

Academic Research

# Accelerating cutting-edge research

Advanced Research  
Computing at Cardiff (ARCCA)

To help astrophysics researchers at the University of Cardiff investigate the origins and nature of the universe, ARCCA teamed up with Lenovo and Logicalis to boost the performance of key HPC workloads by up to 100%.

Lenovo

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Image credit: A. Duarte Cabral, FFOGG project

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## Who is ARCCA?

ARCCA (Advanced Research Computing at Cardiff) is Cardiff University's high-end research computing service. The division offers state-of-the-art hardware and software to help tackle global research challenges in fields including astrophysics, chemistry and engineering, life sciences, humanities, and more.

Through Hawk—its high-performance computing (HPC) cluster—ARCCA provides access to supercomputing tools and resources including computer simulation and modeling, manipulating and storing large amounts of data, and many other methods to help solve complex research problems. ARCCA sees that demand for its resources will continue to grow as new AI and big data use cases emerge across nearly every discipline.



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## The Challenge

Cardiff University and ARCCA play a key role in world-leading scientific research projects. For more than 15 years, ARCCA has been one of the largest HPC providers to the Laser Interferometer Gravitational-Wave Observatory (LIGO) Scientific Collaboration. LIGO is a large-scale physics experiment and observatory designed to detect gravitational waves produced by the collision of black holes. When these collisions occur, the impacts send ripples through space-time, enabling researchers to perform precision tests of Einstein's theory of general relativity.

Professor Stephen Fairhurst, Head of the Gravity Exploration Institute at Cardiff University, says: "LIGO continuously collects data during the current two-year observing run. As LIGO detectors become more sensitive over a broader signal band, the number of detection events has grown from one per month to almost one per day. Analyzing these events requires large amounts of compute resources—and ahead of the fourth LIGO observing run, we aimed to use funding from the Science and Technology Facilities Council to scale out the ARCCA cluster."



At the same time, another group of researchers at Cardiff wanted to leverage its own funding to expand the Hawk cluster. Dr. Ana Duarte Cabral, Royal Society University Research Fellow at Cardiff University, explains: “Our research focuses on the creation of stars in spiral galaxies like our own. We run simulations of full galaxies and the individual star-forming regions within them—a computationally demanding process.”

Using existing HPC resources, running the most complex star-formation simulations required just over a month of continuous processing. However, on average the research team only had access to three days of processing a week—meaning that it took between three and four months to perform a full simulation.

“To understand how the structure and dynamics of spiral galaxies affect star formation processes, we need to identify statistically robust trends from many simulations,” continues Dr. Duarte Cabral. “To obtain the necessary data faster, we asked ARCCA to use a grant from the Royal Society to add dedicated compute nodes for our project.”



**Professor Martyn Guest**

Technical Director, Supercomputing Wales



“To help the LIGO and star-formation research teams achieve their objectives, we had to move fast—as the funding for both projects was time-sensitive. To find the optimal infrastructure solutions for both projects, we engaged our technology partner Logicalis.”

# Boosting HPC performance

Working closely with Logicalis, ARCCA determined that Lenovo could deliver the optimal HPC resources for both research groups.

For the LIGO project, the organization selected Lenovo ThinkSystem SR645 servers. Powered by AMD EPYC™ processors with simultaneous multi-threading, the solution delivers an excellent price/performance ratio for LIGO's High Throughput Computing (HTC) workloads given the requirement for aggressive SPECfprate performance.

To support the parallel processing requirements of the star formation project, ARCCA selected Lenovo ThinkSystem SR630 servers with Lenovo ThinkSystem SR650 servers for storage.

## Hardware

Lenovo ThinkSystem SR645  
powered by AMD EPYC™ processors  
Lenovo ThinkSystem SR630 V2  
Lenovo ThinkSystem SR650  
NVIDIA AS4610 1GbE Managed  
Switch  
NVIDIA QM8790 HDR IB  
Unmanaged Switch  
NVIDIA SN2410 25GbE Managed  
Switch  
NVIDIA ConnectX-6  
HDR100/100GbE VPI Adapters  
NVIDIA ConnectX-6 Lx 10/25GbE  
SFP28 Ethernet Adapters

## Software

Logicalis Ubiquity

## Services

Lenovo Foundation Service – 5 Year  
Next Business Day Response

## **Integrating with the main cluster**

The new HPC solutions are networked with NVIDIA ConnectX-6 adapters (formerly Mellanox) and connected to the existing Hawk cluster via Ubiquity—an open-source cluster management solution developed by Logicalis.

Professor Guest comments: “We wanted to integrate the new compute resources with the existing Hawk cluster. When Logicalis showed us the capabilities of Ubiquity, we were convinced that our goal was achievable. The technical leadership that Logicalis and Lenovo showed throughout proved pivotal to achieving our mission of supporting scientific discovery. Our ability to plug advanced computing equipment into a professionally managed HPC environment has allowed research groups to secure R&D funding for Wales. These include facilities for AI, big data, microbial bioinformatics, and dementia research.”

Chris Coates, Head of Engineering for HPC at Logicalis, adds: “Ubiquity is a HPC platform built using cloud-native technologies, which delivers consistent performance for workloads running on practically any compute platform and massively reduces overheads for day-to-day administration. By using Ubiquity in conjunction with the modular architecture of the Hawk cluster, we enabled ARCCA to integrate the new Lenovo hardware with its existing HPC platform.”

Today, Ubiquity is proving to be an increasingly vital component of the expanded Hawk cluster. The solution includes automated management workflows for deploying updates and new nodes, significantly reducing management and maintenance requirements for the ARCCA team.



**“The new HPC resources we’ve deployed with Logicalis and Lenovo are enabling research teams at Cardiff to accelerate their existing workloads and pursue new and more complex types of analysis.”**

**Dr. Jon Lockley**

Director of Advanced Research Computing, Cardiff University



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## The Results

ARCCA is delivering a major HPC performance boost for key research projects at Cardiff University. For LIGO—which accounts for around 25% of all Hawk workloads—the new solution exceeded real-world application performance benchmarks by up to 100% in some cases. The solution also offers a minimum performance uplift of 46% compared with a traditional HPC environment with identical hardware specifications.

“We are getting even greater per-core performance than we expected,” confirms Professor Fairhurst.

“Crucially, the new cluster was up and running in time for the start of the latest LIGO observing run. We can now process detection events faster and can share the data with astronomers sooner—helping them to locate the sources of the signals more easily.”



Exceeds HPC benchmarks by up to 100%



Outperforms traditional HPC environments by 46%



Automates key cluster management tasks

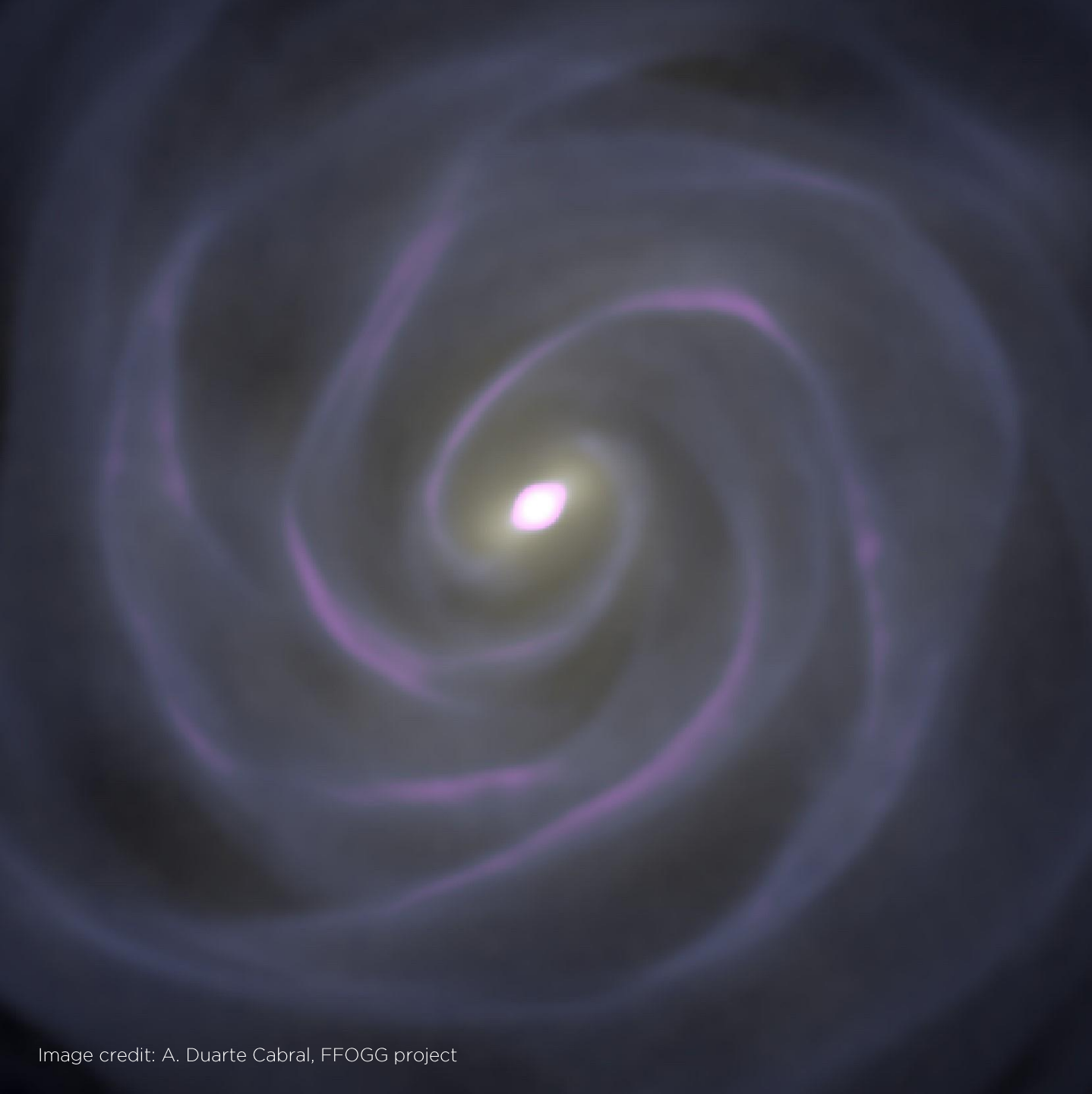
## On course for new discoveries

The new compute resources will also have a powerful impact on star-formation research at Cardiff University—offering twice the performance of the previous HPC cluster.

Dr. Duarte Cabral comments: “We are currently preparing to run our first production simulations on the new cluster, and we’re very confident that it will offer a substantial performance increase. The early benchmarks we ran with Logicalis completed several hours ahead of schedule—and we believe that this improvement will hold as we start to run more complex simulations on the platform.”

The solution will provide uninterrupted access to HPC resources, enabling researchers to perform simulations at greater speed and scale.

“The new nodes will allow us to cascade down from the scale of entire galaxies to the scale of specific star-forming regions,” adds Dr. Duarte Cabral. “With a dedicated cluster, we can significantly increase the amount of data we can collect—potentially enabling us to become world leaders in this field.”



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“We were working to extremely tight funding deadlines, and while other vendors quoted us nine-month lead times for delivery, Lenovo and Logicalis truly understood the urgency. They never stopped pushing to help us complete the projects on time and within budget.”

**Professor Martyn Guest**

Technical Director, Supercomputing Wales

# Why **Lenovo**?

As well as offering an aggressive timeline for deployment, Lenovo and Logicalis provided ARCCA with the combination of proven Lenovo HPC hardware, powerful AMD EPYC™ processors, and innovative software. With the AMD roadmap to 4<sup>th</sup> generation processors and beyond, this installation provides a clear direction of travel for future systems. Furthermore, with Ubiquity, Logicalis allows ARCCA to integrate the new servers with the existing Hawk cluster while significantly reducing management overhead.

“One of the challenges we face is that our research software engineers are also responsible for system administration—so it’s crucial that we make cluster management as straightforward as possible,” says Dr. Jon Lockley. “With Ubiquity, many of these management tasks are automated, which helps to reduce the burden on our research software engineers so they can focus on what matters.”



## Partner perspective: Logicalis

“ARCCA is helping research teams across the University of Cardiff and around the world to push the boundaries of scientific knowledge. At Logicalis, we’re proud to have played a role in designing and deploying a brand-new set of HPC resources that could help researchers uncover new insights into the origins and workings of our universe.”

**Georgina Ellis**

Account Manager, Logicalis



# How can research organizations accelerate complex projects?

Advanced Research Computing at Cardiff boosts HPC performance by 100% with Lenovo, Logicalis, and AMD technology.

[Explore Lenovo HPC Solutions](#)

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