

## JOINT UNIVERSITIES ACCELERATOR SCHOOL

Recreating the experience,  
maintaining the standards

Particle and photon beams are the quintessential probes of matter over a vast range of length and energy scales, from the dimensions of cancer cells, that they can destroy with exquisite precision, to fundamental phenomena a trillion times smaller, revealed in collisions at the LHC. **Progress in many fields of science, technology and medicine is driven by the continuing construction, exploitation and improvement of particle accelerators, large and small, across the world.**

JUAS has been meeting the need to train specialists in the physics, technology and applications of particle accelerators since 1994. Courses are given by experts from CERN and other major accelerator laboratories, some located near our campus at ESI in Archamps, France. They can be recognized for ECTS credits towards master's and PhD degrees in our network of Partner Universities.

Our alumni play key roles in technology companies across Europe.

The 2021 edition of JUAS took place in the shadow of the global pandemic and it was impossible to bring the students into residence at Archamps. Since a year without JUAS would have supply of accelerator specialists in Europe, the courses had to be reimagined and conducted entirely remotely.

**In the absence of physical space limitations, the introduction of "Full" and "Abridged" versions allowed them to be opened to an additional cohort of students.** In all, some 60 students and early-career professionals participated.

We thank our faculty, their assistants, and moderators for the efforts made to adapt or create new lecture courses. The cooperation of our Partner Universities in arranging examinations locally was invaluable. Colleagues at CERN, the ALICE experiment, ESRF, PSI, Synchrotron Soleil, Bergoz and HUG displayed remarkable ingenuity in recreating visits, seminars, and even interactive laboratory work in online versions.

**The final exam results were similar to previous years, confirming that academic standards were maintained.**



Dr John  
Jowett

JUAS Director

## PARTNER UNIVERSITIES



A school by **esi** ...  
European Scientific Institute

The European Scientific Institute was founded as a French non-profit organisation in 1994 at the initiative of CERN-based physicists in order to develop high level training courses on technologies developed at CERN, the world's largest particle physics laboratory.

Located on the French-Geneva border, ESI organises thematic postgraduate schools with an extensive network of partner universities on the science, technology and applications of particle accelerators and detectors. More recently ESI has developed a series of summer schools in partnership with Université Grenoble-Alpes in the fast-moving area of digital health.

ESI's schools attract an international audience of post-graduate students and early-career professionals. Since its creation, ESI has delivered high level teaching and training to more than 2500 young scientists from over 30 countries.

[www.esi-archamps.eu](http://www.esi-archamps.eu)

### ESI IS SUPPORTED BY :





Rather than MOOC-style pre-recorded video capsules, the vast majority of core lectures were given by live video-conference including tutorials and practical exercises. Many sessions involved a moderator in charge of managing questions via the chat. Participants were invited to put their newly found knowledge to the test working as teams in a challenging accelerator-design workshop.



The lecturers are all experts passionate about sharing their knowledge. This is really the key asset of JUAS. 🗨️

**Damien Gilmant**

SYSTEM OWNER RHODOTRON TT300HE,  
ION BEAM APPLICATIONS (IBA)



I cannot imagine the time it would have taken and the volumes of books and magazines I would have had to read to get this level of experience. The content of the lectures has been rich and in some cases challenging to understand. The fact that after just five weeks at JUAS I am already considering changing career shows the degree to which I have been transformed by the school. 🗨️

**Akomoneh RAYMOND**

(MSC COMPUTATIONAL SCIENCE & ENGINEERING, UNIVERSITÄT ROSTOCK)

## CORE TOPICS

### Special Relativity

John JOWETT (CERN RET.)

### Electromagnetic Fields for Accelerators

Elias METRAL (CERN)

### Particle Dynamics & Optics

Nicolo BIANCACCI (CERN)

### MADX

(incl. workshops)

Guido STERBINI with  
Nuria FUSTER MARTINEZ  
(CERN)

& Hector GARCIA MORALES  
(UNIV. OXFORD)

### Linear Imperfections

Hannes BARTOSIK  
(CERN)

### Accelerator Design & Design Workshop

Bernhard HOLZER (CERN)  
with Bastian HÄRER (KIT)

### Non-linear Effects

Hannes BARTOSIK  
(CERN)

### Injection / Extraction

Thomas PERRON  
(ESRF)

### Cyclotrons & FFAs

Bertrand JACQUOT  
(GANIL)

### Longitudinal dynamics

(Exam subject)

Elias METRAL & Benoît SALVANT  
(CERN)

### Space Charge & Instabilities

(Exam subject)

Mauro MIGLIORATI  
(UNI. ROME LA SAPIENZA)

### Linacs

(Exam subject)

David ALESINI (INFN)

### Transverse Dynamics

(Exam subject)

Hector GARCIA MORALES  
(UNIV. OXFORD)

### Synchrotron Radiation

(Exam subject)

Rasmus ISCHEBECK (PSI)



As Deputy Director of JUAS I followed the complete programme and was hugely impressed by the commitment of all faculty members and the efforts they made to duplicate the « JUAS experience » on line. Only one thing was missing: the students! And in particular trying to answer all their (sometimes difficult) questions over coffee and at meals. 🗨️

**Elias METRAL**

(CERN) JUAS DEPUTY DIRECTOR  
& LECTURER IN LONGITUDINAL  
DYNAMICS



It was great to have the accelerator design course and workshop as it was an occasion to put all we saw together and to have an overview on what designing a particle accelerator may be. 🗨️

**Victor DU BUAT**

(MSC NUCLEAR ENGINEERING, GRENOBLE INP-UGA)

# Course 1

An essential part of JUAS is the programme of specialist seminars, traditionally given by invited speakers at the end of the school day or during visits of accelerator facilities. Course 1 seminars aim to give participants an opportunity to broaden their vision of large-scale accelerators as they exist today and how they may look tomorrow.

## SEMINARS

### Particle Accelerators in the 21st Century

Maurizio VRETENAR (CERN)

### CERN & its Accelerator Complex

Reyes ALEMANY FERNANDEZ (CERN)

### Future High-energy Linear Colliders

Louis RINOLFI (CERN RET.)

### Novel High-gradient Particle Accelerators

Ralph ASSMANN (DESY)

### Free-electron Lasers

Eduard PRAT

(PSI)

### Electron-positron Circular Colliders

Frank ZIMMERMANN (CERN)

### LHC & Future High-energy Circular Colliders

Oliver BRÜNING (CERN)

### The US Electron-Ion Colliders

Todd SATOGATA (JEFFERSON LAB)

“ By providing a comprehensive and coherent course programme, JUAS really fulfilled my expectation of building a strong foundation in the field. I have gained so much more understanding in accelerator physics. ”

**Watanyu FOOSANG**

(PHD CANDIDATE,  
UNIVERSITÉ PARIS-SACLAY)

## VIRTUALS VISITS

One of the particular challenges of the remote format was to maintain the highly popular visits of accelerator facilities. Participants were appreciative of the efforts deployed by their virtual tour guides, despite the occasional technical glitches due to poor connectivity in a tunnel, or an ailing smartphone battery!

### ALICE Experiment at LHC

Despina HATZIFOTIADOU (INFN) &  
Roberto DIVIA (CERN)

### Synchrotron SOLEIL

David AMORIM

(SOLEIL - JUAS ALUMNUS 2016)

### European Synchrotron Radiation Facility

Jean-Luc REVOL

(ESRF)

“ A remote JUAS was a completely new experience, not only for the students, but also for the lecturers. While it was not always easy to get direct feedback during the lectures, it was a great pleasure to work with the students. It would be a pleasure to meet them in person at some conference or at another opportunity in the future ”

Rasmus ISCHEBECK

(PSI) LECTURER IN SYNCHROTRON RADIATION

## Course 1 in figures



14 lectures - 8 seminars - 3 virtual visits



(8. 10 moderators)

from 10 Universities / Institutions



30 followed the full program  
and 10 the abridged version  
(28 took the exams)

# TECHNOLOGY & APPLICATIONS OF PARTICLE ACCELERATORS

15 February - 18 March

In Course 2, on top of the full lecture programme, participants worked in groups to deliver reports on normal-conducting and superconducting magnets workshops run as an integral part of the Magnets core topic.

“ My lectures covered methods of beam diagnostics for accelerator operation and development, backed up by a mini-workshop aimed at putting this knowledge into practice. I was impressed by the keen interest and valuable contributions from students despite the remote format. ”

Peter Forck

(GSI) LECTURER IN BEAM INSTRUMENTATION

## CORE TOPICS

### Radio-Frequency (RF) engineering

Fritz CASPERS (CERN RET.)

### Particle sources

Thomas THUILLIER (CNRS-IN2P3)

### Accelerators for medical & industrial applications

Wiel KLEEVEN (IBA)

### Survey alignment of accelerators

Hélène MAINAUD-DURAND (CERN)

### Low energy electron accelerators

Wim MONDELAERS (GHENT UNIVERSITY)

### Life cycle & operability of particle accelerators

Samuel MEYRONEINC (INSTITUT CURIE)

### High power proton linacs

Sébastien BOUSSON (CNRS-IN2P3)

### Superconducting RF cavities

Fritz CASPERS (RET. CERN)

### Cryogenics for superconducting devices

Philippe LEBRUN (CERN RET.)

“ Whenever I had a question, it was explained to me immediately. This level of interaction with faculty was great. ”

Irene ALONSO ROMERO

(AERNNOVA)

### Vacuum systems

(Exam subject)

Vincent BAGLIN & Roberto KERSEVAN (CERN)

### Beam instrumentation

(Exam subject)

Peter FORCK (GSI)

### Radiation safety

(Exam subject)

Xavier QUERALT (STFC)

### Normal conducting magnets

(Exam subject) & Workshop

Thomas ZICKLER & Jérémie BAUCHE (CERN)

### Superconducting magnets

(Exam subject) & Workshop

Paolo FERRACIN (LBL)



“ Despite the limitations due to the pandemic, it was a fascinating journey into accelerator technologies and their applications guided by exceptional experts ”

Leandro INTELISANO

(PHD CANDIDATE UNIVERSITY OF ROME LA SAPIENZA / CERN)

## Course 2

Key features of Course 2 include visits of CERN, PSI and Geneva University Hospital and the two-day practical technology sessions organised at CERN and the half-day spent at the bench at Bergoz Instrumentation. Thanks to all those who devoted time and energy to organising live-stream visits and virtual practicals, with the indelible memory of Rasmus ISCHEBECK conducting a Zoom session from his bike as he crossed the river Aare to enter the tunnel for a detailed explanation of the structure and workings of PSI's state-of-the-art facility.

### VIRTUALS VISITS

#### CERN : AD ELENA, LINAC4, Thin-film coating facilities

Christian CARLI, Alessandra LOMBARDI, Jean-Baptiste LALLEMENT, Pedro COSTA PINTO & Wilhelmus VOLLENBERG

#### Paul Scherrer Institute

Rasmus ISCHEBECK, Jacobus Maarten SCHIPPERS, Jörg RAABE & Christian SCHLEPÜTZ

#### Bergoz Instrumentation

Etienne TOUZAIN and the Bergoz team

#### Geneva University Hospital - Dept. of Radio-Oncology

André DURHAM

#### Practical sessions at CERN (RF, Vacuum, Magnets)

Andrea MOSTACCI, Fritz CASPERS, Manfred WENDT, Michele BOZZOLAN, Jérémie BAUCHE, Lucio FISCARELLI, Roberto KERSEVAN, Marton ADY, Berthold JENNINGER, Sophie MEUNIER

“ The school allowed to me to deepen my knowledge in technologies and applications of particle accelerators, to acquire cutting-edge information from the lectures and seminars and to expand my working network. Considering the logistical difficulties, the organization of the school in the on-line format was excellent. ”

**Grazia D'AGOSTINO**

MARIE SKLODOWSKA-CURIE  
INDIVIDUAL FELLOW AT IBA

### SEMINARS

#### Particle Accelerators, Instruments of Discovery in Physics

Philippe LEBRUN (CERN RET.)

#### Accelerator-Driven Systems

Frederic BOULY (IN2P3)

#### Materials for SCRF Cavities : Beyond Niobium

Sergio CALATRONI (CERN)

#### Machine Learning

Jochem SNUVERINK (PSI)

#### Dielectric Laser Accelerators

Benedikt HERMANN (PSI)

#### Energy Recovery Linacs

Michaela ARNOLD (TU DARMSTADT)

#### Muon Colliders

Daniel SCHULTE (CERN)

#### Radiation Oncology: Biology, Physics & Clinical

André DURHAM (HUG)



Although it took some efforts to adapt the lectures and tutorials to the new format of remote teaching, it was a pleasure to see all these highly motivated students, lecturers and organizers, who did their utmost to make JUAS 2021 a success ”

**Thomas ZICKLER**

(CERN), LECTURER IN NORMAL-CONDUCTING MAGNETS

### Course 2 in figures



14 lectures - 8 seminars - 5 virtual visits



(8. 13 moderators)  
from 13 Universities / Institutions



28 followed the full program  
and 19 the abridged version  
(24 took the exams)

# juas ADVISORY BOARD

For the second year running, the JUAS Advisory Board met by remote connexion over two half-days on 29 and 30 April. In the light of the evaluation forms completed by participants at the end of each course, the remote format adopted for JUAS 2021 was considered to have gone satisfactorily. Thanks were expressed to Heino HENKE, stepping down after many years. The Board welcomed Olivier GUILBAUD as the representative from Université Paris-Saclay. Sophie KAZAMIAS remains on the Board as the representative of the LASCALA consortium.

It is to be hoped that 2022 will see members at last able to avail of the kind invitation from La Sapienza to host a face-to-face meeting in Rome.

# juas IN EUROPEAN PROGRAMMES

## JUAS figures in two newly approved European Commission funded programmes.



Firstly as one of the year-2 electives in the new Erasmus Mundus Joint Master LASCALA (Large-scale Accelerators and Lasers) : a two-year international master's programme, created by the universities of Paris-Saclay, Rome La Sapienza, Lund and Szegen, aimed at **training experts in the most advanced experimental and theoretical tools and concepts in accelerators physics, high power lasers, laser plasma interaction at high intensity**, as well as in **their applications related to new sources of energy, health, and security diagnostics**.



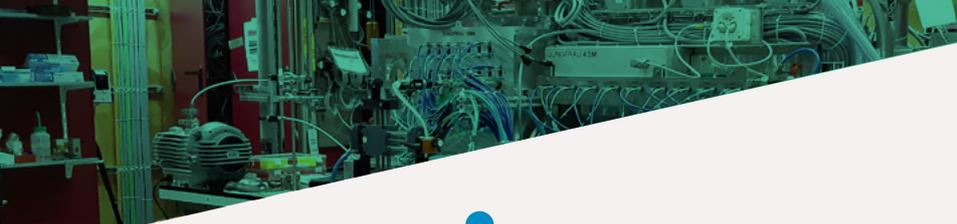
Secondly, in the H2020 project I.Fast (Innovation Fostering in Accelerator Science and Technology), as one of the inspirations of **the I.Fast Challenge Based Initiative on "Accelerators for Society"**, to be held at ESI-Archamps in July 2022.



## JUAS SPONSORS

JUAS would not be able to function without the financial and/or in-kind support it receives from a range of facilities, companies and research programmes. They are joined in 2021 by "Normandy Hadrontherapy" the world's first cyclotron-based carbon therapy system in Caen, France.





# juas

2022

SAVE THE DATE!

10 JANUARY TO 18 MARCH 2022

• Course 1 •

THE SCIENCE OF  
PARTICLE ACCELERATORS

between 10 January and 11 February

• Course 2 •

THE TECHNOLOGY & APPLICATIONS  
OF PARTICLE ACCELERATORS

between 14 February and 18 March



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