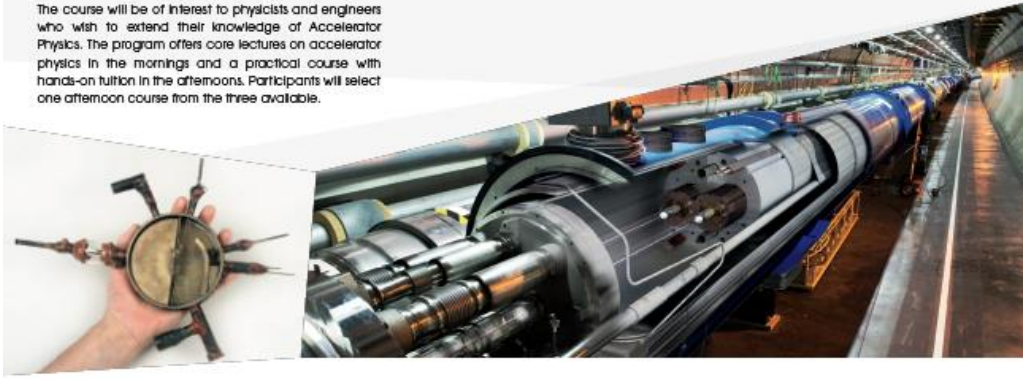
The CERN Accelerator School and
Royal Holloway University of London
are organizing a course on

Advanced Accelerator Physics

3 to 15 September, 2017

Royal Holloway University, Egham, London, United Kingdom

The course will be of interest to physicists and engineers who wish to extend their knowledge of Accelerator Physics. The program offers core lectures on accelerator physics in the mornings and a practical course with hands-on tuition in the afternoons. Participants will select one afternoon course from the three available.



The CERN Accelerator School

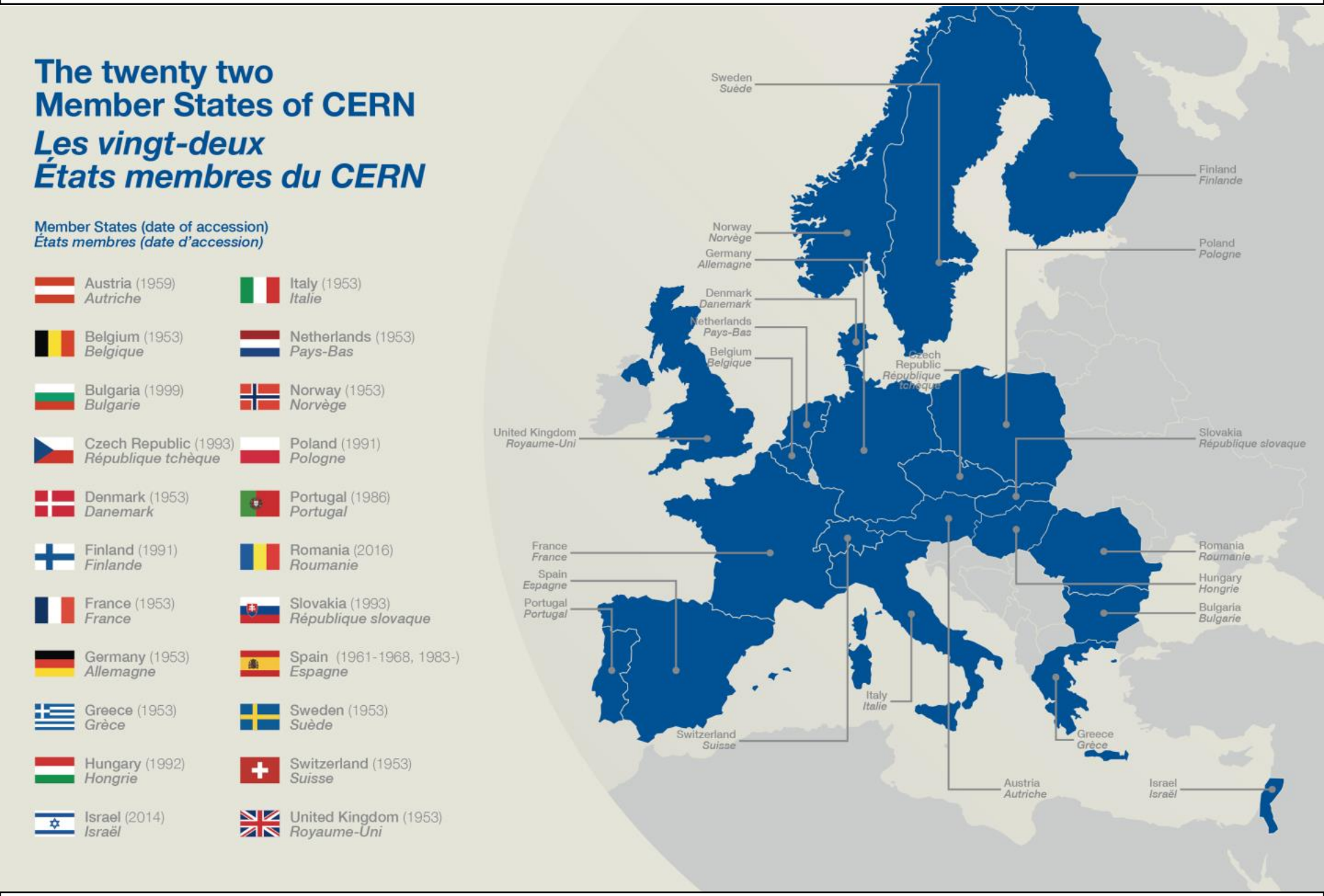
Contact: CERN Accelerator School
CH – 1211 Geneva 23
cern.ch/schools/CAS

John Adams Institute for Accelerator Science

ROYAL HOLLOWAY UNIVERSITY of London

CERN

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, now yearly, alternating between
    - Introduction to Accelerator Physics
    - Advanced Accelerator Physics
  - Specialized topic in the field, was yearly, now two/three per year
- 67 schools held so far
  - 50 to 60 hours teaching in 1-2 week intensive residential courses
- Occasional courses in the framework of the US-CERN-Japan-Russia Joint Accelerator School (JAS)
  - 13 schools held so far (since 1985)

Scope

Accelerator Physics

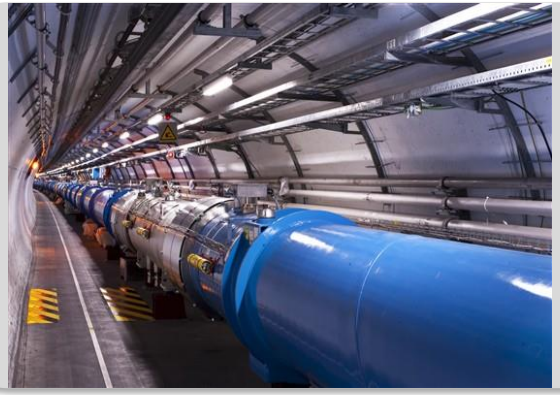
Relativity / Electro-Magnetic Theory / Transverse Beam Dynamics / Longitudinal Beam Dynamics / Linear Imperfections and Resonances / Synchrotron Radiation / Electron Beam Dynamics / Multi-Particle Effects / Non-Linear Dynamics Beam Instabilities / Landau Damping / Beam-Beam Effects

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

2017

- Injection & Extraction
  - » Erice, Italy, March
- Vacuum for Accelerators
  - » MaxIV, Sweden, June
- Advanced AP
  - » RHUL, UK, September
- RF technologies (JAS)
  - » Japan, October

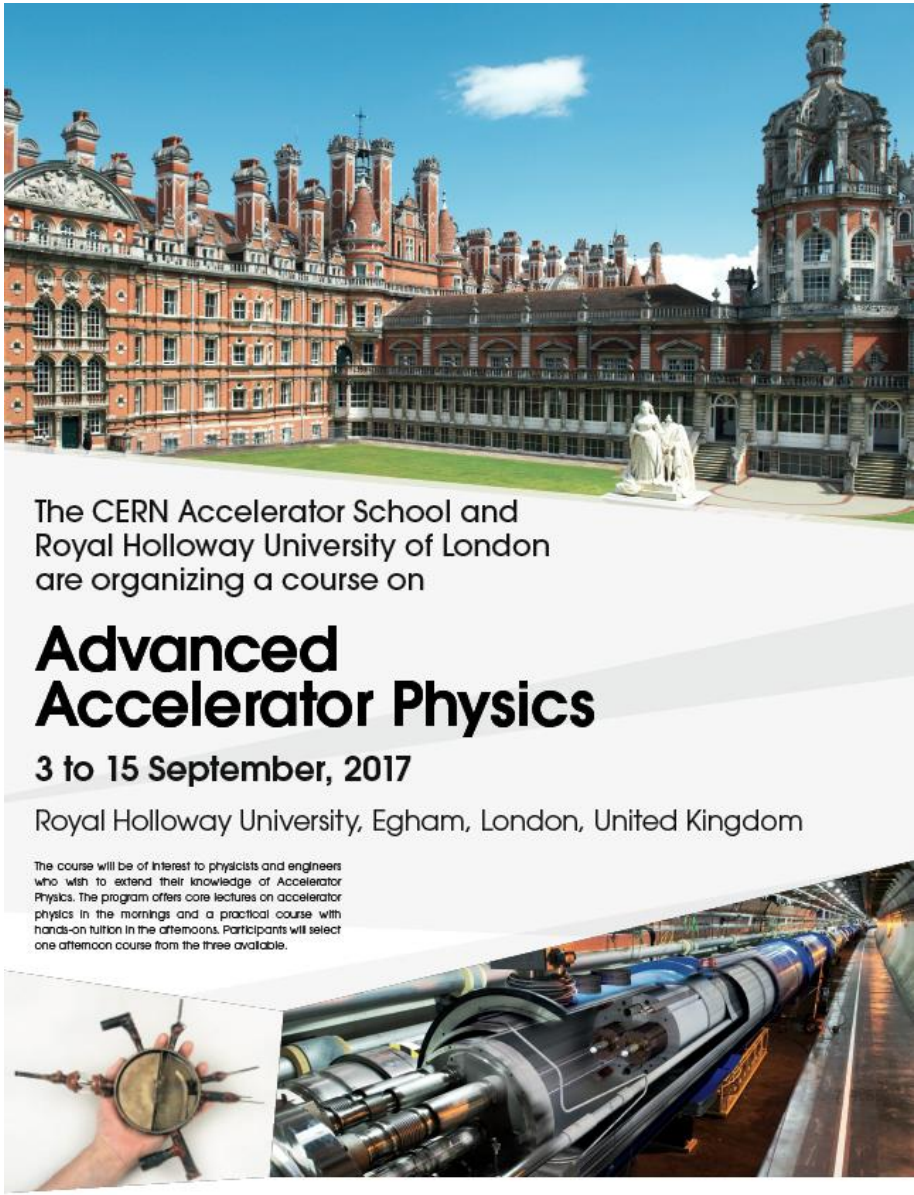
2018

- Future Colliders for HEP
  - » Zurich, Switzerland
- Beam Instrumentation
  - » Helsinki, Finland
- Introduction to AP
  - » Romania
- Computing and Simulation
  - » Greece

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

Advanced Accelerator Physics, London, UK

- In collaboration with RHUL
  - Faculty of Science
    - Professor Paul Hogg
  - Department of Physics
    - Professor Stewart Boogert
      - Tracy Webster
      - Siobhan Alden (AV and printing)
      - Andrey Abramov (excursion)
      - Sophie Bashforth (excursion)
  - Conferencing
    - Helen Earwaker
      - Adela Fernandez



CAS Courses on Accelerator Physics

The programmes for the Introductory and Advanced level courses are elaborated at a dedicated program committee, held every two years, and which is strongly guided by the CAS Syllabus. This syllabus was reviewed in 2015, a revised edition was released in 2016 and will evolve in the coming years.

Syllabus and Conventions for General Courses organized by the CERN Accelerator School

Compiled by CAS Team

February 2016

Abstract

In this document we provide a combined syllabus for the general CAS courses "Introduction to Accelerator Physics" and "Advanced Accelerator Physics Course". It is meant to give guidelines to the lecturers and to give an overview of the topics to the participants.
It is based on input from CAS committees, lectures and participants from previous schools.

CAS Syllabus

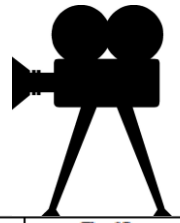
Introductory Course programme overview

Introduction to accelerators
Electromagnetic theory
Particle motion in EM fields
Relativity and kinematics of particle beams
Linear accelerators
Transverse linear beam dynamics for synchrotrons and beam lines
Cyclotrons and FFAG
Longitudinal beam dynamics in circular accelerators
RF systems
Applications of accelerators
Linear imperfections
Beam instrumentation and diagnostics
Electron beam dynamics - synchrotrons and light sources
Non-linear beam dynamics
Collective and multi-particle effects
Luminosity and colliders
Injection, extraction, beam transfer, secondary beams and targets
Supplementary lectures

Advanced Course programme overview

RECAPITULATION TRANSVERE AND LONGITUDINAL BEAM DYNAMICS
PREPARATION FOR COURSES
Introduction to Beam Instrumentation
Introduction to RF measurement
Introduction to Optics Design
NON-LINEAR DYNAMICS
Nonlinear dynamics - phenomenology
Nonlinear dynamics - mathematical Tools and methods
INSTABILITIES AND COLLECTIVE EFFECTS
Impedance and wakefields
Instabilities in linear and circular accelerators
Space charge Landau damping and feedback systems
Beam-beam effects
LOW EMITTANCE MACHINES AND LIGHT SOURCES
Types of light sources
Optics and lattices for light sources
Insertion devices
SUPPLEMENTARY TOPICS

Program for the Introductory School



Draft Program for the 2016 CAS - Introduction to Accelerator Physics - Budapest, October 02 to 14

	Sun	Mon 03	Tue 04	Wed 05	Thu 06	Fri 07	Sat 08	Sun	Mon 10	Tue 11	Wed 12	Thu 13	Fri
08:30	Arrival day and registration	Opening	Particle motion in Electromagnetic Fields I Sheehy	Cyclotrons I Seidel	Linear Imperfections Tomas	Applications of Accelerators Sheehy	Non-Linear Beam Dynamics I Wolski	Excursion	Electron Beam Dynamics I Rivkin	Synchrotron light machines and FELs I Rivkin	Synchrotron light machines and FELs II Ischebeck	Kickers, Septa and Beam Transfer Fraser	Departure day
09:30		Discussion							Discussion				
09:45		Introduction to Accelerators Steerenberg	Linear Accelerators I Alesini	Transverse Linear Beam Dynamics II Holzer B	Longitudinal Beam Dynamics in Circular Machines II Tecker	Luminosity and Colliders Papotti	Vacuum Technology and Systems Grabski		Beam Instrumentation Holzer E	Collective Effects II Franchetti	Injection and Extraction Fraser	Secondary beams and targets Knie	
10:45		Coffee							Coffee				
11:15		Electromagnetic Theory I Franchetti	Particle motion in Electromagnetic Fields II Sheehy	Cyclotrons II Seidel	Discussion on Transverse Beam Dynamics	Discussion on Longitudinal Beam Dynamics	Tutorial 1		Electron Beam Dynamics II Rivkin	Beam Losses and Machine Protection Issues Strasik	Tutorial 2	Tutorial 3	
12:15		Lunch							Lunch				
13:45		Electromagnetic Theory II Franchetti	Transverse Linear Beam Dynamics I Holzer B	Longitudinal Beam Dynamics in Circular Machines I Tecker	Free	Warm Magnets de Rijk	Non-Linear Beam Dynamics II Wolski		Collective Effects I Franchetti	Collective Effects III Franchetti	Free	Sources Faircloth	
14:45		Discussion				Discussion			Discussion			Discussion	
15:00		Kinematics of Particle Beams I - Relativity Herr	Linear Accelerators II Alesini	Transverse Linear Beam Dynamics III Holzer B		Fixed Field Alternating Gradient Machines Sheehy	Power Convertors Burnet		Discussion on Electron Beam Dynamics	Discussion on Collective Effects		Putting it all Together Herr	
16:00		Coffee				Coffee			Coffee			Coffee	
16:30		Kinematics of Particle Beams II Herr	Tutorial Explanation Bailey/Herr	RF systems Tecker		Superconducting Magnets de Rijk	Poster session with authors present		Beam Diagnostics Holzer E	** Seminar ** Applications of Lasers Corner		** Seminar ** Advanced accelerator concepts Ferrario	
17:30		1 slide 1 minute		Posters displayed		Posters displayed	Posters dismounted					Closing remarks	
18:30													
19:30		Dinner at Hotel										Banquet	

Coord		Theme	Tutors				Tutorials
Bernhard	Theme 1	Transverse Beam Dynamics	Bernhard	Frank	Werner	Hermann	1
Frank	Theme 2	Longitudinal Beam Dynamics	Bernhard	Frank	Werner	Hermann	1
Lenny	Theme 3	Electron Beam Dynamics	Lenny	Giuliano	Werner	Hermann	2
Massimo	Theme 4	Non Linear and Collective Effects	Massimo	Giuliano	Werner	Hermann	3

Program for the Advanced School

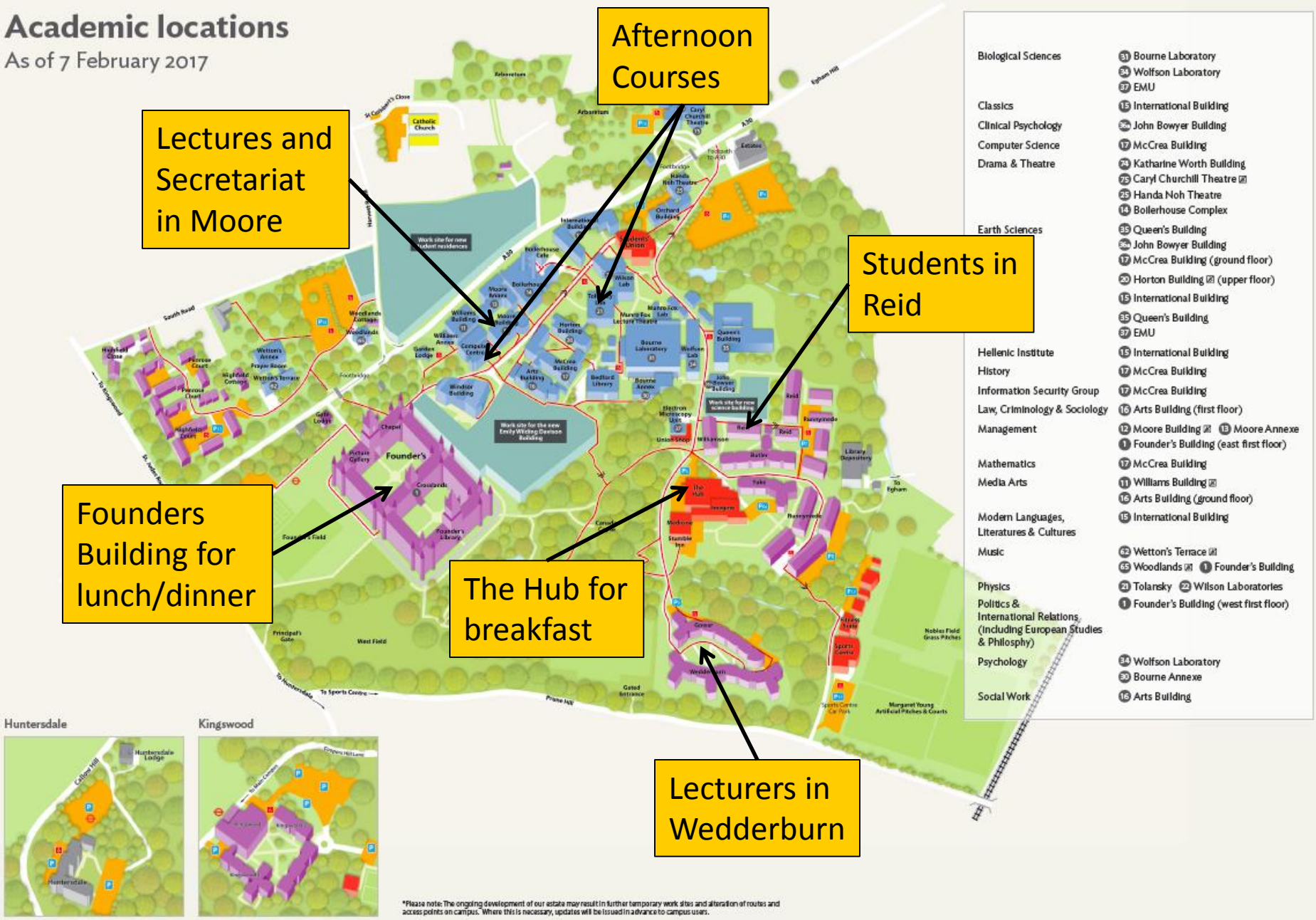
Draft Program for the 2017 CAS - Advanced Accelerator Physics - RHUL - September 3 to 15

	3 Sun	4 Mon	5 Tue	6 Wed	7 Thu	8 Fri	9 Sat	10 Sun	11 Mon	12 Tue	13 Wed	14 Thu	15 Fri
08:30	Arrival day and registration	Opening	Intro to Lattice Cells Holzer	Wakefields and Impedances Rumolo	Beam Instabilities - Longitudinal Li	Beam Instabilities - Transverse Rumolo	Electron Cloud and instabilities Li	Excursion	Beam-Beam effects Pieloni	NLD - Methods and Tools II Herr	NLD - Methods and Tools III Herr	Low emittance machines I Wolski	Departure day
09:20		Discussion							Discussion				
09:30		Recap Tranvsverse Beam Dynamics I Schmickler	Recap Longitudinal Beam Dynamics I Tecker	Space charge in linear machines Ferrario	Space charge in circular machines Ferrario	Instabilities in Linacs Ferrario	Feedback systems II Schmickler		Timing and synchronisation Gallo	NLD - Phenomenology I Papaphilippou	NLD - Phenomenology II Papaphilippou	Insertion Devices Clarke	
10:30		Coffee							Coffee				
11:00		Intro to RF measurement techniques Wendt	Intro to Beam Instrumentation and Diagnostics II Jones	Recap Longitudinal Beam Dynamics II Tecker	Energy Recovery Linacs Jankowiak	Feedback systems I Schmickler	Discussion on Instabilities		NLD - Methods and Tools I Herr	Study	High Brightness Beam Diagnistics Cianchi	Low emittance machines II Wolski	
11:50		Discussion							Discussion				
12:00		Intro to Beam Instrumentation and Diagnostics I Jones	Intro to Insertions Holzer	Introduction to Non Linear Dynamics Papaphilippou	Landau Damping I Kornilov	Landau Damping II Kornilov	Beam-driven acceleration Ferrario		Beam cooling Steck	Advanced magnet technologies Quettier (CEA)	Discussion on Non Linear Dynamics	Laser-driven acceleration Hooker	
13:00		Lunch							Lunch				
14:30		Recap Tranvsverse Beam Dynamics II Schmickler	C1 C2 C3	C1 C2 C3	Free	C1 C2 C3 Note Bene C1 in RF lab C2 in BI lab	C1 C2 C3		C1 C2 C3	C1 C2 C3	Free	C1 C2 C3 Presentations	
15:30		Intro to Optics Design Holzer											
16:30		Coffee				Coffee			Coffee			Coffee	
17:00		1S1M	C1 C2 C3	C1 C2 C3		C1 C2 C3 Note Bene C1 in RF lab C2 in BI lab	C1 C2 C3		C1 C2 C3	C1 C2 C3		Closing	
18:00													
19:30	Dinner												

Coord		Theme
MF	1	Instabilities
YP	2	Non Linear Dynamics
AW	3	Low emittance machines

Academic locations

As of 7 February 2017



Biological Sciences	31 Bourne Laboratory 34 Wolfson Laboratory 37 EMU
Classics	15 International Building
Clinical Psychology	36a John Bowyer Building
Computer Science	17 McCrea Building
Drama & Theatre	24 Katharine Worth Building 25 Caryl Churchill Theatre 25 Handa Noh Theatre 14 Boilerhouse Complex
Earth Sciences	35 Queen's Building 36a John Bowyer Building 17 McCrea Building (ground floor) 20 Horton Building (upper floor) 15 International Building 35 Queen's Building 37 EMU
Hellenic Institute	15 International Building
History	17 McCrea Building
Information Security Group	17 McCrea Building
Law, Criminology & Sociology	16 Arts Building (first floor)
Management	12 Moore Building 13 Moore Annexe 1 Founder's Building (east first floor)
Mathematics	17 McCrea Building
Media Arts	11 Williams Building 16 Arts Building (ground floor)
Modern Languages, Literatures & Cultures	15 International Building
Music	62 Wetton's Terrace 65 Woodlands 1 Founder's Building
Physics	21 Tolansky 22 Wilson Laboratories
Politics & International Relations (including European Studies & Philosphy)	1 Founder's Building (west first floor)
Psychology	34 Wolfson Laboratory 30 Bourne Annexe
Social Work	16 Arts Building

*Please note: The ongoing development of our estate may result in further temporary work sites and alteration of routes and access points on campus. Where this is necessary, updates will be issued in advance to campus users.

Comments on the program

- All lectures in Moore
  - Secretariat in Moore-02-03

- Opening, Closing, 1 Slide 1 Minute, Study (4h)

- Lectures (38h)
  - Recap on essentials and introductions to the afternoon courses
  - Advanced topics on beam behaviour
  - Technology and systems needed for modern facilities

These lectures in 3 themes

– Instabilities	Massimo Ferrario
– Non Linear Dynamics	Yannis Papaphilippou
– Low Emittance Machines	Andy Wolski

- Discussion session for each of the first two (2h)

Afternoon courses (18h + 2h presentations)

Draft Program for the 2017 CAS - Advanced Accelerator Physics - RHUL - September 3 to 15

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10:30		Coffee							Coffee				
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11:50		Discussion							Discussion				
12:00		Intro to Beam Instrumentation and Diagnostics I Jones	Intro to Insertions Holzer	Introduction to Non Linear Dynamics Papaphilippou	Landau Damping I Kornilov	Landau Damping II Kornilov	Beam-driven acceleration Ferrario		Beam cooling Steck	Advanced magnet technologies Quettier (CEA)	Discussion on Non Linear Dynamics	Laser-driven acceleration Hooker	
13:00		Lunch							Lunch				
14:30		Recap Tranvsverse Beam Dynamics II Schmickler	C1 C2 C3	C1 C2 C3	Free	C1 C2 C3 Note Bene C1 in RF lab C2 in BI lab	C1 C2 C3		C1 C2 C3	C1 C2 C3	Free	C1 C2 C3 Presentations	
15:30		Intro to Optics Design Holzer											
16:30			Coffee			Coffee			Coffee			Coffee	
17:00		1S1M	C1 C2 C3	C1 C2 C3		C1 C2 C3 Note Bene C1 in RF lab C2 in BI lab	C1 C2 C3		C1 C2 C3	C1 C2 C3		Closing	
18:00													
19:30	Dinner												

Coord		Theme
MF	1	Instabilities
YP	2	Non Linear Dynamics
AW	3	Low emittance machines

Afternoon courses (20h)

- C1 Beam Instrumentation and Diagnostics
  - In Physics Department
- C2 RF Measurement Techniques
  - In Physics Department
- C3 Optics Design and Correction
  - In PC lab 7 in the Computer Centre

- NB switch of location C1 and C2, Friday 8th

- Presentations on last afternoon within the course group
- Details will be given early in the course

- Sign up for course of choice, end Monday, with Barbara
- Maybe select something that you have not done

1 Slide 1 Minute

First	Name		First	Name
Nils	Lockmann		Roger	Bailey
Sergey	Sadovich		Werner	Herr
Harsch	Purwar		Hermann	Schmickler
Alexis	Gamelin			
Andrey	Abramov			
Aamna	Khan			
Carsten	Mai			
Andrea	Santamaria			
Ozgur	Etisken			
Lucy	Martin			
Emy	Mulyani			
George	Coombs			
Danilo	Quartullo			
Raffael	Niemczy			
Elisabeth	Renner			
Andrei	Olenik			
Helena	Pikhartova			
Sophie	Bashforth			
Stuart	Warren			
Sarah	Vichter Fichou			
Philipp	Amstutz			
Jiri	Krai			
Total	**22**		**Total lecturers**	**3**

Meals

- Buffet Breakfast always in The Hub
- Buffet Lunch in the dining room of Founder's Building
- Buffet Dinner in SCR in Founder's Building except
  - Friday 8
    - BBQ Dinner in South Quad of Founder's Building
  - Monday 11
    - Dinner in Crossland Suite of Founder's Building
  - Tuesday 12
    - Dinner in Picture Gallery of Founder's Building
- Morning coffee breaks in Moore
- Afternoon coffee breaks also in Moore
- Monday 4 (today)
  - Reception in Picture Gallery of Founder's Building

WiFi

- Free WiFi access to ‘CampusNet’, our high speed wireless internet service, is available across the entire campus. Each conference is issued with a unique guest username and password which will allow you to register on the WiFi network and provide you with access for the duration of your stay

- To log on:
  - Open internet browser
  - Of the 2 available options, click on the ‘Guest User’ option
  - Terms of use - confirm acceptance
  - Enter username and password:

    - **Username: RHULCAS**
    - **Password: CAS2017**

Excursion Sunday 10th

- 08.45 Meet in the Hub car park
- 09.00 Coach from The Hub

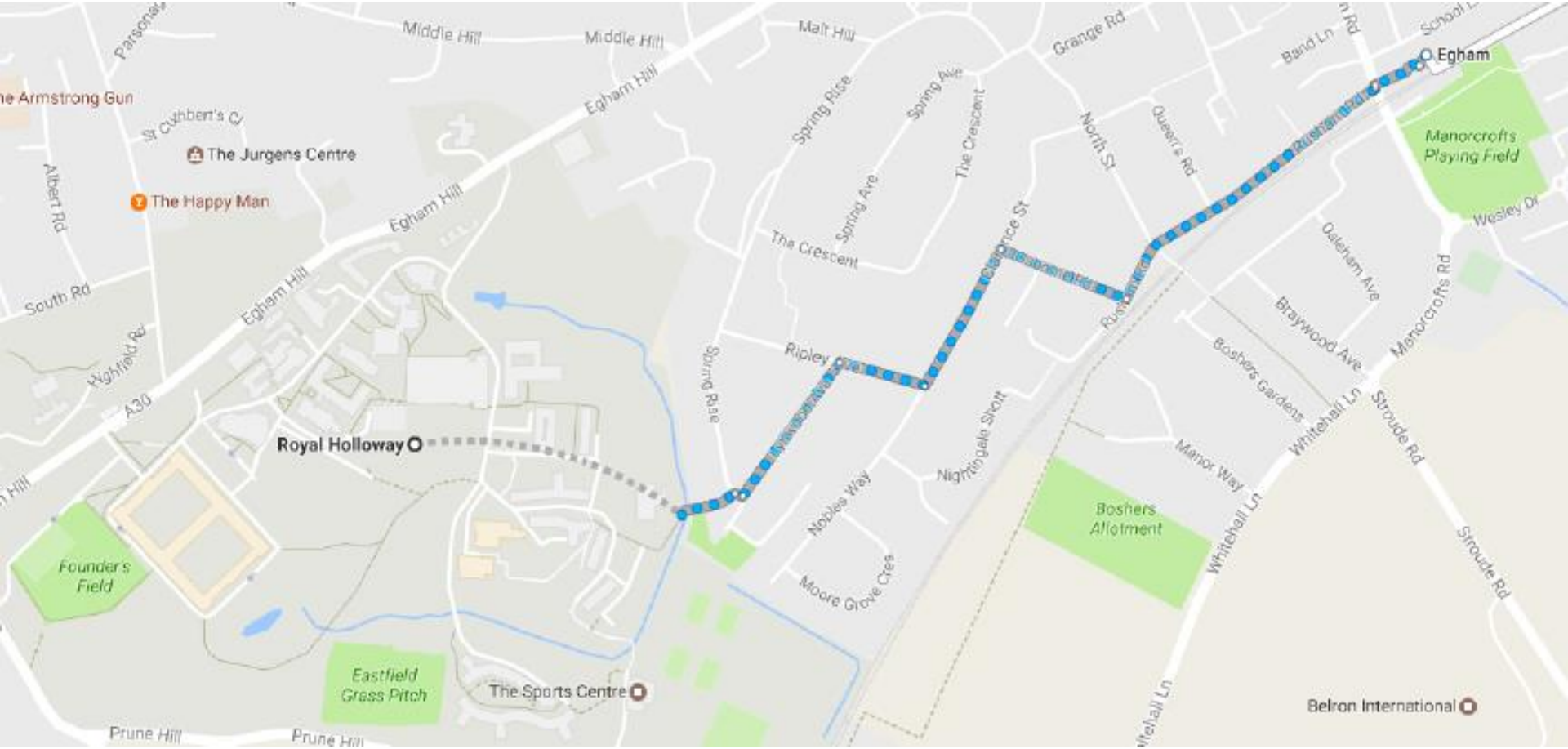
- 09.30 Boat ride to Windsor
  Lunch on the boat
- 14.00 Tour of Windsor castle

- 16.00 Free time in Windsor

- 17.45 Meet at Windsor Castle
- 18.00 Coach from Windsor back to RHUL

Free afternoons on Thurs 7th and Weds 13th

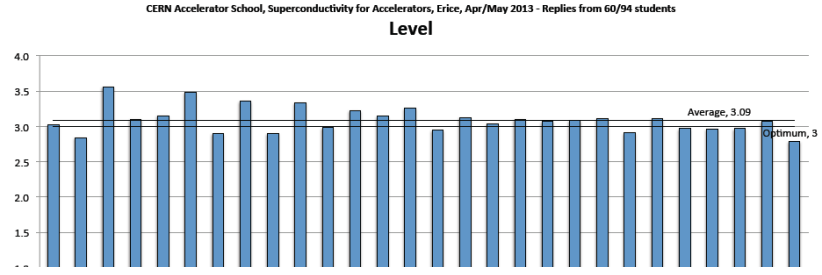
- Trains direct from Egham station (15 minutes walk)
- To Waterloo in Central London (45 minute ride)

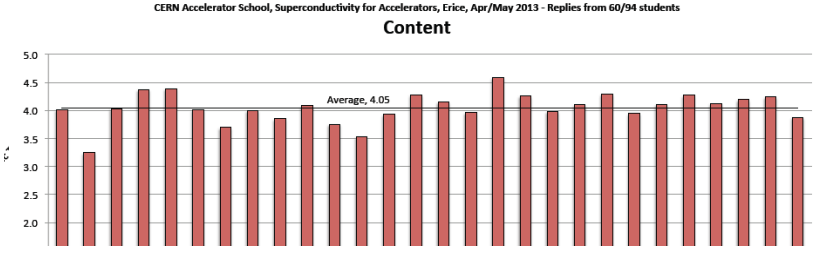


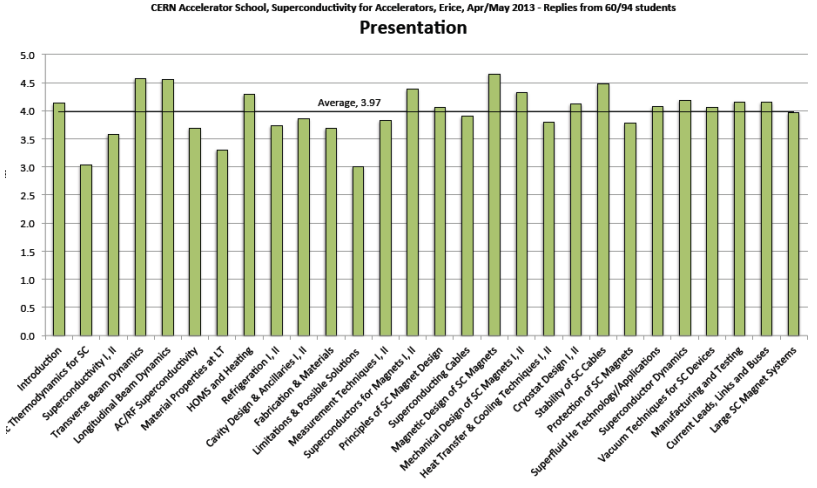
Feedback

- 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			