PRODUCTION OF K^0, π^0 AND η IN TWO AND THREE JET EVENTS AND FIRST INDICATION OF $\xi(2230)$ IN HADRONIC Z DECAYS

Gilles FORCONI*
Massachusetts Institute of Technology, Cambridge, MA 02139

Thanks to the three jet events occurring in hadronic Z decays, a first measurement of the inclusive production of K^0_S, π^0 and η within different categories of jets has been performed by using the L3 detector. Comparisons with Monte Carlo expectations are presented. A first indication for the presence of $\xi(2230)$ in the $K^0_S\bar{K}^0_S$ channel is also shown.

1 Introduction

The comparison of the rate of particles produced by quark fragmentation and by gluon fragmentation is of interest to study the process of hadronization. Presently, the best Monte Carlo known at the range of LEP energies is JETSET, for which the hadronization is modelled by string fragmentation. No specific treatment is applied to differentiate the fragmentation scheme according to the initial quarks or radiative gluons, which produce the observed jets. So, differences between data and such a simulation may highlight specific properties of the two sources of jets. In this paper, K^0_S, π^0 and η production rates in two and three jets' events, and within jets, are compared with JETSET expectations. Finally, this paper reports a first observation of the $\xi(2230)$ in hadronic Z decays. This complements other observations done in J/ψ decays experiments.

2 Selections

3.1 million of events are accepted by our usual selection for hadronic Z decays(91-94 data). About 2.4 million of events are generated with a tuned version of the JETSET 7.4 program and treated by our full detector simulation. The LUCLUS jet finder algorithm is used to reconstruct jets. The events with more than two jets are tagged as three jet events. The measured variation of the fraction of two and three jet events, according to the d_{join} value used to dissociate jets in LUCLUS, is well reproduced by our simulation. For the three jet classified events, the two most energetic jets are tagged as quark jets while the remaining jets are tagged as gluon jets. By using the JETSET program, the probability that the so tagged gluon jets be originating from a gluon fragmentation is measured to be greater than 70%, while the probability that the so tagged quark jets are originating from one of the primary quark fragmentation is greater than 85%. The mesons are associated to the closest jets according to the angle between their reconstructed momentum direction and the jet axis. All our angular distributions are well simulated.

---

* representing the L3 Collaboration, Aug.-96. (email: forconi@hpl3mit1.cern.ch)

For the K^0_S selection, all charged particles are requested to reach the central part of the detector ($40°<\theta<140°$). Very loose cuts are used to minimise possible systematical errors. Secondary vertex candidates are counted by integration of the mass distribution, between 300 and 800 MeV, after background subtraction. The simulation shows that this distribution is mainly populated by K^0_S, but also by Λ's which have to be removed according to the Monte Carlo expectation. For π^0 and η selection, the photon candidates are clusters of fired crystals isolated by at least 50 mrad from any charged particle impacts, and their measured shower shape have to be consistent with an electromagnetic shower. To remove the $\gamma\gamma$ combinatorial background to the η, all photons contributing to the reconstruction of a π^0 are vetoed. This last operation is well reproduced by our simulation and doesn't affect the results presented in the next section.

3 Results and comparisons with Monte Carlo expectations

The measured total rates for K^0_S, π^0 and η are in agreement with other LEP measurements (respectively, 1.02±0.02, 9.90±0.33 and 0.93±0.1 meson/event). The numerical results, measured in the different categories of jets and events, are in Table 1 and the differential cross sections are shown as Figure 1. It shows that the production rates, both for K^0_S and π^0, are well reproduced by JETSET in quark enriched jets as well as in gluon enriched jets. As expected, the momentum spectra are softer in gluon enriched jets than in quark enriched jets and the production rates are higher at low momentum in gluon enriched jets than in quark enriched jets. Numerically, while no significant deviation between data and JETSET expectations is observed both in quark and gluon enriched jets for K^0_S and π^0, an important disagreement appears for η mesons, which reaches 28% in gluon enriched jets. This disagreement comes with a harder momentum distribution in gluon enriched jets. Moreover, it is impossible to tune JETSET in order to have a better agreement for η mesons without deteriorating the agreement obtained for π^0. Clearly, JETSET failed to reproduce the production of η mesons in gluon jets, both qualitatively and quantitatively. This illustrates that gluon fragmentation, as well as isoscalars like η mesons, may have their specific properties. The above mentioned remarks, don't depend on the choice of the d_{join} value used to reconstruct jets.

Table 1: Production rates of K^0_S, $\pi^0$and η mesons in different categories of jets. Only for η mesons, the Monte Carlo rates are globally rescaled in order to match to the experimental results in 2 jet events. The errors are statistical and systematic,. For K^0_S, the errors are mainly systematic and are strongly correlated from one column to another. The d_{join} value used for K^0_S is 7 GeV, while 5 GeV is used for π^0 and η. 70 %(54%) of events are dijet events for d_{join}=7 GeV(5 GeV)

	2 jet events <meson/jet>		3 jet events <meson/jet>		Quark enriched jets <meson/jet>		Gluon enriched jets <meson/jet>	
	DATA	JETSET	DATA	JETSET	DATA	JETSET	DATA	JETSET
K^0_S	0.47±0.01	0.47	0.40±0.01	0.39	0.42±0.01	0.42	0.36±0.01	0.35
π^0	4.3±0.15	4.25	3.87±0.13	3.87	3.94±0.13	3.91	3.67±0.15	3.50
η	0.37±0.04	0.37	0.38±0.03	0.34	0.36±0.05	0.35	0.41±0.03	0.32

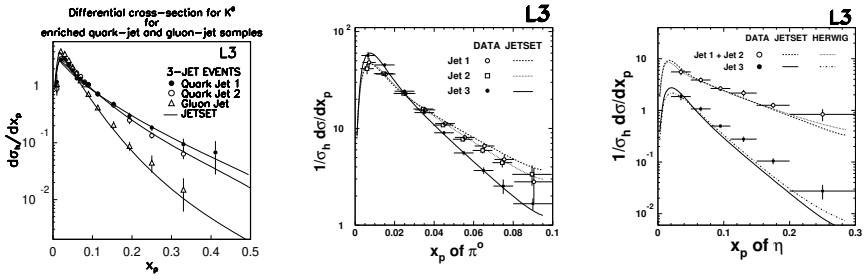

Figure 1: Differential cross sections for K^0, π^0, and η mesons in three jet events. The lines indicate JETSET expectations for the two quark enriched jets (summed for the η) and gluon enriched jets.

4 Observation of the ξ(2230)

During the last decade, many interests have been attributed to the $K\bar{K}$ system in the 2.2 GeV mass region in radiative J/ψ decays, where a narrow signal (Γ=21±17 MeV) has been observed, namely the ξ(2230), by the MARK III and the BES experiments. A Glueball interpretation for the ξ(2230) is frequently mentioned. Nevertheless, new observations for this small signal are always welcome to better interpret its real nature. With the use of the L3 detector and on the basis of about 3.6 millions of hadronic Z decays, a study of the $K_S^0K_S^0$ channel has been performed taking into account of the jet families. In order to reduce the combinatorial background, only pions associated to a same jet are combined to reconstruct K_S^0, and only K_S^0 candidates associated to a same jet are assembled to build the $K_S^0K_S^0$ mass distributions shown as Figures 2. A small signal is visible at 2.234 GeV and is only visible in the less energetic jets of three jet events (gluon jet enriched sample). The ratio signal/noise is strongly improved by looking only at low multiplicity jets with less than 6 tracks (Fig. 2b). This also increases the inefficiency, especially for the two most energetic jets. A preliminary Monte Carlo study shows that these observations are consistent with a meson generated only in gluon jets, but, with the present status of this analysis, the consistency with a meson generated everywhere cannot be discarded. Studies are on progress.

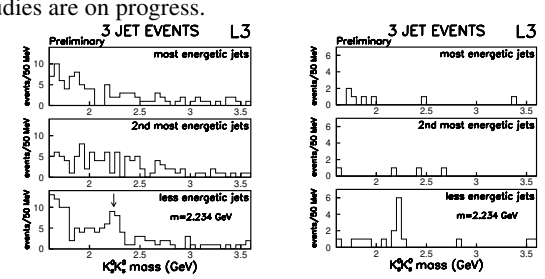

Figure 2: $K_S^0K_S^0$ mass distributions in 3 jet events for the 3 different families of jets. From the most energetic jets, at the top, to the less energetic jets at the bottom (a) . The same plots only for low multiplicity jets (b).

Filename: DPF96.DOC
Directory: G:\HOME\FORCONI
Template: C:\WINWORD\TEMPLATE\NORMAL.DOT
Title:
Subject:
Author: Forconi Gilles
Keywords:
Comments:
Creation Date: 08/08/96 7:14 PM
Revision Number: 15
Last Saved On: 10/31/96 1:52 PM
Last Saved By: LABROUSSE Delphine
Total Editing Time: 195 Minutes
Last Printed On: 10/31/96 2:01 PM
As of Last Complete Printing
Number of Pages: 4
Number of Words: 1,190 (approx.)
Number of Characters: 6,783 (approx.)