

ASTROLAB has been realized thanks to the contribution of:



Ministero della Salute



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il gigante
Edi Scavolini del Piacenza

SPREAFICO

Special thanks to UNIVERLECCO

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A HI-TECH REHABILITATION LAB
for children and adolescents

ASTROLAB

ASTROLAB

AstroLab is a research and medical treatment laboratory offering to children and adolescents a place where rehabilitation becomes a game, thanks to state-of-art technologies and futuristic settings and environments.

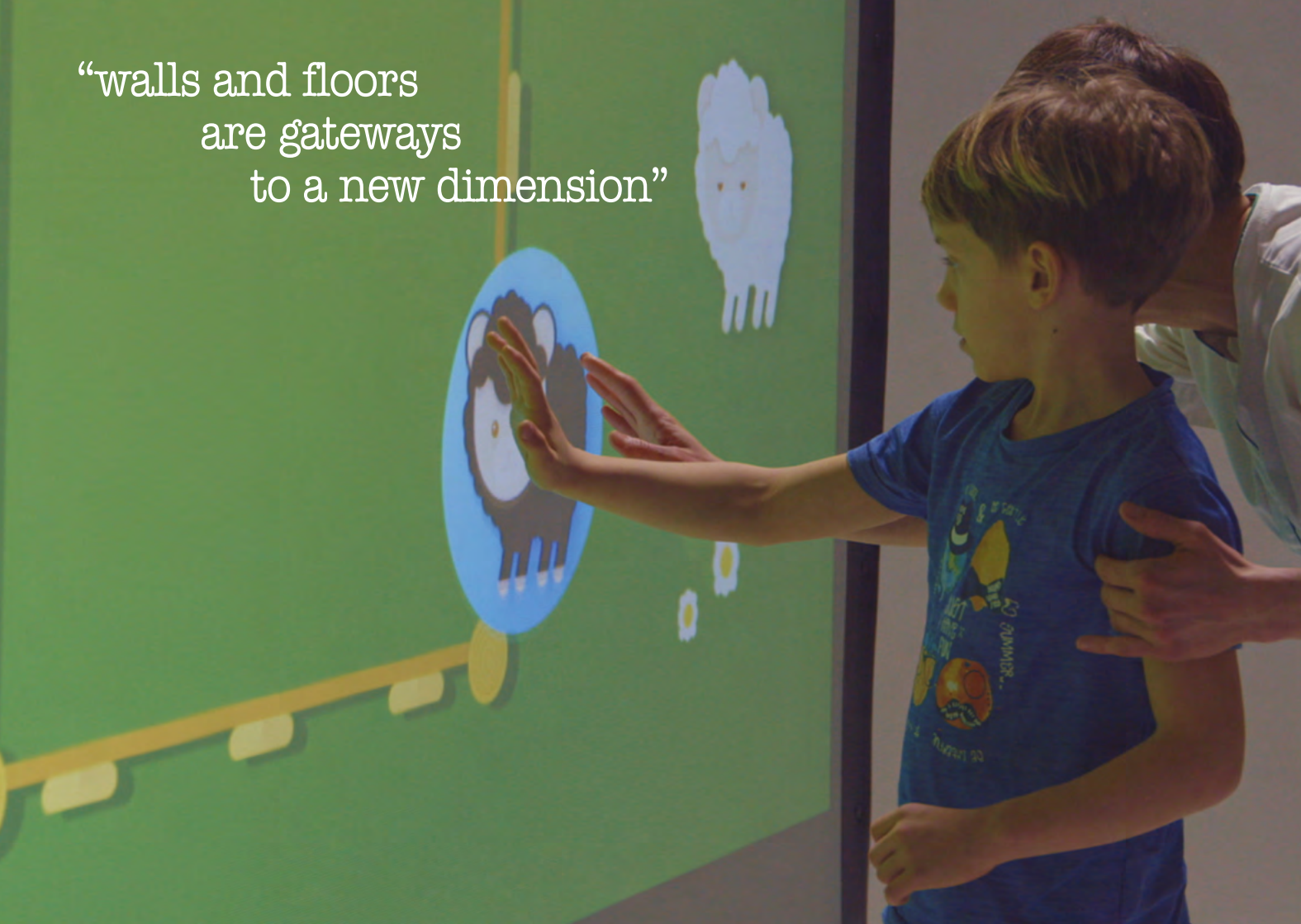
Nowadays, virtual reality and robotics have largely contributed ways to help our young patients with movement control, balance, posture, muscle recruitment, attention, memory, oculomotor coordination, visual spatial coordination, and so on. These abilities can now be trained as if they were games. Recent research has demonstrated that exergaming in rehabilitation is effective, improves cognitive and motor functions and probably even contributes to remodelling the neuronal system.

In Italy, hundreds of thousands of young people do suffer from a motor impairment as a consequence of traumatic injuries (e.g. car accidents), serious illnesses (e.g. brain tumors), increasingly common pathologies (e.g. autism) or even disabilities that are present since birth.

For these patients and their rehabilitation needs, and in order to contribute to research and testing of new treatments, IRCCS Medea has designed and set up AstroLab, the first hi-tech laboratory for children and adolescents.

The AstroLab project came into being thanks to the support of the Italian Ministry of Health, and through the participation of our Institute to **EMPATI@Lecco**, a rehabilitation project funded by Fondazione Cariplo in the Lecco area, which also received the support of Lombardy Region. We also wish to acknowledge generous funding in the form of private donations.

“walls and floors
are gateways
to a new dimension”



A WINDOW LOOKING INTO SPACE

Multisensory stimulation

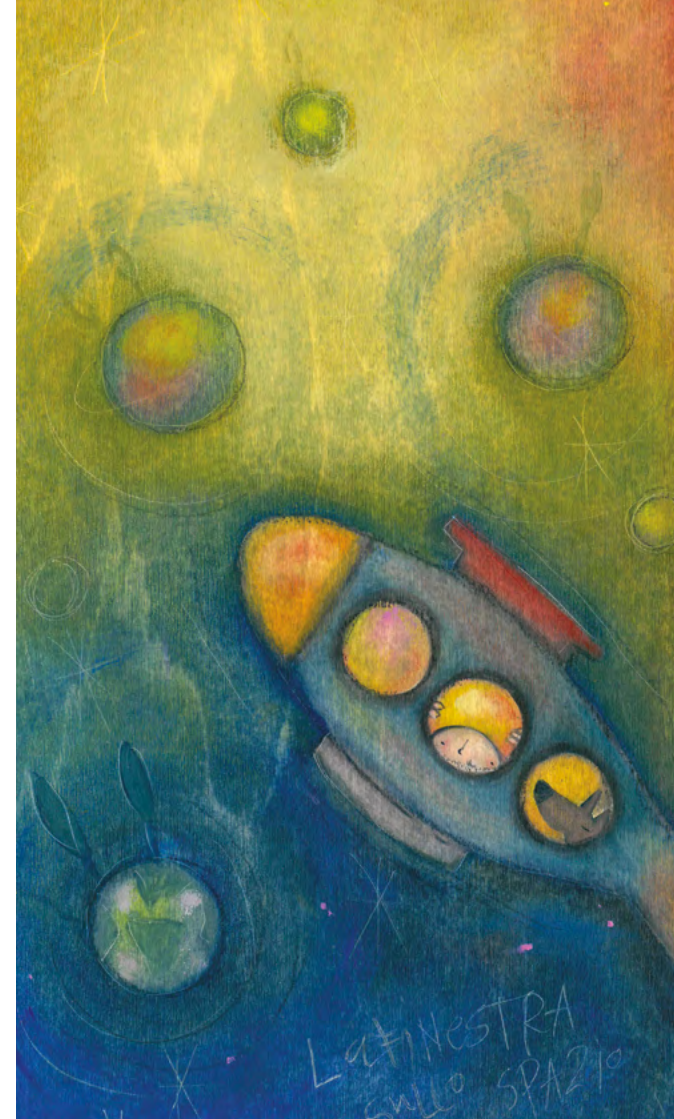
The “Window looking into Space” is a laboratory equipped with an immersive multisensory stimulation system (Nirvana™, BTS Bioengineering). A set of projectors generate interactive stimulation scenarios on walls and floors, while movement sensors detect how patients interact with the environment.

Projections transform walls and floors into something completely different: **a cloudy sky, a desert, a lawn with a dog happily wagging his tail.**

Young patients can interact with these scenarios touching clouds, crossing the sand desert, getting chased by a joyful dog. Aspects such as task complexity, exercise speed and range of motion are appropriate, yet challenging, for them **and contribute to improving their conditions.**

The system records the patient’s performance and monitors treatment trends over time.

The “Window looking into Space” is available for patients aged 9 months, suffering from diseases such as neuromotor disabilities, cerebral palsy, autism, cerebellar ataxia, acquired brain injury, cognitive impairment, neurodegenerative diseases.





“reality turns
into a fairy-tale world”

THE MAGIC CAVE

Immersive virtual reality

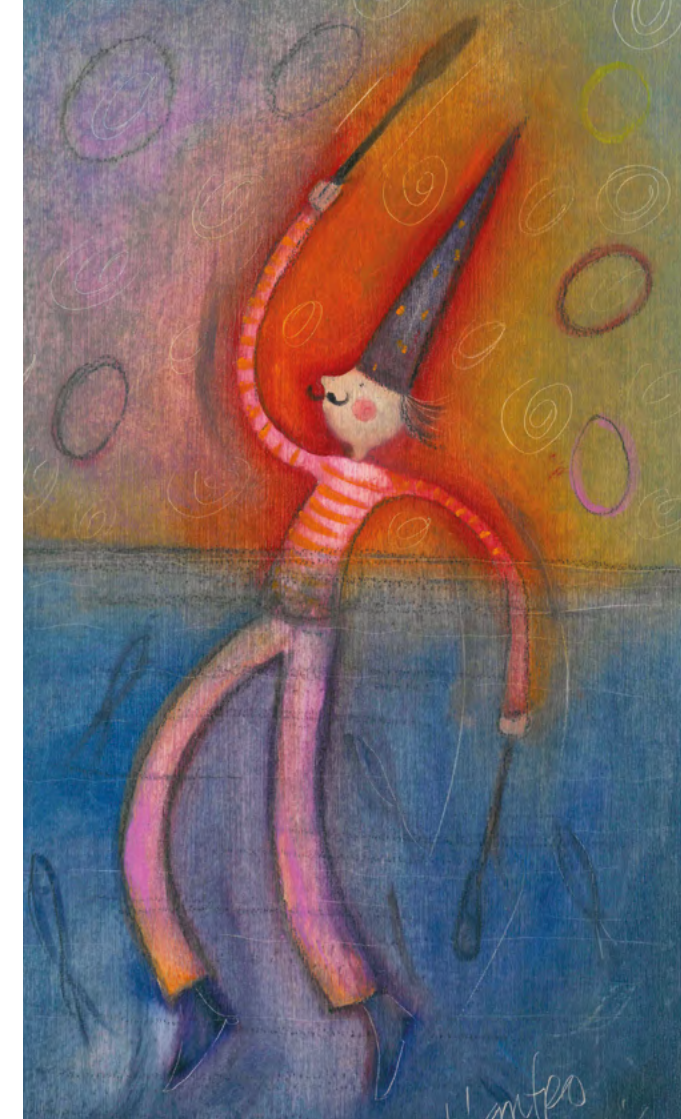
The Magic Cave is a large room equipped with an immersive virtual reality and real-time gait analysis system (GRAIL™, Motekforce Link): a scenario is projected on a semicircular screen, which surrounds and stimulates the patient. A surround audio system provides feedback and stimulation to young patients, along with a double-belt treadmill that completes the virtual reality system.

When the virtual reality system is turned on, **the room changes to a forest, a lake, a snowy mountain, a labyrinth, a playground, any scenario developed by the research team.**

Immersed in this magical and enchanted place, young patients carry out activities in the form of games which enable them to exercise and improve their abilities such as movement, orientation, socialization, behavior and cognition.

The system collects a great amount of data that are used for evaluating the therapeutic process and outcome and to study deeper the observed pathologies.

The Magic Cave is for patients aged 6 years and onwards, suffering from infantile cerebral palsy, autism, cerebellar ataxia, acquired brain injuries, cognitive disorders.



“a step
at a time”

THE SPACE WALK

Gait analysis

The Space Walk is equipped with a high resolution optoelectronic system for gait analysis with 8 cameras and 4 force platforms (SMART-DX™, BTS Bioengineering), integrated with a wireless surface electromyograph (FREEEMG 1000, BTS Bioengineering).

Small adhesive spheres, called markers, are applied to young patients in reference points according to specific protocols. While patients **walk back and forth in the room**, the system points out dynamically the markers' positions processing movement patterns through tridimensional models.

This laboratory enables a quantitatively precise study of gait in young patients, from how they articulate the movement to how they place their feet onto the ground, from which muscles are used to which forces are exerted.

The Space Walk is designed for patients from age 3 years, affected for example by acquired brain injuries, musculoskeletal disorders, cerebral palsy, autism, neurodegenerative diseases, rare syndromes.





THE ROBOTIC LAB

Robotics for rehabilitation

This laboratory is equipped with robotic devices for the rehabilitation of lower and upper limbs. The equipment includes Lokomat and the pediatric version of Armeo® Spring (Hocoma), Wrist (In Motion), Yougrabber (YouRehab), Hand, Arm and Leg Tutor (MediTouch).

Young patients needing motor rehabilitation are **connected to one** of these **robotic devices in a futuristic human-machine interaction**. They exercise in a videogame setting where patient and machine move together on a path, move tools, take objects.

Robots adapt to the young patient's abilities, sometimes providing them with all the physical strength necessary to perform a given task, sometimes simply compensating for the motor deficit, sometimes requiring personal effort.

These devices support patients' performance, providing really individualized therapeutic rehabilitation.

The Robotic Lab can be used with patients from 4 years of age, affected by motor disorders such as acquired brain injuries, musculoskeletal disorders, cerebral palsy, hereditary spastic paraparesis.



“we are made
of stardust”

THE STAR CONSTELLATION

Computerized optoelectronic plethysmography

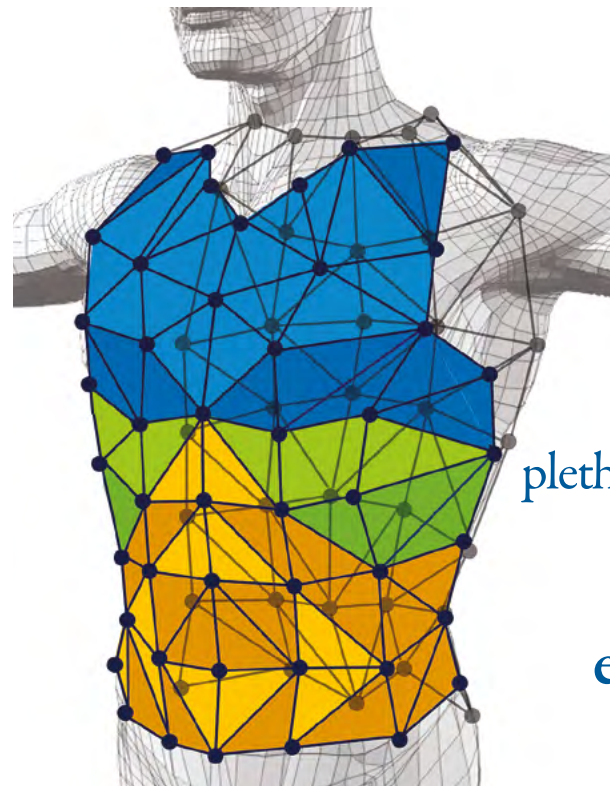
This Lab is equipped with a high resolution optoelectronic plethysmography system based on 8 cameras (SMART-D™, BTS Bioengineering), integrated by a wireless surface electromyograph (FREEEMG 1000, BTS Bioengineering).

Retroreflective markers, consisting of adhesive spheres, are applied to the young patient, according to specific protocols. Thus, a **dense geometric network is virtually drawn on the chest wall**, which changes dynamically following the patient's spontaneous respiratory rhythm.

This laboratory **allows to quantitatively study changes in lung volume breath by breath**, in a non-invasive way, even for a prolonged time. The system also allows for a compartmental analysis, for a detailed study of respiratory muscle action.

Innovative applications extend the use of the system to the study of fine upper limb movements, to early detect warning signs of disease progression, for example in autism.

The Star Constellations can be used by patients from 2 years of age, affected for example by neuromuscular diseases, autism, cerebellar ataxia.



high resolution
optoelectronic
plethysmography system
8 cameras
**1 wireless surface
electromyograph**



“we design
and produce
your custom-made
space suit”



SPACE SUIT ROOM

3D printing

The 3D printing lab is equipped with a 3D scanning system, 3D printers and CAD-CAM software for ortho-prosthetists to build scoliosis braces, splints, orthoses and tools that support personal autonomy in a rapid, non-invasive and highly specialized way.

To make a custom-built orthosis for a young patient, the anatomical region of interest is measured without physical contact with the body. The acquired data are entered into a mathematical model that reconstructs the real shape of an object by 3D printing.

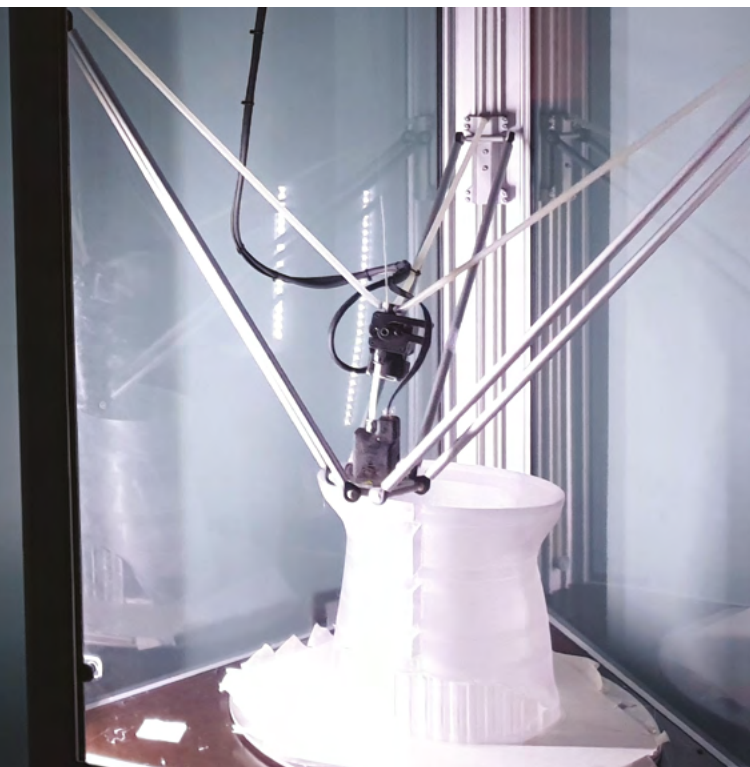
The new production processes aim to use materials that are more comfortable, lighter, more colorful and cheerful, increasing accuracy and production speed and, at the same time, reducing both errors and waste. **This personalized precision medicine approach goes beyond traditional production processes.**

Young patients can receive orthoses guaranteeing better wearability and tolerability and improving therapeutic effectiveness.

The Space Suit Room is for patients aged from 3 years, with different pathologies such as acquired brain injuries, musculoskeletal disorders, rare diseases, infantile cerebral palsy and neurodegenerative diseases.

**highly wearable, tolerable
and more therapeutically
effective orthoses**

**3D scanning system,
3D printers,
CAD-CAM software
for ortho-prosthetists**





THE REACTOR ROOMS

Bioengineering Lab

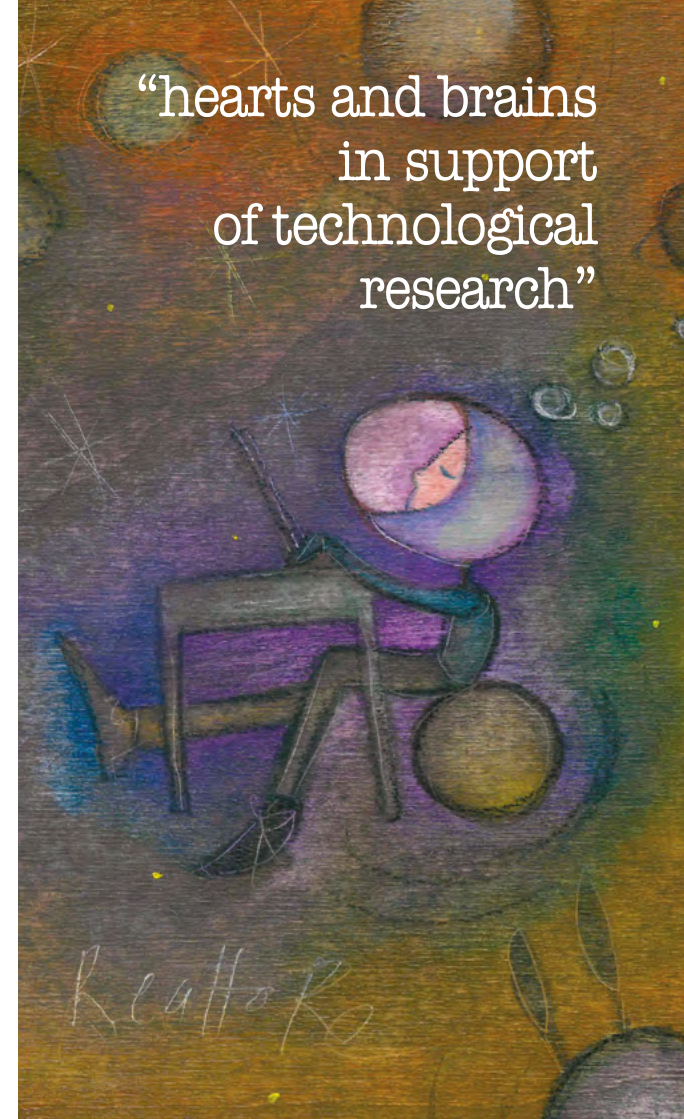
The Reactor Rooms is the physical place where our team of Research Engineers works and collaborates with clinicians, therapists and psychologists to the development of new therapeutic scenarios and new rehabilitation technologies in order to constantly improve care and treatment for young patients.

Diverse skills are available, including: the ability to design and certify new medical devices; development of mathematical models to analyze biomedical signals generated by the brain, heart and muscles of our young patients; setting up of new virtual reality protocols; testing and evaluation of new rehabilitative or assistive technologies already on the market or in a prototype stage.

By working side by side with therapists, clinicians, psychologists and patients, engineers get a comprehensive overview of the rehabilitation process and can design technical solutions for immediate use, ensuring real usability.

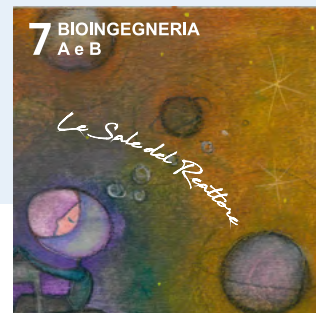
The Reactor Rooms team is made up of engineers with doctorate degrees in different disciplines, assisted by engineers with master's degrees, PhD students and undergraduate students.

“hearts and brains
in support
of technological
research”





ASTROLAB



pbp

Polo Bosio Parini

Scientific Institute Eugenio Medea

Scientific Institute (IRCCS) Eugenio Medea is the scientific section of Association “La Nostra Famiglia”. It is a **highly specialized Institute providing care and rehabilitation to children and adolescents with neurological and neuropsychiatric pathologies.**

The site of Bosio Parini, a few kilometers from Lecco, Como and Milan (North of Italy), provides care and treatment to children suffering from neurological and neuromotor diseases, cognitive disorders and neuropsychological deficits, emotional and relational disorders, psychosis, or presenting with reduced functions and skills owing to traumatic brain injuries or central nervous system disorders.

The research activity is also very intense, focusing on etiological and functional diagnosis of rare and complex pathologies, study and experimentation of new intervention protocols and **technological advances in the bioengineering field.**

Our research results are periodically published in the most authoritative international journals.

