

AUTOMATIC CONTROL OF THE JÜLICH BEAM HANDLING SYSTEM

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Summary

In a first step to automate the beam handling control at the Jülich Isochronous Cyclotron electronical equipment in integrated-circuit-TTL technique has been designed and tested. The system allows to automatically activate all beam handling components according to a preselected beam path. In a second step of automation a link to a PDP-15 computer will be provided.

Introduction

The automation of the Jülich beam handling control will be carried out in three steps. The first step includes the automation of the main functions as activation and survey of the vacuum and magnet components and those for personnel and operational safety. This takes a main burden away from the operator and gives him time for magnet current setting and beam optimization. Beam viewing components and a graphic display board are used as a visual aid. After an appropriate time of experience the second step is the automatic setting and survey of all analogue functions in the system as for instance magnet currents and slit widths. The development of non-intersecting quick beam profile monitors comes prior to the third step, which is the automatic beam optimization. This should be done only if there is a real benefit in tune up time. This paper deals with the first step and gives an out-line of the further development.

System description

The Jülich beam handling system includes a double monochromator. The beam will be distributed by three switching magnets to 10 target stations located in six shielded areas. For ease of maintenance and to facilitate the development of the control logic the system components are combined in local sections. Each section comprises separate power terminals, closed water cooling loops, magnet components and vacuum pumping stations.

The block diagram of the system is shown in fig. 1. According to the preselected beam path the subsystems (closed-circuit-water cooling, vacuum path, beam plugs and peripheral beam stops and personnel safety) are activated and surveyed each via a separate control logic. The activation is performed directly or by switches at the main console in case of slow subsystems. The external interlocks of each subsystem logic are used to form two main interlocks for operational and personnel safety, respectively. The first interlock acts on the first beam stop follo-

wing the cyclotron exit, the second on the RF of the cyclotron.

The system can be operated in three modes. The first is the above described "automatic" mode. In this mode all components which are not used for the selected beam path can be manually operated for setting up and testing new experiments in non irradiated target areas. The second mode is called "automatic and manual"; it is used for the quick shut down of malfunctioning components the elimination of which can be tolerated for the selected beam path. The third mode is purely manual and suited for maintenance and repair work.

The status of all beam handling components is indicated on the main display board. Push buttons on this board are used for manual control in the three modes as well as for the manual control of all beam viewing components. A fully activated beam path is then indicated as a green illuminated non interrupted path to one target station as shown in fig. 2.

All automatic control electronics are designed in integrated-circuit-TTL technique and have been manufactured and tested in our electronics shop.

All signals are gathered or distributed at subterminals in the local sections of the beam handling system. The signal transport from and to the main terminal is achieved by multiwire cables in case of the vacuum system and the personnel safety interlock system and by CARRYPLEX for all other subsystems. CARRYPLEX is a frequency multiplex system with 400 channels each operating on a fixed frequency in the range of 200 to 300 kHz¹. All terminals allow quick access to all control units in case of failure.

Further development

The system has successfully undergone simulation tests and will be installed during the set up of the beam handling and target facilities scheduled in the next months. The formulation of the task of a PDP-15 computer used in the second step of automation of the Jülich beam handling control is under preparation. The computer has to perform the activation sequence of the different subsystems and shall set and read analogues. It will use the measurements of an emittance measuring device² and the readings of the magnet currents for beam envelope calculation. This system will be similar to that reported by Marcowitz et al.³

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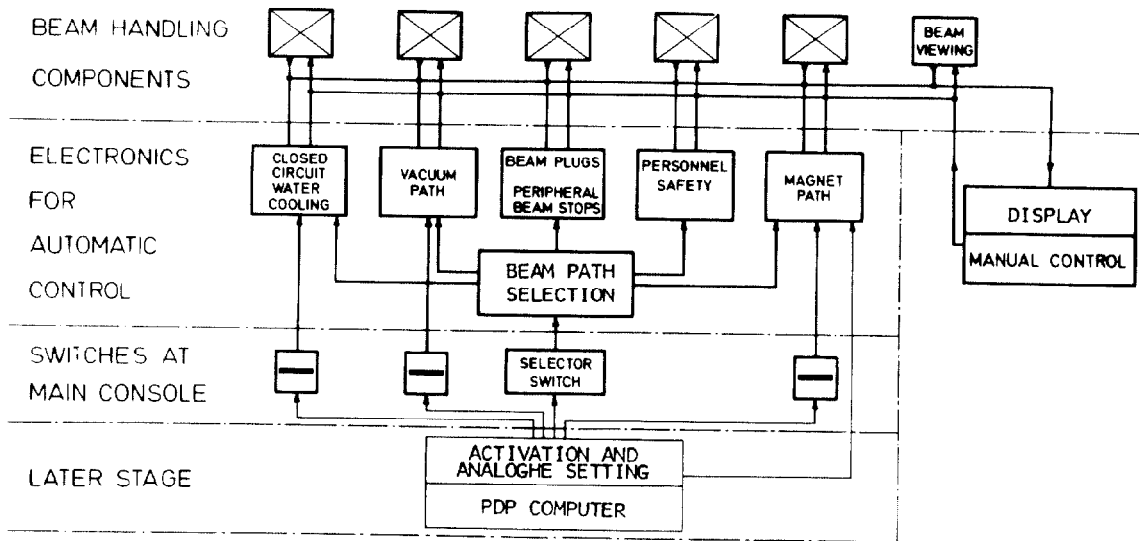


Figure 1. Block diagram of the Jülich beam handling control

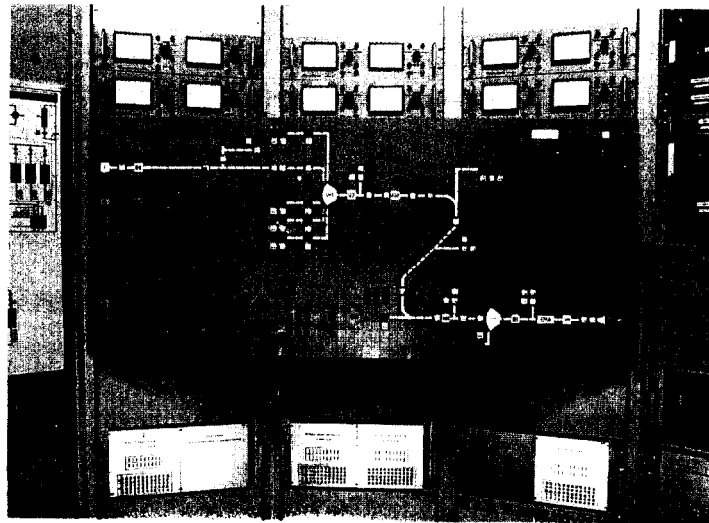


Figure 2. Display board showing a fully activated beam path