

ESTIMATION OF THE RESPONSE OF CR-39 (HCB 0.5%) AS A MEDIUM
AND HEAVY PRIMARY COSMIC NUCLEI DETECTOR

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Received 15 November 1989

UDC 539.14

Original scientific paper

The balloon borne CR-39 (HCB 0.5%) stack was exposed to primary cosmic ray nuclei flux for 16 hours and 41 minutes from Alice Springs, Australia and the collected plates were chemically etched in 6.7N NaOH aqueous solution for 27 hours. The etch pit diameters were measured using a Leitz Ortholux microscope having objective 40 \times and a filar micrometer eyepiece 15 \times . The diameter histogram shows the clear separation of individual charge peaks for charged nuclei identification. The measured charge resolution of the CR-39 (HCB 0.5%) detector has been found to be 0.46 e for the detector of nuclei within the charge range of $5 < Z < 26$. This result is in accord with the earlier data of Hayashi and Doke, Tasaka et al. and Ginjaume et al.

1. Introduction

The study of the response of passive detector for detection of relativistic primary cosmic ray nuclei is important for the precise estimation of the cosmic ray abundants near the top of the atmosphere.

Earlier Hayashi and Doke¹⁾, Tasaka et al.²⁾ and Ginjaume et al.³⁾ have estimated the response of CR-39 plastics for the detection of charged cosmic ray nuclei at balloon altitudes. Two groups^{1,2)} have used CR-39 of Solar Optical Japan Limited and Barcelona group³⁾ have used CR-39 (DOP) (Persore) and observed that the estimated response for the detection of cosmic ray charged nuclei was between $0.4e-0.44e$.

In the present work we have estimated the response of CR-39 (HCB 0.5%) exposed to primary cosmic rays having charges between $5 < Z < 26$ and have compared them with the earlier results¹⁻³⁾.

2. The experiment

The CR-39 (HCB 0.5%) plastics of area $20 \times 25 \text{ cm}^2$ was exposed to primary cosmic rays by balloons at an atmospheric depth of 9.8 g/cm^2 from Alice Springs, Australia in 1983. The flight duration was 16 hours and 41 minutes. The plate was etched in 6.7N NaOH solution at $(70 \pm 0.1)^\circ\text{C}$ for 27 hours. The estimated bulk etch rate was found to be 1.71 micrometer per hour. The etch pit diameters were measured under a transmitted light Leitz Ortholux microscope with a $10\times$ objective and $15\times$ filar micrometer eyepiece.

3. Results and discussion

The histogram of the 1208 etch pit diameter distribution has been plotted in Fig. 1. The clear separation of individual charge peaks exhibit the existence of the nuclei of charges in the range $5 < Z < 26$. We have estimated the ratio of bulk etch rate to the track etch rates. The estimated relation follows the form

$$s = V_T/V_G - 1 = 0.00012 Z^2 + 0.056 Z - 0.217, \quad (1)$$

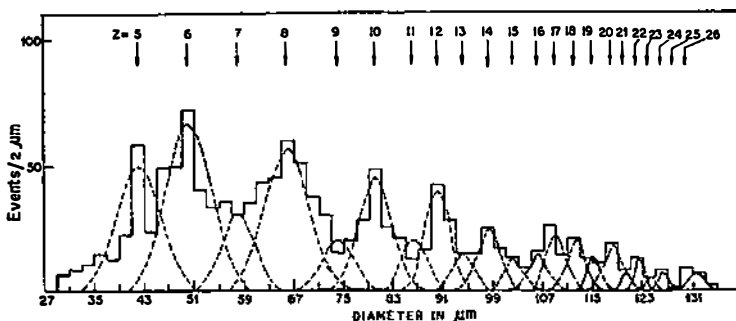


Fig. 1. Diameter distribution of the charged primary nuclei detected over Alice Springs, Australia at a residual atmospheric pressure of 980 Pa. Lines drawn to the charge distribution represent the Gaussian fit to the experimental results. The peaks represent the nature of charged particle detected near the top of the atmosphere.

and the estimated assigned nuclei charge Z and the measured diameter obeyed the relation

$$D (\mu\text{m}) = 2.85 + 9.16Z - 0.17Z^2. \quad (2)$$

The charge resolution of the CR-39 (HCB 0.5%) detector exposed to cosmic ray nuclei has been estimated from Fig. 1 and the estimated charge resolution follows the form

$$\sigma_z = (0.3644 + 0.00597Z) e. \quad (3)$$

Table 1 shows the charge resolution estimated from the present study along with those found by different authors¹⁻³⁾.

TABLE 1.

Source of ions	Type of passive detector polymer	$\sigma_z (e)$	Authors
Primary cosmic ray heavy nuclei (Fe)	CR-39 from Sola Optical, Japan	0.4e	Hayashi and Doke ¹⁾
Primary cosmic ray Fe nuclei	CR-39 Sola Optical, Japan	0.4e	Tasaka et al. ²⁾
Primary cosmic ray VH nuclei	CR-39 (DOP) Pershore Mouldings Co., U. K.	0.44e	Ginjaume et al. ³⁾
Present work	CR-39 (HCB 0.5%) Japan made	0.46e	Present work

References

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- 2) S. Tasaka, Y. Sato, N. Tateyama, H. Sugimoto, F. Fumuro and K. Hoshino, Nucl. Instr. Meth. **A236** (1985) 400;
- 3) M. Ginjaume, C. Baixeras, F. Fernandez and A. Vidal-Quadras, Nucl. Tracks **12** (1986) 443.

PROCJENA ODZIVA CR-39 (HCB 0.5%) KAO MEDIJA I DETEKTORA
ZA TEŠKE PRIMARNE KOZMIČKE JEZGRE

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Originalni znanstveni rad

CR-39 (HCB 0.5%) detektor podignut je balonom iz Alice Springsa, Australia, i izložen primarnom kozmičkom zračenju 16 sati i 41 minutu. Ploče su zatim kemijski obrađene u 6,7 N otopini NaOH u trajanju od 27 sati. Mjerenja promjera uzvisina pokazala su jasnu separaciju vrhova za identifikaciju nabijenih jezgri. Mjerena nabojna rezolucija detektora iznosi $0,46e$ za detekciju jezgara s nabojem $5 < Z < 26$.