Monitor system for the selection of π^--meson stop

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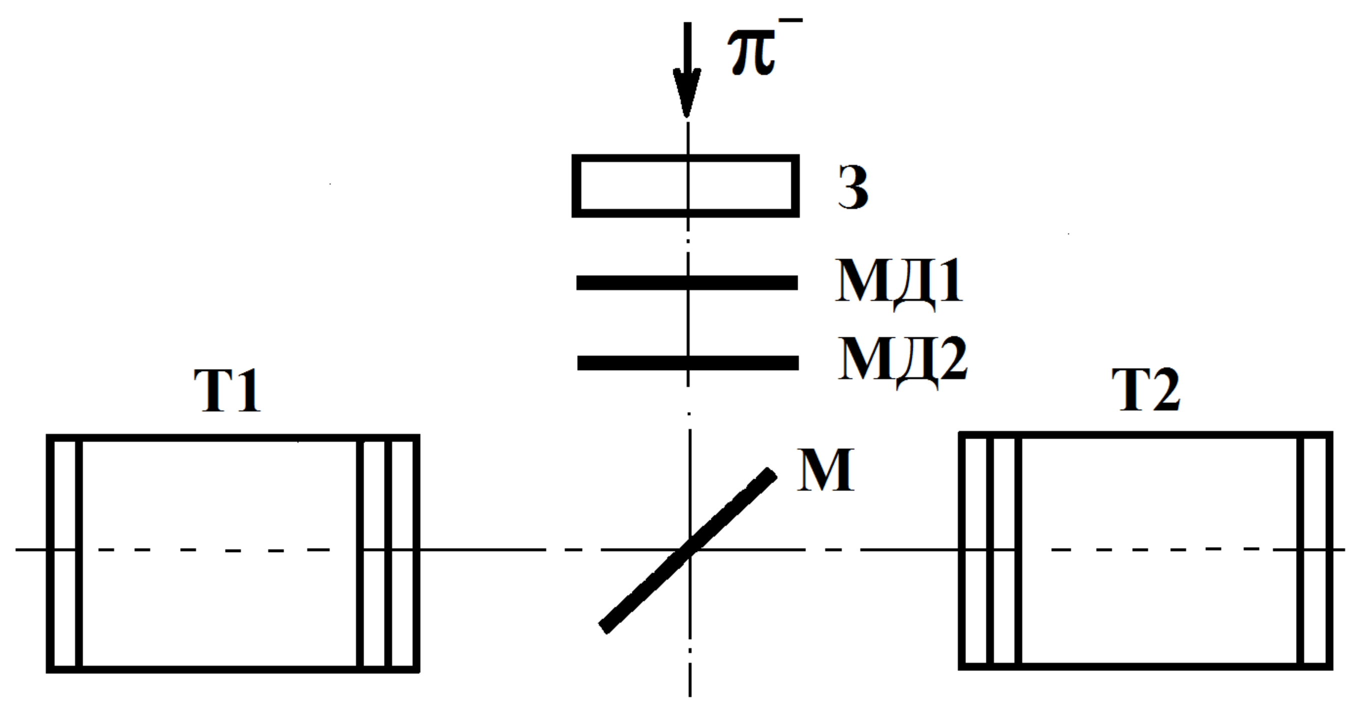

Fig. 1 A beam of π^--mesons with a energy of 30 MeV was slowed down by a moderator (З), then passed through a monitor system consisting of two MD1, MD2 detectors. Then it stopped in the target (M). Target was located at an angle of 45° to the beam (diameter of 32 mm, thickness of 0.1 g/cm^2). Charged particles from pion absorption in the target are detected by two multilayer telescopes T1 and T2. Each telescope consisted of two Si(Au)-detectors 100 and 600 microns thick and eleven lithium-drift detectors 3.5 mm thick. The setup allowed recording single-charge particles with an energy of ~ 100 MeV with high resolution $\Delta E/E \approx 0.5\%$.

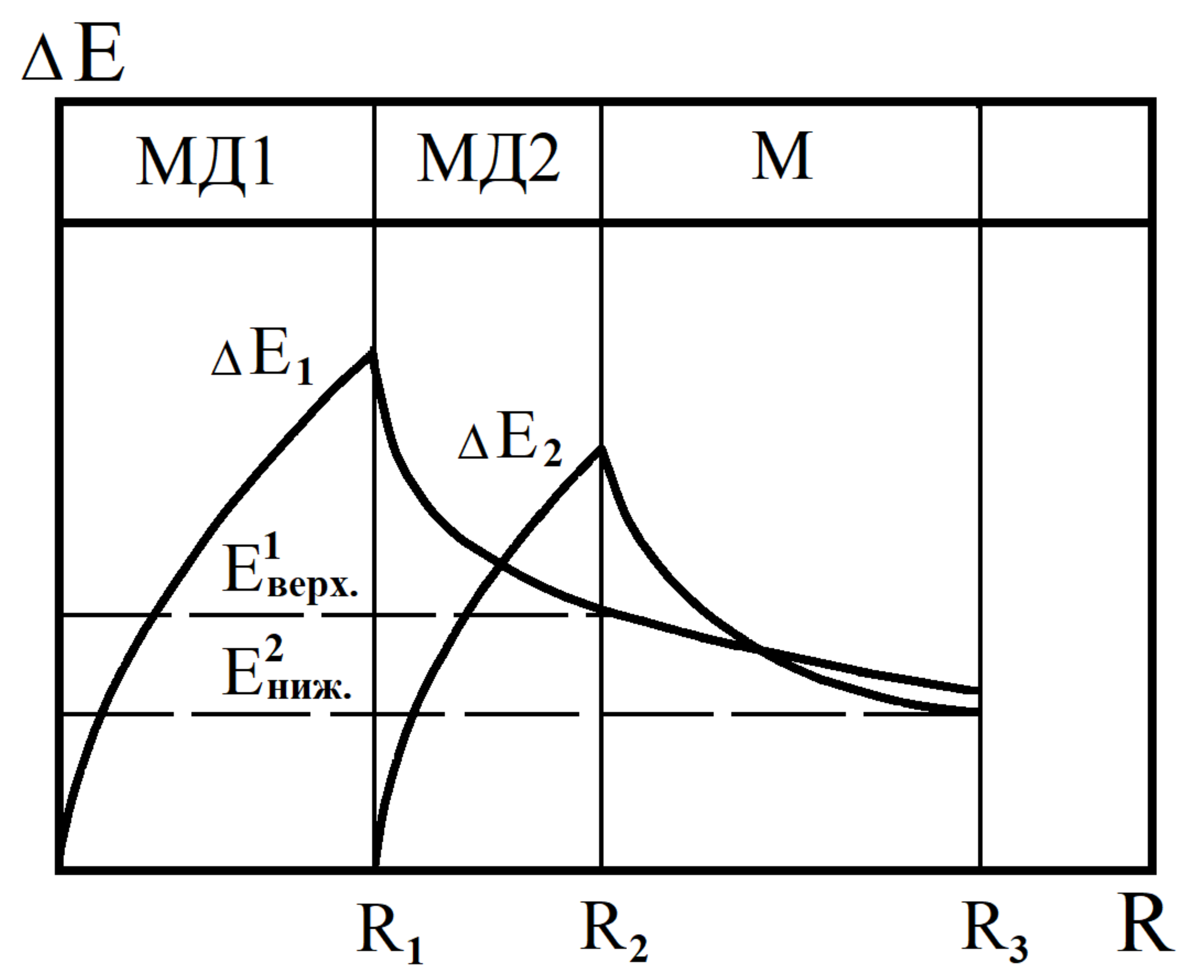

Fig. 2 illustrates the principle of selecting pion stops. The curves show the average energy losses of pions in monitor detectors (MD1, MD2) depending on their mileage. Solid vertical lines correspond to the thicknesses of MD1, MD2 and the target (M).

To reject pion stops in MD2, a limit on the maximum possible energy release in MD1 is used – setting an upper threshold. To reject pions that pass through the target, a limit on the minimum possible energy release in the MD2 detector is used – setting a lower threshold. Thus, by setting the upper and lower thresholds, we can distinguish pions in the interval of residual runs $R_3 - R_2$, which corresponds to their stops in the target.

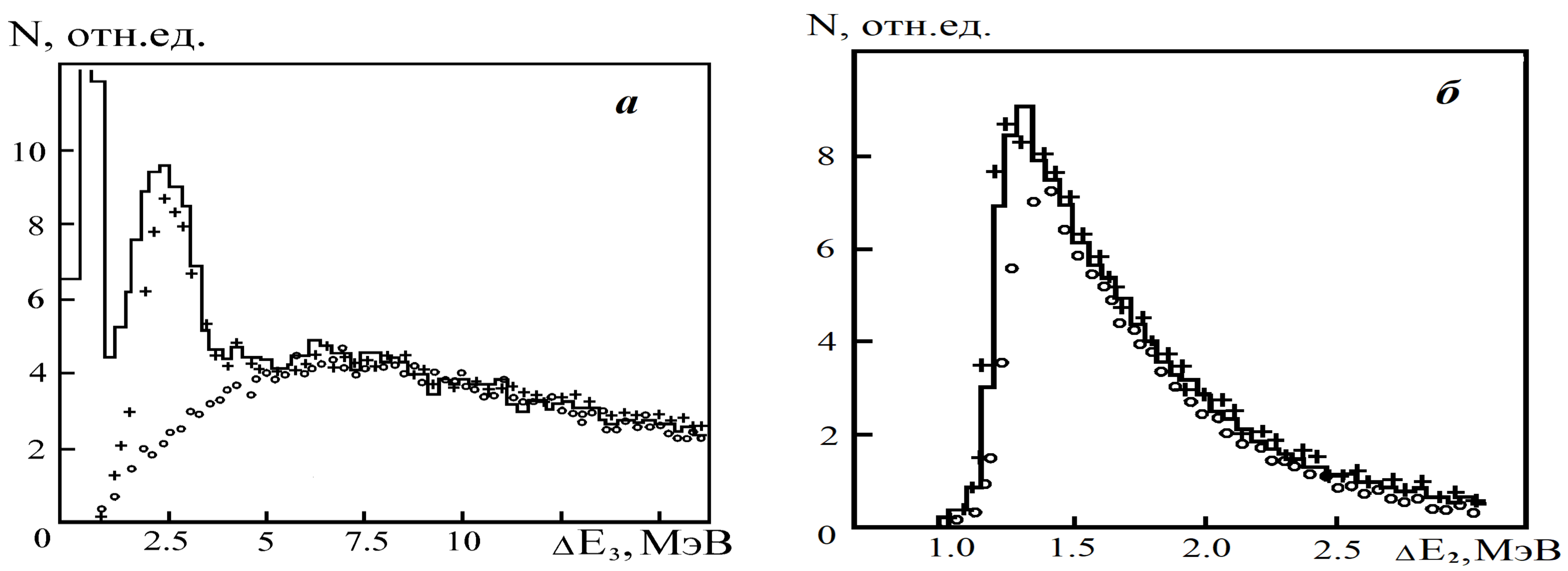

Fig. 3. energy release spectra in the "active" target (a) and the MD2 monitor detector (b) under different conditions of event selection: histogram (spectrum 1) selection of events when only MD1 and MD2 detectors are included in the selection logic; + (spectrum 2) "active" target is enabled to coincide with MD1 and MD2; o (spectrum 3) the monitor system is enabled to coincide with the T1 and T2 telescopes.

The number of matches of monitor signals Nmon and the number of stops in the target with Nπ are related by the ratio: $N\pi = Nmon \cdot K1 \cdot K2$
K1 – the proportion of pions that fall into the target area, from the number of monitors Nmon, K2 – the proportion of pions that stopped in the target, from those that fell into the target area $Nmon \cdot K1$.

The ratio of the areas S1, S2, S3 under the spectra 1, 2, 3 when normalized on the right side of the spectra (Etag > 7.5 MeV) allows us to determine K1 and K2:
$K1 = S2/S1 = 0.51 \pm 0.01$ $K2 = S3/S2 = 0.89 + 0.01$

Errors in determining the following parameters and factors that can lead to changes in the coefficients K1 and K2: beam stability (momentum, intensity) - 2.5%, beam composition (muons, pions, secondary particles) - 4%, threshold stability on monitor detectors - 2%, launch with and without a target - 4%. Taking into account these factors, the error in determining the number of stops was 5% when using the "active" target and 6.5% for normal targets.