Scientific Computing

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1 Introduction

Over the years, the role of the scientific computing center at the Laboratories has evolved beyond its original function as a Grid farm for ATLAS, becoming a facility supporting other experiments and scientific activities at LNF, in line with INFN distributed computing policies and projects.
Since 2017, the PADME experiment has also carried out part of its offline computing at the Tier2 center, in close collaboration with the experiment team, covering tasks such as Monte Carlo simulations, data reconstruction and analysis, evaluation of referee requests, and hardware selection and procurement, optimizing operations shared among multiple experiments. In addition, the center supports Grid computing for other experiments as well as local computing needs, such as the ATLAS Micromegas chamber validation system and user interfaces for various experiments. At the same time, it contributes to numerous INFN computing initiatives, including the ICSC (Italian Research Centre on High-Performance Computing, Big Data, and Quantum Computing) data center, funded through PNRR resources.
These computing activities are carried out in close collaboration with multiple LNF services, including Technical, Safety, Computing, and Administrative services, as well as the experiment coordinators. The Data Center features approximately 10 PB of disk storage, 250kHS06 of computing power distributed over around 20,000 cores, and a network infrastructure with 100/25/10 Gbps capacity. The majority of

these resources are dedicated to ATLAS computing activities and to new ICSC projects.
The recent expansion of computing activities ,and the significant growth of personnel involved in scientific computing at the Laboratories, has led to the establishment of a dedicated High-Technology Computing service. This service is structured into three departments: “Support for Experiments and Laboratory Infrastructures”, “Computing Resource Management”, and “Scientific Data Management”.

2 Most recent activities

The most recent activities of LNF’s scientific computing are carried out within the broader context of INFN computing initiatives and international collaborations. Key projects include the Italian ATLAS computing collaboration, PON Ibisco (in partnership with INAF/OAR), CIR Ibisco, the CTA Data Center (in collaboration with INAF/OAR and CTAO), and the national PNRR program, supporting the development of the INFN-Cloud at Tier2 and the new Space Economy Data Center.

2.1 LNF ATLAS Tier2

During the reporting period, the HTCondor cluster was consolidated and secured within a private network, with the operating system upgraded to AlmaLinux9. The capability to run jobs based on CentOS7 via containers was also introduced, ensuring full compatibility with legacy environments and enabling a seamless technological transition without impacting computing activities.
The migration of the distributed Grid storage management system from Disk Pool Manager to dCache was completed, in line with the recommendations of the EGI community.
Finally, a centralized access system to the User Interfaces (UI) based on Single Sign-On (SSO) was implemented, providing improvements in security, identity management, and overall user experience.

2.2 Italian Cherenkov Telescope Array Data Center

In 2014, a collaboration with INAF/OAR was established for the development and implementation of computing infrastructure for the ASTRI and Cherenkov Telescope Array (CTA) experiments at the Frascati Tier2 center. This collaboration

was further strengthened in 2018 through the I.Bi.S.Co. PON project, positioning LNF as the main hub for INAF computing resources dedicated to CTA.
Throughout 2024, the Tier2 data center continued to host the Italian CTA data center, one of four worldwide, in collaboration with the CTA INFN group and the INAF/OAR team. The other data centers are located at PIC (Spain), DESY (Germany), and CSCS (Swiss National Supercomputing Center).

2.3 PNRR ICSC-Spoke 0

The Frascati National Laboratories participate in the Italian PNRR (National Recovery and Resilience Plan) through several projects. In the field of computing, Frascati will host two data centers within the framework of Spoke 0 of ICSC – the National Centre for Research in High Performance Computing, Big Data and Quantum Computing.
One of the two data centers involved in ICSC is the existing Tier2 Data Center. The current computing facility dedicated to scientific activities at the Laboratories is going to be consolidated and upgraded to host a node of the new INFN-Cloud distributed computing infrastructure, based on OpenStack middleware.
The second, and most significant, contribution to ICSC is the construction of a new data center that will host a dedicated High Performance Computing (HPC) facility. This new infrastructure, named the Space Economy Center, will support INFN scientific computing through the deployment of an additional INFN-Cloud node and will provide hosting capabilities for new experimental data centers such as CTA, the EuPRAXIA HPC Data Center, and potentially future collaborations.
The project is going on with the realization of a 400 m² data center within a newly acquired building. The facility is designed to accommodate approximately 36 racks, supporting both standard-density and high-density (HPC) systems. The total installable IT load will reach approximately 1.2 MW, distributed as 800 kW via Direct Liquid Cooling (DLC) and 400 kW via air cooling. The infrastructure will include fully redundant UPS and cooling systems, as well as a heat recovery system to provide building heating during winter. The data center has been designed for scalability and future expansion, both in terms of floor space and IT power capacity. The estimated cost of the infrastructure is approximately €4 million.
Additional funding under the PNRR ICSC initiative, amounting to approximately €2 million, has been allocated for the procurement of hardware resources and the implementation of further infrastructure upgrades. In addition, the PNRR program has supported the recruitment of specialized personnel in the field of scientific computing, including three technologists and one technician.
Furthermore, several development activities have been undertaken to establish an HPC computing farm and a distributed cloud infrastructure based on OpenStack technology. Both infrastructures will be integrated into the INFN DataCloud project

and made available to users, experiments, and projects within INFN and ICSC.
The HPC farm currently under development includes a new SLURM cluster featuring approximately 5,000 CPU cores and 24 GPUs. In parallel, a storage system based on Ceph technology is being deployed to provide shared storage services for both the HPC and the OpenStack infrastructures.

2.4 SSRIP-TT

In 2025, the deployment of the network infrastructure for the SSRIP-TT accelerator (formerly ELI-NP) was successfully coordinated at IFIN-HH in Măgurele, Romania. In parallel, the complete hardware and software infrastructure required to host and operate the accelerator control system was installed, configured, and fully tested. The infrastructure is based on innovative software solutions, including Kubernetes, ensuring scalability, resilience, and efficient resource management.