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MEASUREMENT OF THE ISOTOPIC COMPOSITION OF THE PRIMARY COSMIC RADIATION FOR THE ELEMENTS B-NE

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Referat (sammandrag)

The results are given from an investigation of the isotopic composition of primary cosmic ray B, C, N and O. Preliminary result is also given from an investigation of Ne. The mass measurements are made in nuclear emulsions exposed at about 5 g/cm^2 atmospheric depth. The results for B-O represented as quotients extrapolated to the top of the atmosphere, are:

$^{11}B/B = 0.61 \pm 0.10$; $^{13}C/C = 0.06 \pm 0.03$

$^{15}N/N = 0.35 \pm 0.09$; $^{17}O/O = 0.05 \pm 0.03$; $^{18}O/O = 0.08 \pm 0.03$.

The preliminary result from the Ne-measurements shows that nuclei with masses larger than 20 exist among the primary neon nuclei.

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The results are given from an investigation of the isotopic composition of primary cosmic ray B, C, N and O. Preliminary result is also given from an investigation of Ne. The mass measurements are made in nuclear emulsions exposed at about 3 g/cm^2 atmospheric depth. The results for B-O represented as quotients extrapolated to the top of the atmosphere, are:

$^{11}B/B = 0.61 \pm 0.10$; $^{13}C/C = 0.06 \pm 0.03$

$^{15}N/N = 0.33 \pm 0.09$; $^{17}O/O = 0.05 \pm 0.03$; $^{18}O/O = 0.08 \pm 0.03$.

The preliminary result from the Ne-measurements shows that nuclei with masses larger than 20 exist among the primary neon nuclei.

1. Introduction. In this report we discuss the final results of an investigation of the isotopic composition of primary cosmic ray B, C, N and O. We also give a preliminary result of a Ne-measurement. As most other investigations on the mass content of cosmic ray nuclei are made with counter telescope, it is necessary to make measurements in independent detector media. Our detector, an Ilford G5 nuclear emulsion stack, was exposed 1970 over Canada. The energies of the nuclei fall in the interval 200-500 MeV/n.

2. Mass determination. The masses of the nuclei have been determined from measurements of the relation between track width and residual range on the last 12 mm of the stopping nuclei. The measurements are made with a slit photometer.

A detailed description of the present measurements of B and C is given by Bjarle and Herrström 1976 and of the N and O measurements by Jacobsson 1977. The measuring technique has been extensively described by Jönsson et al. 1970 in connection with a previous study of the isotopic composition of carbon. The mass resolution is 0.42 AMU for the carbon measurement and 0.50 AMU for the oxygen measurements.

3. Results. Our results for B-O are shown in Figures 1-4. The Figures show the mass spectra at the exposure depth in the atmosphere.

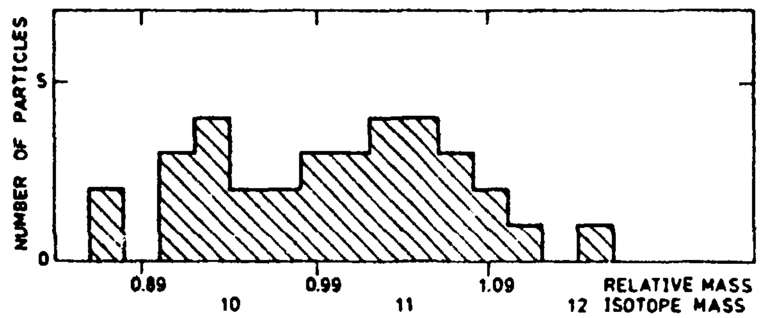

Figure 1.

Boron spectrum

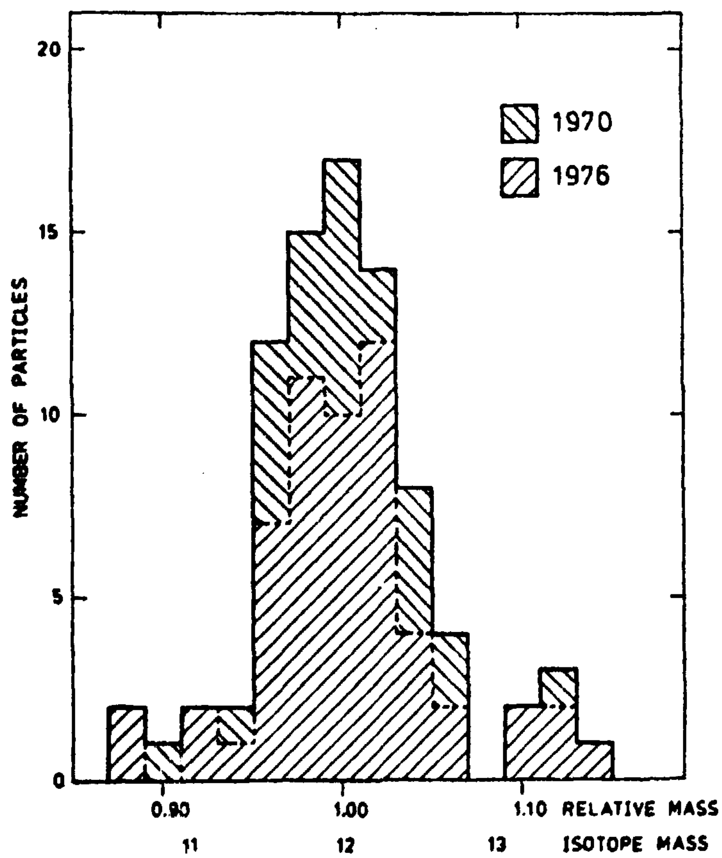

Figure 2.

Carbon spectrum

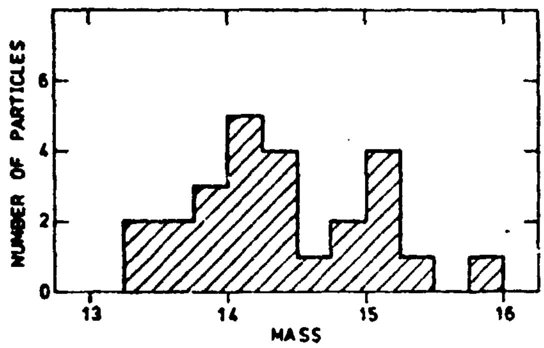

Figure 3.
Nitrogen spectrum

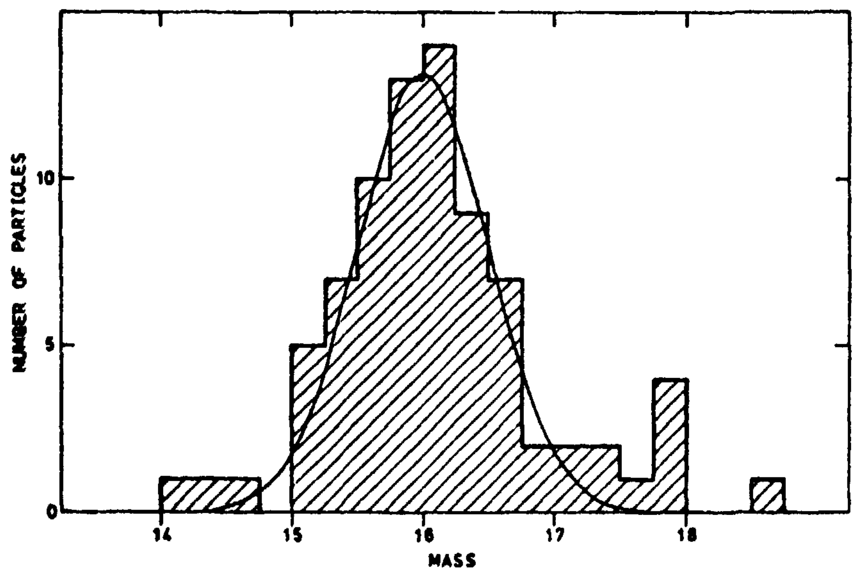

Figure 4.
Oxygen spectrum

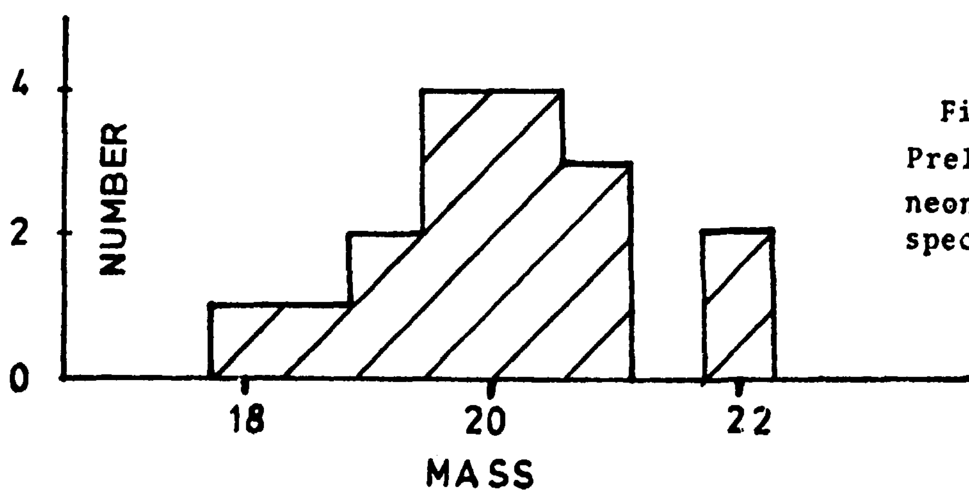

Figure 5.
Preliminary neon spectrum

Table 1 shows the estimated number of nuclides in the spectra of the Figures 1-4 and the isotopic quotients extrapolated to the top of the atmosphere.

Table 1

	Mass	Number of particles	Extrapolated quotient
Boron	10	14	
	11	19	$\frac{^{11}B}{B} = 0.61 \pm 0.10$
	12	1	
Carbon	11	3	
	12	74	$\frac{^{13}C}{C} = 0.06 \pm 0.03$
	13	6	
Nitrogen	14	16	$\frac{^{15}N}{N} = 0.33 \pm 0.09$
	15	9	
Oxygen	14+15	4	$\frac{^{17}O}{O} = 0.05 \pm 0.03$
	16	66	
	17	4	$\frac{^{18}O}{O} = 0.08 \pm 0.03$
	18	6	

The result for boron indicates that the boron quotient for the radiation is somewhat smaller than the corresponding quotient for the solar system.

An extrapolation of the carbon quotient to the source (Tsao, Shapiro and Silberberg 1973) shows that the abundance of ^{13}C in the source must be very small - less than 5% on the 95% confidence level.

The nitrogen quotient supports the assumption that nitrogen is present in the source. The nitrogen abundance in the CNO group is about 5% in the source.

Our $^{17}O+^{18}O$ abundance is somewhat larger than expected from the calculations by Tsao, Shapiro and Silberberg (1973). The difference is, however, not statistically significant.

The Figure 5 shows the preliminary neon spectrum at the point of measurement. We have fixed the mass scale on the bases of the knowledge of

1) The distance in the spectrum between the different isotope

2) The mass resolution.

3) That only small amounts of ^{18}Ne and ^{19}Ne can be produced in the atmosphere.

A preliminary extrapolation to the top of the atmosphere gives the quotient $^{20}Ne/Ne = 0.87$.

4. Acknowledgment. We are grateful to the Office of Naval Research, Washington D.C. for the balloon exposure of the stack and to the Swedish Natural Science Research Council for financial support.

5. References.

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