Rigidity Responses of Ionization Chambers Derived from Cosmic-Ray Time Variations.

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Summary. — The coupling coefficient which connects the cosmic-ray variation in space with that observed on the ground is obtained for the case of the ionization chamber. The differential coefficients with respect to the zenith angles are averaged with weights corresponding to the zenith angle dependence of a spherically symmetric chamber at sea-level and mountain altitude. The resultant coefficients satisfactorily accord with the results of the neutron monitors and the multidirectional muon telescopes for the cases of great Forbush decreases.

1. — Introduction.

The continuous registration of the cosmic-ray intensity in the early stages of the research was realized by using the ionization chamber (1). Although the muon telescopes (2) and the neutron monitors (3) are the main instruments for the continuous registration of the cosmic-ray intensity nowadays, the ionization chamber has been the most stable detector, especially for long-term and diurnal variations the of cosmic-ray intensity, e.g. data available at the

world network of Carnegie Institution (4) are still useful to the researchers of present days.

In the thirties, according to the report of Compton Model-C metre (1), the ionization chambers were developed at the Institute of Physical and Chemical Research. These chambers are called IPCR-type or Nishina-type ionization chamber (2,5). There are five identical Nishina-type chambers in operation at Sapporo (the vertical cut-off rigidity is 8.22 GV; the operation has been suspended and the removal of the chamber to a new site near Sapporo is planned), Mt. Norikura (2770 m above sea-level and the vertical cut-off rigidity is 11.39 GV), Tokyo (the vertical cut-off rigidity is 11.61 GV), Honk Kong (the vertical cut-off rigidity is 16.23 GV) and Kochi (the vertical cut-off rigidity is 12.66 GV).

Though the accuracy of observation with the use of the ionization chamber is not so high as those of the neutron monitors and the large-area muon telescopes, the data can be used even for transient variations as in the great Forbush decreases (6, 7). In order to use the ionization chamber data as information of primary cosmic-ray variations it is necessary to know the coupling coefficients (8). These coefficients connect the cosmic-ray variations in space with those observed by the detectors on the ground through the response functions and the variation spectrum of primary cosmic rays.

In this paper, only the isotropic component in the cases of Forbush decreases is treated. A single power-law spectrum up to 100 GV with an exponent of \(-1.0\) is assumed. The coupling coefficients are obtained from the existing differential coefficients with respect to the zenith angle. They were examined by the well-known great Forbush decreases on August 5, 1972 and February 15, 1978, and a satisfactory result is obtained.

2. - Numerical estimation.

The shapes of ionization chambers are spherical as the Compton Model-C metre and ASK-1 (8) or cylindrical with one hemispherical end as the Nishina-type chamber. Therefore, it can be assumed that the cross-sectional area is independent of the zenith angle. The zenith angle dependence of the cosmic-ray

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