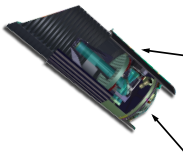
A Concept for JDEM Science Computing and Operations

Erik Gottschalk (Fermilab) on behalf of the JDEM/DOE Ground Data System Team

The Joint Dark Energy Mission (JDEM) is a collaboration between NASA and the U.S. Department of Energy (DOE) to build a space telescope for the study of dark energy using several complementary techniques. The primary scientific objective is to determine the nature of dark energy in the universe by measuring the expansion history and the growth rate of large scale structure. DOE's responsibilities include the fabrication of a major science instrument and the development of a Science Operations Center.



Launch and early orbit support

White Sands Complex

Ka-Band Telemetry

S-Band Command, Telemetry, Tracking

Commands Telemetry

Deep Space Network (DSN)

Tracking

Orbit

Flight Dynamics Facility

Mission Operations Center (MOC)

- Spacecraft and instrument health and safety monitoring
- Real time and stored command load generation
- Spacecraft subsystem trending and analysis
- Level 0 processing
- Mission planning and scheduling
- Ground System monitoring
- Anomaly Resolution
- Safemode Recovery

NASA

Level 0 Data

Instrument Commands

Pointing plans & schedules

Science Support Center (SSC)

- **Ingest Level 0, 1, 2, 3 data and calibration products**
- **Perform relevant Level 3 processing as required by science teams**
- **Collaborative development, with SOC, of pipeline architecture and standards**
- **Science team and participating science support**
- **Run JDEM Participating Science Program**
- **Outreach to astronomy community**
- **Education and Public Outreach**
- **Science planning & scheduling interface to science teams, MOC, and SOC**

NASA

Level 0,1,2,3 Data

Level 0,1,2,3 Data

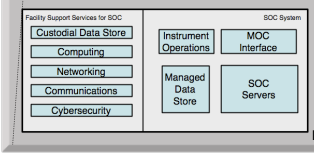
JDEM Archive Center

Science Operations Center (SOC)

- Ingest Level 0 data and generate FITS files
- Perform Level 1 and Level 2 data processing
- Perform relevant Level 3 processing and pipeline development as higher level data products become available
- Perform data challenges
- Develop science analysis software
- Develop calibration software
- Instrument health and safety monitoring
- Instrument simulation and mock data generation
- Monitor instrument performance, trending and housekeeping
- Instrument command validation & command interface to MOC
- Maintain instrument testbed for verification & anomaly resolution
- Generate and transmit instrument-generated science triggers
- Transmit Level 0, 1, 2, 3 data to SSC & archive

DOE

SOC Infrastructure

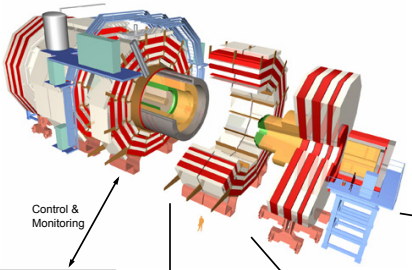


DOE

The Compact Muon Solenoid (CMS) experiment is one of the colliding beam experiments that will begin operating at the Large Hadron Collider (LHC) at CERN in 2009. In the U.S., the LHC Physics Center at Fermilab provides science support to CMS scientists. Remote operations capabilities are expected to help streamline CMS operations. The development of these capabilities began at Fermilab with the LHC@FNAL Remote Operations Center and has evolved into numerous remote operations and monitoring centers around the world.

Capabilities similar to those developed for CMS at Fermilab can be used for JDEM science computing and operations, and to support science teams. This includes computing, networking and mass storage infrastructure, as well as quality control, provenance tracking, and workflow management. Compared to the computing resources that Fermilab has deployed for CMS, JDEM will need a small fraction of available resources and can therefore leverage existing capabilities.

LHC@FNAL Remote Operations Center



Control & Monitoring

CMS Control Room

- Detector health and safety monitoring
- Detector and trigger operations
- Detector calibration
- Real time data quality monitoring

CERN

Monitoring

Triggered Data

CMS Tier 0 Computing

- Prompt reconstruction of data
- Time critical calibration
- Calculate conditions/alignment data
- Perform data challenges
- Data archiving

CERN

Tier 0 Data

Monitoring

CMS Computing and Operations at Fermilab

- Ingest Tier 0 data from CERN (10 Gbps network links)
- Perform Tier 1 data processing, which consists of reprocessing data with new conditions/alignment constants or new software
- Serve data to Tier 2 sites for data analyses
- Perform Tier 3 processing (science team data analyses)
- Perform data challenges
- Data quality monitoring shifts (real time & offline monitoring)
- Monitoring of data processing and data movement
- Data archiving
- Science team support

FNAL

CMS Science Computing at Fermilab

- Current core count = 11,000 (24,000 total)
- Current disk space = 6 PB (10 PB total)
- Current tape capacity = 24 PB (48 PB total)

(Tape cartridge capacity doubles every 2-3 years)

CMS Centre @ CERN

- Data quality monitoring shifts (real time & offline monitoring)
- Monitoring of data processing and data movement
- Provide updated conditions/alignment data
- Science team support

CERN

Fermilab is operated by Fermi Research Alliance, LLC under Contract No. DE-AC02-07CH11359 with the United States Department of Energy.