Determination of the detection threshold for polyethylene terephthalate (PET) Track Detector using 11MeV Carbon Beam

Rupamoy Bhattacharyya1,∗ S. Dey1, Sanjay K. Ghosh1,2, A. Maulik1, Sibaji Raha1,2, and D. Syam1
1Center for Astroparticle Physics and Space Science, Bose Institute, Kolkata 700 091, India and
2Department of Physics, Bose Institute, Kolkata 700 009, India

Introduction
To detect exotic events (e.g. strangelets) predicted to be present in cosmic radiation at mountain altitude [1], a detector with high detection threshold is very much useful, as it will not record the low charge background (mainly proton and alpha) in cosmic rays in which low Z particles are abundant. Our work shows that polyethylene terephthalate (PET) meets the need.

Experiment
Two types of Solid State Nuclear Track Detector (PET and CR-39) were exposed by 2 MeV proton and 11 MeV carbon beam. When charged particle passes through the passive detector material, it produces narrow damage trails. Conical etch pits are being formed after chemical etching with suitable etchant (6.25N aqueous solution NaOH), which was viewed under the x100 dry objective of optical microscope[3].

Results and Discussions
Experimental results are given below:
From Fig. 1, it is clear that no track have been registered PET detector.
Protons with the above mentioned energy value, are simultaneously incident on CR-39 and there tracks have been observed. The histogram corresponding to minor axis distribution of the tracks is shown in Fig. 2:

100µm thick PET detectors were exposed by 11 MeV carbon beam. After 4 hrs of etching the thickness of the exposed surface of PET detector was reduced by 4.2µm (as found using SRIM software[3]). As the particle penetrates inside the detector it loses it’s energy

FIG. 1: PET irradiated by proton beam (2 MeV) after 9hrs of etching while focusing at the surface.

FIG. 2: Minor axis distribution for 2 MeV proton on CR-39 after 4 hrs of etching.

∗Electronic address: rupamoy@jcbose.ac.in

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FIG. 3: Tracks have been registered on the PET detector (after 3 hr of etching), but the tracks are so small that the track parameters could not be measured by existing experimental facility.

FIG. 4: The track-pits (after 4 hrs of etching) acquired dimension for measurement.

FIG. 5: $V_T/V_B$ distribution for 11 MeV carbon on PET after 4 hrs of etching. From track parameter measurement we have found $V_T/V_B = 1.7 \pm 0.1 \pm 0.5$ according to Bethe-Bloch formula. The reduced value of energy (after 4 hrs of etching) of carbon is 6.8 MeV and corresponding $Z/\beta$ value is 172.6.

**Conclusion**

From the above experimental data it is quite clear that we are getting tracks on CR-39 and simultaneously there is no signature of 2 MeV proton inside PET. We have found $Z/\beta$ threshold value (for which the tracks will just get the minimum required dimension for measurement) is given by 172.6 for PET detector. It was found that PET has a much higher detection threshold compared to CR-39 or other SSNTDs.

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**References**

