STATUS OF THE RIKEN SSC PROJECT

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Abstract

Construction of the RIKEN Separated Sector Cyclotron is well under way according to schedule. Two sector magnets were completed at the factory in June and field distributions were measured. Design of the remaining parts of the cyclotron is now in progress.

Introduction

The RIKEN Separated Sector Cyclotron (SSC) Project started in 1980. It is aimed at the construction of a k=540 SSC as a post accelerator of the variable-frequency heavy-ion linac (RILAC) for the purpose to extend research activities on nuclear science at the Institute of Physical and Chemical Research (RIKEN)[1].

The sector magnets including trim coils and power supplies were ordered to Sumitomo Heavy Industries Ltd. in 1981 and construction of them is now under way. Design studies of RF system, vacuum chambers and vacuum pumps, injection and extraction system, beam transport lines between the injectors and the SSC and the controle and beam diagnostic system are in progress.

Basic design of the building for the SSC was finished. Problems concerning the radiation safety were discussed at the ad hoc committee.

Sector Magnets

Two sector magnets were completed successively in March and in June of this year and excitation characteristics as well as the field distributions were measured at the factory by installing them at right angles to each other and exciting them independently or at the same time. Very good agreement was obtained between results of the measurements and calculations by TRIM code on the excitation characteristics[2]. The magnetic field of 1.55 T, which is the maximum base field required for operation at the highest magnetic rigidity, was achieved with a magnetomotive force of 1.28×10^5 AT.

Distributions of base field in the valley and hill regions were measured at the field strength of 0.7, 1.1, 1.5 and 1.57 T . Effective field boundaries and effective sector angles were determined from the measured field distributions as a function of radial coordinates, R . Variation of the effective sector angles with R is small except for the region of small R [2].

Field distributions produced by trim coils were also measured along the hill center line. Method of the optimization of the trim coil currents are developed[3]. Orbit calculations were made by taking into account the actual field distributions.

RF System

Conceptual design of the RF system has been performed. Two types of resonator cavities were investigated from electrical and mechanical points of view and finally the resonator having a "movable box" was selected. The one fifth scale model resonator was made and the resonant frequency, Q-values and radial distribution of RF electric field were measured for it. The results of the measurements were quite satisfactory and a larger scale model will be installed to get more precise data [4].

Vacuum Chamber and Pumping System

The vacuum chamber of the SSC is divided into eight sections, that is, four magnet chambers, two RF resonator chambers and two valley chambers, The reason is that RF resonators can be withdrawn backwards for tuning and repair. Because of limited space in the central region of the SSC, it seems to be impossible to apply usual vacuum sealing technique. A sealing method with pneumatic expansion

seals is considered to save a space and to simplify connecting and disconnecting procedure of the RF resonator.

Three different types of one-thirds model of the seal were made and tested to investigate their performance [5]. Numerical analysis of the elastic and plastic deformation of the seal using a finite element method is now in progress.

Design of the evacuation system has been performed. Total pumping speed of 16×10^4 ℓ/sec is needed to keep the vacuum in the chambers lower than 1×10^{-7} Torr. Cryogenic pumps as well as turbomolecular pumps will be used. To increase the effective pumping speed and to save the time for pumping, possibility to apply the discharge cleaning technique has been investigated [6].

Injection and Extraction System

Beam from the injectors is to be injected along a line tilted to the median plane of the SSC [1]. Design of the beam transport line between the RILAC and SSC and the beam matching section to the acceptance of the SSC was almost finished. Detailed design of the injection elements such as bending magnets, magnetic inflection channels and electric inflection channel and also the extraction elements has been performed [7].

Controle and Beam Diagnostic System

Conceptual design of the controle system of the SSC has been continued . It consists of network of several minicomputors and CAMAC system. To decrease a number of CAMAC crates and signal cables, new camac modules named CIM (communication Interface Module) and DIM (Device Interface Module) are being developed. They have microprocessor in them and are connected to CAMAC data way. Sixteen DIMs will be connected to one CIM through serial line of optical fibre cables. The CIM has a random access memory to stire the data sent from the DIM at a predetermined time interval.

We have a plan to optimize the operation of the SSC by using the computor. To realize this successfully, it is necessary to develop various types of beam diagnostic devices for the measurements of current distributions, emittance, phase of beam inside of the SSC and along the beam transport lines. The theoretical study of adjusting procedure is in progress. Detailed design of the beam diagnostic devices is continued.

Beam Handling System

The beam transport lines to the experimental area can be operated in the following modes: 1) achromatic, double telescopic transport to every target area; 2) Double dispersive, double telescopic transport with a momentum resolution up to 25000; and 3) isochronous, non-dispersive, double telescopic transport. Beam dynamical calculations were almost finished and detailed design of each magnet is in progress

Building

Conceptual design of the SSC building were completed in last year and radiation protection and controle system was designed and approved by the ad hoc committee. Construction of the building will start in this year.

References

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