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A COMPACT FAST DATA ACQUISITION AND DATA ANALYSIS SYSTEM FOR TIME OF FLIGHT MASS SPECTROMETRY. TIME AND S.I. INTENSITY MEASUREMENTS WITH A NEW MULTISTOP TDC.

S. Della-Negra and Y. Le Beyec,

Institut de Physique Nucléaire, B.P. N°1, 91406 Orsay, France.

In the recent years very fast data acquisition system have been built for multiparameter experiments in Nuclear Physics. Fast electronic and detectors for precise time measurements have also been developed in the laboratories. These types of equipment were used at the Institut for particle induced desorption studies using MeV heavy ion beams from accelerators [1,3], as well as for coincidence experiments in time of flight mass spectrometry using a ^{252}Cf source [4]. Recently, a data acquisition system has been develcped at the Institut for time of flight mass spectrometry and correlated measurements. The system is based on a PC AT computer in which an additional DMI memory card (128 K channels) has been added to store the data transferred from a fast microprocessor (MIPRE) built in the CAMAC standard. Several time digital converters (18 bits) - TDC -, analog digital converters (13 bits) - ADC -, charge digital converters (6 or 8 bits) - CDC -, can be read by the microprocessor through a CAMAC interface. The "MIPRE" is preprogrammed in such a way that time windows can be defined on the TDC's in order to correlate many time of flight spectra. A selection of the number of stops can also be preselected. Windows can also be defined on the ADC's. Each window set on one direct spectrum gives one coincidence spectrum issued from one TDC or ADC. These data acquisition conditions are entered in the MIPRE through the PC computer.

The PC is also used to display the various single or coincidence spectra on a video colour screen. A dynamic display of four spectra simultaneously (at maximum) can be seen on the screen during data acquisition. With MeV particles and keV particles as well (pulse ion gun) the data acquisition is made event by event.

A specific analysis program of time of flight mass spectra (writen by Mr Perrot - P2A for PC) is used for automatic peak findings, mass calibration, peak area...

This data acquisition system is fast and well adapted to time of flight experiments. It includes one CAMAC power supply, 2 TDC's, 2 CDC's and ADC's, a power full preprogrammed microprocessor and a modified PC AT with the software for data analysis. Fig. 1 shows a schematic diagram of the system. Data can be transferred in the list mode from the MIPRE to a 6250 BPI tape in order to be able to make sophisticated subsequent analysis, event by event, if necessary. There is also a possibility to connect the PC to a VAX computer through an Eternet link.

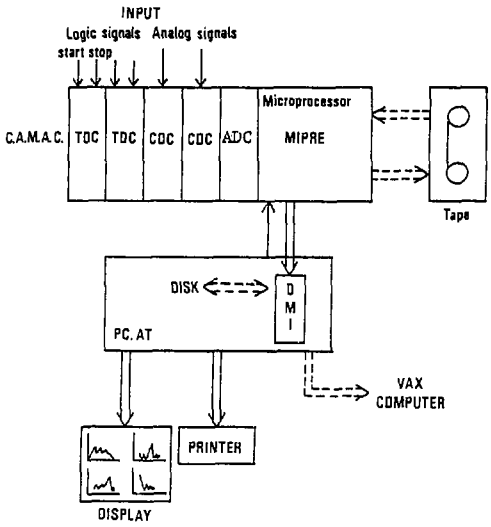

Fig. 1:Diagram of the data acquisition system.

For 10^4 start pulse/second, a time range of 100 µsec externally set on the TDC (this time range depends on the maximum time of flight) and 100 stop events per start event about 5.10^5 counts per second can be analysed and stored in memory.

In the coincidence mode, 1000 start events with 10 stop events (per second) on one TDC allow to record 10 spectra (2 single TDC spectra, 2 multistop distribution spectra and 6 correlated spectra corresponding to coincidence windows).

A new time digital converter for secondary ion time of flight mass spectrometry has been developed and tested at the Institut. This TDC is used in the present data acquisition system. It combines the advantages of measuring the exact time event by event and the number of secondary ions desorbed by the primary process (fission fragment, pulsed keV ion gun or even laser shot). The pulse height response of microchannel plates (MCP)

is proportional to the number of ions hitting simultaneously the detector. This has been verified with secondary electrons emitted from a surface bombarded by keV ions and bent by a magnetic field either to a silicon detector or to a MCP detector. A linear response has been measured for both detectors [5]. Fig. 2 shows distributions of pulse height responses from a MCP detector bombarded by different numbers of incident cesium ions arriving at the same instant on the detector. A pulsed Cs ion gun was used to induce desorption of Cs^+ from a CsI target. An increasing number of primary ions per pulse was used to generate an increasing number of Cs^+ secondary ions. With a normal multistop TDC [6] only the time is measured between the start pulse and the stop pulses whatever the number of secondary ions hitting the detector.

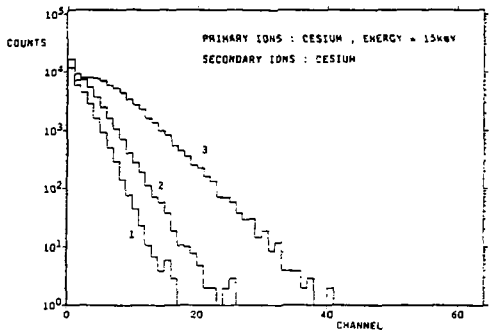

Fig. 2:Pulse height distributions of the stop detectors under secondary Cs^+ ion impacts. Three different values of the primary ion beam intensities have been used: 1 (10 Primary Ions per pulse), (20 P.I./pulse), 3 (40 P.I./pulse).

This means that only one count is added in the "histogram memory" at the corresponding time. In the new version of the apparatus a number proportional to the area of the distributions is added in the memory at the corresponding time. The digital (see Fig. 2) conversion is made within the dead time of the TDC (around 20 nsec) and 6 bits are used for the conversion (possibility of 8 bits if necessary).

Two spectra are shown in Fig. 3A-B. Fig. 3A shows the spectrum measured with the normal multistop TDC [6]. Fig. 3B shows the spectrum obtained during the same recording time with the new TDC. It is seen that intensities of H^+ and Cs^+ ions are enhanced because of multi ion impacts. The Cs^+ peak as increased by 2.5. This electronic module will be extremely useful in the

future not only to improve the analytical measurements but also for desorption mechanism studies.

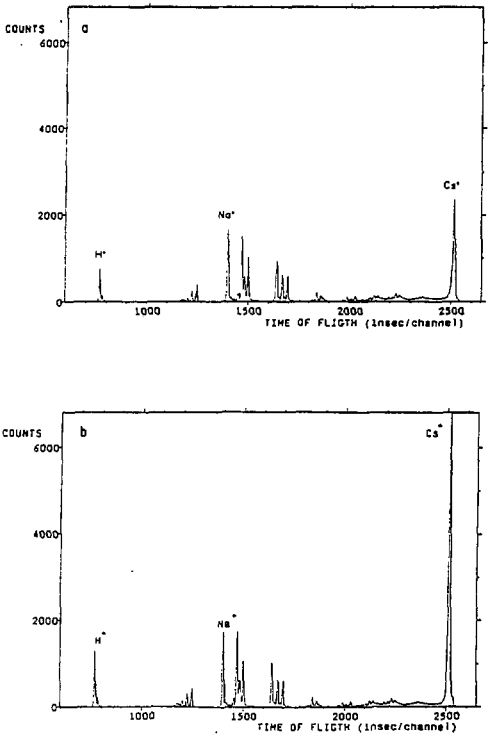

Figure 3
Secondary ion spectra showing the response of the new TDC (same time of measurement)
A. normal multistop TDC
B. new TDC.

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References

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