Search for stranglets and catastrophic energy lost in the ZEUS detector.

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1 Introduction

1.1 The physics subiect of interest are as follows.

1.1.1 Stranglets

Exotic nuclear fragments, with highly unusual charge to mass ratio, have been observed in cosmic ray experiments. They are interpreted to be lumps of strange quark matter (strangelets).

> Strange quark matter or stranglets, consisting of aproximately equal numbers of up, down and strange quarks, represents the true ground state of Quantum Chromodynamics, the underlying theory of strong interaction physics. The characteristic feature of stable (or metastable) small lumps of stranglets would be very abnormal electric charge (Z) to mass (A) ratio ($Z/A << 1$). A definitive confirmation of the existence of strangelets can explain some of the most intriguing aspects of present day physics and astrophysics, like the cosmological dark matter, cosmological QCD phase transition or abundance of strange stars. Events with $A \approx 350 - 500$ and $Z \approx 10 - 20$ in cosmic ray experiments, they have vastly different charge-to-mass ratios, so-called exotic cosmic ray events.

A major problem with such a hypotlesis is that to reach the earth's surface, they must possess an unusually high penetrability throught the terrestial atmosphere. However they might create extensive air showers and their μ component can reach underground detectors like the ZEUS detector. The events with large energy or large number of muons are candide for stranglets. Five special events were observed by the ALEPH detector at least $20\mu/m^2$ of energy above 70 GeV.

1.2 Catastrophic energy lost

One muon events with a lot of energy deposited are candidates for events with catastrophic energy loss.

2 Analysis of experimental date

Energy deposited E_{total} in the ZEUS uranium calorimeter from ep interactions or beam gas interactions we expect to be much smaller than the incoming proton energy(820 GeV or 920 GeV). There fore these one with large energy are of a special interest.

Events were selected with energy deposited in the uranium calorimeter $E_{total} > 750$ GeV. The selected sample contains 79 events. These events were scanned and the results are as follows.

The scanned events are classifed as:

27 cosmic events (k);

9 beam gas events (bg);

1 hallo muon event (h);

10 muon events (m); - 0ne muon or two muons or possible three muons.

6 strangelet candidates (sl);

27 events were not found in MINIDST.

The following criteria are used to classify the events:

sl - all BAC was shining;

m - it was one muon or two muons or possibly three muons;

k - μ bundles with least of three muons, but mainly with a countless number of muons;

bg - tracks went out from to the accelerator pipe and looked like beam gass interactions.

h - one track horizontal to the accelerator pipe.

3 Conclusions

Visual scan has been performed to classify events with a high energy deposited in the uranium calorimeter. Distribution of the deposited energy is show in the figure1. There we see two maxima and a long tail of events with large energy up to 3200 GeV. The events with energy deposite $E_{total} > 750$ GeV are selected.

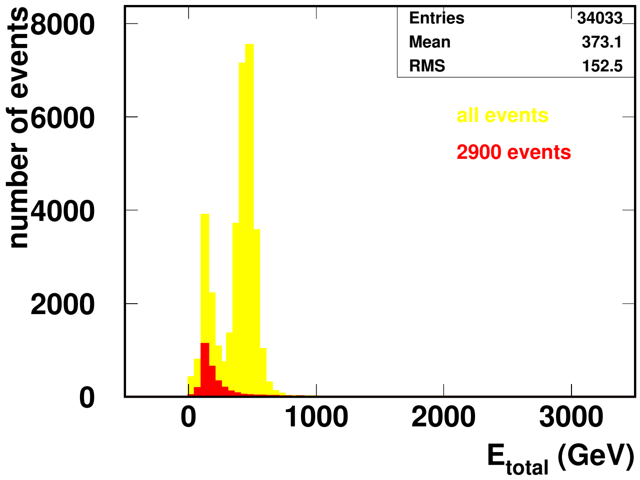

Figure 1: This figure show distribution the energy deposite in the ZEUS uranium calorimeter from *ep* interaction or beam gas interaction.

References

[1] S.Banerjee, Strange quark matter in cosmic ray flux and exotic events (2000)

[2] M.Rybczyński, Z.Włodarczyk and G.Wilk, Muons from strangelets (2000)