Observation of Forbush decrease by the narrow angle muon telescope at Mt. Norikura

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Abstract

Forbush decrease events were observed on 26 August and 25 September in 1998 by the narrow angle multi-directional muon telescope at Mt. Norikura. The differences of the counting rate from a level before Forbush decrease are plotted in the two-dimensional map of 21×21 bin (angular resolution $\pm 7^o$). It is seen from the time sequence of the plot that the wall of magnetic cloud which causes Forbush decrease is not uniform during the earth pass into it but become uniform after passing it in both events.

1 Forbush decrease on 26 August and 25 September in 1998:

On August 26 and September 25 in 1998, a considerably large Forbush decrease were observed by the narrow angle muon telescope at Mt. Norikura as shown in Fig. 1. The sudden commencement of the earth magnetic field which shows the arrival of the IMF-shock wave or the magnetic cloud, occurred at 0650 (U.T.) on 26 August and at 2345 on 24 September. The sudden decrease of cosmic ray intensity also occurred at nearlythe same time. It is inferred that the both magnetic cloud were created by the solar flares of importance 3B that occurred at the location of (N35, E09) and (N18,E09).

After pressure correction, the differences ($\Delta I_{ij}^{OB}(t)$) for ij-th telescope of the counting rate from a level before Forbush decrease are plotted in the two-dimensional map of 21×21 bin of the new multi-directional muon telescope during Forbush decrease (see Y. Ohashi et al. 1997).

2 Response of the new telescope for Forbush decrease

We estimate the response of the new telescope to Forbush decrease. Decrement of the cosmic ray intensity (ΔI_{ij}^{EX}) for ij-th telescope s expected from the following rigidity spectrum ($S(p)dp$):

$$S(p)dp = (p/p_0)^\gamma dp/p_0; \;\; p_0 = 10GV \tag{1}$$

We calculate ΔI_{ij}^{EX}, taking into account the influence of cosmic-r ay's geomagnetic deflection and nuclear interaction with the terrestrial materia l (Murakami et al. 1979) and also the geometrical configuration of the muon tele scope. Figure 2 shows the contour map (21×21 bin) of the decrement of For bush decrease assuming γ=–1. In the figure, it is seen that the region o f maximum decrement shifts toward south-west from vertical direction. This fact is due to lower cut off rigidity. The decrement due to Forbush decrease of the i nclined telescopes are small. This fact is due to observe in higher rigidity.

3 Two-dimensional map during Forbush decrease

To estimate justly the covering effect for cosmic rays of the wall of the magnetic cloud, we must convert the observed data ($\Delta I_{ij}^{OB}(t)$) to $\Delta I_{ij}^{OB}(t) \times (\Delta I_{i=11,j=11}^{EX} / \Delta I_{ij}^{EX})$. After above correction, the observed data are plotted in the two-dimens ional map of 21×21 bin. Figure 3 shows the two-dimensional map from 9h to 14h (U.T.) on 26 August and from 6h to 11h (U.T.) on 25 September. The duration of sharp decrease are from 7h to 13h on August event and from 5h to 10h on Sept ember event as shown in Fig 1. It is seen from the time sequence of the plot tha t the decrease of cosmic rays starts from the direction of north-east into sharp decreasing phase and become uniform in the end of the decreasing phase in both events. Speaking other words, when the wall (the disturbance region) of the magn etic cloud is thin, the covering effect for cosmic rays is not uniform.

4 Conclusion

Forbush decrease events were observed on 26 August and 25 September in 1998 by t he new narrow angle multi-directional muon telescope at Mt. Norikura. The differ ences of the counting rate from a level before Forbush decrease are plotted in t he two-dimensional map of 21$\times$21 bin. It is seen from the time sequence of the plot that the wall effects of magnetic cloud is not uniform during the eart h pass into it but become uniform after passing it in both events.

References

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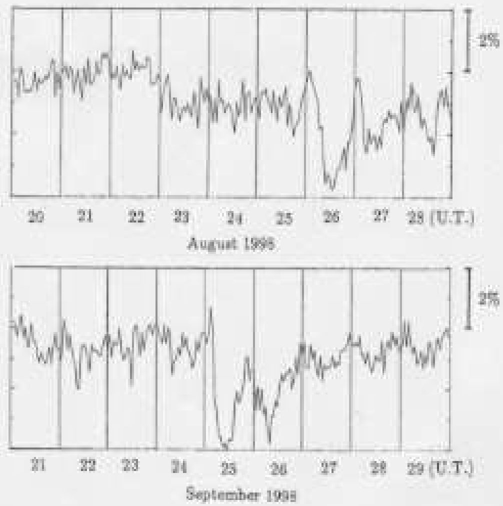

Fig. 1
Forbush event observed by the vertical telescope of the narrow angle muon telescope at Mt. Norikura on August 26 and September 25 in 1998.

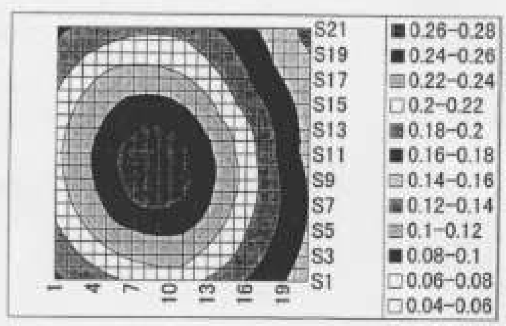

Fig. 2
The contour map (21×21 bin) of the expected decrement of Forbush decrease of the new narrow angle muon telescope at Mt. Norikura, assuming γ=-1.

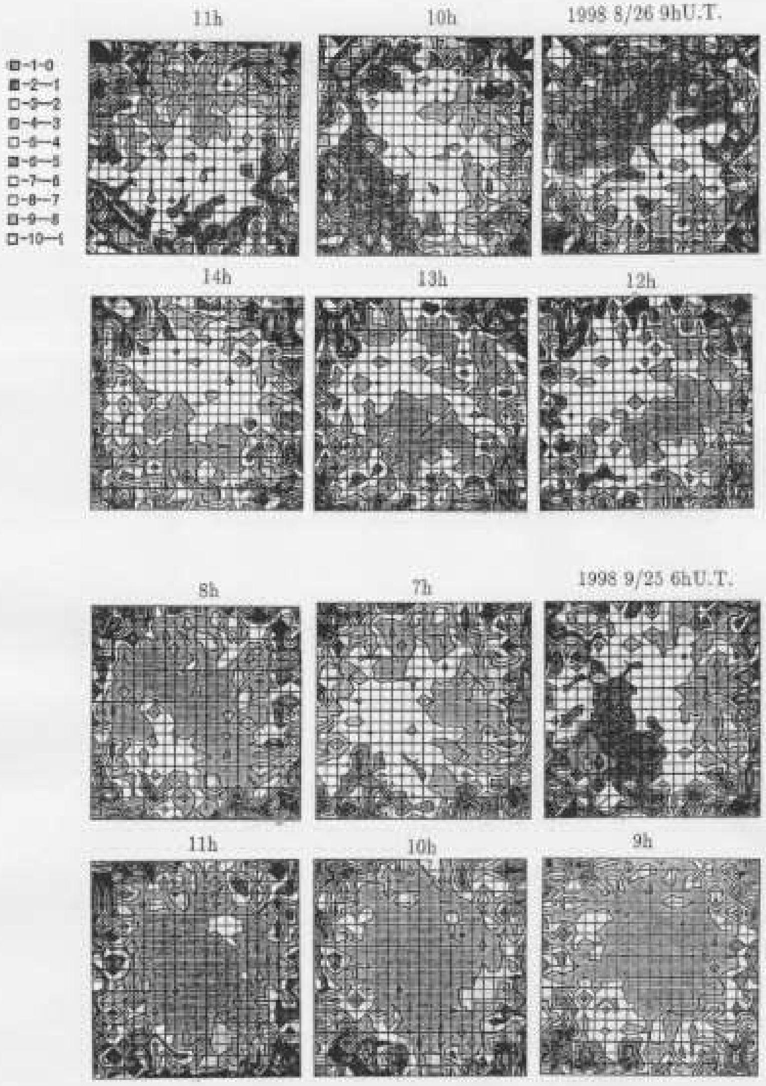

Fig. 3

Two-dimensional map from 9h to 14h (U.T.) on 26 August and from 6h to 11h on 25 September.