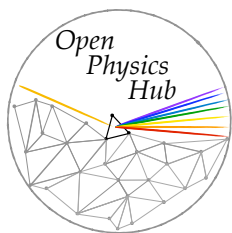
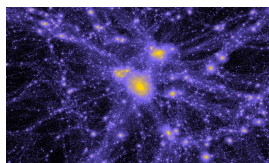


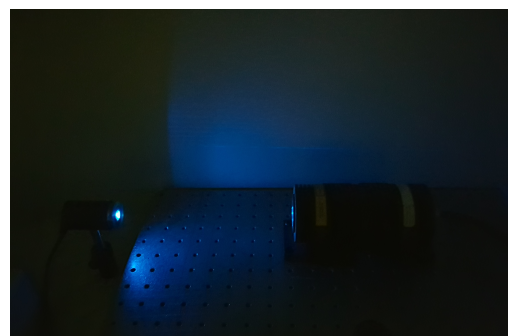
DEPARTMENT OF PHYSICS AND ASTRONOMY - DIFA

ADVANCE SENSING
LABORATORYHIGH PERFORMANCE
COMPUTING CLUSTERALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

OPH NEWSLETTER

Open Physics Hub: a new workspace for the contamination of ideas

The Open Physics Hub is a five-year project funded by the University of Bologna for the strategic development of the Department of Physics and Astronomy, with the aim of promoting excellence and innovation. The project includes frontier scientific research, higher education teaching, technology transfer, science outreach and



international academic

relations. OPH is managed by an Executive Board with the support of an Advisory Board (see pag. 5 for details), both nominated by the Department Council. As the name of the project suggests, OPH facilities are available to the researchers of DIFA as well as researchers of UNIBO or from other academic institutions and industrial partners through a joint research project with a member of DIFA.

In summary, OPH represents the ideal context to support the international relations of the Department of Physics and Astronomy. For instance, the available infrastructures will increase the attractiveness of the Department as a Host Institution for international research initiatives such as European FP9 projects. In addition, OPH aims at attracting professors, researchers and students from other countries (for short-time research collaborations and extended visiting

professorships). Specific initiatives are envisaged to enhance the mobility of students (scholarships and summer schools) eventually increasing Erasmus exchanges and high-level professors hire for teaching in Master and PhD courses.

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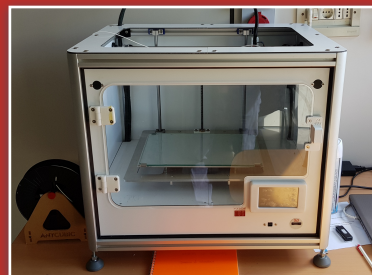
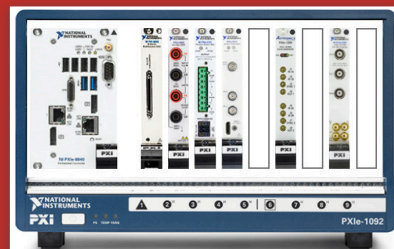
Advanced Sensing Laboratory

Science and scientific progress are linked to the ability to sense - in other words - to detect the occurrence of physical phenomena through the interaction between matter and radiation. This is the prerequisite for any research activity in physics and astrophysics as well as in engineering operations and society wellbeing. Modern research, for instance high-energy physics and astro-particle physics, integrates a large number of sensors, distributed over a wide area, to retrieve fundamental information of the physical process under investigation. As a consequence, one of the major requirements in these fields are innovative and pioneering sensing and detecting technologies. In other research fields, ranging from material science to geophysics, biomedical physics and physics of complex systems, the investigation of physical properties of materials, the need of smart measurements and on-line monitoring call for new ideas in sensing techniques as well as innovative applications of sensors.

OPH is provided with an Advanced Sensing Laboratory with the goal of developing a specific expertise in the field of detectors and sensors within the Department of Physics and Astronomy and of fostering new ideas in the context of all those research fields that involve the use of detectors. Moreover, the research activities carried out in the Advanced Sensing Laboratory are directly linked to dedicated classes for undergraduate and post-graduate university courses in order to provide the new generation of students with the necessary knowledge and skills to plan and handle new challenging experiments.

The advanced sensing lab, located at DIFA - viale Berti Pichat 6/2, room B10/11, B12/13 and A34, consists of several stations to study the response of sensors and detectors to different sources in controlled environmental conditions in collaboration and with the support of INFN. In particular OPH features a white chamber equipped with a climatic chamber, an X-ray bunker equipped with an X-ray microfocus, an electrical test probe station, an optical pumping station based on a pico-second pulsed laser, a time-of-flight station with VME crate, a data acquisition system based on National Instruments PXI modules, an electronic station, a thermal imaging camera (FLIR system) and a climatic chamber. Other tools such for example oscilloscopes, power supplies, function generators, Femto amplifiers, plasma etcher, 3D printer, laser micro writer, blade coater, MHz current amplifiers and electronic tools are available. Users may ask for short-period accesses to one of these stations and for more demanding studies, it is possible to combine the available instrumentation and create a more complex measurement station.

Cutting-edge
instrumentation for
excellent research



Examples of available
instrumentation, from top:
NI PXI acquisition system,
X-ray micro focus and 3D
printer.

High Performance Computing, Big Data Analysis

High Performance Computing is an essential tool for a wide range of research activities in physics and astrophysics, as well as for industrial and societal applications, and plays a major role in the era of Big Data science. This requires that physicists acquire and develop a specific expertise in the field of parallel computing and demands for the introduction of High-Performance Computing basic skills in the programs of undergraduate and post-graduate university courses, in order to provide the next generation of scientists with the necessary fluency in handling sophisticated and advanced parallel applications.

OPH has been equipped with a new powerful parallel computing facility, featuring the High-Performance Computing cluster “Matrix” and its companion Data Analysis cluster “BladeRunner”, that will allow to pursue these activities through a dedicated infrastructure providing a promptly available environment for developing and debugging parallel codes, for mid-size production runs, and for hands-on teaching activities on parallel programming and Big Data analytics.

HPC Cluster “Matrix”

A new parallel computing cluster equipped with 896 cores and a total memory of 3.6 TB (4 GB/core) has been recently installed at the OPH premises and will soon be opened for scientific applications. The cluster, which is called “Matrix”, will be hosted in the server room of the partner computing center INFN-CNAF and will be accessible to all DIFA members and to external scientists that share a common research project with a DIFA staff member. The system will be provided with a dedicated data storage area of 240 TB.

“MATRIX” features

- 32 multi-core Intel XeonGold 5120 processors with dual thread
- 8 GB of memory per physical core (4 GB per virtual dual threaded core)
- 100 Gb/s InfiniBand connection
- 240 TB of disk space on SAS disks

Data Analysis Cluster “Blade Runner”

The main computing facility of the Open Physics Hub - the HPC cluster “Matrix” - is directly connected with a smaller cluster primarily devoted to post-processing and data analysis activities, the BladeRunner cluster, equipped with a heterogeneous architecture of computing nodes with different numbers of cores, memory, and network connections, and with a dedicated disk storage space of 43 TB backed-up with RAID-5 protocols. The different computing nodes of the BladeRunner cluster have been tailored for different types of post-processing and data analysis jobs that are handled and prioritized by a dedicated job scheduler (SLURM). All the nodes have x86_64 instruction set.

“BLADE RUNNER” specifications:

Infiniband connected nodes:

- 2 nodes with 24 virtual cores and 64 GB RAM
- 2 nodes with 32 virtual cores and 64 GB RAM
- 1 node with 32 virtual cores and 128 GB RAM
- 2 nodes with 16 virtual cores and 24 GB RAM

Ethernet connected nodes:

- 2 nodes with 12 virtual cores and 16 GB RAM
- 2 nodes with 32 virtual cores and 64 GB RAM

Teaching and outreach

The Open Physics Hub aims at promoting and implementing innovative teaching initiatives at all levels of University education (Bachelor, Master, and PhD) related to the main scientific activities of the Department of Physics and Astronomy. In particular, a broadening of the teaching offer is planned through the introduction of new teaching methodologies, transversal competence and interdisciplinary topics.



Such innovative teaching will be conceived and realised with the goal of:

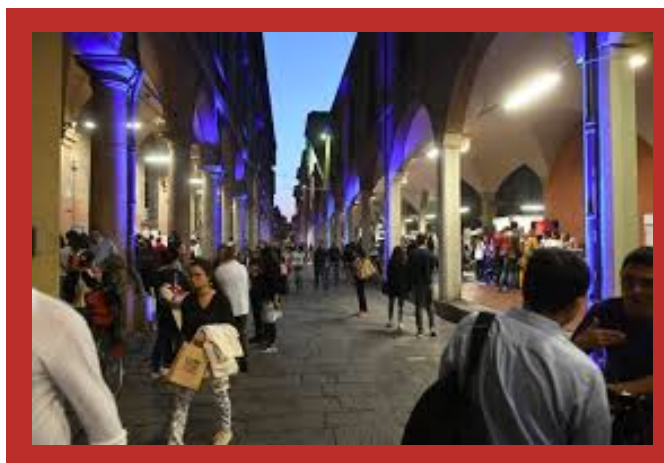
- Bridging soft-skills already provided by other courses of the University of Bologna with the teachings of the Master Degree in Physics, so to offer different examples of integration between specific and transversal expertise to our students;
- Addressing recommendations from social partners relative to the demand of specific skills in the job market;
- Fulfilling the quality criteria defined for EU projects dealing with monitoring and support to teaching quality.
- Organisation of summer schools, such as the periodical “[International Summer School on Physical Sensing and Processing](#)”.

Furthermore, the Open Physics Hub will promote the opening of new specific courses in all the Master and PhD programs offered by DIFA to provide basic training in fields related to Advanced Sensing and High-Performance Computing.

As part of the Department of Physics and Astronomy, the Open Physics Hub will contribute to the institutional outreach initiatives carried out by its staff members and will promote new outreach actions aimed at advertising to the general public the activities and the main research topics covered by the project.

In particular, the Open Physics Hub supports the following specific outreach programs:

- Participation of Physics and Astronomy undergraduate students to the [International Physics Tournament](#)
- Participation with a number of exhibits and hands-on experiments to the [European Researchers Night](#)
- Contribution to the organisation of the Astronomy Public Conferences “[Conferenze alla Specola](#)” jointly with the INAF Observatory for Astrophysics and Space Science
- Lectures on topics related to the OPH main research directions at public schools.



Ongoing Activities and State of the art

The project has reached its first year of activity. The actions undertaken and the achievements are listed as follows:

- Staff recruitment is following the milestones.
- Three co-financed PhD grants have started, and three more are being activated.
- Most of the instrumentation purchases of the first two-year period have been completed.
- The laboratory preparation is in its final stage.
- Innovative teaching activities are already available for the 2019/20 academic year:
 - Computational Material Physics (Msc in Physics, Prof. Cesare Franchini)
 - High-Performance Computing in Astrophysics and Cosmology (Msc in Astrophysics, Dr. Marco Baldi)
 - Innovative Detectors (Msc in Physics, Prof. Mauro Villa)
 - Pattern recognition and neural networks (Msc in Physics, Prof. Gastone Castellani and Prof. Daniel Remondini)
- Internationalisation activities: 3 co-financed procedures for visiting professors have been activated.
- The 2nd edition of the “[International Summer School on Physical Sensing and Processing](#)” is being organised.
- Participation of the OPH infrastructures to 6 EU competitive projects.
- 3 research and consultancy contracts with national and international companies.
- 1 Master and 1 Bachelor Thesis.
- Dissemination: realisation of the [OPH web-site](#).

Governance

The Open Physics Hub is managed by an Executive Board with the support of an Advisory Board, both nominated by the Department Council.

Executive Board

The Executive Board has the role of managing the OPH by defining its functioning policies, by allocating its funding to specific initiatives, and by advertising its activities. The current members are: Prof. Nicola Semprini Cesari, Prof. Mauro Villa, Dr. Eleonora Ciccone, Prof. Beatrice Fraboni, Prof. Lauro Moscardini, Dr. Marco Baldi, Dr. Cristian Massimi, Dr. Filippo Zaniboni.



Advisory Board

The Advisory Board has the role of supporting the initiatives of the OPH by monitoring their commitment to the main mission of the project and by advising the Executive Board on good practice. The current members are: Prof. Federico Boscherini, Prof. Angelo Carbone, Prof. Daniel Remondini, Prof. Silvana Di Sabatino, Prof. Elisa Ercolessi, Prof. Paolo Gasperini, Prof. Olivia Levrini, Prof. Fabio Maltoni.

Contacts

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OPH Contact Point: eleonora.ciccone@unibo.it
OPH Computing Facilities: marco.baldi5@unibo.it
OPH Advanced Sensing Lab: cristian.massimi@unibo.it

Useful links

OPH website

<https://site.unibo.it/openphysicshub/en/>

Department of Physics and Astronomy

<https://fisica-astronomia.unibo.it/it>

INFN

<http://www.bo.infn.it/>

CNAF

<https://www.cnaf.infn.it/en/>

International Summer School on Physical Sensing and Processing

<https://www.unibo.it/en/teaching/summer-and-winter-schools/2019/international-summer-school-on-physical-sensing-and-processing>

International Physics Tournament

iptnet.info/

European Researcher Night

<http://nottedeiricercatori-society.eu/>

Astronomy Public Conferences

<https://www.oas.inaf.it/it/conferenze-specola/>