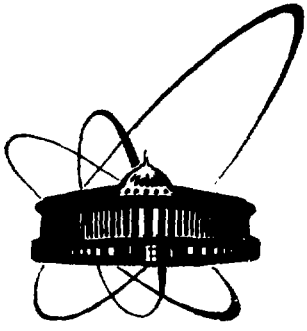

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ELECTRONIC EQUIPMENT AND SOFTWARE FOR DEVICE "FAZA"

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The device "FAZA" [1], mounted in the beam from the JINR synchrophasotron, is designed for investigation of intermediate-mass fragments (Z_f = 2...20) in nucleus-nucleus interactions. The device consists of a vacuum chamber 1 m in diameter with a target 1 mg/cm^2 thick in the middle of it. Making a sphere around the target, there are detectors with a total solid angle 86% of 4П. The larger part of this solid angle is covered by a fragment multiplicity detector. It consists of 58 scintillation counters with layer CsJ(Tl) ($\simeq$ 25 mg/cm^2). Analogue signals from each PM tube come to two ADCs, to which strobes are supplied with a 400-ns shift. It allows codes corresponding to "prompt" Cherenkov radiation and slower de-exitation of CsJ(Tl) to be distinguished in a two-dimensional plot. Triggers are five time-of-flight telescopes (TOF). TOF consists of a low-pressure avalanche counter (AC) and a Si(Au) detector (SBD). Besides, the device comprises a large (30×30 cm^2) position-sensitive avalanche chamber (PPAC) to measure space and velocity correlations of fragments in the chamber and TOF. Using TOF, one can measure the velocity v_1, the energy E_1 and thus the first fragment mass A_1 with a good resolution. Knowing the velocity of this fragment, one can reconstruct the time of its escape from the target and thus find the time of flight of the coincidence particle in the large avalanche counter. With ortho-coordinates of the avalanche counter one can find the time of flight, the velocity v_2, and the lab angles θ and Φ of the second fragment. Thus, one can measure the correlation angle θ_{ff}, Φ_{ff} and the relative velocity v_{ff} between the two fragments.

The device allows one to get energy and mass spectra of fragments, angular distributions and correlations, distributions in multiplicity and relative velocities of fragments.

Electronic equipment

In Fig.1 there is a block diagram for connection of converters to one TOF, one PM tube, and a position-sensitive avalanche chamber. Converters were triggered by "time" signals from surface-barrier detectors. To amplify the SBD energy signal, a spectrometric amplifier (SA) was used; for dE and time signals in a PPAC fast linear amplifiers (FA) were used. To determine the time position, fast analogue signals were converted into logic signals by "Constant-Fraction" discriminators (CF). Time of flight was determined in TOF systems by time converters (TDC) with a dispersion of 200 ps/chan.

Stop signals for TOF were pulses from avalanche counters. Stop signals for the position-sensitive avalanche chamber were orthosignals X, Y from delay lines. The time between the PPAC start signal and its orthosignals T_x, T_y was determined by TDCs with a dispersion of 200ps/chan. Coincidences between PPAC and SBD were determined by the gate time (TC84) equal to 225ns. Converters were read 80 μs after the start. The time resolution of TOF was 0.5 ns, which allowed a velocity resolution of $\simeq$ 1.5%. The energy resolution of 2% and the mass resolution of 5% were obtained. PPAC allowed reading time signals from delay lines proportional to orthosignals X, Y and a signal proportional to energy losses. The spatial resolution of the chamber of 4 mm, which allowed an angular resolution of 1°. Codes from time and analogue converters arrived at two buffers KL033 [2], which were read by controller KK009 [3] (program FAZA), and then were fed into a PC AT386.

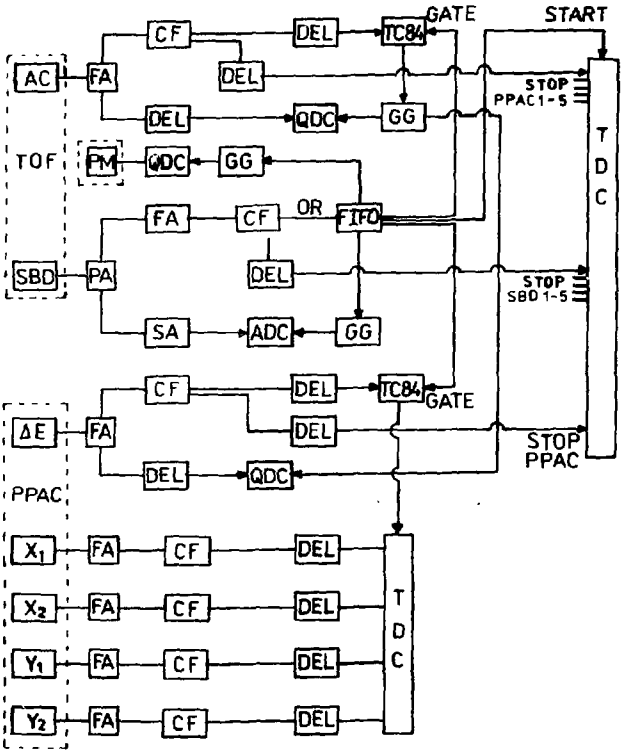

Fig. 1. Block diagram of the electronic equipment for FAZA.

PPAC - parallel plate avalanche counter;
AC - avalanche counter;
SBD - surface-barrier detector;
dE - signal proportional to energy losses;
X,Y - time signals proportional to particle coordinates in large proportional chamber;
PA - preamplifier;
FA - fast amplifier;
SA - spectroscopic amplifier;
CF - "constant fraction" discriminator;
DEL - delay;
FIFO - fan-out;
PM - signals from scintillation counters;
QDC - charge-to-code converter;
ADC - amplitude-to-code converter;
TDC - time-to-code converter;
GG - "gate" generator;
TC84 - "gate".

Software

I. MICROFN, KA333 is a program for working with controlled CAMAC blocks.

II. FAZA is an on-line program for reading buffers KL033, monitoring, recording data on a disc.

III. COMPRESS, CMPSAVE, READ, EXPAND are programs for packing data and recording the packed data on the tape-recorder, reading the packed data from the tape-recorder, unpacking the data.

I. KA333 is a program for calibration of TDC blocks with pulser KB311 [4] (180 MHz) and stop generator KA333 [5]. The program allows one to set the frequency division factor from 0 to 15 and the number of stops from 0 to 15. MICROFN allows working with the following CAMAC blocks :

1. KA224 - 8 discriminators. One can change thresholds and pulse durations after discriminators. Codes corresponding to the thresholds and durations can be stored on a disc. Then one can restore the saved states of discriminators by reading the relevant file.
2. KL354 [6] - 4 coincidences (with 4 inputs each) in one block. One can choose the necessary coincidence circuit, connect the necessary number of inputs for coincidences, switch it on in the OR mode. All settings can be stored on a disc or read from a disc.
3. KL355 [6] - 4 64-ns delays with a step of 1 ns. One can change the delay duration. Settings can be stored on or read from a disc. The program can measure a coincidence curve and plot it if there are blocks KL355, KL354, KC023 [7], KC013 [8].
4. KL364 [6] is a univibrator. One can change the univibrator pulse duration roughly and finely, store settings on and read from a disc.

The preliminary set parameters of all these blocks stored on a disc, the program allows initialization of all these blocks by one command. Besides, the program can do simple processing of two-dimensional spectra (128×128) : separate required regions in a two-dimensional spectrum, make projections onto an axis, rotate a picture about axis Z.

II. FAZA. The program can :

1. Read buffers KL033, construct 256 one-dimensional spectra of 256 channels each, 5 two-dimensional spectra (128×128), store data on a disc. In this case 178 bytes can be read from converters in two CAMAC crates. It corresponds that 46 events can be stored in one KL033 buffer. In one beam spill 3 buffers could be filled and read, which corresponds to 138 events. Fig. 2 shows the examples of two-dimensional spectra reconstructed by the program FAZA.
2. Read data from a disc and reconstruct spectra obtained in an experiment : 256 one-dimensional spectra of 256 channels each and 5 two-dimensional spectra (128×128).

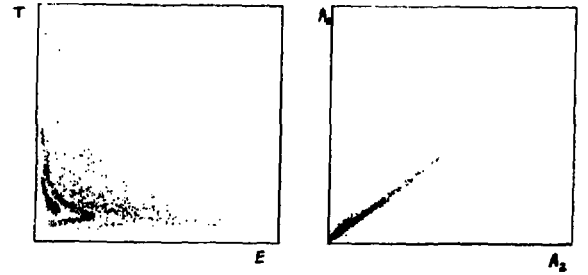

Fig. 2. Two two-dimensional spectra reconstructed with the program FAZA. The first spectrum is obtained on one of the telescopes. The time (T) and energy (E) are laid off as ordinate and abscissa. The second spectrum is the amplitude distribution in one of PM tubes. The amplitudes (A_2) plotted on the abscissa correspond to the strobe at the pulse maximum. The amplitudes (A_1) plotted on the ordinate correspond to the strobe 400ns earlier.

III. COMPRESS is a programme for packing data stored on a disc. Working files are reduced by a factor of 2, files with calibrations by a factor of 10.
CMPSAVE copies packed files from a disc to magnetic tapes of the CARTRIDGE type.
READ reads data from CARTRIDGE tapes and writes them on a disc.
EXPAND is a program for unpacking data on a disc.

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Авдеев С.П. и др.

E13-92-60

Электронное оборудование
и программное обеспечение установки "ФАЗА"

Описана электронная аппаратура и программное обеспечение установки "ФАЗА", предназначенной для изучения процесса мультифрагментации ядер. Установка состоит из 5 времяпролетных телескопов, позиционно-чувствительной лавинной камеры и 58 ФЭУ. Временное разрешение времяпролетных телескопов составляет 0,5 нс, что приводит к разрешению по скоростям 1,5%. Пространственное разрешение большого лавинного счетчика составляет 4 мм, что приводит к разрешению по углу 1°. Аналоговые сигналы с каждого ФЭУ поступают на два АЦП, на которые подаются стробы со сдвижкой 400 нс, что позволяет разделять на двухмерном плоте коды, соответствующие черенковскому излучению и высвечиванию CsJ(Tl).

Работа выполнена в Лаборатории ядерных проблем ОИЯИ.

Препринт Объединенного института ядерных исследований. Дубна 1992

Avdeyev S.P. et al.

E13-92-60

Electronic Equipment
and Software for Device "FAZA"

Electronic equipment and software for the device "FAZA" are described. The device, designed for studying the nuclear multifragmentation process, consists of 5 time-of-flight telescopes, a position-sensitive avalanche chamber and 58 PM tubes. The time resolution of the time-of-flight telescopes is 0.5 ns, which allows a velocity resolution of 1.5%. The spatial resolution of the large avaianche counter is 4 mm, which allows angular resolution of 1°. Analogue signals from each PM tube come to two ADCs, to which strobes are supplied with a 400 ns shift. It allows codes corresponding to Cherenkov radiation and deexcitation of CsJ(Tl) to be distinguished in a two-dimensional plot.

The investigation has been performed at the Laboratory of Nuclear Problems, JINR.

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