Tevatron Low-Beta Optics
Measurements and Upgrade Plans

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Contents

- Orbit Response Matrix measurements after 06 shutdown, $\beta^*$ values
- Beam-beam effects and luminosity evolution analysis
- Second order chromaticity correction
- Prospects
ORM Measurements After 06 Shutdown

- Two measurements, 6/6 and 10/24
- No significant changes compared to pre-shutdown
- Vertical $\beta^*$ is larger at both experiments

<table>
<thead>
<tr>
<th>Location</th>
<th>$\beta_x^*$ (cm)</th>
<th>$\beta_y^*$ (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDF</td>
<td>28.5</td>
<td>35.0</td>
</tr>
<tr>
<td>D0</td>
<td>27.1</td>
<td>35.5</td>
</tr>
</tbody>
</table>
Luminosity Lifetime

Lifetimes over First 2 Hours of HEP
Last 100 Stores

Store #

Lifetime [hr]

Proton Lifetime [hr]

Pbar
Lumi
EffEmit
Proton
Proton Non-Luminous Lifetime

Lifetimes over First 2 Hours of HEP
Last 100 Stores

- Proton
- Proton Non-Luminous
Luminosity Evolution

Store 4859, L=170
**New Tevatron Working Point**

- Currently operating between 4/7 and 3/5 with beam-beam $\xi_a = 0.02$
- To increase number of protons need more tune space – WP near $\frac{1}{2}$ should allow 40% more!

- However, vicinity of half-integer increases sensitivity to quadrupole errors, especially chromatic
Beam-Beam Simulation: $\xi_a=0.026$ (30% increase)

- Relative Horizontal Emittance
- Relative Vertical Emittance
- Normalized Beam Intensity
- Luminosity

Graphs showing the evolution of these parameters over 50 steps (1.E+4 turns).
Second Order Tune Chromaticity

Measured $C_2 = -16560$  
Model $C_2 = -16480$
Correction of $\beta$-function Chromaticity

- Reconnection of sextupoles into new families
Beam-Beam Simulation: Effect of Corrected C2

- Normalized Beam Intensity
- Vertical Emittance ($\pi$ mm$^2$mmrad)
- Dutch Length (cm)
- Luminosity

Graphs showing the simulation results for different values of $\xi$.
Prospects

- Fix proton injection line matching
- Gradually increase proton intensity
- Implement C2 correction
  - SD and SF circuits are split into 3 each
  - Cables for new circuits have been pulled during shutdown
  - Power supplies are being installed and tested
  - Controls software modifications \( \frac{1}{2} \) done
  - Beam studies to begin in ~ January
    - Operate the new circuits in present configuration
    - Operate the new circuits at zero current at Injection
    - Propagate changes up to LowBeta
Beam-Beam Simulation for Protons