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Advancing Fundamental Research and Space Economy in Italy through the ICSC large-scale national initiative

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Forty months after its inception under the Italian National Recovery and Resilience Plan (NRRP), the National Centre for High-Performance Computing, Big Data, and Quantum Computing - established and managed by the ICSC Foundation - has reached a mature and productive phase, consolidating its role as a strategic infrastructure for research, innovation, and industrial competitiveness. The Centre's mission to strengthen national computational capabilities and promote cross-sectoral collaboration between academia, research institutions, and industry has led to significant progress across its network of hubs and spokes.

In this contribution, we present the main results achieved during this first phase, with emphasis on frontier research in theoretical and experimental physics. Various activities have advanced the data-intensive and computational frontiers of high-energy, astroparticle and gravitational-wave physics. By integrating high-performance computing, cloud and distributed infrastructures, and advanced data analytics, the Centre has supported an expanding portfolio of scientific collaborations, developed novel tools for large-scale simulation, and fostered an interoperable ecosystem linking national and European research infrastructures. The deployment of heterogeneous computing architectures, including GPU- and FPGA-based systems, has also accelerated analysis pipelines and reinforced synergies across scientific domains.

As we move towards the future of the Centre, efforts will focus on consolidating these achievements and ensuring the long-term sustainability of the developed infrastructures, while expanding collaborations with European and industrial partners and exploring emerging opportunities in exascale computing and artificial intelligence.

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