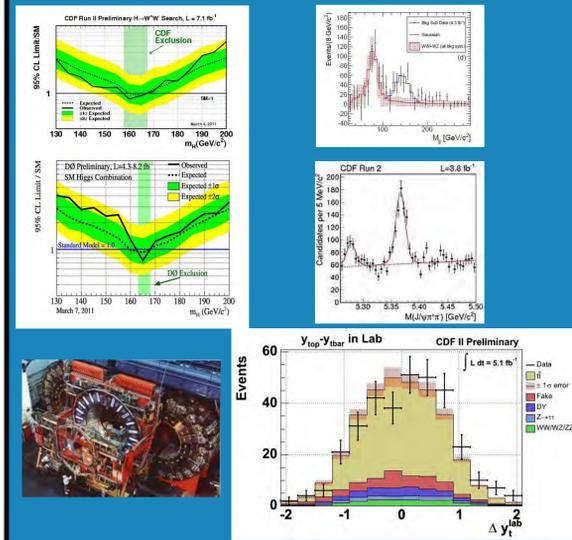


# FermiGrid

Supporting local and remote users sharing resources across Fermilab and the Open Science Grid

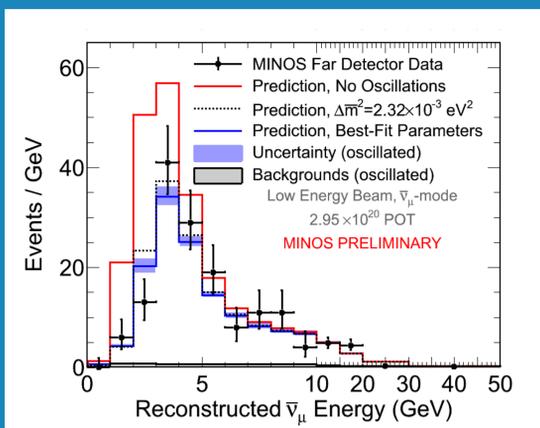
## CDF Science Results

- Use FermiGrid, Open Science Grid, INFN and KISTI



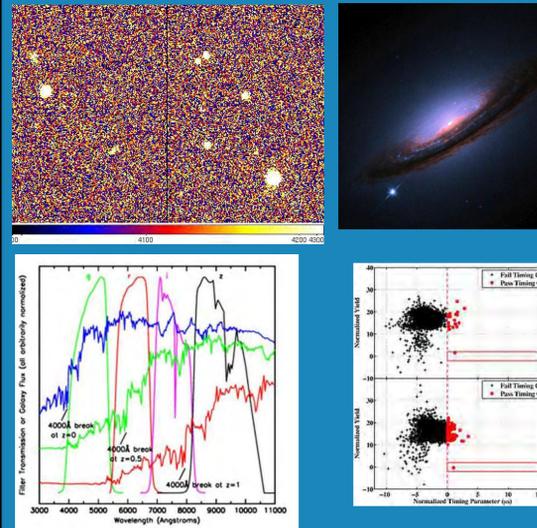
## Intensity Frontier Science Results

- All experiments use Grid computing



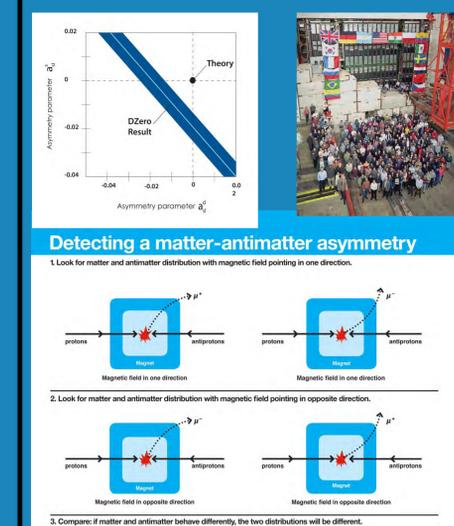
## Cosmic Frontier Science Results

- All Experiments use Grid computing



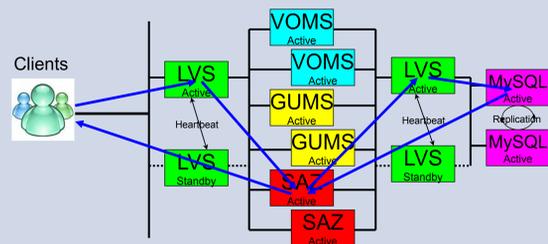
## D0 Science Results

- Use FermiGrid, Open Science Grid, EGI for monte-carlo simulation and reconstruction



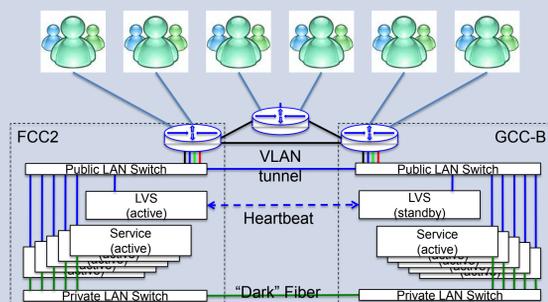
## FermiGrid-HA Services

### Service Redundancy

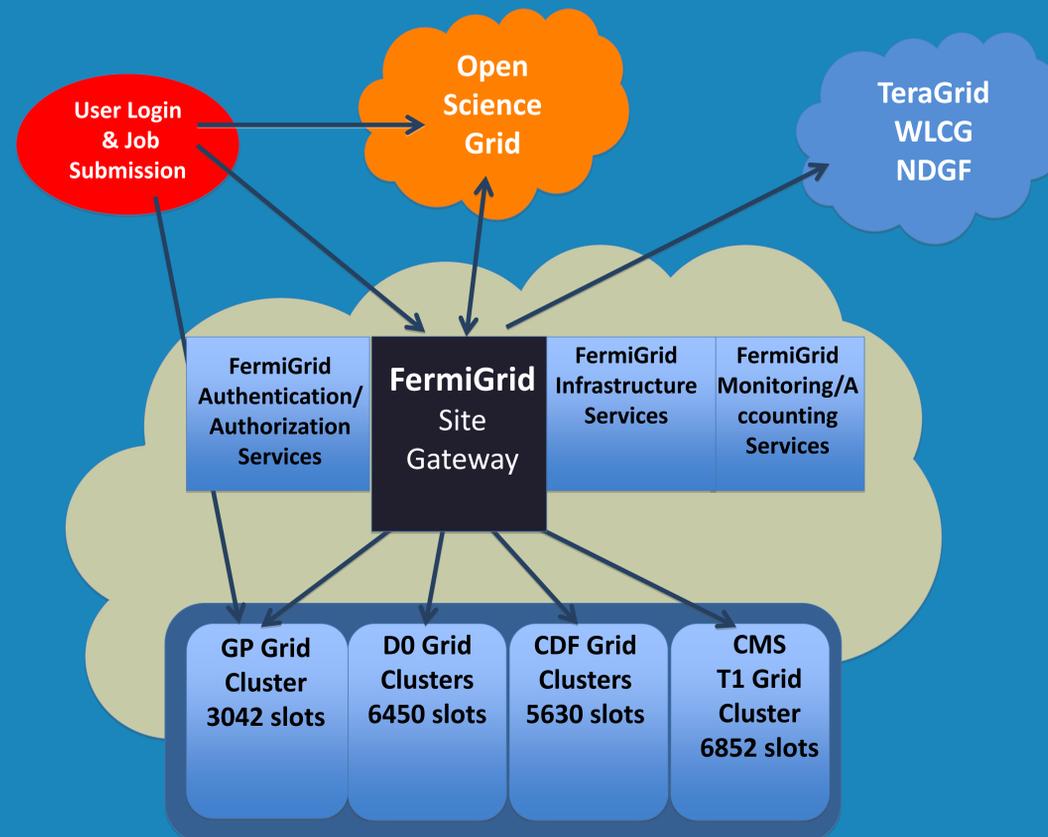


Service	Raw Availability	HA Configuration	Measured HA Availability	Minutes of Downtime
VOMS – VO Management Service	99.657%	Active-Active	100.000%	0
GUMS – Grid User Mapping Service	99.652%	Active-Active	100.000%	0
SAZ – Site Authorization Service	99.657%	Active-Active	100.000%	0
Squid – Web Cache	99.640%	Active-Active	100.000%	0
MyProxy – Grid Proxy Server	99.954%	Active-Standby	99.954%	240
ReSS – Resource Selection Service	99.635%	Active-Active	100.000%	0
Gratia – Fermilab and OSH Accounting	99.365%	Active-Standby	99.997%	120
Database	99.765%	Active-Active	99.988%	60

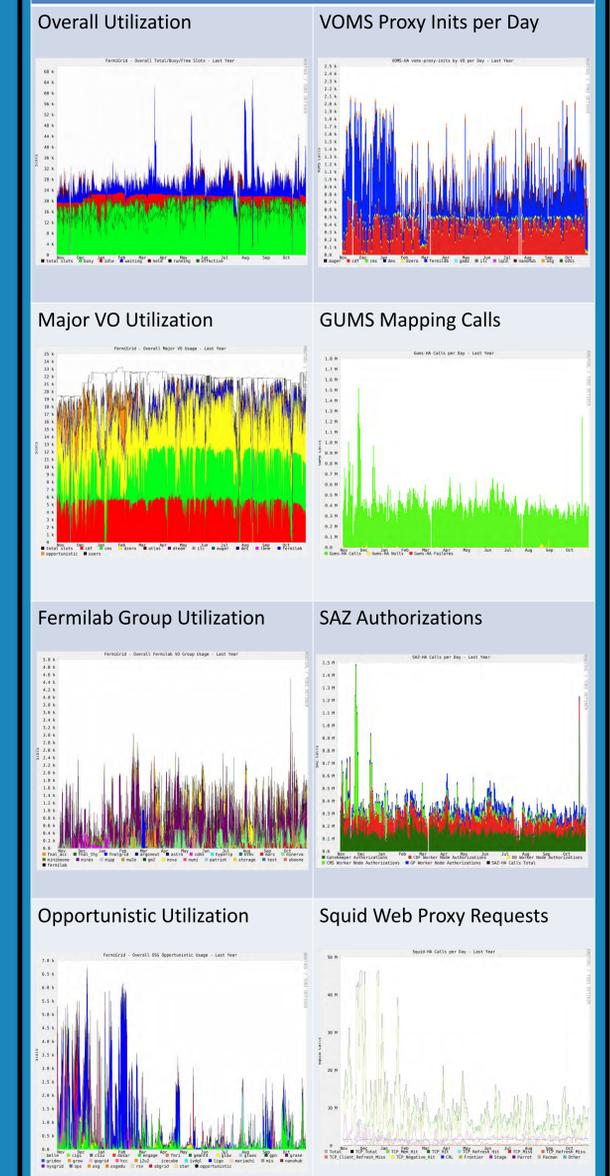
### Geographic Redundancy



## FermiGrid Architecture



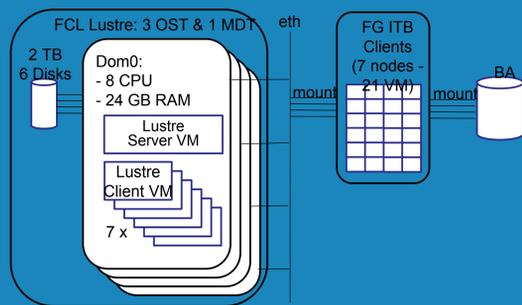
## FermiGrid Performance



# FermiCloud: A private cloud to support Fermilab Scientific Users

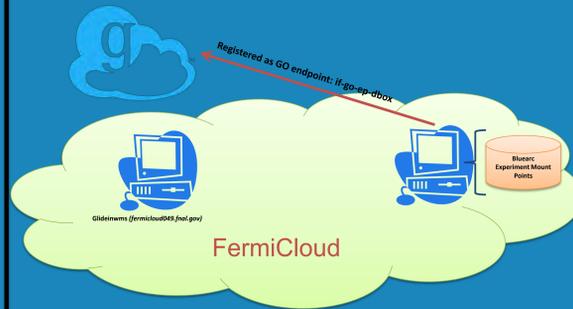
## Intensity Frontier Storage

- FermiCloud configurable test bed, 10TB of storage per node, dedicated network
- Run real MINOS and NOVA user code on Lustre, Hadoop, OrangeFS



## Intensity Frontier Data Transfer

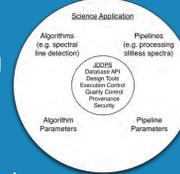
- Flexible service deployments for several experiments
- Gridftp endpoint server hosted in FermiCloud
- Grid users can transfer output files back to experiment disk at Fermilab.
- Files have right user and group.



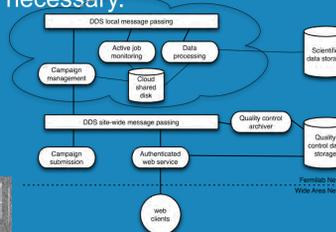
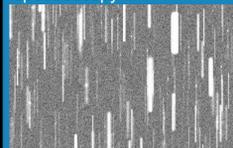
End-To-End Solution using Globus Online & GlideinWMS

## Cosmic Frontier Fault-tolerance Development

- Demonstration Data Processing System
- Data Distribution Service with distributed message passing
- Cloud environment gives isolated private net, fault tolerance testing, interactive login if necessary.



Baryon acoustic oscillations simulation of slitless spectroscopy



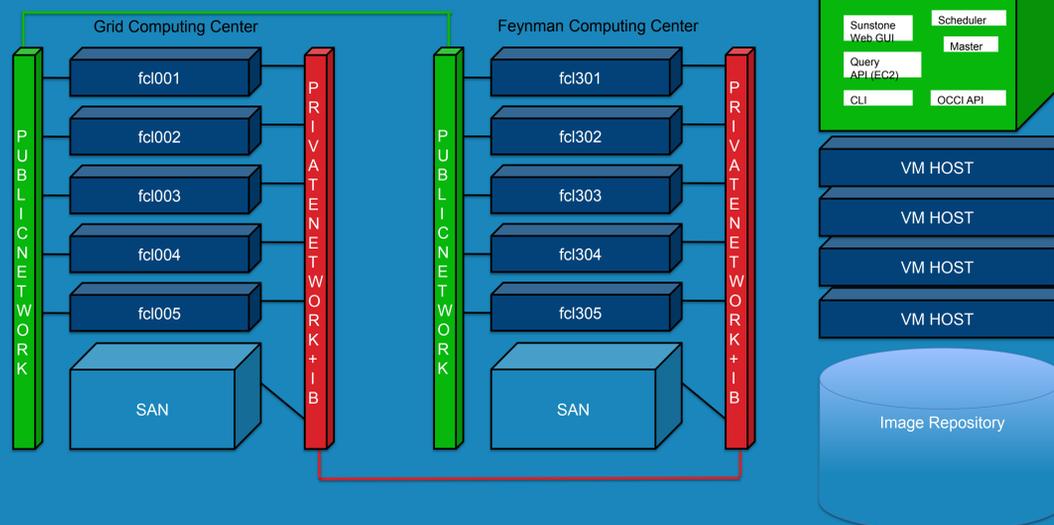
## D0 SAMGRID Service Hosting

- Forwarding Node Servers divide a project into individual jobs and submit to the grid.
- Low CPU and network requirements, good candidate for virtualization.
- Increased hosting efficiency through multiple services on one physical node.

## What is FermiCloud?

- Infrastructure-as-a-service private cloud for Fermilab Scientific Program.
- Integrated into Fermilab site security structure.
- Virtual machines have full access to existing Fermilab network and mass storage devices.
- Scientific stakeholders get on-demand access to virtual machines without system administrator intervention.
- Virtual machines created by users and destroyed or suspended when no longer needed.
- Testbed for developers and integrators to evaluate new grid and storage applications on behalf of scientific stakeholders.
- Ongoing project to build and expand the facility:
  - Technology evaluation, requirements, deployment.
  - Scalability, monitoring, performance improvement.
  - High availability and reliability

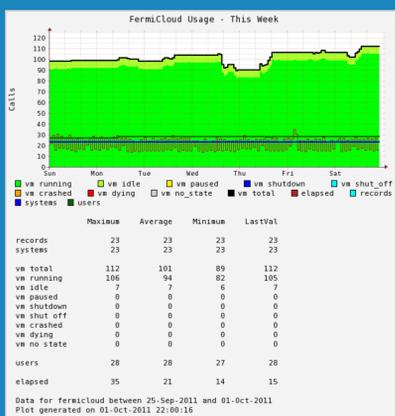
## FermiCloud Architecture Diagrams



## FermiCloud Operations

- Stock virtual machine images are provided for new users.
- Active virtual machines get security patches from site patching services.
- Dormant virtual machines get woken up periodically to get their patches.
- New virtual machines scanned by site anti-virus and vulnerability scanners, don't get network access until they pass.
- Three levels of service:
  - 24 by 7 high availability, can have fixed IP number,
  - 9 by 5 development/integration, use one of a pool of fixed IP's,
  - Opportunistic—Can be pre-empted if idle or if higher-priority users need cloud.

## FermiCloud Metrics



In production for 1 year, number of VM's quadrupled during that time.

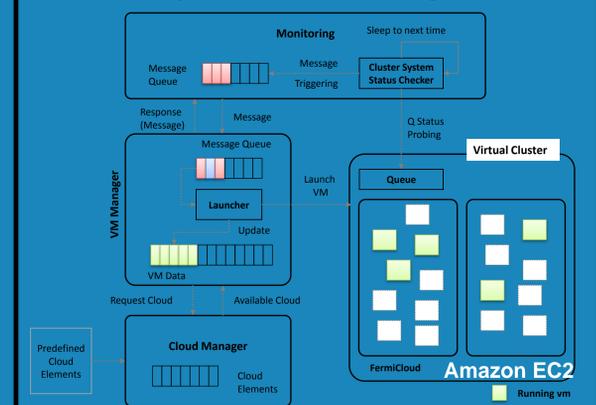
## X.509 Authentication

- Use OpenNebula Pluggable authentication feature.
- Wrote X.509 authentication plugin and contributed back to OpenNebula, included in OpenNebula 3.
- X.509 Authentication is integrated into command line tools, EC2 Query API, OCCI API, SunStone management GUI.
- Contributing to standards bodies to make authorization callout to external services, similar to Grid authentication.

## Fabric Investigations

- Easily reconfigurable test bed to test new technologies and configurations
- Small MPI applications with Infiniband-enabled virtual machines. Collaboration with KISTI.
- Test bed for IPv6 investigations.
- SAN investigation for live migration and failover between buildings in case of a building failure.

On-demand Grid Cluster in Cloud  
Increase utilization of physical resources with shared opportunistic grid jobs;  
Also prototype for cloudbursting to EC2



Joint investigation with KISTI