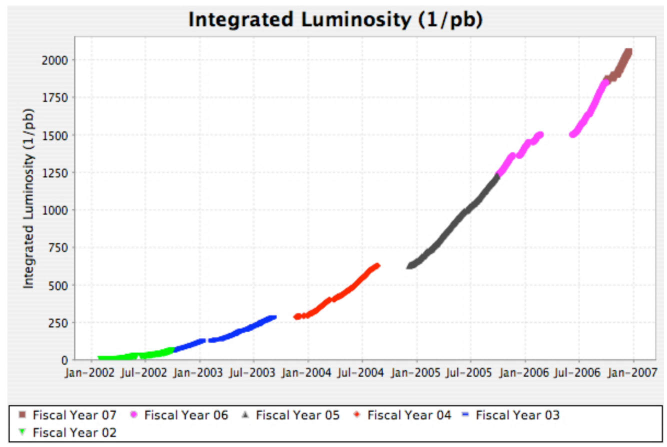
# Tevatron 2006 Highlights

# Program successes

## Introduction

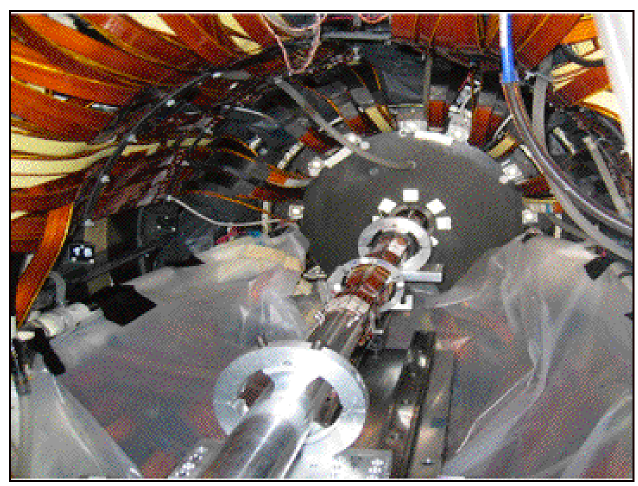
*“The Tevatron continues to run at the world’s premier energy frontier, setting record luminosities and providing world-class data to the experiments. Both CDF and D-Zero have collected over 1 fb-1 of data and produced an impressive set of results. The initial observation of Bs mixing generated a fair amount of excitement. The new results of the top quark and the W boson and the stronger constraints on searches for new physics will continue to be important. The collaborations improved their analysis techniques and understanding of backgrounds in many areas, so that the experiments are now more sensitive to various physics processes than was expected at the beginning of Run II”.*




From the findings of the Annual Fermilab Program Review Committee (December 1st, 2006).

## Luminosity Records

The record instantaneous luminosity is 2.4 $10^{32}$ $cm^{-2}s^{-1}$
The total delivered luminosity is 2.2 $fb^{-1}$ per experiment.



## Detector Upgrades Completed

All CDF and D0 Run II upgrades have been completed. This includes D-Zero’s “Layer-0” Silicon detector which will further enhance the Tevatron’s physics program.

## The Physics Program

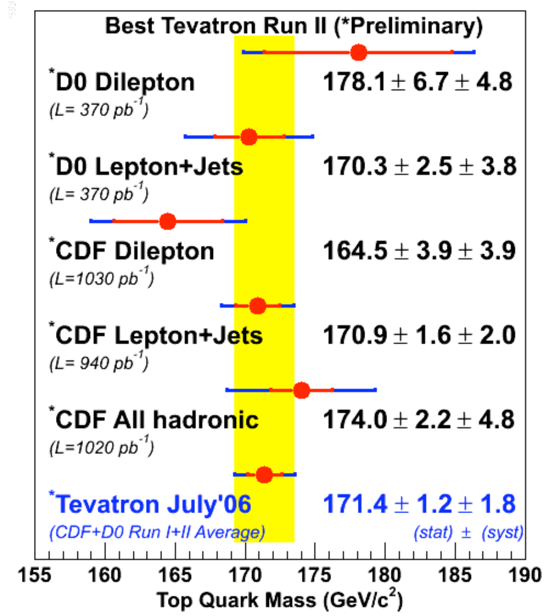
In 2006 we made several discoveries and important measurements. Our physics program has resulted in 80 publications submitted to refereed journals and about 500 conference presentations. Some of these results are highlighted here. About 150 students have obtained Ph.D. theses from Run II thus far and about 250 others are currently working towards their degrees.

# Electroweak Symmetry

## *Top mass measurement*

Made the world's most precise measurement. The precision in the combined CDF and D0 top mass measurement has reached 2.1 GeV (or 1.2 %).

The measured value is: 171.4 GeV

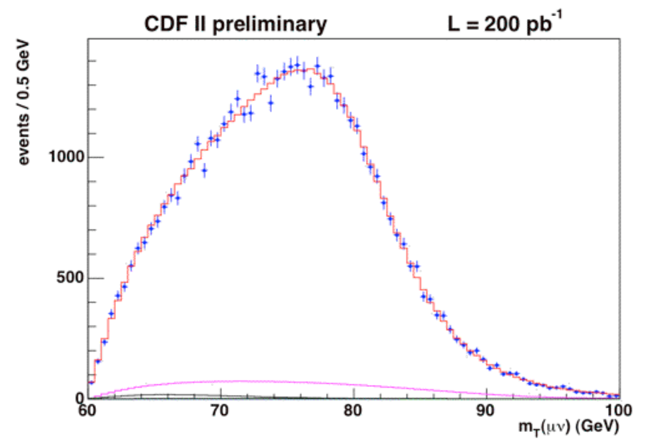



## *W mass measurement*

The world's single most-precise measurement with 48 MeV uncertainty.

The measured value is: 80.413 GeV

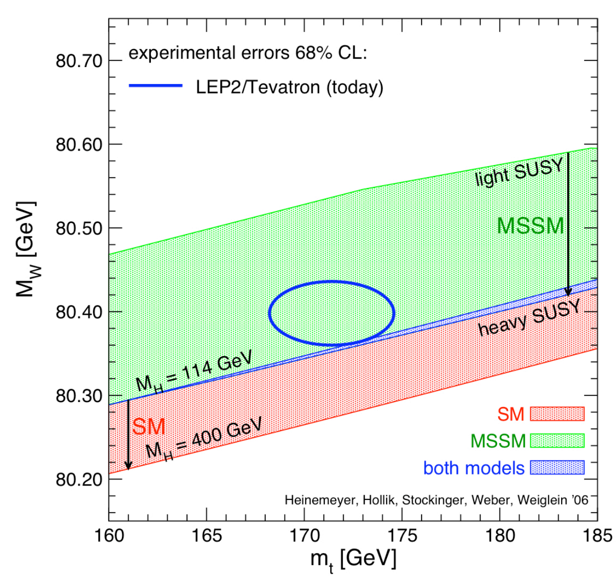
The world's average is now: 80.398 GeV




## *Light-mass Higgs preferred !*

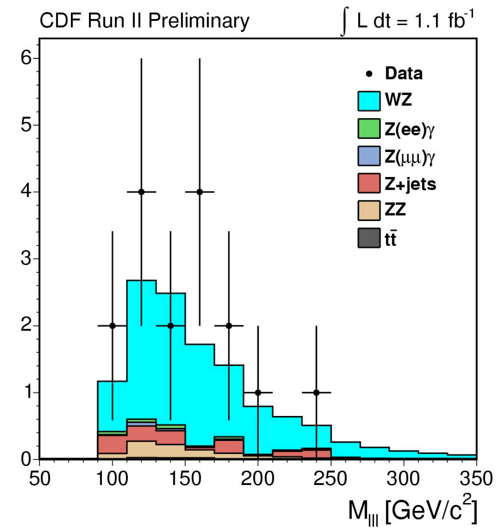
The precise determination of the top and W mass values are used to predict the Higgs mass.

The good news for Tevatron program is that, as the top mass has moved low and the W mass high, a Higgs with lighter mass is preferred. This is the mass region best suited for our experiments.



# The road to the Higgs

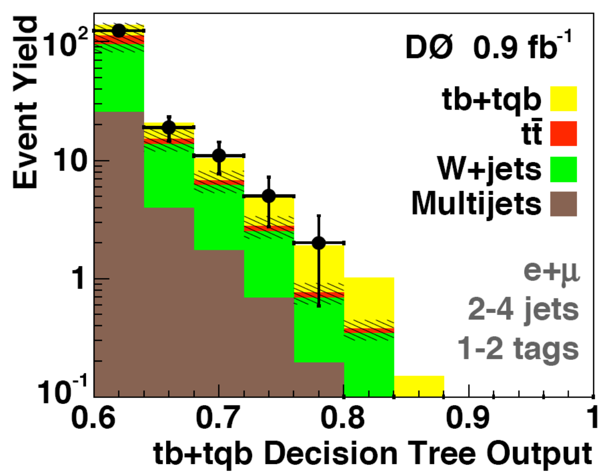
## Discovery of WZ production




We observed a 5.9 sigma result on the associated production of W and Z bosons.

The measured cross section is 5.0 (1.7) pb.

## Evidence for Single-Top production

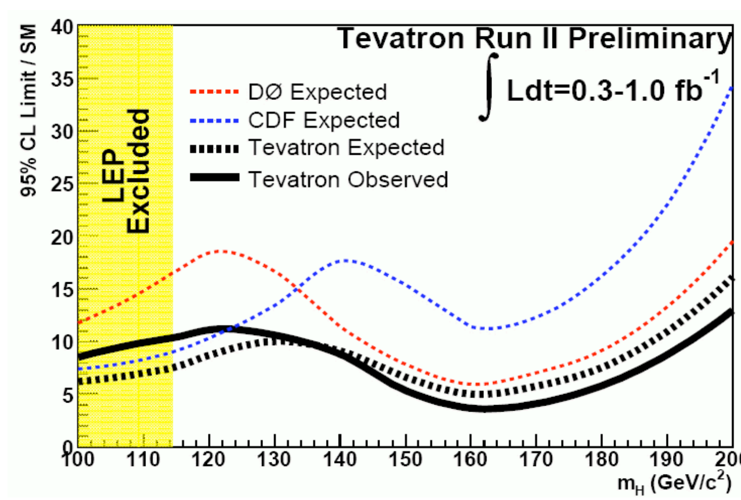



We observed a 3.4 sigma result on the production of events with single-top quarks.

The measured cross section is 4.9 (1.4) pb.

## Higgs Sensitivity

With 1 fb$^{-1}$ data analyzed by each experiment we are getting closer to a possible observation of the Higgs particle. The WZ and single-top observations demonstrate our ability to observe small signals similar to those from the Higgs. We are developing many new tools and techniques that will improve the analyses significantly. A critical factor is the accumulation of large datasets as a result of more luminosity from the Tevatron.

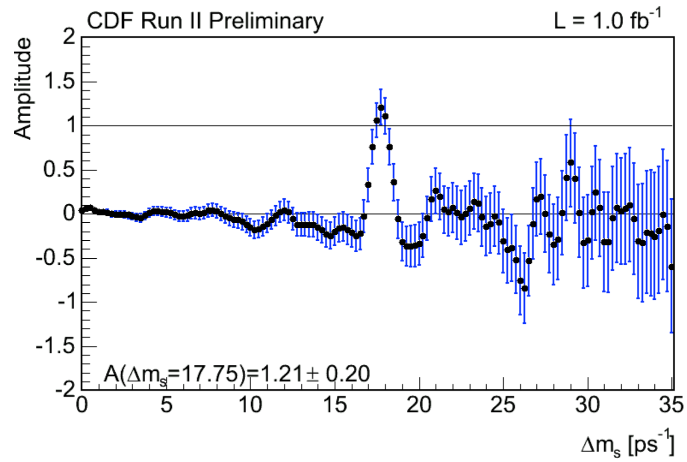


# Discoveries

## Bs-oscillations

Measured the rapid transition between matter and anti-matter in the Bs meson; formed by a bottom and a strange quark. This a scientific and technical Tour de Force for the Tevatron program.

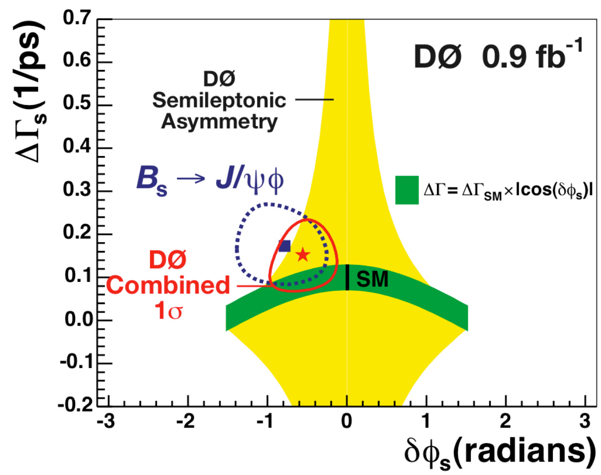
The measured oscillation rate is 3 trillion times per second; consistent with the Standard Model and restricting the possible types of Supersymmetric models allowed in Nature.




## CP-violation in the Bs-system

Measured possible differences between matter and antimatter in the Bs system to study CP-violation effects.

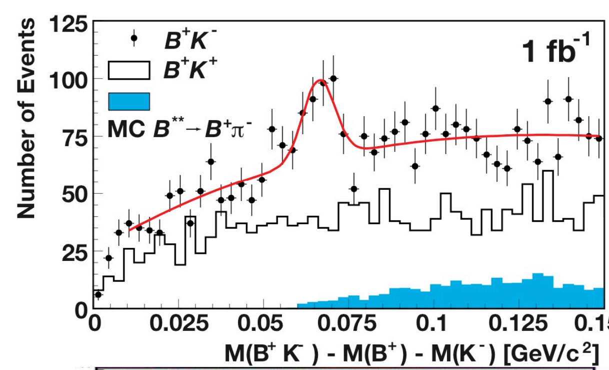
CP-violation plays an important role in understanding the apparent predominance of matter over antimatter in the Universe.

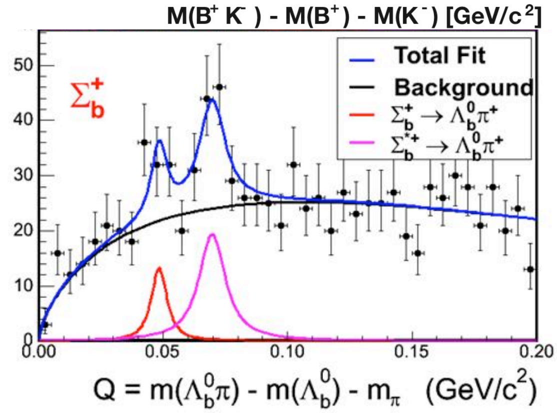



## New heavy baryons

Discovered rare new particles containing bottom quarks. Four of these are exotic relatives of the proton and the neutron, formed by the three-quark combination uub or ddb. We also observed an excited state of the Bs meson.

The large datasets now available in Run 2 allow us to discover ever more rare processes. This in turn enables us to study the Standard Model in exquisite detail and opens the possibility for finding new physics.



# Closing in on New Physics

As we accumulate more and more data, we push forward in our hunt for the ultimate discovery; what lies beyond the Standard Model. We will continually probe for the presence of Super-symmetric particles, test the theories of Extra Dimensions, and search for the existence of Dark Matter. These are examples of important queries of new physics which we could observe here.

It is the nature of how hadron collider physics progresses; one moves from setting limits on a given physics process, to finding evidence for it, and ultimately to its discovery. WZ production and Bs mixing are two examples of this journey this year. We look forward to the completion of the journey for single-top production in 2007.

The year 2006 has proven to be a very fruitful year for the Tevatron experiments and we expect a rich harvest of even more important and exciting results in the years ahead. We think the best is yet to come.