ICTP Programmes and MLAB activities

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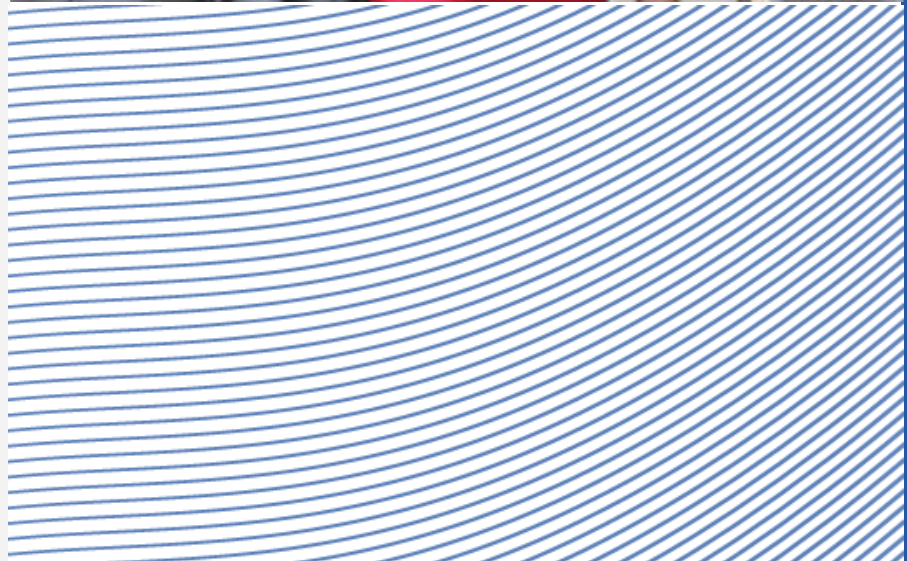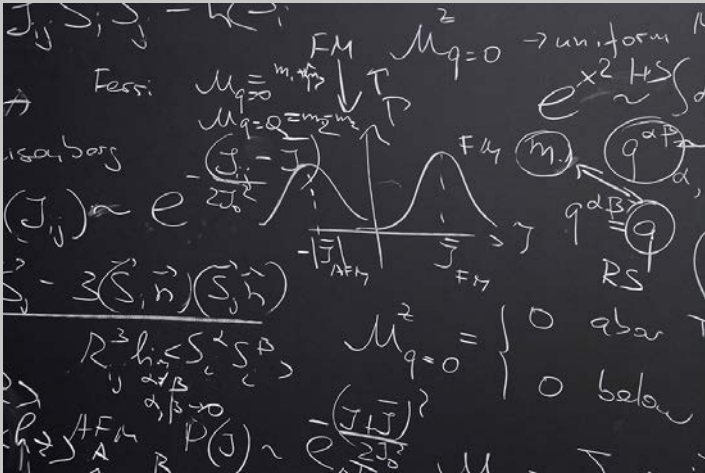
What is ICTP?

- Founded in 1964 by Nobel Laureate Abdus Salam to enhance international cooperation through science.

- Combines world class research with a unique global mission of building science capacity in the developing world.

- Governed by tripartite agreement between Italy UNESCO and IAEA.

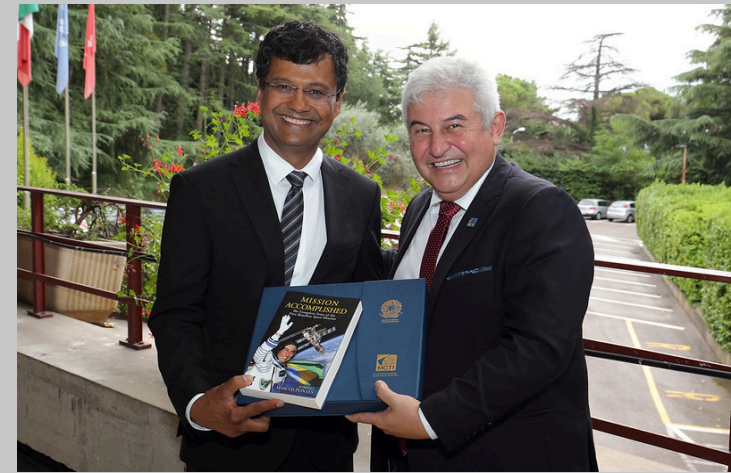- Run by scientists for scientists

What is ICTP?

Research

Education

Cooperation

Research Sections

High Energy Cosmology & Astroparticle Physics

Condensed Matter and Statistical Physics

Mathematics

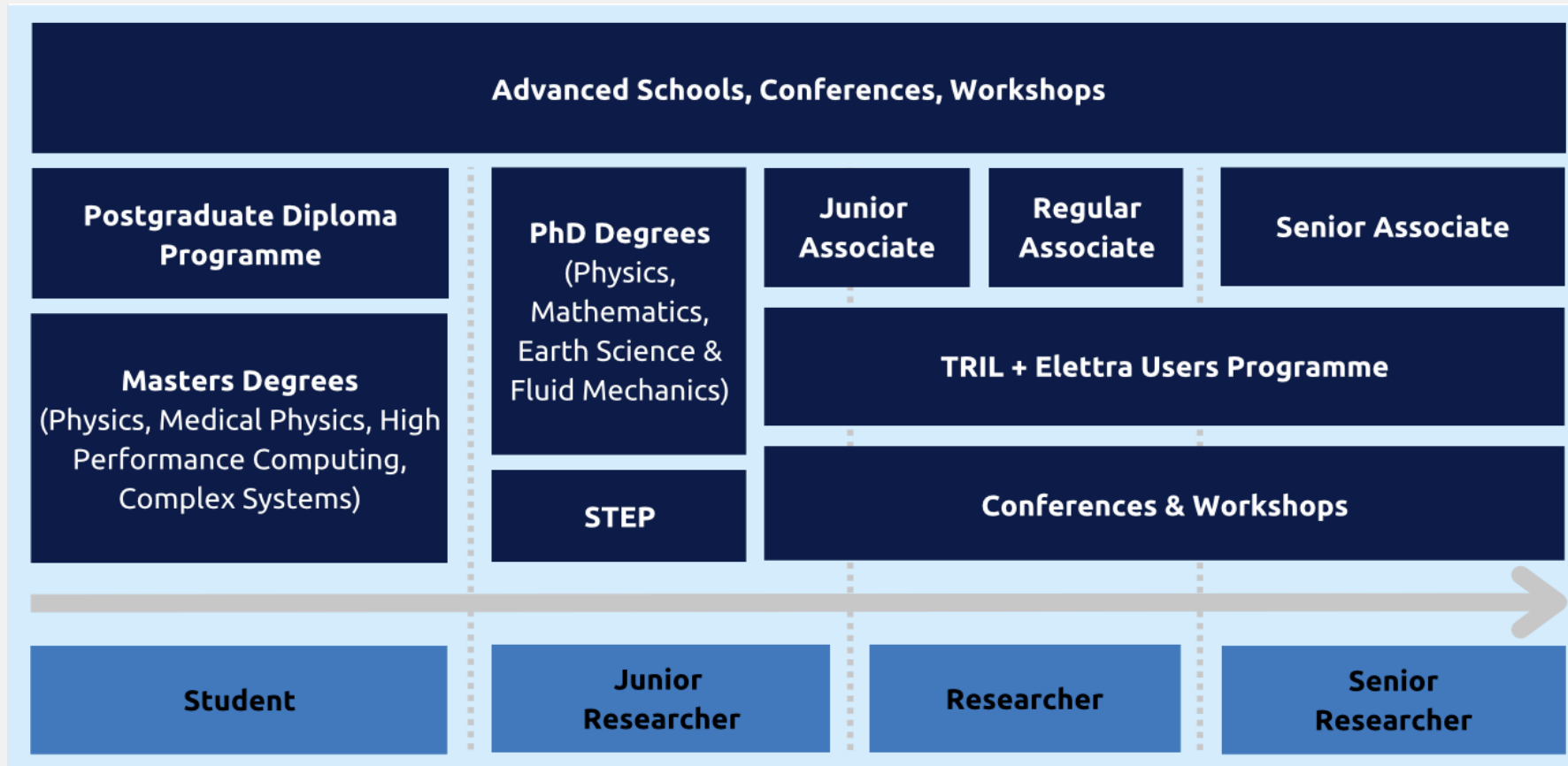Science, Technology and Innovation

Earth System Physics

Quantitative Life Sciences

Also: Sustainable Energy and High Performance Computing

ICTP Programmes:
Supporting Scientists in all Stages of their Careers

ICTP's Postgraduate Diploma Programme
Preparing Young Scholars for PhD Studies

Since 1991:

- **1000+** Diploma graduates

- More than **75%** earned or working toward PhDs

ICTP Degree Programmes

- Master in Medical Physics (with University of Trieste - UniTS)

- Master in High Performance Computing (with SISSA)

- Master of Complex Systems (consortium of European universities)

- PhD in Physics (with UniTS)

- PhD in Physics and Mathematics (with SISSA)

- PhD in Earth Science and Fluid Mechanics (with UniTS)

- *PhD in Engineering and Information Systems (with UniTS)*

ICTP/IAEA Sandwich Training Education Programme (STEP)

PhD Students

- Fellowships for students enrolled in a PhD in their home countries. PhD awarded at their home institutes.

- Support to visit ICTP or a collaborating institute for a three- to six-month stay each year for up to three successive years.

- Fellows work on their PhD theses with their advisors at their home institutes and co-advisors at the hosting institutes.

Training and Research in Italian Laboratories (TRIL)

- Hands-on experience in world-class laboratories (including the ICTP Labs).

- Scientists having at least a university Master's Degree

- Fellowships range in length from a few months to one year (Maximum period: two years)

Associate, Postdoc and Short-term Visitors
Working Together at ICTP

ICTP Associates

- Junior: Scientists up to age 35

- Regular: Scientists from age 36 to 45

- Senior: Scientists from age 45 to 65

- 6-year appointment, during which associate visits ICTP for stays of between 30 and 60 days each

Postdoc fellowships

- Check ICTP website for Postdoctoral opportunities (2-year appointment)

Short-term visits

- Up to 3 months

- Agreement with ICTP faculty member

ICTP: An International Hub for Scientific Networking

- Organises more than **60** conferences, schools & workshops each year (at ICTP and abroad)

- Welcomes up to more than **7,000** scientists from **145** nations each year

- **Scientific Calendar**
  Please visit: https://www.ictp.it/home/scientific-calendar

Scientific Capacity Building in Developing Countries
External Activities Unit

ICTP Affiliated Centres

- Institutes or university departments in developing countries with which ICTP has established a formal collaboration.

- Collaboration may focus on research, training, or a combination of both.

- Make use of ICTP programmes in order to have maximum impact in research or training in the region.

Scientific Meetings and Research Networks

- Regional scientific meetings in developing countries by offering financial assistance to the organisers of conferences, workshops, and schools.

- Scientific network projects proposed by institutes or individuals with common scientific interests who agree upon a well defined joint project that emphasises collaboration and the sharing of expertise and facilities.

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ICTP Visiting Scientists:
Where do they come from?

SINCE 1970:

IN 2022:

More than

180,000
visits

29%
of visitors where women

67%
of visitors where from developing and least-developed countries

from scientists from
188 countries around the world

Science, Technology and Innovation

Areas of research such as fast and reliable connectivity and development of advanced instrumentation

ICTP Laboratories (MLab, Marconi Lab, SciFabLab)

Marconi Lab

- Wireless ICT and IoT

- Ionospheric Physics and Modelling, Space Weather

SciFabLab

- Open-source digital fabrication (3D printers)

- Science Dissemination

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Multidisciplinary Laboratory (MLab)

Research and Development of Advanced Scientific Instrumentation

- Particle Physics Experiments

- Nuclear Applications

- Multidisciplinary Experimental Projects

- X-Ray Imaging for Cultural Heritage

- Applied Optics and Lasers

Multidisciplinary Laboratory (MLab)
Main Collaborations

- INFN and CERN

- IAEA (NSIL)

- Trieste Synchrotron Elettra

- University of Trieste (Joint PhD students and postdoc fellows)

- Universities from developing countries (STEP and TRIL fellows, Associates and other visitors)

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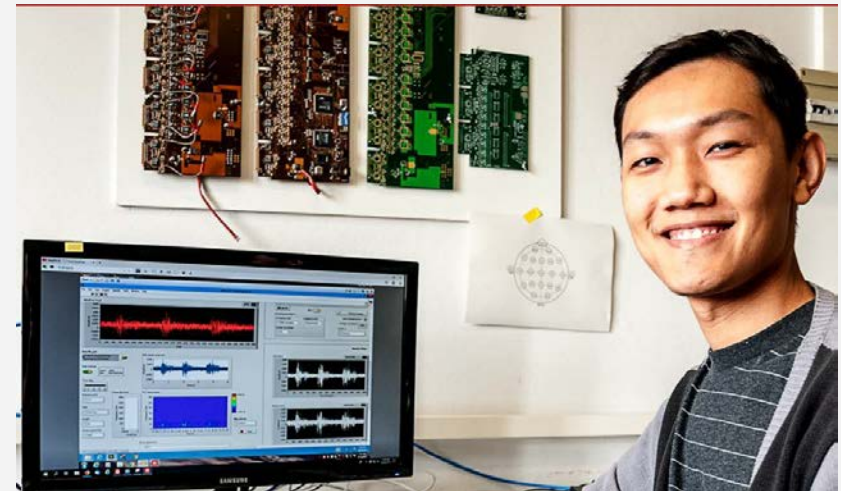
Multidisciplinary Laboratory (MLab)
Particle Physics Instrumentation

- Large number of multichannel detectors (>10^4 chn)

- Huge amount of data per unit of time (~TB/sec)

- Data need to be acquired in real-time by complex acquisition systems (DAQ)

- Online data processing methods to extract useful information contained in the acquired data

- Reduce data rate and save computational and storage resources for further offline analysis
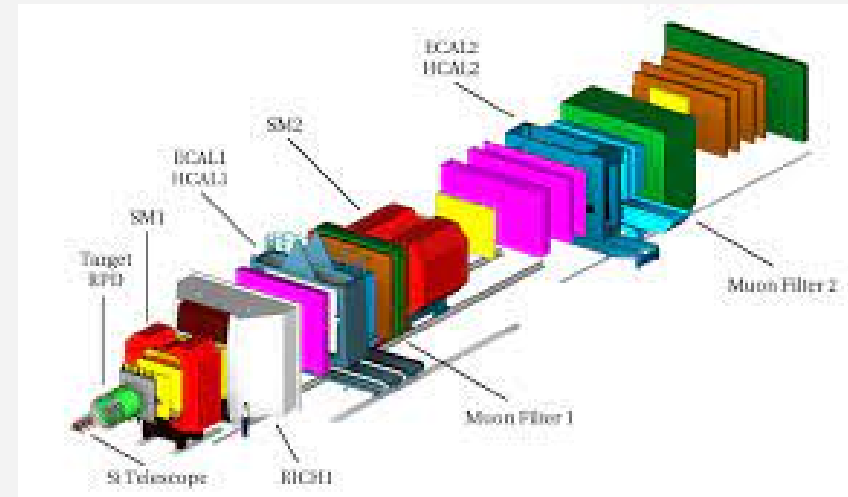
Multidisciplinary Laboratory (MLab)
Particle Physics Instrumentation

- FPGA: intrinsic parallelism, hardware re-configurability, low-latency, high-throughput and low power.

- FPGA based Systems-on-Chip (SoC)
  - Hardware's high performance of FPGAs
  - Software's flexibility of multi-core processors
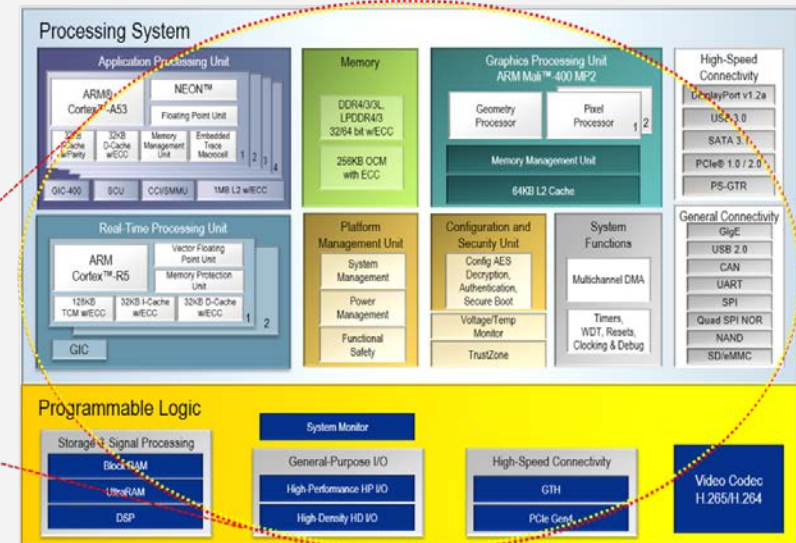
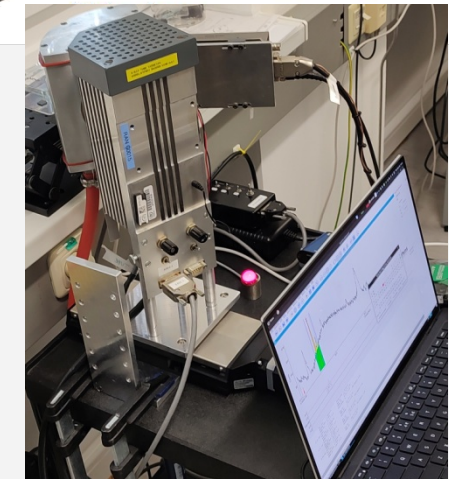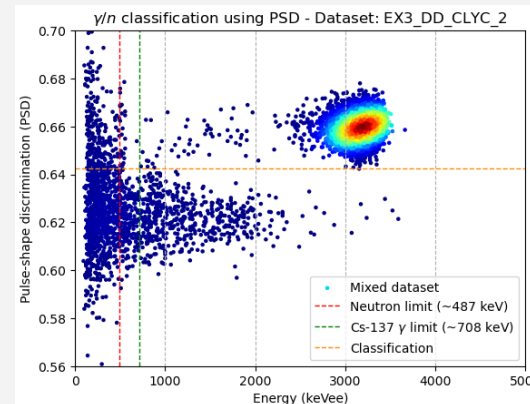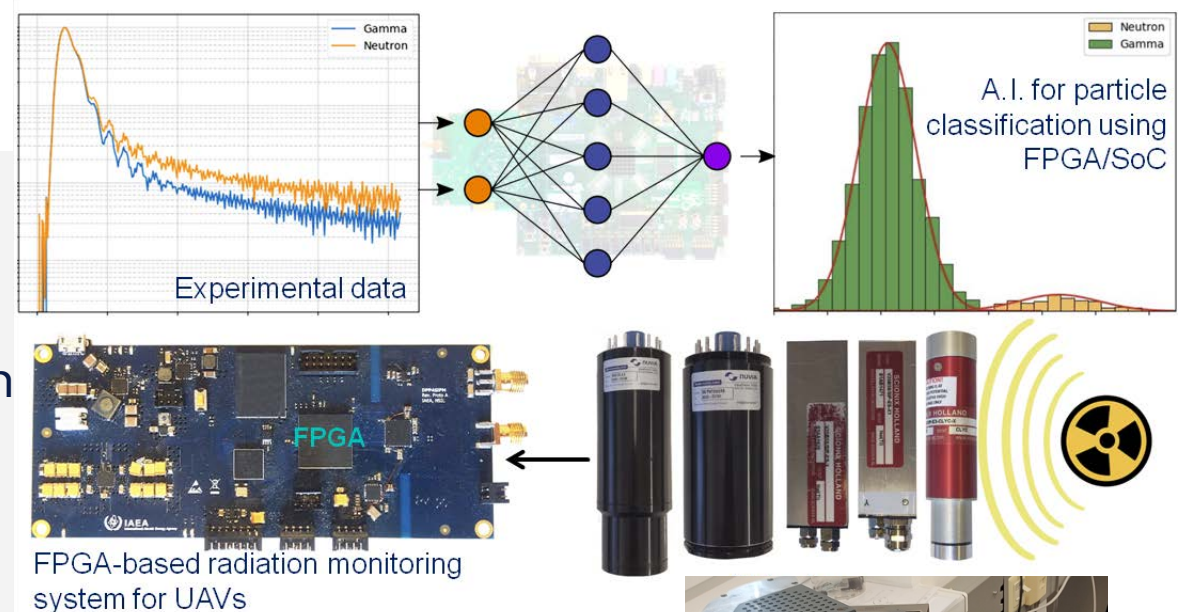# Multidisciplinary Laboratory (MLab)
AMBER Experiment at CERN

- AMBER is a particle physics experiment at the CERN SPS starting its data-taking in 2023
  - Fundamental properties of the proton and its relatives

- DAQ system for the 3000-chn ECAL2 detector

- Digital Pulse Processing for online feature extraction
  - Pulse detection and Arrival time
  - Precise amplitude measurement (proportional to the energy of the particle)

- Reduction of the data rate and the amount of data to be stored for offline analysis
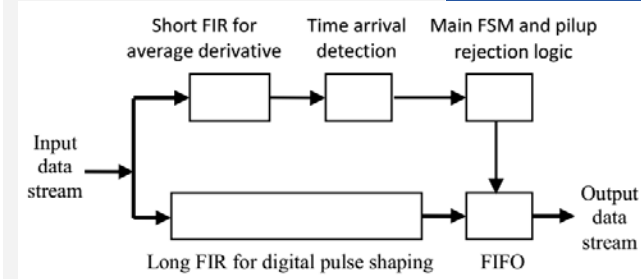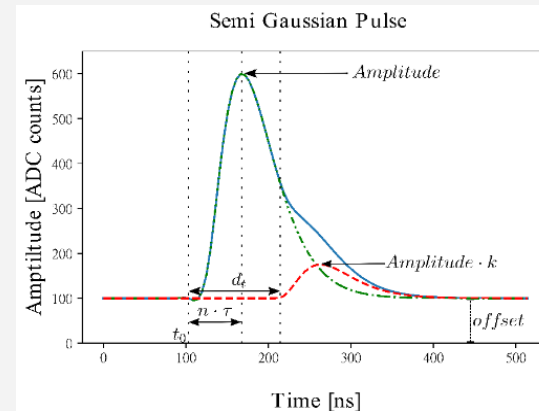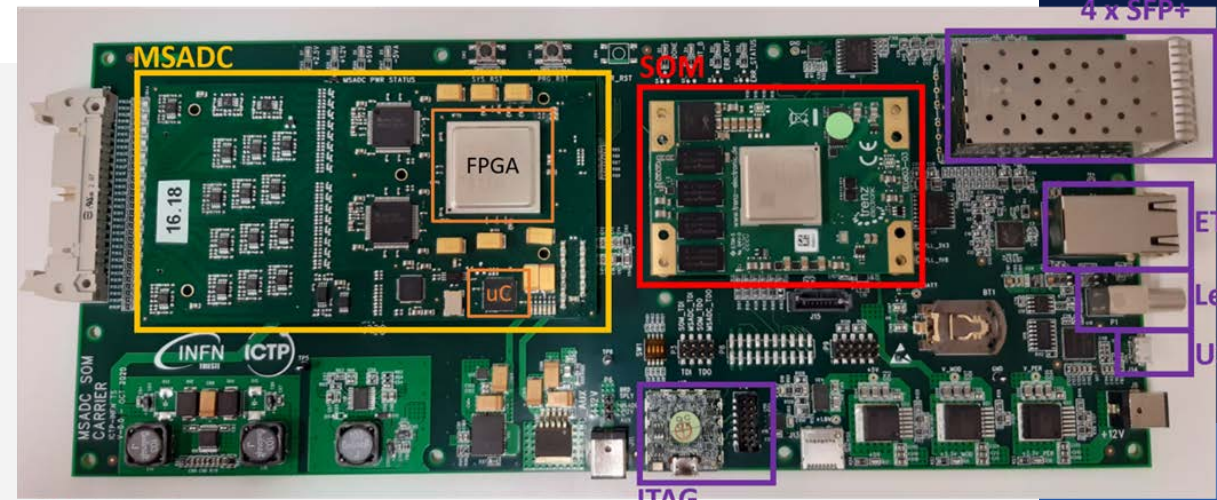
Multidisciplinary Laboratory (MLab)
Nuclear Instrumentation with IAEA

- Radiation Monitor and Spectrometer

  - SiPM detectors and FPGAs

- Real-time Classification of ionizing radiation

  - Pulse Shape Discrimination methods

  - ML and compression techniques

- X-Ray Fluorescence Scanner for cultural heritage

  - XRF detector head

  - Three-axis positioning system

Experimental data

A.I. for particle classification using FPGA/SoC

FPGA-based radiation monitoring system for UAVs

γ/n classification using PSD - Dataset: EX3_DD_CLYC_2

Mixed dataset
Neutron limit (~487 keV)
Cs-137 γ limit (~708 keV)
Classification

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XRF System
Preliminary Scans

Elemental Composition Analysis & Reconstruction
Painting Size: 220x170 mm

Ca

Fe

Ti
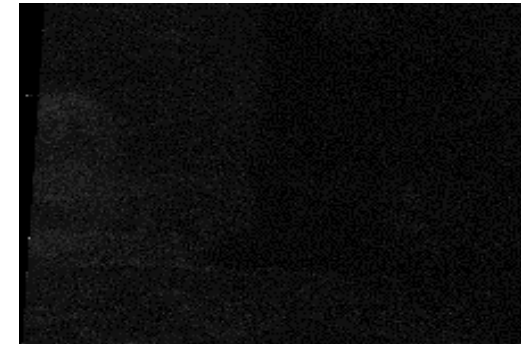
Cu

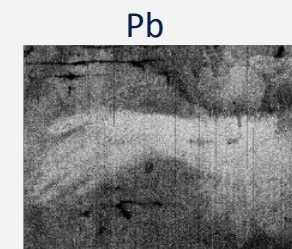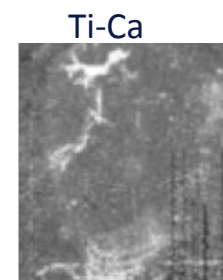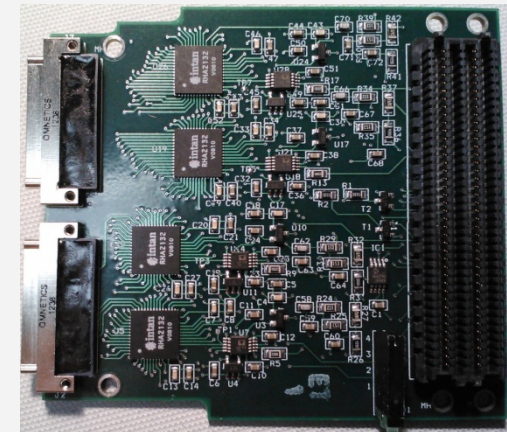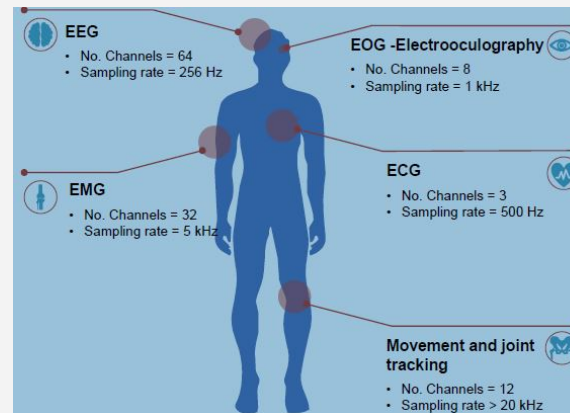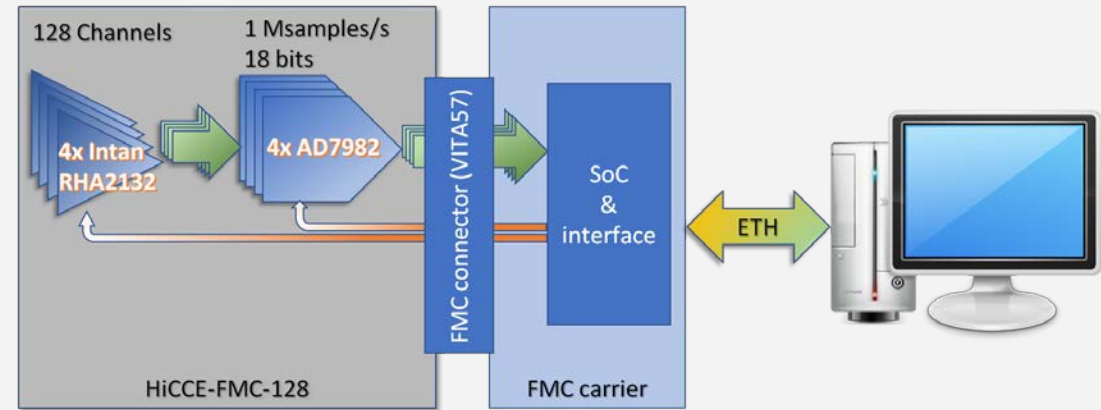# XRF System: Painting Scan in collaboration with Elettra

Ti-Ca

Fe

Pb
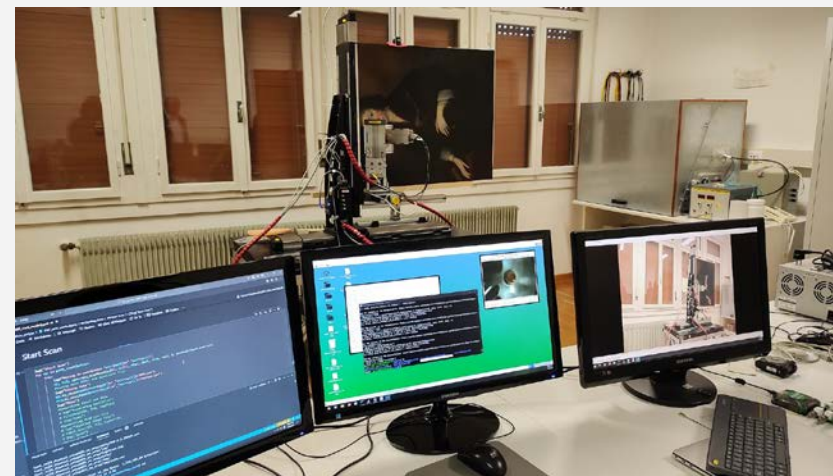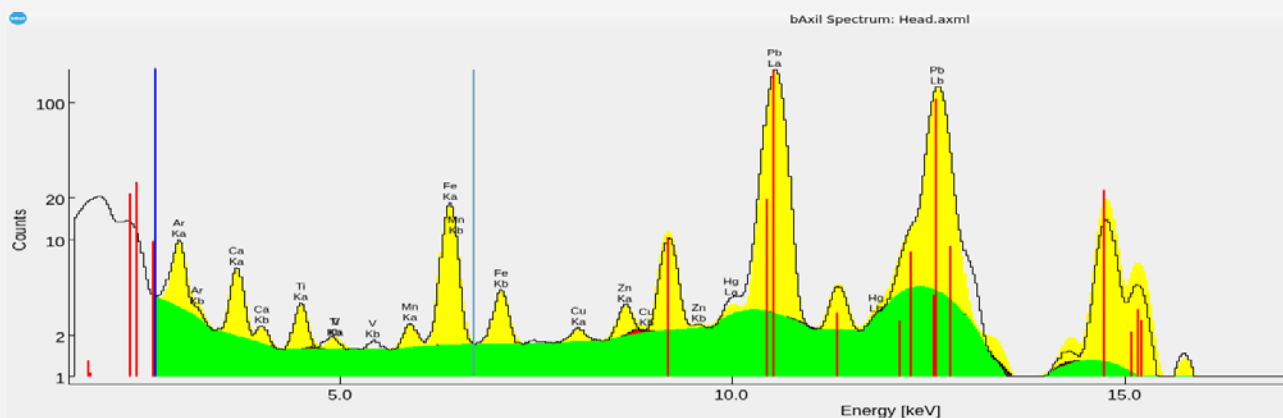
Multidisciplinary Laboratory (MLab)

Cluster of SoC-FPGA for Reconfigurable Supercomputing and Scientific Applications

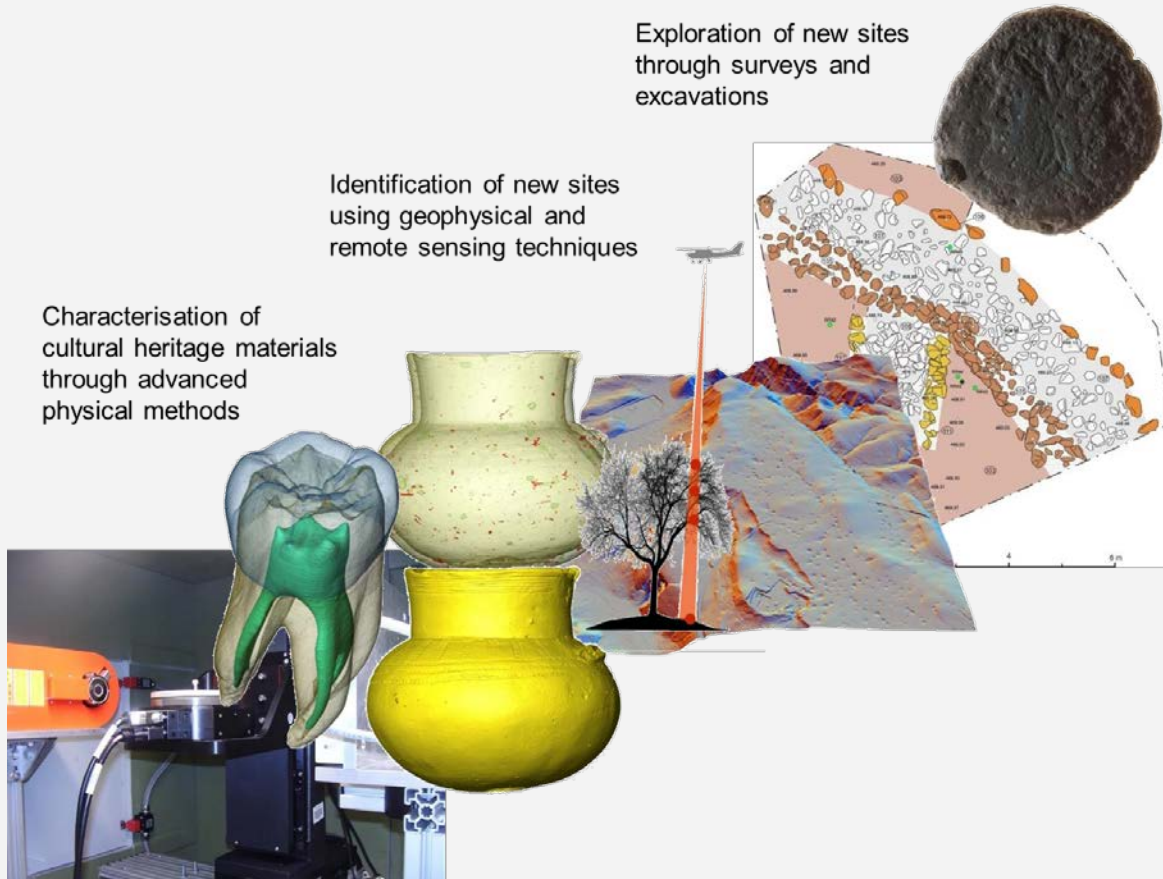## HiCCE: 128-channel Acquisition System for Electrophysiological Signals

Multidisciplinary Laboratory (MLab)

X-Ray Imaging and Applied Science for Cultural Heritage

Multidisciplinary Laboratory (MLab)
Optics and Lasers
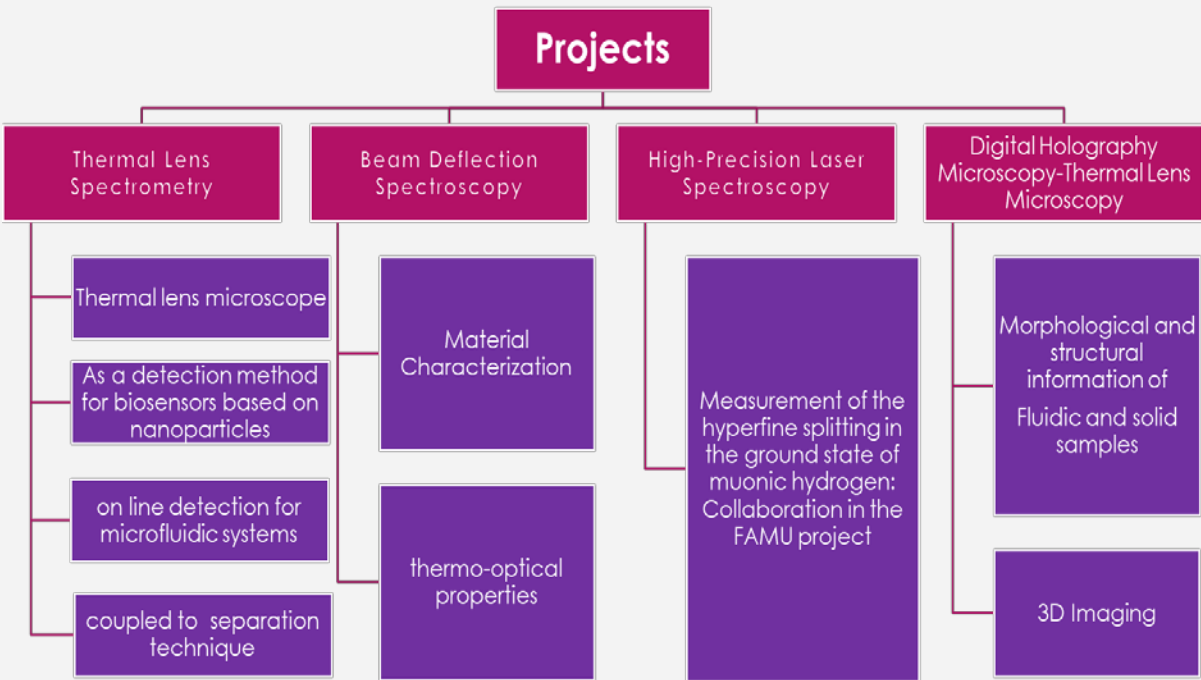
Multidisciplinary Laboratory (MLab)
Training

- 10 PhD students (Joint students with UniTS and STEP fellows)

- Several TRIL and postdoctoral fellows, associates and other visitors

- Organized more than 10 schools and workshops on FPGA and SoC for Scientific Instrumentation, held at ICTP

- Organized conferences and workshops in 11 developing countries: Argentina, Bangladesh, Brazil, Colombia, Costa Rica, Cuba, India, Malaysia, Mexico, Pakistan, Peru

3rd International Conference on Advances in Electrical, Electronics and System Engineering (ICAEESE 2024) & Workshop on Fully-Programmable Systems-on-Chip for Scientific Applications (October 2024, Qatar)

Thank you!