International School of Brain Cells & circuits "Camillo Golgi"

The Ettore Majorana Foundation and Centre for Scientific Culture opened, in 2015, the International school of brain cells & circuits dedicated to the Italian Nobel laureate "Camillo Golgi".
The brain, with 10^{12} neurons interacting through 10^{15} synapses, is quite surely the most complex structure of the whole Universe. Neurosciences are systematically tackling brain functions at multiple complexity levels, from cells to microcircuits to the whole brain. Understanding the brain is a Grand Challenge for the Humankind with social implications in the biomedical and technological fields. Multiscale computational modelling is a new powerful approach for understanding the brain that has recently been supported by international initiatives like the *Human Brain* Project and EBRAINS.
The school of Brain Cells & Circuits will face hot topics in modern Neuroscience, providing the basics of understanding, fuelling discussion, and helping to form a critical perspective in the new generation of Neuroscientists. Our vision is that, to explain brain functions, it is fundamental to integrate molecular and cellular knowledge into microcircuits and large-scale networks using multiscale computational models. The school is now supported by the EBRAINS training programme.

Further reading can be found in the review articles:

Modelling the brain: Elementary components to explain ensemble functions
Authors: *Egidio D'Angelo and Claudia Gandini Wheeler-Kingshott* (2017)
Il Nuovo Cimento. DOI: 10.1393/ncr/i2017-10137-5 pp. 297-333

The coming decade of digital brain research - A vision for neuroscience at the intersection of technology and computing.
Authors: *Amunts,* et al. (2022).
Zenodo. DOI: 10.5281/zenodo.6345821

The quest for multiscale brain modelling
Authors: *Egidio D'Angelo and Viktor Jirsa* (2022)
Trends Neurosci. 2022 Jul 26; S0166-2236(22)00125-4.
doi: 10.1016/j.tins.2022.06.007.

Brain digital twins: a roadmap to clinical adoption. 13-18th December 2026

Ettore Majorana Foundation and Centre for Scientific Culture
Erice (Italy)



Course Directors: *Egidio D'Angelo, Claudia Gandini Wheeler-Kingshott and Viktor Jirsa*
***Course Admin**: Alessia Bonafede*

The 2026 course, *Brain Digital Twins: A Roadmap to Clinical Adoption*, marks the start of a new decade for the School and places a strong emphasis on translation to the clinic. Brain digital twins—personalised, multiscale computational representations of individual brains—are increasingly being explored as tools to understand disease mechanisms, predict disease progression, and support pharmacological, neurosurgical, and neurostimulation interventions.

The programme is centred on real clinical challenges. Clinicians and scientists will present key open questions across neurological and psychiatric disorders, ageing, neuropharmacology, and neuromodulation, followed by focused discussions on how brain digital twins can contribute to their resolution. Particular attention is given to the requirements for clinical adoption, including validation, ethics and legislation, informatic infrastructures, FAIR data practices, sustainability, and equitable access.

In the spirit of Erice, the School promotes critical discussion and cross-disciplinary exchange through foundational lectures, thematic sessions, and open debates. We warmly welcome participants to engage in the scientific and human exchange that defines the Ettore Majorana Schools and to contribute to the responsible development of brain digital twins toward meaningful clinical impact.

FOUNDATION ZOOM LECTURE SERIES

Foundation lectures that we encourage all attendees to view can be found here: https://shorturl.at/vbfZR

Programme

Arrival day – Sunday 13th December 2026

9pm: Evening gathering in the Marsala Cellar St. Rocco Monastery
Marsala wine and marzipan pastries typical of Erice. Music and chats as people join in.

Day 1 – Monday 14th December 2026

BUILDING BLOCKS OF BRAIN DIGITAL TWINS

08:30 – **Welcome**
Claudia Gandini Wheeler-Kingshott, Egidio D'Angelo & Viktor Jirsa

09:00 – **Multi-scale brain modelling and clinical impact**
Egidio D'Angelo

10:00 – **Cellular models and pathologies**
Jonathan Mapelli

10:45-11:15 Coffee Break & posters

11:15 – **Presentations from the 2025 winners**

Computational modelling theme

1st place: Matthew Bassat
A continuum of asynchronous states in cortical networks.

Imaging/experimental theme

1st place: Julia Rodriguez-Sanchez
Computational modelling of excitatory and inhibitory cell function in clinical high risk for psychosis

2nd place: Anita Monteverdi, Gökçe Korkmaz, Arianna Mancini

Anita Monteverdi
Virtual brain and electroencephalography to predict mild cognitive impairment progression.

Gökçe Korkmaz
A unified multiscale modelling framework reveals excitatory-inhibitory imbalance in multiple sclerosis

Arianna Mancini
Investigating Network Spreading Models of disease starting from a whole-brain healthy structural connectome: the role of the cerebellum

12:30 -14:00 Lunch in San Rocco

14:00 – **Microcircuits modelling and pathologies**
Claudia Casellato

14:45 – **Mean field models to capture cortical specialisation and pathology**
Alain Destexhe

15:30-16:00 Coffee break & posters

16:00 - Poster lightening talks

17:00 –**The Virtual Brain (TVB) & brain digital twins**
Viktor Jirsa

Day 2 – Tuesday 15th December 2026

TWINS FOR PATHOLOGY PREDICTION & EVOLUTION

08:30 – **Clinical position: challenges of predicting disease progression and personalised medicine**
Menno Schoonheim, Amsterdam

9:15 – **Computational models of disease spreading**
Sonja Soskic, UCL

10:00 – **General Discussion:**
When models of disease progression meet with brain digital twins
Claudia Gandini Wheeler-Kingshott

10:30-11:00 Coffee break & posters

TWINS FOR NEUROPHARMACOLOGY

11:00 – **Clinical position: challenges of neuropharmacology**
Neil Harrison

11:45 – **Machine learning and digital twins in psychiatry**
Nikos Koutsouleris

12:30 – **Brain digital twins and schizophrenia**
Giacomo Preti

1:00-14:30 Lunch in San Rocco

TWINS FOR NEUROSURGERY & NEUROSTIMULATION

14:30 – **Clinical position: challenges of neurosurgery & neurostimulation**
Rob Brownstone

15:15 – **Brain digital twins and neurosurgery**
Huifang Wang

16:00-16:30 Coffee break

16:30 – **Brain digital twins for non-invasive neurostimulation**
Florian Missey & Christos Liontas

17:15 – **Brain digital twins for deep brain stimulation**
Jil Mona Meier

18:00 – **General Discussion: tbc**

Day 3 – Wednesday 16th December 2026

SOCIAL OUTINGS & SOCIAL DINNER

Day 4 – Thursday 17th December 2026

EQUITABLE ADOPTION

9:00 – **The Physics of brain digital twins for low resource settings: a UKRI project born in Erice**.
Claudia Gandini Wheeler-Kingshott

9:15 – **The quest for equitable infrastructures**
Derek Jones

10:00 – **The point of view from a fast-developing country**
Shyam Diwakar

10:30-11:00 Coffee break

11:00 – **Personalisation of digital twins with equitable hardware**
Mara Cercignani

11:45 – **The engineering challenges of Halbach MRI scanners**
Johnes Obungoloch

12:15 – **Alternative methods for recording brain function**
David Holder

12:45-14:15 Lunch in San Rocco

14:15 – **Computation & sustainability of brain digital twins**
Marco Palombo

15:00 - **Academic Benefits and Challenges of Cross-Cultural Biomedical Engineering Partnerships**
Robert Tamale Ssekitoleko

15:30-16:30 Coffee break & poster

THE SCIENCE of DIGITAL TWINS: TAKING STOCK

16:30 – **How EBRAINS & HPC can support the design of digital twins.**
Sandra Diaz

17:15 – **General discussion:**
Scientific salient points from the first 3 days

Day 5 – Friday 18th December 2026

BRAIN DIGITAL TWINS

9:00 – **Architecting the Virtual Brain: Infrastructure, Performance, and AI**
Lia Domide

9:45 – **From single neuron to whole brain simulations**
Neigel Pedersen

10:30-11:00 Coffee break

11:00 – **Challenges of drug development and trials**
Valentina Ticcinelli

11:45 – **Closing round table**

12:45 – **Poster prize & conclusions**

13:00 Farewell