Study of the Structure of Hadronic Events and Determination of α_{S} at $\sqrt{s} = 130 GeV$ and $136 GeV$

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Outline

- **Introduction**
- **Selection of Hadronic Events**
- **Definition and Measurement of the Observables**
- **Energy Dependence of the Mean Values**
- **Determination of α_s**

Introduction

We present new sample of events, collected by the L3 Detector at center-of-mass energy of 130 and 136 GeV from the LEP high energy run (LEP 1.5) and its analysis.

The measured event shape variables have been compared to a second order QCD calculations with resummed leading and next-to-leading terms.

Selection of Hadronic Events

We use events collected by L3 Detector at $\sqrt{s} = 130.3$ and 136.3 GeV from the 1995 LEP high energy run, corresponding to a total integrated luminosity of 5 pb^{-1}.

The event selection $e^+e^- \rightarrow$ *hadrons* is based on the energy measured in the electromagnetic and hadronic calorimeters.

First set of selection cuts:

- $N_{\mathrm{cluster}} > 13$ **for** $|\cos\theta_{\mathrm{thrust}}| < 0.7$ **(L3 barrel)**
- $N_{\mathrm{cluster}} > 17$ **for** $|\cos\theta_{\mathrm{thrust}}| > 0.7$ **(L3 end-caps)**
- $E_{\mathrm{vis}}/\sqrt{s} > 0.5$
- $E_{\perp}/E_{\mathrm{vis}} < 0.5$.

Physics events after cuts ≈ 1500.

Same cuts applied to Monte-Carlo events yields 96% acceptance.

The contamination due to two-photon collisions is estimated to be $< 4\%$.

Selection of Hadronic Events

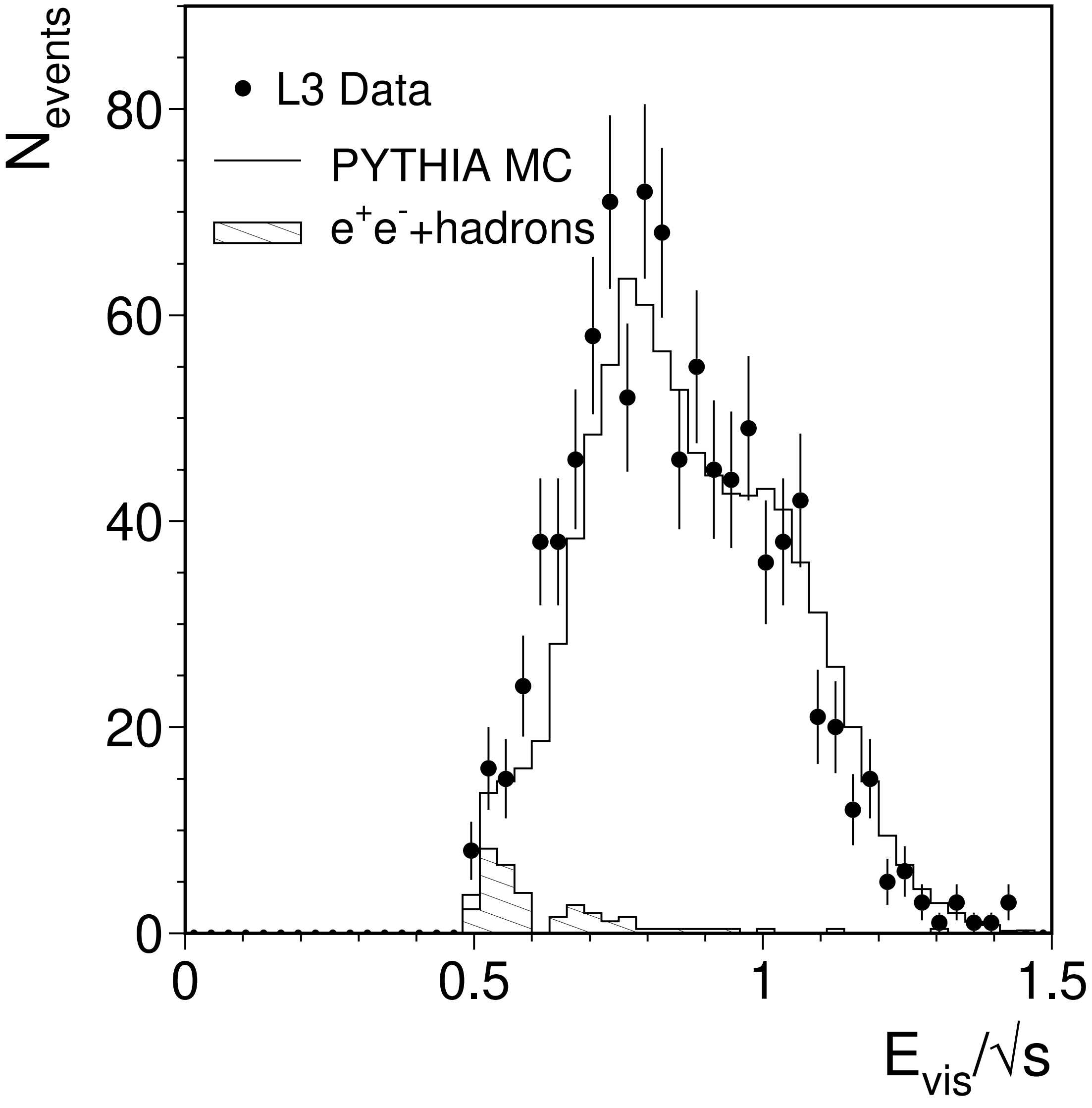
Second set of selection cuts:

- $(|\ \mathrm{E}_{||}\ |\ /\mathrm{E}_{\mathrm{vis}}) + 0.2 < 0.4(\mathrm{E}_{\mathrm{vis}}/\sqrt{s})$
- **energy of the most energetic** $\gamma < 15$ GeV**.**

These cuts are needed to remove the fraction of events with hard initial state radiation.

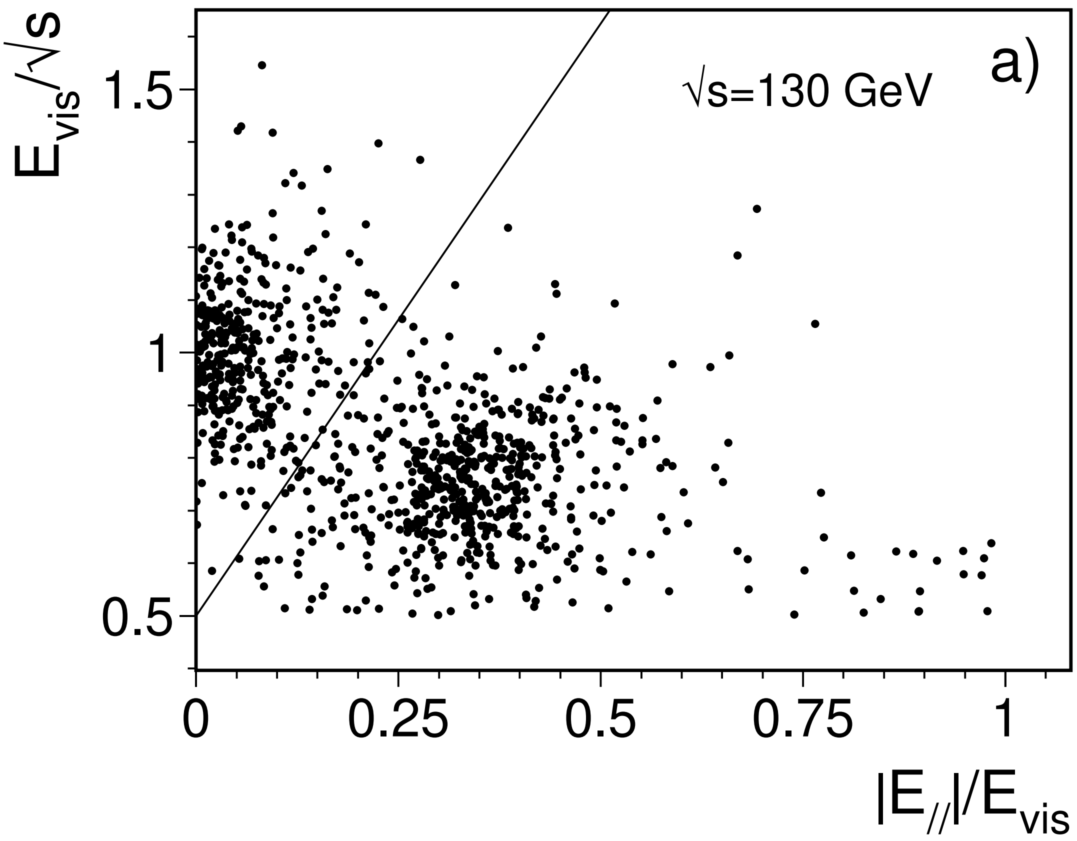
Final number of events after first and second set of selection cuts = 402.

Selection of Hadronic Events



Visible energy after applying hadronic selection for events at $\sqrt{s} = 130$ GeV.

Selection of Hadronic Events



Normalized visible energy shown as a function of the longitudinal non-balance for events at $\sqrt{s} = 130$ GeV.

Definition and Measurement of the Observables

Variables used (with available QCD calculations):

- **Thrust:**

$$T = \max \frac{\sum |\vec{p}_i \cdot \vec{n}_T|}{\sum |\vec{p}_i|}$$

- **Scaled heavy jet mass:**

$$M_H = \max[M_+(\vec{n}_T), M_-(\vec{n}_T)]$$

$$\rho = M_H^2/s$$

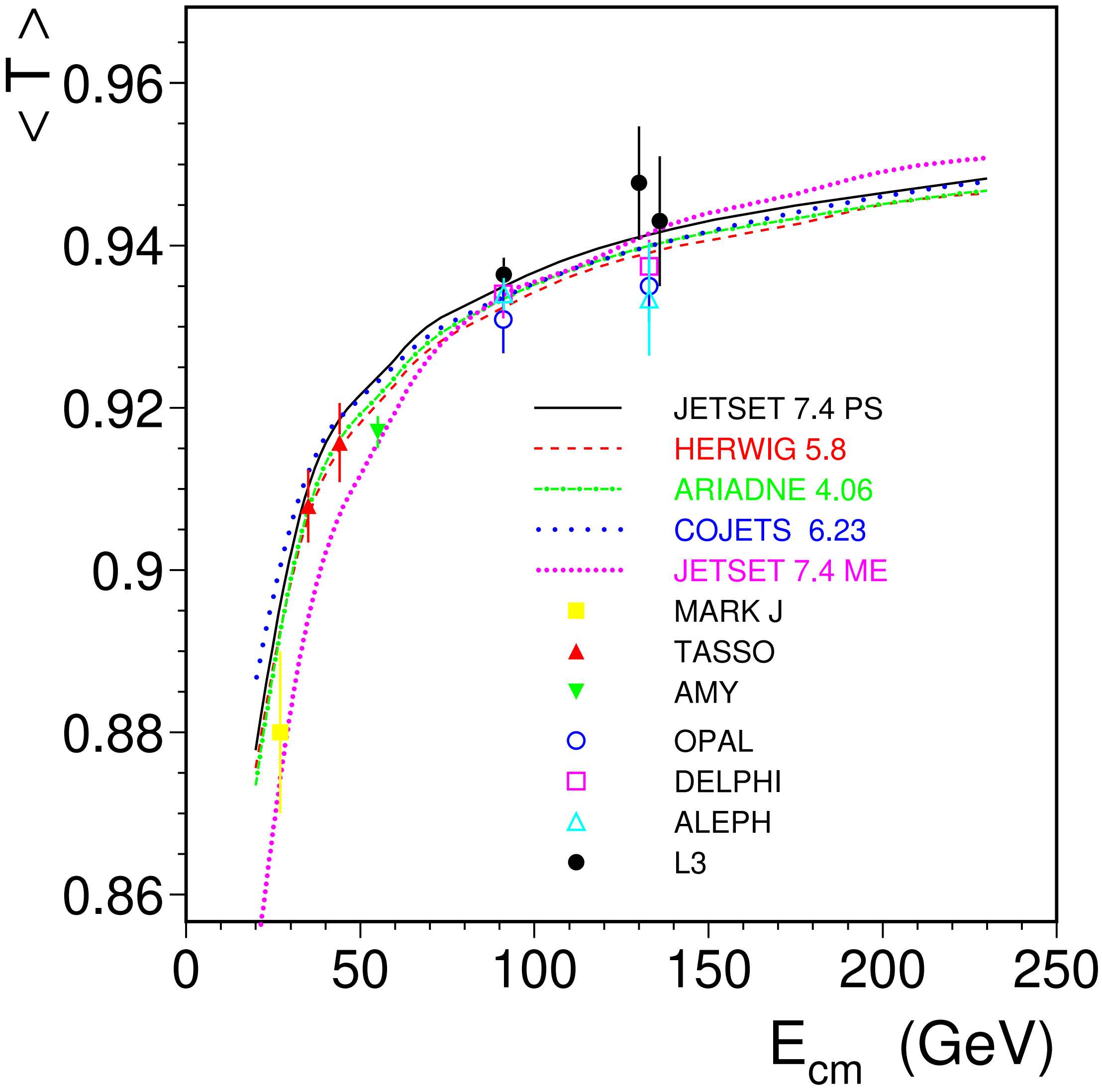
- **Jet broadening:**

$$B_\pm = \frac{\sum_{i \in S_\pm} |\vec{p}_i \times \vec{n}_T|}{2 \sum_i |\vec{p}_i|} .$$

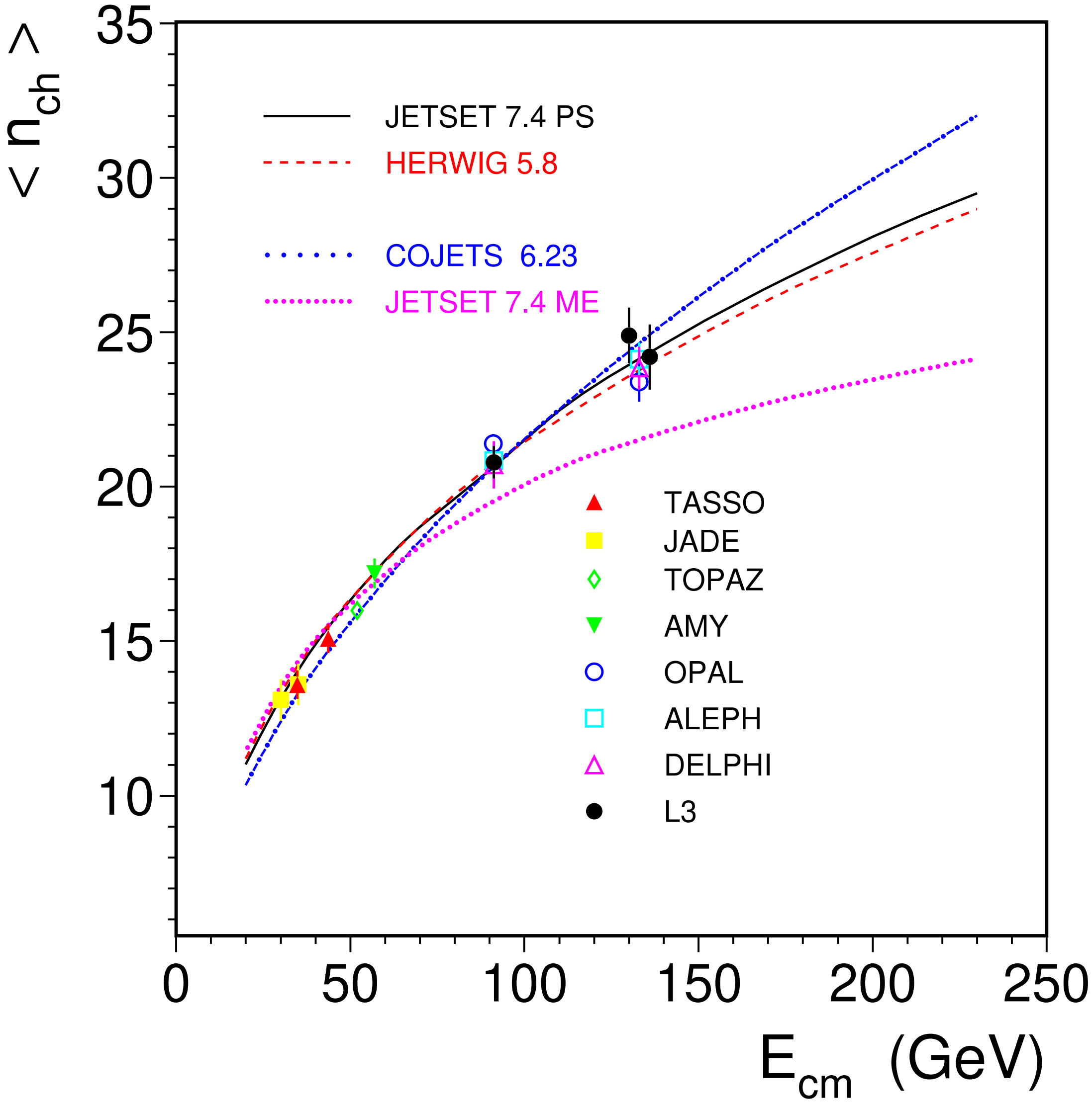
$$B_T = B_+ + B_- \quad \text{and} \quad B_W = \max(B_+, B_-)$$

- **Charge multiplicity:** n_{ch}

Energy Dependence of the mean Thrust



Energy Dependence of the mean Charge multiplicity



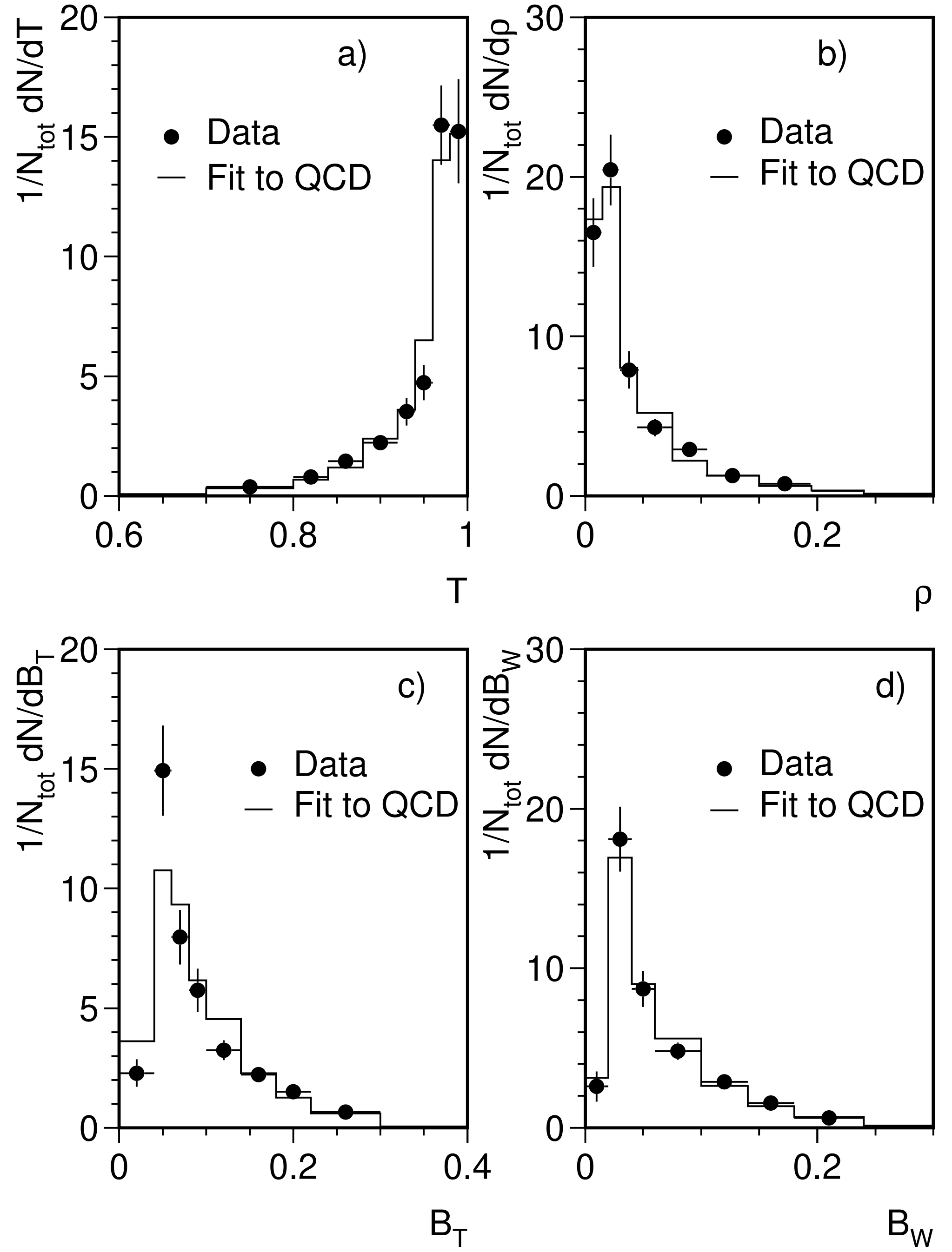
Energy Dependence of the Mean Values

Mean values of thrust, T, scaled heavy jet mass, ρ, total jet broadening, B_T, wide jet broadening, B_W, and charge multiplicity, n_{ch}, measured at $\sqrt{s}$ = 130 and 136 GeV. The first error is the statistical one and the second is the systematical.

	$\sqrt{s}$ = 130 GeV	$\sqrt{s}$ = 136 GeV
$< T >$	0.948 $\pm$ 0.004 $\pm$ 0.007	0.943 $\pm$ 0.005 $\pm$ 0.008
$< \rho >$	0.045 $\pm$ 0.003 $\pm$ 0.001	0.046 $\pm$ 0.004 $\pm$ 0.001
$< B_T >$	0.095 $\pm$ 0.004 $\pm$ 0.001	0.094 $\pm$ 0.005 $\pm$ 0.001
$< B_W >$	0.067 $\pm$ 0.003 $\pm$ 0.001	0.066 $\pm$ 0.004 $\pm$ 0.001
$< n_{ch} >$	24.9 $\pm$ 0.5 $\pm$ 0.8	24.2 $\pm$ 0.7 $\pm$ 0.8

Determination of α_s

Method: fit of the theoretical QCD calculations for T, ρ, B_T and B_W to the measured event shape distribution at fixed $\mu = \sqrt{s}$.



Determination of α_s

Results:

	$(1-T)$	ρ	B_T	B_W
α_s(**133** GeV)	**0.1094**	**0.1078**	**0.1071**	**0.1031**
χ^2/**d.o.f.**	**1.04**	**0.74**	**2.12**	**0.54**
Overall experimental error	± 0.0051	± 0.0050	± 0.0037	± 0.0040
Overall theoretical error	± 0.0072	± 0.0031	± 0.0079	± 0.0057

Combined result of L3 measurements:

$$\alpha_s(133\ \text{GeV}) = 0.107 \pm 0.005 \pm 0.006$$

Summary: α_s Determination at 133 GeV