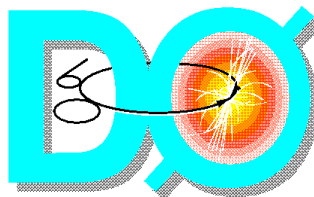


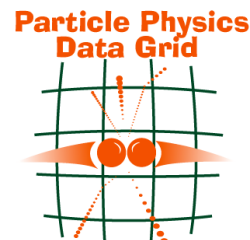
### D0 Remote Reprocessing.

D0 has successfully reprocessed over 500 million events using a distributed system that included grid tools and tested grid functionality

News Update – 26th April 2004



D0 Experiment



Particle Physics Data Grid

The DØ experiment has repeated the reconstruction of all its recorded data to create a homogeneous dataset for physics analysis based on an up to date understanding of the detector. To finalise this effort in time for the winter conferences new computing resources had to be exploited. DØ therefore performed the task in a fully distributed manner utilising 6 computing centres in 6 countries, using its computing software SAMGrid to distribute the data and retrieve the reprocessed data for storage.

The data were for the most part transmitted using Grid file transfer protocols, and some of the centers used Grid management tools provided by PPDG effort.

#### Overview

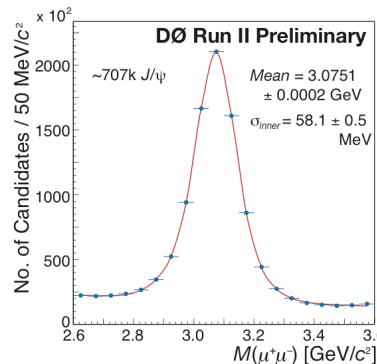
DØ has been steadily using and further developing its distributed data handling system Sequential Access using Metadata (SAM) for simulation montecarlo data creation and processing before the start of data taking, and for data acquisition, processing and analysis of data acquired from the Tevatron over the last two years.

During the months of November 2003 – January 2004 a reprocessing of the complete dataset has been done. Twenty percent of the 500 million events were reprocessed using non-Fermilab computing resources, with the input and output processed event data being transmitted using GridFTP.

The success of the reprocessing project meant that physics results using improved reconstruction were completed in time for the Moriond and Lathuile conferences in March.

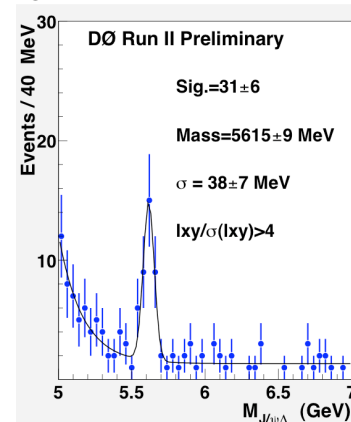
The plots show data samples which have improved as a result of using the newer reconstruction version. The alignment of the detector was improved significantly in the reprocessed data, leading to improved resolution in samples like the J/Ψ mass plot shown in the first plot below.

The well-known resonances like the J/Ψ are important both in the calibration of the detector and for a wide range of B physics studies.



The second plot below shows the detection of a signal for the Λ<sub>b</sub> decaying to Λ and J/Ψ.

Clearly, the second aspect of the improved reconstruction, higher efficiency for track detection, is important in the detection of samples with small statistics in the present data set. The study of the Λ<sub>b</sub> lifetime, once more statistics have



been accumulated, will be an important contribution to understanding whether the current theoretical predictions regarding the lifetimes of B baryons compared with B mesons are correct (current experimental results show some discrepancies).

#### Data Transfer with GridFTP

Over 50 Terabytes of event data were transported with GridFTP into and out of the central mass storage system at Fermilab by the reprocessing effort. Tens of Terabytes have been transmitted for simulation and offsite analysis (there are more than

650 Terabytes of data stored in the mass storage system for DØ). Using multiple streams in GridFTP has increased the throughput rate a factor of 5 over previous FTP technology.

### Condor Matchmaking Extensions

Matchmaking at the Grid scheduler level was developed for Condor-G as part of PPDG through the direct collaboration of the D0 and Condor teams. The extensions developed are now part of the standard Condor product releases and are used by biology applications at the University of Wisconsin and elsewhere.

### SamGrid JIM Job Scheduling

Through this PPDG effort, in parallel with the reprocessing work, Grid based job scheduling, management and monitoring (JIM) has been introduced into the system on a still larger scale. Some of the continuously ongoing production of simulated events for the use of the physics analysis groups has now been converted to using the JIM job submission machinery within SAMGrid. In addition to the improvement to operational convenience, this conversion has produced the tangible benefit to the DØ experiment of being able to use resources from an institution (the University of Wisconsin) which is not even a collaborating institution on the DØ physics program.

It is a considerable achievement to bring the use of the Grid job and information management technologies – Condor-G, Globus Gatekeeper, Dagman, MDS – into a real production system with all the implications that brings with regard to robustness and broad deployability.

In 2004, more than 8000 jobs have been run using the JIM based job planning and management tools based on Condor-G matchmaking. For DØ, JIM job execution is being used since March as the standard mode at 3 sites, (CCIN2P3 in France, Manchester in the UK, Wisconsin in the US).. Early use of the JIM technology has convinced the physicists that gains in effort of 1-2 FTEs over the 5 FTEs needed for the recent reprocessing are achievable in the next 12 months and that the efficiency of processing results will be sufficient for a production operation.

The following metrics were the result of focussed attention to improving the robustness of each

component of the system. The infrastructure efficiency quoted in the table refers to the efficiency for submitting a job and having it successfully start to run on the remote site – this efficiency was improved by systematically chasing down problems in the SAMGrid and middleware portions from a quite low number in the earliest commissioning to the current stable 99%. The second number is the efficiency obtained by looking at the fraction of events stored into SAMGrid and available to end users over the events requested in that submission.

The number of events from a given request available to users is easily obtained with a query to the SAMGrid metadata catalog. This efficiency includes a huge range of operational effects, from downtimes and problems at the respective centers to crashes in the experiment's simulation executables, so it can vary substantially week to week; we quote the numbers from our first post-commissioning week.

The experience using local submission tools is that sustaining this number in the 90% range constitutes very good performance, so it is quite encouraging to obtain some comparable numbers in a new system of considerable complexity, although we continue to work on a variety of issues to gain further improvement.

Test results from 1 week of testing	UK	France	U.S.
Grid Job Planning and Management (JIM) infrastructure efficiency	>99%	>99%	>99%
End to end efficiency of running the application	~85%	~60%	~60%

### Future Plans

DØ's future plans call for continuing the collaboration with the Condor and Globus teams, towards using the full SAMGrid machinery, including JIM job submission, for all simulation production by the end of summer. The infrastructure will also be used for the next major round of reprocessing which will start sometime between June and October 2004. This round will be an even heftier undertaking, with 6 months of flat-out running on the available remote resources. The experiment will work with the Condor team to move toward greater reliance on automated scheduling.