SINGLE PASS COLLIDER MEMO

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TITLE: FORCES ON THE CONDUCTORS OF THE ARC AG MAGNET

In the evaluation of the design of the support system for the Arc AG Magnets, factors which could deform or move the magnet have to be considered. Typically they are the ground movements, temperature effects, water vibrations, magnetic forces on the magnet and coil, and accidental human or equipment impacts. This note calculates the magnetic forces on the conductors at an excitation for a 50GeV beam. It is found that the force is not negligible; therefore, a method to restrict the movement of the conductors should be introduced.

To calculate the magnetic forces on the coil, let us consider the magnet profile as shown in Fig. 1. It corresponds to a focusing magnet in the reverse bend region in the North Arc for the electron. Here the electron is moving into the paper and the direction of the currents in the four conductors are as shown in the picture. In the coordinate system shown the center of the four conductors are given in Table 1.

At about 3,800 amps the magnetic field at the beam center line is found by the Poisson program * to be 5.97 KG and those at the center of each conductors are listed in Table 1. Then the forces on the conductors can be found by the relation that

$$\vec{F} = (\vec{I} \times \vec{B}) \quad 1 \quad (1)$$

where the length of the conductor 1 is equal to 2.5m. The forces on the conductors are calculated according to equation 1, and again listed in Table 1. We have used the field at the center of the conductor as the average field across the conductor which should be good to 20%.

From Fig. 1 it can be seen that all the forces pull away from the beam center line. The net horizontal forces from all four conductors are 24 lb toward the outside conductors, however, the net vertical forces is zero because of the built in upper-lower symmetry with respect to the median plane. The forces on the conductors will appear and disappear whenever the current excitation is turned on and off.

At the transition from a focusing to a defocusing magnet, the inside conductors become the outside ones and vice versa. Consequently the net horizontal force alternates from F to D magnet.

* The results of the field distribution was supplied by Dr. G. Fischer

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TABLE 1 THE MAGNETIC FORCES ON THE CONDUCTORS.
(AT 3,800 AMPS)

CONDUCTORS	Position X/Y (mm)	Field Bx/By (Gauss)	Force Fx/Fy (lb)
1	75/45	121/107	-24/27
2	180/45	-450/165	36/99
3	180/-45	450/165	36/-99
4	75/-45	-121/107	-24/-27

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Fig. 1 The crossection of the AC Magnet.