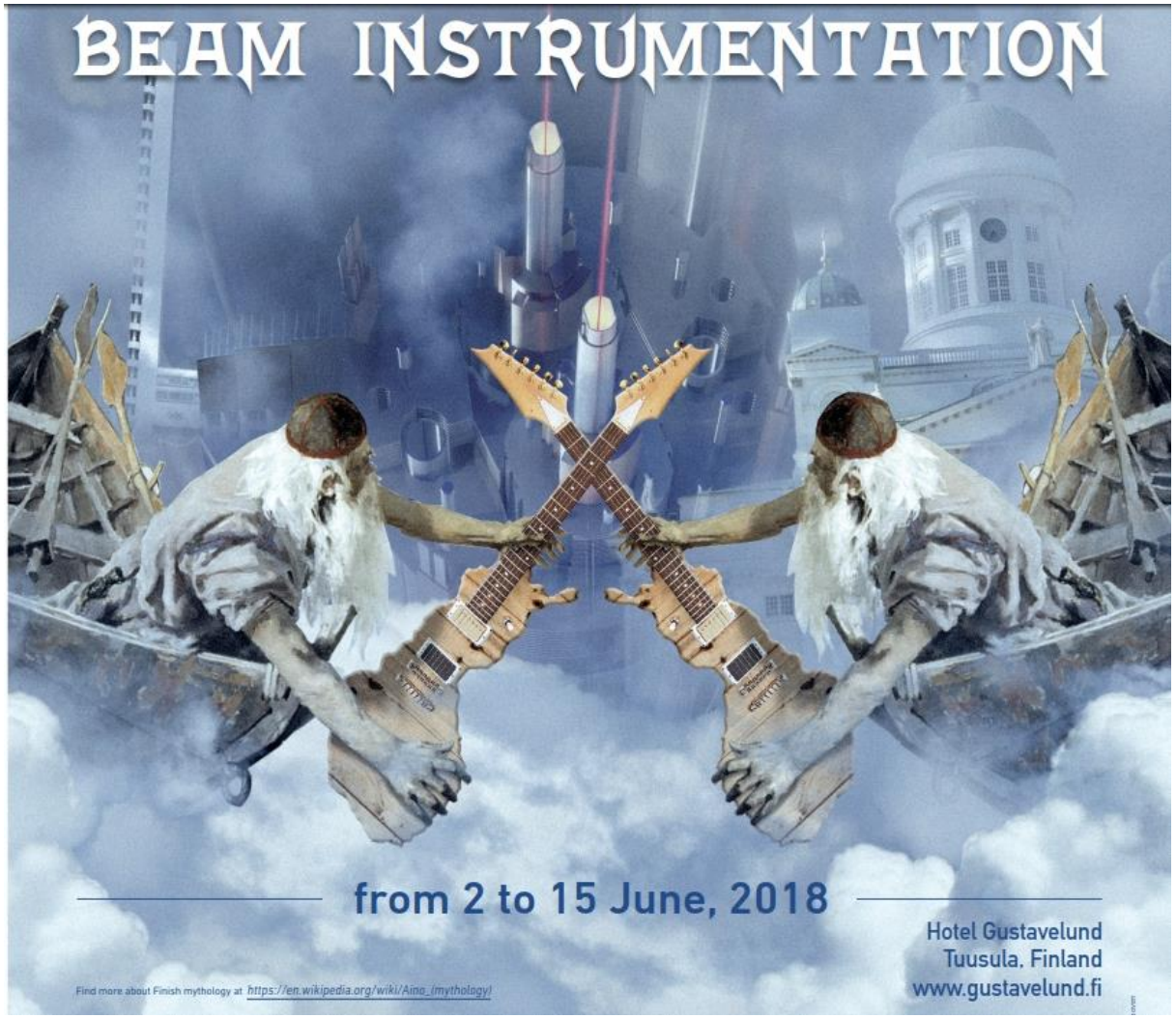
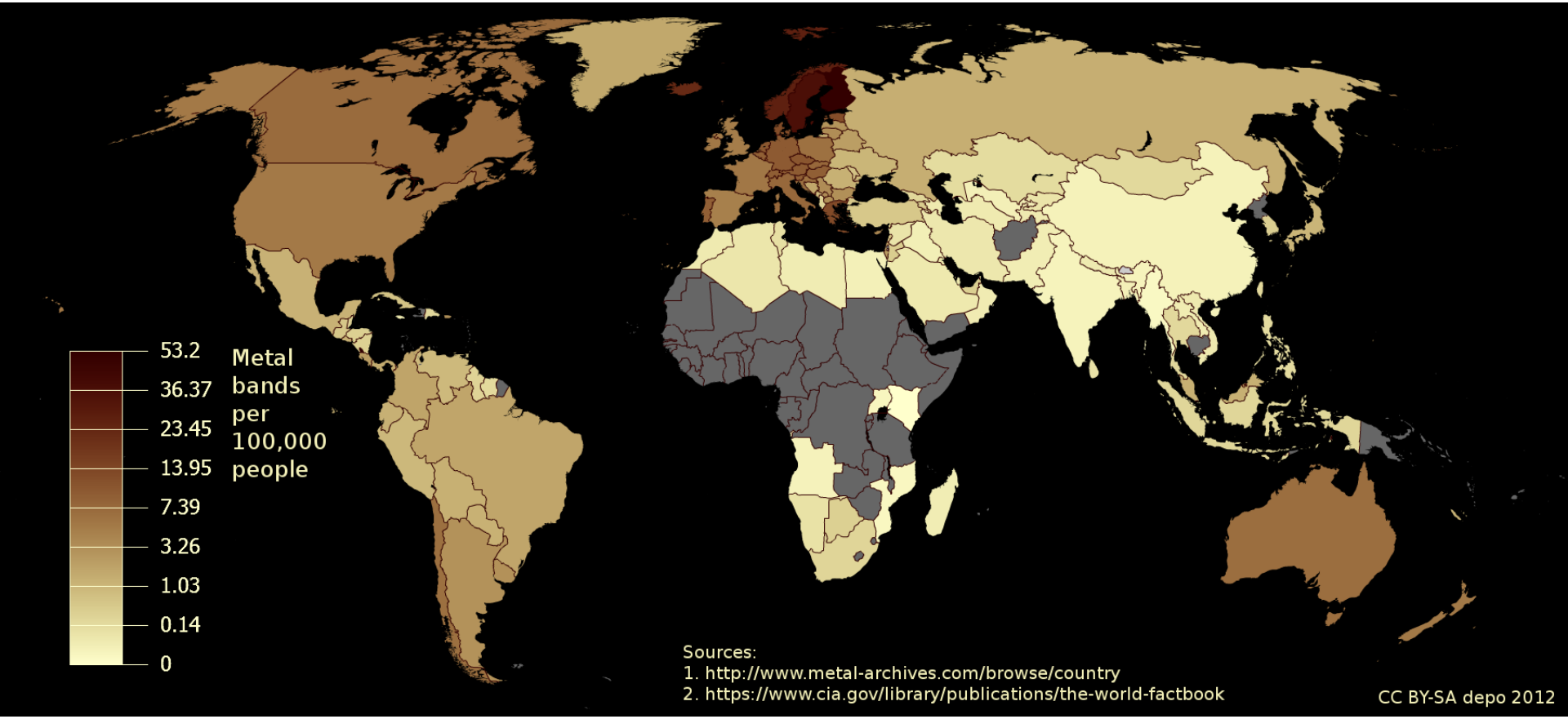
Welcome to Tuusula (Finland) to the CAS course on

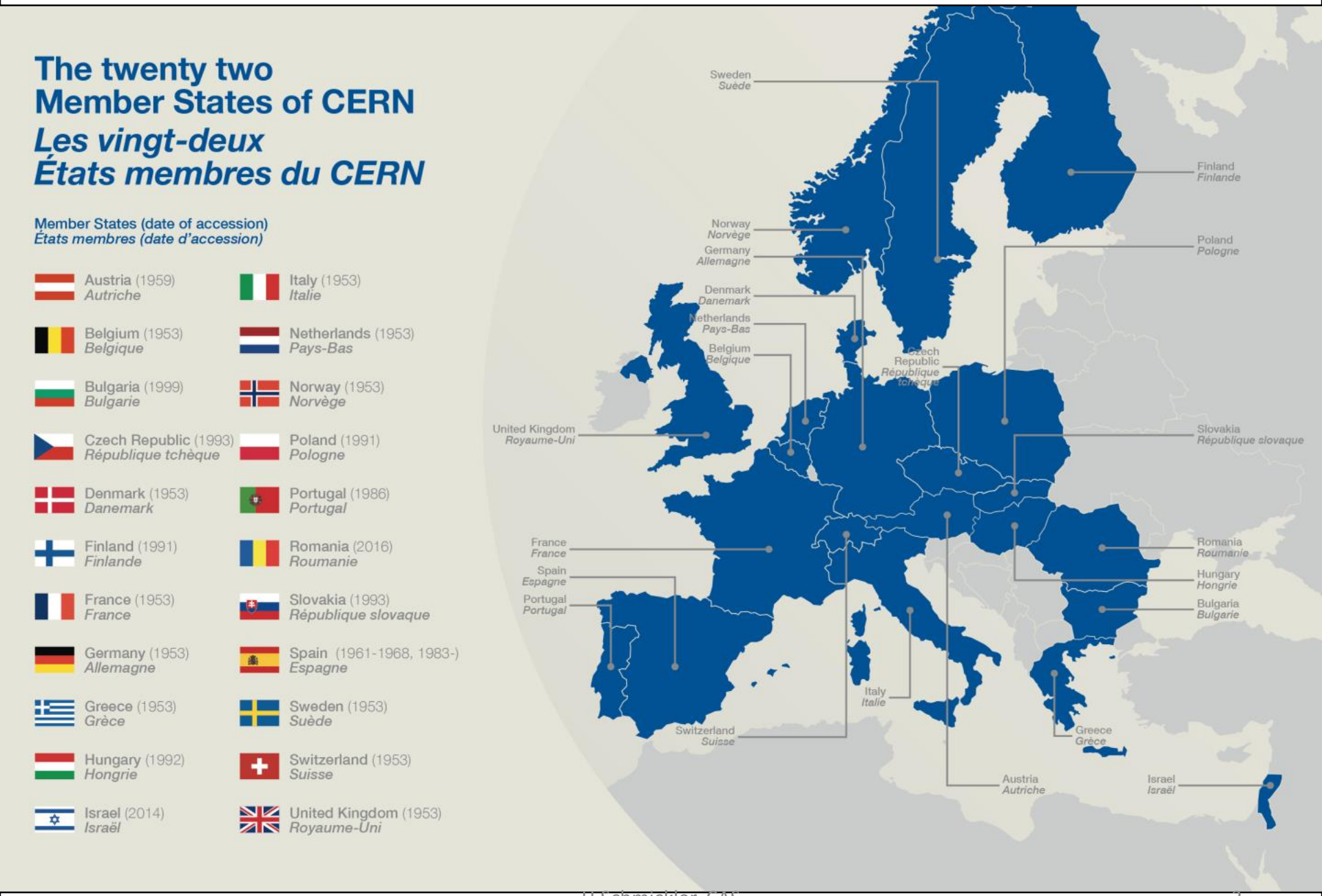
Beam Instrumentation





One of the reasons why we are in Finland:
- Highest per capita density of heavy metal --- often used in beam instrumentation

The CERN Accelerator School holds courses in all of the Member States of CERN



Have been to all except Israel (joined 2014) and Romania (joined 2016)

The CERN Accelerator School

- 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 topic in the field
  - 50 to 70 hours teaching in 1-2 week intensive residential courses
- About 70 courses held so far

- Occasional courses in the framework of the US-CERN-Japan-Russia Joint Accelerator School (JAS)
  - 14 schools held so far (since 1985)

Scope

Accelerator Physics

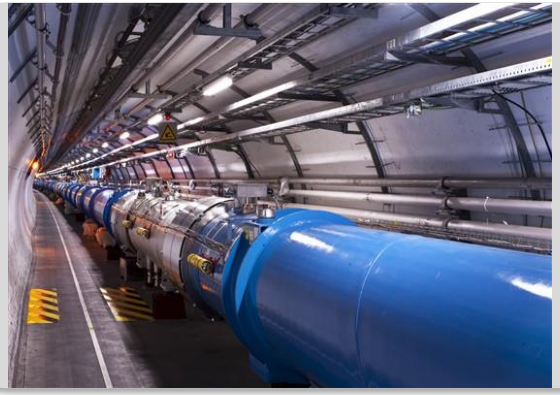
Relativity / Electro-Magnetic Theory / Transverse Beam Dynamics / Longitudinal Beam Dynamics / Linear Imperfections and Resonances / Synchrotron Radiation / Electron Beam Dynamics / Multi-Particle Effects / Non-Linear Dynamics Beam Instabilities / Landau Damping / Beam-Beam Effects

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
FFAGs
Cyclotrons
Synchrotrons
Colliders



Applications

High Energy Physics
Nuclear Physics
Industrial Applications
Medical Applications
Cancer Therapy

The CERN Accelerator School holds courses in all of the Member States of CERN

2018

- Beam Dynamics and technologies for future colliders
  - » Zürich, Switzerland
- Beam Instrumentation
  - » Helsinki, Finland
- Introduction to AP
  - » Constanta, Romania
- Computing and Simulation
  - » Thessaloniki, Greece

Have been to all except Israel (joined 2014) and Romania (joined 2016)

What's new at CAS?

- More courses/year
  - Introductory General Course **every** year (September)
  - Advanced General Course remains every second year (June)
  - Basic (non-residential) course in the vicinity of CERN every year (also open for people from outside CERN)
- Joint Accelerator School course every second year
- Major topical courses every 4-5 years (beam instrumentation, RF, vacuum, magnets…)
- New topical courses never done at CAS (i.e. mechanical engineering…)

- 10 students grants for every course
- New splendid website http://cas.web.cern.ch/

The CERN Accelerator School

Course Program 2018 - 2021

	Period I Feb-April	Period II May-June	Period IIb End June	Period III Sept-Oct	Period IV Nov-Dec	**JAS 2017: RF** Japan (Hayama)
2018	**Future Colliders** Switzerland	**Beam Instrumentation** Finland	**Short Introduction** France (local)	**General Introduction** Romenia	**Comp. Methods** Greece	
2019	**Advanced Acc. Concepts** Portugal (Lisbon)	**General Advanced** Danmark	**Short Introduction** France (local)	**General Introduction** Slovakia	**JAS: Ion Colliders** Russia	
2020	**RF** associate member state	**Mechanical Engineering** Holland	**Short Introduction** France (local)	**General Introduction** Ukraine earmarked	**Warm magnets** Austria	
2021	**Digital Signal Processing** tbd	**General Advanced** tbd	**Short Introduction** France (local)	**General Introduction** tbd	**JAS: Very Advanced Beam Dynamics** "In the Americas"	

* CAS@ESI
(Archamps)

This course

- Organized in collaboration with HIP Helsinki
  - Professor Kenneth Oesterberg
  - Jukka Vainola
- Last course in Dourdan (2008)
- Teaching Method:
  - no parallel teaching
  - large number of internationally known experts as teachers, determined by a large program committee
  - during the mornings classical lecturing plus discussion sessions
  - during most of the afternoons hands-on experiments
- - no final examination (like all CAS courses)

Time table

	2.6.	3.6	4.6.	5.6.	6.6.	7.6.	8.6	9.6	10.6	11.6	12.6.	13.6.	14.6.	15.6
08:30	Arrival day and registration	Opening	BD Requirements Overview/Measurement Principles III	Numerical methods, mathematical background I	Numerical methods, mathematical background II	Diagnostics Examples from CTF3	Bunch Length Diagnostics II	Excursion	Diagnostics Examples from light sources	BPM systems II	Free	Collective Effects & its diagnostics I	Timing and Synchronization II	Departure day
		local speaker/ H.Schmickler	G. Kube	L. Nadolski	L. Nadolski	F.Tecker	A. Gillespie		K. Wittenburg	M.Wendt		V. Kornilov	A. Gallo	
09:30		BD Requirements Overview/Measurement Principles I	Analog Electronics I	Tune, Chromaticity & Coupling Measurements	Diagnostics examples from HE colliders	Bunch Length Diagnostics I	Application of Lasers in Beam Instrumentation		BPM systems I	Medical Applications Instrumentation & Diagnostics	Beam Loss Monitors	Timing and Synchronization I	Collective Effects & its diagnostics II	
		G. Kube	J. Bellemann	R. Jones	R.Jones	A. Gillespie	S. Gibson		M. Wendt	A. Peters	K. Wittenburg	A. Gallo	V. Kornilov	
10:30		Coffee							Coffee					
11:00		Transverse beam dynamics recap I	RF measurement techniques	Analog Electronics II	Linear Imperfections and Corrections I	Lasers (technologies & setups)	Transverse Profile Measurements I		Transverse Profile Measurements II	Analog Digital Conversion	Schottky Diagnostics	Halo diagnostics	Diagnostic Needs for Wakefield Accelerator Experiments	
		H.Schmickler	M. Wendt	J. Bellemann	J. Wenninger	S. Gibson	E. Bravin		E. Bravin	M. Gasior	P. Kowina	K. Wittenburg	A. Cianchi	
12:00		BD Requirements Overview/Measurement Principles II	Video Cameras (signal generation and transmission)	Discussion/Q&A I	Introduction to Optics (basics, components, diffraction)	Linear Imperfections and Corrections II	Discussion/Q&A II		Intensity Measurements	Emittance Measurements	Diagnostics Examples from lepton-linacs and FELs	Discussion/Q&A III	Transverse Feedbacks	
		G. Kube	B. Walasek-Hoehne	H.Schmickler	S. Gibson	J. Wenninger	H.Schmickler		A. Peters	E. Bravin	A. Cianchi	H.Schmickler	H.Schmickler	
13:00		Lunch								Lunch				
14:30		Transverse beam dynamics recap II	Block A -1	Block A- 4	Free	Block B -1	Block B- 4		Block C -1	Block C- 4	Free	Block D -1	Block D- 4	
		H.Schmickler	Course Team	Course Team		Course Team	Course Team		Course Team	Course Team		Course Team	Course Team	
15:30		Longitudinal beam dynamics recap	Block A- 2	Block A -5		Block B- 2	Block B -5		Block C- 2	Block C -5		Block D- 2	Block D -5	
		F. Tecker	Course Team	Course Team		Course Team	Course Team		Course Team	Course Team		Course Team	Course Team	
16:30		Coffee	Coffee			Coffee			Coffee			Coffee		
17:00		Transverse beam dynamics recap III	Block A -3	Block A- 6		Block B -3	Block B- 6		Block C -3	Block C- 6		Block D -3	Block D- 6	
		H.Schmickler	Course Team	Course Team		Course Team	Course Team		Course Team	Course Team		Course Team	Course Team	
18:00		OneS-OneM				How the forest breathes	Poster session			Space and Space Weather			Closing	
		All				M. Kulmala	Organizer			M. Palmroth				
19:30		Dinner			Dinner in Helsinki	Dinner								
21:00										social event				

…more on this course…

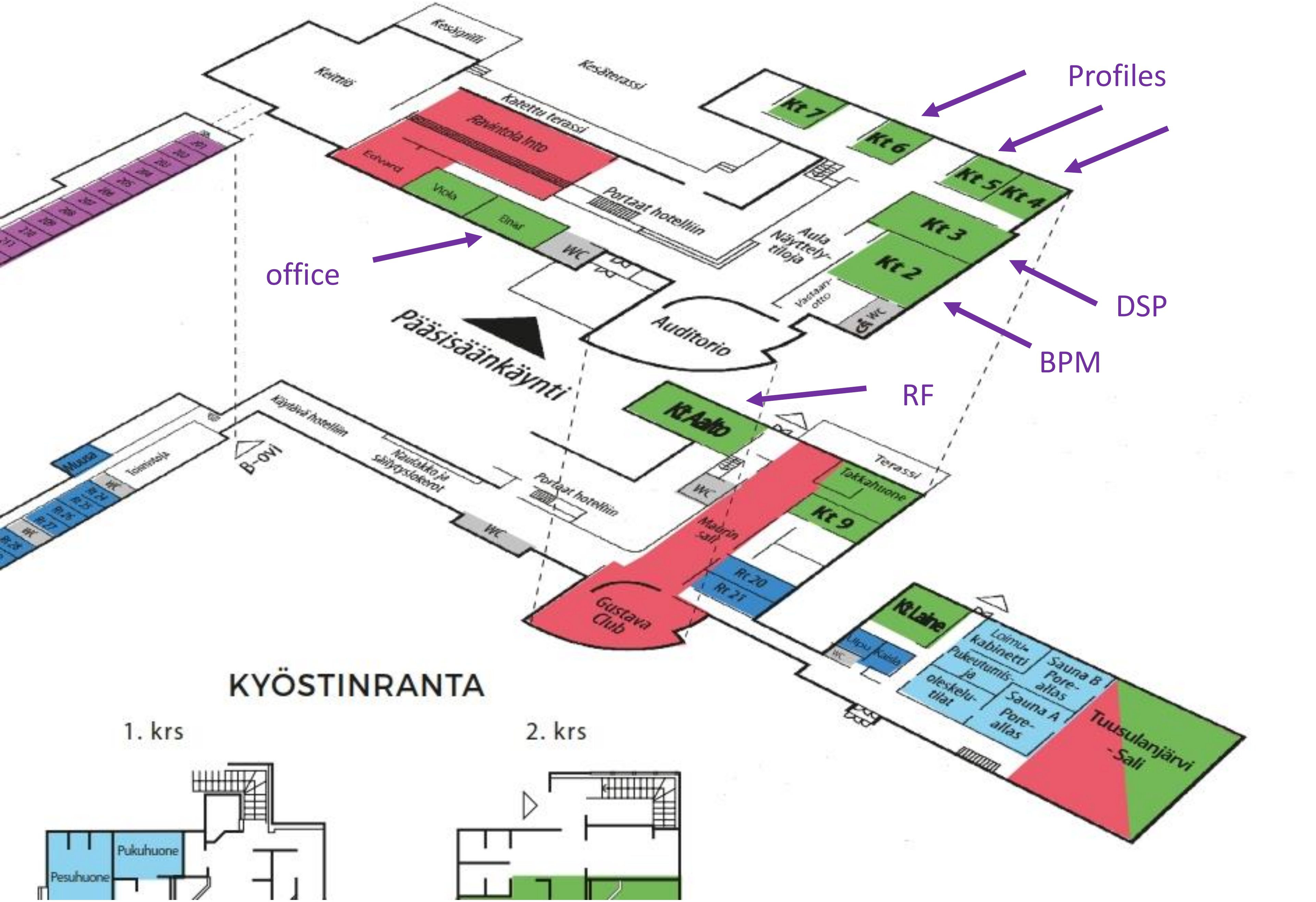
- The lecturers stay (if possible) a little longer than just for their lecture. Spend this time with them…
  …make friends…find a subject for your thesis?...
  …find a job?....
- Networking is an essential part of each CAS course.
  → case studies
  → excursion
  → film evening (11.6.)
  …need volunteers for “program committee”

Afternoon Courses

- 4 Courses each 2 x 3 hours (2 afternoons)
- Every students does all 4 courses

- A group starts with: BPM simulations
- B group starts with: DSP (tune, chromaticity, coupling…)
- C group starts with: Profile Measurements
- D group starts with: RF measurements

- After two days we rotate:
  A→B; B→ C; C→ D; D→A
  and so on….



Profiles
office
DSP
BPM
RF
Kesägrilli
Keittiö
Kesäterassi
Katettu terassi
Ravintola Into
Edvard
Viola
Einar
WC
Portaat hotelliin
Aula
Näyttely-
tiloja
Vastaan-
otto
Kt 7
Kt 6
Kt 5
Kt 4
Kt 3
Kt 2
Auditorio
Pääsisäänkäynti
Kt Aalto
Käytävä hotelliin
Naulakko ja
säilytyslokerot
B-ovi
Toimintoja
Muusa
Terassi
Takkahuone
Kt 9
Maurin
sali
Rt 20
Rt 21
Gustava
Club
Kt Lahe
Loimu-
kabinetti
Pukeutumis-
ja
oleskelu-
tilat
Sauna B
Pore-
allas
Sauna A
Pore-
allas
Tuusulanjärvi
-Sali
Ulpu
Kaisla
KYÖSTINRANTA
1. krs
2. krs
Pukuhuone
Pesuhuone

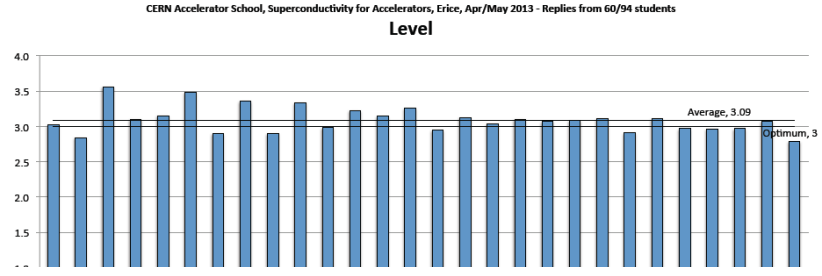
Excursion/free afternoon in Helsinki

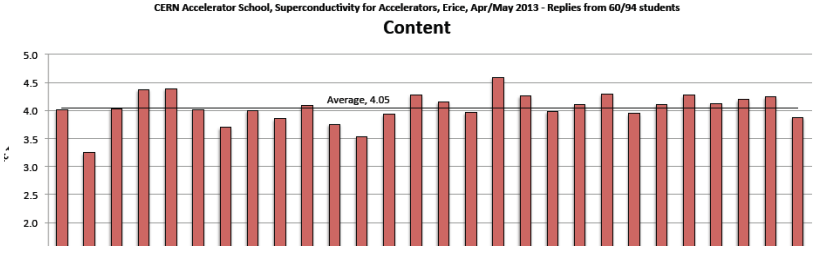
- Details will all be announced in due time
- Rather expensive events…if you know beforehand that you do not want to join, please tell us in time such that we can reduce the number of reservations.
- Free afternoon in Helsinki (6.6.)
  - bus transfer to downtown Helsinki after lunch
  - afternoon free
  - dinner in an old theatre (2km outside town center)
  - bus transport back after dinner
- Excursion:
  over day and lunch in Nuuksio national park
  dinner on old sailboats on the Baltic sea

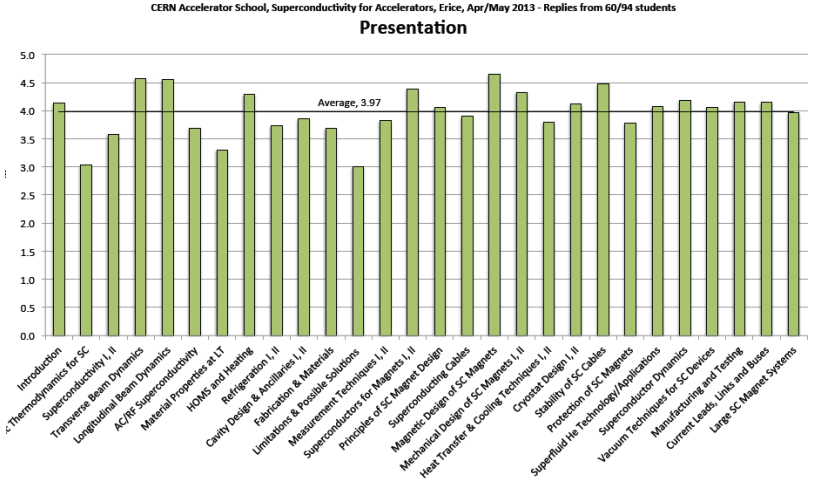
Feedback

- Please, please, please
  - Give us your feedback

LEVEL	CONTENT	PRESENTATION
1 – Much too low	1 – Completely uninteresting	1 – Very poor
2 – Low	2 – Uninteresting	2 – Poor
3 – Just right	3 – Of some interest	3 – Fair
4 – Too high	4 – Interesting	4 – Good
5 – Much too high	5 – Very interesting	5 – Very good

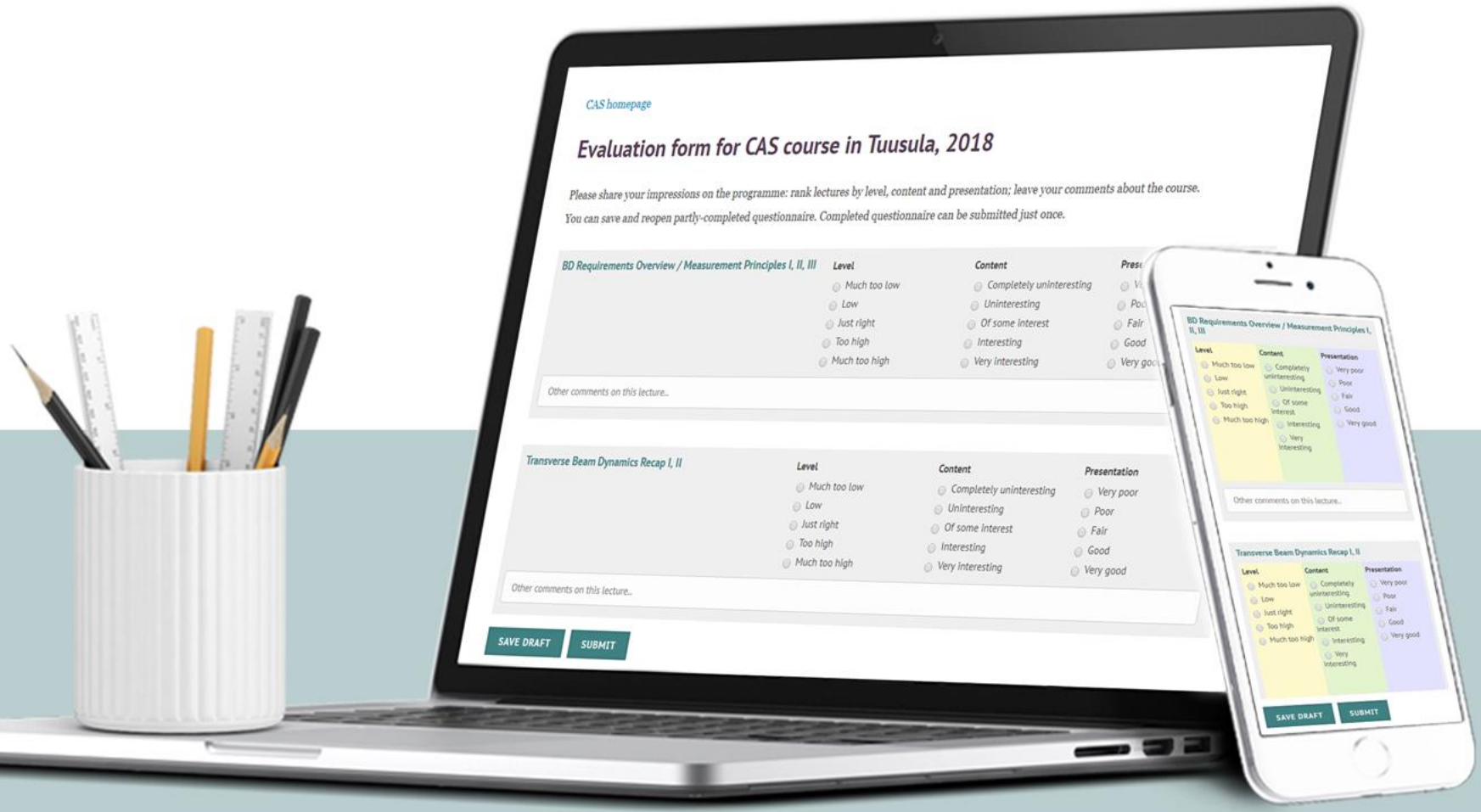






TITLE	LEVEL	CONTENT	PRESENTATION
Recap. Transverse Beam Dynamics I, II			
Introduction to RF Measurement Techniques			
Introduction to Beam Instrumentation and Diagnostics I, II			
Introduction to Optics Design			
Introduction to Lattice Cells			
Recap. Longitudinal Beam Dynamics I, II			
Introduction to Insertions			
Wakefields and Impedances			
Space Charge in Linear Machines			
Introduction to Non-Linear Dynamics			
Beam Instabilities - Longitudinal			
Space Charge in Circular Machines			
Energy Recovery Linacs			
Landau Damping I, II			
Beam Instabilities - Transverse			
Instabilities in Linacs			
Feedback Systems I, II			
Electron Cloud and Instabilities			
Advanced Concepts for Beam-Driven Acceleration			
Beam-Beam Effects			
Timing and Synchronisation			
NLD Methods I, II, III			
Beam Cooling			
NLD Phenomenology I, II			
Advanced Magnet Technologies			
High Brightness Beam Diagnostics			
Low Emittance Machines I, II			
Insertion Devices			
Advanced Concepts for Laser-Driven Acceleration			

Online evaluation



Evaluation form: access

Access to web-form is granted to participants using the email addresses indicated in their Indico registrations

Step 1:

email with the link has been sent to all participants

If you did not receive the email, contact Anastasiya.Safronava@cern.ch

Step 2:

to login use the same email account; it will certainly work for CERN and for Google accounts, but not only

If you can not login, contact Anastasiya.Safronava@cern.ch

Solutions: provide your Google account if you have one, or a temporary CERN account will be created for you

CAS Promotional Actions

- 5 days of film shooting
  - first part done at CAS in Zuerich
  - second part here:
  those who do not want to be filmed, please tell us
  those who want to be filmed or interviewed, tell us…
- Testimonials for the web:
  - all you need is a photo and a sentence.
  Have a look at: http://cas.web.cern.ch/

On the organizational side…

- Registration with Delphine…
  → badge, bag, program, info….still possible
- 4 lists on the pin-board with 25 slots for the start-up assignment of the afternoon courses. First come…first served.
  But no rush please: Everybody does everything…
- Jukka knows everything about practical arrangements
- Anastasiya (for the online feedback) will be here from the 7th of June.
- CAS office open every day during a few hours, details will be communicated)