THE AUTOMATIC CHECKING OF STABILITY OF A COSMIC RAYS MEASURING INSTRUMENT

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Before the beginning of the IQSY (International Year of the Quiet Sun) a new instrument — called the Neutron Supermonitor NM-64 [1] was developed for a detailed events analysis in the measurement of the nucleonic components of cosmic rays. The number of counts in an NM-64 at stations at sea level and high geographic latitudes is on the average 43 000 impulse per hour for each counter. This increased number of counts was the reason why the world-wide network of stations for the registration of the nucleonic component of cosmic rays changed their former way of registration by means of the Simpson [2] type Neutron Monitors — introduced during the IGY (International Geophysical Year) and began registration with instruments of the NM-64 type.

From January 1, 1972 at the Lomnický štít station (geographic coordinates 49.20 °E, 20.22 °N, altitude 2634 m above sea level a Neutron Monitor of the NM-64 type is in operation with average counts of 200 000 impulse per hour for a single counter. The instrument is divided into four independent counter sections. Its measuring stability is automatically checked — the checking method is as follows:

Let $N_i(t)$, or $N_j(t)$ resp. by the number of counts in the i-th, or the j-th NM-64 counter, resp. registered at the time t. Taking into account the high counting rate we introduce the reduced number of counts $N'_i(t)$, or $N'_j(t)$, resp.

$$N_i(t) = k_i N'_i(t), \quad N_j(t) = k_j N'_j(t),$$

where k_i or k_j, resp. are the corresponding reduction coefficients. Let

$$N'_{ij}(t) = N'_i(t) - N'_j(t) = \frac{1}{k_i} N_i(t) - \frac{1}{k_j} N_j(t) \tag{1}$$

be the counting rate difference of the i-th and the j-th counter during the time t. From the errors propagation theory [3], we have for the variance $\sigma^2_{N'ij}$ of the difference $N'_{ij}(t)$:

$$\sigma^2_{N'ij} = \frac{\sigma^2_{N_i(t)}}{k_i^2} + \frac{\sigma^2_{N_j(t)}}{k_j^2} - \operatorname{cov}(N_i N_j), \tag{2}$$

where $\sigma^2_{N_i}$ or $\sigma^2_{N_j}$, resp. are variances of the counting rates $N_i(t)$, or $N_j(t)$, resp. which at the same time involve the multiplicity effect [4]. The third term in the equation (2) expresses the correlation between the counting rates $N_i(t)$ and $N_j(t)$ caused by the multiplicity in the atmosphere and in the monitor and it is negligible, taking into account the independence of the counters. Supposing $N_i(t) \doteq N_j(t)$ and $k_i = k_j$, the equation (2) can be simplified:

$$\sigma^2_{N'ij} \doteq 2 \frac{\sigma^2_{N_i}}{k_i^2}. \tag{3}$$

For the determination of $N'_{ij}(t)$ and for testing the overflowing of $(N'_{ij}(t) \pm \sigma_{N'ij})$ an instrument was developed, the block scheme of which is in Fig. 1. At the input of the

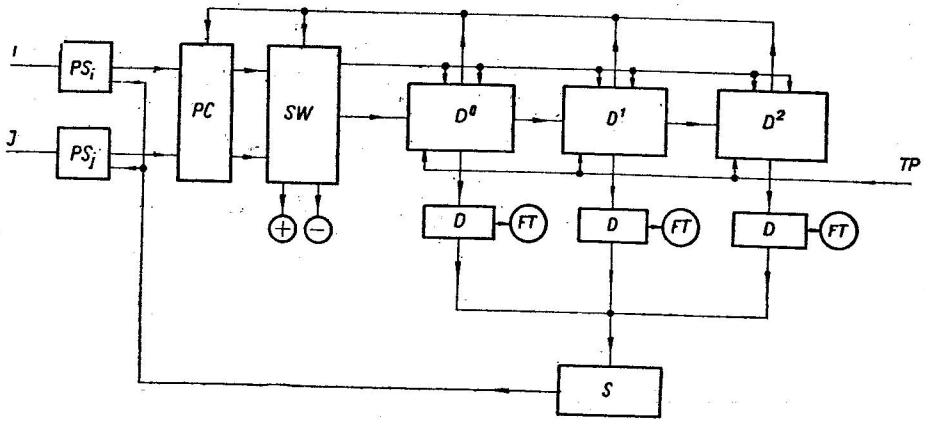

Fig. 1. The block scheme.

pulse shaper PS_i, PS_j are fed by the impulses of the i-th, or j-th counter, resp. after a proper reduction. The shaped pulses are then led into the pulse comparer PC, which expels the simultaneous impulses from PS_i, PS_j. The pulses which differ in time are evaluated by the switcher SW in reading decades D^0, D^1, D^2 and are denoted by the + or − sign. The condition of the reading decade $N'_{ij}(t)$ in the BCD code is indicated through the decoder D (WK 06061) by the digital flash tubes FT (ZM 1020). The admissible overflowing of the condition $(N'_{ij}(t) \pm \sigma_{N'ij})$ is signalized by the instrument S, which at the same time blocks the outputs PS_i, PS_j. With the time pulse TP, which determines the length of the checked time interval, the instrument is reset to the original condition. The instrument is constructed mainly from the logical transistor circuits Regimat [5]. For the stability checking of the whole apparatus 4-NM-64 it is necessary to check the overflowing conditions $(N'_{ij}(t) \pm \sigma_{N'ij})$ for $ij = 12, 23, 34, 41$.

The described apparatus permits the 4-NM-64 stability checking automatically and continuously for a previously determined checking time length, which decreases the number of the omitted registration intervals to minimum.

We wish to thank Ladislav György from the Cosmic Ray Department of the Institute of Experimental Physics of the Slovak Academy of Sciences for his help in the construction of the apparatus.

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Received November 29th, 1972