



Introduction to the LPC Dijet Topology Working Group

Robert Harris (FNAL), Jane Nachtman(Iowa)

JTerm III

January 14, 2009



Outline

- Organization
- Motivation for New Physics in Dijets
- Overview of Dijet Group Goals and Activities
 - Physics with early collision data – QCD measurements and New Physics searches
 - Higher-order QCD studies
 - CRAFT Analysis Commissioning
- Current Opportunities and Plans

Please attend today's parallel session for all of the details!!!



Organization

- Dijet group is part of international CMS physics organization
 - Physics Analysis Groups: Exotica, SUSY and QCD
 - Exotica: Dijet effort on High Energy Pairs
 - SUSY: early searches with multijets
 - QCD -- high P_T jets.
 - DPG, POG: HCAL, JetMET
 - algorithms, software, examples, corrections and validation.
 - CRAFT Analysis, Detector Commissioning
 - Jet Energy Scale group
- Based at Fermilab LPC



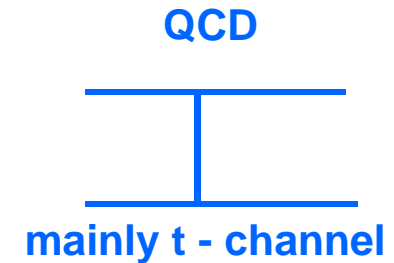
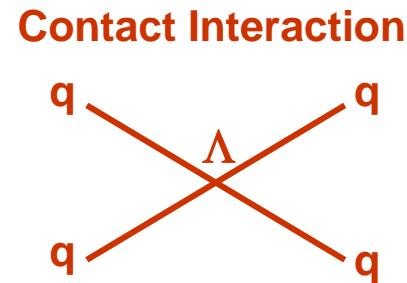
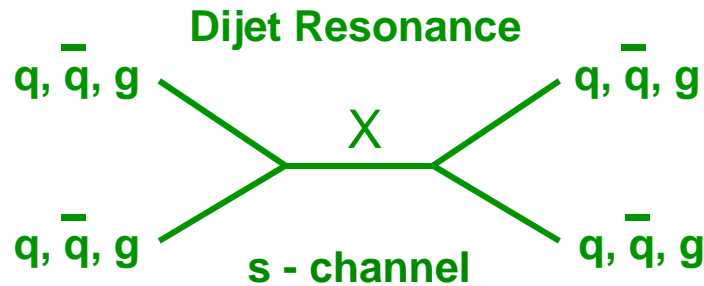
Physics Motivation

- New Physics Searches with Dijets :
 - Dijet Resonances
 - Contact Interactions
 - SUSY
- **Experimental Motivation**
 - Resonances: LHC is a parton-parton resonance factory in a previously unexplored region
 - LHC will explore dijets in a new mass region at turn on of machine.
 - A strongly-produced signal will be seen immediately !
 - Very early signals can be seen in basic QCD distributions
- **Theoretical Motivation**
 - Many different models, ideas for dijet signatures:
 - GUTs, Extra Dimensions, Superstrings, Technicolor, Compositeness.





Dijet Measurement Strategy

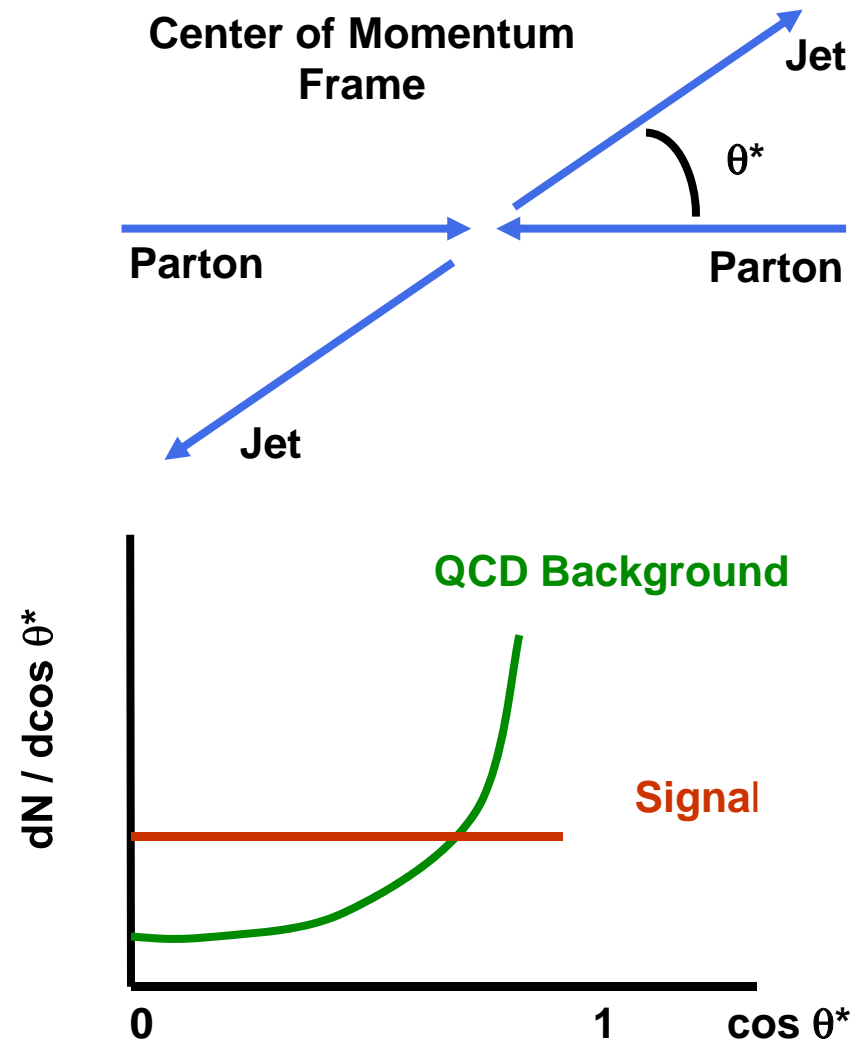


- Basic strategy established (published analysis)
- Measure an inclusive quantity ($pp \rightarrow 2 \text{ jets} + X$)
 - No cuts on extra jets in the event.
 - Easier to understand signal efficiency & QCD background.
 - Applicable to many New Physics Signatures
- “Dijet” defined as leading two jets (highest p_T)
- Typically look at dijets in the barrel region
 - Greater sensitivity to new physics, simplifies analysis & systematics
- Standard measurements -- dijet mass and dijet ratio



New Physics in Dijet Angular Distribution

- New physics is often more isotropic than QCD.
 - Resonances.
 - Contact Interactions
- Angular distribution has much smaller systematic uncertainties than cross section vs. dijet mass.
- Technique -- Use Dijet Ratio = $(N(|\eta| < 0.7) / N(0.7 < |\eta| < 1.3))^{**}$ to see effect of New Physics emerge at high mass
 - ** Number of events in which each leading jet has $|\eta| < 0.7$, divided by the number in which each leading jet has $0.7 < |\eta| < 1.3$





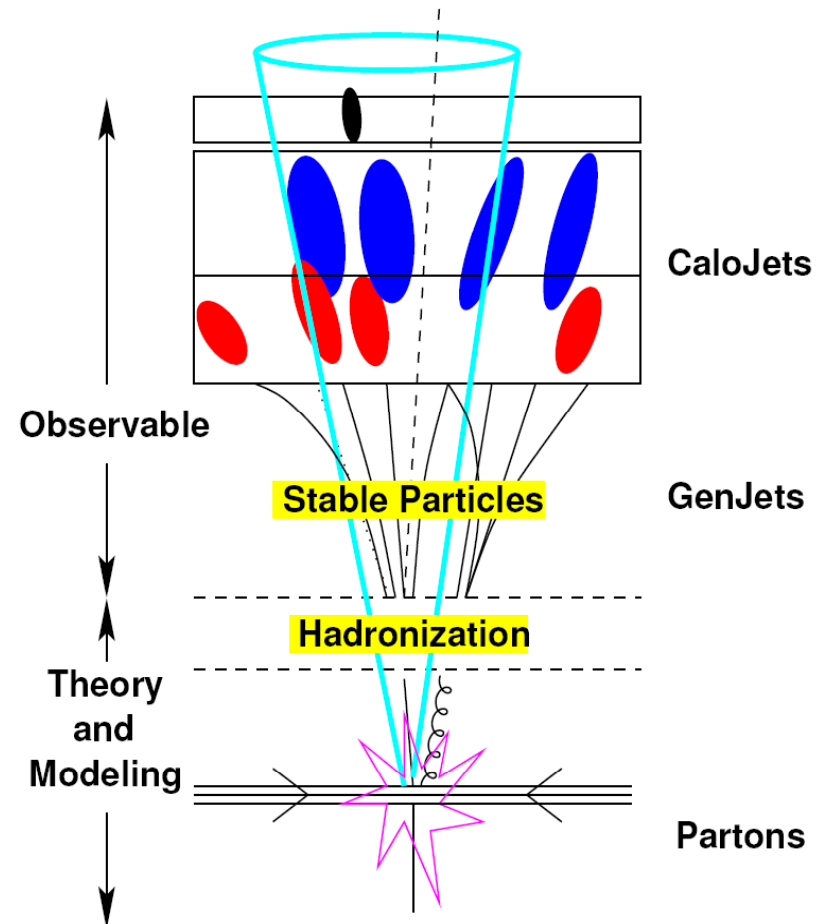
Current Dijet Group Interests

- Main emphases
 - QCD analyses
 - Early physics measurements, tests of SM
 - Higher-order QCD studies
 - New Physics searches
 - Exploiting QCD measurements for New Physics Searches
 - Next generation of published analyses
 - Early SUSY analyses
 - Analysis commissioning efforts
 - CRAFT data analyses
- See parallel session, also recent J+J working group meetings for details



QCD Early Analysis with Dijets

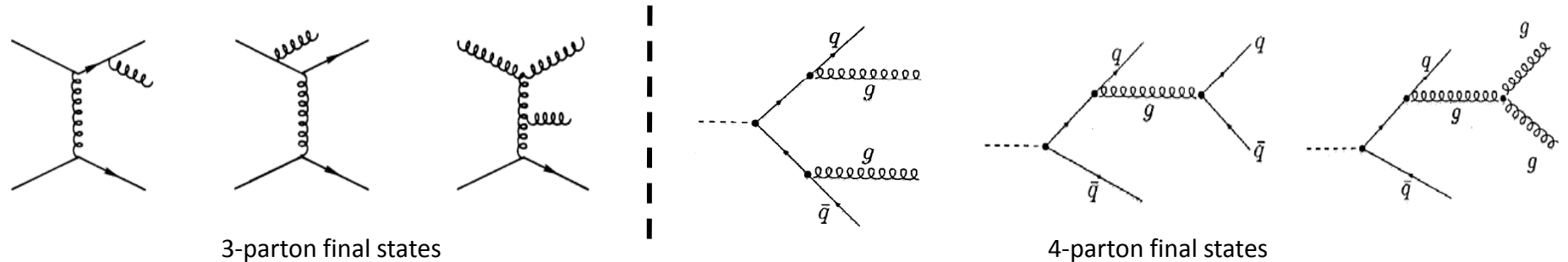
- Jet Pt spectrum – Essential QCD analysis with first data
 - See Pratima Jindal's and Konstantinos Kousouris' talk
- Jet Shapes, Algorithms
 - See Pelin Kurt's talk
- Studies of Dijet Angular Distributions, Correlations
 - See talks by Cosmin Dragoiu and Agata Smoron
- Dijet Ratio – update with expected first conditions – 10 TeV and 10 pb^{-1}
 - See Dan Miner's talk



From Pelin Kurt



Exploring Higher-Order QCD



From Sudaveep Bose

- Multijet QCD Studies – higher order QCD tests
 - See Sudaveep Bose's talk
- QCD Multijet Angular Distributions → apply to New Physics Searches
 - See Burak Bilki's talk

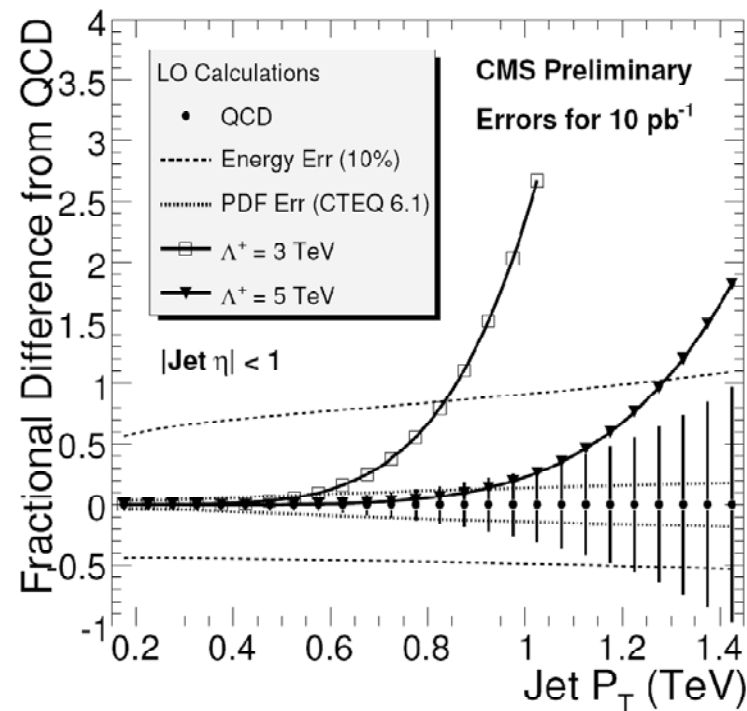


New Physics Searches

- Guido Tonelli's talk on Monday → dijet signatures are a good bet for first New Physics!!

→ With early data, we could find evidence for New Physics

Example: contact interactions through the jet energy spectrum, with 10 pb^{-1}

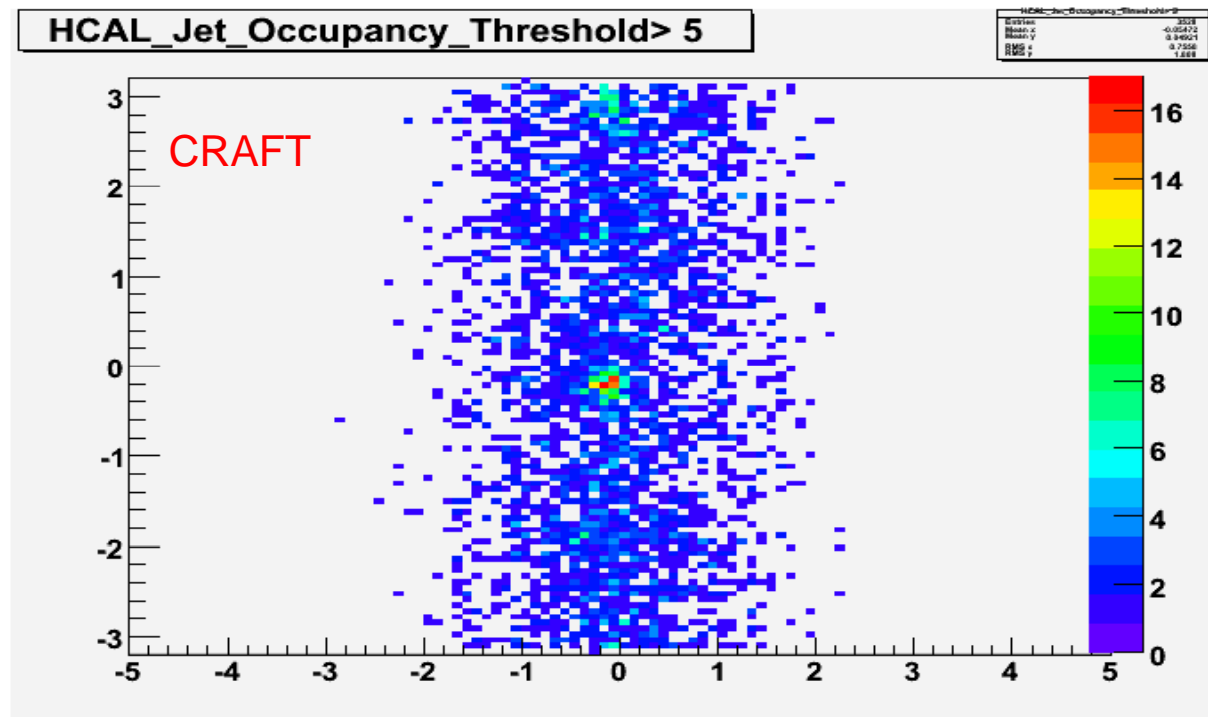


- Extending with new ideas
 - Rutger's group multijet resonance search
 - See Amit Lath's talk in parallel session
- Insert your idea here!!



CRAFT Analysis

- Crucial for preparing for first data, analysis commissioning!
 - Study noise, occupancy, pedestals, trigger rates/stability
 - See Kwangzoo Chung and Kerem Cankocak's talk in parallel session

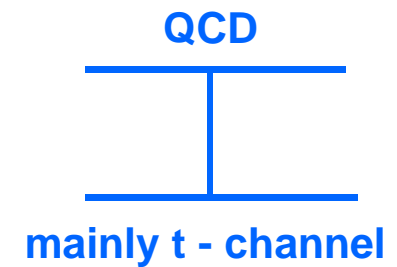
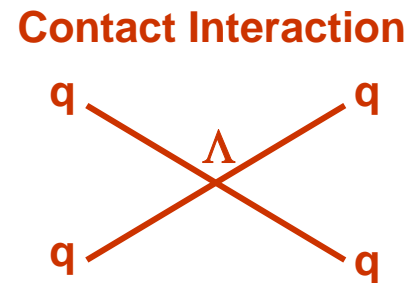
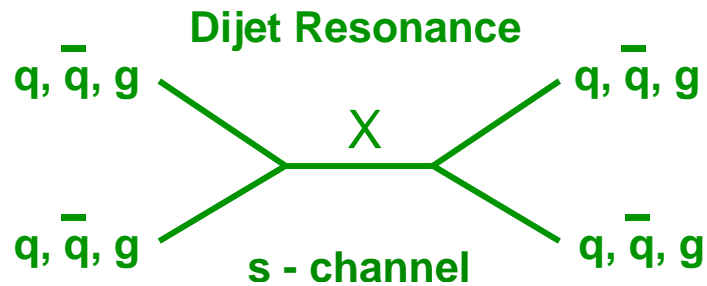


From Kerem Cankocak



Conclusion

- Much activity in dijet-based analyses at CMS!
 - Lots to do with first data (starting with CRAFT data!)
 - Potential for QCD, Exotica, SUSY analyses



Please join the parallel session, come to our working group meetings, or see Rob or Jane!!



Extra slides



Dijet Ratio: Simple Angular Measure

- Dijet Ratio = $N(|\eta| < 0.7) / N(0.7 < |\eta| < 1.3)$
 - Number of events in which each leading jet has $|\eta| < 0.7$, divided by the number in which each leading jet has $0.7 < |\eta| < 1.3$
- Simplest measurement of angle dist.
 - Uses experimental variable η and avoids crossing crack boundaries. Barrel only, reduces systematics.
 - Uses same mass binning as dijet resonance search.
 - Measurement is almost automatic from $d\sigma/dm$ for $|\eta| < 1$.
 - Just need to understand response variation with η in the barrel.
- Search for both contact interactions and resonances.

