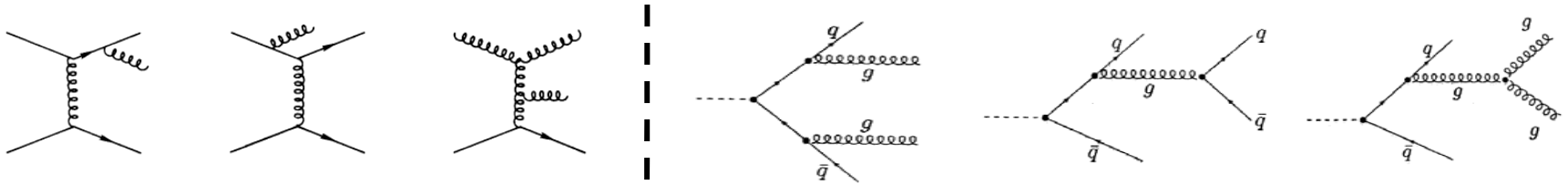
Multijet Study

Motivation:

- The essential features of QCD are provided by the vector nature of gluon and gluon self coupling. These reflect on the so called colour factors which appear in various vertices.



3-parton final states

4-parton final states

- Several tests of QCD which are sensitive to the gluon self-coupling have already been carried out in the earlier e^+e^- and hadron collider experiments which are based on study of angular correlations in 3-jet and 4-jet events.

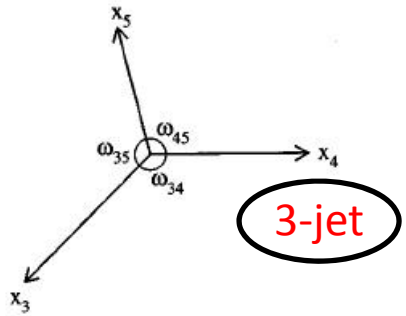
- Study of thee and four jet events allows a test of the validity of the QCD calculations to higher order and a probe of the underlying QCD dynamics. The topological distributions of these multijet events provide sensitive tests of the QCD matrix element calculations.

Different topological properties of Multijets

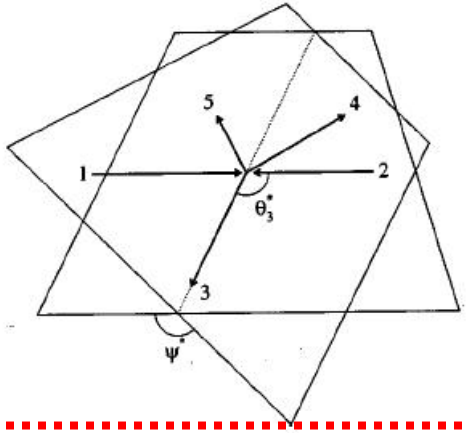
$$x_i = 2E_i / \sqrt{s} \qquad x_3 + x_4 + x_5 = 2$$

$$x_i = \frac{2\sin\omega_{jk}}{\sin\omega_{34} + \sin\omega_{45} + \sin\omega_{53}}$$

$$1 + 2 \rightarrow 3 + 4 + 5$$



3-jet



$$\cos\psi^* = \frac{(\vec{p}_1 \times \vec{p}_3)\cdot(\vec{p}_4 \times \vec{p}_5)}{|\vec{p}_1 \times \vec{p}_3||\vec{p}_4 \times \vec{p}_5|}$$

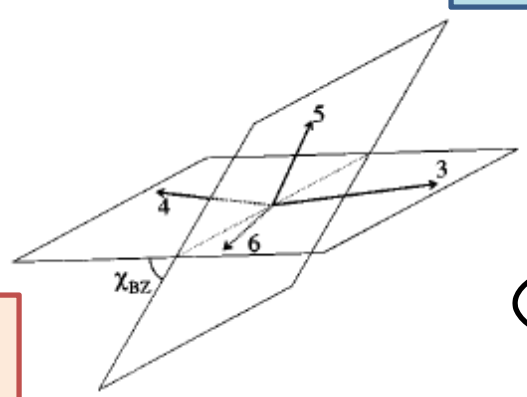
Independent kinematic variables for 3-jet

$$x_3, x_5, \cos\theta_3, \psi^*$$

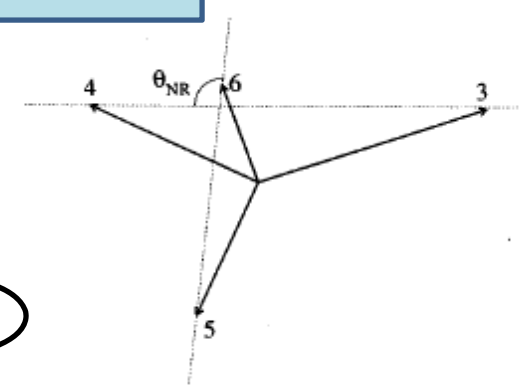
$$\cos\chi_{BZ} = \frac{(\vec{p}_3 \times \vec{p}_4)\cdot(\vec{p}_5 \times \vec{p}_6)}{|\vec{p}_3 \times \vec{p}_4||\vec{p}_5 \times \vec{p}_6|}$$

$$\cos\theta_{NR} = \frac{(\vec{p}_3 - \vec{p}_4)\cdot(\vec{p}_5 - \vec{p}_6)}{|\vec{p}_3 - \vec{p}_4||\vec{p}_5 - \vec{p}_6|}$$

$$1 + 2 \rightarrow 3 + 4 + 5 + 6$$



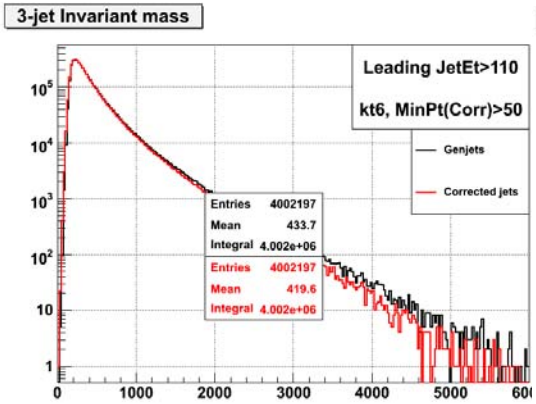
4-jet

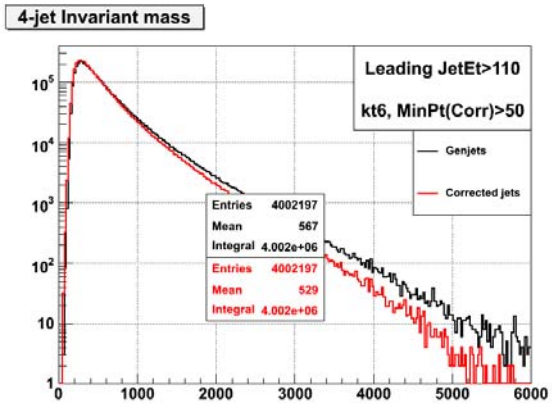


$$x_i, \cos\theta_i, \omega_{jk}, \cos\chi_{BZ}, \cos\theta_{NR}$$

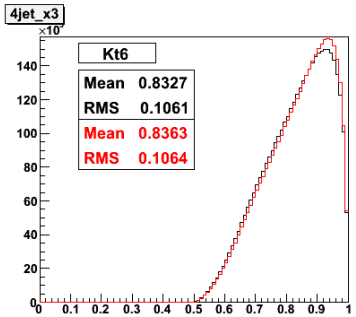
Independent kinematic variables for 4-jet

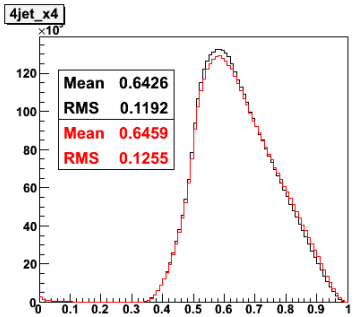
- **Event selection** was done in the following way: (CSA08 - S156 QCD samples used)
  1. **HLT conditions (threshold of 110 GeV on leading jet Pt) and eta acceptance are applied.**
  2. **An additional threshold (50 GeV) applied on all corrected jets.**
  3. **Inclusive 3 jet and 4 jet events are selected with the jets being ordered in their transverse energy, Et. The jets are boosted to the 3-jet/4-jet centre of mass frame and ordered in descending order of their energies (E) in the boosted frame.**

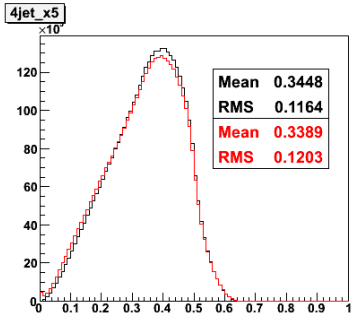


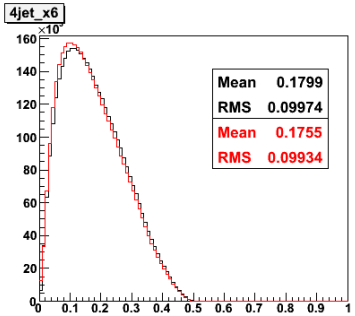


Invariant masses of 3-jet and 4-jet events

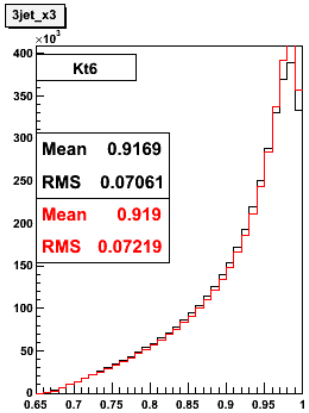


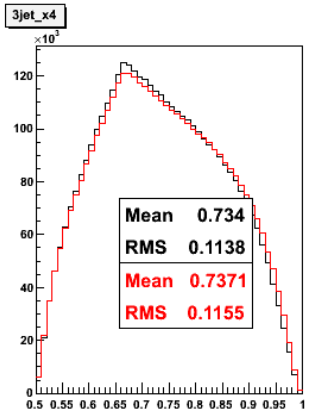


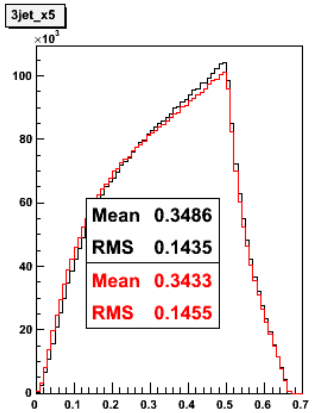




Scaled energies of 4-jet events





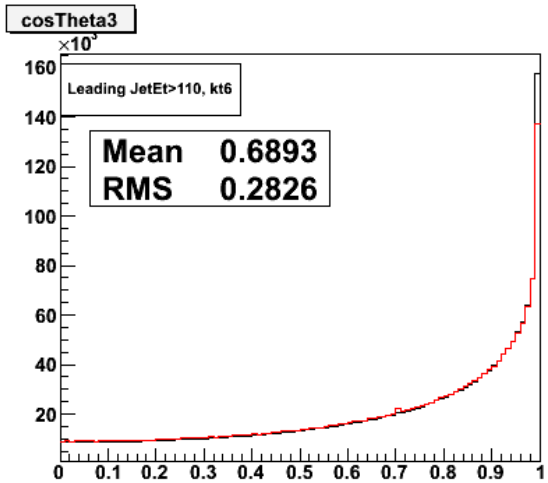


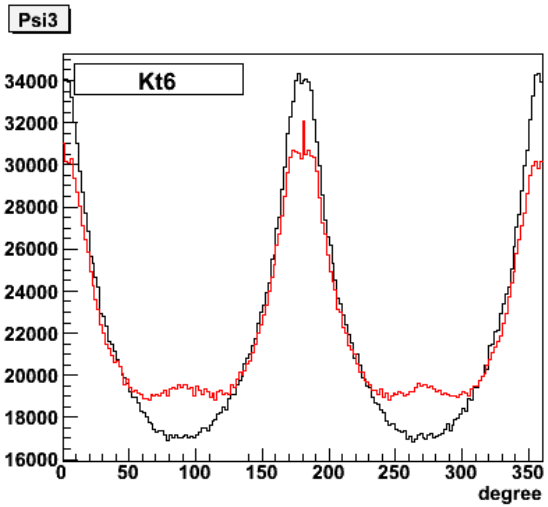
Scaled energies of 3-jet events (x3,x4,x5)

Comparison of GenJets (——) and Corrected(L2L3) Calojets (——)

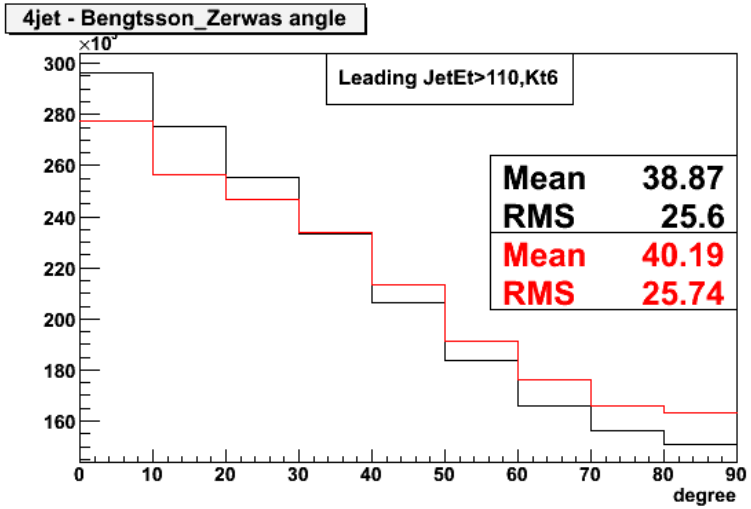
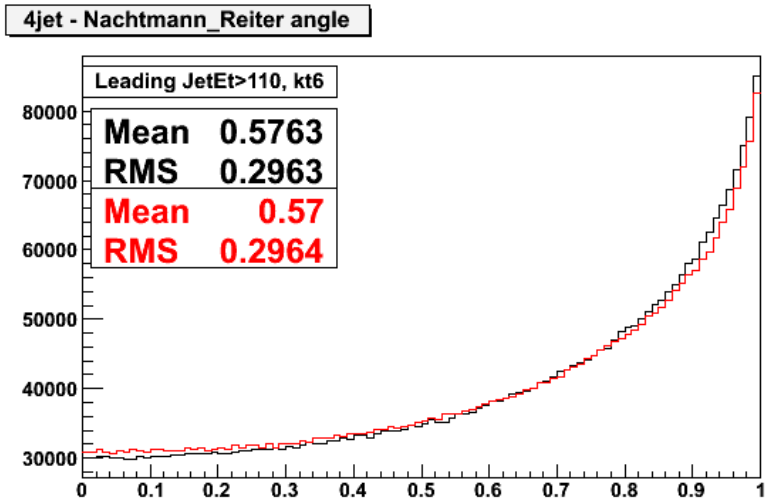
========== Additional plots ==========

Cosine of polar angle & the Psi angle – 3-parton case





The Bengtsson_Zerwas angle for 4-parton case



The Nachtmann-Reiter angle for 4-parton case