

Measurement of the Top- Quark Mass in All-Hadronic Decays in pp(bar) Collisions at CDF II

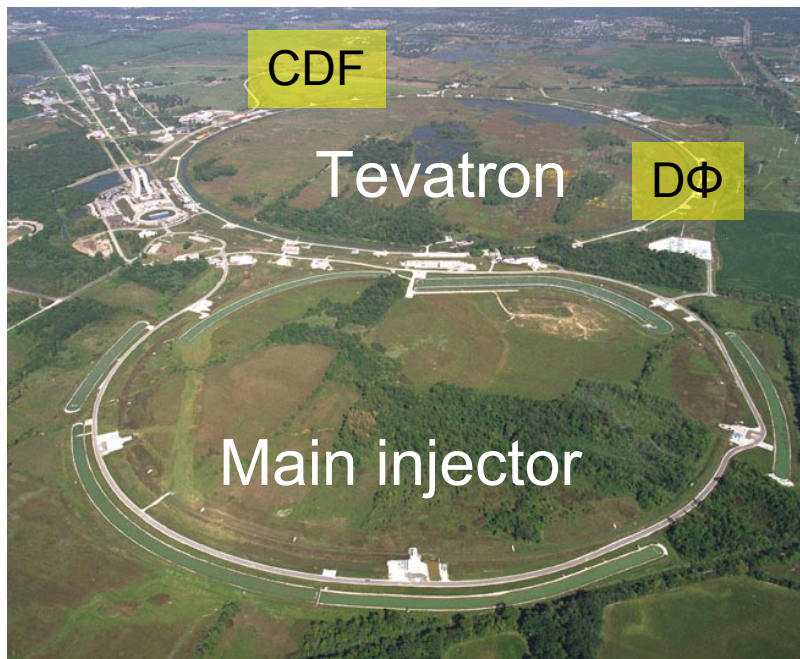
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Contents

- Tevatron
- Motivation
- Mode
- Methods
- Results

Tevatron

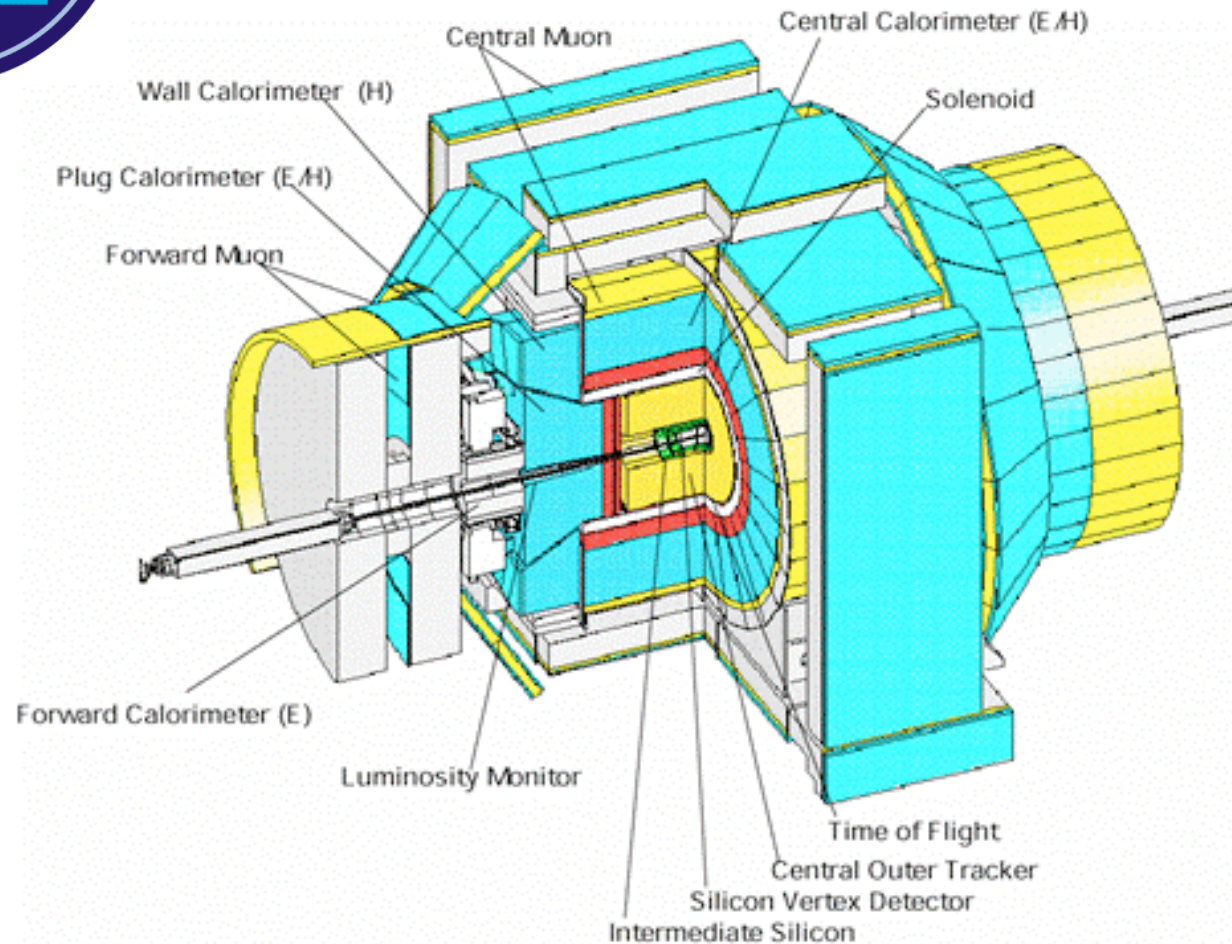


- Fermilab
- pp(bar) collider
- $E_{\text{CM}} = 1.96 \text{ TeV}$
- Detector
 - CDF
 - D0



CDF II

(Collider Detector at Fermilab)



Magnetic field : 1.4T

$$\eta = -\ln (\tan \theta/2) = 3.6$$

Motivation of the top quark mass measurement

- M_{top}
 - is an important free parameter of SM.
 - can constrain the mass of the Higgs and particles predicted in extensions of the SM.

Mode

- Signal : $pp(\bar{p}) \rightarrow t\bar{t}(\bar{p})$
 - $t \rightarrow bW^+$: almost 100% branching ratio(CKM).
 - $W \rightarrow qq(\bar{q})$: 66.7%
 - No missing energy due to neutrinos.
 - Final state : 6 jets
- B.G. : multi-jet events from QCD process.
 - Their cross-sections are not well known.
 - There are many multi-jet B.G.
- Luminosity : 310 pb^{-1}
 - Feb. 2002 - Aug. 2004
 - The first top mass measurement in this mode using Tevatron Run II data.

Methods

- Based on an event-by-event likelihood.
 - ${}_6C_2 \times {}_4C_2 = 90$ assignments.
- Cuts
 - Requirement of six jet.
 - $ET > 15\text{GeV}$
 - $\eta \leq 2$ ($\sim 15^\circ$)
 - At least one jet must have b-tag.

The final data sample contains 290 events.

Methods

Weight $w_i = \exp\left(-\frac{1}{2}\chi_i^2\right) \prod_{j=1}^2 p_j^b \prod_{j=3}^6 p_j^q,$

Signal likelihood term $\mathcal{L}_i^{\text{sig}}(M_{\text{top}}) = \prod_{j=1,2} \int G(m'_j | m_i^j, \sigma_i^j) F_{\text{BW}}(m'_j | M_{\text{top}}) dm'_j.$

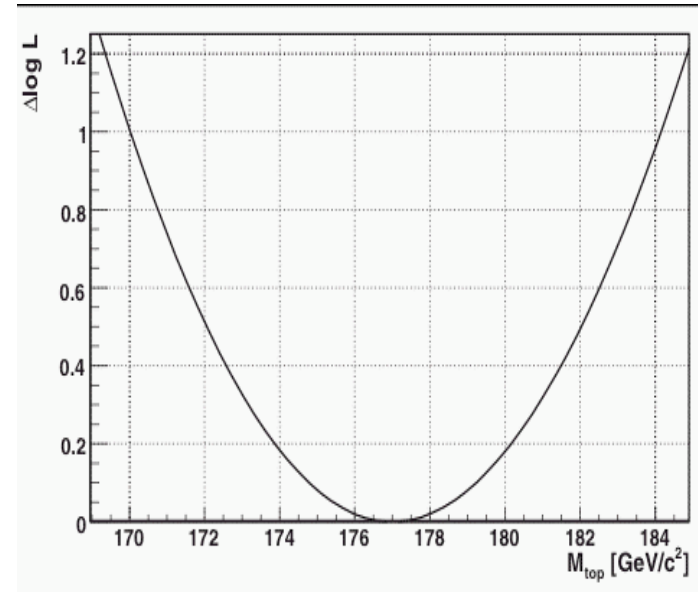
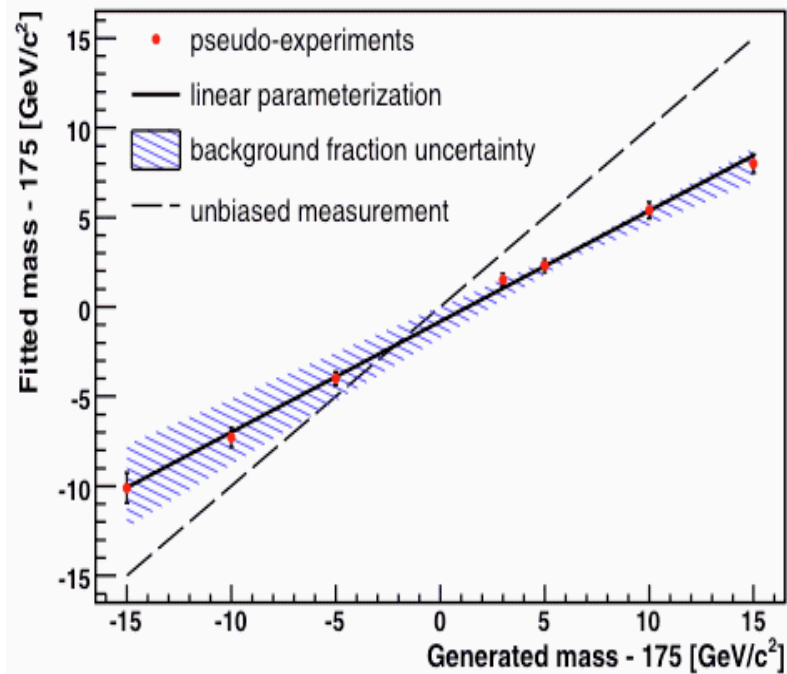
Breit-Wigner distribution : $F_{\text{BW}} \propto 1/((m_j - M_{\text{top}})^2 + 1)$

Likelihood $\mathcal{L}^n(M_{\text{top}}, \mathcal{P}) = \sum_{i=1}^{90} w_i [\mathcal{P} \mathcal{L}_i^{\text{sig}}(M_{\text{top}}) + (1 - \mathcal{P}) \mathcal{L}_i^{\text{bg}}].$

Sample purity value is 0.21 ± 0.07 for 290 events.

Expected value(SM) : ~ 0.2

Linear parameterization



Results

- $M_{\text{top}} = 177.1 \pm 4.9(\text{stat}) \pm 4.7(\text{syst}) \text{ GeV}/c^2$

	All jet	dilepton	Jet+lepton
Run I	$186 \pm 10 \pm 5.7$	$167.4 \pm 10.3 \pm 4.8$	$176.1 \pm 5.1 \pm 5.3$
Run II	$177.1 \pm 4.9 \pm 4.7$	$167.9 \pm 5.2 \pm 3.7$	$173.2 + {}^{+2.6}_{-2.4} \pm 3.2$

All jet channel : $tt \rightarrow bW \ bW \rightarrow bqq \ bqq$

Dilepton channel : $tt \rightarrow bW \ bW \rightarrow bl\nu \ bl\nu$

Jet+lepton channel : $tt \rightarrow bW \ bW \rightarrow bqq \ bl\nu$