Muon and Neutrino Results from KGF Experiment at a depth of 7000 hg/cm^2

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1. Introduction

The KGF nucleon decay experiment at a depth of 7000 hg/cm^2 has provided valuable data on muons and neutrinos. The detector comprising of 34 crossed layers of proportional counters (cross section $10 \times 10\ cm^2$; lengths 4m and 6m) sandwiched between 1.2cm thick iron plates can record tracks of charged particles to an accuracy of 1° for tracks that traverse the whole of the detector. A special two-fold coincidence system enables the detector to record charged particles that enter at very large zenith angles.

In a live time of 3.6 years about 2600 events have been recorded. These events include atmospheric muons, neutrino induced muons from rock, stopping muons, showers and events which have their production vertex inside the detector. In this paper we present the results on atmospheric muons and neutrino events.

2. Results on atmospheric muons

The angular distribution of muons in the zenith angular interval 0°-55° agrees very well with expectations based on the assumption that atmospheric muons are produced through decays of π's and K's. This part of the angular distribution has been used to study possible direct (prompt) production of muons in high energy ($E_\mu \sim 15$-500 TeV) collisions. We compare the observed ratio of I_{TOTAL}/I_{DECAY} with theoretical predictions for different values of the parameter $x = \mu_{DIRECT}/\pi$ in hadron collisions. From this we set a conservative upper limit of 10^{-3} for the ratio of prompt muons to pions in hadron collisions leading to muons of energy 15-500 TeV.

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3. Results on neutrino induced events

The zenith angular distribution of muons with $\theta > 55^{o}$ has been compared with calculations which assume that the cross sections found at accelerators for neutrino interactions at low energies can be extrapolated to high energies. The agreement between the observed and predicted results is good within statistics.

Further, we have recorded 40 events that have vertex inside the detector. These have been analysed mainly from the point of view of their contribution to the background for nucleon decay events. In this analysis, by using the rate of neutrino induced muons from rock and events inside the detector we establish that the assumed neutrino energy spectrum is a correct one.

Out of these 40 events with vertex inside the detector 19 events are fully confined within the volume of the detector. These special events comprise of 9 single prong and 10 multiprong events. A detailed calculation using the above mentioned neutrino spectrum was done to predict the visible energy spectrum of these fully confined events. The agreement between prediction and observation is good. But it is to be pointed out that track configuration, total energy content and momentum balance of four of these confined events is such that they are unlikely to be neutrino induced events and indeed are consistent with nucleon decay.

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