



The CERN Accelerator School

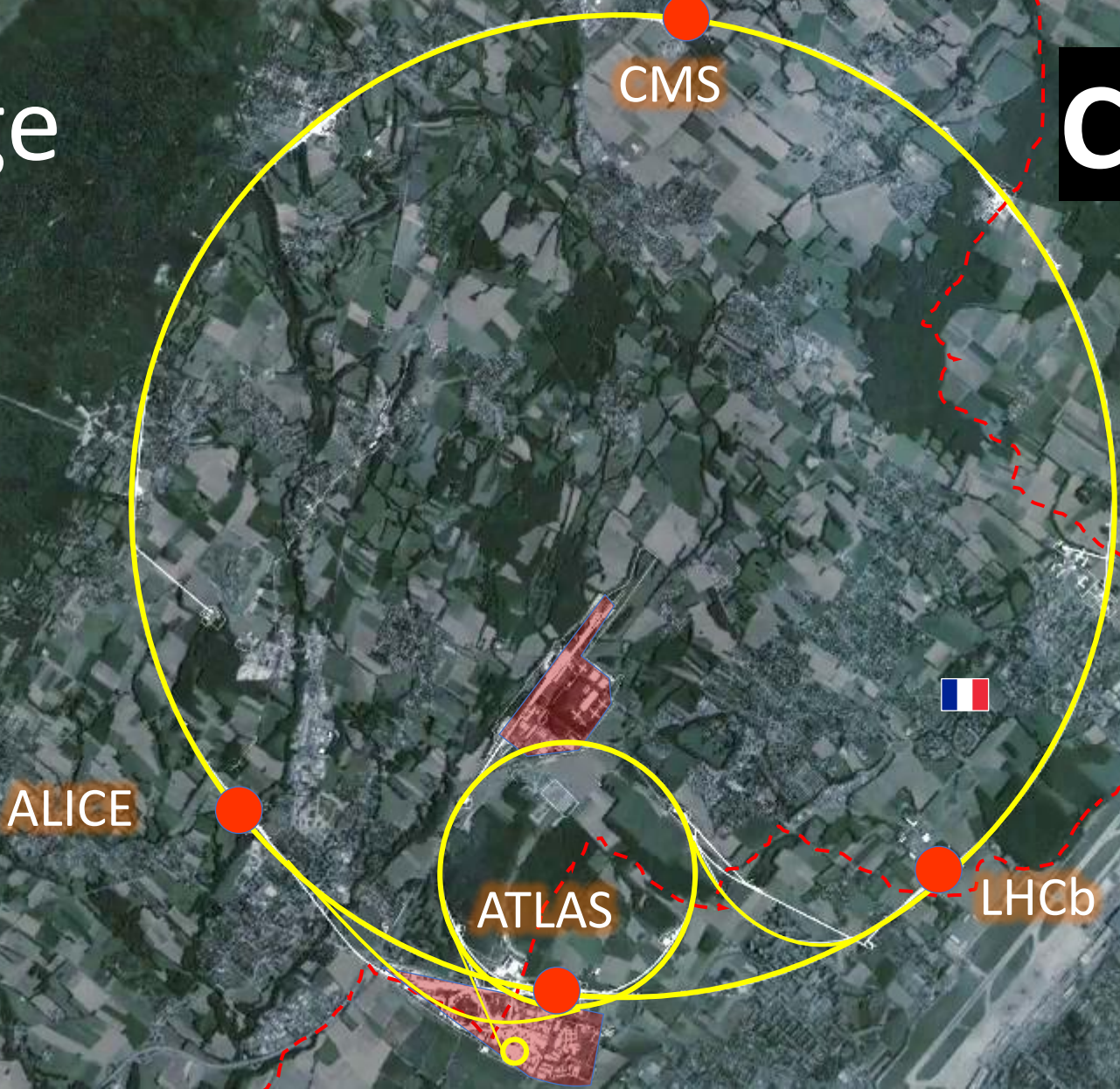
Mechanical & Materials Engineering for Particle Accelerators and Detectors

2 –15 June 2024

Hotel de Ruwenberg, Sint Michielsgestel, Netherlands

WELCOME!

LHC - Large
Hadron
Collider
Largest
machine
on Earth



CERN

European
Organization
for Nuclear
Research

20000 persons

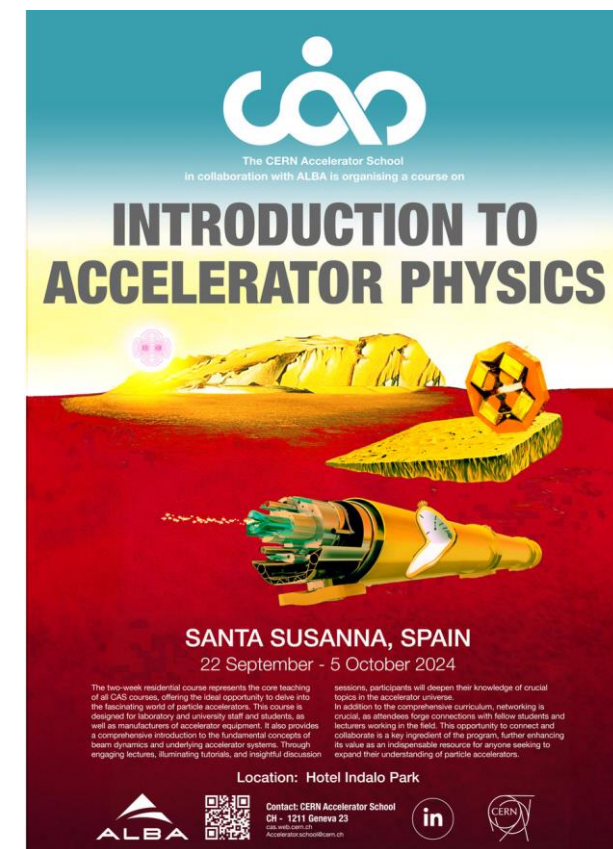
Credit: François Briard

The CERN Accelerator School - CAS

- **Established** at the beginning of **1983** – Just celebrated 40 years of CAS
 - 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), Superconductivity course in July 2023

Upcoming Residential CAS Courses

- **Introduction to Accelerator Physics** (yearly – in Sept.)
 - 22 Sep – 5 Oct 2024 (Santa Susanna, Spain)
 - Hands-on in transverse and longitudinal beam dynamics
- **Advanced Accelerator Physics** (every two years)
 - 10 – 22 Nov 2024 in Spa, Belgium
 - Hands-on in RF, Beam Instrumentation and Beam Dynamics
- **Topical courses 2025:**
Intensity Limitations for Hadron Beams, Beam Instrumentation, ...
- **Basic course** (5 days, non-residential) near CERN
 - open for external participants
 - next 10 – 14 March 2025



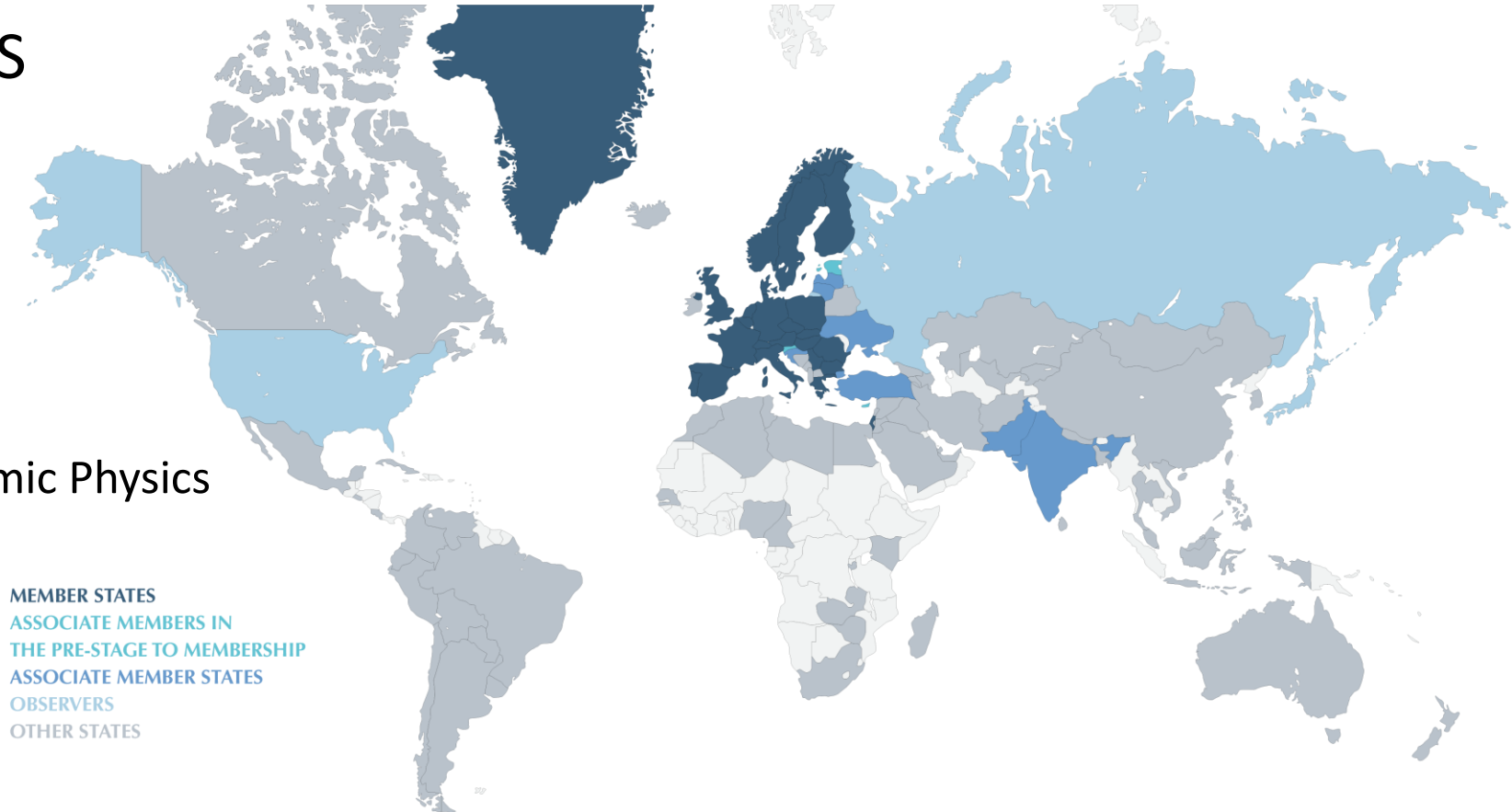
Why are we in the Netherlands now?

- CERN is financed by 23 member states and 11 associated member states
- **CAS visits all CERN member states and associated member states in turn**
- Previous residential CAS in NL in 2005
- In collaboration with

Nikhef

Dutch National Institute for Subatomic Physics

- Many thanks to Jan Visser



Organised with the CERN MME Group

- 1st time topic of Mechanical Engineering for a CAS
- Planned before Covid to take place in 2020
 - By the former CAS director, Hermann Schmickler
- Postponed twice – but we finally made it
- Many thanks to
 - Francesco Bertinelli (former group leader)
 - Said Atieh (present group leader)
 - Galia Jaouni
 - Alessandro Bertarelli



The CERN Accelerator School

Mechanical & Materials Engineering

Organization of the Course

Timetable – please be on time for the lectures!

Program for the CAS course on "Mechanical & Materials Engineering" June 2024

	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat				
08:00																		
08:30		Opening F. Tecker / J.Visser / A.Bertarelli	Standards and Safety Luca Dassa (CERN)	Steels & Stainless Steels II Stefano Sgobba (CERN)	Visit DIFFER (all groups)	Beam Intercepting Devices Davide Reggiani (PSI)	Additive Manufacturing A. Astarita (Univ. of Naples)	Excursion	Welding I Joseph Mark Krumenacker (SLV)	Vacuum systems for Accelerators Vincent Baglin (CERN)	Free study time	Fabrication summary Said Atieh (CERN)	Detector Magnets and Structures Herman Ten Kate (ex-CERN)	Departure day				
09:30		Introd. to Mechanics and Structures I Martina Scapin (Polito)	Computational Tools I (design) Federico Carra (CERN)	Machining Julius Tschöepel (IPK)		NC magnets Stephane Sanfilippo (PSI)	Large structures for Fusion Technology Neil Mitchell (Gauss Fusion)		Introduction to Metrology Paul Shore (NPL - UK)	Forming Charbel Moussa (CEMEF)		Undulators Haimo Joehri (PSI)	Collider basics Hermann Schmickler (ex-CERN)					
10:30		Coffee				Coffee			Coffee			Coffee						
11:00		Introd. to Mechanics and Structures II Martina Scapin (Polito)	Computational Tools II (fabrication) Federico Carra (CERN)	Mechanical measurements Kurt Artoos (CERN)		SC magnets Stephane Sanfilippo (PSI)	Design for Additive Manufacturing A. Astarita (Univ. of Naples)		Vacuum brazing Serge Mathot (CERN)	Measurement Uncertainty Samanta Piano (Nottingham)		RF Applications Thomas Lucas (PSI)	Beam instrumentation Ray Veness (CERN)					
12:00		Introduction to Engineering Materials A. Arauzo (Univ. Zaragoza)	Non Destructive Testing Gonzalo Arnau (CERN)	Plastics and Composite Materials Ana Teresa Perez (CERN)		Cryostats and cryomodules Vittorio Parma (CERN)	Digital Twins for Accelerators and Detectors Oscar Sacristan (CERN)		Welding II Romain Gerard (CERN)	Surface Treatments & Coatings Mauro Taborelli (CERN)		RF Power and Couplers Eric Montesinos (CERN)	Alignment and Metrology Hélène Mainaud (CERN)					
13:00		Lunch																
14:30		Introduction to Design for Accelerators Marc Timmins (CERN)	Mechanical Testing Klaus Peter Weiss (KIT)	Mech. Meas.(Group A) Design (Group B) NDT (Group C) Study time (Group D)		Mech. Meas.(Group D) Design (Group A) NDT (Group B) Study time (Group C)	Mech. Meas.(Group C) Design (Group D) NDT (Group A) Study time (Group B)		Mech. Meas.(Group B) Design (Group C) NDT (Group D) Study time (Group A)	Metrology (Gr. A) Fabrication (Group B) Visit VDL (Groups C & D)		Metrology (Gr. C) Fabrication (Group D) Visit VDL (Groups A & B)	Metrology (Gr. B) Fabrication (Group A) Visit IBS/Sioux (Groups C & D)		Metrology (Gr. D) Fabrication (Group C) Visit IBS/Sioux (Groups A & B)	Accelerator Technology Highlights Hermann Schmickler (ex-CERN)		
15:30		Physical properties & testing A. Arauzo (Univ. Zaragoza)	Steels & Stainless Steels I Stefano Sgobba (CERN)														Closing	
16:00		Coffee																
16:30		Coffee															F. Tecker	
17:00		Sustainable and Affordable Design Wilfried van Kessel (VDL)	Non Ferrous Materials Ignacio Aviles (CERN)	Mech. Meas.(Group A) Design (Group B) NDT (Group C) Study time (Group D)	Mech. Meas.(Group D) Design (Group A) NDT (Group B) Study time (Group C)	Mech. Meas.(Group C) Design (Group D) NDT (Group A) Study time (Group B)	Mech. Meas.(Group B) Design (Group C) NDT (Group D) Study time (Group A)	Metrology (Gr. A) Fabrication (Group B) Visit VDL (Groups C & D)	Metrology (Gr. C) Fabrication (Group D) Visit VDL (Groups A & B)	Metrology (Gr. B) Fabrication (Group A) Visit IBS/Sioux (Groups C & D)	Metrology (Gr. D) Fabrication (Group C) Visit IBS/Sioux (Groups A & B)							
18:00																		
18:30		1S1M		Seminar - Jan Visser Mechanics of Golf		Seminar - P. Werneke Einstein Telescope												
19:30		Dinner																
										cinema evening			gala dinner					

This course

- **85 participants** (42 CERN, 43 external) – with 20 different nationalities
- **49 (!) colleagues for lectures and hands-on**, 5 more for the CAS team
- Lectures 45-50 minutes + discussion
- **Hands-on courses for**
 - Mechanical design
 - Mechanical Measurements
 - Non-destructive Testing
 - Metrology
 - Fabrication
- Special entertaining **seminars** on Wednesday and Friday:
 - Mechanics of Golf, Jan Visser
 - Einstein Telescope, Patrick Werneke, Eric Hennes

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
- **DIFFER visit** this Thursday 24/11- **buses leave at 8:30!**
- **Excursion on Sunday**, followed by free time - **buses leave at 8:45!**
- Cinema evening next week on Tuesday
- CASaoke

Hands-on courses

- **4 different groups (A-D)** rotate through according to schedule
 - Please enter your background knowledge on the sheet that we pass
 - Group assignment shown tomorrow

WEEK 01	Wednesday			Thursday			Friday			Saturday		
	Room 1	Amphi	Room 2	Room 1	Room 2	Amphi	Room 1	Room 2	Amphi	Room 1	Room 2	Amphi
14h30 to 16h00	Measurement Group A	Design/FEA Group B	NDT/Material Group C	Measurement Group D	Design/FEA Group A	NDT/Material Group B	Measurement Group C	Design/FEA Group D	NDT/Material Group A	Measurement Group B	Design/FEA Group C	NDT/Material Group D
16h30 to 18h00	Measurement Group A	Design/FEA Group B	NDT/Material Group C	Measurement Group D	Design/FEA Group A	NDT/Material Group B	Measurement Group C	Design/FEA Group D	NDT/Material Group A	Measurement Group B	Design/FEA Group C	NDT/Material Group D
	Group D : Study time			Group C : Study time			Group B : Study time			Group A : Study time		

WEEK 02	Monday				Tuesday				Wednesday				Thursday			
	Room 1	Amphi	Room 2	Visit	Room 1	Amphi	Room 2	Visit	Room 1	Amphi	Room 2	Visit	Room 1	Amphi	Room 2	Visit
14h30 to 16h00	Metrology Group A	Fabrication Group B	Room 2	Visit	Metrology Group C	Fabrication Group D	Room 2	Visit	Metrology Group B	Fabrication Group A	Room 2	Visit	Metrology Group D	Fabrication Group C	Room 2	Visit
16h30 to 18h00	Metrology Group A	Fabrication Group B	Room 2	Visit	Metrology Group C	Fabrication Group D	Room 2	Visit	Metrology Group B	Fabrication Group A	Room 2	Visit	Metrology Group D	Fabrication Group C	Room 2	Visit
	Group C & D : Visit VDL				Group A & B : Visit VDL				Group C & D : Visit IBS/Sioux				Group A & B : Visit IBS/Sioux			

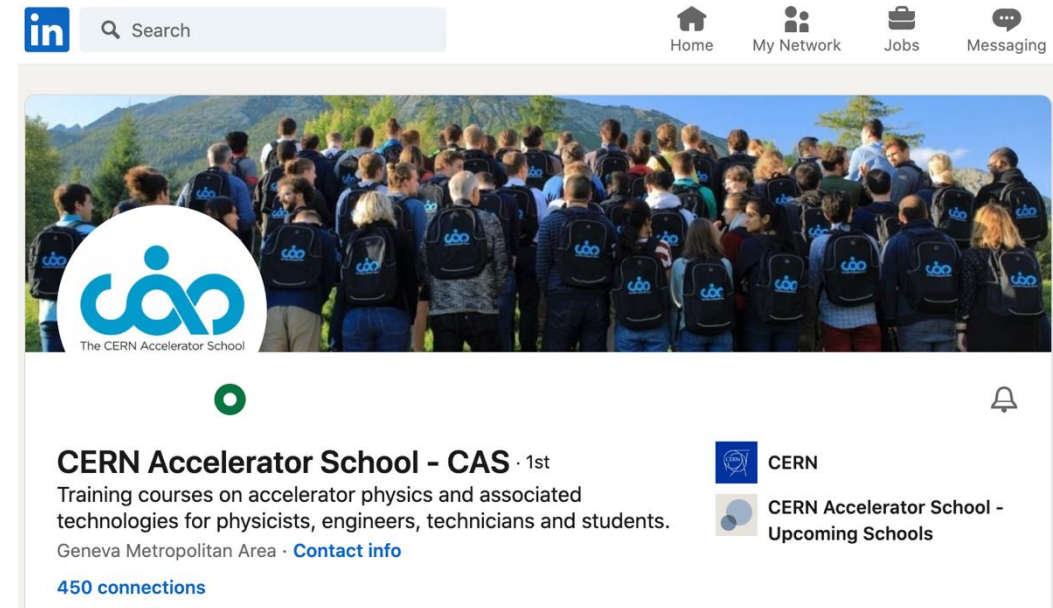
Networking

- 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, CASaoke
- excursion

- LinkedIn

- From the CAS web page, by the QR code posted here
- 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



CAS Mechanical

WhatsApp group



This group QR code is private. If it is shared with someone, they can scan it with their WhatsApp camera to join this group.

The CAS Team



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/sint-michielsgestel-2024>
- 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

Mechanical & Materials Engineering

Enjoy the course!

<http://cern.ch/cas>

