Title
AN INEXPENSIVE COMPUTER DATA-ACQUISITION SYSTEM

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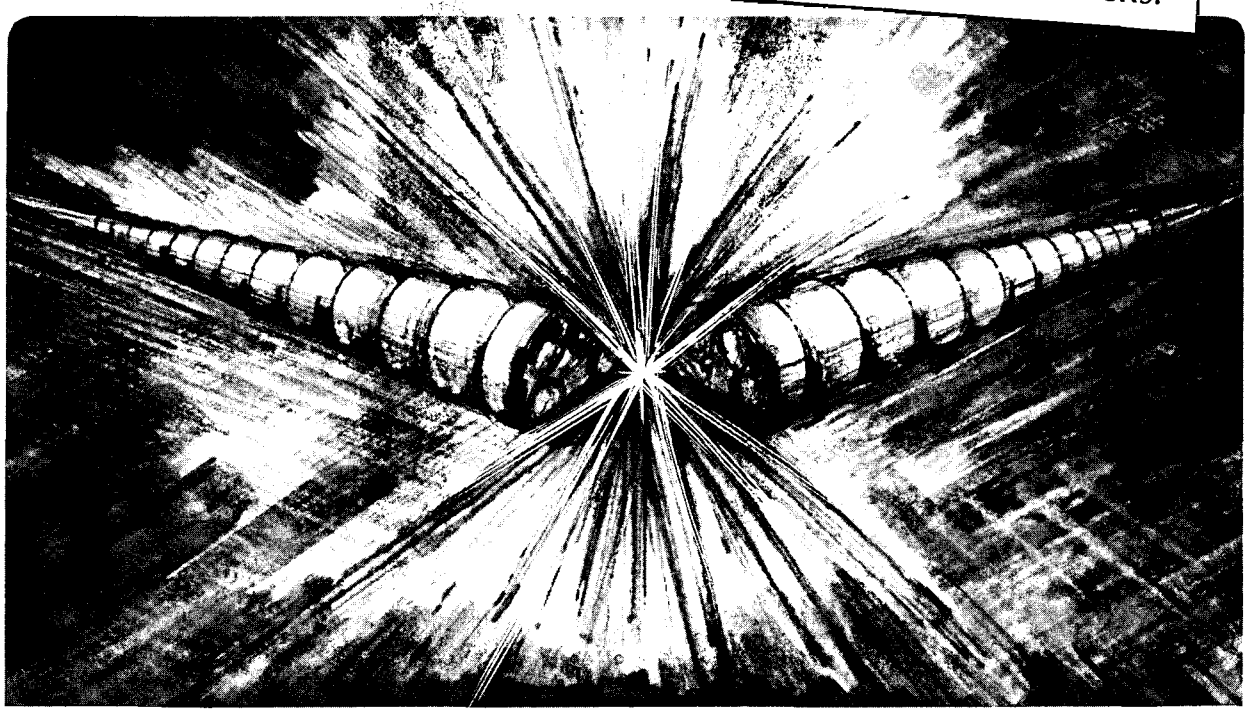
December 1984



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DISCLAIMER

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An Inexpensive Computer Data-Acquisition System*

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ABSTRACT:

We describe a simple computerized system that we've developed for on-line data acquisition, analysis and presentation. Our particular application is on-line monitoring of ion beam characteristics (beam current, angular divergence, emittance, current within a given radius, etc), necessary for the accelerator ion source development program at LBL.

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We've constructed a small, simple, and inexpensive laboratory data acquisition system using an Apple II+ personal computer and some commercially available plug-in expansion cards (slightly modified by us). We had need for the on-line analysis of data obtained from an ion beam profile monitor[1] together with visual presentation of the beam profile, a fitted smooth curve, and a full complement of derived beam parameters - current, emittance, current into a specified acceptance, etc. The facility we've constructed has allowed us to rapidly survey the effect of a large number of ion source parameters on the quality of the extracted ion beam, and thereby to optimise the source.

The complete system consists of an Apple II+ computer with a single disk drive and monitor, two interface cards located within the computer, the ion beam profile monitoring hardware, and software to operate the system.

Interfacing between the beam profile monitor and the computer is provided by two plug-in cards - an Applied Engineering Super I/O board, and an Applied Engineering 8-bit, 8-channel A/D board[2]. The I/O board inputs and outputs 8-bit logic signals. The A/D board, as purchased, inputs 8 analog signals and converts them to 8-bit data, but because the sequencing of the 8 input channels is not under software control we replaced the original AD7581 8-channel chip with an AD7574 single-channel chip. Both boards appear as memory to software.

The ion beam profile monitor is fully described elsewhere[1]. It consists of a linear array of 16 Faraday cups followed by 16 integrators and a 16:1 analog multiplexer. Four of the I/O outputs control the multiplexer, one triggers the A/D, and one input accepts an external 'start' signal.

Software waits for a 'start' signal, sequences the multiplexer, reads the 16 voltages, subtracts a previous baseline reading, and presents a profile plot to the monitor. A smooth Gaussian curve is fitted to the data and plotted over the discrete data points. From the known geometry, A/D calibrations, and Gaussian constants, the computer then calculates and displays derived data such as total beam current, emittance (an approximate calculation), beam angular divergence, source perveance, etc. The program is written in BASIC with a small assembly language driver for the interface.

A block diagram of the entire configuration is shown in Figure 1, and typical output, as recorded by polaroid photographs of the computer monitor screen, in Figure 2. The system can be adapted to a wide variety of other laboratory applications.

References

1. J.E. Galvin and I.G. Brown, Rev. Sci. Instrum. 55, 1866 (1984).

2. Applied Engineering, P.O. Box 470301, Dallas TX 75247

Figure Captions

Fig 1. Schematic of the data acquisition configuration.

Fig 2. (a) Computer monitor display of the data points read by the profile monitor and the best fit Gaussian curve.

Fig 2. (b) Computer monitor display of the parameters and derived beam data for a shot such as Fig 2(a).

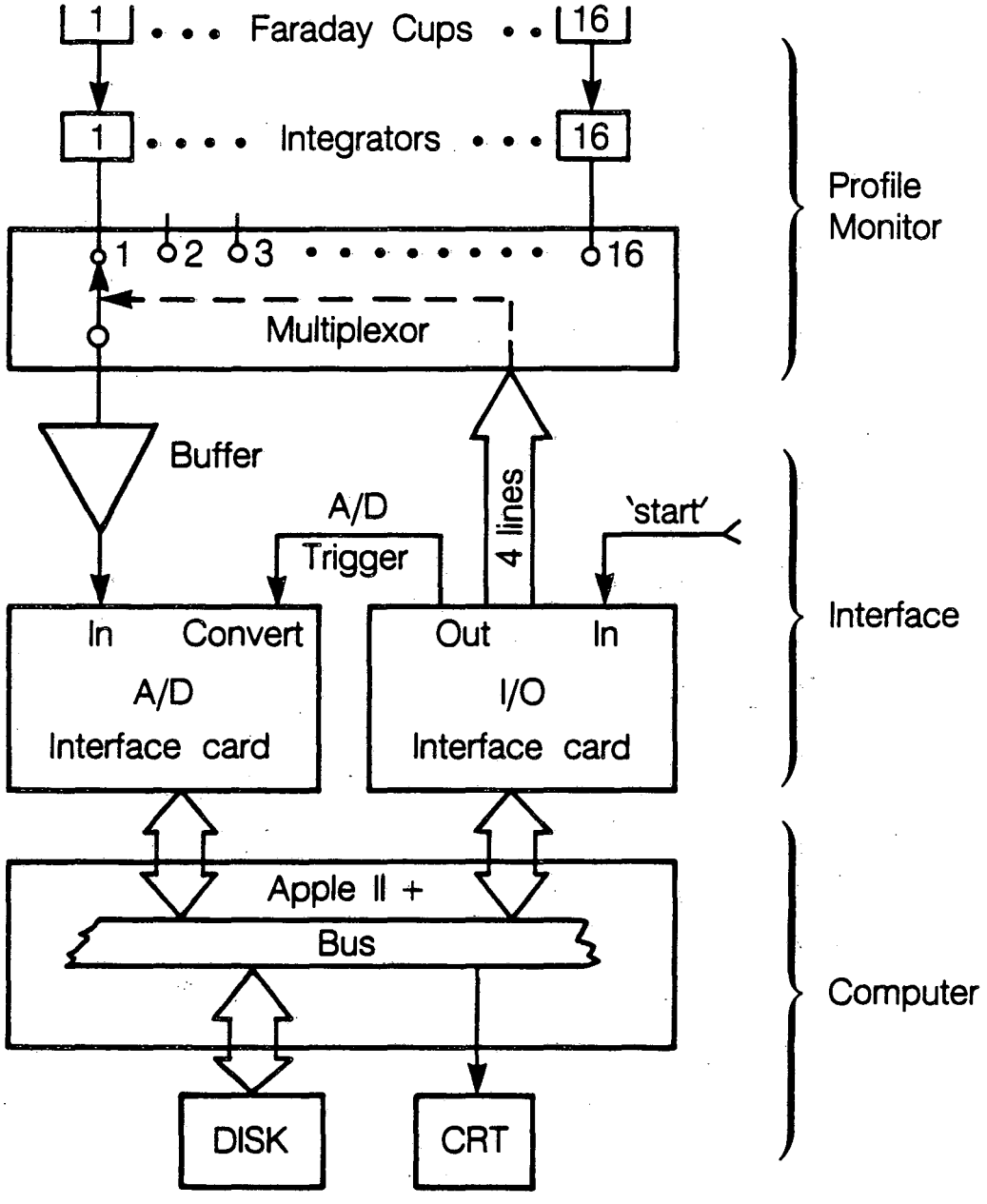
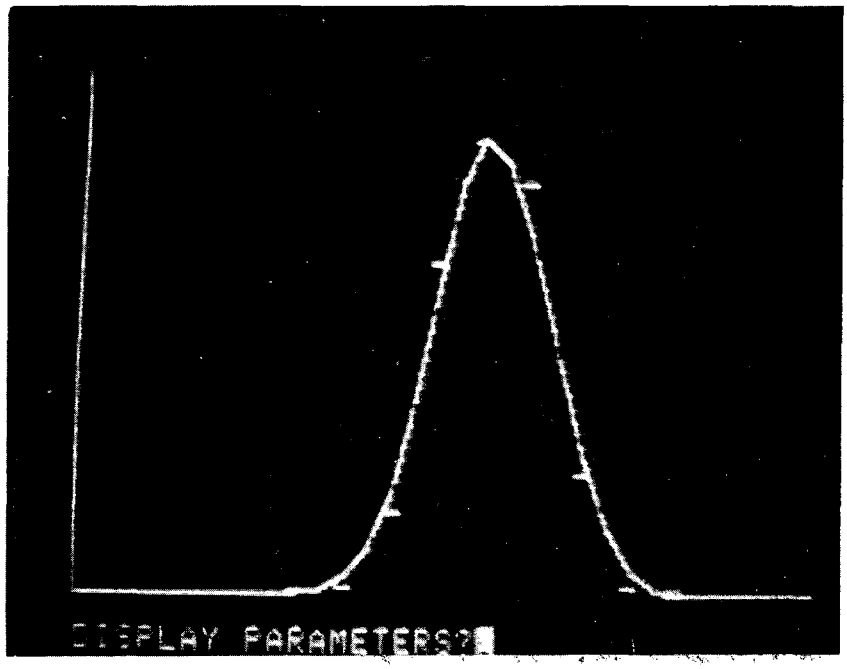

1
Faraday Cups
16
1
Integrators
16
Profile Monitor
1 2 3 16
Multiplexor
Buffer
A/D
Trigger
4 lines
'start'
In Convert
A/D
Interface card
Out In
I/O
Interface card
Interface
Apple II +
Bus
Computer
DISK
CRT
XBL 8412-5973

Fig. 1

(a)



(b)

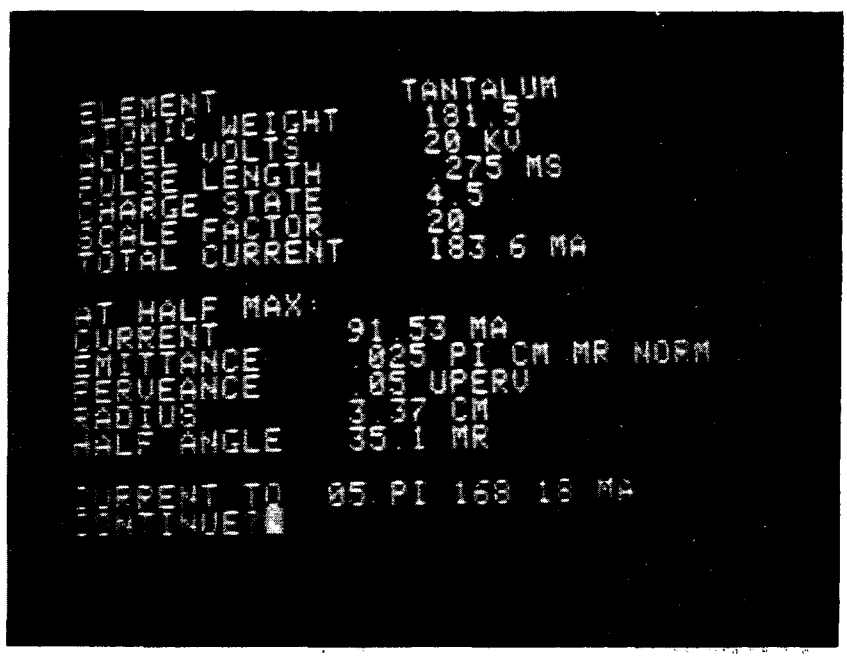


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Fig. 2

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