and registration	Opening F.Tecker local speakers	Field description for magnets III S. Russenschuck	Introduction to code for practical exercises Hands-on teams	Technical superconductors (LTS) M. Eisterer	Quench detection & magnet protection E. Todesco	Dielectric insulation & HV issues R. Piccin	Excursion	Mapping techniques (Hall Probes) M. Liebsch	Material for magnets & measurements II S. Sgobba		Metrology, alignment & fiducialisation P. Bestmann	Powering infrastructures S. Yammine	Departure day
09:30		Overview Design of accelerator magnets S. Russenschuck	Basics of numerical field computation H. de Gersem	RT magnet design, fabrication, testing III A. Milanese	SC magnet design - EM part II S. Farinon	Hands-on block 2	Magnetic measurement systems overview M. Buzio		Hysteresis and dynamic effects in SC magnets E. Todesco	NC dynamic effects, reproducibility M. Buzio		SC magnet fabrication + testing I S.Izquierdo Bermudez	Permanent magnets G. Le Bec	
10:30		Coffee							Coffee			Coffee		
11:00		Field description for magnets I S. Russenschuck	Magnetic field computation using FEM H. de Gersem	SC magnet design - EM part I S. Farinon	Technical superconductors (HTS) A. Ballarino	Hands-on block 2	Rotating coils, flux metric method, wire systems L. Fiscarelli		Heat transfer, cryostat, conduction cooling I R. van Weelderen	Heat transfer, cryostat, conduction cooling II R. van Weelderen		Injection & extraction devices J. Borburgh	Superferric magnets M. Statera	
12:00		Field description for magnets II S. Russenschuck	Introduction to practical exercises Hands-on teams	SC magnet design - mechanical I F. Toral	SC magnet design - mechanical II F. Toral		Low-emittance ring magnets F. Toral		Material for magnets & measurements I S. Sgobba	NC Modelling & measurement of non-linear effects M. Buzio		SC magnet fabrication + testing II S.Izquierdo Bermudez	Magnets for medical applications M. Pivi	
13:00		Lunch							Lunch					
14:30		Beam dynamics + resulting magnet specifications I H. Schmickler	RT magnet design, fabrication, testing I A. Milanese	Hands-on block 1		Medaustron Visit	Hands-on block 2		Hands-on block 3		Hands-on block 4		Insertion devices A. Bernhard	
15:30		Beam dynamics + resulting magnet specifications II H. Schmickler	Superconductivity M. Eisterer										Collider magnets (incl. muon collider) L. Bottura	
16:30		Coffee					Coffee		Coffee					
17:00		One slide - one minute All	RT magnet design, fabrication, testing II A. Milanese	Hands-on block 1			Hands-on block 2		Hands-on block 3		Hands-on block 4		Closing F.Tecker	
18:00		Welcome Drink		Seminar: Simulation, AI & beyond D. Rothschedl	Poster Session									
19:30		Dinner											Special Dinner	
21:00										Social Event				v6.2

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This course

- **95 participants** (29 CERN, 63 external, 3 grants)
- **37 (!) colleagues for lectures and hands-on**, 4 more for the CAS team
- Lectures 45-50 minutes + discussion
- **Hands-on courses for**
  - Superconducting magnet design
  - Resistive magnet design
  - Magnetic Measurements
  - Superconductivity experiments

- Special entertaining **seminar: "Simulation, AI, and beyond"** on Wednesday by Dominik Rothschedl

This course

- Lunch and coffee breaks between the lectures
- dinner buffet 19:30 – 21:00, beer, wine, soft drinks (2 per person)
- use this for networking

- 1 slide – 1 minute today followed by Welcome drink
- Poster session this Thursday after hands-on
- **Medaustron visit** this Friday 24/11- **buses leave at 14:00**
  - persons with a pacemaker, and pregnant or breastfeeding women cannot participate in the visit
- **Excursion** on **Sunday**, followed by free time - **buses leave at 9:00!**
- Cinema evening next week on Tuesday

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Hands-on courses

- **4** different **topics**, **4 groups** rotate through every 2 days
  - Group assignment shown tomorrow

- **Superconducting magnet design (in this auditorium)**
- **Resistive magnet design (1st floor: “WEINVIERTEL”)**
  - both use the FEMM code, and Lua (installed on your own computer, we have a few laptops)
  - code introduction on Wednesday

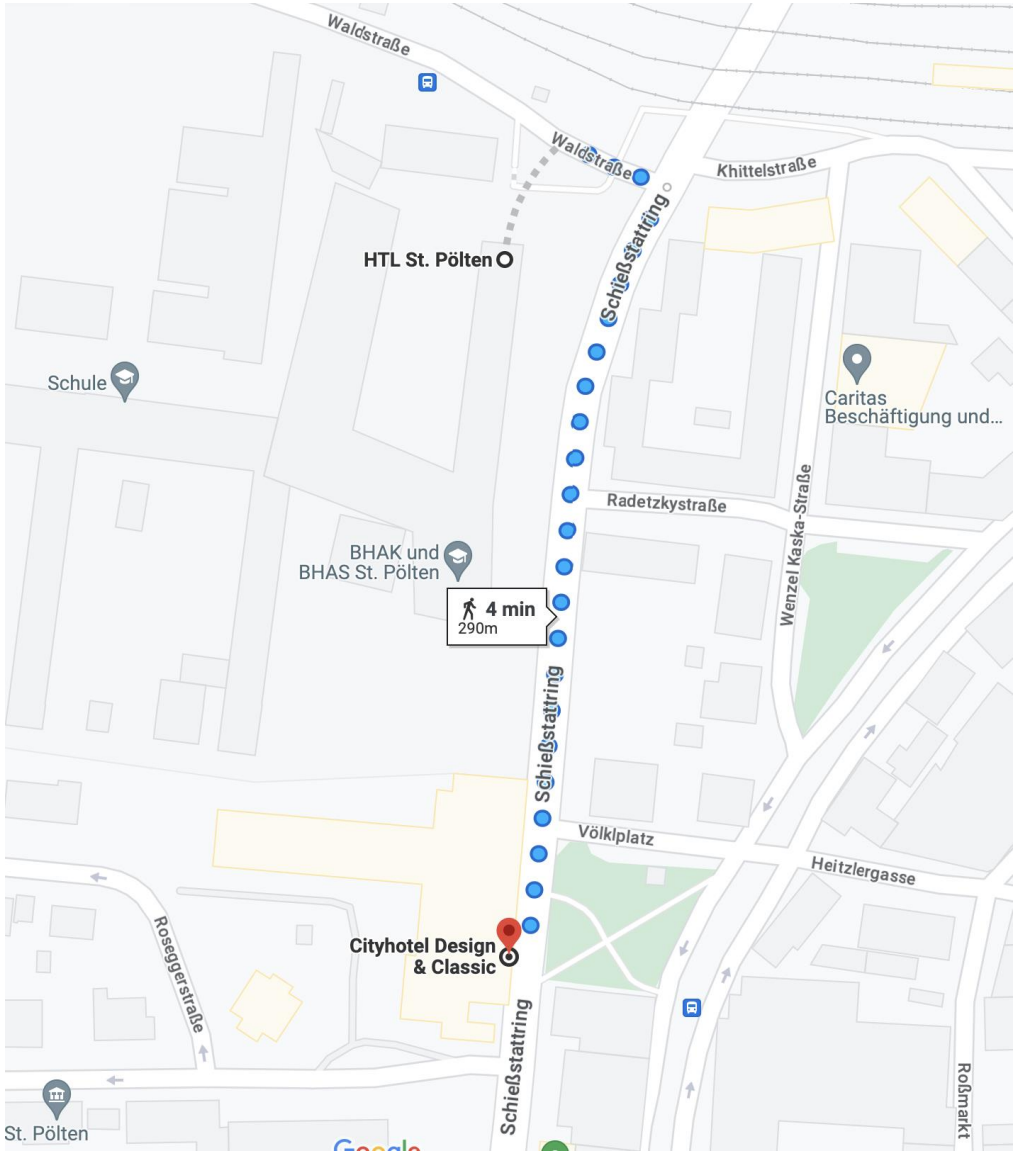
- **Superconductivity experiments (1st floor: „WALDVIERTEL“)**
- **Magnetic Measurements (in the HTL - Höhere Technische Lehranstalt)**
  - Introduction (including safety tomorrow)
- **Persons with implanted medical devices (e.g. pacemaker or insulin pump) must not enter these last two laboratories**

Höhere Technische Lehranstalt - HTL

HTL ST. PÖLTEN

- All information available at: https://www.htlstp.ac.at/
- Many thanks to Director Pfeffel for the collaboration

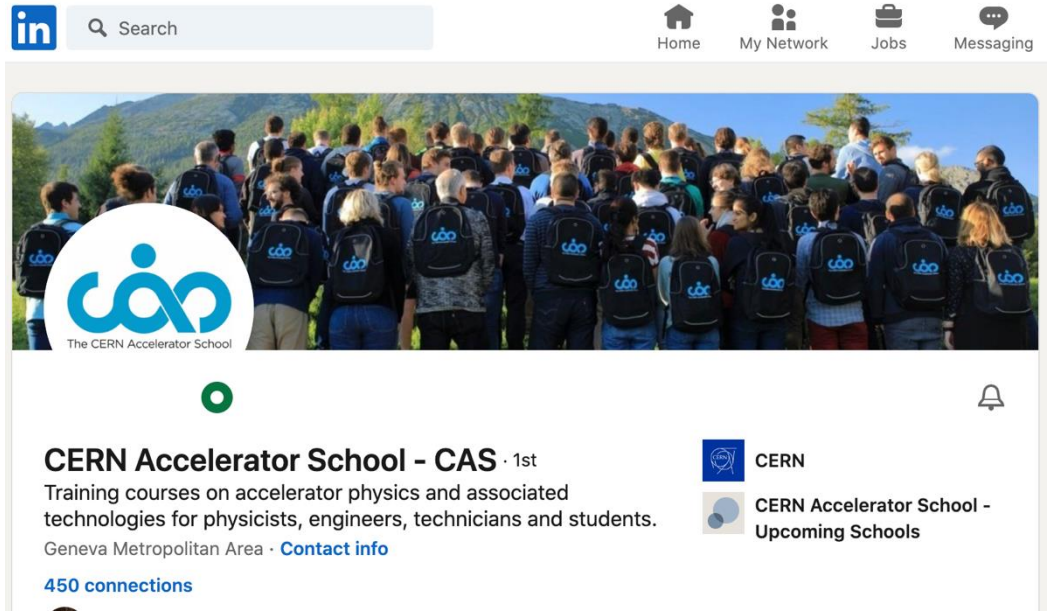
- We will announce location of hands-on exercises



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, karaoke
  - excursion



- LinkedIn
  - From the CAS web page
  - CAS profile: https://www.linkedin.com/in/cern-cas/

Networking

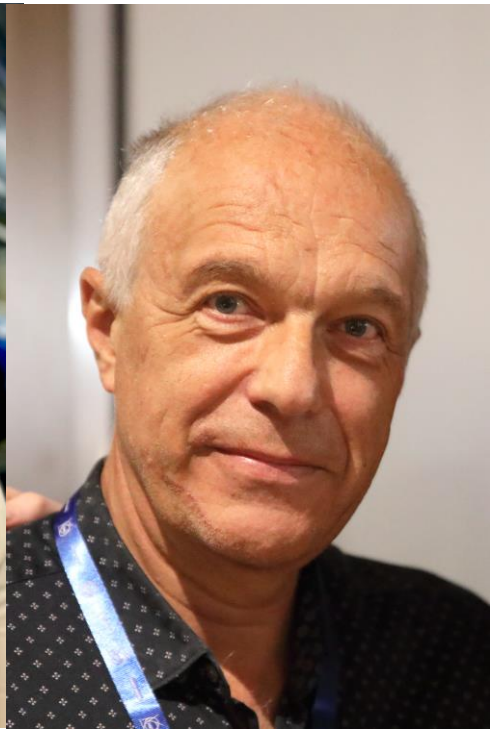
- **WhatsApp Group**
  - **Informal exchange for activities**
  - **everyone can join**
  - **share it with your fellow participants**

The CERN Accelerator School

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

Hermann Schmickler

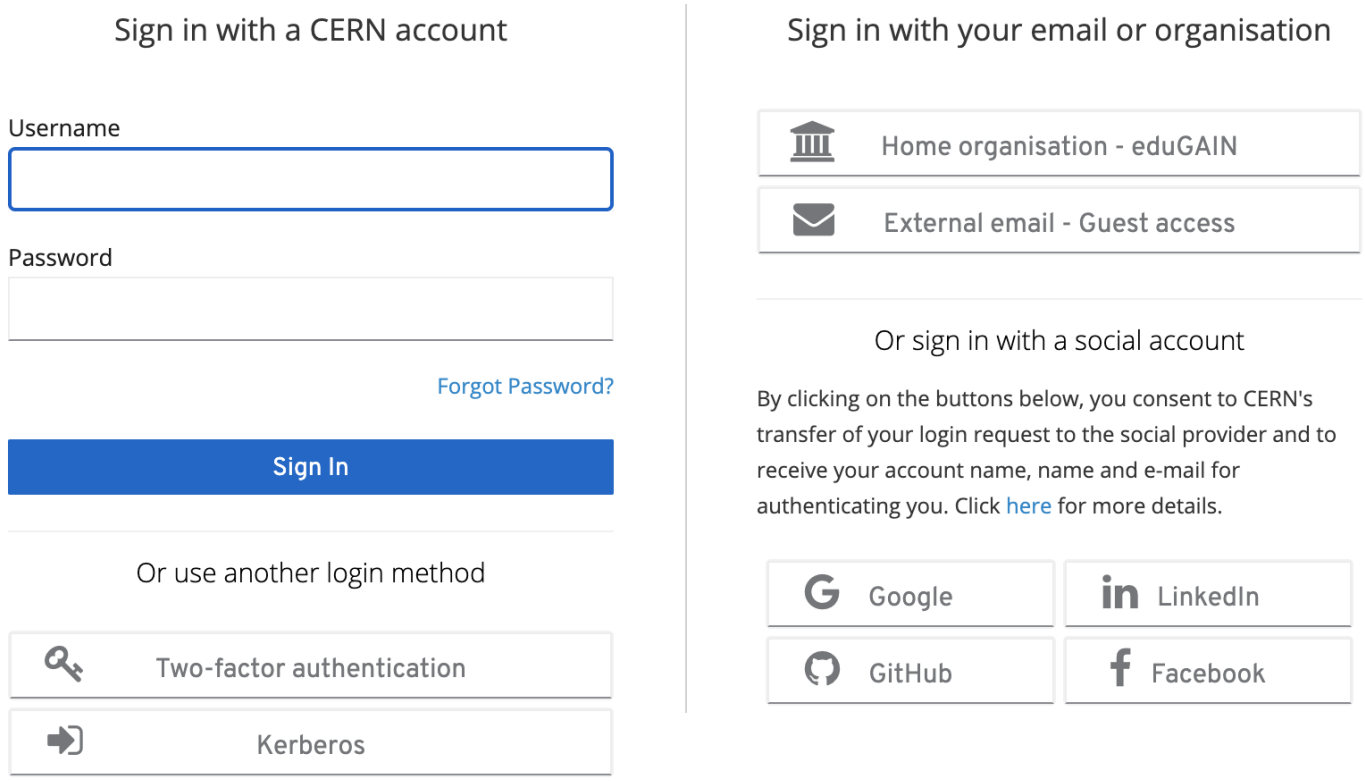
previous Director

Ron Suykerbuyk

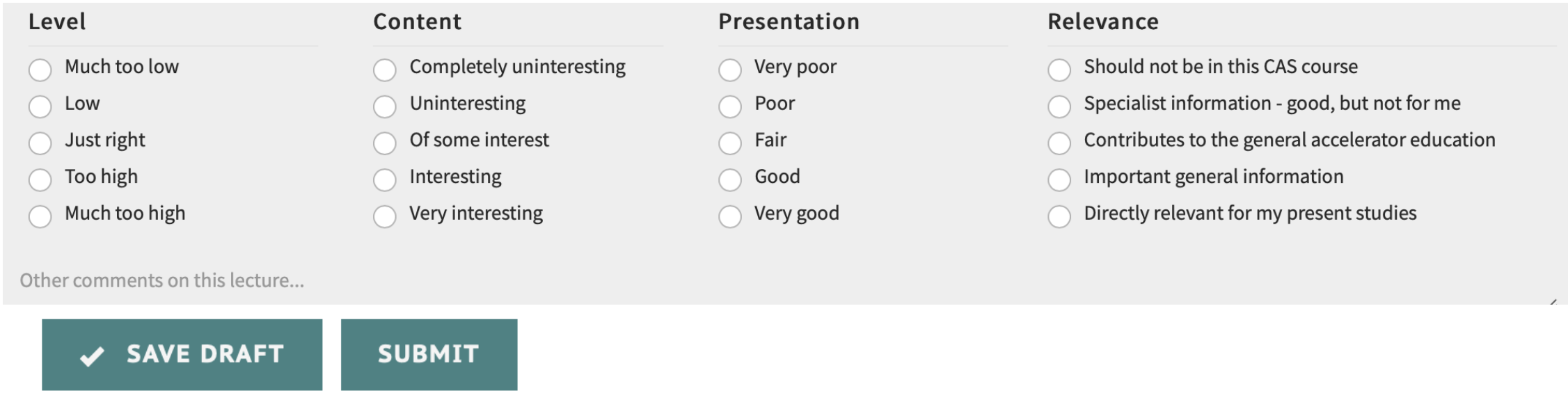
Filming

Online Evaluation Form

- Important to maintain / improve the high quality of teaching
- https://cas.web.cern.ch/evaluation/st-polten-2023
- Log in with CERN account or many other ways (Google, LinkedIn, …)



Online Evaluation Form



- 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**

Normal- and Superconducting Magnets

Enjoy the course!

http://cern.ch/cas