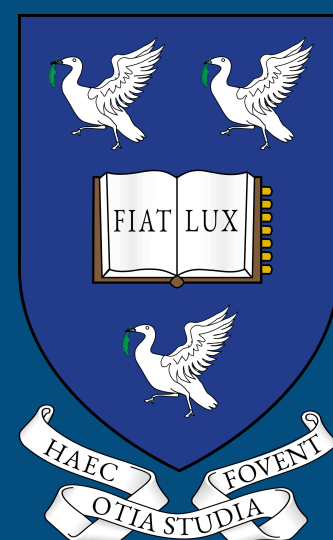


MUCCA

Multi-disciplinary Use Cases for Convergent new Approaches to AI explainability

CHIST-ERA Projects Seminar 2021



MUCCA PROJECT

- Ultimate goal: quantifying strengths and solving weaknesses of new and available xAI methods
- Strategy: apply the same array of techniques for explainability to interesting use-cases intentionally chosen to be quite heterogeneous with respect to the types of data, learning tasks, scientific questions
- Three steps implementation of the research project:
 - I. **develop and implement AI and AI-explainability techniques**, properly chosen based on the requirements, are applied to the cases under consideration
 - II. **identification of possible shortcomings of the techniques**: ability to explain the prediction of the models and make them more transparent, level of certifiability, technical issues (scalability to high-dimensional and raw data, computational cost, ...)
 - III. **combine methods and knowledge** built in each use-case in order to document the results and to **develop general procedures and engineering pipelines** useful for the use of xAI methods in general and different domains

TIME LINE

Description	Year 1				Year2				Year3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WP0 Project management, coordination												
T0.1 Project management and coordination												
T0.2 Coordination of the periodic technical and financial reporting												
T0.3 Planning of project meetings												
T0.4 Networking and participation in public conferences												
T0.5 Creation of a dissemination and communication plan												
T0.6 Plan for exploitation of project results												
WP1 HEP-1												
T1.1 HEP1-SUSY												
T1.2 HEP1-DARK												
T1.3 HEP1-BENCH												
WP2 HEP-2												
T2.1 Collection of experimental data												
T2.2 Simulation of electromagnetic showers												
T2.3 Reconstruction of charges and times												
T2.4 Shower reconstruction												
WP3 HEP-3												
T3.1 Preparation of the dataset												
T3.2 Implementation of baseline AI models												
T3.3 Syntesis of the baseline model in VHDL												
T3.4 Deployment of xAI methods												
T3.5 Dissemination and exploitation of results												

Description	Year 1				Year2				Year3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WP4 MED-1												
T4.1 Selection of AI algorithms												
T4.2 Application of state-of-the-art explainability algorithms												
T4.3 Test of new xAI algorithms												
T4.4 Stability of xAI algorithms												
WP5 MED-2												
T 5.1 Reconstruction on tomographic scans												
T5.2 Experiments and validation on air-mucus in idealized geometries												
T5.3 Experiments and validation on air-mucus in respiratory geometries												
T5.4 Test of xAI on simulation results												
WP6 NS-1												
T6.1 Uncover task-relevant neural spatio-temporal pattterns of neural activity												
T6.2 xAI-assisted selection of neural dynamic models												
WP7 XAI-TOOLS												
T7.1 xAI methods survey												
T7.2 xAI tools delivery to the use cases												
T7.3 Engineering pipelines for general xAI applications and documentation												

official starting date 1.2.2021

MUCCA CONSORTIUM

project overarches multiple disciplines, from fundamental science to medical clinic and neuroscience, putting together world-experts from the respective fields

Istituto Nazionale Fisica Nucleare (IT)
Rome group

INFN



University of Sofia St.Kl.Ohridski (BG)
Faculty of Physics

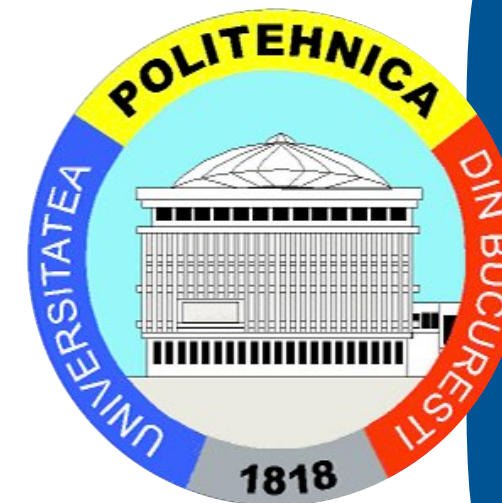
Fundamental research with cutting edge technologies and instruments, applications in several fields (HEP, medicine imaging/diagnosis/prognosis/therapy)

extended expertise in detector development, firmware, experiment software in HEP

Sapienza University of Rome (IT)
Departments of Physics, Physiology, and
Information Engineering



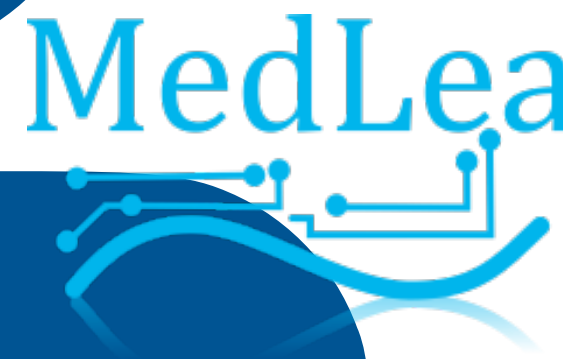
HEP: data-analysis, detectors, simulation
AI: ML/DL methods in basic/applied research and industry,
intelligent signal processing
Neurosciences: brain encoding of complex behaviours, ML
in electrophysiology, multi-scale modelling approaches



Polytechnic University of Bucharest (RO)
Department of Hydraulics, Hydraulic Equipment and
Environmental Engineering

Complex Fluids and Microfluidics expertise: mucus/saliva
rheology, reconstruction and simulation of respiratory airways,
AI applications for airflow predictions in respiratory conducts

Medlea S.r.l.s (IT)



high tech startup, with an established track record in medical
image analysis and high-performance simulation and
capabilities of developing and deploying industry-standard
software solutions



University of Liverpool (UK)
Department of Physics

physics data analysis at hadron colliders experiments,
simulation, ML and DL methods in HEP

EXPECTED RESULTS AND POSSIBLE IMPACT

- Results: **knowledge base and xAI tools** (documentation and procedures/engineering pipelines)
- Success of the project is expected to generate impact at multiple levels and scales:
 - enable users to **better understand AI models** and to **diagnose model limitations** using different explainable AI methods, as well as to **refine and optimise** the models
 - systematic understanding of which aspects of different xAI methods better adapt to the specific application (different data structure, tasks, etc) and are more predictive of success in xAI analysis
 - systematic cross-application assessment of the many available approaches to xAI
 - skills development and training on xAI methods for young researchers

DISSEMINATION AND EXPLOITATION OF RESULTS

- Dissemination from each WG in **scientific publications** and national and international **conferences** on Physics, NeuroScience, Data Science and Pneumology
- xAI **applications** and **developed metrics** will be proposed in formats usable by the widest community: methodological details and **open-access toolkits** for xAI approaches through **public servers and repositories**
- **Passive and active science communication dissemination** strategies will be followed
 - passive dissemination through a **dedicated web site** devoted to the project objectives and through social media presence
 - active dissemination through wide **public science communication** (open doors days at member institutes, science festivals), and targeted dissemination (**topical classes** on AI and xAI for high school students and high school teachers, **lectures for undergraduate and graduate students**), organisation of a **hackathon/kaggle challenges** focusing on both disseminate and test the proposed procedures