HEP APPLICATIONS

The High -Energy Physics (HEP) community is one of the pilot application domains in EGEE, and is the largest user of the EGEE Grid infrastructure. The four LHC experiments at CERN are currently the major users of the infrastructure, with very large-scale production work involving more than 20,000 jobs/day and generating many hundreds of terabytes of data each year. Other major HEP experiments, such as BaBar, CDF, H1, ZEUS and DØ, have also adopted Grid technologies, and use the EGEE infrastructure for routine physics data processing.

By their nature, the demanding HEP applications also serve as a powerful means to understand and improve the services delivered by EGEE. This is true for all services, ranging from documentation and user support to middleware evolution. In addition, the HEP experiments produce valuable high-level middleware components that can be regarded as prototypes for the overall Grid community. More generally, the experience developed by HEP users is open to the other EGEE Grid users: the HEP application domain is one of the driving forces within the EGEE project and collaboration across different sciences is a powerful tool for progress.

Large Hadron Collider (LHC) Experiments

The LHC is a new particle collider currently under construction at CERN (The European Organization for Nuclear Research) in Geneva, Switzerland, for which four major experiments are being constructed: ALICE, ATLAS, CMS and LHCb. These are using Grid resources – both from EGEE as well as from sister projects such as OSG in the USA and NDGF in Europe – to establish a globally distributed production environment for physics data processing. Use of the EGEE infrastructure has already started on a large scale, and is now routine, used as an essential tool for the preparation of the LHC project's scientific programme. As a by-product, this usage stress-tests the infrastructure in preparation for the start of the LHC data-taking in 2008.

Each experiment has different physics goals but all need to perform massive simulation studies of the 'events' that will be produced when high energy beams of protons or heavy ions collide.

- **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.
- **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.

Last Update: 14/09/2007

EGEE-II is a project funded by the European Commission - contract number INFSO-RI-031688

Non-LHC HEP applications

Other HEP experiments using the EGEE infrastructure are advanced projects already in data-taking mode. They represent the state-of-the-art of physics research, and anticipate some of the challenges awaiting the LHC experiments. In addition they are interesting to EGEE as they explore Grid use cases either different from or anticipating the needs of the LHC experiments. For example, since they have been in data-taking mode for several years, they have their full processing chains in place, and produce physics results on a regular basis. Some examples are:

- **BaBar**, a HEP experiment located at the Stanford Linear Accelerator Center in California. The goal of the experiment is to study CP violation in the decay of B mesons.
- The **CDF** (Collider Detector at Fermilab) experiment aims to discover the identity and properties of the particles that make up the universe, and to understand the forces and interactions between those particles.
- The **DØ** experiment is located at the Tevatron Collider at the Fermi National Accelerator Laboratory (Fermilab) in Batavia, Illinois, USA, and searches for subatomic clues that reveal the character of the building blocks of the universe.
- The **H1** and **ZEUS** experiments at the electron-proton collider HERA at DESY in Hamburg, Germany, are studying the particle reactions to push forward the understanding of fundamental particles and forces of nature.

EGEE is keen to consider other applications. For further information on how to participate, as well as more information about the applications running on EGEE, visit the User and Application Portal at http://egeena4.lal.in2p3.fr/

Last Update: 14/09/2007

EGEE-II is a project funded by the European Commission - contract number INFSO-RI-031688