DZero Analysis Plans and Institutional Commitments

The Dø Collaboration

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Fermilab PAC, June 24 2011
DØ today is an international collaboration of 460 physicists from 20 nations

- **Institutions 86 total**
  - 37 US, 49 non-US
  - ~170 students and postdocs
Tevatron is performing extremely well
- ~ 1.9 fb\(^{-1}\) delivered since October 1\(^{st}\) 2010
  - 60-70 pb\(^{-1}\) per week
- Record initial luminosity of \(4.2 \times 10^{32}\) cm\(^{-2}\)sec\(^{-1}\)
- May 2011 was the best month for delivered luminosity
  - 287 pb\(^{-1}\) delivered
- Total delivered luminosity is 11.2 fb\(^{-1}\)
• DØ experiment is smoothly recording high quality physics data
• Averaging ~90% data taking efficiency
  • Even with high luminosity
• As of today DØ has 10 fb⁻¹ on tapes
  • Record month of May with 260 pb⁻¹ recorded
• All detectors are functioning well
Estimates are pretty accurate by now with end of data taking expected on September 30, 2011: delivered ~12.1 fb\(^{-1}\) and recorded to tapes ~10.9 fb\(^{-1}\)

We expect that many legacy results from DZero will be on over 10 fb\(^{-1}\) data set
Data reconstruction program is smoothly running on the farms
Switching resources between analysis and reconstruction to optimize CPU utilization
Improvements are planned for reconstruction version to be used later this year for partial Run II data reprocessing
  - ~15% of data will be reprocessed for Summer 2012 conferences
Access to data will be provided to DZero collaborators for ~5 years after the end of the data taking
  - In contact with other Laboratories and experiments on long term data access
Monte Carlo Generation

- Monte Carlo generation
  - Effective use of GRID resources and in2p3 farm
  - ~50 million events per week generated - enough for physics analysis needs
- Improved new MC release for Run IIb3 (2009/2010)
  - Improvements to provide better simulation of the detector
- Strong commitment of the collaboration to continue providing necessary CPU resources for MC events generation
Excellent Progress with Physics Analyses

- 24 papers submitted by DØ in 2011
  - On track to have an excellent year!
- New results in all physics areas
  - B physics, Electroweak, New Phenomena Searches, QCD, Top Quark, Higgs Searches
- Over 100 invited talks at 2011 conferences already
  - Great training ground for young collaboration members
- Submitted over 70 abstracts with new results for summer 2011 conferences
- Priorities in analyses are changing
  - With data set increase reaching systematic limits
  - New theoretical models and new experimental results
  - LHC is becoming competitive
    - 1 fb\(^{-1}\) already accumulated
- Publications are one of the main legacies of DØ!

- Training excellent young scientists is another legacy of DØ
  - 30 PhD theses defended in 2010
  - ~100 students are on the experiment
- Expect very productive 2-3 years ahead
Latest Publications

- Measurements of Inclusive W+Jets Production Rates as a Function of Jet Transverse Momentum in pp Collisions at $\sqrt{s} = 1.96$ TeV
- Study of the Dijet Invariant Mass Distribution in pp→W(→lν)+jj Final States at $\sqrt{s} = 1.96$ TeV
- Precise Measurement of the Top-Quark Mass from Lepton+Jets Events at DØ
- Measurement of the $t\bar{t}$ Production Cross Section Using Dilepton Events in pp Collisions
- Model-Independent Measurement of $t$-Channel Single Top Quark Production in pp Collisions at $\sqrt{s} = 1.96$ TeV
- Measurement of the Production Fraction Times Branching Fraction $f(b\rightarrow\Lambda_b) \cdot B(\Lambda_b\rightarrow J/\psi \Lambda)$
- Precise Measurement of the Top Quark Mass in the Dilepton Channel at DØ
- Measurement of Spin Correlation in $t\bar{t}$ Production Using a Matrix Element Approach
- Measurement of the $\sin^2\theta_{\text{eff}}$ and Z-Light Quark Couplings using the Forward-Backward Charge Asymmetry in pp→Z/$\gamma^*$→ee Events with L = 5.0 fb$^{-1}$ at $\sqrt{s} = 1.96$ TeV
- Search for a Fourth Generation $t'$ Quark in pp Collisions at $\sqrt{s} = 1.96$ TeV
- Measurement of the ZZ Production Cross Section in pp Collisions at $\sqrt{s} = 1.96$ TeV
- Measurement of Three-Jet Differential Cross Sections $d\sigma_3\text{jet}/dM_3\text{jet}$ in pp Collisions at $\sqrt{s} = 1.96$ TeV
- Determination of the Pole and MS Masses of the Top Quark from the $t\bar{t}$ Cross Section
- Search for Flavor Changing Neutral Currents in Decays of Top Quarks
- Measurement of Spin Correlation in $t\bar{t}$ Production Using Dilepton Final States

DØ, 6.4 fb$^{-1}$

Data
Signal
Background

ZZ Production
Higgs Searches

- Excellent progress in all search channels
- Single experiment exclusion for winter 2011 conferences: 163-168 GeV
- Combined Tevatron exclusion is 157-175 GeV
- Starting to exclude low masses close to 115 GeV LEP limit
Tevatron and LHC - Complementarity

High yields of low mass states, including Higgs, at the Tevatron complement large cross sections of heavy objects at the LHC

DZero, Fermilab PAC June 2011
15 MeV error on W boson mass with no changes in the mean values of W and top masses means SM Higgs exclusion with $M_H < 117$ GeV

DZero, Fermilab PAC June 2011
With 10 fb\(^{-1}\) can reach 95% CL exclusion Higgs in full allowed mass range and 3\(\sigma\) sensitivity at low and high masses
Combining Direct and Indirect Searches

March 2011 update: Higgs mass is 126 +/- 11 GeV – excellent match for the Tevatron!
Tevatron Analyses for 2011 and 2012

- **Higgs**
  - Searches in all channels
  - Sensitivity to b-bbar decay channel for low mass Higgs
  - Exclusion in the full 115-185 GeV mass range, if Higgs does not exist
  - Results of precision measurements of backgrounds, including W+jets(including b-jets), ttbar cross sections, di-boson production.

- **Top quark**
  - Precision measurement of top quark mass with below 1 GeV precision
  - Precision measurement of top/anti-top quarks mass difference
  - Measurements of top quark production properties, including cross sections
  - Measurements of top quark decay properties
  - Measurements of s- and t-channels single top quark production
  - Measurement of spin correlations
  - Measurement of Forward/Backward production asymmetry

- **Electroweak**
  - W boson mass measurement with ~20 MeV precision
  - Production and decay properties of di-bosons: WW, WZ, ZZ, Wγ, Zγ
  - Precision measurement of sin(θ_W)
Tevatron Analyses for 2011 and 2012

- **B physics**
  - Precision measurement of $B_s$ oscillation frequency
  - Studies of di-muon production asymmetry and CP violation
  - Measurements of b-baryons and b-mesons production, properties and lifetimes

- **QCD**
  - Precision measurements of single, double and triple jets cross sections
  - Precision measurement of angular correlations in jets production
  - Extraction of $\alpha_{QCD}$ and PDFs

- **New Phenomena**
  - Model independent search for new physics
  - Supersymmetry searches, including MSSM Higgs

- Our goal is to complete absolute majority of the above analyses in about a year after full data set is collected. The timing in most cases will be determined by the complexity of the analysis.
Steady decrease over last few years at ~5%/year as expected
Currently 460 active members
### Recent Years Collaboration Efforts Reports

- Need ~50 FTEs to collect data (will end this year) and ~ 50 FTEs to perform tasks in computing, algorithms and management
- The rest is devoted to physics analysis
  - ~150 FTEs provide critical mass to perform wide spectrum of physics studies

#### Task

<table>
<thead>
<tr>
<th>Task</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
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</thead>
<tbody>
<tr>
<td>Algorithms</td>
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<tr>
<td>Computing</td>
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<td><strong>101</strong></td>
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<td>15</td>
<td>12</td>
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<tr>
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<td><strong>Totals</strong></td>
<td><strong>307</strong></td>
<td><strong>277</strong></td>
<td><strong>258</strong></td>
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DZero, Fermilab PAC June 2011
Collaboration Commitment for 2011/2012

- In May 2011 we performed a survey of the collaboration's personpower for the years 2011 and 2012
  - All 86 collaborating groups participated

<table>
<thead>
<tr>
<th>Category</th>
<th>2011</th>
<th>2012</th>
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<tbody>
<tr>
<td>Academics/Senior</td>
<td>113</td>
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<td>Researcher</td>
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<td>Postdocs</td>
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<td>54</td>
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<td>Students</td>
<td>92</td>
<td>66</td>
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<tr>
<td><strong>Totals</strong></td>
<td><strong>279</strong></td>
<td><strong>215</strong></td>
</tr>
</tbody>
</table>

- Numbers above indicate that the effort available in 2012 for analysis of the Tevatron data should be similar to 2011
  - Sufficient number of people to perform vibrant physics program!
Support by the Funding Agencies and the Laboratory

- Physics analyses that the Tevatron experiments performing are time critical
- Our needs in the coming year will be to maintain a sufficient and active teams working on each of the legacy analyses to get the results out in a timely fashion
- Support from the funding agencies is critical for success
  - DoE, NSF as well as non-US funding agencies demonstrate strong commitments
- Continuing support from Fermilab is very important factor
  - We have excellent working relations with Computing Division
  - Continuing support by Particle Physics Division is critical
    - Keep Fermilab scientists involved in DZero
    - Continue International Fellows program
    - Continue Guest and Visitors support in FY12 on FY11 level
      - Over 100 scientists are able to participate in the experiment supported by ~$1M per year funding
        - In most cases Fermilab provides small fraction of total expenses
        - We would like to re-program FY11 detector operations support into analysis efforts in FY12.
- Support from the Laboratory and funding agencies is critical to assure Tevatron legacy measurement are accomplished timely
DØ Summary

- Tevatron is performing better than ever
  - ~12 fb\(^{-1}\) to be delivered by September 30
- Excellent detector operation
  - ~11 fb\(^{-1}\) to be recorded in Run II
- Reconstruction and Monte Carlo are performing well
- ~70 new results are expected for summer conferences and over 40 publications in 2011
- Exciting list of analyses on ~10 fb\(^{-1}\) data set
  - Higgs searches
  - Search for new particles and phenomena
  - Precision legacy measurements
- Strong commitment from the collaboration to continue vibrant physics program
- Support from the Laboratory is critical to accomplish Tevatron legacy measurements