

# 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 per year**
- 65 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

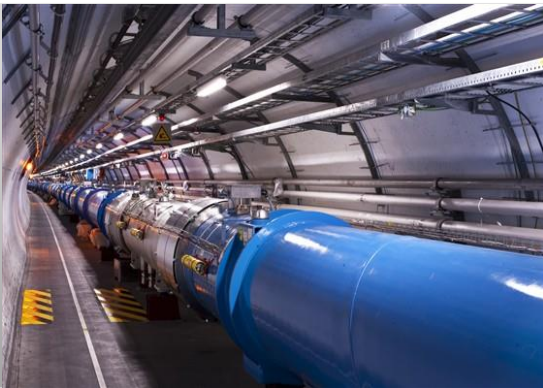
Particle Sources / RFQ / LEBT  
RF Systems / Beam Instrumentation / Feedback Systems / Beam Injection and Extraction / Beam Transfer Power Convertors / Warm Magnets / Superconducting Magnets / Vacuum Systems Machine Protection Systems Radiation and Radioprotection

## 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

- Beam Injection  
Extraction & Transfer  
» Erice, Italy, March
- Vacuum for Accelerators  
» ESS, Sweden, June
- Advanced AP  
» UK, September
- RF technology (JAS)  
» Japan, October

## 2018

- Future Colliders  
» Switzerland
- Beam Diagnostics  
» Finland
- Introduction to AP  
» ??, September
- Computation in AP  
» ??, ??



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

# CAS@CERN

- In 2013, request from ATS Department Heads
  - Basic level school aimed at **technical staff**
  - Accelerator Science and Technology at CERN
  - Sometime in the middle of LS1
- Program based on CAS introductory course
  - Concentrate on CERN machines
  - All lecturers from CERN
  - Full week non-residential
- Level of interest
  - BE TE and EN departments asked to decide who should come
  - Produced **over 160 participants** ! 90 given priority for Nov 2013
  - Second course in Feb 2014 (80 participants)

# Program for 2014

	Monday 3 February	Tuesday 4 February	Wednesday 5 February	Thursday 6 February	Friday 7 February
08:30	Coffee	Coffee	Coffee	Coffee	Coffee
09:00	Welcome R. Bailey	Transverse Beam Dynamics I	Longitudinal Beam Dynamics II	Injection and Extraction	Collective Effects
09:10	Accelerators for Beginners				
10:00	R. Steerenberg	B. Holzer	F. Tecker	W. Bartmann	G. Rumolo
10:00	Overview of the CERN Complex	Magnets	Sources	Beam Transfer	Luminosity at LHC
11:00	R. Alemany- Fernandez	P. Fessia	R. Scrivens	V. Kain	G. Papotti
	Coffee	Coffee	Coffee	Coffee	Coffee
11:30	Basic Mathematics and Units	Longitudinal Beam Dynamics I	Transverse Beam Dynamics III	Kickers and Septa	Beam-Beam Effects at LHC
12:30	R. Steerenberg	F. Tecker	B. Holzer	M. Barnes	T. Pieloni
	Lunch	Lunch	Lunch	Lunch	Lunch
14:00	E.M. Theory	Cryogenics	RF Systems	Linacs	Machine Protection
15:00	W. Herr	S. Claudet	E. Jensen	M. Vretenar	J. Wenninger
15:00	Standard Model and Beyond	Transverse Beam Dynamics II	Longitudinal Beam Dynamics III	Vacuum Systems	Collimation
16:00	P. Sphicas	B. Holzer	F. Tecker	V. Baglin	S. Redaelli
	Tea	Tea	Tea	Tea	Tea
16:30	Relativity	Power Converters	Linear Imperfections	Beam Instrumentation	Exploitation of LHC and Future Circular Colliders
17:30	W. Herr	J.P. Bumer	R. Tomas	U. Raich	F. Bordry

- Overall very good
- Very dense
- No time for discussion
- Too many equations
- Not enough equations

# CAS@CERN

- In 2016, request from ATS Department Heads
  - Basic level school aimed at **technical staff**
  - Accelerator Science and Technology at CERN
  - Sometime in EYETS 2016/17
- Program similar to 2013/2014 schools but
  - Make it less dense
  - Avoid consecutive lectures
  - Introduce discussion sessions
- Level of interest
  - BE TE and EN departments asked to decide who should come
  - Produced **over 100 participants**
  - **A few from outside the sector (Welcome!)**

# Topics selected

	Course	Speaker
Background	Accelerators for Beginners and the CERN Complex	Steerenberg
	Basic Mathematics and Units	Steerenberg
	Electromagnetic Theory	Herr
	Relativity	Herr
	Standard Model and Beyond	Sphicas
Beam Physics	Transverse Beam Dynamics I	Holzer
	Transverse Beam Dynamics II	Holzer
	Transverse Beam Dynamics III	Holzer
	Longitudinal Beam Dynamics I	Tecker
	Longitudinal Beam Dynamics II	Tecker
	Linear Imperfections	Wenninger
	Collective effects	Cornelis
	Luminosity and Beam-Beam at the LHC	Papotti
Accelerator Systems	Cryogenics	Claudet
	Magnets	De Rijk
	Power Converters for Particle Accelerators	Burnet
	Particle Sources	Scrivens
	RF Systems	Tecker
	Injection and Extraction	Schmidt
	Kickers and Septa and Beam Transfer	Kramer
	Linacs	Lombardi
	Vacuum Systems	Baglin
	Beam Instrumentation	Schmickler
	Machine Protection	Zerlauth
	Next	CLIC
LHC upgrades and Future Circular Colliders		Benedikt
	<b>26</b>	<b>20</b>

Program for the 2017 CAS - Basics of Accelerator Physics and Technology - Chavannes, February 6 to 10					
	Mon 06	Tue 07	Wed 08	Thu 09	Fri 10
08:30	Coffee				
09:00	Accelerators for Beginners and the CERN Complex Steerenberg	Transverse Beam Dynamics I Holzer	Longitudinal Beam Dynamics II Tecker	Injection and Extraction Schmidt	Machine Protection Zerlauth
10:00	Pause				
10:15	Basic Mathematics and Units Steerenberg	Magnets De Rijk	Beam Instrumentation Schmickler	Power Converters for Particle Accelerators Burnet	Collective effects Cornelis
11:15	Coffee				
11:45	Electromagnetic Theory Herr	Longitudinal Beam Dynamics I Tecker	Transverse Beam Dynamics III Holzer	Kickers and Septa and Beam Transfer Kramer	Vacuum Systems Baglin
12:45	Lunch				
14:00	Relativity Herr	Transverse Beam Dynamics II Holzer	Linacs Lombardi	Discussion	Discussion
15:00	Particle Sources Scrivens	Discussion	Discussion	Cryogenics Claudet	CLIC Schmickler
16:00	Coffee				
16:30	Standard Model and Beyond Sphicas	RF Systems Tecker	Linear Imperfections Wenninger	Luminosity and Beam-Beam at the LHC Papotti	LHC upgrades and Future Circular Colliders Benedikt
17:30					



# Attendance

DEPARTMENT	MONDAY	EN DEPARTMENT	MONDAY	TE DEPARTMENT	MONDAY	DG DEPARTMENT	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
	3 February		3 February		3 February	3 February	3 February	3 February	4 February	5 February	6 February
AKROH, A.		ANDREASSEN, O.		APOLLONIO, A.		VAN DEN BOGAARD, L.					
ALLICA, J.		ARROYO, J.		ASENSI CONEJERO, E.		PH DEPARTMENT					
BEHRENS, A.		BARBERAN-MARIN, M.		BURKART, F.		RAVAT, S.					
COLLING, M.		CHARRONDIERE, C.		CABALEIRO, F.							
DOBERTS, T.		CHEVALLEY, J.		CHESI, M.							
DUMONT, J.-C.		COPY, B.		CHRITIN, R.							
FERRARI, M.		CRESPO-LOPEZ, O.		DEFERNE, G.							
FINK, D.		DERREZ, C.		DELPRAT, L.							
FRASSIER, A.		FERNANDES, RAMOS, J.		FEUVRIER, J.							
FREYERMUTH, P.		HARROUCH, E.		GIANNELLI, S.							
GALINDO MUNOZ, N.		HORVATH, D.		GILOTEAUX, D.							
GALLERANI, L.		LAFARGE, D.		KOETTIG, T.							
GOLDBLATT, A.		LANGESLAG, S.		MAGRANS DE ABRIL, M.							
GONZALEZ COBAS, J.		LEHTINEN, J.		OBERSON, D.							
GUDKOV, D.		MACIARIELLO, F.		ROWAN, S.							
HEBERT, F.		MANOUSOS, A.		SCHWARZ, P.							
HERTY, A.		MOCCIA, S.		STAMOS, P.							
JALAL, A.		MOUCHE, B.		SURACI, A.							
KELLER, O.		ORTOLA VIDAL, J.		UZNANSKI, S.							
KITTEL, C.		PEPINSTER, P.		VAN TRAPPEN, P.							
MAILLET, R.		RICCI, D.									
MAKONNEN, Z.		TORREGROSA, C.									
MASSOT, S.		VENTURI, V.									
MERTZIG, R.		VICENTE LEITAO, I.									
PETERS, B.		VOITIER, A.									
RAINS, S.											
SOBY, L.											
STAPLEY, N.											
SUYKERBUYK, R.											
TAN, J.											
VARELA CAMPELO, J.											
WENANDER, F.											

. Bailey, CAS

# BASICS OF ACCELERATOR SCIENCE AND TECHNOLOGY AT CERN

3 – 7 February, 2014

Chavannes de Bogis, Switzerland

## YOUR IMPRESSIONS OF THE PROGRAMME

Please mark each lecture with a number 1 to 5 in each of the three columns labelled "Level, Content and Presentation". The meaning of the numbers is as shown below. Please return this sheet to Barbara Strasser or Roger Bailey as soon as possible when completed. Your answers are confidential.

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
Accelerators for Beginners			
Overview of the CERN Complex			
Basic Mathematics and Units			
E.M. Theory			
Standard Model and Beyond			
Relativity			
Transverse Beam Dynamics I, II, III			
Magnets			
Longitudinal Beam Dynamics I, II, III			
Cryogenics			
Power Converters			
Sources			
RF Systems			
Linear Imperfections			
Injection and Extraction			
Beam Transfer			
Kickers and Septa			
Linacs			
Vacuum Systems			
Beam Instrumentation			
Collective Effects			
Luminosity at LHC			
Beam-Beam Effects at LHC			
Machine Protection			
Collimation			
Exploitation of LHC and Future Circular Colliders			