The Galactic Cosmic Ray All-Particle Spectrum, Preliminary Results from the TIC Experiment

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Abstract

In the energy range from 100 GeV to 10 TeV current theoretical models predict that the galactic cosmic ray elemental spectra (and therefore the all-particle galactic cosmic ray spectrum) follow a simple power law. Previous measurements of the all-particle spectrum in this energy range have been obtained by a mix of active and passive techniques. One of these measurements (Grigorov, 1989) shows a departure from a simple power law and scatter in the remaining measurements do not rule out such a feature. To check if there is a break in the power-law spectrum, we have undertaken to make a measurement of the all-particle spectrum over this energy range with a single instrument. We will report preliminary results from the Thin Ionization Calorimeter (TIC) experiment which was flown for 76 hours in the summer of 1994.

1 Introduction

Above and below an energy of about 1 TeV/n the galactic cosmic ray spectra measured by different techniques, the spectra below 1 TeV/n has been measured by various electronic detectors while above a few TeV/n measurements have been obtained by passive calorimeters, with one exception. The only instruments to span this entire energy range are SEZ-14 experiments on the Proton satellites. Grigorov(1989) has reported measurements of the all-particle energy spectrum from 10 GeV to 10^5 GeV using data from the Proton and Sokol satellite experiments. His results show a kink in the spectrum at around 1 TeV. The data available from other experiments show such point scatter and discontinuities that the presence of this kink cannot be confirmed or ruled out.

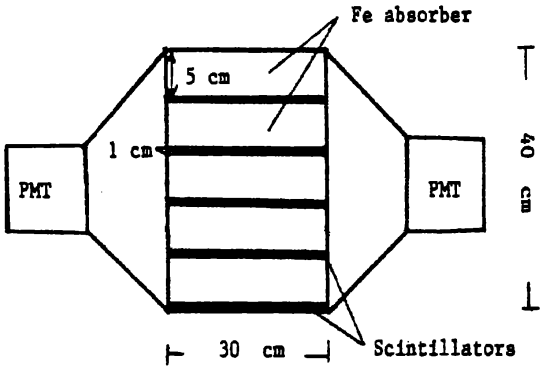
We will report preliminary results on an attempt to make an accurate measurement of the all particle spectrum from 100 GeV to 10 TeV which could confirm the feature reported by Grigorov.

2 The Thin Ionization Calorimeter (TIC)

Figure 1 shows the TIC detector used for these measurements.

TIC was calibrated using cosmic ray muons at sea level. This is done by placing the calorimeter in a charged particle telescope that defines the muon trajectories and insures that the exiting muon is not accompanied by any secondaries that would have resulted from an interaction in the calorimeter. In this way, we determine the response of the photomultiplier to the signal of a single relativistic singly ionized particle. The signal from the cosmic ray shower in the calorimeter is made up mostly of multiple signals from relativistic singly ionized particles.

Figure 1: *Schematic diagram of the TIC :*



It consists of five steel plates that are 30 cm square and 7 cm thick. Each plate is followed by a 1 cm thick scintillator. The entire detector is 40 cm high and 30 cm on each side. It is viewed by two 15 cm diameter photomultiplier tubes which are operated in coincidence.

The TIC experiment was flown for 76 hours in August of 1994 over northern Canada. The altitude of the flight varied from 4 to 10 g/cm^2. This flight provided a high statistics measurement with a simple instrument.

Following the flight, TIC was calibrated with a 2.29 TeV Au beam at Brookhaven National Laboratory to further calibrate the energy deposition measurements.

The data from this flight are still being analyzed. Preliminary results will be presented at the conference.

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