MEASUREMENTS ON THE TRIM COIL FIELDS AND OPTIMIZATION OF THE TRIM COIL CURRENTS FOR THE RIKEN SSC

A. Goto, H. Takebe, S. Motonaga and T. Wada

The Institute of Physical and Chemical Research

Abstract

Measurements on the field distributions produced by trim coils were made for the real SSC sector magnet. Calculations were performed to determine the optimal trim coils' currents that are required in realizing isochronous fields.

On the sector magnets of the RIKEN SSC are set 29 pairs of trim coils, the radial positions and widths of which were designed on the basis of model measurements and field calculations[1]. To determine these parameters, a computer code was used that can optimize currents of the coils with a least square fitting method[1].

We measured this summer the field distributions of trim coils along the hill center-line of one of the two sector magnets which had been completed by then[2]. The measurements were made for trim coils No.3, No.7, No.9, No.14-15, No.18-19 (a hyphen means that these coils are connected in series), No.22, No.26 and No.28 at a base field of 7, 11, 14, 15 and 16 kG. Each trim coil's currents were 150 and 300 Amps. With respect to the measuring system, see Reference 3). Figs. 1 and 2 show the magnetic field distribution of each trim coil at a base field of 7 and 16 kG, respectively. It can be seen that the radial distribution of field undershoot/overshoot is flat in the case of 7 kG, while that it decreases with radius in the case of 16 kG. These differences result from the effects of finite permeability of the return yoke[4]. In all cases we have obtained a very good linearity of the trim coil's field step height to trim coil's current. Furtheremore, we measured trim coil fields under such two conditions that all the trim coils are excited at 150 or 300 Amps and that only one of them is de-excited. The trim coil field distributions obtained by the differences of these two were found not to show so a large change from the before-mentioned distributions as was seen on the cyclotron at IUCF[5].

We have calculated the optimal trim coils' currents for isochronizations in cases of some typical ions using the above-mentioned program code. The magnetic field distributions of the coils other than the eight coils were obtained by interpolating the measured data. In Fig. 3 is shown the comparison of the calculated magnetic field distribution formed by the trim coils with the isochronous field for a 134 Mev/u C^{6+} ion, in which case the radial increase of isochronous field is the largest in the RIKEN SSC. It was found that the trim coils' currents can be less than 500 Amps in the severest case.

References

1) H. Takebe et al.: RIKEN Accel. Prog. Rep., 15, 173 (1981)
2) S. Motonaga et al.: "Present Status of the Sector Magnets of the RIKEN SSC", this conference.
3) H. Takebe et al.: "Magnetic Field Measuring System for the RIKEN SSC Sector Magnet", this conference.
4) E.D. Hudson et al.: Proc. 7th Int. Conf. on Cyclotrons and their Applications, p.201 (1975).
5) D.L. Friesel and R.E. Pollock: IEEE Trans. on Nucl. Sci., vol NS-22, No.3, p.1891 (1975)

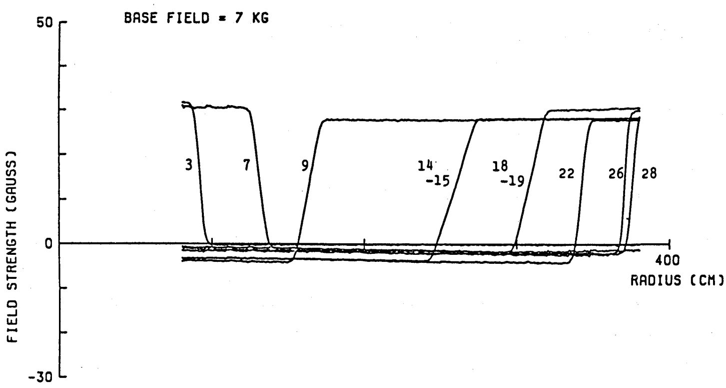

Fig. 1. Magnetic field distribution of each trim coil at a base field of 7 kG.

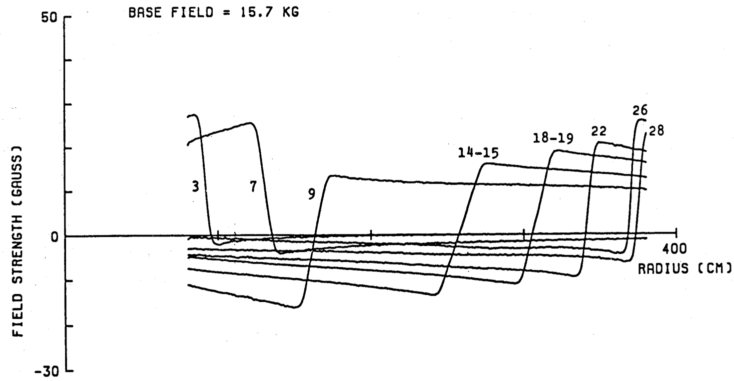

Fig. 2. Magnetic field distribution of each trim coil at a base field of 16 kG. It can be seen that the distributions of field undershoot/overshoot decrease radially because of saturation of the yoke.

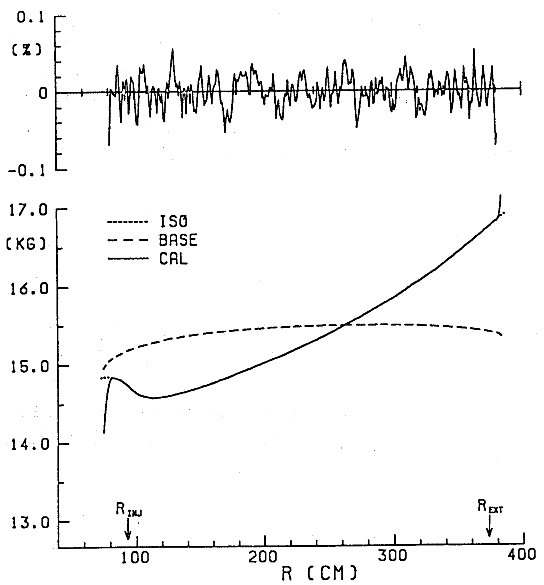

Fig. 3. Comparison of the calculated magnetic field distribution formed by the trim coils with the isochronous field for acceleration of a C^{6+} ion to 134 MeV/u.