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Large-scale Simulation and Data Processing in the NOvA Experiment

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The NOvA experiment at Fermilab is a long-baseline neutrino experiment designed to study ν_e appearance in a ν_μ beam. The detectors' fine-grained design and many resultant channels, coupled with the variety of physics triggers, the high-intensity NuMI neutrino beam, and the large cosmic ray muon rate at the far detector location, together result in computing requirements previously unprecedented for a neutrino experiment. NOvA uses numerous advanced computing infrastructure tools to manage this data at high throughput. The 9 petabytes (70 million files) of simulated, raw, and reconstructed data currently maintained by the experiment are stored on tape and archived, catalogued, and addressed using Fermilab's Sequential Access via Metadata (SAM) system. Files are staged into cache areas using a massively extensible and parallelizable system called dCache, allowing sustained total data transfer rates of over 1 Gbps to a worldwide network of processing node farms. The experiment's software code is also deployed worldwide using the CERN VM File System (CVMFS), allowing fast, scaleable, site-independent access to the codebase. These developments enable NOvA to make heavy use of the Fermigrid and Open Science Grid to do simulation and processing, so that in steady state production, in excess of 10 million neutrino interactions can be simulated and analyzed per day. NOvA's extensive use of new computing tools continues to support the broad physics program that the experiment hosts, and has paved the way for their use by other current and future Intensity Frontier experiments at Fermilab.

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