



Joint Universities Accelerator School

2023

Back to face-to-face teaching, an invaluable part of the JUAS experience

The 2023 session marked the eagerly awaited return to on-site training at ESI after two years on-line due to the Covid-19 pandemic. In our constant drive to improve the programme, a number of changes were initiated, including:

- A compulsory preparatory phase on special relativity and electromagnetism using MOOC videos with an on-line prerequisite questionnaire
- A restructured accelerator-design workshop
- A dedicated afternoon session on colliders
- A re-organised schedule with a re-distribution of the exams and preparatory sessions; more tutorials and quizzes
- Slots for private studies implemented in the school schedule
- Visits to ESRF and PSI scheduled after the exam sessions, etc.

True to the ethos of the particle accelerator community, JUAS is a highly collaborative enterprise. My sincere thanks go to the entire JUAS faculty and to those colleagues at CERN, the ALICE experiment, ESRF, PSI, Bergoz Instrumentation and HUG, who devoted precious time to sharing their passion for accelerators and accelerator technology during bespoke visits and practical lab sessions. And of course, thanks also to the members of the Advisory Board who ensure that JUAS remains a world-class venture, and to the team at ESI, with a special mention for Stéphanie Vandergooten without whose organisational skills JUAS would not be possible.

Dr. Elias Métral
JUAS DIRECTOR



COLLABORATING INSTITUTIONS & PROGRAMMES

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.

In 2023 these were joined by the ELETTRA synchrotron facility in Trieste, Italy and by MYRRHA (Mol, Belgium), the world's first large scale Accelerator Driven System project at power levels scalable to industrial systems.



JUAS PARTNER UNIVERSITIES



The Joint Universities Accelerator School is a recognised course in the Master and/or Doctoral programmes of 14 European universities and the LASCALA Erasmus Mundus Joint Master Diploma. JUAS partner universities and programmes award ECTS and doctoral credits to their students who successfully complete the examinations at the end of each course.



IN MEMORIA



1972 - 2022



1945 - 2023



1941 - 2023

We were immensely saddened to learn of the sudden death of **Sébastien Bousson** in November 2022. Himself as former JUAS student, Sébastien was a much-appreciated member of the JUAS faculty where he taught the course on high-power proton linacs.

More sad news followed in February 2023 with firstly the passing of **Michel Martini**, who for many years taught the transverse beam dynamics course, and secondly, of **Vittorio Vaccaro**, who, after retiring from teaching at JUAS, had remained an enthusiastic member of the Advisory Board.

They are sorely missed.



Before the start of the school, participants were required to view a selection of short videos and successfully complete questionnaires on key aspects of electromagnetism and special relativity, two major topics which are the fundamentals of the program. In addition, a session on “key points to remember for particle accelerators” was run during the first day of the course.

Additional background videos to be viewed prior to the school included introductions to particle accelerators and their applications, radiofrequencies and applications of Hamiltonian formalism. Virtual visits of S-Dalinac, LEIR and the ALICE experiment at the CERN LHC were also made available.

Participants needing to validate the course to obtain ECTS or doctoral credits took five exams and made one oral presentation*: the first two midway through the 5-week course and the remainder during the last week.

*Transverse beam dynamics; Longitudinal beam dynamics, Synchrotron radiation, Transverse Linear Imperfections, Collective effects, Oral presentation on Accelerator design workshop.

CORE TOPICS

(75H25)

Special Relativity, electromagnetism, classical and quantum mechanics: What to remember for particle accelerators

Elias MÉTRAL (CERN)

Transverse Beam Dynamics

Bernhard HOLZER (CERN)

Longitudinal Beam Dynamics

Alexandre LASHEEN (CERN)

MADX (Intro & Workshop)

Nuria FUSTER MARTINEZ (CERN)

PyHeadTail (Intro & Workshop)

Benoît SALVANT (CERN)

Linacs

David ALESINI (INFN)

Transverse Linear Imperfections

Davide GAMBA (CERN)

Cyclotrons & FFAs

Bertrand JACQUOT (GANIL)

Synchrotron Radiation

Rasmus ISCHEBECK (PSI)

Injection / Extraction

Nicola CARMIGNANI (ESRF)

Transverse Nonlinear Effects

Hannes BARTOSIK (CERN)

Accelerator Design & Design Workshop

Bastian HÄRER (KIT) & Adrian OEFTIGER (GSI)

Collective Effects (mainly Space Charge & Instabilities)

Mauro MIGLIORATI (LA SAPIENZA)



The JUAS experience was very interesting in many ways. The comprehensiveness of the JUAS courses gave me a unique insight into these enlightening topics. The visits (CERN, ESRF, PSI), the workshops and the practical days were particularly useful to touch with our hands what we saw during the lectures. The interaction with the faculty members and other students is one of the most valuable aspects of this intense experience. Many people met here could be colleagues in the future and many friendships born here will last a lifetime. ”

Davide Annucci

PHD, UNIVERSITÀ DI ROMA
LA SAPIENZA (ITALY)



→ Course 1

“As a capable but by no means top-of-the-class physicist, I came to JUAS expecting to have to work like hell to keep up. I wasn't wrong, but I've never had so much fun whilst working like hell. The lecturers are brilliant, I learned a great deal and gained so much from being in the company of so many bright people for a few weeks. Highly recommended.”

Alistair Muir
PHD, UNIVERSITÄT ROSTOCK
(GERMANY)



in
figures

5
INTENSIVE
weeks

28
faculty
members

13 lectures
3 workshops
10 seminars
3 visits

from 11 Universities / Institutions

31
participants

10 Master students
19 PhD students
2 Professionals

25
MALES

6
FEMALES

14
nationalities

from 15 different
Universities /
Institutions

26 took the exams

29 followed the full programme
and 2 were registered “à la carte”

SEMINARS

(12H)

Particle Accelerators in the 21st century

Maurizio VRETENAR (CERN)

Introduction to CERN & its Accelerator Complex

Reyes ALEMANY (CERN)

Introduction on colliders session

Elias METRAL (CERN)

Collider session

Olivier BRÜNING (CERN), John JOWETT (CERN), Massimo GIOVANNOZZI (CERN), Jaqueline KEINTZEL (CERN), Todd SATOGATA (JEFFERSON LAB.), Phil BURROWS (UNIV. OF OXFORD), Daniel SCHULTE (CERN)

Transverse non-linear manipulations

Massimo GIOVANNOZZI (CERN)

Free-Electron Lasers

Eduard PRAT COSTA (PSI)

Beam-based impedance measurements

Nicolo BIANCACCI (CERN)

Novel High Gradient Particle Accelerators

Ralph ASSMANN (DESY)

CERN LIU Project: Beam Dynamics aspects & solutions

Giovanni RUMOLO (CERN)

I-FAST-CBI: Challenge based innovation for particle accelerators & related technologies

Nicolas DELERUE (CNRS)

VISITS

(6H45)

- CERN LEIR Accelerator
- ALICE Experiment at the CERN LHC
- European Synchrotron (ESRF)

WORKSHOPS

(18H30)

MADX • PyHeadTail • Accelerator design

The Technology & Applications of Particle Accelerators



13 FEBRUARY – 17 MARCH

As for course 1, participants were required to view background videos on fundamental topics at the core of the program.

The practical days at CERN are a particularly important and appreciated part of JUAS. On the first day of the school, different experts from CERN give presentations of different technologies and their applications at CERN. In 2023 the areas covered were magnets, vacuum, superconductivity, radio frequencies and CLEAR (CERN Linear Electron Accelerator for Research). Participants then had to choose two topics for their practical group work at CERN. Following the sessions, each group had to prepare collectively a written report on the manipulations they undertook and make an oral presentation of the results to a panel of experts.

Participants needing to validate the course to obtain ECTS or doctoral credits took five exams as well as the written report and oral presentation of the practical sessions*:

*RF engineering, Normal & super-conducting magnets, Beam instrumentation, Radiation safety, Vacuum

CORE TOPICS

(76H15)

Introduction to CERN practical days

CERN representatives

Introduction to RF

Andrea MOSTACCI (LA SAPIENZA)

Normal Conducting Magnets

Thomas ZICKLER & Jérémie BAUCHE (CERN)

RF engineering

Christine VOLLINGER & Manfred WENDT (CERN)

Superconductivity (intro): RF vs. Magnets

Claire ANTOINE (CEA)

Cryogenics for superconducting devices

Philippe LEBRUN (CERN)

Superconducting RF Cavities

Fritz CASPERS (CERN)

Vacuum systems

Vincent BAGLIN & Roberto KERSEVAN (CERN)

Superconducting magnets

Paolo FERRACIN (LBL)

Beam instrumentation

Peter FORCK (GSI)

Particle Sources

Thomas THUILLIER (IN2P3)

High Power Proton Linacs

Mohammad ESHRAQI (ESS)

Radiation safety

Xavier QUERALT (STFC)

Low energy accelerators

Wim MONDELAERS (GHENT UNIVERSITY)

Survey and Alignment of Accelerators

Jean-Christophe GAYDE (CERN)

Accelerator for medical & industrial applications

Erik VAN DER KRAAIJ (IBA)

Life-cycle and operability of particle accelerators

Samuel MEYRONEINC (INSTITUT CURIE)

PSI Accelerators Controls

Elke ZIMOCH (PSI)

PSI ProScan Introduction

Jacobus Maarten SCHIPPERS (PSI)



“ The JUAS courses are a unique opportunity to immerse yourself into the accelerator field. With hands on experiences, expert lectures and wonderful camaraderie, JUAS is an intensive program that will only leave you wishing for more. ”

Cesar Andres Perez
Robinson
LASCALA ERASMUS MUNDUS JOINT
MASTER DEGREE (PARIS/ROME)

→ Course 2

in
figures

5
INTENSIVE
weeks

43
faculty
members

19 lectures
2 workshops
9 seminars
4 visits

from 16 Universities / Institutions

39
participants
28 Master students
10 PhD students
1 Professionals

28
MALES

11
FEMALES

17
nationalities

from 16 different
Universities /
Institutions

30 took the exams
34 followed the full programme
and 5 were registered "à la carte"

SEMINARS

(6H40)

Particle accelerators, instruments of discovery in physics

Philippe LEBRUN (CERN)

Materials for SCRF cavities: Beyond niobium

Sergio CALATRONI (CERN)

Muon Colliders & associated technological challenges

Daniel SCHULTE (CERN)

Bench-impedance measurements & materials
characterization

Nicolo BIANCACCI (CERN)

Energy recovery linacs

Félix SCHLIESSMANN (TU DARMSTADT)

Accelerator driven system

Frédéric BOULY (CERN)

Radiation Oncology: Biology, Physics & Clinical Applications

André DURHAM (HUG)

PSI: Machine learning

Jochem SNUVERINK (PSI)

PSI: Dielectric laser accelerators

Benedikt HERMANN (PSI)

VISITS

(14H15)

- CERN: Linac4 + AD ELENA + Thin film coating facilities
- Bergoz instrumentation
- Geneva Hospital
- Paul Scherrer Institute (PSI): SLS, SwissFEL, ProScan, HIPA

WORKSHOPS

(19H30)

CERN Practical Days • Normal conducting magnets

JUAS is an amazing opportunity to learn from experts in the field and get hands-on experience with advanced technology in the field of accelerators. It was great to be able to share this experience with students & professionals from different institutes and universities!

Niek Van Woudenberg
MASTER, LUND UNIVERSITY (SWEDEN)



IPAC is the leading international event for the worldwide accelerator community and industry. IPAC'23 took place in Venice (Italy) in May. It is a unique opportunity to meet, interact and network with accelerator scientists, engineers, students and companies. Each year the JUAS-IPAC award is attributed to the first-ranked master's or doctoral student from Course 1. The award takes the form of a bursary, generously given by the IPAC organisers, covering conference fees, travel, accommodation and subsistence costs.

Dora Erzsebet Veres, PhD students at the Goethe Universität Frankfurt and CERN obtained the highest overall mark this year. During the full week of the IPAC-23 conference, Dora helped Elias to promote JUAS at the stand devoted to ESI (see picture below) by explaining what ESI and JUAS are, and in particular sharing her experience with all the people who came and visited the stand.



Being awarded the JUAS IPAC prize allowed me to attend IPAC in the first year of my PhD studies, which is a rare experience that I am very grateful for. Having attended JUAS, I had all the necessary foundational knowledge to engage in meaningful discussions with experts from various areas of accelerator physics and industry at the conference, which was the perfect opportunity to learn about the state-of-the-art research in the field. I was also able to present my research at the poster session, which proved to be a very valuable learning opportunity and a wonderful chance to take advantage of feedback from experts and peers. I also had the privilege of meeting many experts in my specific area of research at IPAC and learning about their work, which led to many inspiring discussions and the potential for fruitful collaborations in the future. Overall, I am very grateful for the opportunity that JUAS itself, as well as the IPAC prize provided me, and I am very much looking forward to leverage and build on all this knowledge throughout the rest of my PhD journey. 

Dora Erzsebet Veres



European Scientific Institute (ESI)



As JUAS director, Elias was contacted in autumn 2022 to organise a student's tutoring session during the weekend before the IPAC-23 conference itself.

see <https://indico.jacow.org/event/64/>

The goal of this session, organised for the first time in Europe, was to provide student delegates with all the necessary concepts, terminology, and recommendations (e.g. on networking) **to get the most out of the world's biggest conference on particle accelerators which mobilise up to 2000 people. A total of 138 students attended the 11 tutorials** (each comprising a 40-minute talk and a 20-minute discussion) **delivered by speakers from Europe (6), America (3) and Asia (2)**. Subjects ranged from "Overview of history and types of accelerators" to "Accelerators for medical and industrial applications", going through linear and circular accelerators/colliders, superconducting radio-frequency cavities and magnets, synchrotron light sources, free-electron lasers, plasmas, facilities for radioactive ion beams and neutron sources. The session on linacs was run by Louis Rinolfi, former JUAS director and ESI Board member. There were a lot of very interesting questions and discussions and initial feedback from students was extremely positive.





The JUAS Advisory Board, comprising representatives of JUAS partner universities and experts from leading European research facilities, meets annually in one of the partner universities. The 2023 meeting, hosted by Prof. Phil Burrows at Oxford University, took place on 17 and 18 April.

The agenda of the meeting included the report of each course of the 2023 edition of JUAS; an overview of participants' feedback on the program and overall organisation; the budget and review of financial support; proposed improvements for the 2024 edition; information on July's I. FAST-CBI challenge "Particle accelerators for the environment" and a status report on the upcoming JUAS book. This is going well with a number of lecturers sharing draft material from their contributions with participants at JUAS 2023.

The Advisory Board also formally welcomed Prof. Alexander Gerbershagen as representative of the University Medical Center Groningen, the latest addition to the family of JUAS partner universities. UMCG will host the 2024 Advisory Board meeting at its new Particle Therapy Research Center on 6 and 7 May 2024.



The Institut Scientifique Européen (ESI), 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 innovation in digital health.

ESI's schools attract an international audience of post-graduate students and early-career professionals. Since its creation, ESI-Archamps has delivered high level teaching and training to more than 3000 young scientists and engineers from over 60 countries.

www.esi-archamps.eu

ESI IS SUPPORTED BY :



“ Particle accelerators deliver huge amounts of energy into tiny volumes of matter at subatomic scale, allowing particle physicists to penetrate the heart of matter. The by-products of these activities have a wealth of applications from fundamental science to applied science, medicine and industry. Differing in specifications, dimensions and cost, particle accelerators share the same basic principles and technology and the same ambition: to unveil the secrets of matter for the benefit of humankind.

Despite their wide range of applications and high level of maturity and success, particle accelerators face a potentially challenging transition into the future. Innovation is needed to identify and develop new sustainable accelerator technologies capable of reaching the performance required by particle physicists at an acceptable impact on society; and to favour the transfer of key technologies, developed over the last decades, to particle accelerators used for applied science (photon and neutron sources) and for societal applications (medicine, industry, environment). ”

Innovation Fostering in Accelerator Science
and Technology (I.FAST)

This project has received funding from the European Union's Horizon 2020
Research and Innovation programme under Grant Agreement No 101004730

ifast-project.eu



This introductory paragraphs to the I.FAST H2020 project, of which ESI is an associate partner, perfectly sum up the rationale behind the Joint Universities Accelerator School.

To continue innovating in the field of particle accelerators, it is imperative that young physicists and engineers are given the opportunity to gain an in-depth understanding of the underlying physics and technologies. JUAS has been successfully doing this since 1994, and JUAS alumni today play key roles in accelerator-driven research laboratories and technology companies throughout Europe and beyond.

Save the date !

→ Course 1 ●●●

The Science of Particle Accelerators
15 January > 16 February

→ Course 2 ●●●

The Technology & Applications of Particle Accelerators
19 February > 22 March

2024



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