

The high energy physics (HEP) community was a pilot application domain in Enabling Grids for E-science (EGEE), and is still the largest user of the EGEE grid infrastructure. The four Large Hadron Collider experiments at CERN, Europe's central organisation for nuclear research, are currently the major users of the infrastructure. Their production work involves more than 330,000 jobs each day and generates many hundreds of terabytes of data each year.

By their nature HEP applications are very demanding. Because of this they serve a powerful role in understanding and improving EGEE delivered services. The HEP experiments also produce high-level middleware components that often become valuable prototypes for other user communities. The expertise developed by HEP users is open to the other EGEE grid users. The HEP application domain is an important driving force within the EGEE project and promotes progress across many scientific disciplines.

### Large Hadron Collider experiments

The Large Hadron Collider (LHC) is a new particle collider located at CERN in Geneva, Switzerland. CERN hosts four major LHC experiments: ALICE, ATLAS, CMS and LHCb. These use grid resources both from EGEE as well as sister projects such as Open Science Grid in the US and the Nordic DataGrid Facility in Europe. The LHC collaboration has established a globally distributed production environment for physics data processing. Use of the EGEE infrastructure has already started on a large scale and it is an essential tool for the preparation of the LHC project's scientific programme. This usage stress-tests the infrastructure in preparation for the start of the LHC data-taking.

While each experiment has different physics goals, all need to perform massive simulation studies of the 'events' that will be produced when high energy beams of protons or heavy ions. **ALICE** (A Large Ion Collider Experiment) aims to study the physics of strongly interacting matter at extreme energy densities, where the formation of a new phase of matter, the quark-gluon plasma, is expected. **ATLAS** (A Toroidal LHC Apparatus) will explore the fundamental nature of matter and the basic forces that shape our universe. **CMS** (Compact Muon Solenoid) will explore new physics at high energies, in a bid to find the Higgs boson and evidence for supersymmetry. Finally **LHCb** focuses on the study of the violation of charge and parity (CP) symmetry. This effect might be responsible for the matter/antimatter imbalance at the birth of the universe.

### Towards a real data taking regime: the CCRC'08 exercise

In preparation for real data taking, the four LHC experiments performed in 2008 a large scale exercise called Common Computing Readiness Challenge 2008 (CCRC'08). For the first time, the four experiments stressed both their own computational models and the grid infrastructure — four at once.

Large and realistic productions using real data recorded by cosmic rays have been performed putting all grid elements and services together and simulating what the experiments will face in real conditions. The full exercise also stressed the service, support and operation protocols and procedures defined by the grid team towards an efficient data taking approach. This exercise, which is planned to be repeated every year during the scheduled machine shutdown, can be used by any other community as experience and guide to set their own grid infrastructure towards a stable production regime. Further information is available at [www.cern.ch/lcg](http://www.cern.ch/lcg).

### Further grid projects at CERN

CERN also supports other research communities whose fields are not fully related to HEP. Some examples of communities which have been ported to the grid using the EGEE infrastructure include humanitarian projects as UNOSAT (UNO agency), worldwide telecommunication setups with the International Telecommunication Union agency (ITU from UNO), multipurpose simulation tools as Geant4, theoretical physics applications such as Lattice QCD studies and beam tracking and collimation studies of the LHC. The project focusing on beam studies opens interesting collaboration opportunities with other research fields, such as the Fusion environment and collaboration with other research centres such as ITER. For more information visit <http://lcg.web.cern.ch/LCG/activities/arda/arda.html>.

A set of toolkits has been developed at CERN with the HEP support team which help the grid work in a more effective and user-friendly way. These tools, which were developed to assist the high energy community have been successfully exported to other communities as “gridification” standard tools used by a large number of research fields:

- **Ganga**, used to submit to a large number of distributed computing environments including Grid resources with the same interface;
- **Diane**, used to optimise the usage of the available resources;
- **AMGA**, a metadata catalogue;
- **Dashboard**, a standard and general monitoring tool of the user jobs and the status of the resources.

Each of these tools was created for the high energy physics community and later exported to other fields.

### Non-LHC HEP applications

Other HEP experiments using the EGEE infrastructure are advanced projects already in data-taking mode. The following experiments have their full processing chains in place, and produce physics results on a regular basis. Some examples are the CDF (Collider Detector at Fermilab) and D0 experiments from the Fermi National Accelerator Laboratory in Illinois, US, which use the Tevatron Collider to discover the identity and properties of the particles that make up the universe. The BaBar experiment, at the Stanford Linear Accelerator Center, California, US, studies CP violation in the decay of B mesons. Also the H1 and ZEUS experiments located at the electron-proton collider HERA at DESY in Hamburg, Germany, study particle reactions to advance the understanding of the fundamental particles and forces of nature.

### Application webpages

EGEE is keen to consider other applications. For further information on how to participate see <http://technical.eu-egee.org/index.php?id=392>.

More information about the applications running on EGEE be found on the EGEE website at <http://technical.eu-egee.org/index.php?id=148>.

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