

The CERN Accelerator School is organising a course on:

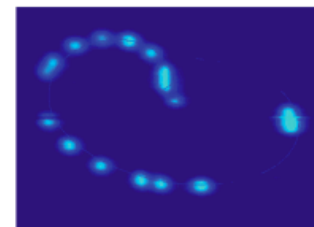
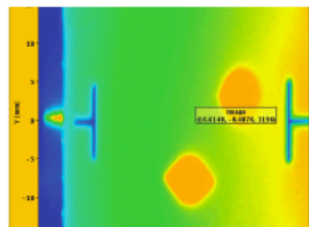
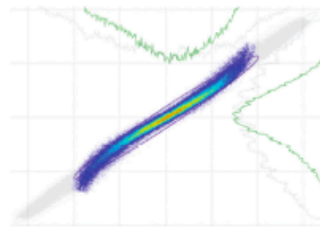
# Beam Injection, Extraction and Transfer

10 - 19 March, 2017

Ettore Majorana Foundation and  
Centre for Scientific Culture Erice, Italy

This course will be of interest to staff and students in accelerator laboratories, university departments and companies manufacturing accelerator equipment who wish to learn about accelerator science and technology.

The course focuses on various aspects of particle injection and extraction and beam transfer and introduces the state of the art techniques of hardware components used in modern accelerators. Participants will have the opportunity to work on realistic case studies as an integral part of the program.



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

## The twenty two Member States of CERN Les vingt-deux États membres du CERN

Member States (date of accession)  
États membres (date d'accession)

 Austria (1959) <i>Autriche</i>	 Italy (1953) <i>Italie</i>
 Belgium (1953) <i>Belgique</i>	 Netherlands (1953) <i>Pays-Bas</i>
 Bulgaria (1999) <i>Bulgarie</i>	 Norway (1953) <i>Norvège</i>
 Czech Republic (1993) <i>République tchèque</i>	 Poland (1991) <i>Pologne</i>
 Denmark (1953) <i>Danemark</i>	 Portugal (1986) <i>Portugal</i>
 Finland (1991) <i>Finlande</i>	 Romania (2016) <i>Roumanie</i>
 France (1953) <i>France</i>	 Slovakia (1993) <i>République slovaque</i>
 Germany (1953) <i>Allemagne</i>	 Spain (1961-1968, 1983-) <i>Espagne</i>
 Greece (1953) <i>Grèce</i>	 Sweden (1953) <i>Suède</i>
 Hungary (1992) <i>Hongrie</i>	 Switzerland (1953) <i>Suisse</i>
 Israel (2014) <i>Israël</i>	 United Kingdom (1953) <i>Royaume-Uni</i>



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 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

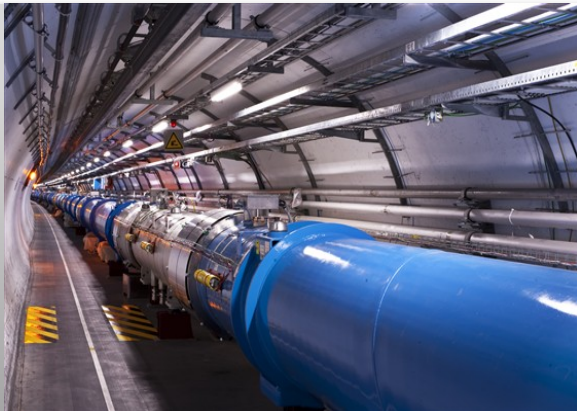
Relativity / Electro-Magnetic Theory / Transverse Beam Dynamics / Longitudinal Beam Dynamics / Linear Imperfections and Resonances / Synchrotron Radiation / Electron Beam Dynamics / Multi-Particle Effects / Non-Linear Dynamics Beam Instabilities / Landau Damping / Beam-Beam Effects

## 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



# Schools 1983-1998

No dedicated course on

Beam Injection Extraction  
& Transfer

in 15 years

Year	Topic	Town	Country	Level	Proceedings
1999	Vacuum Technology	Snekersten	Denmark	Specialised	CERN-99-05
1999	General Accelerator Physics	Bénodet	France	Intermediate	
1998	General Accelerator Physics	Oxford	UK	Introduction	
1997	Measurement and Alignment of Accelerator and Detector Magnets	Anacapri	Italy	Specialised	CERN-98-05
1997	General Accelerator Physics	Gjøvik	Norway	Intermediate	
1996	Synchrotron Radiation and Free Electron Lasers	Grenoble	France	Specialised	CERN-98-04
1996	General Accelerator Physics	Cascais	Portugal	Introduction	
1995	Superconductivity in Particle Accelerators	Hamburg	Germany	Specialised	CERN-96-03
1995	General Accelerator Physics	Eger	Hungary	Intermediate	
1994	Cyclotrons, Linacs and Their Applications	La Hulpe	Belgium	Specialised	CERN 96-02
1994	General Accelerator Physics	Baden	Austria	Introduction	
1993	RF Engineering for Particle Accelerators	Anacapri	Italy	Specialised	
1993	General Accelerator Physics	Rhodes	Greece	Advanced	CERN 95-06 v1, 95-06 v2
1992	General Accelerator Physics	Jyvaskyla	Finland	General	CERN-94-01-V-1, CERN-94-01-V-2
1992	Magnetic Measurement and Alignment	Montreux	Switzerland	Specialised	CERN-92-05
1991	RF Engineering for Particle Accelerators	Oxford	United Kingdom	Specialised	CERN-92-03-V-1, CERN-92-03-V-2
1991	General Accelerator Physics	Noordwijke rhout	Netherlands	Advanced	CERN-92-01
1990	Power Converters for Particle Accelerators	Montreux	Switzerland	Specialised	CERN-90-07
1990	General Accelerator Physics	Julich	Germany	General	CERN-91-04
1989	Synchrotron Radiation and Free Electron Lasers	Chester	United Kingdom	Specialised	CERN-90-03
1989	General Accelerator Physics	Uppsala	Sweden	Advanced	CERN-90-04
1988	Superconductivity in Particle Accelerators	Hamburg	Germany	Specialised	CERN-89-04
1988	General Accelerator Physics	Salamanca	Spain	General	CERN-89-05
1987	General Accelerator Physics	Berlin	West Germany	Advanced	CERN-89-01
1986	Applied Geodesy for Particle Accelerators	Geneva	Switzerland	Specialised	CERN-87-01
1986	General Accelerator Physics	Aarhus	Denmark	General	CERN-87-10
1985	General Accelerator Physics	Oxford	United Kingdom	Advanced	CERN-87-03-V-1, CERN-87-03-V-2
1984	General Accelerator Physics	Gif-sur-Yvette	France	General	CERN-85-19-V-1, CERN-85-19-V-2
1983	Antiprotons for Colliding Beam Facilities	Geneva	Switzerland	Specialised	CERN-84-15

# Schools 1999-2016

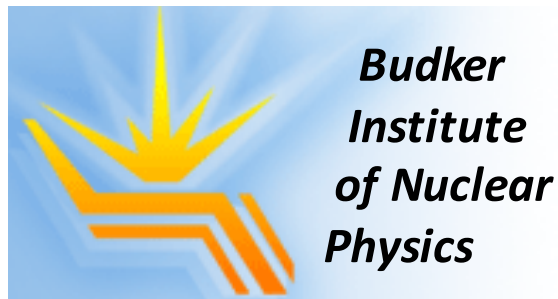
No dedicated course on  
Beam Injection Extraction  
& Transfer  
in another 15 years

Year	Topic	Town	Country	Level	Proceedings
2016	General Accelerator Physics	Budapest	Hungary	Introduction	
2016	FELs and ERLs	Hamburg	Germany	Specialised	
2015	Intensity Limitations	CERN	Switzerland	Specialised	CERN-2016-002
2015	General Accelerator Physics	Warsaw	Poland	Advanced	
2015	Accelerators for Health	Vosendorf	Austria	Specialised	CERN-2016-
2014	Plasma Wake Acceleration	CERN	Switzerland	Specialised	CERN-2016-001
2014	Power Convertors	Baden	Switzerland	Specialised	CERN-2015-003
2014	General Accelerator Physics	Prague	Czech Rep	Introduction	
2013	Superconductivity	Erice	Italy	Specialised	CERN-2014-005
2013	General Accelerator Physics	Trondheim	Norway	Advanced	CERN-
2012	Ion Sources	Senec	Slovakia	Specialised	CERN-2013-007
2012	General Accelerator Physics	Granada	Spain	Introduction	
2011	High Power Machines	Bilbao	Spain	Specialised	CERN-2013-001
2011	General Accelerator Physics	Chios	Greece	Intermediate	
2010	RF for Accelerators	Ebeltoft	Denmark	Specialised	CERN-2011-007
2010	General Accelerator Physics	Varna	Bulgaria	Introduction	
2009	Magnets	Bruges	Belgium	Specialised	CERN-2010-004
2009	General Accelerator Physics	Darmstadt	Germany	Intermediate	
2008	Beam Diagnostics	Dourdan	France	Specialised	CERN-2009-005
2008	General Accelerator Physics	Frascati	Italy	Introduction	
2007	Digital Signal Processing	Sigtuna	Sweden	Specialised	CERN-2008-003
2007	General Accelerator Physics	Daresbury	UK	Intermediate	
2006	Vacuum in Accelerators	Platja d'Aro	Spain	Specialised	CERN-2007-003
2006	General Accelerator Physics	Zakopane	Poland	Introduction	
2005	Small Accelerators	Zeegse	Netherlands	Specialised	CERN-2006-012
2005	General Accelerator Physics	Trieste	Italy	Intermediate	
2004	Power Convertors	Warrington	UK	Specialised	CERN-2006-010
2004	General Accelerator Physics	Baden	Austria	Introduction	
2003	Synchrotron Radiation and Free Electron Lasers	Brunnen	Switzerland	Specialised	CERN-2005-012
2003	General Accelerator Physics	Zeuthen	Germany	Intermediate	
2002	Superconductivity for Accelerators and Detectors	Erice	Italy	Specialised	CERN-2004-008
2002	General Accelerator Physics	Sesimbra	Portugal	Introduction	
2001	Particle Accelerators for Medicine and Industry	Pruhonic	Czech Republic	Specialised	Unpublished
2001	General Accelerator Physics	Seville	Spain	Intermediate	
2000	RF Engineering	Seeheim	Germany	Specialised	CERN-2005-003
2000	General Accelerator Physics	Loutraki	Greece	Introduction	

# Joint Accelerator Schools



The CERN Accelerator School



1985	Santa Margherita di Pula, Sardinia, Italy	Nonlinear Dynamics	Lecture Notes in Physics No. 247 Springer-Verlag
1986	South Padre Island, Texas, USA	Frontiers of Particle Beams	Lecture Notes in Physics No. 296 Springer-Verlag
1988	Anacapri, Italy	Frontiers of Particle Beams: Observation, Diagnosis and Correction	Lecture Notes in Physics No. 343 Springer-Verlag
1990	Hilton Head, South Carolina, USA	Frontiers of Particle Beams: Intensity Limitations	Lecture Notes in Physics No. 400 Springer-Verlag
1992	Benalmadena, Spain	Frontiers of Particle Beams: Factories with e+e- Rings	Lecture Notes in Physics No. 425 Springer-Verlag
1994	Maui, Hawaii, USA	Frontiers of Accelerator Technology	World Scientific, 1996 ISBN 981-02-2537-7
1996	Hayama-machi, Japan	Frontiers of Accelerator Technology: RF Engineering for Particle Accelerators	World Scientific, 1999 ISBN 981-0203838-X
1998	Montreux, Switzerland	Beam Measurement	World Scientific, 1999 ISBN 981-02-3881-9
2000	St. Petersburg, Russia	Frontiers of Accelerator Technology: High Quality Beams	AIP, 2001 ISBN 0-7354-0034-2
2002	Long Beach, California, USA	Frontiers of Accelerator Technology in Linacs	World Scientific, 2004
2011	Erice, Italy	Synchrotron Radiation and Free Electron Lasers	No proceedings
2013	Shizuoka, Japan	Introduction to Particle Accelerators (Regional session)	No proceedings
2014	Newport beach, California, USA	Beam Loss and Accelerator Protection	CERN-2016-02

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## 2016

- ERLs and FELs
  - » Hamburg, Germany
- Introduction to AP
  - » Budapest, Hungary

## 2017

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



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



DRAFT PROGRAMME FOR BEAM INJECTION, EXTRACTION AND TRANSFER SCHOOL  
Erice, Sicily, 10-19 March, 2017

Time	Friday 10 March	Saturday 11 March	Sunday 12 March	Monday 13 March	Tuesday 14 March	Wednesday 15 March	Thursday 16 March	Friday 17 March	Saturday 18 March	Sunday 19 March	
09:00	A R R I V E L D A Y	Opening Talks	Overview of Injection & Extraction Techniques	Timing, Synchronisation & Longitudinal Aspects I	Kicker Magnets I	E X C U R S I O N	Emission Preservation	Beam Instrumentation	Transfer Line Design, Matching and Design Tools II	D E P A R T U R D A Y	
09:50				B. Goddard	H. Damerau		M. Barnes	V. Kain	P. Forck		W. Bartmann
10:00		Review of Transverse Beam Dynamics I	Injection: Electron Beams	Magnets and Special Magnets	Kicker Magnets II			Septa I	Secondary and Radioactive Beams		Exotic Injection and Extraction Methods
10:50		B. Holzer	M. Aiba	C. Muehle	M. Barnes			M. Paraliiev	H. Weick		B. Goddard
11:00		COFFEE	COFFEE	COFFEE	COFFEE			COFFEE	COFFEE		COFFEE
11:30		Review of Longitudinal Beam Dynamics	Injection: Hadron Beams	Timing, Synchronisation & Longitudinal Aspects II	Single and Multi-Turn Extraction			Septa II	Low Energy Beam Transport		Transfer Line Design, Matching and Design Tools III
12:20		F. Tecker	C. Bracco	H. Damerau	M. Fraser			M. Paraliiev	R. Baartman		W. Bartmann
12:30		LUNCH	LUNCH	LUNCH	LUNCH			LUNCH	LUNCH		LUNCH
14:30		Review of Transverse Beam Dynamics II	Phase Space Painting and H-Stripping Injection		Resonant Extraction			Optics Measurement Techniques for Transfer Lines I	Transfer Line Design, Matching and Design Tools I		Seminar Injection into a Trap
15:20		B. Holzer	B. Goddard	F R E E	P. Bryant			P. Forck	W. Bartmann		F. Herfurth
15:30		Particle Interactions with Matter	Introduction to Case Study		Seminar Extraction Techniques for Medical Beams			Optics Measurement Techniques for Transfer Lines II	Machine Protection and Activation		Case Study Presentations
16:20		A. Lechner		A F T E R N O O N	P. Bryant			P. Forck	A. Nordt		
16:30		TEA	TEA		TEA			TEA	TEA		TEA
17:00		Recap. of Electromagnetism	Injection and Extraction in Cyclotrons		Case Study			Case Study	Case Study Preparation		Case Study Presentation
17:50	U. Van Rienen	M. Seidel		Case Study		Case Study	Case Study Preparation				
18:00	Recap. Of Relativity and Space Charge	Case Study									
18:50	M. Ferrario										
20:00	DINNER	DINNER	DINNER	DINNER		DINNER	Special Dinner	DINNER			



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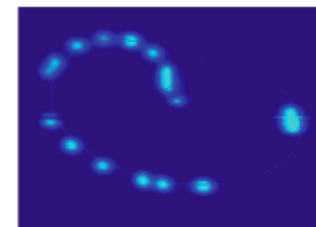
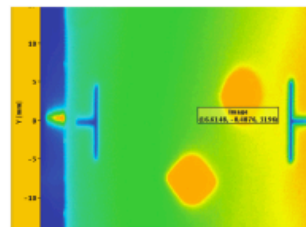
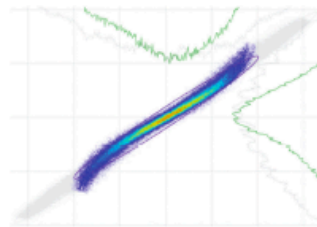
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# Few words of explanation on the following

- Program
- Case study
- Feedback
- Excursion
- Lunch
- Dinner
- Coffee and tea breaks
- Special dinner
- Photo

# Coffee & Tea Breaks & Cookies & Discussions

-- upstairs --

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09:50		B. Goddard	H. Damerau	M. Barnes	V. Kain		P. Forck	W. Bartmann		
10:00		Review of Transverse Beam Dynamics I	Injection: Electron Beams	Magnets and Special Magnets	Kicker Magnets II		Septa I	Secondary and Radioactive Beams	Exotic Injection and Extraction Methods	
10:50		B. Holzer	M. Aiba	C. Muehle	M. Barnes		M. Paraliiev	H. Weick	B. Goddard	
11:00		COFFEE	COFFEE	COFFEE	COFFEE		COFFEE	COFFEE	COFFEE	
11:30		Review of Longitudinal Beam Dynamics	Injection: Hadron Beams	Timing, Synchronisation & Longitudinal Aspects II	Single and Multi-Turn Extraction		Septa II	Low Energy Beam Transport	Transfer Line Design, Matching and Design Tools III	
12:20		F. Tecker	C. Bracco	H. Damerau	M. Fraser		M. Paraliiev	R. Baartman	W. Bartmann	
12:30		LUNCH	LUNCH	LUNCH	LUNCH		LUNCH	LUNCH	LUNCH	
14:30		Review of Transverse Beam Dynamics II	Phase Space Painting and H-Stripping Injection		Resonant Extraction		Optics Measurement Techniques for Transfer Lines I	Transfer Line Design, Matching and Design Tools I	<b>Seminar</b> Injection into a Trap	
15:20		B. Holzer	B. Goddard	F R E E	P. Bryant		P. Forck	W. Bartmann	F. Herfurth	
15:30		Particle Interactions with Matter	Introduction to Case Study		<b>Seminar</b> Extraction Techniques for Medical Beams		Optics Measurement Techniques for Transfer Lines II	Machine Protection and Activation	Case Study Presentations	
16:20		A. Lechner		A	P. Bryant		P. Forck	A. Nordt		
16:30		TEA	TEA	A F T E R N O O N	TEA		TEA	TEA	TEA	
17:00		Recap. of Electromagnetism	Injection and Extraction in Cyclotrons		Case Study		Case Study	Case Study Preparation	Case Study Presentation	
17:50		U. Van Rienen	M. Seidel							
18:00		Recap. Of Relativity and Space Charge	Case Study		Case Study		Case Study	Case Study Preparation	Outlook: Physics beyond the Standard Model	
18:50		M. Ferrario								
20:00		DINNER	DINNER	DINNER	DINNER		DINNER	Special Dinner	DINNER	

# Lunch & Dinner

selected list of restaurants “downtown”

meal is **included** in the CAS fee, → show voucher  
drinks are **NOT**.

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09:50			B. Goddard	H. Damerau	M. Barnes		V. Kain	P. Forck	W. Bartmann	
10:00	A	Review of Transverse Beam Dynamics I	Injection: Electron Beams	Magnets and Special Magnets	Kicker Magnets II		Septa I	Secondary and Radioactive Beams	Exotic Injection and Extraction Methods	D
10:50	R	B. Holzer	M. Aiba	C. Muehle	M. Barnes	E	M. Paraliev	H. Weick	B. Goddard	P
11:00	R	COFFEE	COFFEE	COFFEE	COFFEE	X	COFFEE	COFFEE	COFFEE	
11:30	I	Review of Longitudinal Beam Dynamics	Injection: Hadron Beams	Timing, Synchronisation & Longitudinal Aspects II	Single and Multi-Turn Extraction	C	Septa II	Low Energy Beam Transport	Transfer Line Design, Matching and Design Tools III	A
12:20	V	F. Tecker	C. Bracco	H. Damerau	M. Fraser	U	M. Paraliev	R. Baartman	W. Bartmann	T
12:30	A	LUNCH	LUNCH	LUNCH	LUNCH	R	LUNCH	LUNCH	LUNCH	
14:30	L	Review of Transverse Beam Dynamics II	Phase Space Painting and H-Stripping Injection		Resonant Extraction	S	Optics Measurement Techniques for Transfer Lines I	Transfer Line Design, Matching and Design Tools I	<b>Seminar</b> Injection into a Trap	U
15:20	D	B. Holzer	B. Goddard	F R E	P. Bryant	I	P. Forck	W. Bartmann	F. Herfurth	R
15:30	A	Particle Interactions with Matter	Introduction to Case Study	E	<b>Seminar</b> Extraction Techniques for Medical Beams	O	Optics Measurement Techniques for Transfer Lines II	Machine Protection and Activation	Case Study Presentations	D
16:20	Y	A. Lechner		A	P. Bryant	N	P. Forck	A. Nordt		Y
16:30		TEA	TEA	F	TEA		TEA	TEA	TEA	
17:00		Recap. of Electromagnetism	Injection and Extraction in Cyclotrons	T E R N O O N	Case Study		Case Study	Case Study Preparation	Case Study Presentation	
17:50		U. Van Rienen	M. Seidel							
18:00		Recap. Of Relativity and Space Charge	Case Study	N	Case Study		Case Study	Case Study Preparation	Outlook: Physics beyond the Standard Model	
18:50		M. Ferrario								
20:00		DINNER	DINNER	DINNER	DINNER		DINNER	Special Dinner	DINNER	

“Discussion” Session every evening in the **Marsalla room**

# Special Dinner

*Friday evening,  
to get together at least once in a special place,*

*meal is **included** in CAS fee  
so are the drinks !!*

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10:50	R	B. Holzer	M. Aiba	C. Muehle	M. Barnes	E	M. Paraliev	H. Weick	B. Goddard	P
11:00	R	COFFEE	COFFEE	COFFEE	COFFEE	X	COFFEE	COFFEE	COFFEE	
11:30	I	Review of Longitudinal Beam Dynamics	Injection: Hadron Beams	Timing, Synchronisation & Longitudinal Aspects II	Single and Multi-Turn Extraction	C	Septa II	Low Energy Beam Transport	Transfer Line Design, Matching and Design Tools III	A
12:20	V	F. Tecker	C. Bracco	H. Damerau	M. Fraser	U	M. Paraliev	R. Baartman	W. Bartmann	T
12:30	A	LUNCH	LUNCH	LUNCH	LUNCH	R	LUNCH	LUNCH	LUNCH	
14:30	L	Review of Transverse Beam Dynamics II	Phase Space Painting and H-Stripping Injection		Resonant Extraction	S	Optics Measurement Techniques for Transfer Lines I	Transfer Line Design, Matching and Design Tools I	<b>Seminar</b> Injection into a Trap	U
15:20	D	B. Holzer	B. Goddard	F R E	P. Bryant	O	P. Forck	W. Bartmann	F. Herfurth	R
15:30	A	Particle Interactions with Matter	Introduction to Case Study	E	<b>Seminar</b> Extraction Techniques for Medical Beams	N	Optics Measurement Techniques for Transfer Lines II	Machine Protection and Activation	Case Study Presentations	D
16:20	Y	A. Lechner		A	P. Bryant		P. Forck	A. Nordt		Y
16:30		TEA	TEA	F	TEA		TEA	TEA	TEA	
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18:00		Recap. Of Relativity and Space Charge	Case Study	N	Case Study		Case Study	Case Study Preparation	Outlook: Physics beyond the Standard Model	
18:50		M. Ferrario								
20:00		DINNER	DINNER	DINNER	DINNER		DINNER	<b>Special Dinner</b>	DINNER	

# Excursion on Wednesday

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09:50		B. Goddard	H. Damerau	M. Barnes	V. Kain		P. Forck	W. Bartmann		
10:00		Review of Transverse Beam Dynamics I	Injection: Electron Beams	Magnets and Special Magnets	Kicker Magnets II		Septa I	Secondary and Radioactive Beams	Exotic Injection and Extraction Methods	
10:50		B. Holzer	M. Aiba	C. Muehle	M. Barnes		M. Paraliiev	H. Weick	B. Goddard	
11:00		COFFEE	COFFEE	COFFEE	COFFEE		COFFEE	COFFEE	COFFEE	
11:30		Review of Longitudinal Beam Dynamics	Injection: Hadron Beams	Timing, Synchronisation & Longitudinal Aspects II	Single and Multi-Turn Extraction		Septa II	Low Energy Beam Transport	Transfer Line Design, Matching and Design Tools III	
12:20		F. Tecker	C. Bracco	H. Damerau	M. Fraser		M. Paraliiev	R. Baartman	W. Bartmann	
12:30		LUNCH	LUNCH	LUNCH	LUNCH		LUNCH	LUNCH	LUNCH	
14:30		Review of Transverse Beam Dynamics II	Phase Space Painting and H-Stripping Injection		Resonant Extraction		Optics Measurement Techniques for Transfer Lines I	Transfer Line Design, Matching and Design Tools I	<b>Seminar</b> Injection into a Trap	
15:20		B. Holzer	B. Goddard	F R E E	P. Bryant		P. Forck	W. Bartmann	F. Herfurth	
15:30		Particle Interactions with Matter	Introduction to Case Study		<b>Seminar</b> Extraction Techniques for Medical Beams		Optics Measurement Techniques for Transfer Lines II	Machine Protection and Activation	Case Study Presentations	
16:20		A. Lechner		A	P. Bryant		P. Forck	A. Nordt		
16:30		TEA	TEA	F	TEA		TEA	TEA	TEA	
17:00		Recap. of Electromagnetism	Injection and Extraction in Cyclotrons	T	Case Study		Case Study	Case Study Preparation	Case Study Presentation	
17:50		U. Van Rienen	M. Seidel	R						
18:00		Recap. Of Relativity and Space Charge	Case Study	N	Case Study		Case Study	Case Study Preparation	Outlook: Physics beyond the Standard Model	
18:50		M. Ferrario								
20:00	DINNER	DINNER		DINNER	DINNER	Special Dinner	DINNER			



# Organisation of the Courses

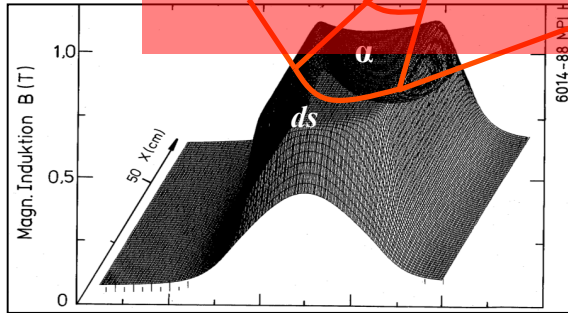
DRAFT PROGRAMME FOR BEAM INJECTION, EXTRACTION AND TRANSFER SCHOOL  
Erice, Sicily, 10-19 March, 2017

Time	Friday 10 March	Saturday 11 March	Sunday 12 March	Monday 13 March	Tuesday 14 March	Wednesday 15 March	Thursday 16 March	Friday 17 March	Saturday 18 March	Sunday 19 March	
09:00	A R R I V E L D A Y	Opening Talks	Overview of Injection & Extraction Techniques	Timing, Synchronisation & Longitudinal Aspects I	Kicker Magnets I	E X C U R S I O N	Emittance Preservation	Beam Instrumentation	Transfer Line Design, Matching and Design Tools II	D E P A R T U R D A Y	
09:50				B. Goddard	H. Damerau		M. Barnes	V. Kain	P. Forck		W. Bartmann
10:00		Review of Transverse Beam Dynamics I	Injection: Electron Beams	Magnets and Special Magnets	Kicker Magnets II			Septa I	Secondary and Radioactive Beams		Exotic Injection and Extraction Methods
10:50		B. Holzer	M. Aiba	C. Muehle	M. Barnes			M. Paraliev	H. Weick		B. Goddard
11:00		COFFEE	COFFEE	COFFEE	COFFEE			COFFEE	COFFEE		COFFEE
11:30		Review of Longitudinal Beam Dynamics	Injection: Hadron Beams	Timing, Synchronisation & Longitudinal Aspects II	Single and Multi-Turn Extraction			Septa II	Low Energy Beam Transport		Transfer Line Design, Matching and Design Tools III
12:20		F. Tecker	C. Bracco	H. Damerau	M. Fraser			M. Paraliev	R. Baartman		W. Bartmann
12:30		LUNCH	LUNCH	LUNCH	LUNCH			LUNCH	LUNCH		LUNCH
14:30		Review of Transverse Beam Dynamics II	Phase Space Painting and H-Stripping Injection		Resonant Extraction			Optics Measurement Techniques for Transfer Lines I	Transfer Line Design, Matching and Design Tools I		<b>Seminar</b> Injection into a Trap
15:20		B. Holzer	B. Goddard	F R E E	P. Bryant			P. Forck	W. Bartmann		F. Herfurth
15:30		Particle Interactions with Matter	Introduction to Case Study		<b>Seminar</b> Extraction Techniques for Medical Beams			Optics Measurement Techniques for Transfer Lines II	Machine Protection and Activation		Case Study Presentations
16:20		A. Lechner			P. Bryant			P. Forck	A. Nordt		
16:30		TEA	TEA		TEA			TEA	TEA		TEA
17:00		Recap. of Electromagnetism	Injection and Extraction in Cyclotrons		Case Study			Case Study	Case Study Preparation		Case Study Presentation
17:50	U. Van Rienen	M. Seidel									
18:00	Recap. Of Relativity and Space Charge	Case Study		Case Study		Case Study	Case Study Preparation	Outlook: Physics beyond the Standard Model			
18:50	M. Ferrario										
20:00	DINNER	DINNER	DINNER	DINNER	DINNER	DINNER	Special Dinner	DINNER			

# Review of beam dynamics, relativity electromagnetism

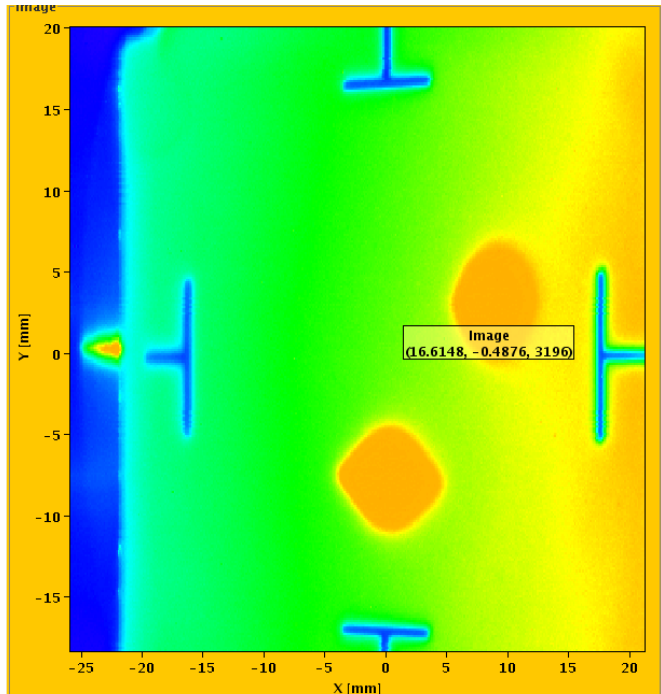
## space charge

DRAFT PROGRAMME FOR BEAM DYNAMICS, EXTRACTION AND TRANSFER SCHOOL  
Erice, Sicily, 10-19 March, 2017



	Saturday 11 March	Sunday 12 March	Monday 13 March	Tuesday 14 March	Wednesday 15 March	Thursday 16 March	Friday 17 March	Saturday 18 March	Sunday 19 March
	Opening Talks	Overview of Injection & Extraction Techniques B. Goddard	Timing, Synchronisation & Longitudinal Aspects I H. Damerau	Kicker Magnets I M. Barnes		Emittance Preservation V. Kain	Beam Instrumentation P. Forck	Transfer Line Design, Matching and Design Tools II W. Bartmann	
	Review of Transverse Beam Dynamics I B. Holzer	Injection: Electron Beams M. Aiba	Magnets and Special Magnets C. Muehle	Kicker Magnets II M. Barnes		Septa I M. Paraliev	Secondary and Radioactive Beams H. Weick	Exotic Injection and Extraction Methods B. Goddard	D E P
	COFFEE	COFFEE	COFFEE	COFFEE	E X	COFFEE	COFFEE	COFFEE	
	Review of Longitudinal Beam Dynamics F. Tecker	Injection: Hadron Beams C. Bracco	Timing, Synchronisation & Longitudinal Aspects II H. Damerau	Single and Multi-Turn Extraction M. Fraser	C U	Septa II M. Paraliev	Low Energy Beam Transport R. Baartman	Transfer Line Design, Matching and Design Tools III W. Bartmann	A R T
	LUNCH	LUNCH	LUNCH	LUNCH	R	LUNCH	LUNCH	LUNCH	
	Review of Transverse Beam Dynamics II B. Holzer	Phase Space Painting and H-Stripping Injection B. Goddard		Resonant Extraction P. Bryant	S I O N	Optics Measurement Techniques for Transfer Lines I P. Forck	Transfer Line Design, Matching and Design Tools I W. Bartmann	<b>Seminar</b> Injection into a Trap F. Herfurth	U R
	Particle Interactions with Matter A. Lechner	Introduction to Case Study TEA		<b>Seminar</b> Extraction Techniques for Medical Beams P. Bryant		Optics Measurement Techniques for Transfer Lines II P. Forck	Machine Protection and Activation A. Nordt	Case Study Presentations	D A Y
	TEA	TEA		TEA		TEA	TEA	TEA	
	Recap. of Electromagnetism U. Van Rienen	Injection and Extraction in Cyclotrons M. Seidel		Case Study		Case Study	Case Study Preparation	Case Study Presentation	
	Recap. Of Relativity and Space Charge M. Ferrario	Case Study		Case Study		Case Study	Case Study Preparation	Outlook: Physics beyond the Standard Model	
	DINNER	DINNER	DINNER	DINNER		DINNER	Special Dinner	DINNER	

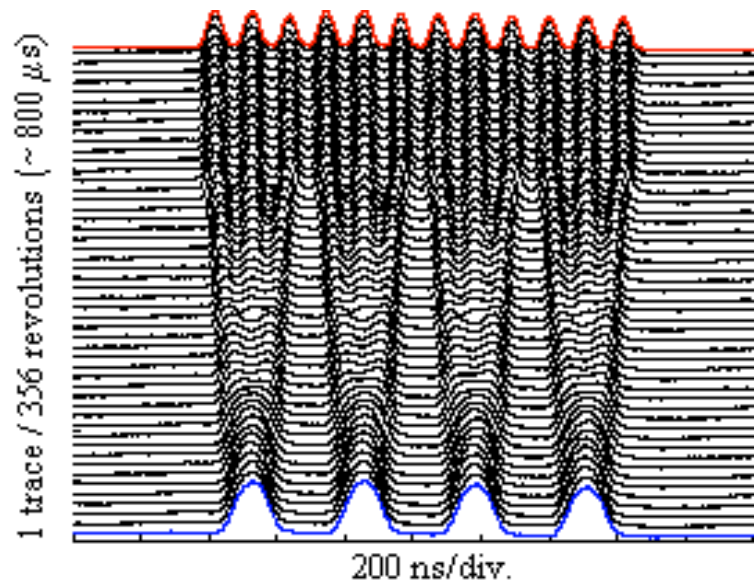
# Beam Injection



## DRAFT PROGRAMME FOR BEAM INJECTION, EXTRACTION AND TRANSFER SCHOOL Erice, Sicily, 10-19 March, 2017

Thursday 11 March	Sunday 12 March	Monday 13 March	Tuesday 14 March	Wednesday 15 March	Thursday 16 March	Friday 17 March	Saturday 18 March	Sunday 19 March
Opening Talks	Overview of Injection & Extraction Techniques B. Goddard	Timing, Synchronisation & Longitudinal Aspects I H. Damerau	Kicker Magnets I M. Barnes		Emittance Preservation V. Kain	Beam Instrumentation P. Forck	Transfer Line Design, Matching and Design Tools II W. Bartmann	
Overview of Inverse Beam Dynamics I Holzer	Injection: Electron Beams M. Aiba	Magnets and Special Magnets C. Muehle	Kicker Magnets II M. Barnes	E	Septa I M. Paraliiev	Secondary and Radioactive Beams H. Weick	Exotic Injection and Extraction Methods B. Goddard	D
COFFEE	COFFEE	COFFEE	COFFEE	X	COFFEE	COFFEE	COFFEE	E
Overview of Longitudinal Dynamics Tecker	Injection: Hadron Beams C. Bracco	Timing, Synchronisation & Longitudinal Aspects II H. Damerau	Single and Multi-Turn Extraction M. Fraser	C	Septa II M. Paraliiev	Low Energy Beam Transport R. Baartman	Transfer Line Design, Matching and Design Tools III W. Bartmann	P
LUNCH	LUNCH	LUNCH	LUNCH	U	LUNCH	LUNCH	LUNCH	A
Overview of Inverse Beam Dynamics II	Phase Space Painting and H-Stripping Injection B. Goddard		Resonant Extraction P. Bryant	R	Optics Measurement Techniques for Transfer Lines I P. Forck	Transfer Line Design, Matching and Design Tools I W. Bartmann	<b>Seminar</b> Injection into a Trap F. Herfurth	R
15:20	B. Holzer	F R E E		O	Optics Measurement Techniques for Transfer Lines II P. Forck	Machine Protection and Activation A. Nordt	Case Study Presentations	D
15:30	Particle Interactions with Matter A. Lechner	Introduction to Case Study TEA		N	TEA	TEA	TEA	A
16:20	TEA	TEA	A F T E R N O O N		Case Study	Case Study Preparation	Case Study Presentation	Y
17:00	Recap. of Electromagnetism U. Van Rienen	Injection and Extraction in Cyclotrons M. Seidel			Case Study	Case Study Preparation	Case Study Presentation	
17:50	Recap. Of Relativity and Space Charge M. Ferrario	Case Study			Case Study	Case Study Preparation	Outlook: Physics beyond the Standard Model	
18:00								
18:50								
20:00	DINNER	DINNER	DINNER	DINNER		DINNER	Special Dinner	DINNER

# Timing, Synchronisation, Emittance Preservation



DRAFT PROGRAMME FOR BEAM INJECTION, EXTRACTION AND TRANSFER SCHOOL  
Erice, Sicily, 10-19 March, 2017

	Sunday 12 March	Monday 13 March	Tuesday 14 March	Wednesday 15 March	Thursday 16 March	Friday 17 March	Saturday 18 March	Sunday 19 March
	Overview of Injection & Extraction Techniques	Timing, Synchronisation & Longitudinal Aspects I	Kicker Magnets I		Emittance Preservation	Beam Instrumentation	Transfer Line Design, Matching and Design Tools II	
	B. Goddard	H. Damerau	M. Barnes		V. Kain	P. Forck	W. Bartmann	
	Injection: Electron Beams	Magnets and Special Magnets	Kicker Magnets II	E	Septa I	Secondary and Radioactive Beams	Exotic Injection and Extraction Methods	D
	M. Aiba	C. Muehle	M. Barnes	X	M. Paraliev	H. Weick	B. Goddard	P
	COFFEE	COFFEE	COFFEE	C	COFFEE	COFFEE	COFFEE	A
	Injection: Hadron Beams	Timing, Synchronisation & Longitudinal Aspects II	Single and Multi-Turn Extraction	U	Septa II	Low Energy Beam Transport	Transfer Line Design, Matching and Design Tools III	R
	C. Bracco	H. Damerau	M. Fraser	R	M. Paraliev	R. Baartman	W. Bartmann	T
12:20	F. Tecker				LUNCH	LUNCH	LUNCH	U
12:30	LUNCH	LUNCH	LUNCH		LUNCH	LUNCH	LUNCH	R
14:30	Review of Transverse Beam Dynamics II	Phase Space Painting and H-Stripping Injection		S	Optics Measurement Techniques for Transfer Lines I	Transfer Line Design, Matching and Design Tools I	<b>Seminar</b> Injection into a Trap	R
15:20	B. Holzer	B. Goddard	F R E E	O	P. Forck	W. Bartmann	F. Herfurth	
15:30	Particle Interactions with Matter	Introduction to Case Study	E	N	P. Bryant	Machine Protection and Activation	Case Study Presentations	D
16:20	A. Lechner		A F T E R N O O N		<b>Seminar</b> Extraction Techniques for Medical Beams			A
16:30	TEA	TEA			P. Bryant	A. Nordt		Y
17:00	Recap. of Electromagnetism	Injection and Extraction in Cyclotrons			TEA	TEA	TEA	
17:50	U. Van Rienen	M. Seidel			Case Study	Case Study Preparation	Case Study Presentation	
18:00	Recap. Of Relativity and Space Charge	Case Study			Case Study	Case Study Preparation	physics beyond the standard model and future colliders	
18:50	M. Ferrario				Case Study	Case Study Preparation		
20:00	DINNER	DINNER	DINNER		DINNER	Special Dinner	DINNER	

# Magnets Kickers & Septa



## DRAFT PROGRAMME FOR BEAM INJECTION, EXTRACTION AND TRANSFER SCHOOL Erice, Sicily, 10-19 March, 2017

Day	Monday 13 March	Tuesday 14 March	Wednesday 15 March	Thursday 16 March	Friday 17 March	Saturday 18 March	Sunday 19 March
Review of Injection & Extraction Techniques	Timing, Synchronisation & Longitudinal Aspects I	Kicker Magnets I		Emittance Preservation	Beam Instrumentation	Transfer Line Design, Matching and Design Tools II	
Standard Injection: Iron Beams	H. Damerau	M. Barnes		V. Kain	P. Forck	W. Bartmann	
Liba COFFEE	Magnets and Special Magnets	Kicker Magnets II		Septa I	Secondary and Radioactive Beams	Exotic Injection and Extraction Methods	D
Injection: Iron Beams	C. Muehle	M. Barnes	E	M. Paraliev	H. Weick	B. Goddard	E
Acco COFFEE	COFFEE	COFFEE	X	COFFEE	COFFEE	COFFEE	P
Injection: Iron Beams	Timing, Synchronisation & Longitudinal Aspects II	Single and Multi- Turn Extraction	C	Septa II	Low Energy Beam Transport	Transfer Line Design, Matching and Design Tools III	A
Acco LUNCH	H. Damerau	M. Fraser	U	M. Paraliev	R. Baartman	W. Bartmann	R
Space g and apping	LUNCH	LUNCH	R	LUNCH	LUNCH	LUNCH	T
Injection		Resonant Extraction	S	Optics Measurement Techniques for Transfer Lines I	Transfer Line Design, Matching and Design Tools I	<b>Seminar</b> Injection into a Trap	U
15:20	D	F R E E	O	P. Forck	W. Bartmann	F. Herfurth	
15:30	A		N	Optics Measurement Techniques for Transfer Lines II	Machine Protection and Activation	Case Study Presentations	D
16:20	Y			P. Forck	A. Nordt		A
16:30		A F T E R N O O N		TEA	TEA	TEA	Y
17:00				Case Study	Case Study Preparation	Case Study Presentation	
17:50							
18:00				Case Study	Case Study Preparation	Outlook: Physics beyond the Standard Model	
18:50							
20:00		DINNER		DINNER	DINNER	Special Dinner	DINNER

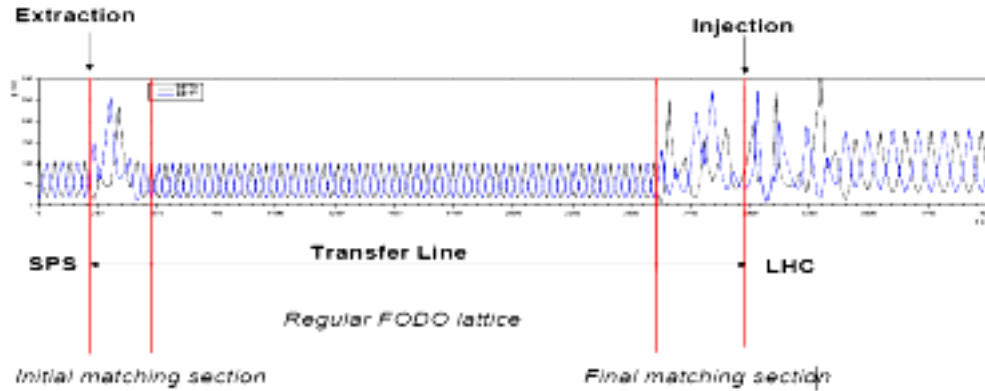


# Beam Measurements & Instrumentation

DRAFT PROGRAMME FOR BEAM INJECTION, EXTRACTION AND TRANSFER SCHOOL  
Erice, Sicily, 10-19 March, 2017

Time	Friday 10 March	Saturday 11 March	Sunday 12 March	Monday 13 March	Tuesday 14 March	Wednesday 15 March	Thursday 16 March	Friday 17 March	Saturday 18 March	Sunday 19 March	
09:00		Opening Talks	Overview of Injection & Extraction Techniques	Timing, Synchronisation & Longitudinal Aspects I	Kicker Magnets I		Emittance Preservation	Beam Instrumentation	Transfer Line Design, Matching and Design Tools II		
09:50		Review of	B. Goddard	H. Damerau	M. Barnes		V. Kain	P. Forck	W. Bartmann		
10:00			Injection:	Magnets and	Kicker Magnets II		Septa I	Secondary and Radioactive Beams	Exotic Injection and Extraction Methods	D	
		Ceramic Insert						M. Paraliiev	H. Weick	B. Goddard	E
					M. Barnes			COFFEE			P
					Single and Multi-Turn Extraction			Septa II	Low Energy Beam Transport	Transfer Line Design, Matching and Design Tools III	A
					M. Fraser			M. Paraliiev	R. Baartman	W. Bartmann	R
					LUNCH			LUNCH	LUNCH	LUNCH	T
					Resonant Extraction			Optics Measurement Techniques for Transfer Lines I	Transfer Line Design, Matching and Design Tools I	<b>Seminar</b> Injection into a Trap	U
		Transfer Line Dynamics II	H-Stripping Injection					Optics Measurement Techniques for Transfer Lines II	Machine Protection and Activation	Case Study Presentations	R
15:20	D	B. Holzer	B. Goddard		P. Bryant			P. Forck	W. Bartmann	F. Herfurth	
15:30	A	Particle Interactions with Matter	Introduction to Case Study		<b>Seminar</b> Extraction Techniques for Medical Beams			P. Forck	A. Nordt		D
16:20	Y	A. Lechner			P. Bryant			P. Forck			A
16:30		TEA	TEA		TEA			TEA	TEA	TEA	Y
17:00		Recap. of Electromagnetism	Injection and Extraction in Cyclotrons		Case Study			Case Study	Case Study Preparation	Case Study Presentation	
17:50		U. Van Rienen	M. Seidel								
18:00		Recap. Of Relativity and Space Charge	Case Study		Case Study			Case Study	Case Study Preparation	physics beyond the standard model and future colliders	
18:50		M. Ferrario									
20:00		DINNER	DINNER	DINNER	DINNER		DINNER	Special Dinner	DINNER		

# Transferline Design



SION, EXTRACTION AND TRANSFER SCHOOL  
10-19 March, 2017

	Tuesday 4 March	Wednesday 15 March	Thursday 16 March	Friday 17 March	Saturday 18 March	Sunday 19 March
	Transfer Magnets I M. Barnes		Emittance Preservation V. Kain	Beam Instrumentation P. Forck	Transfer Line Design, Matching and Design Tools II W. Bartmann	
	Transfer Magnets II M. Barnes		Septa I M. Paraliiev	Secondary and Radioactive Beams H. Weick	Exotic Injection and Extraction Methods B. Goddard	D
			COFFEE	COFFEE	COFFEE	E
			Single and Multi-Turn Extraction M. Fraser	Septa II M. Paraliiev	Low Energy Beam Transport R. Baartman	P
			LUNCH	LUNCH	LUNCH	A
			Resonant Extraction P. Bryant	Optics Measurement Techniques for Transfer Lines I P. Forck	Transfer Line Design, Matching and Design Tools I W. Bartmann	R
			SEMINAR Extraction Techniques for Medical Beams P. Bryant	Machine Protection and Activation A. Nordt	SEMINAR Injection into a Trap F. Herfurth	T
			TEA	Optics Measurement Techniques for Transfer Lines II P. Forck	Case Study Presentations F. Herfurth	U
			Case Study	TEA	TEA	R
			Case Study	Case Study	Case Study Preparation	D
			Case Study	Case Study	Case Study Preparation	A
			Case Study	Case Study	physics beyond the standard model and future colliders	Y
	DINNER	DINNER	DINNER	DINNER	DINNER	
					Special Dinner	

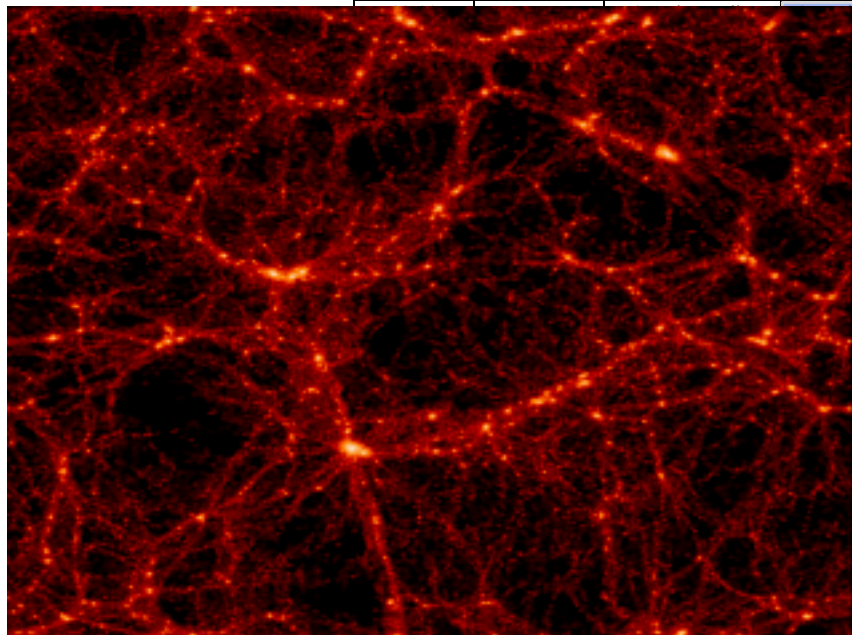




# Where do we go to and how ???

## DRAFT PROGRAMME FOR BEAM INJECTION, EXTRACTION AND TRANSFER SCHOOL Erice, Sicily, 10-19 March, 2017

Time	Friday 10 March	Saturday 11 March	Sunday 12 March	Monday 13 March	Tuesday 14 March	Wednesday 15 March	Thursday 16 March	Friday 17 March	Saturday 18 March	Sunday 19 March
				Timing, Synchronisation & Longitudinal Aspects I H. Damerau	Kicker Magnets I M. Barnes		Emittance Preservation V. Kain	Beam Instrumentation P. Forck	Transfer Line Design, Matching and Design Tools II W. Bartmann	
				Magnets and Special Magnets C. Muehle	Kicker Magnets II M. Barnes		Septa I M. Paraliiev	Secondary and Radioactive Beams H. Weick	Exotic injection and Extraction Methods B. Goddard	D
				COFFEE	COFFEE		COFFEE	COFFEE	COFFEE	E
				Timing, Synchronisation & Longitudinal Aspects II H. Damerau	Single and Multi-Turn Extraction M. Fraser		Septa II M. Paraliiev	Low Energy Beam Transport R. Baartman	Transfer Line Design, Matching and Design Tools III W. Bartmann	P
				LUNCH	LUNCH		LUNCH	LUNCH	LUNCH	A
					Resonant Extraction P. Bryant		Optics Measurement Techniques for Transfer Lines I P. Forck	Transfer Line Design, Matching and Design Tools I W. Bartmann	Seminar Injection into a Trap F. Herfurth	R
					Seminar Extraction Techniques for Medical Beams P. Bryant		Optics Measurement Techniques for Transfer Lines II P. Forck	Machine Protection and Activation A. Nordt	Case Study Presentations	T
							TEA	TEA	TEA	U
16:20		Matter	Study				Case Study	Case Study Preparation	Case Study Presentation	R
16:30		TEA	TEA							
17:00		Recap. of Electromagnetism	Injection and Extraction in Cyclotrons							
17:50		U. Van Rienen	M. Seidel							
18:00		Recap. Of Relativity and Space Charge	Case Study				Case Study	Case Study Preparation	physics beyond the standard model and future colliders	
18:50		M. Ferrario								
20:00		DINNER	DINNER	DINNER	DINNER		DINNER	Special Dinner	DINNER	D



# Case Study:

*... it's your turn now !*

grouping into teams of 6 students,  
 actually work on a pre-defined problem / project / study  
 with the help of several tutors  
 → to learn & discuss

Location: in the Centre's Court, Meeting Rooms, Marsala room

Details & coordination: Matthew Fraser

									Friday 17 March	Saturday 18 March	Sunday 19 March
	A	Transverse Beam Dynamics I	Electron Beams	Special Magnets	II				am entation	Transfer Line Design, Matching and Design Tools II	
10:50	R	B. Holzer	M. Aiba	C. Muehle	M. Barnes	E	M. Paraliiev	Radioactive Beams	ork	W. Bartmann	
11:00	R	COFFEE	COFFEE	COFFEE	COFFEE	X	COFFEE	COFFEE	ary and	Exotic Injection and Extraction Methods	D
11:30	I	Review of Longitudinal Beam Dynamics	Injection: Hadron Beams	Timing, Synchronisation & Longitudinal Aspects II	Single and Multi-Turn Extraction	C	Septa II	Low Energy Beam Transport		Transfer Line Design, Matching and Design Tools III	A
12:20	V	F. Tecker	C. Bracco	H. Damerau	M. Fraser	U	M. Paraliiev	R. Baartman		W. Bartmann	T
12:30	A	LUNCH	LUNCH	LUNCH	LUNCH	R	LUNCH	LUNCH		LUNCH	U
14:30	L	Review of Transverse Beam Dynamics II	Phase Space Painting and H-Stripping Injection		Resonant Extraction	S	Optics Measurement Techniques for Transfer Lines I	Transfer Line Design, Matching and Design Tools I		<b>Seminar</b> Injection into a Trap	R
15:20	D	B. Holzer	B. Goddard	F R E E	P. Bryant	O	P. Forck	W. Bartmann		F. Herfurth	
15:30	A	Particle Interactions with Matter	Introduction to Case Study		<b>Seminar</b> Extraction Techniques for Medical Beams	N	Optics Measurement Techniques for Transfer Lines II	Machine Protection and Activation		Case Study Presentations	D
16:20	Y	A. Lechner		A	P. Bryant		P. Forck	A. Nordt			A
16:30		TEA	TEA	F T E R N O O N	TEA		TEA	TEA		TEA	Y
17:00		Recap. of Electromagnetism	Injection and Extraction in Cyclotrons		Case Study		Case Study	Case Study Preparation		Case Study Presentation	
17:50		U. Van Rienen	M. Seidel		Case Study		Case Study	Case Study Preparation		Outlook: Physics beyond the Standard Model	
18:00		Recap. Of Relativity and Space Charge	Case Study		Case Study		Case Study	Case Study Preparation			
18:50		M. Ferrario									
20:00		DINNER	DINNER	DINNER	DINNER		DINNER	Special Dinner		DINNER	

# The Evaluation Form

*to help us in order to get feedback  
& optimise the school*

**Attention:**

*content ... "5" is super  
presentation... "5" is super  
level ... "3" is ideal*

*and please notice that there is a second page  
which is blank !!*

## BEAM INJECTION, EXTRACTION AND TRANSFER

10-19 March, 2017

Erice, Italy

### 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
Review of Transverse Beam Dynamics I, II			
Review of Longitudinal Beam Dynamics			
Particle Interactions with Matter			
Recap. of Electromagnetism			
Recap. of Relativity and Space Charge			
Overview of Injection & Extraction Techniques			
Injection: Electron Beams			
Injection: Hadron Beams			
Phase Space Painting and H-Stripping Injection			
Injection and Extraction in Cyclotrons			
Timing, Synchronization & Longitudinal Aspects I, II			
Magnets and Special Magnets			
Kicker Magnets I, II			
Single and Multi-turn Extraction			
Resonant Extraction			
Emittance Preservation			
Septa I, II			
Optics Measurement Techniques for Transfer Lines I, II			
Beam Instrumentation			
Secondary and Radioactive Beams			
Low Energy Beam Transport			
Transfer Line Design, Matching and Design Tools I, II, III			
Machine Protection and Activation			
Exotic Injection and Extraction Methods			

If you have any general comments about the course, please write them on the reverse side of this page.

## *The School Photo*



*Details – depending on weather conditions – will come*