

Expanding DUNE Computing in the UK

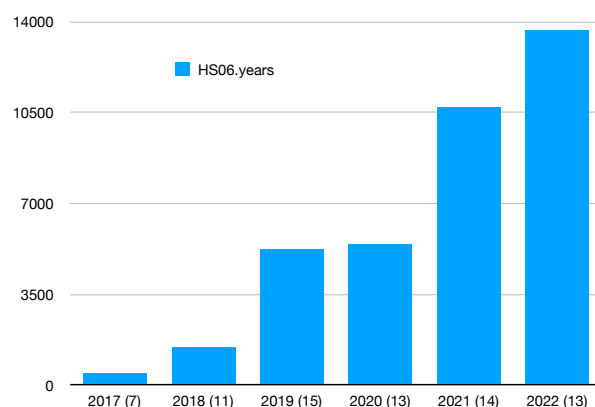
Andrew McNab, University of Manchester, for the DUNE Collaboration

DUNE is a future liquid argon TPC neutrino oscillation and astrophysical neutrino experiment that will take data at a rate of 30 PB/year.

After the formation of the DUNE collaboration, the UK began a concerted effort to prepare for data taking by the DUNE prototypes (“protoDUNE”) running at CERN and for contributions to the construction of DUNE itself.

Increasing the UK capacity

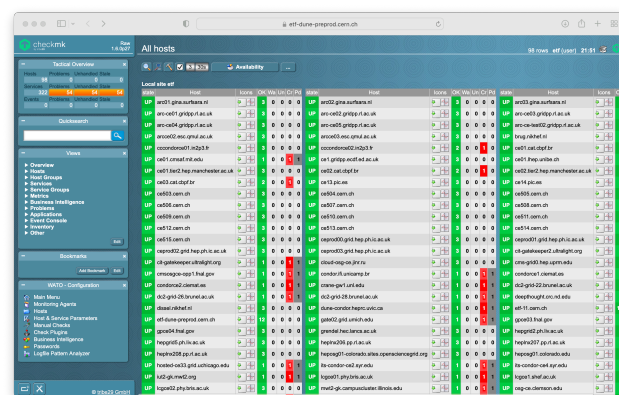
This chart shows the increase of computing power delivered to DUNE by UK sites from 2017 (with the number of participating sites in brackets.) 2022 is calculated pro-rata from Q1/Q2.



The increase in the number of UK sites was facilitated by the existing GridPP collaboration which had been created in 2001 to support the LHC experiments as part of the Worldwide LHC Computing Grid (WLCG). DUNE members in the UK used the weekly GridPP operations meetings, mailing lists and management structure to support new sites and communicate problems back to the DUNE computing operations team. Weekly DUNE/UK sites meetings evolved into a general weekly meeting for sites around the world and the DUNE computing ops team.

To further improve the human interface between DUNE and the UK sites, the UK led the addition of DUNE to the GGUS ticketing system used by all WLCG sites and UK staff members represented DUNE on various WLCG boards and working groups, and adapted the ETF site

monitoring system for DUNE which is used by the LHC experiments (shown below)

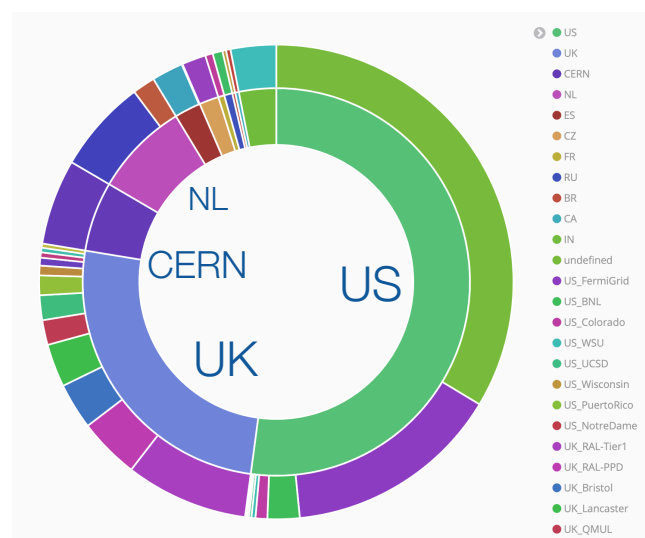


IRIS Funding

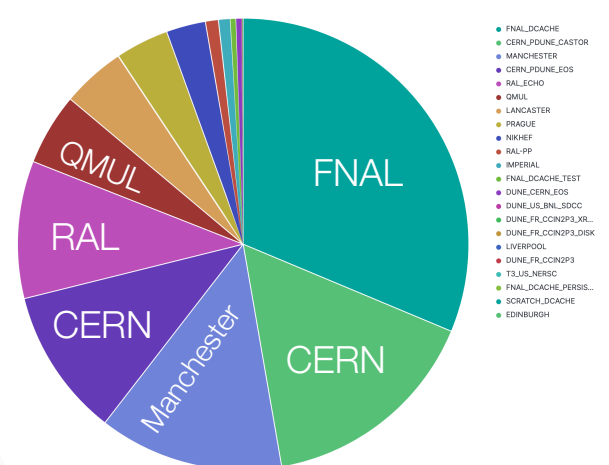
Initially DUNE ran within the 10% of capacity at GridPP sites provided to non-LHC experiments, but in 2018 the UK funded the IRIS project to provide computing capacity for astronomy projects and particle physics experiments other than those at the LHC. DUNE’s increase in resources was provided through IRIS. This required DUNE to submit responses to the annual IRIS resource allocation procedure and the DUNE resource estimation procedure was extended to supply the necessary justification, in parallel with the DUNE requests to the Fermilab Computing Resource Scrutiny Group process.

UK resources in context

This chart shows the fraction of CPU delivered by countries and sites for DUNE production jobs in 2022 Q1 and Q2, including FNAL and NERSC. The UK contributed 25% in this period.



The next chart shows a snapshot of storage usage in June 2022 at all sites, as DUNE prepared for the 2022 Data Challenge.



Computing development

The DUNE computing system has evolved from the heritage of neutrino and collider experiments based at Fermilab. To achieve the increase in scale required by DUNE it has been necessary to modernise the framework that was largely built around SAM (“Serial Access to Metadata”), dating back to the Tevatron collider experiments. Where possible DUNE is reusing tools developed for other HEP experiments and for WLCG.

DUNE has chosen to adopt Rucio as the basis for its data management strategy. UK staff have contributed core components of Rucio needed by DUNE and experiment specific modules needed to ensure consistency with the DUNE metadata catalogue.

The arrival of large amounts of storage at UK sites has also exposed limitations with the SAM-based framework when matching work to sites. To address this, the UK has led the DUNE workflow system design and development, which aims to run work at or near sites where the relevant data is stored where necessary. This optimisation is particularly important for UK sites which are designed with this model in mind, prioritising investment in local storage rather than streaming data from remote sites.