RECORDING SYSTEM FOR THE SOLAR NEUTRON MONITORING AT MT. NORIKURA

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ABSTRACT

In order to monitor the solar neutron events, a new recording system will be installed at Mt. Norikura Cosmic Ray Observatory. The recording system is composed of a pulse counter with clock and a microcomputer with minifloppy disk. The counter and the microcomputer are connected through the General Purpose Interface Bus line. The one-minute total count of neutron monitor is recorded on the minifloppy disk.

1. Introduction

Direct observations of the solar neutrons associated with solar flares were made at the earth, on June 21, 1980 and June 3, 1982 by the Gamma-Ray Spectrometer (GRS) on board the Solar Maximum Mission satellite (SMM).[1,2] It was reported that, on June 3, 1982, the solar neutrons were also detected by the ground-based neutron monitors at Jungfraujoch,[2,3] Lomnicky Stit,[4] and Rome.[5,6] From the analysis of the Rome NM-64 data, Iucci *et al.*[6] analyzed that the solar energetic neutron events could be detected by ground-based stations particularly when they were located at mountain altitudes and low latitudes.

Here, we present a plan to record the output of neutron monitor at Mt.Norikura (4-NM-64, altitude=2770m, cutoff=11.36GV) and, if possible, simultaneously at Tokyo (36-NM-64, altitude=20m, cutoff=11.61GV).

2. Recording hardware system

This system is contrived to record the total counts from the neutron monitor in every minute. Figure 1 shows the arrangement for recordings of the neutron monitor counts. The counter/clock is operated through the IEEE-488 standard digital interface bus for programable instrumentation (or General Purpose Interface Bus, GPIB). The control of GPIB and the data acquisition is operated by an ordinary microcomputer.[7]

The interface between microcomputer and GPIB is made by using an LSI (TMS9914, Texas Instruments), and 4 MHz clock pulse is supplied from the microcomputer. The control of the counter/clock is operated through an interface LSI (SM8530B, Nippon Precision Circuits).

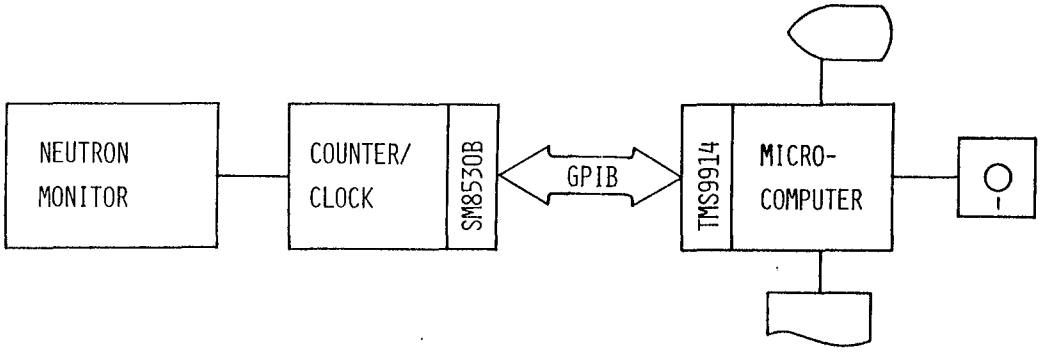

Fig.1. Blockdiagram of the recording system for the solar neutron monitoring.

3. Recording software system

The microcomputer is operated under the operating system of CP/M (Control Program for Microprocessors, Digital Research). The LSI TMS9914 that we used contains all of the logic necessary to interface TALK, LISTEN and CONTROL in accordance with GPIB. For the microcomputer, the control of GPIB means the read-and-write process to the various registers in the TMS9914. All programs which control the TMS9914, the floppy disk and the printer, are written in C language (C compiler by BD Software).

Figure 2 shows the flow chart of the operating program of the recording system. The counting rates of the neutron monitor in every one minute is transfered from the counter/clock to the memory of microcomputer, and written on the minifloppy disk in every ten minutes. Year, month, day, hour and minute are written at the beginning of the hour. The exchange of floppy disk can be operated between the ten minute recording. One block of data is composed of an hour data, which requires 128 bytes each. A sheet of floppy disk (in this case) can be operated for three months. The records on the floppy disk are transfered to a magnetic tape, and the data will be analyzed by using electronic computers.

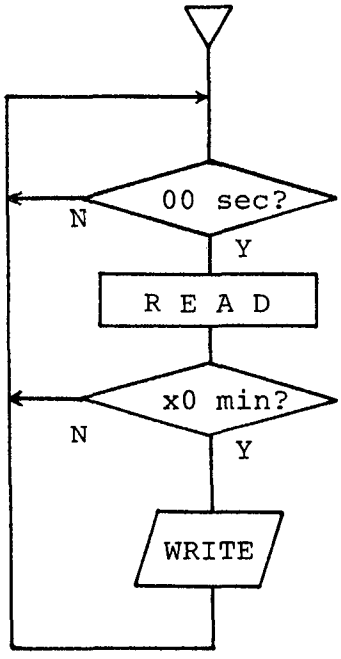

Fig.2. Flowchart of operating program.

Table 1. Distribution of neutron monitors.

Station	Jungfraujoch	Rome	Mt. Norikura	Tokyo
Monitor	IGY	12-NM-64	4-NM-64	36-NM-64
Latitude	46.55° N	41.91° N	36.11° N	35.75° N
Longitude	7.98° E	12.50° E	137.55° E	139.75° E
Altitude	3550 m	60 m	2770 m	20 m
Cutoff rigidity	4.48 GV	6.32 GV	11.36 GV	11.61 GV
Counting rates (Nov. 1977)	6.0×10^5 /hr	3.0×10^5 /hr	5.5×10^5 /hr	9.4×10^5 /hr

4. Discussion and Summary

As is seen in Table 1, Mt. Norikura station is located at an advantageous place, namely, mountain altitude, relatively low latitude, and different longitude from European stations. It is preferable that one minute record at Tokyo neutron monitor should be operated simultaneously to study the response and yield function for the solar neutron.

The features of the the recording system for the solar neutron monitoring are summarized as follows:

1) Using of the general purpose interface bus (GPIB) to facilitate the automatic data handling and also the alteration of the recording system.

2) By the adoptation of an ordinary microcomputer and the control and operation software in C language, it is easy to change operation system afterwards.

3) One minute count data from the neutron monitor are recorded on the minifloppy disk, which can endure for a long time record (in this case, three months).

5. Acknowledgments

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