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ABSTRACT

The data systems on the three mass spectrometers at LLL are computer-controlled, pulse-counting systems synchronized to a repeated y-swept magnetic field. The data are accumulated in the memory of the computer or in a Nuclear Data ND 180 in a multi-scaler mode of operation. This mode of sweeping allows a continuous check of the background stability and makes tune-up easier. But the main benefit is a reduction in the required ion emission rate stability. By the use of standards to set the system dead time, we have been able to utilize the sensitivity of a pulse counting system without the expense of exotic equipment.

Hardware

The electron multiplier is an 18-stage EMI 9642/2B beryllium-copper venetian blind type. The socket is a specially made ceramic unit that forms the vacuum seal and electrical interface. Every stage is bypassed directly to ground. The first dynode is run at -3.5 to -6.0 kV (depending on the age of the multiplier). The last dynode, at ground potential, is dc coupled to the preamp.

The preamplifier is an in-house design using a Fairchild 733 wide-band video amplifier. It is connected as a gain of 100 and performs the discrimination function also. The bandwidth of the preamp is dc to 75 MHz. The data scaler was designed and built at LLL. It is a 100 MHz T^2L binary counter with switch selectable serial or parallel output. The serial output is used when the counter is connected to a Nuclear Data ND 180 and the parallel output is interfaced directly to the PDP8.

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The computer system CPU is a Digital Equipment Corporation PDP8 with 16K of core. Bulk storage for the system is two Diablo disk drives, one fixed platter and one removable platter. Peripherals on the system are a 2400 baud Telray 3300 CRT terminal, a 100 character-per-second Centronics 306 printer, a 14 inch H-P 1300A display scope, a DEC high-speed paper-tape reader-punch, and an inhouse fabricated joystick for operator data interaction.

Software

The software for the system is a group of FORTRAN II programs divided into sets that are chained together. The sets are all similar but perform different actions or calculations as may be required by different samples.

The first program in each set establishes the initial parameters such as log number, sample identification, mass range, and system dead time. It also opens the variable file.

The second program does the data acquisition, either by reading the ND 180 memory or reading the data counter. When the data counter is being used, the program provides a linear or log display of the data as it accumulates. The program then writes the data into a temporary data file on the disk.

The third program allows the operator to correct any dropped channels or noise spikes that may have occurred. It then does data smoothing by an algorithm called a moving average. It then goes through the data a peak at a time, finding peaks and backgrounds. The computer's choice is displayed using cursors to mark the selected points. The operator may correct these choices and the program then calculates the peak heights and isotope ratios. These ratios and their errors are then printed. If the operator wishes to take more data, the chain goes back to the second program; if he is through, the chain goes on to the fourth program.

The fourth program calculates and prints the final ratios and errors from all the data accumulated. Then, depending on the experimental requirements, any further calculations are performed.

The last program in the set gathers all the temporary data files into one permanent data file for long term storage and deletes all the temporary files.

There is another program that retrieves the permanent data files and

creates new temporary data files, allowing the data to be reprocessed if needed.

Results

We feel that the on-line computer and pulse counting system has allowed us to increase our precision and dynamic range. We are now reporting the following results:

For routine samples in the 50 pico gram to 300 nano gram range, a precision of ± .5% on minor isotopes. By special requist (and handling) we have been able to report ± 10% precision on 10^8 atoms of sample, ± .2% precision on 1500-to-1 adjacent mass dynamic range, and ± 10% precision on 10^6-to-1 adjacent mass dynamic range.