

Fermilab's Enterprise Quality Grid Computing Center



Energy Conservation Measures

- ✓ Separate hot, cold aisles
- ✓ Cold aisle air containment
- ✓ Blanking and threshold panels on racks
- ✓ Elevated cold aisle temperatures
- ✓ Overhead cabling
- ✓ Cold air supply under raised floors with air conditioners ducted to hot air layer near ceiling
- ✓ Air conditioning mated to temperature sensor in front of computer racks
- ✓ UPS units with greater than 90 percent efficiency

Temperature Monitoring

- 24/7 web-based temperature monitoring.
- Thermocouple sensors provide readings.



White temperature probe positioned on a rack (thermocouple)



Webservice box with thermocouple connections

Enabling Scientific Research

The GCC distributes and stores experiment data that's accessible by collaborators worldwide, providing computing support for:

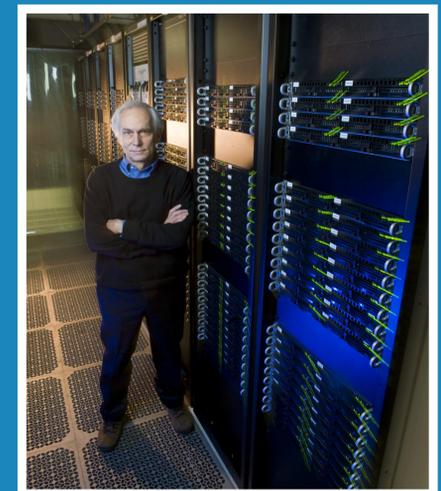
- **Compact Muon Solenoid (CMS)** experiment, running analysis jobs (typically 120-200k jobs/week), collecting 4-5 petabytes of data per year (CMS has a 200GB per second network allocation) and filling one tape robot every 2 years.
- **Lattice Quantum Chromodynamics (LQCD)** experiment, including high performance computing (Lattice Gauge calculations).
- **CDF and Dzero**, Run II experiments that utilize GCC resources for reconstruction and analysis (turning raw data into physics objects). Support continues for Monte-Carlo production and analyses.
- **Dark Energy experiments**, including massive surveys, simulations and high precision models.
- Accelerator modeling



Enstore tape library



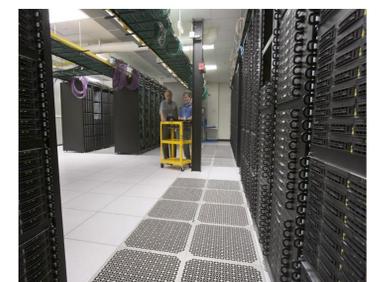
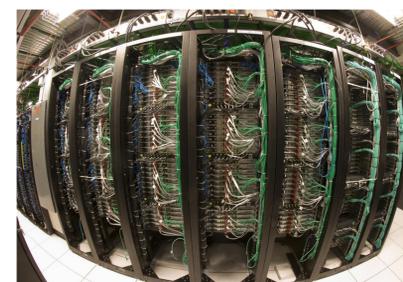
Energy-efficient overhead cabling



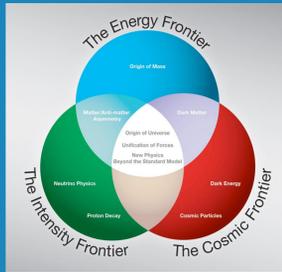
Paul Mackenzie next to the Lattice QCD farm

Former Wide Band Lab (1997)

GCC conversion (2004)



Grid Computing Center Metrics



Mission

Provide researchers with the facilities to conduct research into the high energy physics, intensity and cosmic frontiers. Maximize assets including networking, data storage robotics, grid and cloud computing to optimally arrange large clusters of computers and storage solutions to support the production of scientific results.

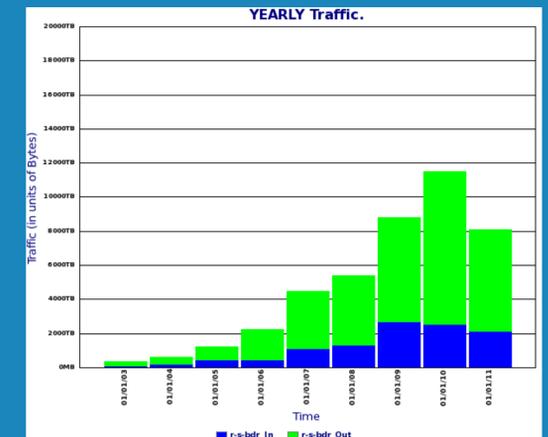
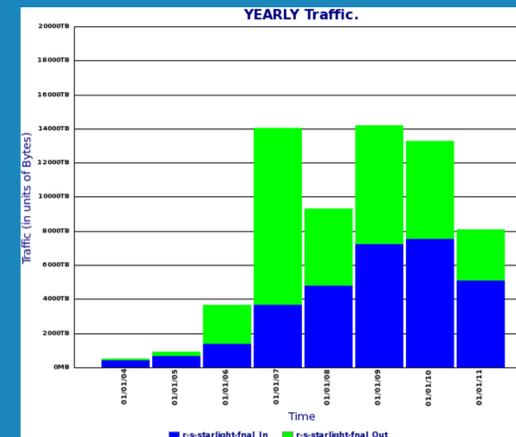
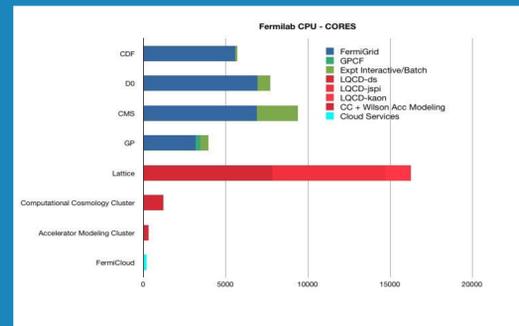
High Speed Networking

High-speed networking to and from facilities at Fermilab and on to facilities across the world enables the collection, archiving, processing, simulation and analysis of data from global scientific programs.

2011 Facility Statistics

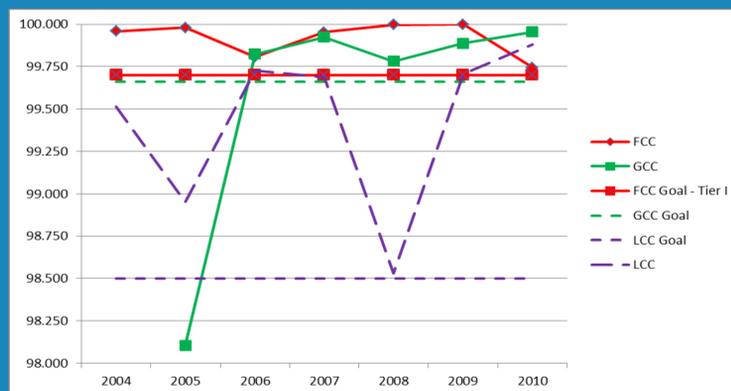
- ✓ 10,384 sq. ft. of raised floor data center
- ✓ 255 rack spaces for high-density computers
- ✓ 6,000 computers (multi-CPU, multi-core)
- ✓ 4 tape robots
- ✓ Building consumes 2.5 megawatts of power
- ✓ Computers consume 10 kilowatts per rack
- ✓ More than 6,000 computers using 1.5 megawatts of power
- ✓ 1,000 tons of air conditioning removing heat generated by computers

CPU Core Count for Science



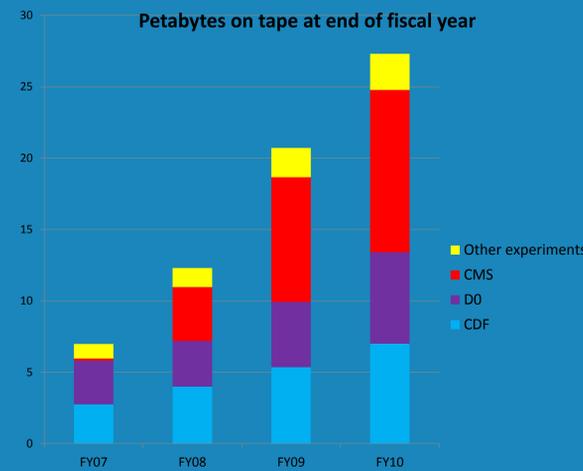
Computer Room Availability

- ✓ 99.75% average up time (Since 2006)



Experiment Data Storage

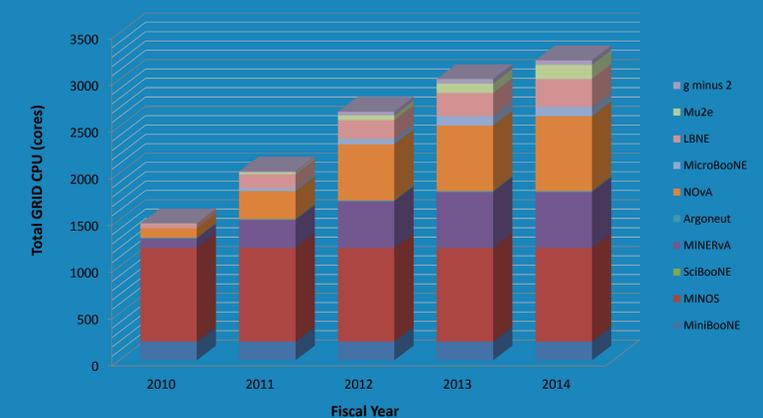
Energy and Intensity experiments' Tape storage demand has tripled since 2007.



Intensity Frontier Demand

By 2014:

- ✓ Total Grid CPU cores for each experiment projected to increase by 1100.
- ✓ Total disk space expected to double.



GCC Capacity & Usage

- ✓ Capacity / demand is steadily increasing
- ✓ Highly available for computer power usage

