Data Preservation at D0

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5th Workshop on Data Preservation and Long Term Analysis in HEP

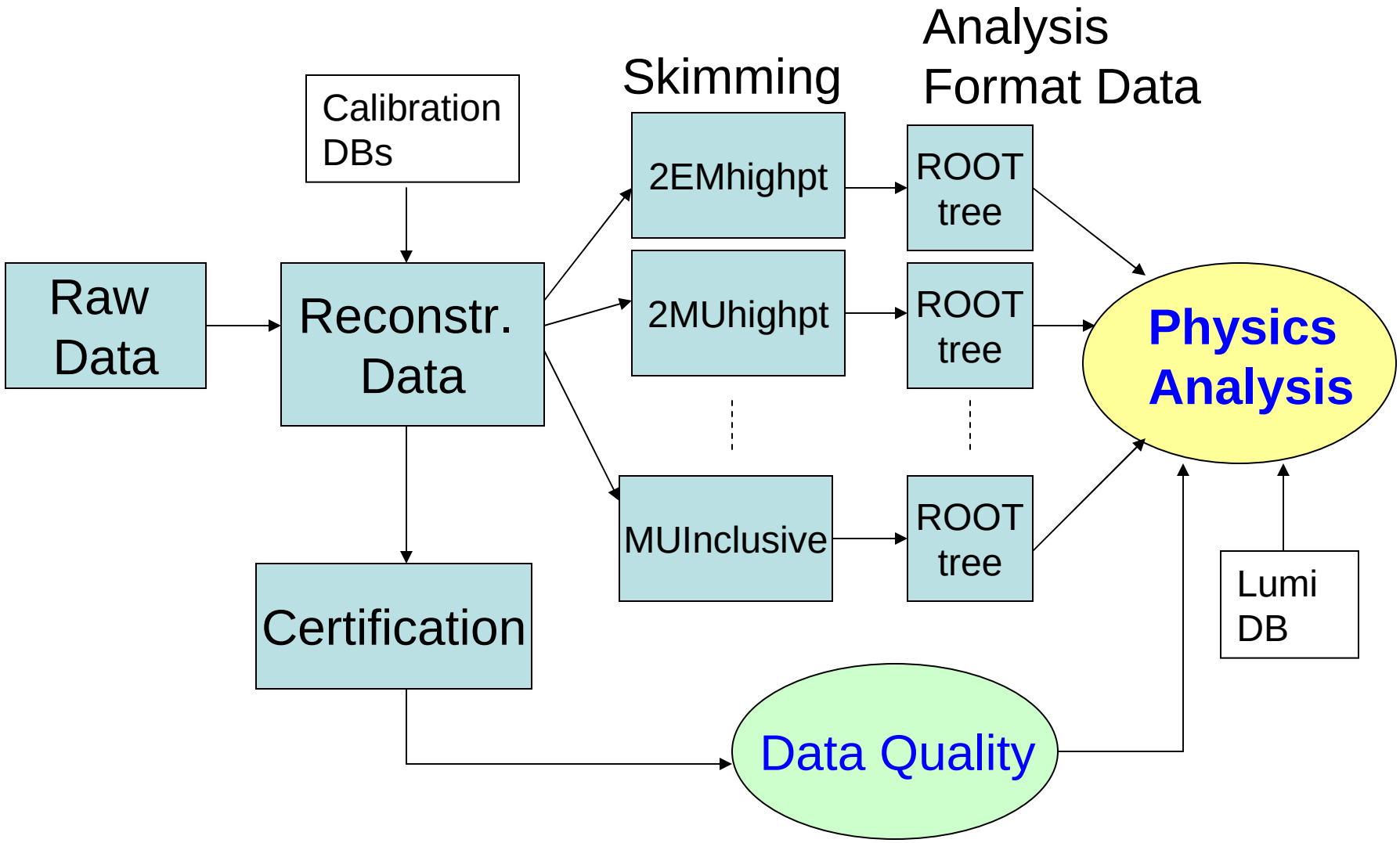
Outline

- Overview of D0 computing
- Current plans after Tevatron run ends
- Data preservation at D0

Overview of D0 Computing

- Data Reconstruction
  - Local farms (FermiGrid) with mature and stable algorithms
- Monte Carlo Generation
  - Remote Farms (OSG, LCG, native SamGrid, and non-grid, etc.)
- Analysis
  - Local clusters
  - CPU-intensive analyses use grid resources

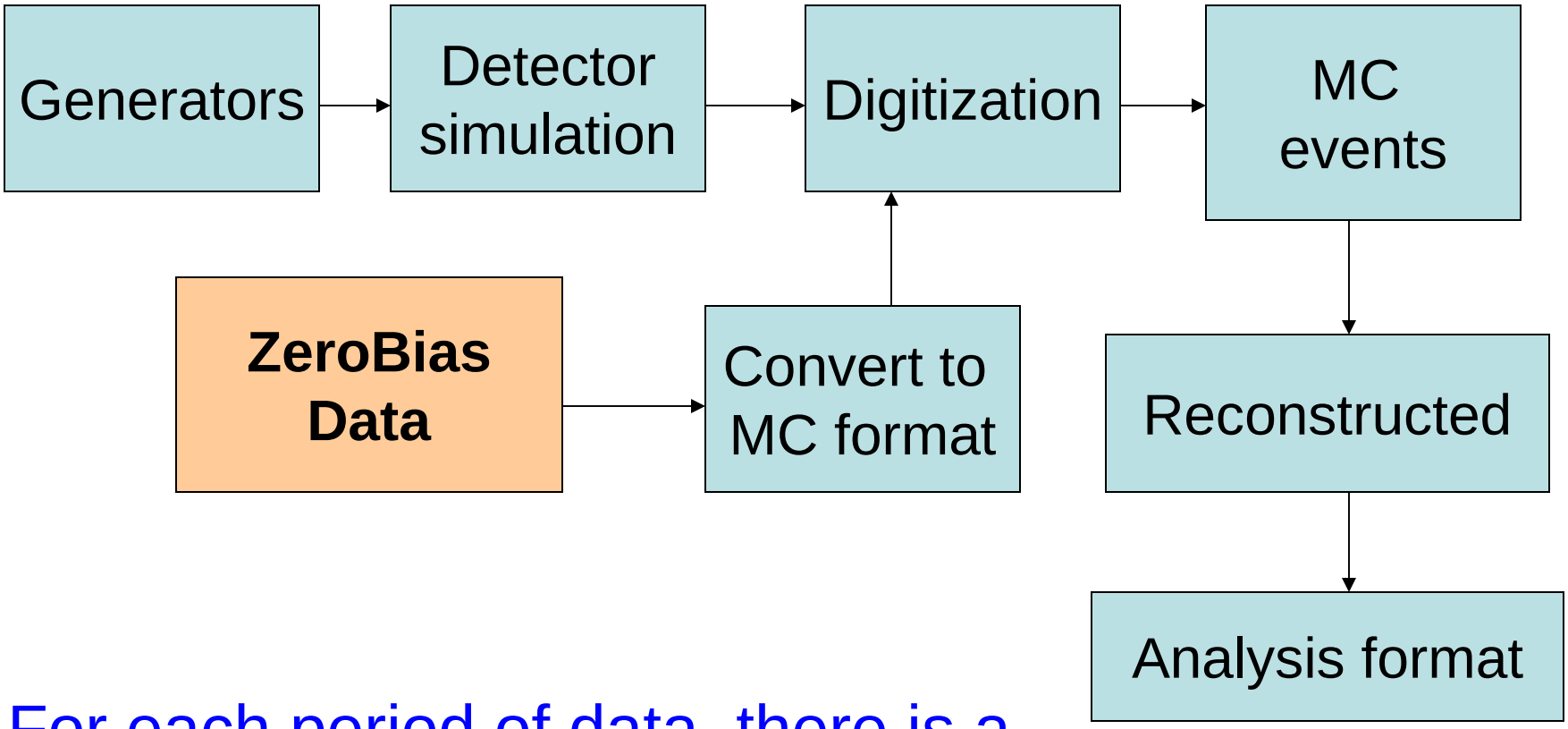
D0 Analysis Model



Data Processing and Handling

- The data reconstruction is done on two farms:
  - a local data processing farm at D0 and
  - a General Purpose farm at Fermilab
  - process ~2 billion events per year
- D0 data are stored in several kinds of formats:
  - Raw data
  - Reconstructed data (Physics Objects)
  - Analysis format data (ROOT-tree)
- All data are put into SAM (a data handling system) to be stored into a Fermilab mass storage system, Enstore.
- SAM uses a set of servers, communicating via CORBA database, to store and retrieve files and associated metadata.

Monte Carlo Simulation

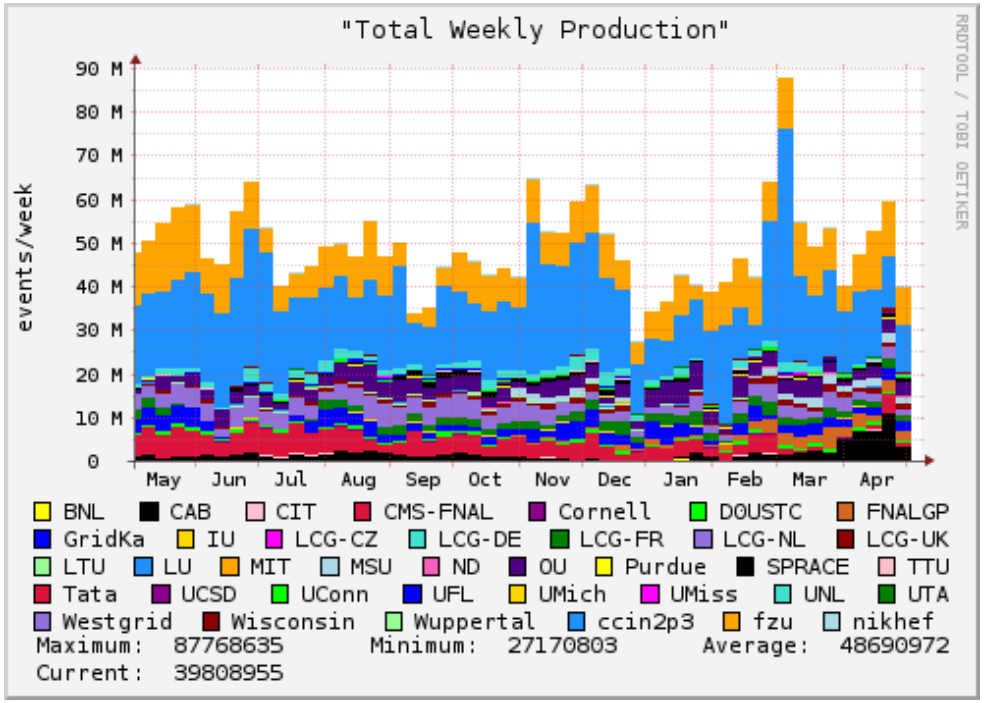


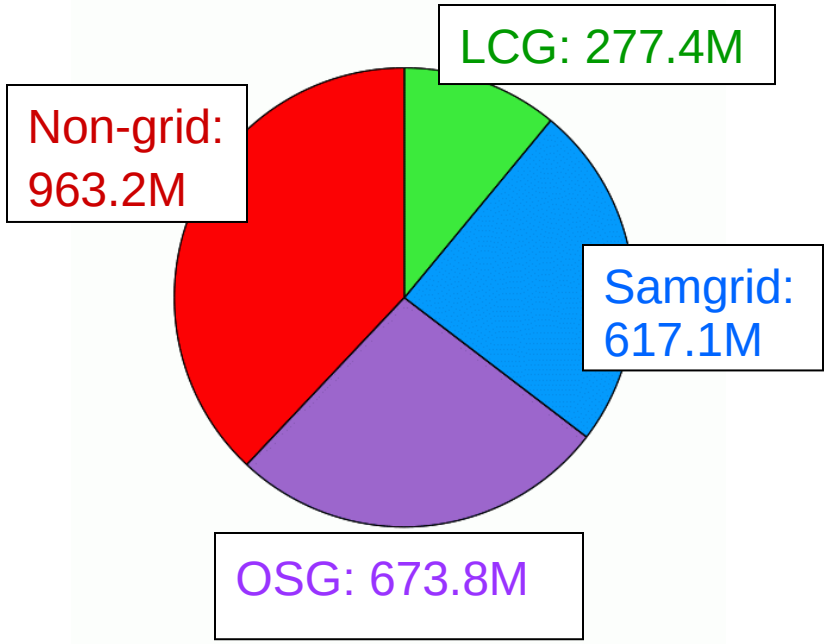
For each period of data, there is a corresponding Monte Carlo model.

Monte Carlo Generation

- Monte Carlo events are generated at remote sites
  - Most are through Grid.

From 5/2010 – 4/2011, total 2.53 billions MC events generated.





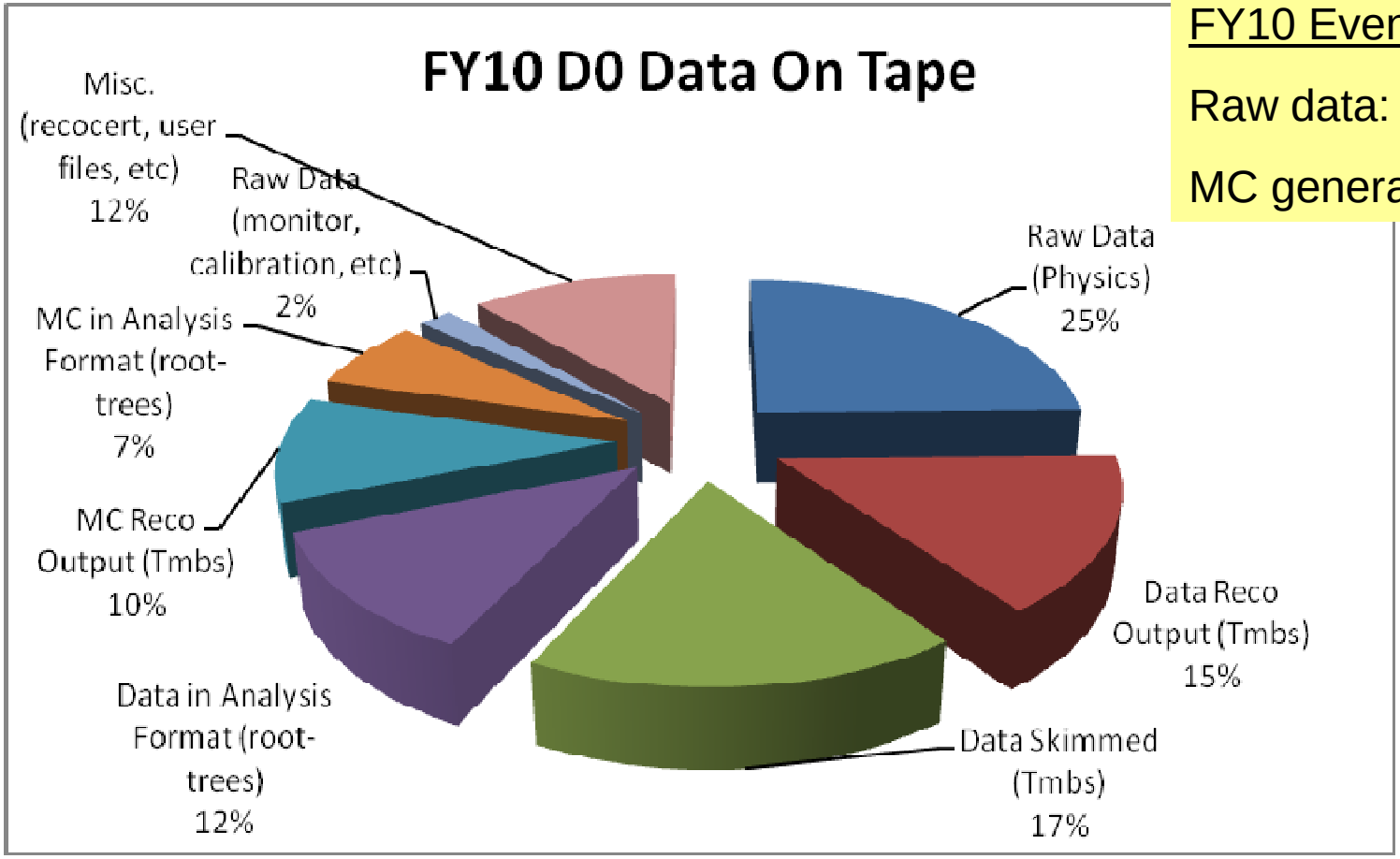
Data Size

- Total storage (as of today): 7014 TB.
- Raw data in Run II:
  - Total 9.3 billions events collected so far,
  - Expect ~10.5 billions events by the end of Run II.
- Data sample sizes:
  - Raw data: 220 kb/event
  - Reconstructed data: 135 kb/event
  - Skimmed data: 140 kb/event
  - Analysis format: 80 kb/event
  - MC reconstructed: 110 - 135 kb/event
  - MC analysis format: 70 - 100 kb/event

Data Storage Distribution

(10/01/2009 - 09/30/2010)

The total storage on the tapes in FY10: 1802 TB



FY10 Events (in billions)

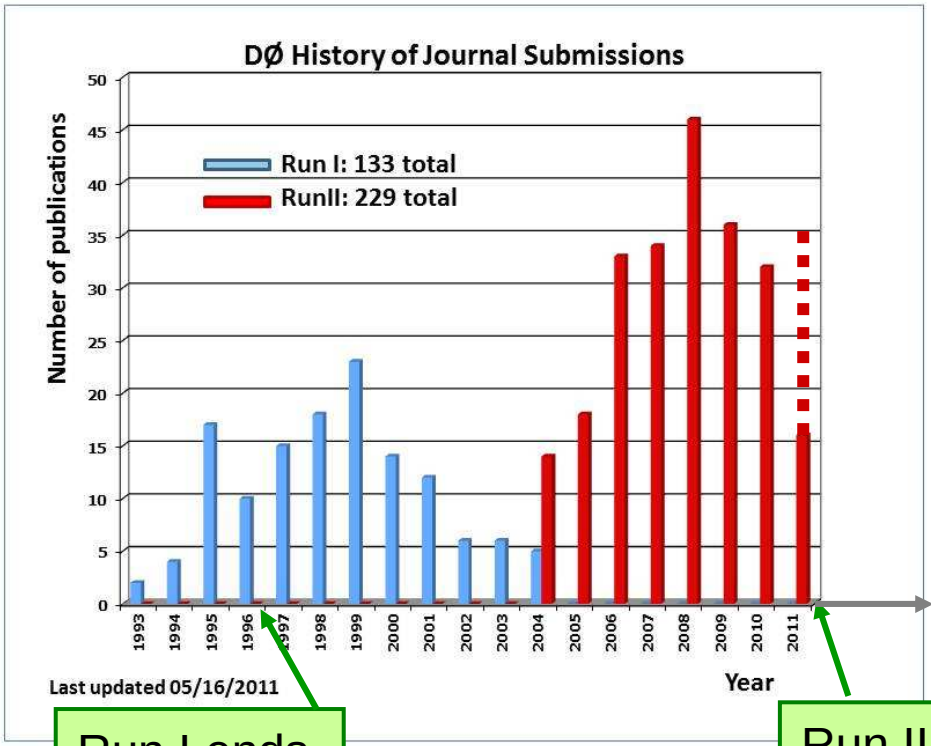
Raw data: 2.02

MC generated: 2.18

Current Plans

- Tevatron run will end on Sept. 30, 2011.
- Short term plan (~1 year):
  - Will reprocess ~20% of raw data with improved algorithms
  - Continue generating Monte Carlo events.
- Medium term plan (~5 years):
  - Will continue physics analysis for at least five years after Tevatron run ends
  - Maintain the current computing infrastructure
  - Fermilab Computing Division has agreed to continue providing computing support at the same capacity level for the next 5 years
  - Need to be able to continue generating MC events
  - Keep migrating data to new technology (tape storage)

D0 Trends



D0 Physics Publications

- Run I publications continued for 8 years after Run I ended.
- Run II publications will also continue for several years after Run II ends.

Data Preservation

- Long term data storage plan:
  - Fermilab Computing Division will keep migrating data to new technology (Enstore tape storage) beyond 5 years.
  - Fermilab will keep databases as well
  - Not clear yet for how long
- There are discussions at D0 about data preservation
  - About format of data
  - About MC event generation
  - About future data access

Data Preservation Discussion

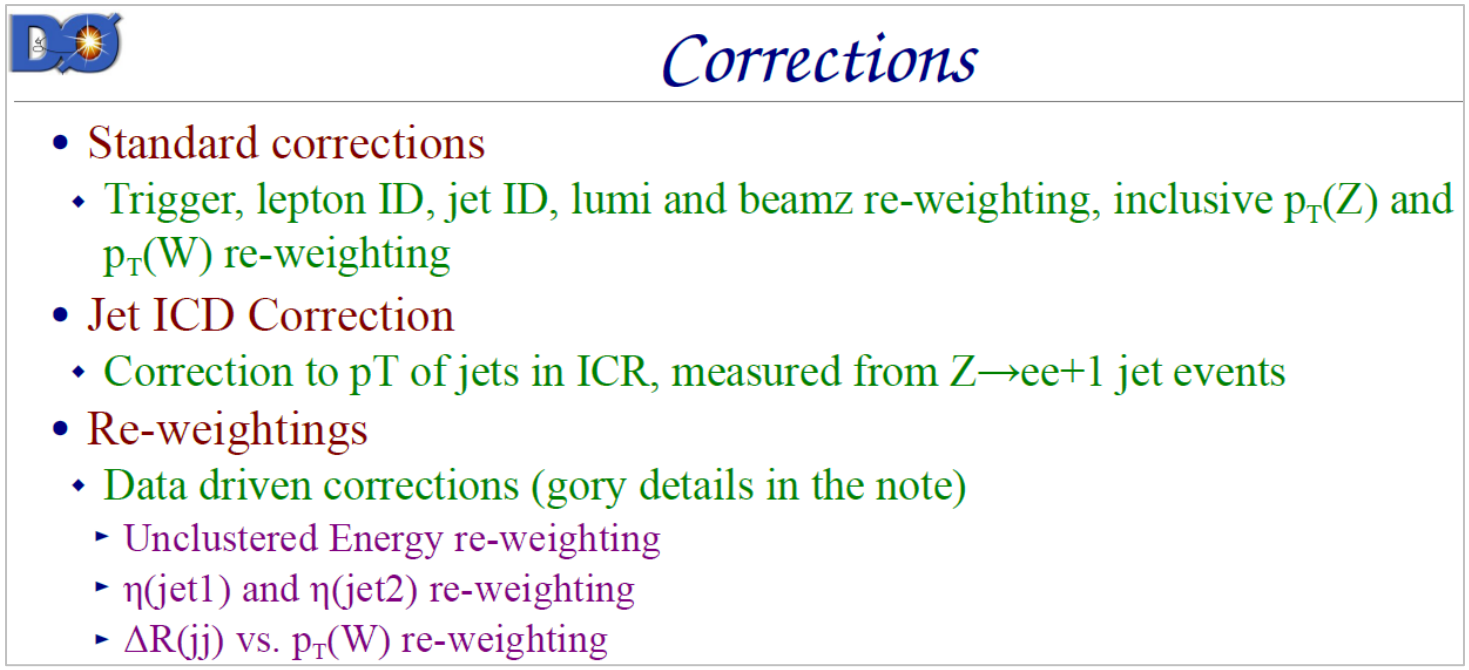
- At what level should data be preserved?
  - To be able to re-analyze: the only sensible solution would be a high level format, in which most calibrations and corrections have already been applied to the data.
  - To keep raw data: for how long?
- Where will the data and software be physically stored?
  - Fermilab seems the natural storage location
  - Fermilab Enstore will keep the preserved data
  - Fermilab cvs system will store algorithm code
- How to access the preserved data in future?

Challenges

- It is hard to design a data format or a system to preserve the Run II data for anyone to use without the detailed understanding of
  - detector performance,
  - instrumental effects,
  - complications of simulation,
  - … etc
- Need to avoid misinterpret Run II data

Complicated Corrections Needed in Analyses

- An example of a D0 analysis:
  - Below is a page from an analysis talk



Corrections

- Standard corrections
  - Trigger, lepton ID, jet ID, lumi and beamz re-weighting, inclusive $p_T(Z)$ and $p_T(W)$ re-weighting
- Jet ICD Correction
  - Correction to pT of jets in ICR, measured from Z→ee+1 jet events
- Re-weightings
  - Data driven corrections (gory details in the note)
    - Unclustered Energy re-weighting
    - η(jet1) and η(jet2) re-weighting
    - ΔR(jj) vs. $p_T(W)$ re-weighting

- For data preservation, we have to develop procedures to address these kinds of corrections.

Summary

- DØ analysis and computing model provides efficient way to do physics analysis.
- After Tevatron run ends, D0 will reprocess part of raw data and continue physics analysis for at least 5 years.
- Data preservation for Run II data is challenging.
- We are participating in this workshop to develop experiment strategy.