



Misure di QCD alle energie di LEP2

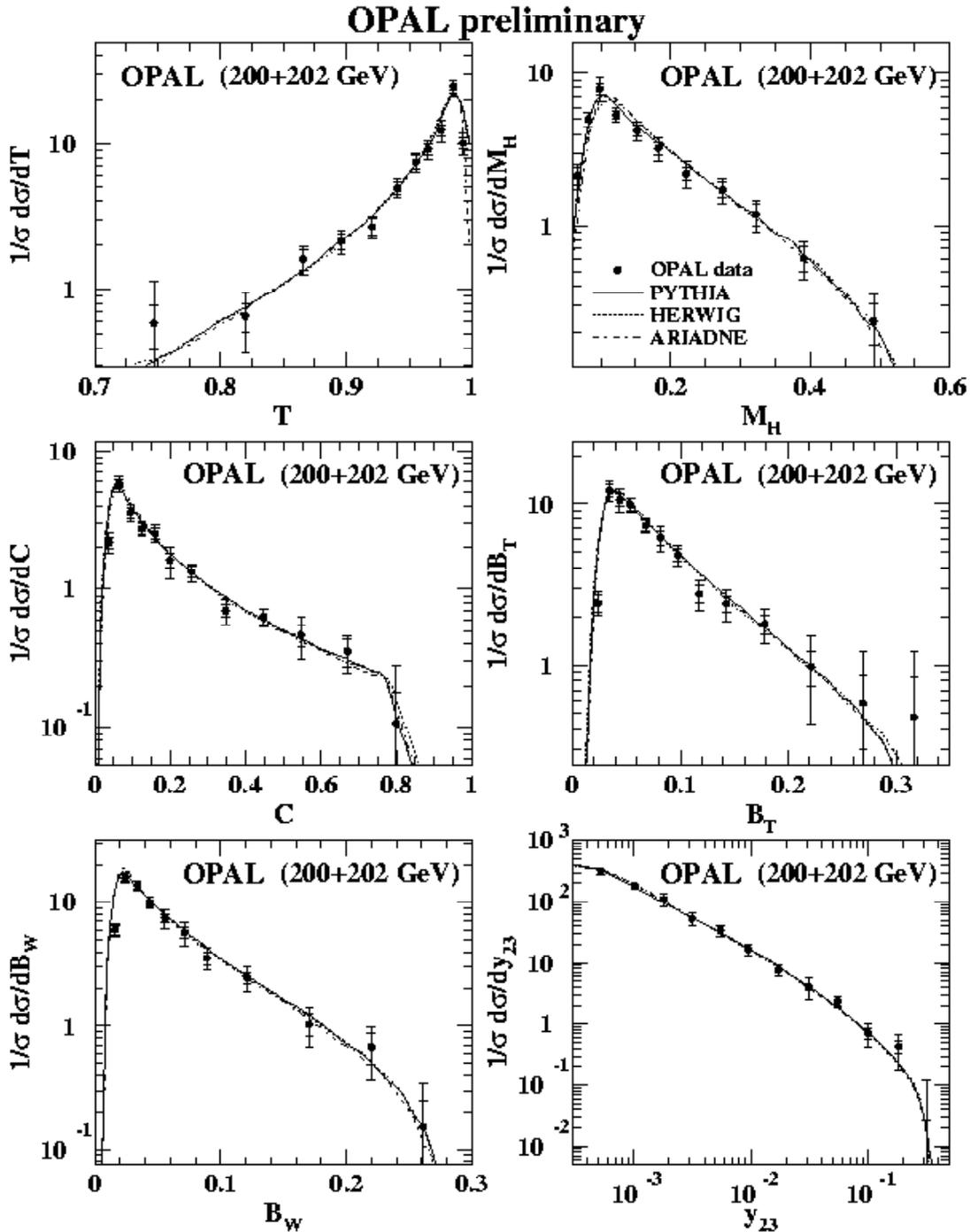
Studi delle proprietà globali degli eventi multiadronici a LEP2 e della loro evoluzione energetica

- ✓ variabili di forma globali (“event shape”)
- ✓ misura di α_s alle energie di LEP2
- ✓ “jet rates”
- ✓ spettri d’impulso di singola particella
- ✓ molteplicità adronica carica



Variabili “event shape”

- ✓ Studio della struttura globale di un evento mh mediante l’analisi delle variabili di forma (T, T_{major}, T_{minor}, O, S, A, C-param., M_H, B_T, B_w)



200 GeV
 L=76 pb⁻¹
 # 1105

202 GeV
 L=23 pb⁻¹
 # 347

- ✓ Nessuna deviazione significativa dalle previsioni dei modelli PS a ciascuna energia di LEP2 indagata
(NB: i modelli usati implementano la frammentazione partonica in modi differenti)



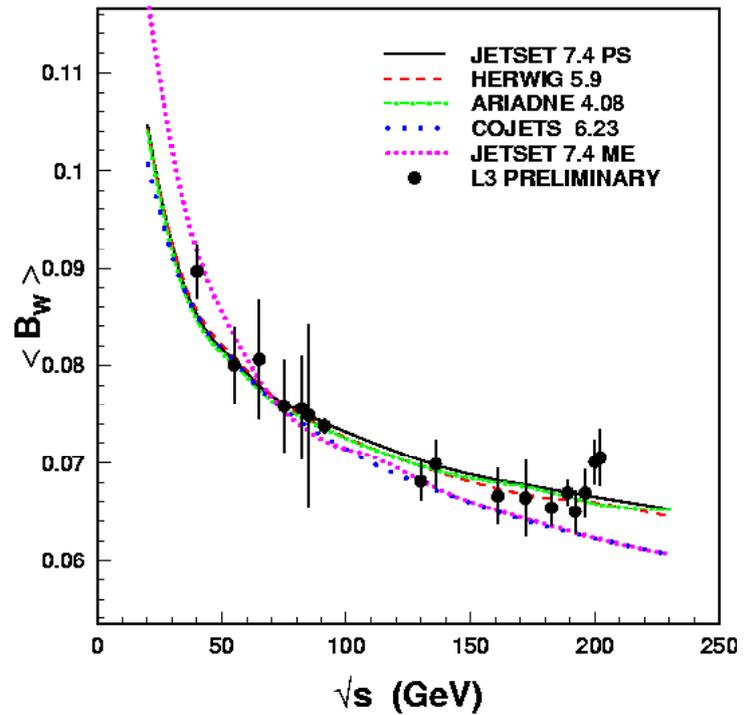
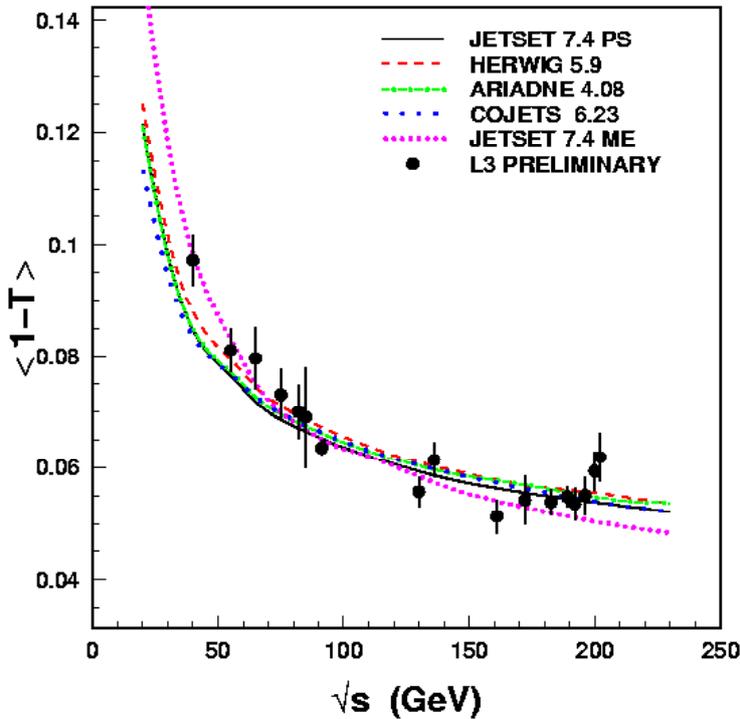
DATI di qualità e forte braccio di leva (alte energie raggiunte)

PREDIZIONI TEORICHE per l'evoluzione energetica dei valori medi

Modelli basati su approcci differenti per descrivere fase pert. e non pert. QCD

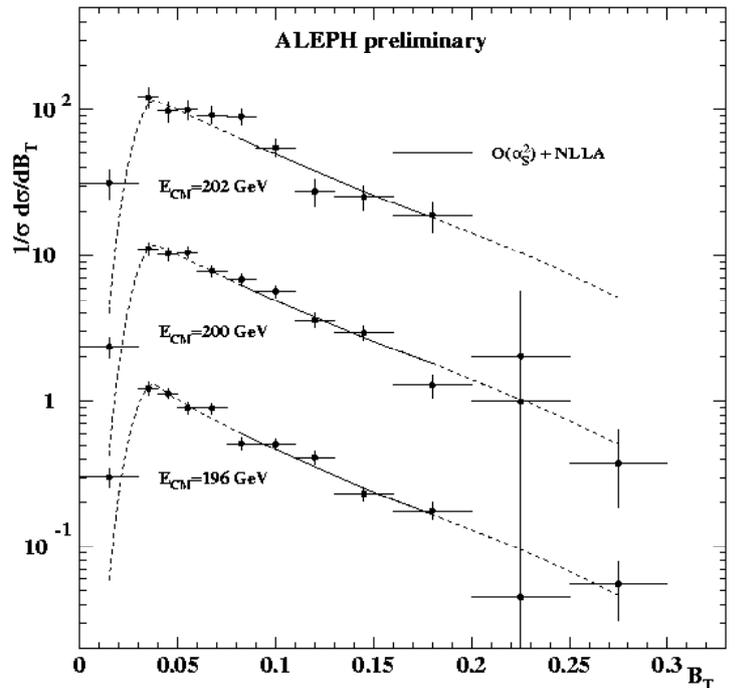
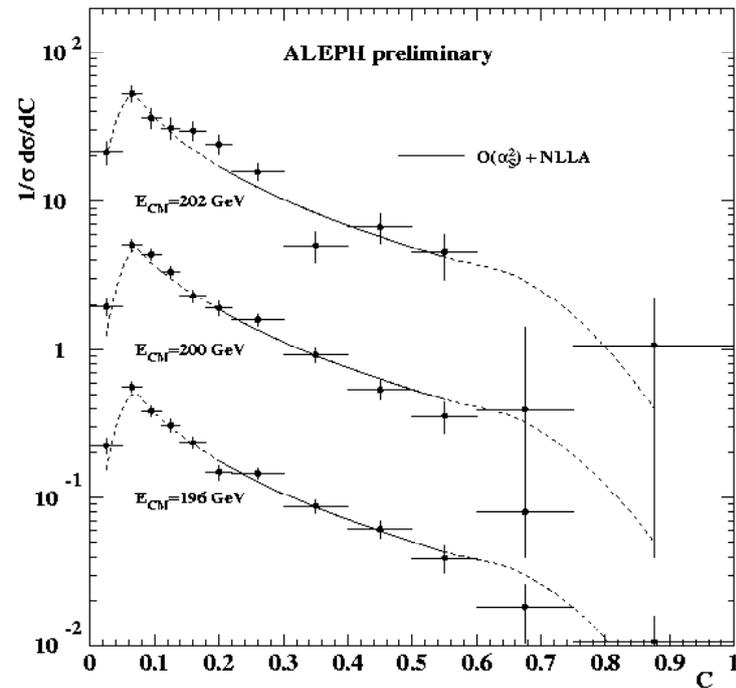
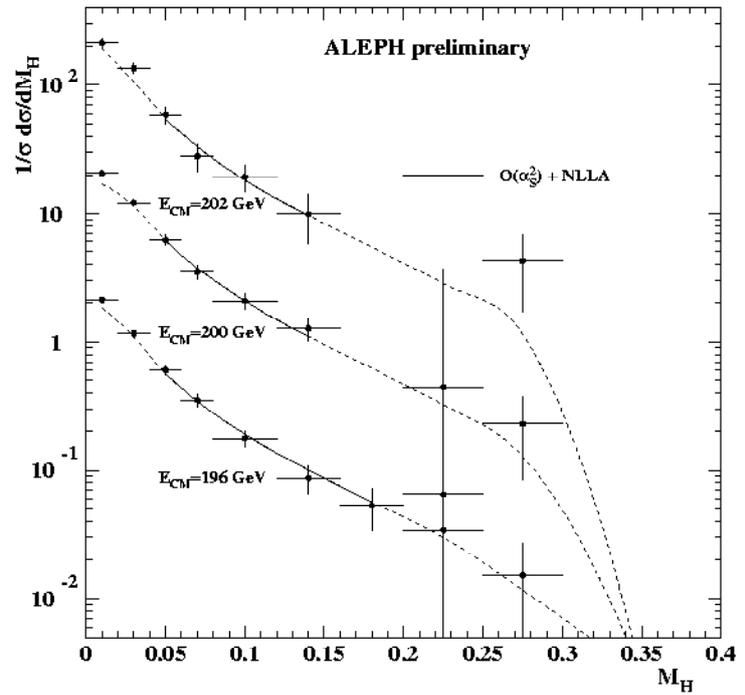
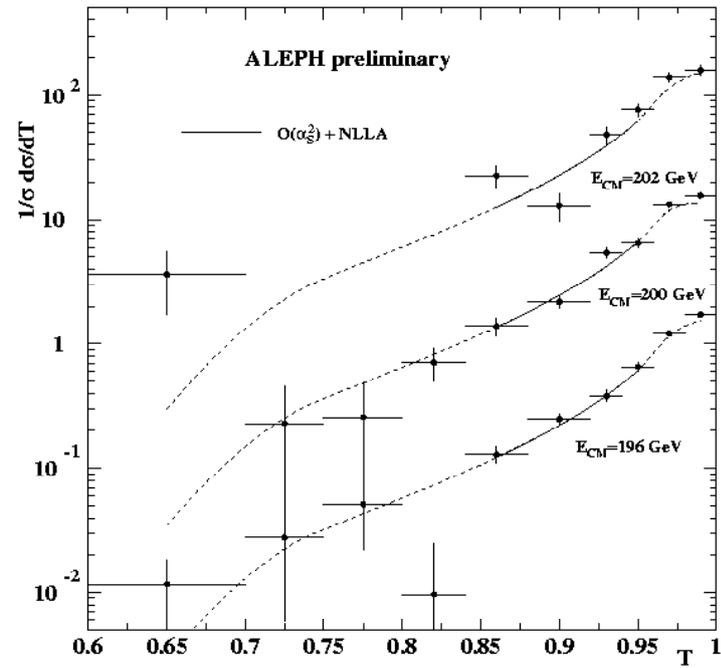
Estensione test di consistenza QCD

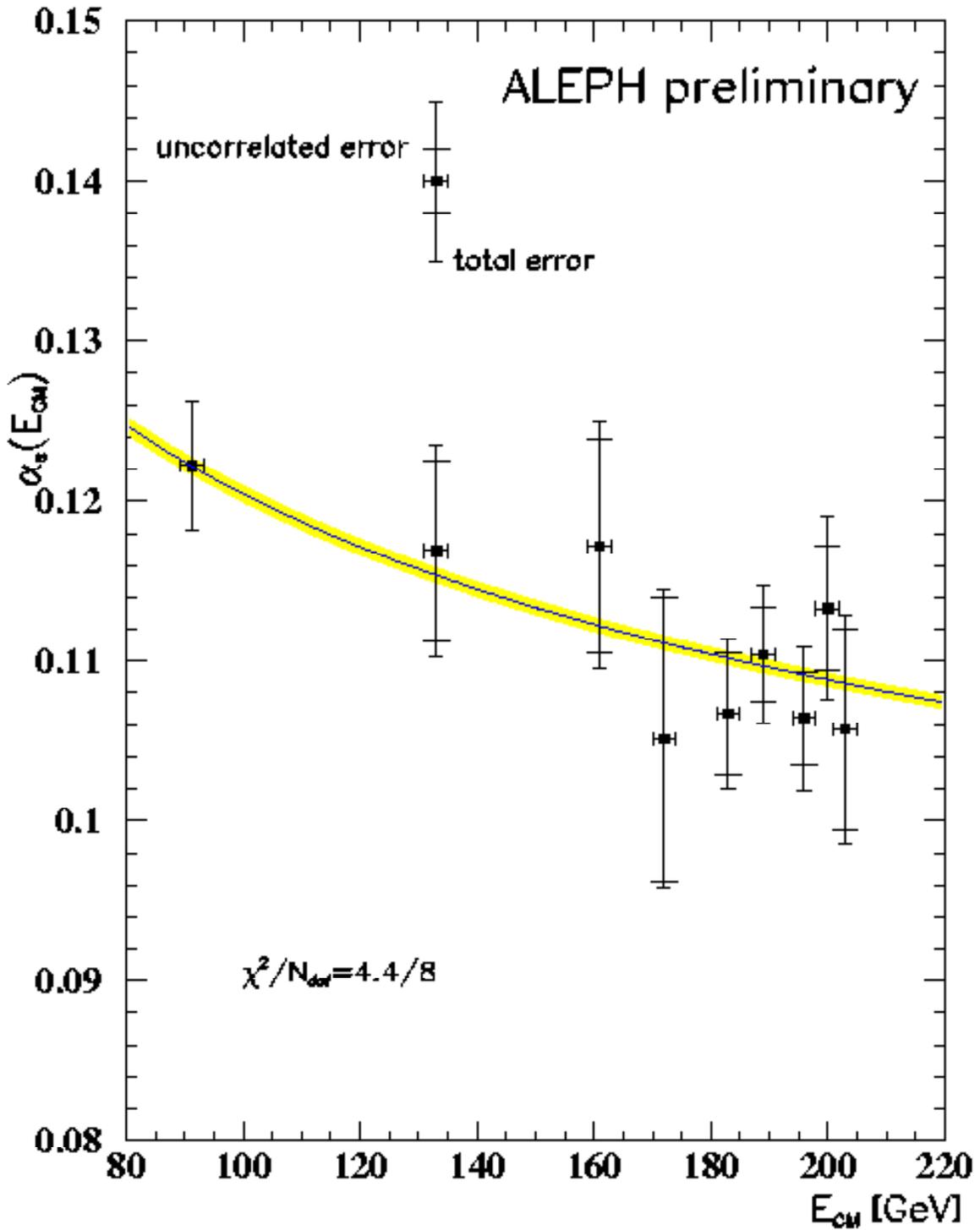
Terreno fertile per test dei modelli





Misura di α_s da distribuzioni di variabili "event shape"





α_s (196 GeV) = 0.1065 ± 0.0027 (stat) ± 0.0018 (sist) ± 0.0035 (theo)

α_s (200 GeV) = 0.1133 ± 0.0030 (stat) ± 0.0018 (sist) ± 0.0042 (theo)

α_s (202 GeV) = 0.1051 ± 0.0046 (stat) ± 0.0018 (sist) ± 0.0034 (theo)

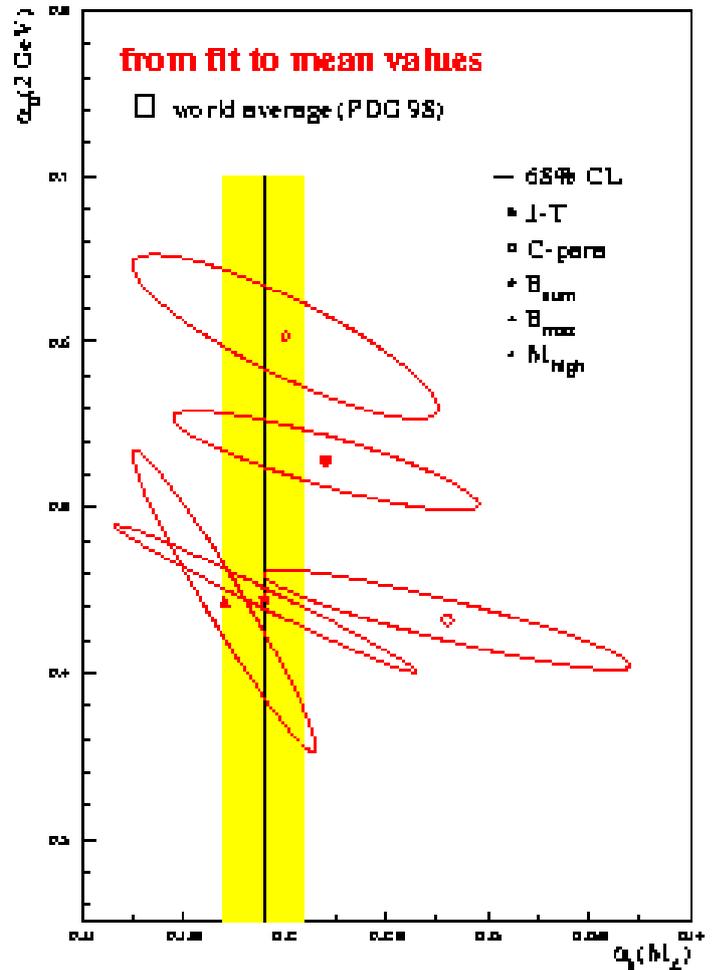
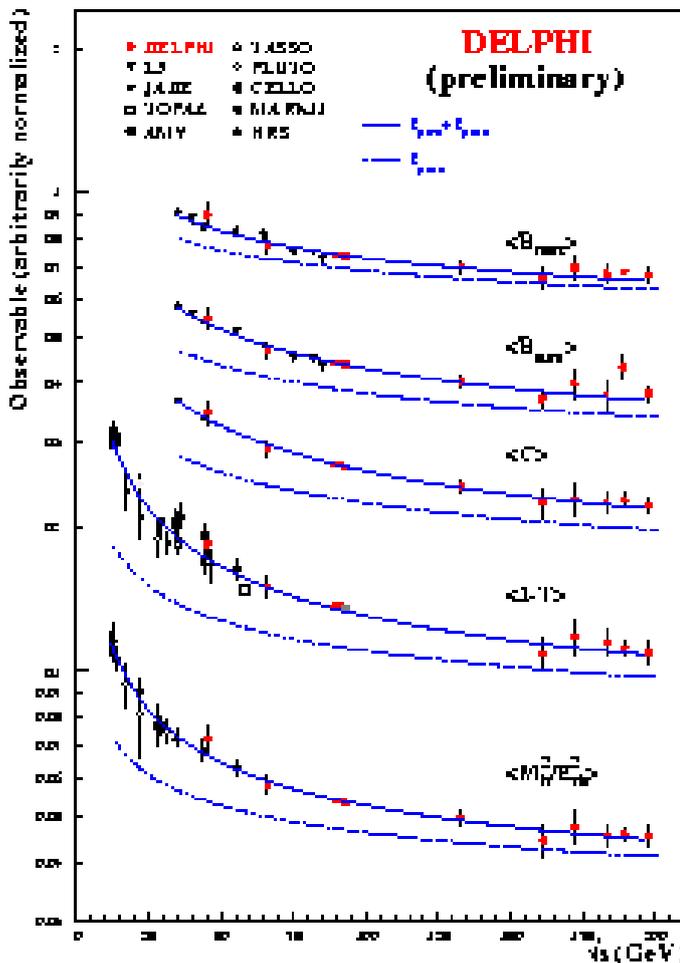


Misura di α_s da valori medi di variabili “event shape”

- ✓ Correzione per adronizzazione mediante aggiunta di un termine non perturbativo alla predizione $O(\alpha_s^2)$ per l'evoluzione energetica dei valori medi:

$$\langle f \rangle = \langle f_{\text{pert}} \rangle + \langle f_{\text{pow}} \rangle$$

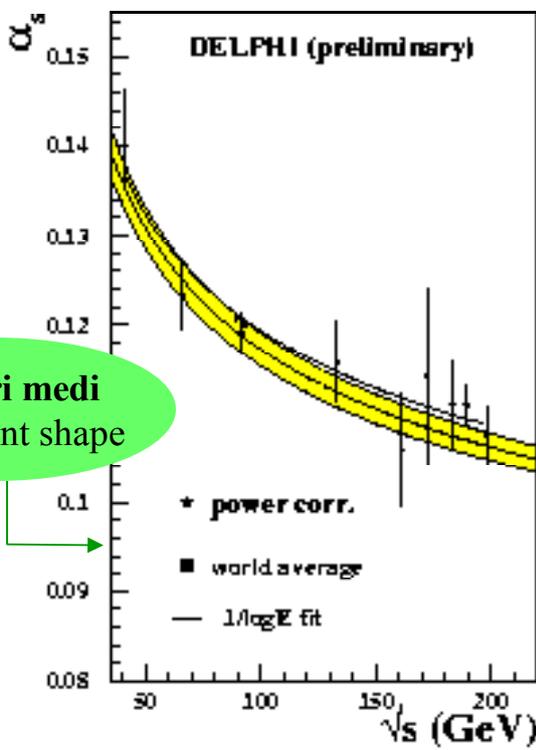
“power correction” DW ansatz (Dokshitzer-Webber)



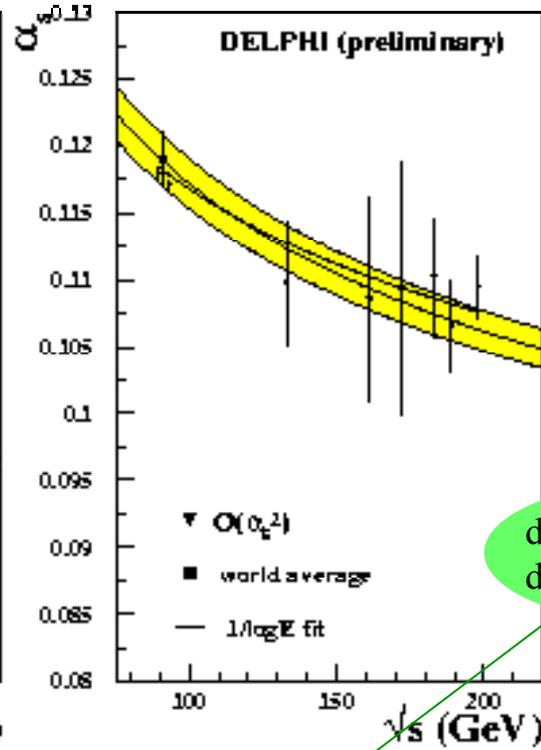
- ✓ I valori di α_s estratti dai fit sono consistenti tra loro e in buon accordo con la media mondiale



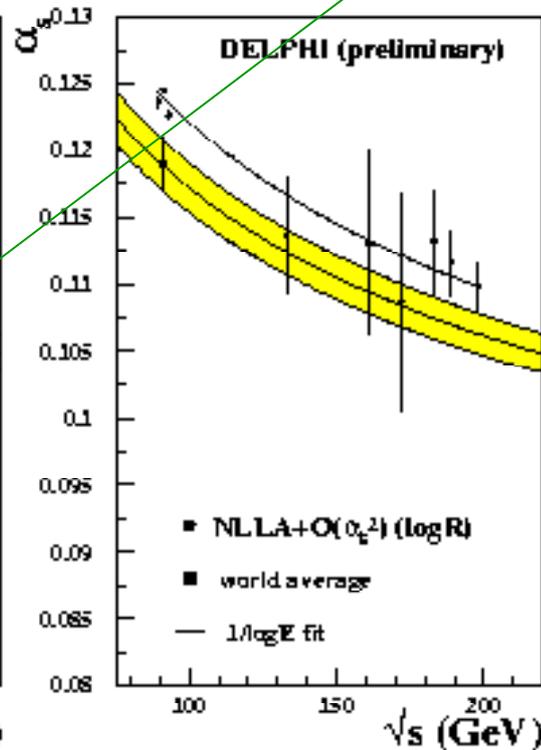
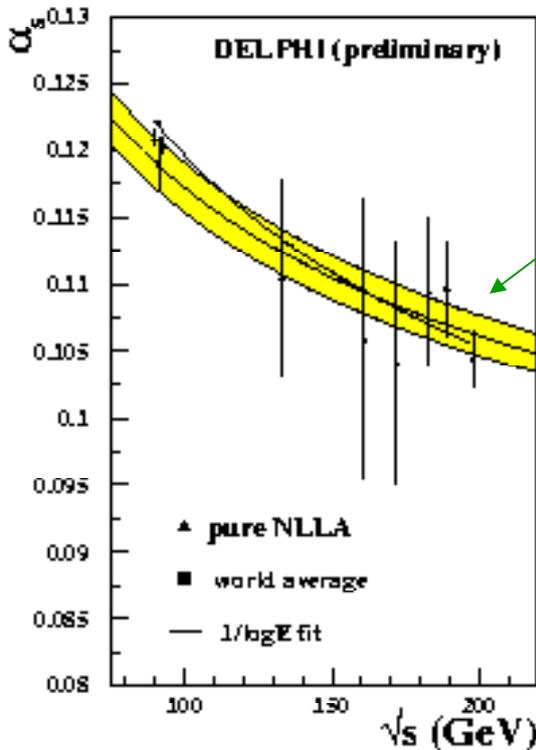
“Running” di α_s



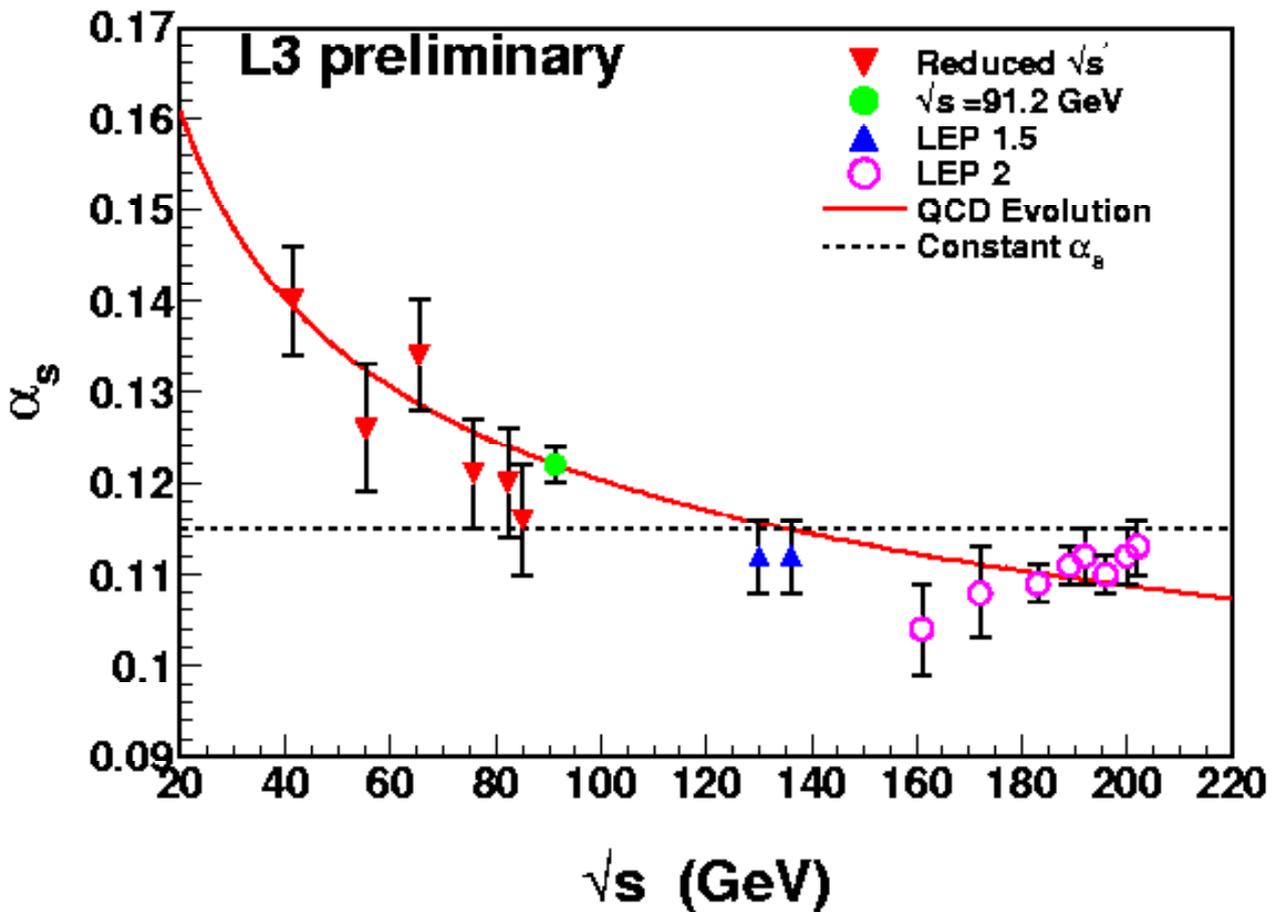
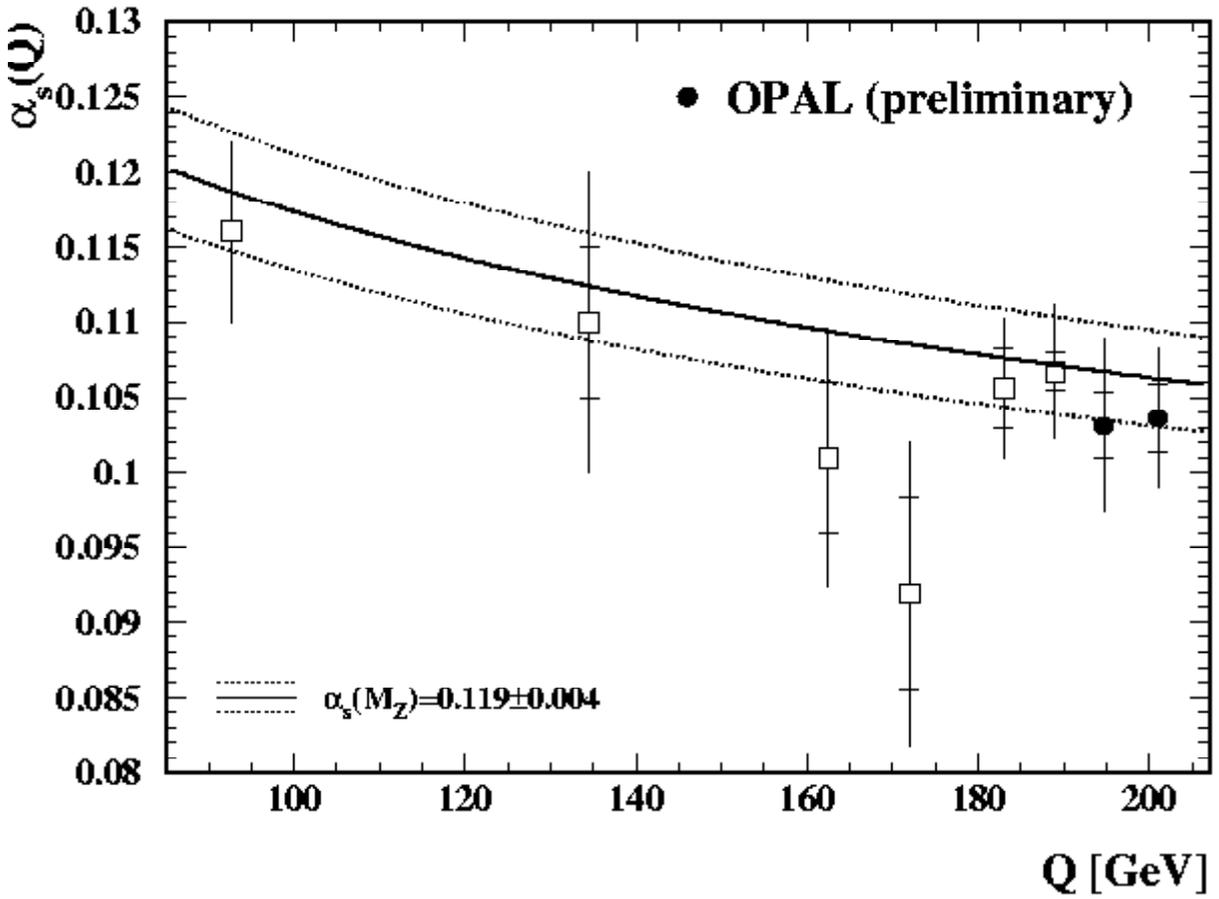
dai valori medi delle event shape



dalle distribuzioni delle event shape



✓ La dipendenza energetica della costante di accoppiamento forte è consistente con le previsioni QCD





Aleph

$$\alpha_s(196 \text{ GeV}) = 0.1065 \pm 0.0027 \text{ (stat)} \pm 0.0018 \text{ (sist)} \pm 0.0035 \text{ (theo)}$$

$$\alpha_s(200 \text{ GeV}) = 0.1133 \pm 0.0030 \text{ (stat)} \pm 0.0018 \text{ (sist)} \pm 0.0042 \text{ (theo)}$$

$$\alpha_s(202 \text{ GeV}) = 0.1051 \pm 0.0046 \text{ (stat)} \pm 0.0018 \text{ (sist)} \pm 0.0034 \text{ (theo)}$$

Delphi

$$\alpha_s(198 \text{ GeV}) = 0.1076 \pm 0.0028 \text{ (stat)} \pm 0.0029 \text{ (sist)} \pm 0.0050 \text{ (theo)}$$

(power corrections)

$$\Rightarrow \alpha_s(M_Z) = 0.1205 \pm 0.0036 \text{ (stat)} \pm 0.0031 \text{ (sist)} \pm 0.0060 \text{ (theo)}$$

L3

$$\alpha_s(192 \text{ GeV}) = 0.1129 \pm 0.0035 \text{ (stat+sist)} \pm 0.0055 \text{ (theo)}$$

$$\alpha_s(196 \text{ GeV}) = 0.1106 \pm 0.0024 \text{ (stat+sist)} \pm 0.0056 \text{ (theo)}$$

$$\alpha_s(200 \text{ GeV}) = 0.1127 \pm 0.0026 \text{ (stat+sist)} \pm 0.0056 \text{ (theo)}$$

$$\alpha_s(202 \text{ GeV}) = 0.1130 \pm 0.0033 \text{ (stat+sist)} \pm 0.0055 \text{ (theo)}$$

Preliminary!

Opal

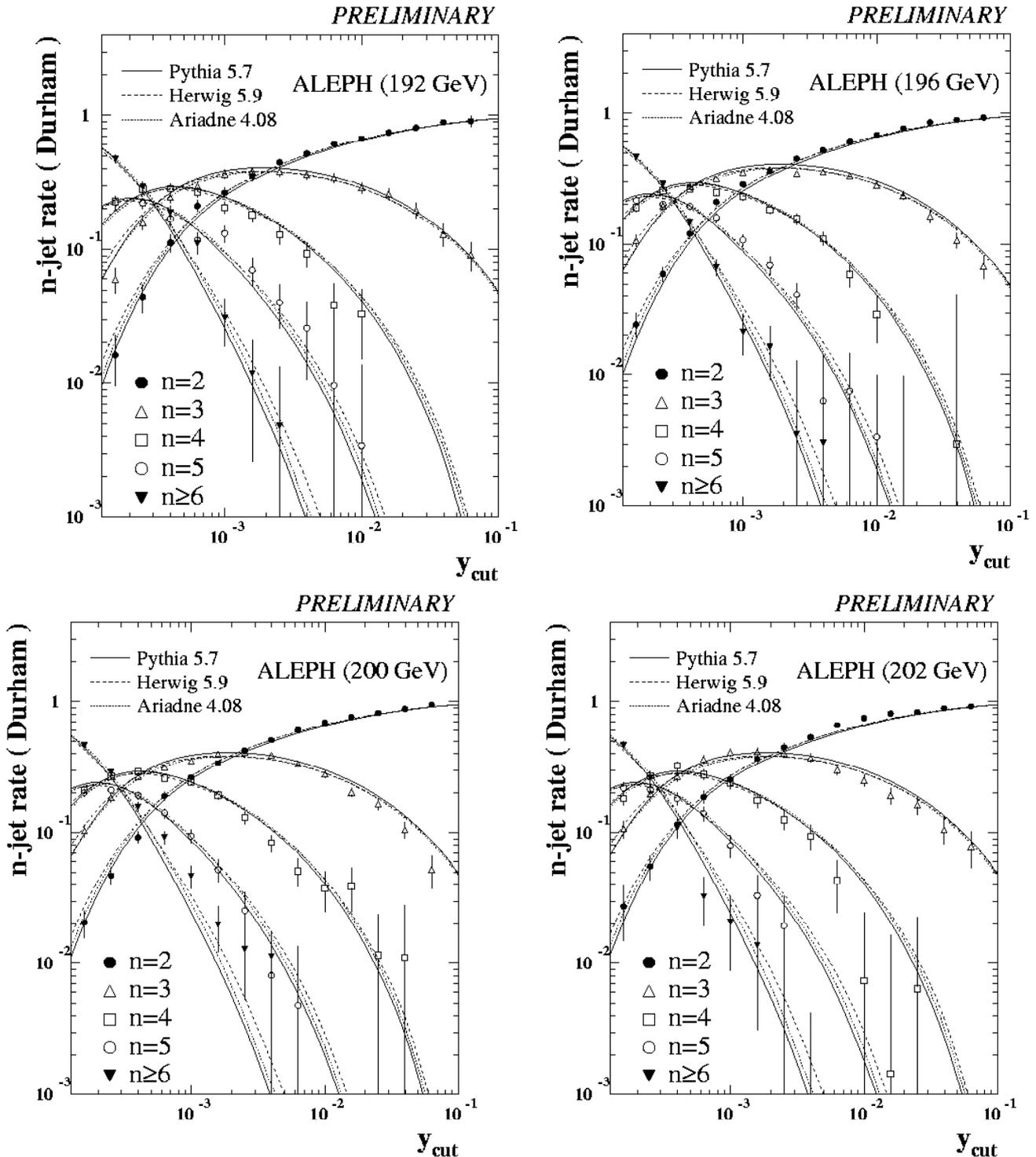
$$\alpha_s(195 \text{ GeV}) = 0.103 \pm 0.002 \text{ (stat)} \pm 0.005 \text{ (sist)}$$

$$\alpha_s(201 \text{ GeV}) = 0.104 \pm 0.002 \text{ (stat)} \pm 0.004 \text{ (sist)}$$



“Jet rates”

- ✓ Frequenze relative di eventi a più jets rispetto alla totale produzione mh (schemi usati: Jade (E0), Durham, Cone)

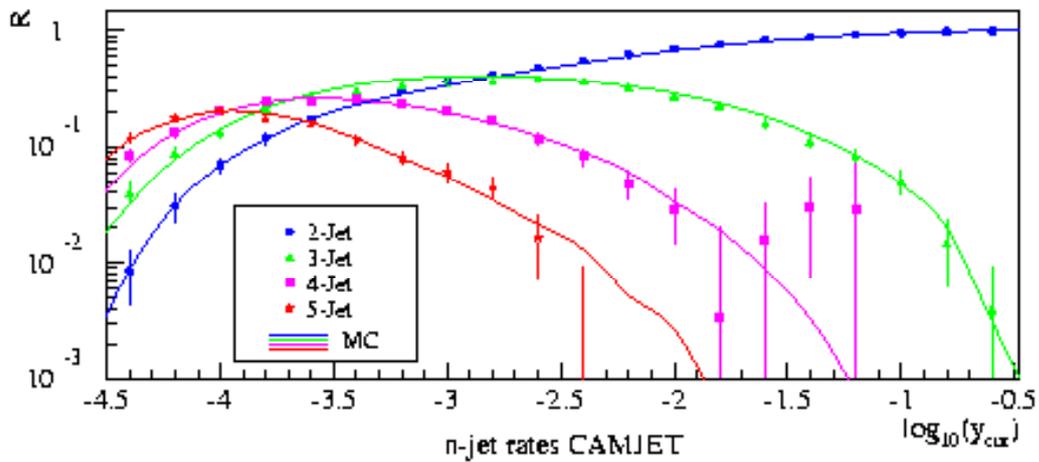
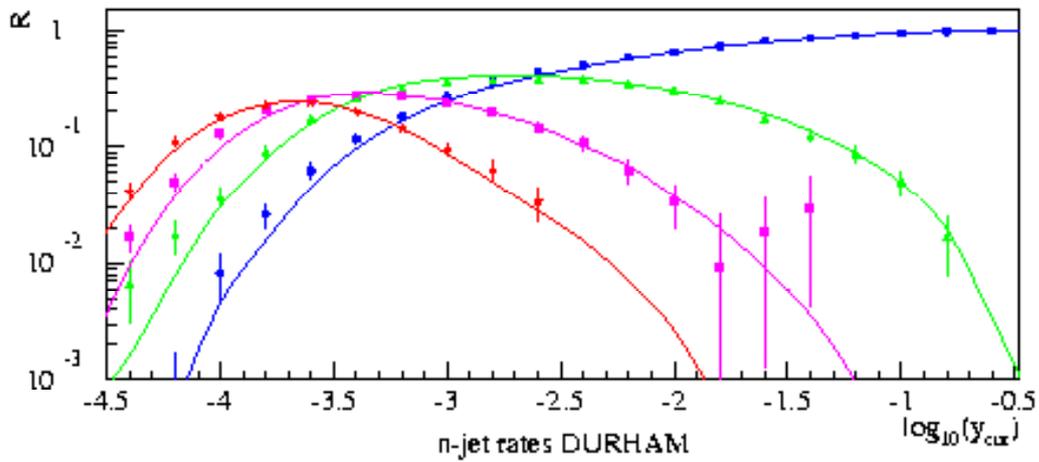
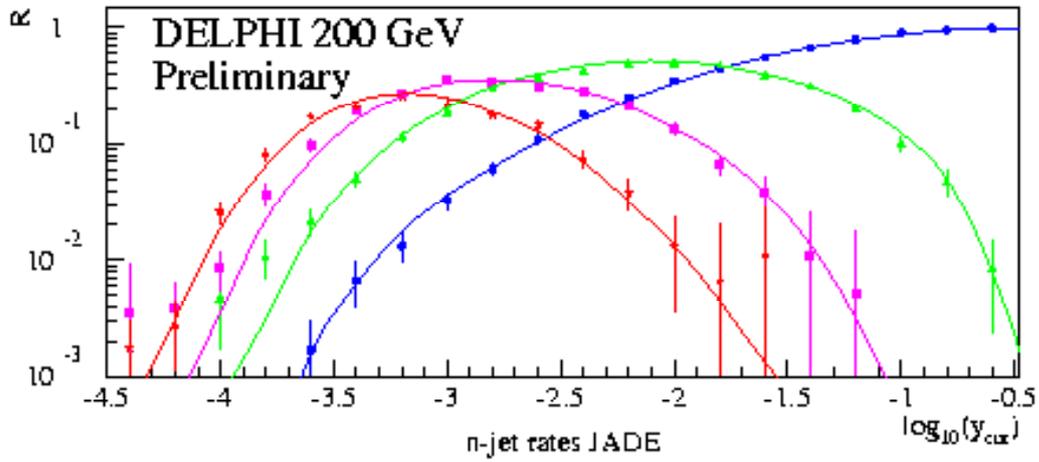


- ✓ Differenti modelli PS in accordo con i dati sperimentali (indipendentemente dallo schema di ricombinazione utilizzato)



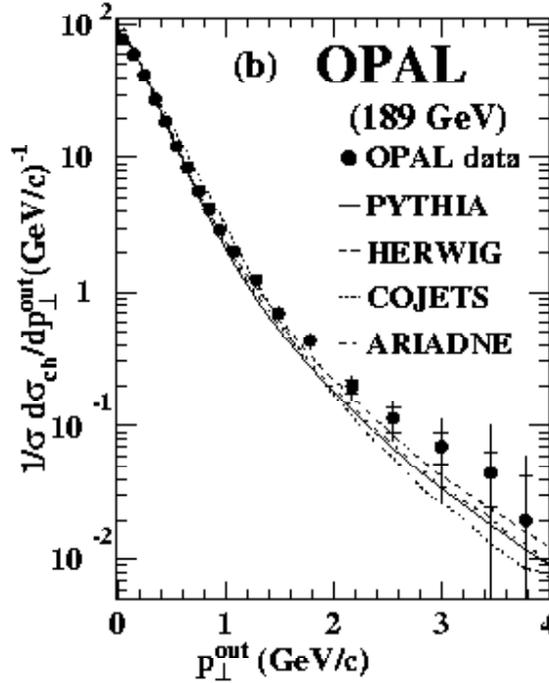
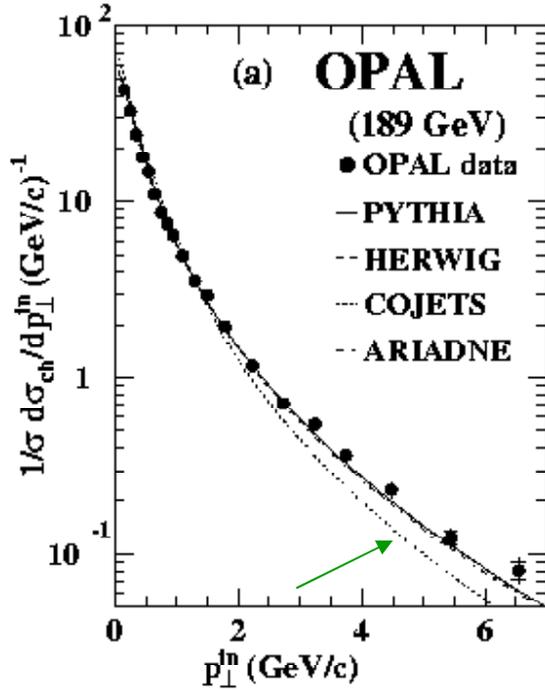
LEP Trieste

XII Convegno sulla Fisica al Lep
Trieste, 26-28 aprile 2000

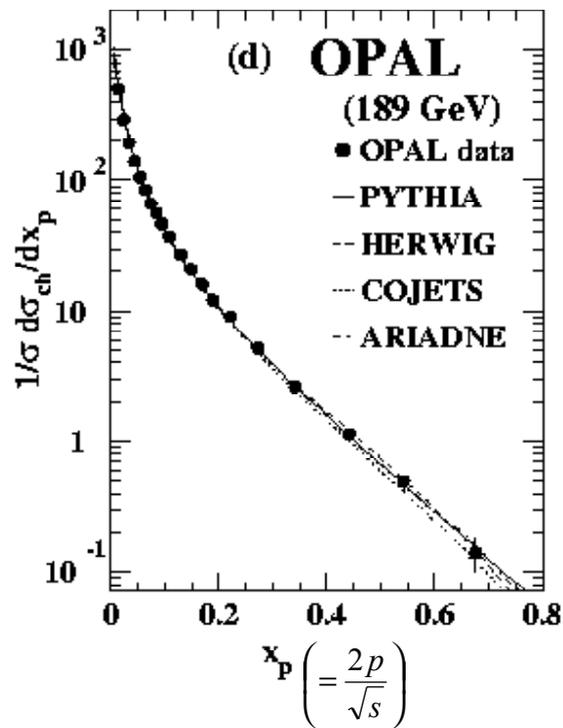
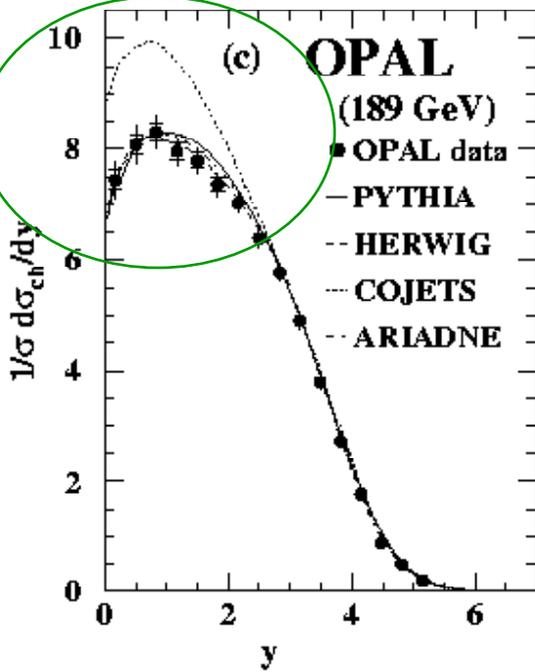




Spettri d'impulso di particella carica



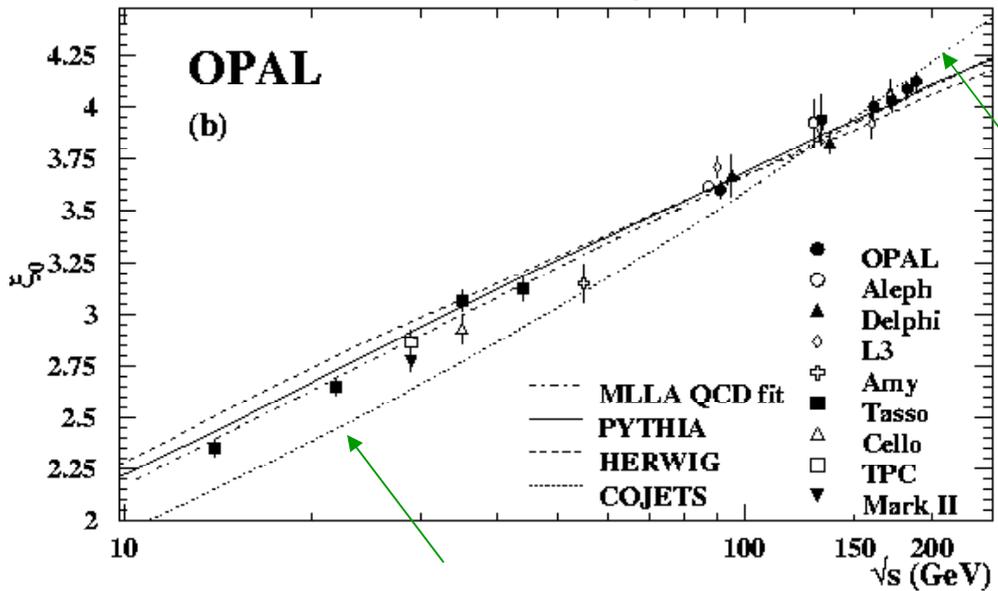
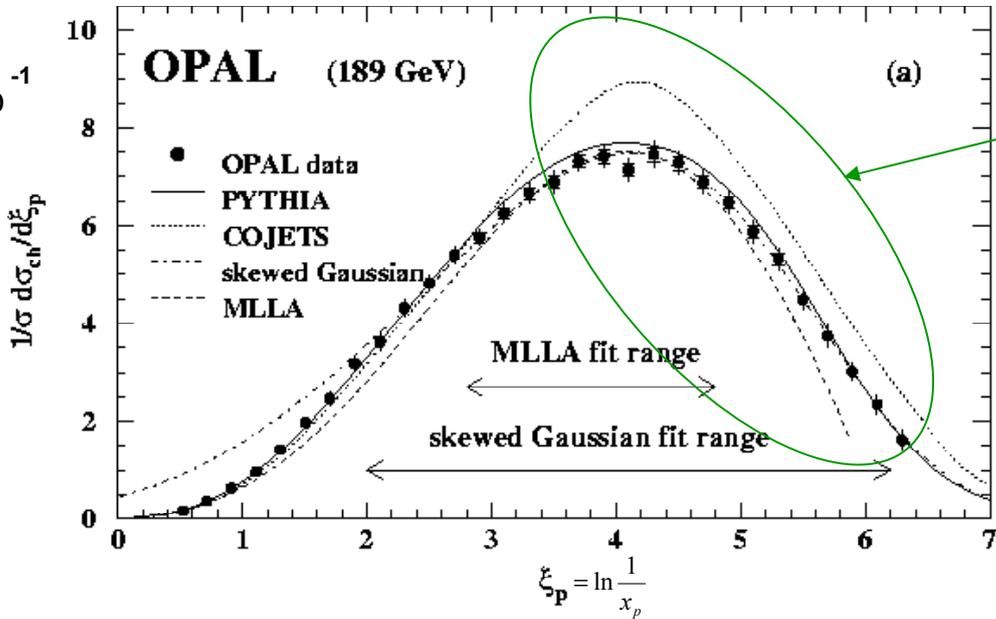
L=186.3 pb⁻¹
3277



- ✓ buon accordo con PY, HW, AR
- ✓ produzione particelle cariche a bassa y sovrastimata da CJ



L=186.3 pb⁻¹
 # 3277

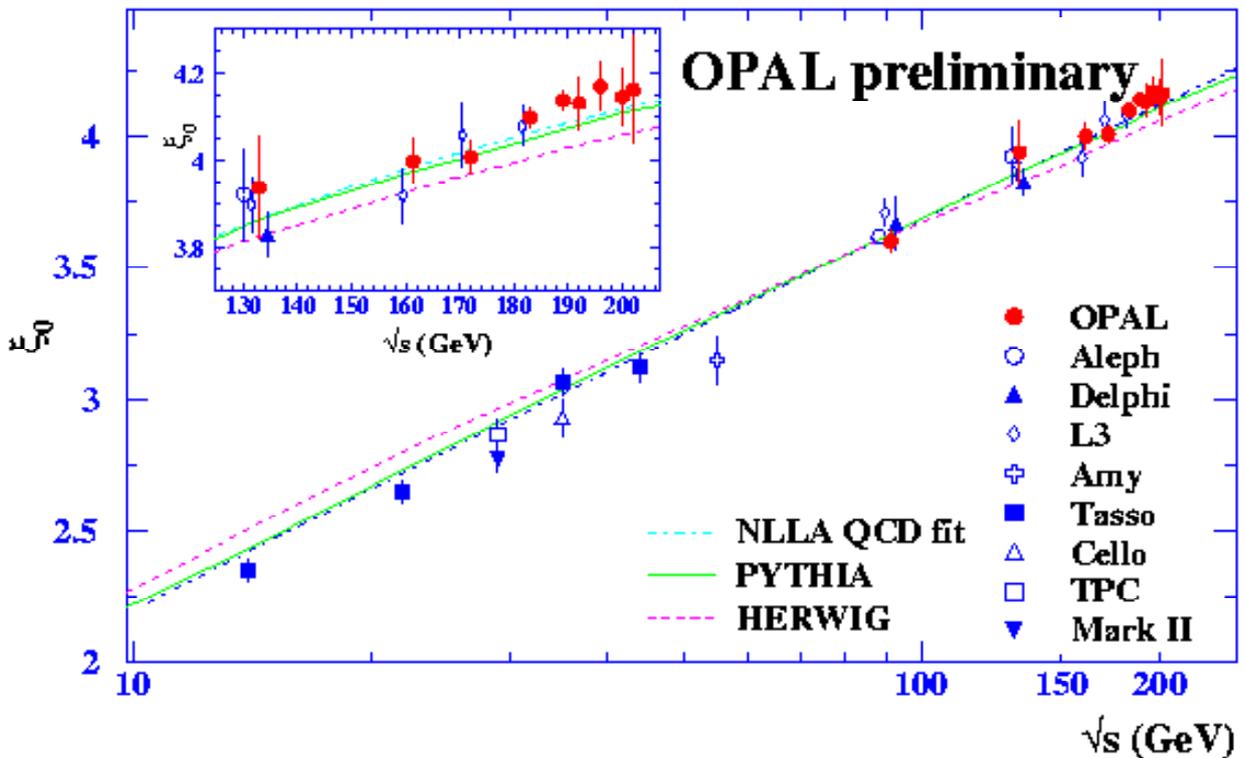
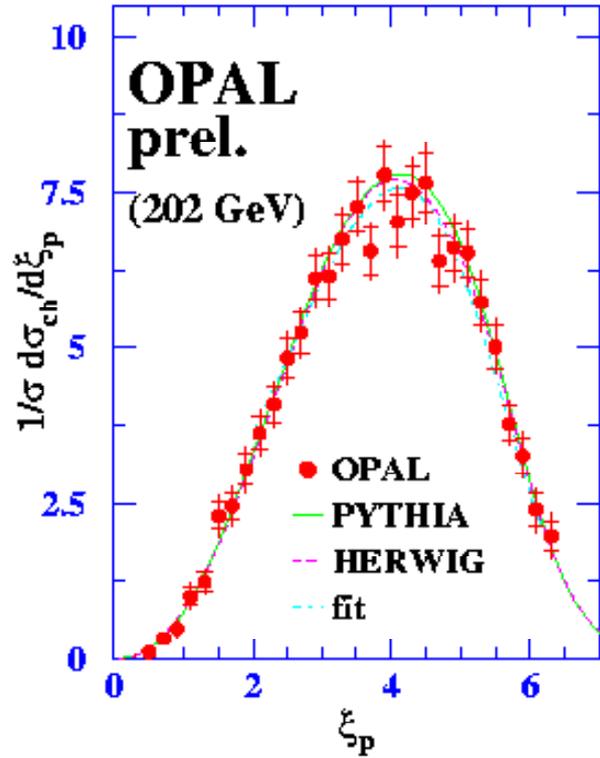
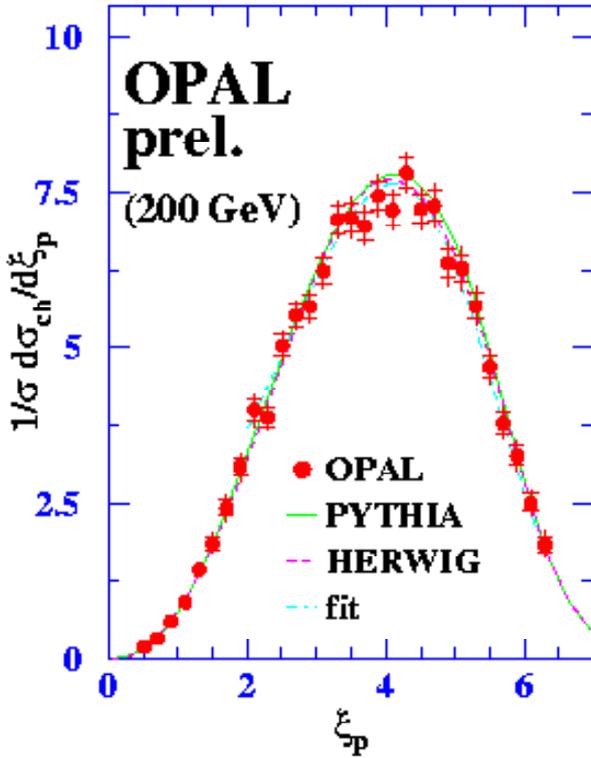


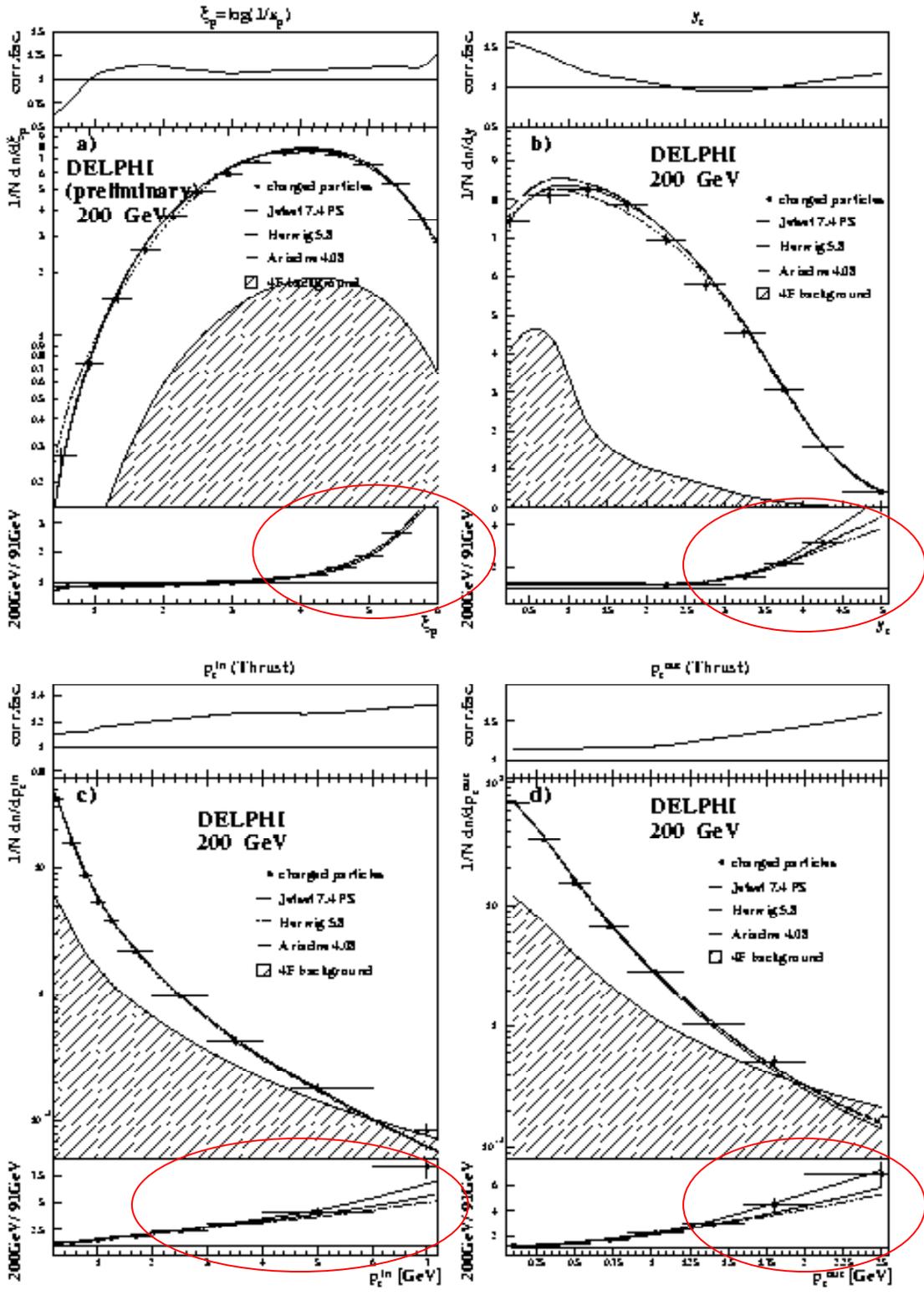
- ✓ spettri di particella carica (e shape della ξ) ben descritti da PY (normalizzazione → differenza nch predetta e osservata)
- ✓ CJ predice troppe particelle al picco e ad alti ξ (= bassi x_p) (approccio LLA: “soft gluon production” ridotta per interferenza distruttiva)
- ✓ QCD NLLA + LPHD predice una “skewed Gaussian” per ξ ⇒ fit ⇒ estratto il valore ξ_0 al picco



200 GeV $L=76 \text{ pb}^{-1}$
 # 1105

202 GeV $L=23 \text{ pb}^{-1}$
 # 347

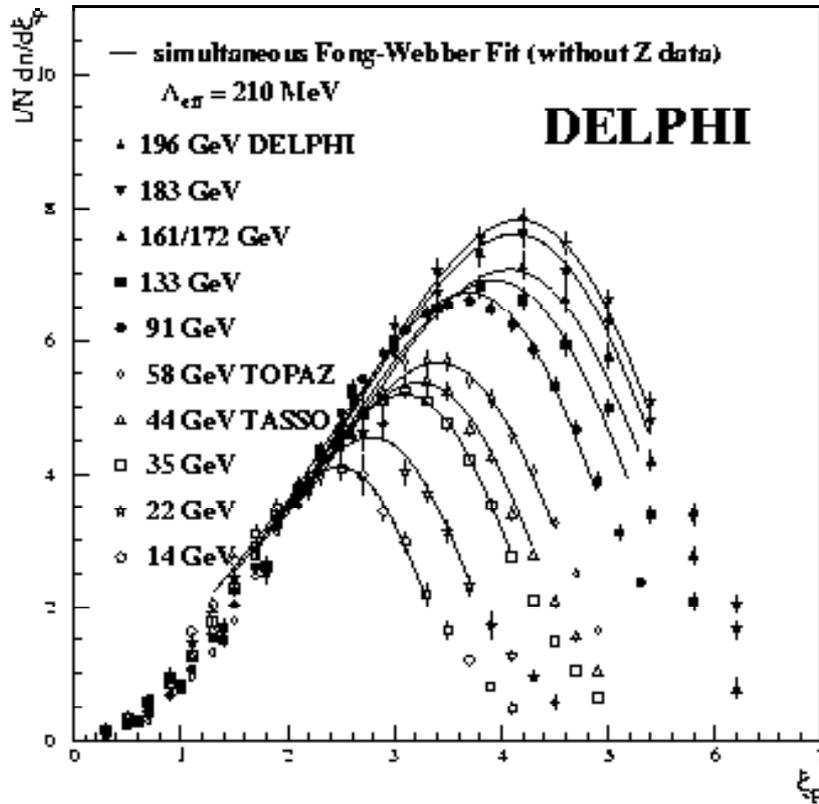




$L=81.4 \text{ pb}^{-1}$
 # 1164

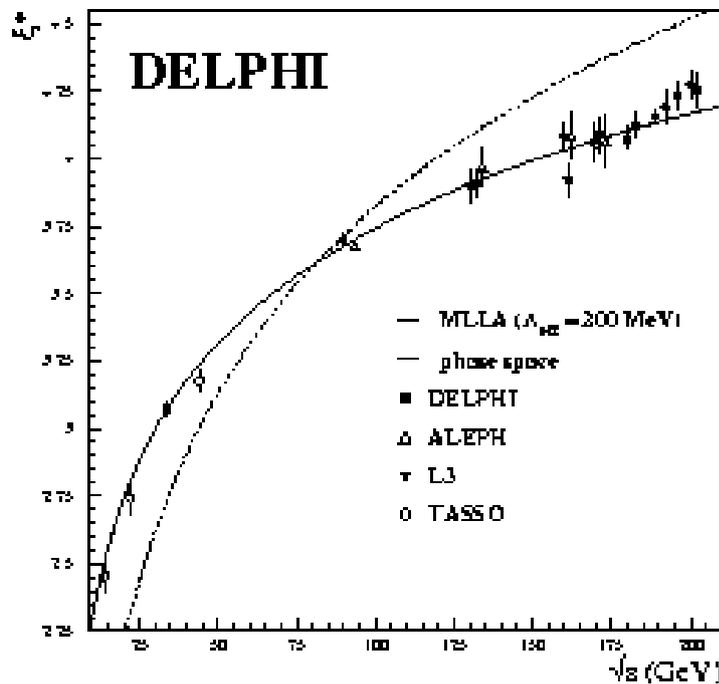


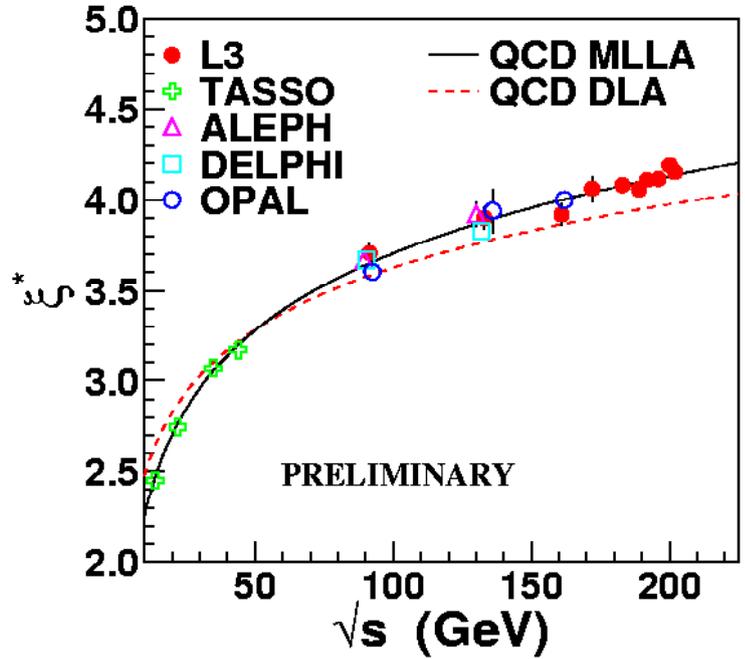
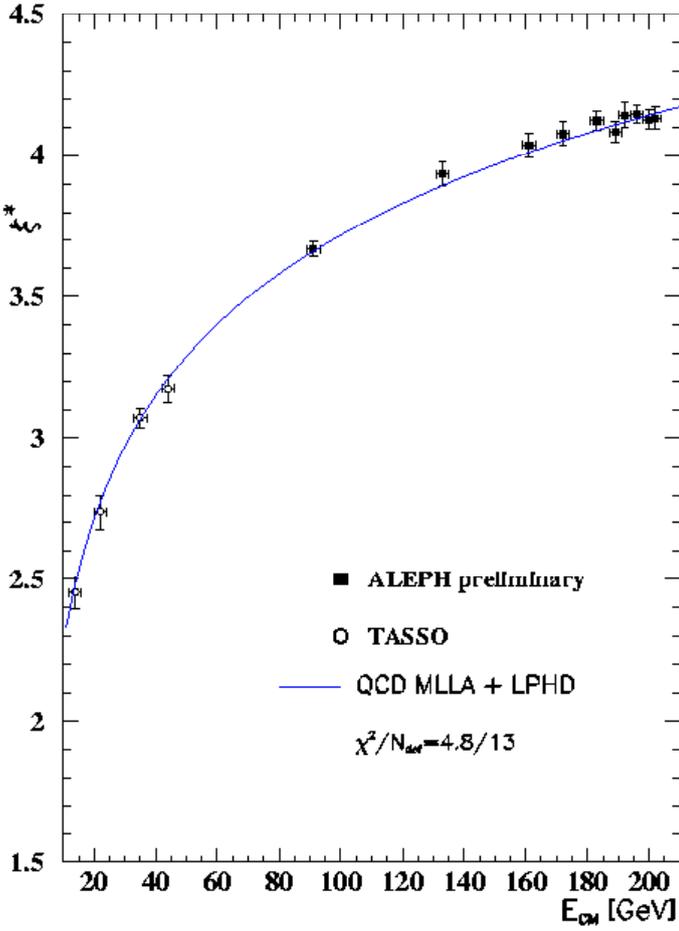
✓ “gluon radiation” sempre più rilevante alle alte energie



$L=81.4 \text{ pb}^{-1}$
 # 1164

✓ QCD NLLA + LPHD predice dipendenza energetica del picco ξ_0





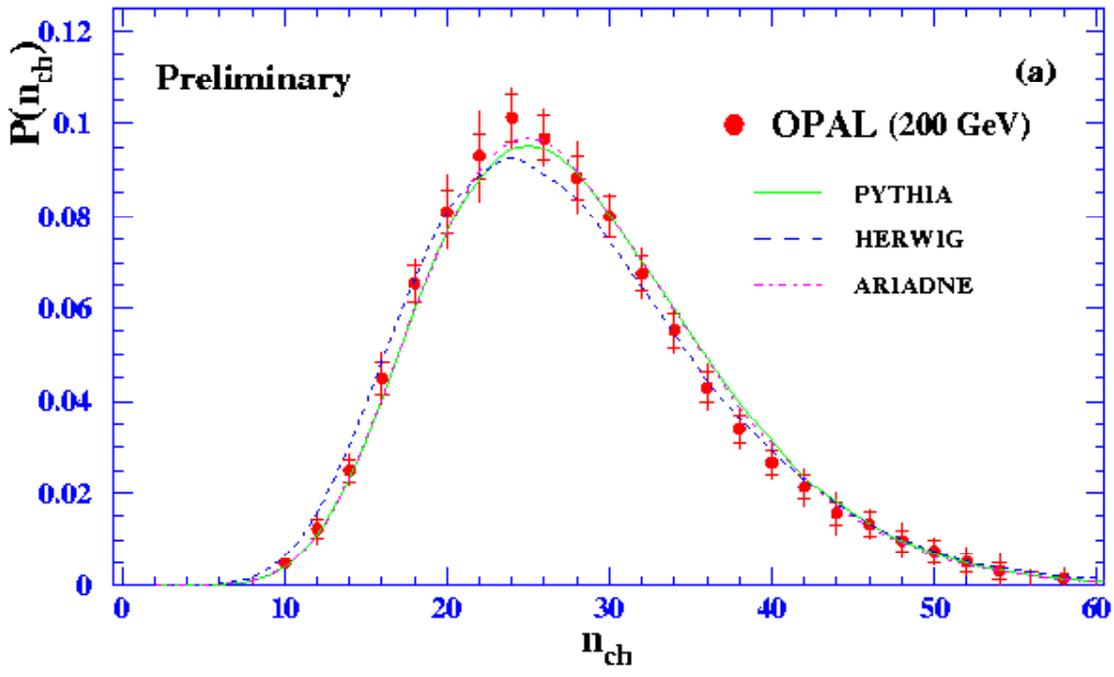
- Aleph ξ_0 (200 GeV) = 4.127 ± 0.024 (stat) ± 0.024 (sist)
- Delphi ξ_0 (200 GeV) = 4.27 ± 0.05 (stat+sist in quadratura)
- L3 ξ_0 (200 GeV) = 4.19 ± 0.02 (stat) ± 0.03 (sist)
- Opal ξ_0 (200 GeV) = 4.15 ± 0.02 (stat) ± 0.06 (sist)



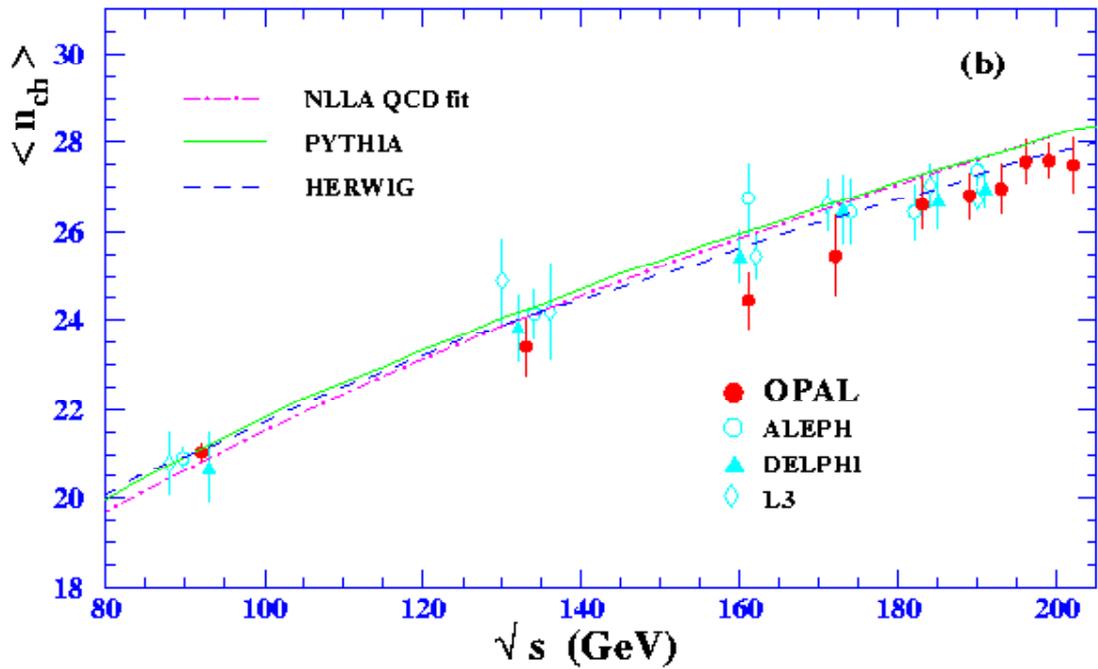
Molteplicità adronica carica

Previsione analitica
NLLA QCD+LPHD

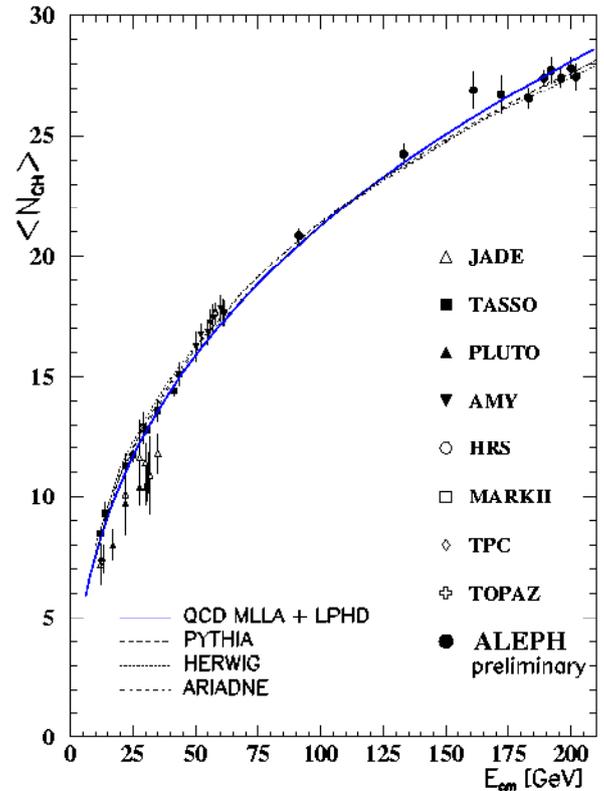
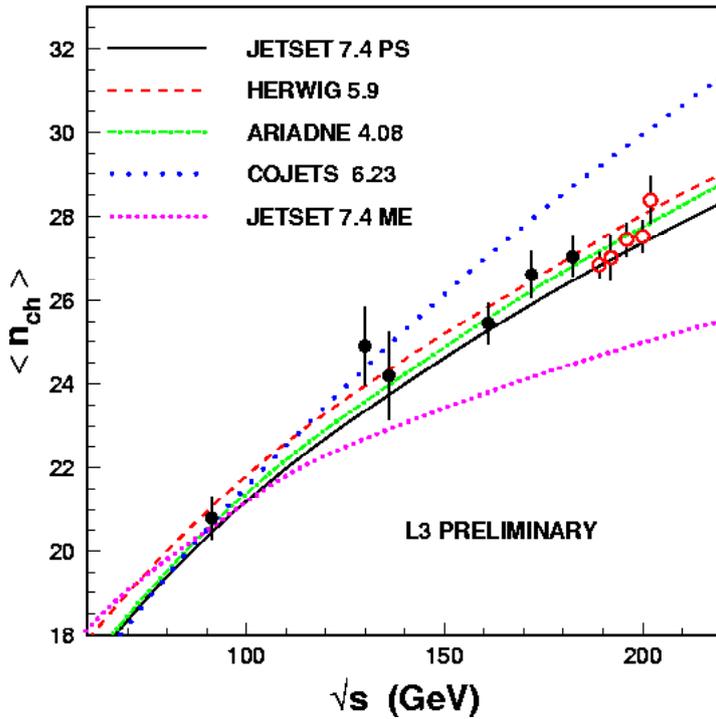
$$\langle n_{ch} \rangle = K_{LPHD} \cdot \alpha_s^b \cdot \exp\left(\frac{c}{\sqrt{\alpha_s}}\right) \cdot \left(1 + d \cdot \sqrt{\alpha_s}\right)$$



L=76 pb⁻¹
 # 1105



✓ Le distribuzioni in molteplicità, a tutte le energie di LEP2, sono ben riprodotte dai modelli PS (tranne CJ)



Aleph $n_{ch}(200 \text{ GeV}) = 27.83 \pm 0.32 \text{ (stat)} \pm 0.41 \text{ (sist)}$

L3 $n_{ch}(200 \text{ GeV}) = 27.52 \pm 0.27 \text{ (stat)} \pm 0.27 \text{ (sist)}$

Opal $n_{ch}(200 \text{ GeV}) = 27.59 \pm 0.28 \text{ (stat)} \pm 0.27 \text{ (sist)}$



Conclusioni

Sono stati presentati *alcuni* studi condotti dagli esperimenti LEP sulle proprietà degli stati finali multiadronici prodotti a LEP2

- ✓ i risultati raccolti sono, in generale, in buon accordo con le previsioni del MS
- ✓ le principali caratteristiche degli eventi adronici a queste energie sono ben descritte da **calcoli analitici QCD**
- ✓ in generale, i **modelli PS** con tuning dei parametri liberi alla M_Z riproducono in modo soddisfacente le proprietà globali degli eventi mh e la loro evoluzione energetica
→ effetti di coerenza sempre più visibili al crescere dell'energia
- ✓ misure di α_s a LEP2 confermano e aumentano la nostra confidenza nel suo carattere “running”