PROTON ALBEDO SPECTRUM OBSERVATION IN LOW LATITUDE REGION, AT HYDERABAD, INDIA

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Abstract

The flux and the energy spectrum of low energy (30-100 MeV) proton albedos, have been observed for the first time in a low latitude region, over Hyderabad, India. The preliminary results, based on the quick look data acquisition and display system are presented. A charged particle telescope, capable of distinguishing singly charged particles such as electrons, muons, protons in low energy region, records the data of both upward as well as downward moving particles. Thus spectra of splash and re-entrant albedo protons have been recorded simultaneously in a high altitude Balloon Flight carried out on 8th December, 1985, over Hyderabad, India. Balloon floated at an altitude of ≈ 37 km (4 mb).

1. Introduction: The presence of low energy charged particles (albedo) among cosmic rays below the geomagnetic cut-off rigidity, have been predicted by Treiman (1953). However, systematic measurement of the flux and the energy spectrum of the albedos has been made by Verma (1967) at high altitudes, over Palestine, Texas. Large number of these are electrons, while protons are less in intensity. These measurements of proton albedos have been extended to high energies over same location upto thousands of MeV by Pennypacker et al (1973). It is expected that the spectrum of these albedo protons has a negative exponent. It is also expected, as shown by Kothari and Verma (1983) that the spectrum of albedos will be similar in low latitude regions such as Hyderabad, India. The flux however is higher at low energies. Next section describes briefly an experiment in which low energy proton albedo spectrum has been measured in low latitude region over Hyderabad, India.

2. Experiment: The flux and energy spectrum of upward moving splash albedo and downward moving re-entrant albedo protons have been first time

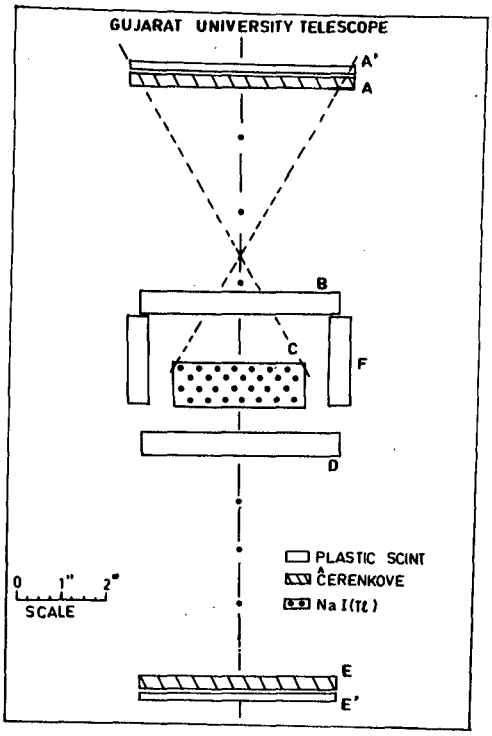


Fig.1

observed in 30-100 MeV energy interval in low latitude region at an altitude ≃ 37 km (≃ 4 mb), above Hyderabad, India. A bi-directional charged particle telescope, described in detail by Verma et.al. (1985), consisting of a total energy NaI(Tl) crystal detector, plastic scintillator and Lucite Cerenkov counters, was used for these observations. This telescope is shown in Fig.1. It has geometric factor ≃ 13 cm^2 Ster. It is capable of separating relativistic electrons from slow moving protons and muons, stopping in NaI(Tl) crystal detector 'C'. All charged particles, incident from upward and downward directions on the telescope and stopping in the NaI(Tl) total energy detector 'C', were selected for the present work. For the downward incident particles plastic scintillator 'B' was used as energy loss detector and D, F were used as anticoincidence counters. Similarly for upward moving particles scintillator 'D' was used as energy loss detector and B, F were used as anti-coincidence counters.

3. Calibration: Pulse amplitudes of B, C and D detectors are digitised by A/D convertors and recorded event by event (Verma et.al. 1985). The energy calibration of these detectors is done using ground level cosmic ray muons. These muons pass through the telescope and are registered as penetrating events. Their energy loss in B, C and D is well known from standard particle data book (Berger and Seltzer, 1966).

4. Data Analysis and Results: The proton flux measurement has been done for the energy range approximately 30 MeV to 105 MeV, both for upward and downward moving protons. A two-dimensional pulse height distribution for particles stopping in energy detector 'C' is shown in Fig.2, for upward

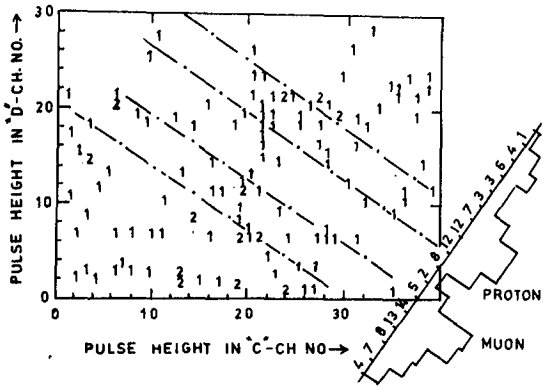
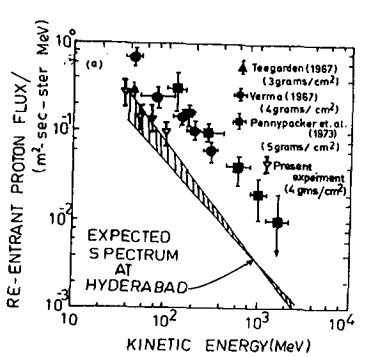


Fig.2

moving particles. The events shown in the Figures are taken during float altitude from quick look data analysis system. The histogram obtained by integrating along the track clearly gives protons and muons peaks both for upward and downward moving particles.

The flux observed for 4 different energy intervals is plotted in Fig.3 for upward moving particles. Triangles represent the flux for present observation of the re-entrant and splash albedo protons at balloon altitude of 4 mb in low latitude region over Hyderabad, India. The squares show the spectrum observed for Palestine, Texas, USA. The flux at Hyderabad, India, is lower for both re-entrant and splash albedo protons than at Palestine, Texas, as expected. The spectrum has a negative slope on a log-log graph, similar to that observed over Texas. The spectra of re-entrant albedo protons (Fig.3a) agree well with calculated spectrum. However, the flux and spectrum of splash albedo protons is somewhat higher than the calculated spectrum (Fig.3b). Data analysis with improved statistics to see if this trend persists, is under way.

Fig.3 *a*



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References:

Berger M.J. and Seltzer S.M. NASA Report, NASA SP-3036 (1966).

Bhatnagar S P and Verma S D, 17th ICRC SH.9, 1124, L, p.266 (1981).

Bhatnagar S P and Verma S D, 18th ICRC 3, p.501 (1983).

Kothari S K & Verma S D, 18th ICRC, Bangalore, India (1983)

Pennypacker C.R., Smoot G.F., Buffington A., Muller R.A., and Smith L.H., Jr. Geophys. Res.78, 1515 (1973).

Treimen S.B., The Cosmic Ray Albedo, Phys.Rev., 91, 457 (1953).

Verma S D, Jr. Geophy. Res. 72, 915 (1967).

Verma S D, Jr. Radio & Sp. Phys., 6, 171 (1977).

Verma S D, Bhatnagar S P & Kothari S K, 19th ICRC HE-7, to be held in San Diego, California, USA, in August (1985).

Fig 3.b