COMPUTER CONTROL FOR THE BEAMLINES OF THE KARLSRUHE COMPACT CYCLOTRON

J. Bialy, H. Heinzmann, W.R. Kappel, B. Kögel, H. Schweickert,
G. Rudolph, T.J. Thouw
Kernforschungszentrum Karlsruhe GmbH, Inst. für Kernphysik III/Zyklotron
Postfach 3640, D-7500 Karlsruhe, FRG

Abstract - The computer control system for the Beam-lines of the CP42H$^-$ compact cyclotron in Karlsruhe is presented. The features of this comfortable and secure system are briefly discussed.

Introduction

The compact cyclotron CP42 H$^-$ in Karlsruhe is a high current H$^-$ variable energy (11-42 MeV) machine, used for isotope production and activation of machine parts.

Control system features

1. Switch to a backup computer system within minutes

2. Comfortable and easy operation via touchpanel

3. Detailed and comprehensive warning/guiding messages

4. Fast response to multiple operator action through separate touchpanel action and priority controlled tasks

5. Seven levels of sensitivity for the variable assignment potentiometer knobs

6. Many touchpanel controlled beam diagnostic elements

7. Extensive hard and software interlocks

8. Live update of all beamline parameters, in the form of blockdiagram and text on colour TV

9. Editor type "message system" for all groups

10. Flexible, table driver, multitasking software written in Fortran

11. Easy to change off-line tables, database entries and warning/guiding messages

12. Optimal usage of the computer capability

Hardware discription

The hardware configuration shown in figure 1 consists mainly of two identical control consoles, a parallel Camac branch, two serial branches together with two NOVA 4 computers with peripherals, part of which is used by both NOVA's.

One console is in the compact cyclotron building, whereas the second is in the control room of the "old" Karlsruhe cyclotron so that both cyclotrons can be operated from there. Switching from one console to the other at any time is done simply by turning a key switch at the console, causing a Camac interrupt and activating a "consol switch handling task". The consoles may alternatively be connected to either Nova 4 computer due to a special "keyboard switch module" and new Camac branch driver, which enables both computers to access the Camac branch at the same time. The long distance between the computers and the Camac crates near the beamlines (≈ 300 m) is bridged by Camac transmitter/receivers. The control console (figure 2) consists of 4 touchpanels, 4 variable assignment potentiometer knobs, a keyboard plus display, 2 black-whithe TV's, an alphanumeric and a graphic colour TV. The graphic TV is directly connected to the Nova 4 computer through a self made interface card.
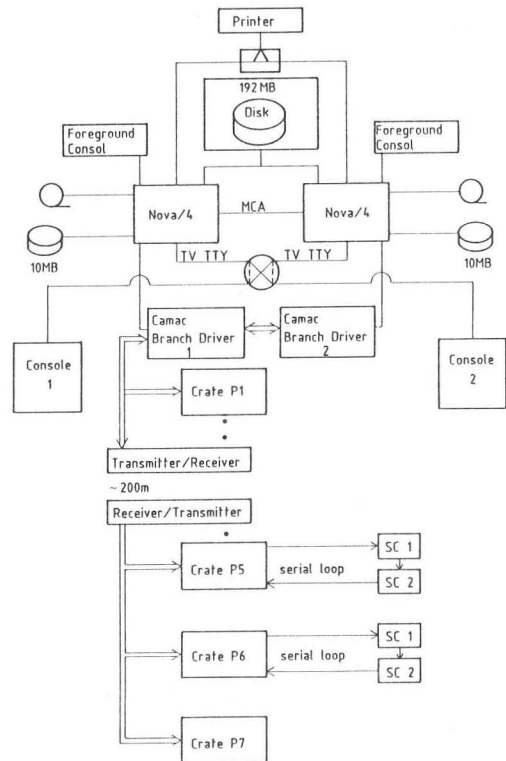

Fig. 1 Hardware configuration of the control system

Fig. 2 Control console

Control method

All actions are initiated by touching a touchpanel field or, in special cases, by entering defined commands at the Dasher keyboard. All touchpanel pictures are

built up as numbered "action pages" for each touchpanel, whereas each page zero consists of a directory page for that touchpanel. Additional buttons on top of the touch-panels are used to scan pages, or return to the direc-tory page. Besides this there are many direct inter-connections between related pages so that there is no need to go back to the directory page. The first touch-panel is used to choose blockdiagrams on TV and to multiplex beam current measurement on current displays, the second for all digital and beam diagnostic actions, while the third one is used to attach the magnet power supplies or vario TV control to the knobs. The fourth is used for group message and for the communication with the cyclotron computer (see figure 3).
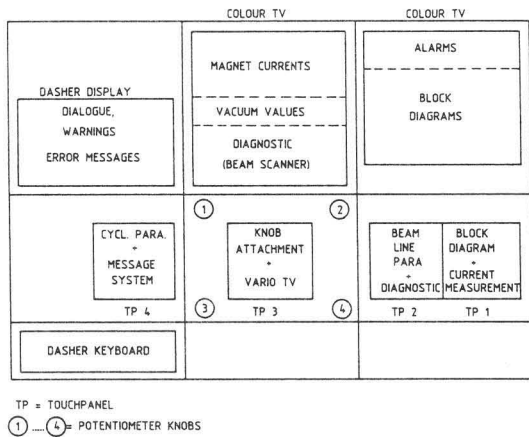
Fig. 3   Schematic view of the control console

Canging the sensitivity of the knobs (sensitivity fac-tors 1/8, 1/4, ... 4,8) is done on touchpanel number three. The status of the cyclotron and all beam line elements are displayed on colour TV in the form of block diagrams and text, utilizing the added informa-tion by using distinct colours and blinking for the possible different states. In case of a parameter mal-function, an additional character is displayed next to the parameter symbol (see figure 4 and 5).
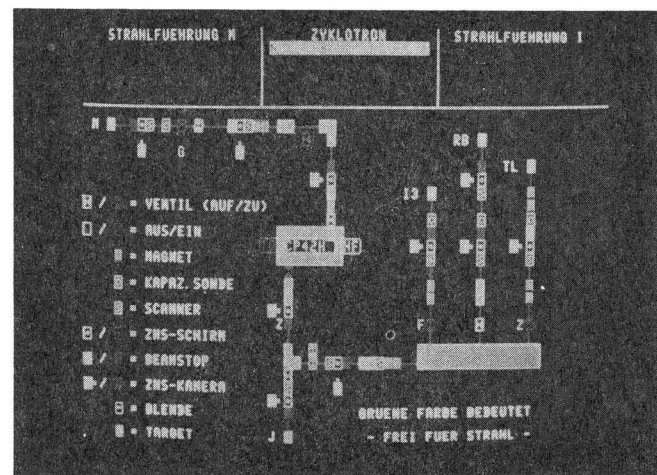
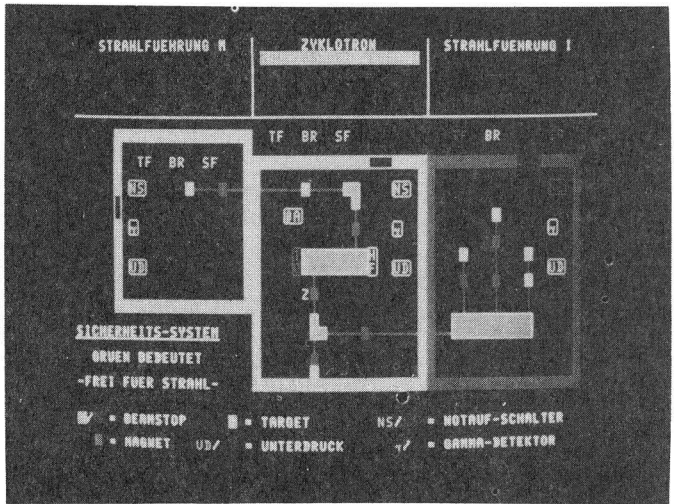Fig. 4   Block diagram of all beamline parameter

Fig. 5: Block diagram of the security system

Analogue values of beam line parameters such as magnet currents, vacuum and beamscanner results are displayed on the graphic colour TV (see figures 6 and 7).

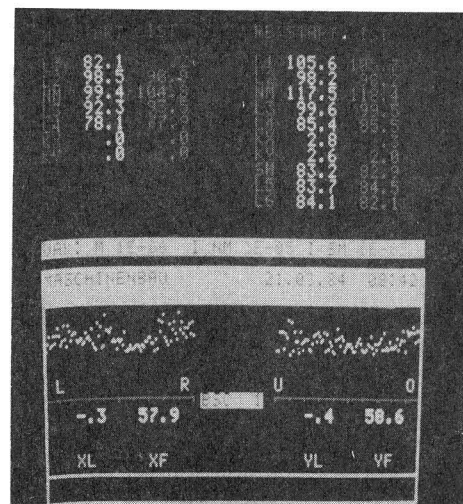Fig. 6   Part of the beam line, including diagnostic elements

Fig. 7   Display of magnet currents, vacuum and beam-scanner values

Displays are generally updated about every 7 seconds, but changing the status of a parameter by touching a touch panel action field or turning an attached knob produces an immediate update. When a parameter changes its status unintentionally, e.g. through malfunction, program restart after computer breakdown etc. or hardware/software interlock action, the touchpanel pictures are also updated so that the touchpanels always show the actual situation of the parameters. Software interlocks assures that the operator follows the correct procedure for tuning up the chosen beamline, e.g. only the proper magnets can be attached to the knobs and only the valid starting values for the magnets can be loaded from a disk file, or that only one ZnS screen can be in the beamline at a time etc.

Software discription

The control program (CP) written in assembler and Fortran, controls and supervises the environment. Basically the CP consists of two parts: the "consol management" running in the background and the "database management" in the foreground (see figure 8).
The consol management reacts to all operator actions on the keyboard, touchpanels, knobs and updates the touchpanel pages, whereas the database management handles the database and updates the colour TV's. All Camac interrupts are intercepted by the console management and if necessary it contacts the database management, which is responsible for the actual action such as checking and changing the parameter/process condition.

Both grounds run on equal priorities and communicate with each other through the Nova computer "MCA" in the background ——> foreground direction and using fore-background dialogue calls (plus setting a Camac Dataway interrupt, which causes the background to get the information) in the other direction. The multitasking concept is used for both grounds, with task priorities depending on the response time wanted for the particular task.
Some tasks are job specific, whereas others are table driven. The arrays for the touchpanel pictures, TV pictures, tables and database are loaded in the so called "extended" memories in both grounds. The access of tasks to these data areas is achieved with the computer map facility. "Wait loops" and flags prevent multiple task access at one time. This program structure ensures program flexibility for further program development or expansion.

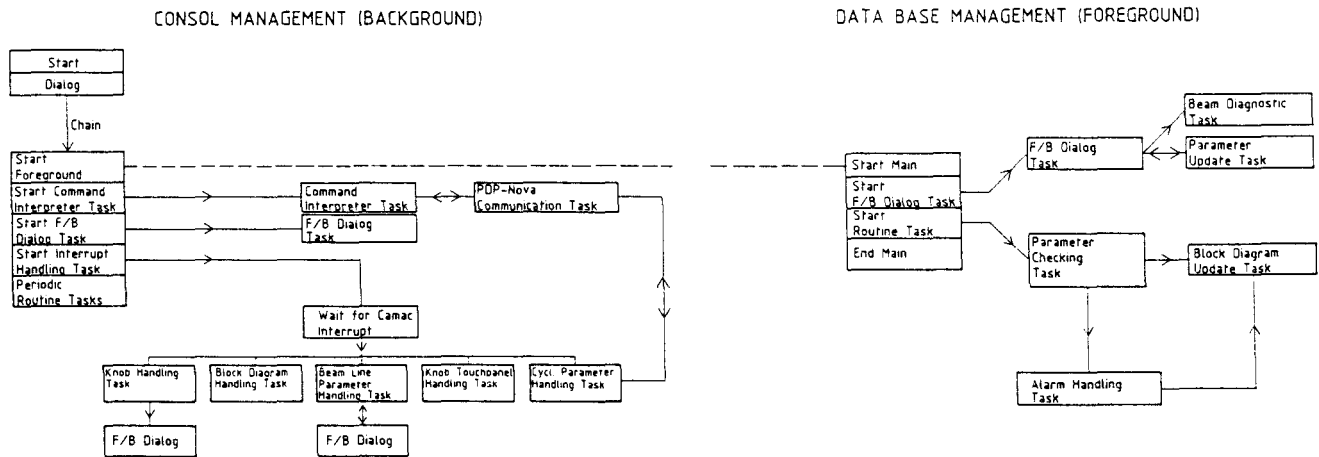CONSOL MANAGEMENT (BACKGROUND)   DATA BASE MANAGEMENT (FOREGROUND)

Fig. 8: Simplified blockdiagram of the control program