THRUST JET ANALYSIS OF DIFFRACTIVE DEEP-INELASTIC SCATTERING EVENTS

A.VALKÁROVÁ
Nuclear Center of Charles University, V Holešovičkách 2,Prague
Czech Republic

An analysis of thrust in the hadronic final state X of deep-inelastic diffractive electron-proton interactions is presented. The data were recorded by the H1 detector at HERA in 1994. A basic 2-jet structure is observed for which the values of thrust are smaller than those measured in e^+e^-annihilation, indicating that for a system of the same mass higher order perturbative QCD contributions are more important in this reaction than in e^+e^-annihilation. The P_t^2 distributions of thrust jets show alignment with the γ^*p collision axis, a large high P_t tail and an approximate independence of the hadron final state mass M_X.

We present results from a thrust analysis of hadronic final states in large rapidity gap (LRG) events emerging from the interaction of virtual photons with protons in ep collisions at the HERA collider

$$e + p \rightarrow e' + X + Y.$$

The systems X and Y are distinguished as those separated by the largest rapidity gap in the total hadronic final state. A total of 7132 such events, with an identified electron, corresponding to an integrated luminosity of $1.96pb^{-1}$ were selected with the H1 detector in 1994.
An estimate of non-diffractive contributions was subtracted with the help of the Monte Carlo model DJANGO for deep-inelastic events. The amount of non-diffractive background is small, and the results do not depend significantly on the background subtraction. For the thrust analysis we used events with mass M_X, $5 < M_X < 28.3\,\mathrm{GeV/c^2}$, $< Q^2 >= 22\,\mathrm{GeV}^2$ and scaled longitudinal momentum transfer from the proton $10^{-4} < x_{I\!P} < 0.05$, with $< x_{I\!P} >= 0.013$.

The thrust T is defined as

$$T = 1/M_X \cdot \max \sum_{i=1}^{N} |\vec{p}_i.\vec{n}|$$

with $\vec{p}_i$ the momentum of final state particle i and N the total number of particles. In the CMS of the X system $\sum_{i=1}^{N} \vec{p}_i = 0$, and the axis $\vec{n}$ is such that the energy flow projected into it is maximal. The orientation $\vec{n}$ and the event

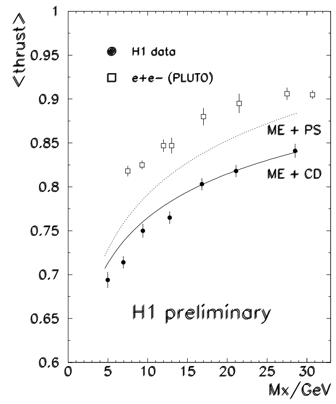

Figure 1: Average values of the thrust T, as a function of the hadronic mass M_X. Full circles: H1 data (fully corrected), open squares: e^+e^-annihilation (PLUTO). The lines are predictions of two versions of the RAPGAP matrix element simulation.

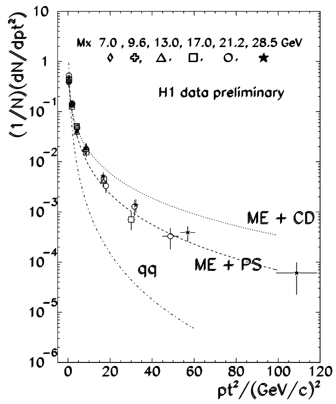

Figure 2: P_t^2 distributions of thrust jets for all M_X, the data points being shown at $< P_t^2 >$ of each P_t^2 interval, each of the distributions being normalized to 1. The curves are RAPGAP predictions for $24 < M_X < 36$ GeV/c^2, the one labeled qq is intended to modelise an aligned jet configuration.

shape given by T $(0.5 < T < 1)$ are obtained for each event. The variable P_t is defined as the thrust jet momentum transverse to the proton beam direction, as seen in the rest frame of the hadronic system X.

In the selected sample, the average thrust values are larger than 2/3 and are growing with M_X, which indicates a 2-jet pattern as the salient topological feature of the hadronic final state (see Fig. 1). The average thrust is smaller for the H1 deep-inelastic diffractive data than for e^+e^-annihilation, indicating that in diffractive dissociation configurations with higher parton multiplicities than in $e^+e^-$are created. Fig. 2 shows the P_t^2 distributions for all mass intervals. We observe a dominant alignment of the final state with the initial $\gamma^* p$ collision direction. However there is also a substantial P_t^2 tail for thrust jets up to 120 $(GeV/c)^2$ and a large fraction of events has $p_t^2 > 3\,GeV^2$ ($\sim 30\%$). P_t^2 distributions follow an universal shape $1/\sigma \cdot \mathrm{d}\sigma/\mathrm{d}P_t^2(M_X, P_t^2) = A(M_X) \cdot G(P_t^2)$ for all mass intervals. These observations may be interpreted in terms of a significant contribution to deep-inelastic diffractive dissociation from photon-gluon fusion (as included for example in RAPGAP models).