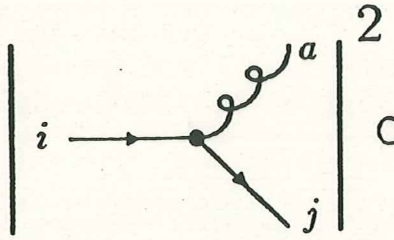
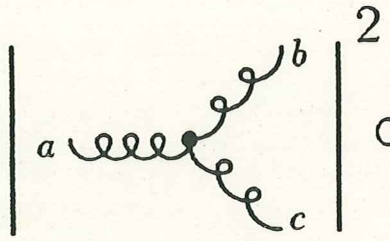
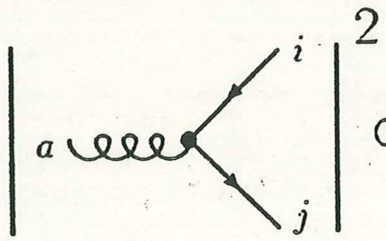
Gluon distribution ?!
Where the hell is it gone ?!
Spin 1 @ TASSO

(a) 

$\propto C_F$

(b) 

$\propto C_A$

(c) 

$\propto T_F$

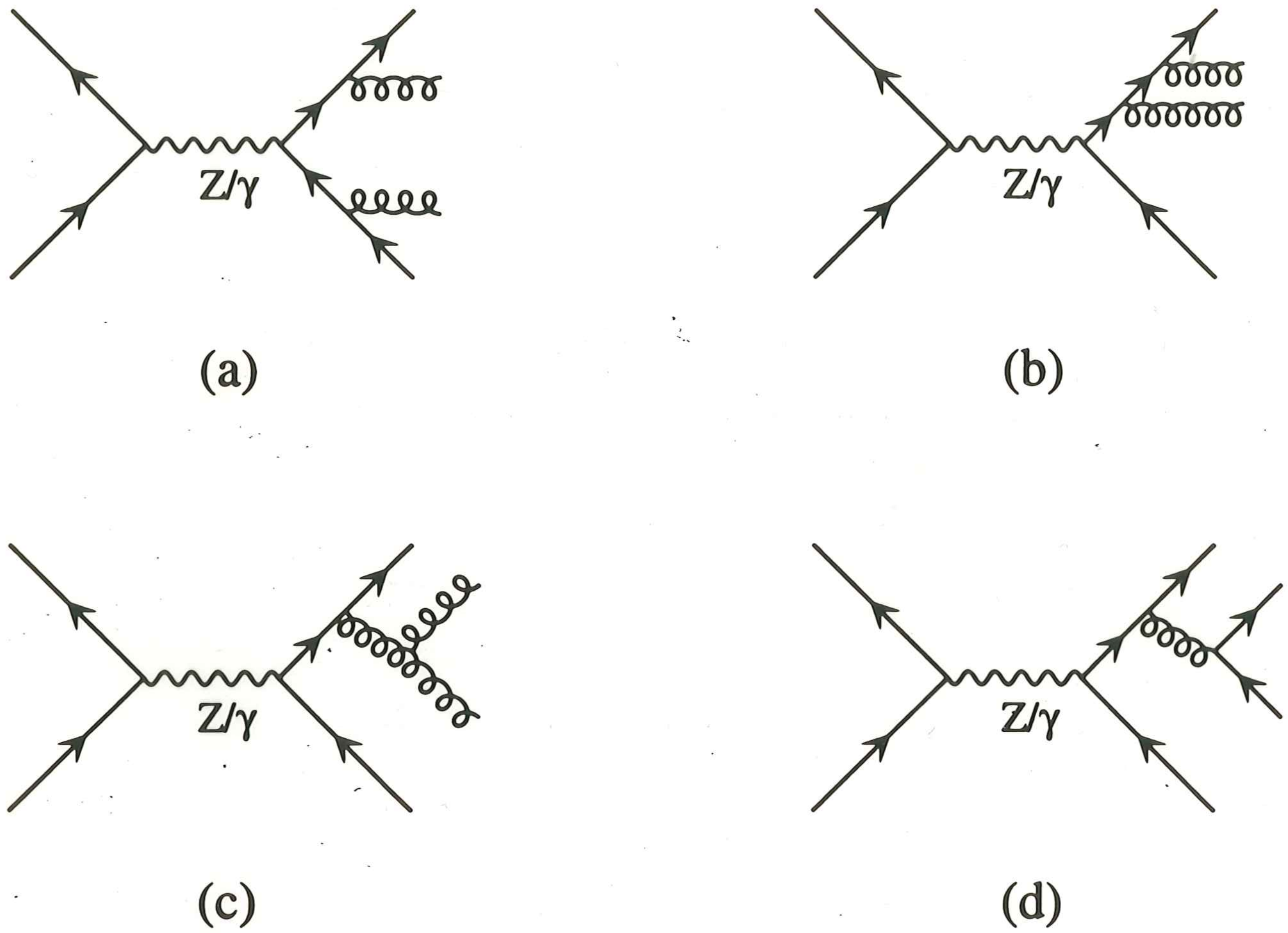


Fig. 2

Some formulae ...

The matrix element (ME) for the 4q process is:

$$|\mathcal{M}|^2 = C_{+}^{q\bar{q}q'\bar{q}'}|\mathcal{M}_+|^2 + C_{-}^{q\bar{q}q'\bar{q}'}|\mathcal{M}_-|^2, \quad (1)$$

$$C_{\pm}^{q\bar{q}q'\bar{q}'} = \frac{1}{2}N_C C_F(T_F \mp (C_F - \frac{1}{2}C_A)), \quad (2)$$

$$\mathcal{M}_{\pm} = \mathcal{M}_1 + \mathcal{M}_2 + \mathcal{M}_3 + \mathcal{M}_4 \pm \delta^{qq'}(\mathcal{M}_5 + \mathcal{M}_6 + \mathcal{M}_7 + \mathcal{M}_8). \quad (3)$$

The ME for the 2q2G process can be split into two gauge invariant parts:

$$|\mathcal{M}|^2 = C_a^{q\bar{q}GG}|\mathcal{M}_a|^2 + C_b^{q\bar{q}GG}|\mathcal{M}_b|^2, \quad (4)$$

$$\mathcal{M}_a = \sum_{i=1,6} \mathcal{M}_i, \quad (5)$$

$$\mathcal{M}_b = \mathcal{M}_1 + \mathcal{M}_3 + \mathcal{M}_5 - \mathcal{M}_2 - \mathcal{M}_4 - \mathcal{M}_6 - 2\,\mathrm{i}[\mathcal{M}_7 + \mathcal{M}_8], \quad (6)$$

$$C_a^{q\bar{q}GG} = \frac{1}{2}N_C C_F(2C_F - \frac{1}{2}C_A) = \frac{7}{3}, \quad C_b^{q\bar{q}GG} = \frac{1}{2}N_C C_F \frac{1}{2}C_A = 3. \quad (7)$$

Note: the second term in eq. (4) is characteristic of non-Abelian theories and would be absent in any Abelian model.

Angular variables

The definitions are

$$\theta^*_{NR} = \angle(\vec{p}_1 - \vec{p}_2, \vec{p}_3 - \vec{p}_4), \tag{8}$$

$$\chi_{BZ} = \angle(\vec{p}_1 \times \vec{p}_2, \vec{p}_3 \times \vec{p}_4), \tag{9}$$

and

$$\theta_{34} = \angle(\vec{p}_3, \vec{p}_4). \tag{10}$$

For events where

$$|\vec{p}_1 + \vec{p}_3| > |\vec{p}_1 + \vec{p}_4| \tag{11}$$

we define

$$\Phi^*_{KSW} = \angle(\vec{p}_1 \times \vec{p}_3, \vec{p}_2 \times \vec{p}_4), \tag{12}$$

whereas in the opposite case, we define Φ^*_{KSW} with $\vec{p}_3$ and $\vec{p}_4$ interchanged.

The definition in eqs. (11)-(12) is a modification of the original angle Φ_{KSW}, introduced by J.B. Tausk and myself (see Z. Phys. **C69** (1996) 635).

It is equivalent to the original definition of Φ_{KSW} in events where the thrust axis is along $\vec{p}_1 + \vec{p}_3$ or $\vec{p}_1 + \vec{p}_4$.

Note: in the definitions of the angular variables given above, energy ordering on the jets is supposed, so that $\vec{p}_i$ indicates the three-momentum of the i-th jet, with energy E_i such that $E_1 \geq E_2 \geq E_3 \geq E_4$.

$$P(x_G) = \frac{d\sigma_{\parallel} - d\sigma_{\perp}}{d\sigma_{\parallel} + d\sigma_{\perp}} = 2\frac{1 - x_G}{x_q^2 + x_{\bar{q}}^2}, \tag{1}$$

for the degree of polarization, being $x_i = 2E_i/\sqrt{s}$.

Fragmentation of a linearly polarized gluon into daughter partons depends on the azimuthal angle χ between the final state plane and the polarization vector.

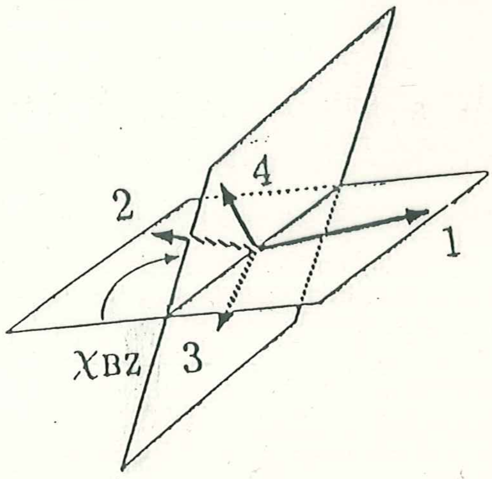
The χ-dependent terms are:

$$D_{G\to GG}(z,\chi) = \frac{6}{2\pi}\left[\frac{(1-z+z^2)^2}{z(1-z)} + z(1-z)\cos 2\chi\right], \tag{2}$$

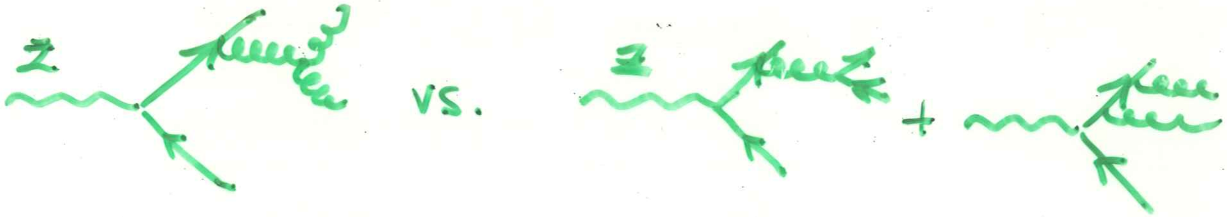
$$D_{G\to q\bar{q}}(z,\chi) = \frac{6}{2\pi}\left[\frac{1}{2}(z^2 + (1-z)^2) - z(1-z)\cos 2\chi\right]. \tag{3}$$

Therefore, the distribution in the Bengtsson-Zerwas angle $\chi_{BZ}(\equiv \chi)$, defined as

$$\chi_{BZ} = \angle(\vec{p}_1 \times \vec{p}_2, \vec{p}_3 \times \vec{p}_4),$$

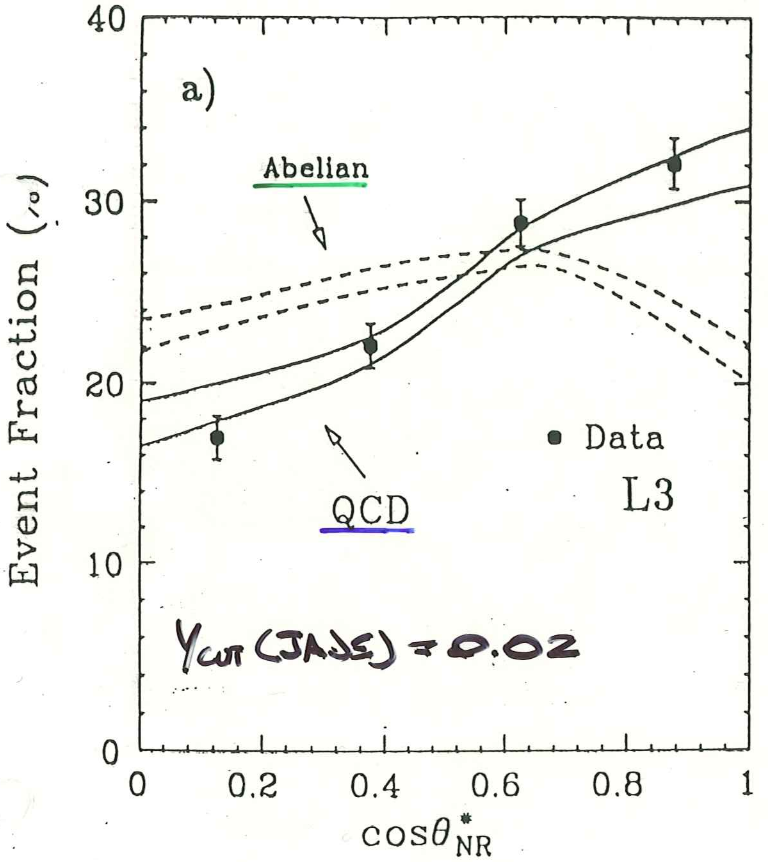


is expected *to be rather flat for the $G \to GG$ contribution if compared with the $G \to q\bar{q}$ one, which generally peaks at* $\chi_{BZ} \approx 90^o$.



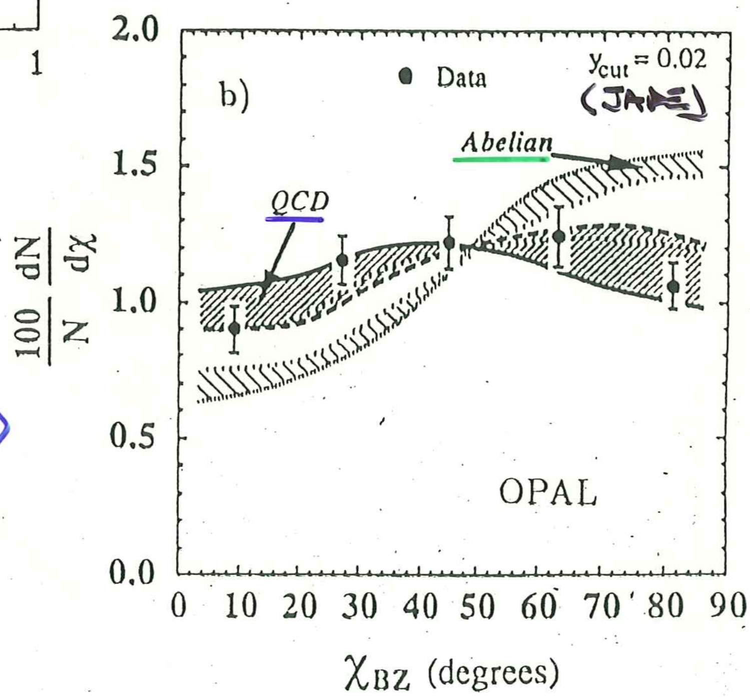
Experimental results from 4-*jet*

- No flavour identification is assumed.
- *Jets* are ordered in energy. $E_1 > E_2 > E_3 > E_4$

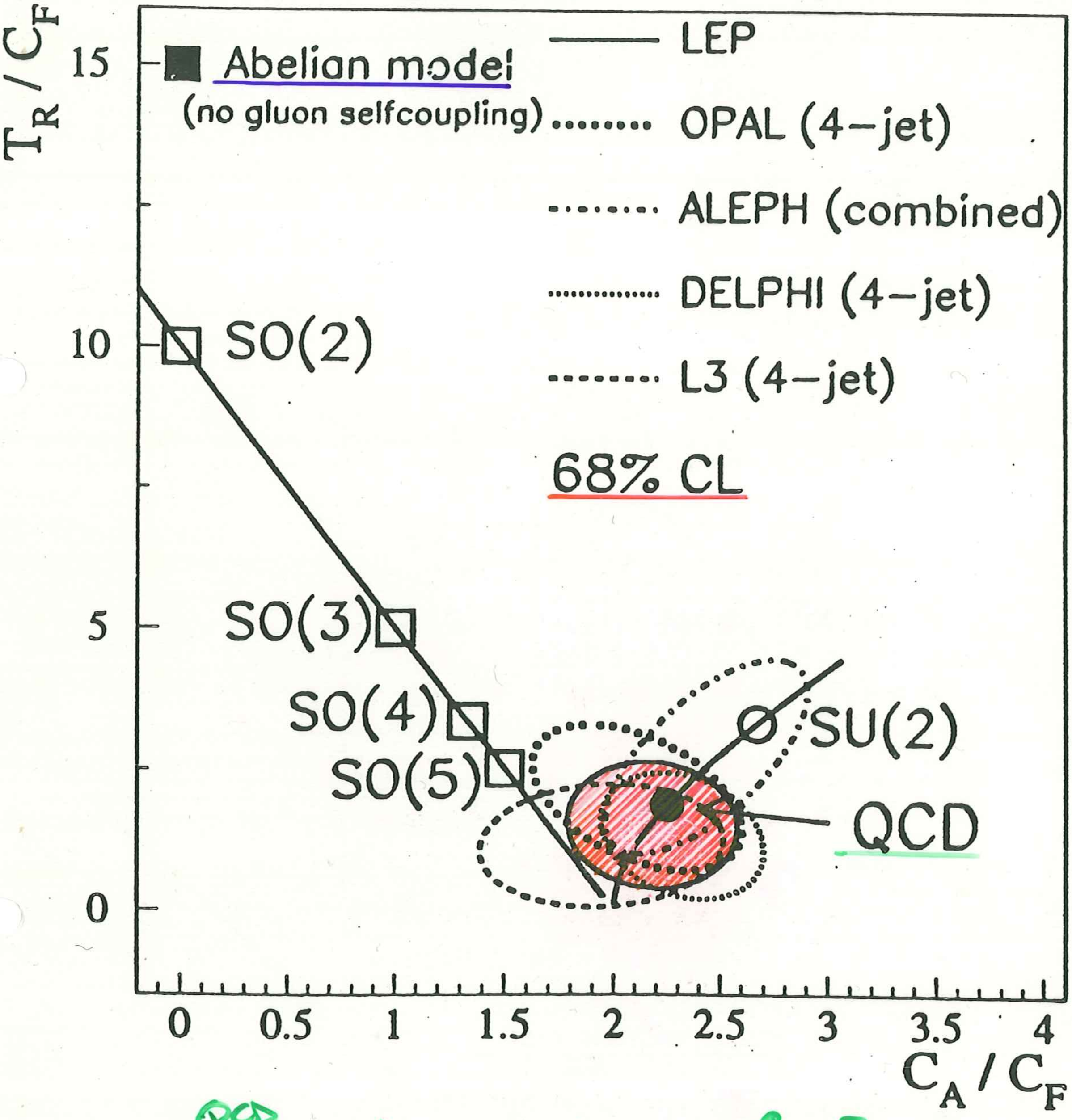


$\theta^*_{NR} = \angle(\vec{p}_1 - \vec{p}_2, \vec{p}_3 - \vec{p}_4)$

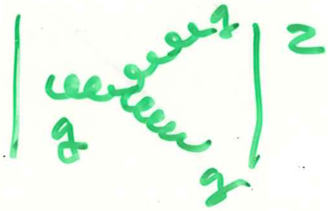
$\chi_{BZ} = \angle(\vec{p}_1 \times \vec{p}_2, \vec{p}_3 \times \vec{p}_4)$

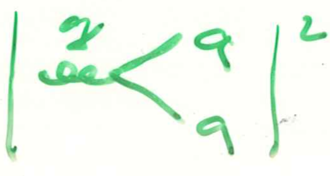


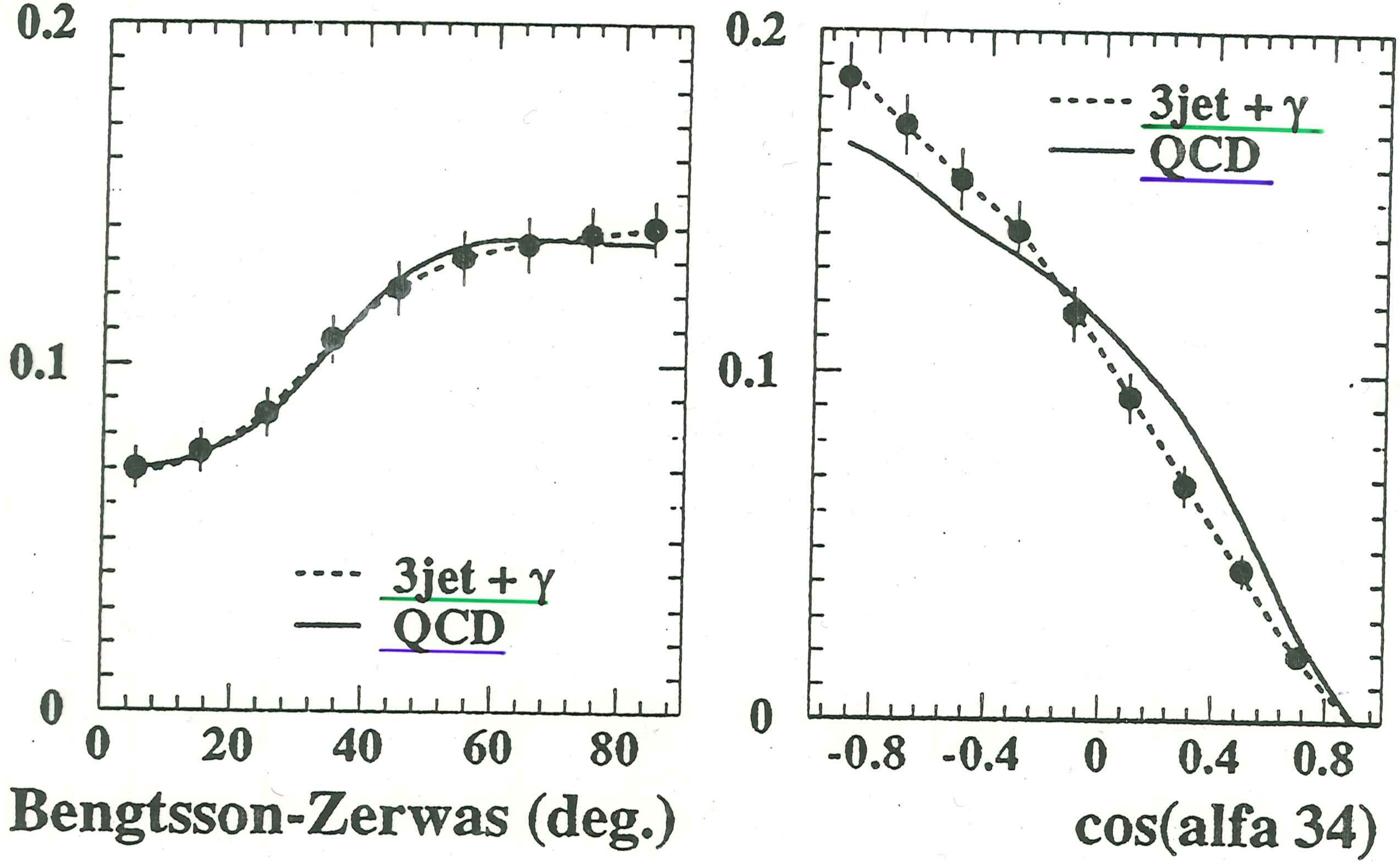
JADE



$C_F^{QCD} = \frac{4}{3} \sim$ 

$C_A^{QCD} = 3 \sim$ 

$T_R^{QCD} = \frac{1}{2} \sim$ 


0.2
0.1
0
0
20
40
60
80
3jet + γ
QCD
Bengtsson-Zerwas (deg.)
0.2
0.1
0
-0.8
-0.4
0
0.4
0.8
3jet + γ
QCD
cos(alfa 34)