FARADAY CUP SELECTOR FOR DC-280 CYCLOTRON

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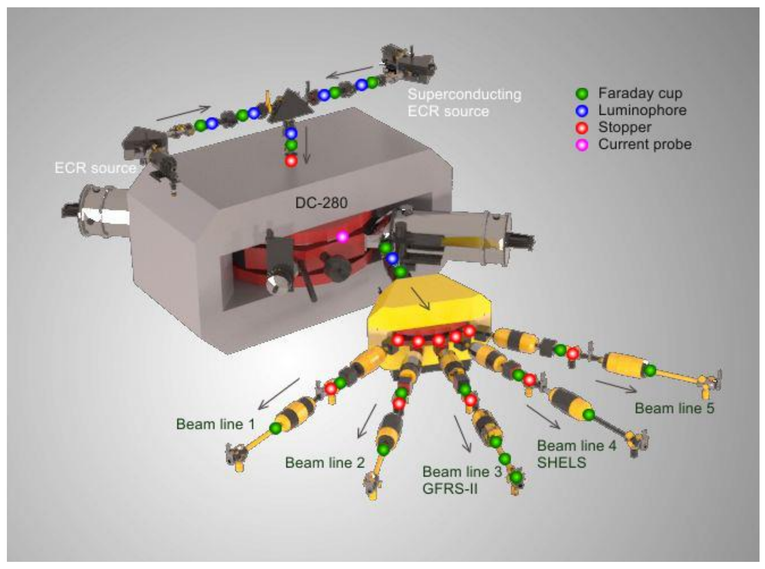
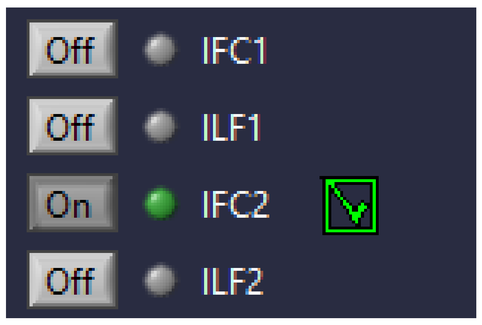
DC-280 is the basic facility of the Super Heavy Element Factory

Abstract

New isochronous cyclotron DC-280, the basic facility of Super Heavy Element (SHE) factory was put into operation in the FLNR JINR on March 25, 2019. Key role in beam diagnostics for lossless transportation is played by Faraday cups. Five elements were installed along the two injection lines and 14 elements on the five transport channels to the experimental facilities. The software was developed to automatically select the active Faraday cup depending on its location and track the current on a single indicator. This paper describes basic principles and algorithm of the Faraday cup Selector module which is a part of the DC-280 cyclotron control system.

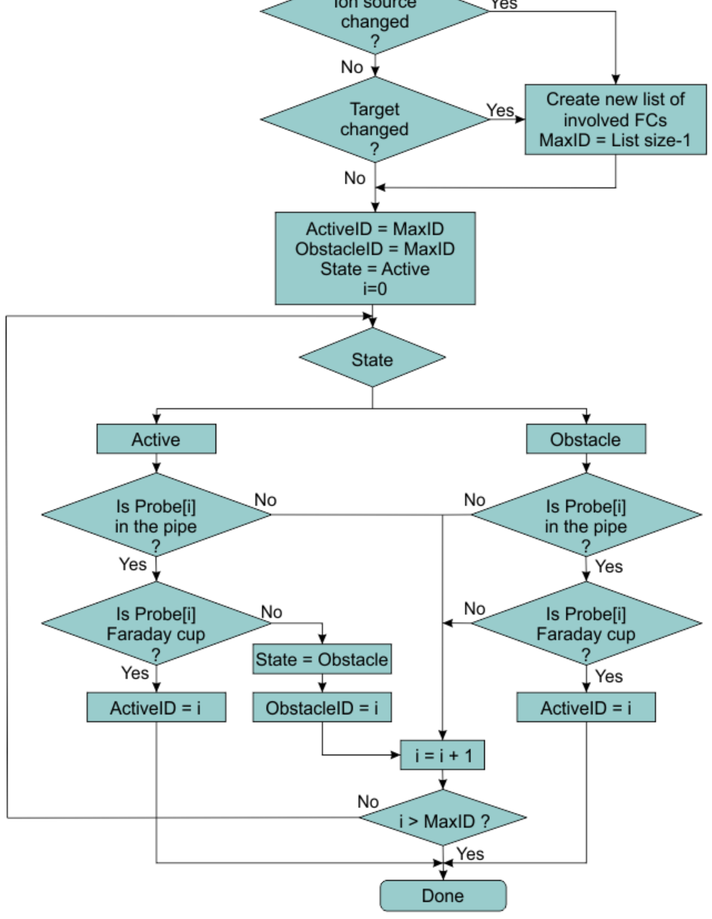


Layout of the DC-280

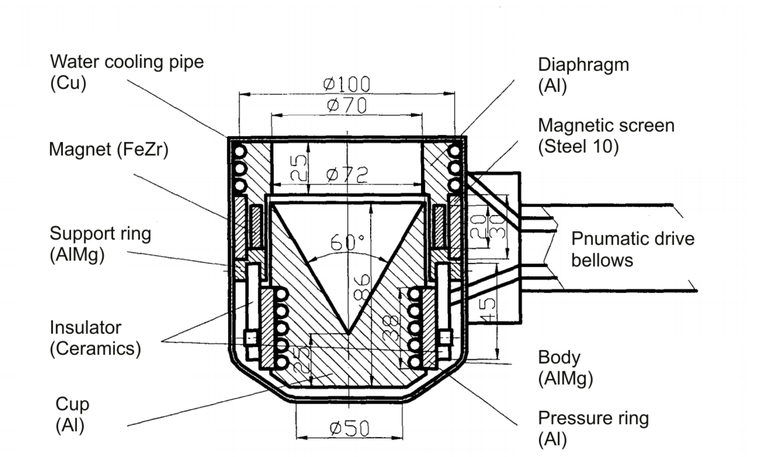


Marks of the active FC and obstacle, if any

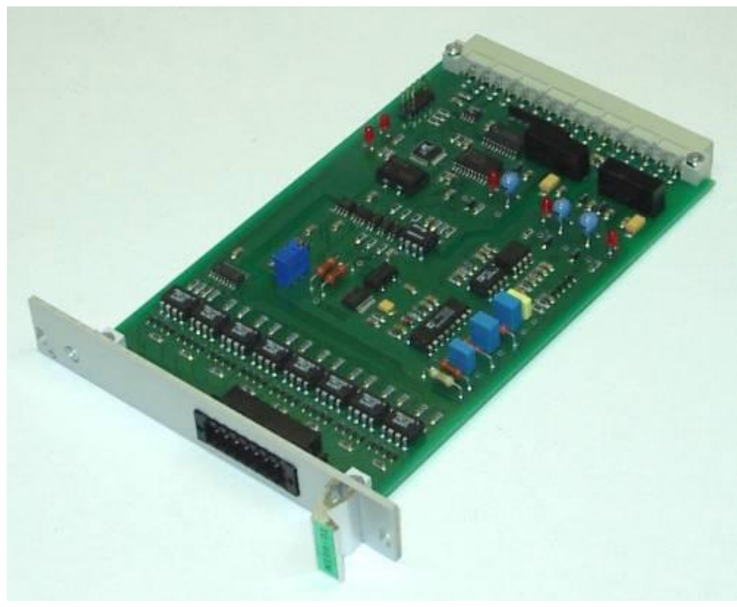
The main purpose of beam transport is lossless and high-quality delivery of accelerated particles to a target in a physical setup. By affecting the particles by the magnetic field of the correction magnetic elements (coils, solenoids, lenses, etc.), the operator focuses and holds the beam in the pipe. The result is measured by means of a variety of devices: current probes, Faraday cups, stoppers, luminophores and so on. Most of these elements are opaque for the beam and interrupt it on the way. Therefore, the only beam current measured on a device that was inserted **first along the beam** is significant. Eight multichannel meters are used to measure current from 21 diagnostic devices. During beam transportation operator has to switch his attention among multiple displays of current meters. For the convenience of the operator it was decided to create a program that automatically determines the actual diagnostic device and toggles its measurement to one common monitor.



Algorithm for calculating the active FC and obstacle

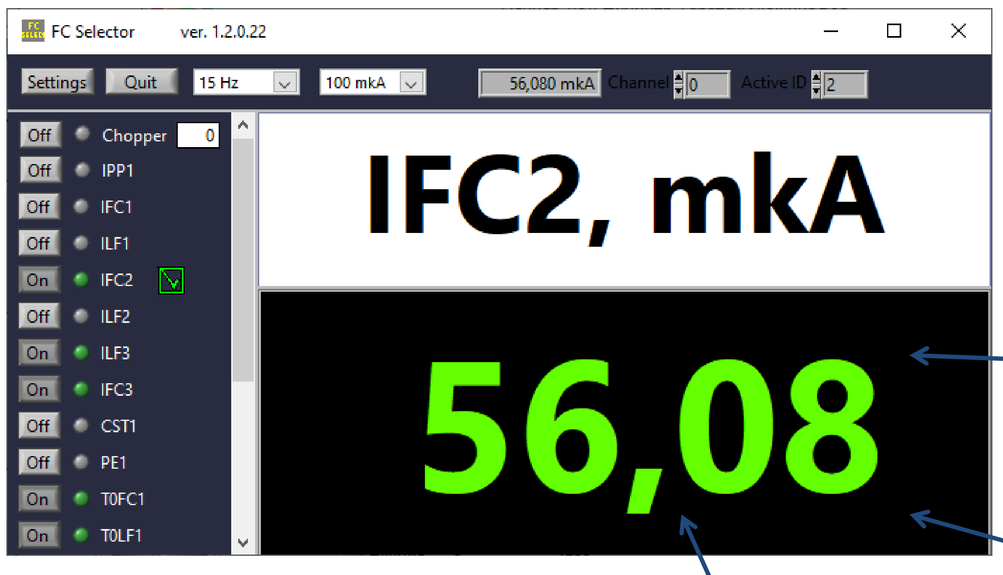


The conical design of the FC distributes heat better and prevents overheat at the beam spot



SMARTBOX-6 module unit MI08-01 for current measurement

To measure the beam current, a specially developed module MI08-01 is used. It was designed and manufactured in FLNR JINR and meets SMARTBOX-6 system specifications. The module has 8 input channels for connecting analog signals multiplexed to one measuring channel. Measuring ranges are: ±1 mA, ±100 µA, ±10 µA and ±1 µA. Type of ADC is sigma-delta with a resolution of 16 bits. The measurement time is 133 ms.



The control system software of DC-280 is based on NI LabVIEW platform with the Datalogging and Supervisory Control module. The control system is distributed over a network. We decided to consider 3 projects (subsystems) for control system software: Injection (ECR source, axial injector), Accelerator (cyclotron, extraction, transport, water cooling) and Low level RF. Its essence is described by means of shared variables which are deployed on the dedicated hosts. The software of the control system consists of a number of program modules that perform corresponding tasks: device drivers, alarms monitor, beam diagnostics, user interfacing, etc. The FC selector is a standalone application and operates with diagnostic devices and current meters, gaining access to shared variables. The DC-280 cyclotron has been functioning successfully for six months. Operating experience requires us to develop programs such as a FC selector. This simple utility gives operator great convenience when using a variety of measuring instruments to monitor the beam.

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