

Challenge

• Predict W+4 jet Production @ Tevatron

- Background to Top Quark Measurements
- Need a Matrix Element (Feynman diagram) calculation
 - No soft/collinear approximations
- Also want to estimate THEORY error
 - Many runs w/ different physics parameters
 - Simplifies combination of CDF and D0 data

Standard Algorithm

• Write down all the Feynman graphs

- Rules inside a computer program (automated)
- # grows quickly: ~10x per added QCD parton
 - W+bb~jj has 1354 unique diagrams
 - 1 diagram = 1 amplitude = 1 function
- Use VEGAS (adaptive Monte Carlo integration)
 - Integrate Square of Summed Amplitudes

Solution

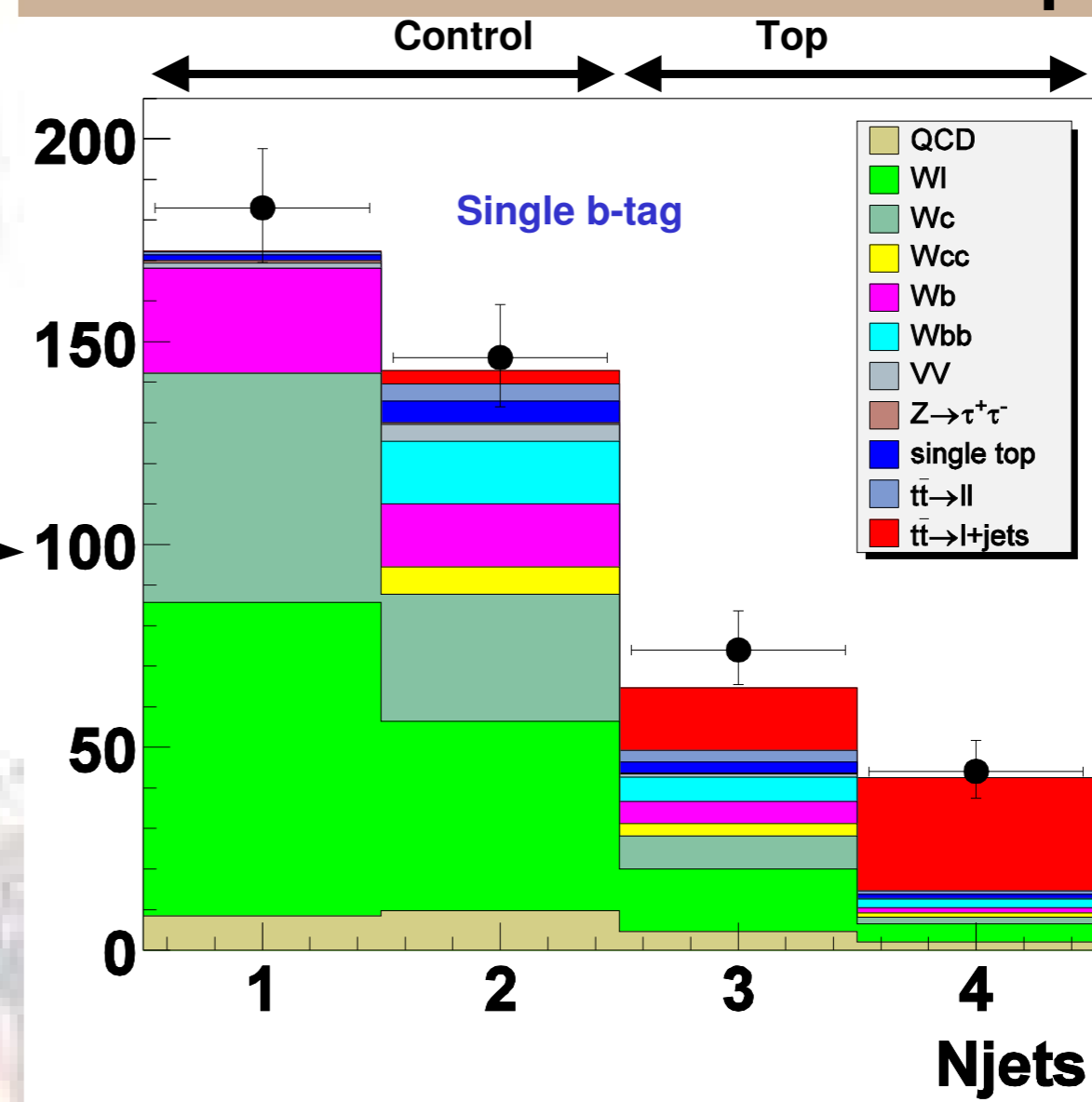
• Multi-channel Integration

- Treat each Amplitude² with a separate MC run
 - Interference terms ($A_1 A_2^*$) added in
- Sum individual (independent) results
 - Small contributions don't need to be known well to get accurate numbers or distributions
- More efficient for unweighting
 - Roughly flat distribution of weights
- Fully automated choices with MADGRAPH

Calculations on FNAL Computing Farms

- 1 Feynman diagram = 1 batch job
- Distributed farm (dfarm) disk storage for intermediary steps
- Final results on Enstore mass storage

Error on Control? Error on Top?



Complications

- Each amplitude has unique singular behavior
 - Difficult to converge on a stable answer
 - Inefficient in generating unweighted events
 - Often, small subset of large weights dominates
 - Want all weights roughly the same

MadGraph HomePage
by Fabio Maltoni and Tim Stelzer

Generate Process Code On-Line

Quarks: d u s c b t d~ u~ s~ c~ b~ t~
Leptons: e~ mu~ ta~ ve vm vt e+ mu+ ta+ ve~ vm~ vt~
Bosons: A Z W+ W- h g

Special: P j (sums over d u s c d~ u~ s~ c~ g)

Process: | PP > W+ > e+ ve jj | Submit | EXAMPLES

Max QCD Order: 4
Max QED Order: 2

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Automated Generation of Code

FBSNG on the web

Farm: FNSFO
Time: Wed Sep 22 11:33:24 2004
Report: List of queues

All queues	Name	Status	Default Process Type	Share	Prio	Waiting	Ready	Running	Total
Active queues	Accel	OK	Accel_Worker	(inf)	9000	0	0	1	1
Jobs	Auger	OK	Auger_Worker	2.50	0	0	0	68	68
Nodes	IOQ_O	OK	IO_Q	(inf)	8000	20	0	0	20
Process Types	KTeVLong	OK	KTeV_Long	1.00	0	0	0	64	70
Graphs	Run2MC	OK	Run2MC	1.50	1000	0	0	1	1

~ 200 worker & 2 I/O nodes

Disk storage for results of intermediate steps

FermiTools

Dfarm - Disk Farm System

Readme File | Software | Documentation

Abstract

Disk Farm allows using disk space distributed among nodes of a big computing farm by organizing physical disk partitions into a single name space structure similar to UNIX file system. Disk Farm users access data stored in Disk Farm through a subset of UNIX file system primitive operations such as "create directory", "list files", "get file", "put file", etc.

Disk Farm helps control negative effects of individual node unreliability by allowing the user to create replicas of data files on multiple farm nodes.

Putting Tools Together

enstore

Multi-Terabyte Mass Storage of final results

Standardized Structure for Datasets

STDHEP & MCFIO

```
PARAMETER (NMXHEP=4000)
COMMON/HEPEVT/NEVHEP,NHEP,ISTHEP(NMXHEP),IDHEP(NMXHEP),
&JMOHEP(2,NMXHEP),JDAHEP(2,NMXHEP),PHEP(5,NMXHEP),VHEP(4,NMXHEP)
DOUBLE PRECISION PHEP,VHEP
```

Product Description

Enstore provides distributed access to and management of data stored on tape. It provides a generic interface so experimenters can efficiently use mass storage systems as easily as if they were native file systems.