The Control System of HIRFL

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1. Introduction

The Heavy Ion Research Facility in Lanzhou (HIRFL) is a multi-purpose and variable energy machine designed to accelerate wide range of ions.⁽¹⁾ In order to obtain а designed beam (particale and energy) and to transport it to a proper experimental areas in a short time, it requires to modify a great number of parameters, this cannot be easily achieved without the help of a computer.

The control system design and construction was started in 1983. First of all, some local control station of accelerator subsystems were finished in 1988 and satisfied the needs of operating and commissioning at the elementary level. Controlling the HIRFL process is implementing at a high level.

2. The brief description of control system

Fig.1 shows the general layout of the control system for HIRFL.⁽²⁾ It is based on CAMAC distributed process configuration.⁽³⁾

(1) The local computer control stations are designed according to the accerlerator subsystems, such as Magnet, R.F, Vacuum, Injection and Extraction, Beam line etc. and were finished in 1988. They can meet the case of beam tuning and accelerator operating at elementary level.

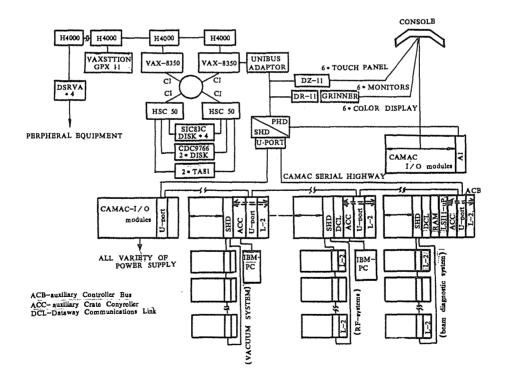


Fig.1 The block diagram of HIRFL control system

(2) All local stations microcomputer links to Host computer by CAMAC serial loop line. Two communication machanism are available:

(1) A memory "mailbox" CAMAC module accessible from both host and remote processors. (2) A CAMAC Dataway Communications module or "DMA port" between the remote processor memory and the Dataway.

2.1 Computer

HIRFL is controled by means of 2 kinds of processors: mini-computers as host computer and microcomputer as local stations. They are linked with CAMAC serial loop line.

The host computer is two VAX-8350 that are connected by cluster configuration. They share 4x520MB disks, 2x300MB movable disks and tapes. Each computer equipped with 12MB memory. One of them is used as a host computer for HIRFL control system. The other is used as a reserved computer when the former one is in fault. In addition, it is also used calculation and data processing for the experiments carried out in the experimental areas.

Microcomputers for the local stations are LSI-11/23 and IBM-PC. They are used to control subsystem for Vacuum, R.F, Beam diagnosis system and so on. These microcomputers are a completed system with memory, disk, terminal.

VAX-8350 control the SSC Cyclotron through the CAMAC bit serial loop. This loop was drived by serial highway driver. Serial rate is 2.5MB. There are about 20 CAMAC crates, corresponding CAMAC module are used for the interface of devices.

2.2 Device control

In order to bring into being link and matching between CAMAC modules and devices, 5V digitalized I/O-signals, 24V switch signals, and 5V analog voltage signals was planned. A variety of condition circuits, such as switch board, status board, DAC adjusting board with accuracy of 16bit-18bit and ADC data acquisition board with accuracy of 12-16bit, had been designed and made. They are used for on / off power supply, status monitor, current adjusting and data acquisition.

A step motor control is used for units requiring accurate position setting, such as electrostatic magnetic channels. The controller of deflectors, step motor is designed to provide with local control function. They are slow acceleration when movable units is started and slow deceleration when movable units is derived to the front of end. So movable units not only can keep running smoothly, but also can obtain higher operating speed.

In order to save funds, a number of digital and analogue multiplexer is used for devices of some slower action. Otherwise, the pressure operated control is mainly used for the units of two movable position such as Faraday cup, vaccum value, secondary emisson multi-wire profile monitor etc.

3. Console

Our console is designed after a careful analysis of which have been done in $GANAL^{(4)}$ and $RIKEN^{(5)}$.

The console, mechanically built with 10 benches is devided in 3 operating console units L, C, R. The central console unit C is devoted to equipments not linked to the computer, such as worksite monitor, RF waveform and beam signal obeservation. The console units L and R are identical.

Controlling the HIRFL process with the console system can be exercised at the elementary level or a higher level. At the elementary level the control system behaves as a large multiplexer. Equipments designed by their device name are handled one by one.

The operator uses the touch panel and the turn pages of the device name to choose one corresponding equipment he wants to control. Then, operator moves a cursor to a selected device name on TV screen with a defined touch key and reads the various informations such as the controlled value the actual value of the parameter and a status word on the TV screen area designed.

Among the numerous signals collected along the accelerator, most of them concerning parameters values or status are digitalized and enter the data flow transmitted by the CAMAC system for processing. A little analog form is remain which are to be used in their anolog form. This is the case of some beam diagnosis signals and R.F signals with time. These waveform siganl observation is necessary.

These signals can be displayed on autoranging picoammeters or on oscilloscopes.

4. The present situation

HIRFL The operating software called HIRFLCSF which is written in Fortran 77. Presently, center console programs are developping for the man-machine interface with Touch Panel. Progress Report, Vol.201, 170(1986)

With time HIRFL operating level on, goes will improve.

Refernce

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