International School on Fusion Reactors Technology

The school is hosted at the historic Ettore Majorana Foundation and Centre for Scientific Culture (EMFCSC), an institution renowned for fostering international scientific exchange since its establishment in 1962 by physicist Antonino Zichichi. Set within the medieval hilltop town of Erice, Italy, the EMFCSC has become a global hub where leading researchers, educators, and young scientists gather to share knowledge and advance emerging fields of science and technology.

The international school on fusion at the EMFCSC was established in 1972 and has since played a pivotal role in training generations of fusion researchers. This year's school is organized in collaboration with the International Atomic Energy Agency (IAEA) and Italy's National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA).

The school combines high-level lectures from leading experts with the unique interdisciplinary spirit that has characterized the EMFCSC for more than sixty years. Participants will gain not only technical knowledge but also the opportunity to engage in open dialogue across disciplines, generations, and national borders, reflecting the school's mission to cultivate the next generation of scientists, engineers, and leaders in fusion research.

Dates
7–12 June 2026

Location
Ettore Majorana Foundation and Centre for Scientific Culture, Erice, Italy
How to reach the EMFCSC: https://centromajorana.it/directions.html

Co-organizers

Co-sponsors

Course Title
Fundamentals of Magnetic Confinement Fusion Design and Technology

Course Directors
Matteo Barbarino (IAEA), Paola Batistoni (ENEA)

Course Description
The school provides a unique, advanced-level training program in fusion energy. This course integrates physics, cutting-edge technology, and engineering practices essential for the realization of fusion power plants. Participants will explore interdisciplinary approaches, addressing the challenges of plasma physics, magnetic confinement, material science, and power plant integration.

A particular emphasis is placed on understanding the intricate relationship between magnetic fields and machine size, a pivotal aspect of magnetic confinement fusion design. The curriculum delves into how magnets technology can influence engineering strategies and material selection, shaping the overall design of fusion power plants. Through lectures, interactive workshops, and case studies, participants will gain comprehensive insights into the future of fusion energy development.

Key focus areas include
- Integration of plasma physics, materials science, and engineering principles.
- Magnetic field strength, scalability, and size in tokamaks.
- Tritium management and self-sufficiency strategies.
- Advances in divertor technology and power exhaust solutions.
- Regulatory, safety, and environmental considerations for commercialization.

Lecturers

Richard Buttery	General Atomics, United States of America
Bethany Colling	UK Atomic Energy Authority, United Kingdom
Dario Cruz	FuseNet
Christian Day	Kyoto Fusioneering
Pietro Alessandro Di Maio	University of Palermo, Italy
Stephanie Diem	University of Wisconsin–Madison, United States of America
Achilleas Evangelias	Renaissance Fusion
Gianfranco Federici	Eurofusion
Francesca Ferrazza	Eni
Jiangang Li	Institute of Plasma Physics Chinese Academy of Sciences, China
Simon McIntosh	ITER Organization
Luigi Muzzi	ENEA, Italy
Gian Mario Polli	DDT, Italy
Lee Packer	UK Atomic Energy Authority, United Kingdom
Diego Pereira	Renaissance Fusion
Alessandro Spagnuolo	Eni
Rosaria Villari	ENEA, Italy
Marco Wischmeier	Eurofusion
Hartmut Zohm	Max Planck Institute for Plasma Physics, Germany

Course Programme

Sunday 7 June

Registration and arrival of participants.
Coordination meetings with school directors, organizers and faculty.

Monday 8 June

08:00–09:00 Breakfast

09:00–10:30 Opening Session

- Welcome by School Directors: P. Batistoni, M. Barbarino, L. Zichichi
- Welcome by A. Dodaro (ENEA, remote)
- Introduction of faculty and participants (All)
- Overview of the School objectives and structure (P. Batistoni)

10:30–11:00 Coffee Break

11:00–12:30 Introduction to Fusion Energy

- Fusion energy in 2026 (M. Barbarino)
- Nuclear fusion as an energy source: status and prospects (H. Zohm)

12:30–14:00 Lunch

14:00–15:30 – Introduction to Fusion Energy (cont.)

- Enabling technologies for fusion: status and prospects (G. Federici)

15:30–16:00 Coffee Break

16:00–17:30 Roundtable

Fusion state of play
(M. Barbarino with P. Batistoni, R. Buttery, G. Federici, H. Zohm)

20:00–22:00 Welcome Dinner

Tuesday 9 June

08:00–09:00 Breakfast

09:00–10:30 Plasma Physics, Magnetic Fields and Machine Size

- Tokamak operation basics, plasma stability, beta limits, magnetic fields (H. Zohm)
- Field strength vs. power density, structural and thermal constraints, case studies BEST/CFEDR (J. Li) (remote)

10:30–11:00 Coffee Break

11:00–12:30 Plasma Physics, Magnetic Fields and Machine Size (cont.)

- Stellarator operation basics, plasma stability, beta limits, magnetic fields (A. Evangelias)
- Materials for magnets, scalability and industrialization (L. Muzzi)

12:30–14:00 Lunch

14:00–15:30 Discussion Session

High-field vs. large-volume design philosophies
(P. Batistoni with A. Evangelias, G. Federici, L. Muzzi, H. Zohm)

15:30–16:00 Coffee Break

16:00–17:30 High Beta Path to Steady State

- Tokamak physics from energetic particles, transport, and stability behaviour to fusion performance, self-sustainment and power handling (R. Buttery)

Evening: Free time

Wednesday 10 June

08:00–09:00 Breakfast

09:00–10:30 Power Exhaust and Divertor Technology

- Heat flux management challenges, scenarios development (M. Wischmeier)
- Case study DTT (G. Polli)

10:30–11:00 Coffee Break

11:00–12:30 Fusion Neutronics and Engineering

- Neutronics and nuclear aspects (R. Villari)
- Activation and transmutation (L. Packer)

12:30–14:00 Lunch

Afternoon: Excursion

Thursday 11 June

08:00–09:00 Breakfast

09:00–10:30 Extended Fuel Cycle Engineering

- Fuel cycle architecture, blanket integration, systems engineering (C. Day)
- Breeding blanket case study (A. Spagnuolo)

10:30–11:00 Coffee Break

11:00–12:30 Techno-Economic and Engineering Readiness

- Validation and qualification of components (C. Day)
- Scaling, supply chain, grid integration (F. Ferrazza)

12:30–14:00 Lunch

14:00–15:30 Materials and Engineering

- Stellarator coil design and optimization (D. Pereira)
- Thermo-hydraulics and thermo-mechanics of reactor components (P.A. Di Maio)

15:30–16:00 Coffee Break

16:00–17:30 Roundtable

Preparing the next generation of fusion workforce
(D. Cruz with P. Batistoni, R. Buttery, B. Colling, S. Diem, S. McIntosh)

20:00–22:00 School Banquet

Friday 12 June

08:00–09:00 Breakfast

09:00–10:30 Safety, Regulation and Waste Considerations

- Safety and regulation (B. Colling)
- Environmental impacts, waste strategies (S. Diem)

10:30–11:00 Coffee Break

11:00–12:00 Closing Lectures

- The ITER project (S. McIntosh)
- Harnessing the atom for humanity (N. Mokhtar, Deputy Director General, IAEA)

12:00–12:30 Closing Remarks & Certificate Ceremony

12:30–14:00 Lunch & Departures