SURVEY AND ALIGNMENT OF THE MIT/BATES SOUTH HALL RING

W. Wade Sapp, Jr., Manouchehr Farkhondeh
and John D. Zumbro

Massachusetts Institute of Technology
Bates Linear Accelerator Center
Middleton, MA 01949

ABSTRACT

The 190 m circumference South Hall Ring facility is planned to be commissionned in 1992. Transverse position precisions of approximately +/- 100 microns (element-to-element) and a total circumference precision of 2 mm are sought. The status of the project is reviewed with particular emphasis on the survey and alignment aspects and reference to specific challenges discussed at this workshop last year.

1. INTRODUCTION

A plan view of the ring is shown in Fig. 1. The ring, which lies in the same plane as the accelerator and beam lines, passes through an existing experimental hall. The new construction is about one third above grade and the remainder is cut-and-fill. The scope of the project including required tolerances and component count has not changed from that discussed in the proceedings for this same workshop last year at SLAC. More recent tolerance calculations by the accelerator physicists have increased our appreciation of the desireability of meeting the +/- 100 micron goal: the closer we come to achieving this goal on the quadrupoles, the more realistic become the tolerances on setting their strengths and the more efficient the overall operation.

The laboratory does not have a survey engineer on its staff and has chosen three nuclear physicists (the authors of this paper) to be responsible for magnetic measurements and survey and alignment for the project. Consequently, this project is a test of survey and alignment technology transfer; we will use some manpower from private industry but continue to rely primarily on consultants from other accelerator facilities: SLAC, LBL/ALS, CEBAF, FNAL and the University of Bonn.

2. THE SURVEY AND ALIGNMENT PLAN

For precision surveys we will use the GEONET database system from SLAC. A base network of floor monuments will be surveyed using both distance measurements (Kern ME35000) and direction measurements (Kern E2). From these monuments we will be able to survey beam line components using direction measure- ments alone.

During the alignment procedure we will utilize optical tooling techniques together with a highly automated triangu- lation system CLASH (also from SLAC), which will make direct use of the base network and associated databases. Finally, the SLAC Industrial Measurement System SIMS will be used not only to fiducialize our large components but also to supplement GEONET wherever necessray.

3. STATUS

The conventional construction including backfilling was completed roughly one year ago. Seven months later cracks in the tunnel floor and walls were cataloged and twenty two of them were patched with plaster to monitor any subsequent movement. The ring dipole magnets, which weigh 30 tons each, were then moved into position. Five months later the plaster patches were examined and showed no cracking or crumbling. We will soon make our first precision floor elevation survey with our recently acquired 2m invar rod and Wild N3 level. Our elevation reference surfaces will be both conventional floor rivets and Fermilab-style wall monu- ments.

A base network consisting of about 80 traverse floor monuments has been laid out with the help of GEONET. Their positions are indicated as simple dots in Fig. 1. This relatively high density of monuments was required because the ring dipoles tend to obscure nearby components. To establish this network will require approximately 250 distance measurements and 320 direction measurements. Error propagation analysis indicates that these measurements should enable us to determine the absolute monument positions to +/- 200 microns and relative component positions to generally better than +/- 100 microns.

4. SPECIAL CHALLENGES

This section is largely an update of the "Open Issues" section in last year's report; a recently proposed large acceptance detector which would encircle the internal target location would be more appropriately discussed in the next workshop.

The connection between the new base network and the accelerator has been made by vacuum bore sighting through the 80m long beam line containing two 2 cm diameter apertures. It was at last year's workshop that we learned of the special techniques and equipment developed at Fermilab which would make this possible. In the limited time available to them, the Fermilab team was able to measure the beam direction to +/- 20 microradians, about a factor of two better than required by our accelerator physics group.

For adjustment stands for the quadrupoles and sextupoles we have adopted the LBL/ALS six-strut system. For most other components we expect to use a three-jack/three-strut system similar to that in use here at DESY. Toward further reductions in strut expense, some thought has been given to using a simple threaded rod for the less critical z adjustment and to using a flexure joint instead of the spherical rod-end bearing.

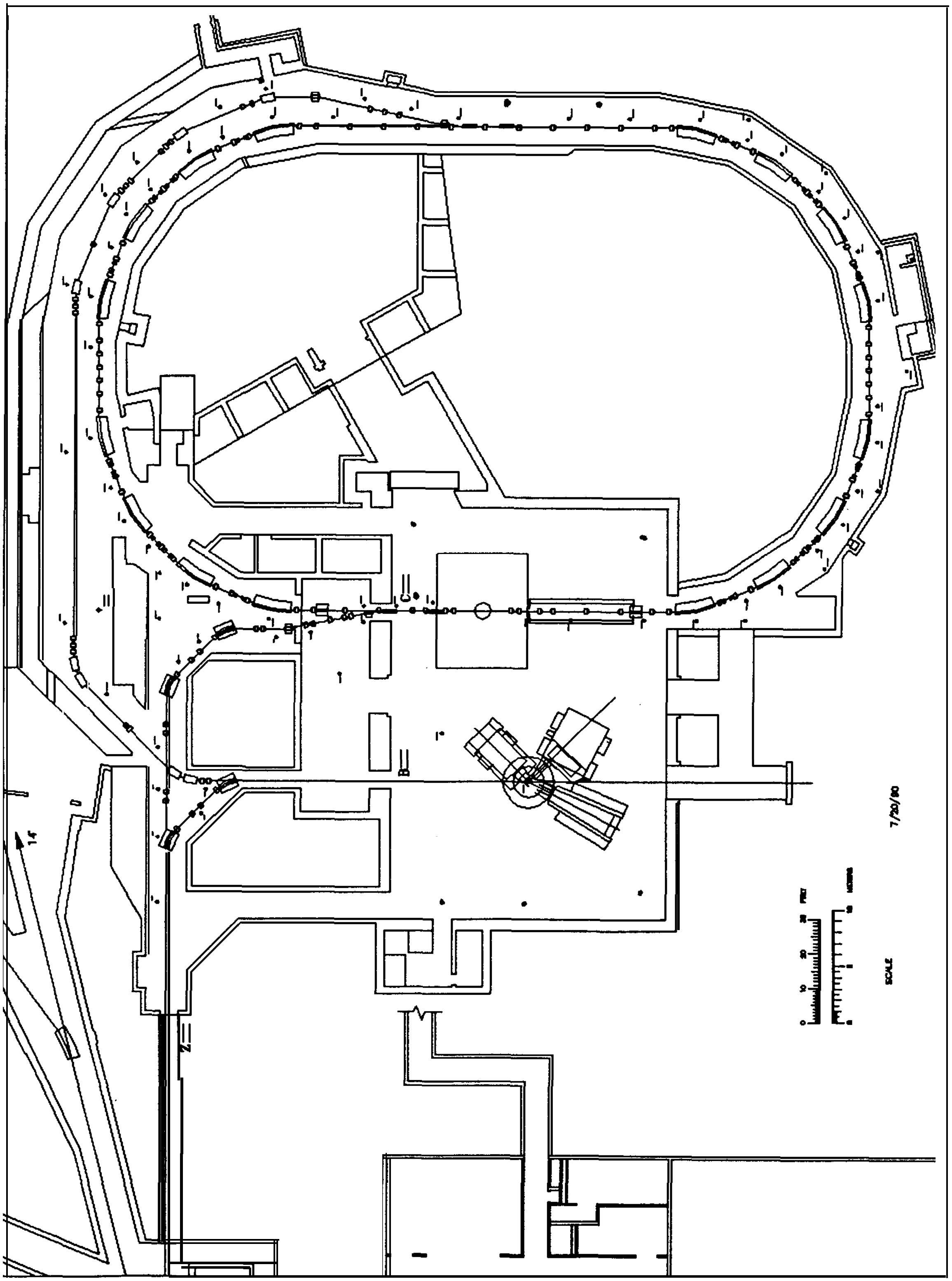
Fiducialization of the dipoles will be with respect to the mechanical centers; SIMS will be used to make the transfer. We are still seeking the most cost effective method for fiducializing the multipoles with respect to their magnetic centers. The bore of the two prototype quadrupoles is asymmetric by about the required centering tolerance. If this asymmetry cannot be reduced for the production models, it may further complicate our fiducialization scheme.

FIGURE CAPTIONS

Figure 1. Detail plan view of the South Hall Ring. The dots are the locations of the floor monuments of the base network. There is no surface network.

ACKNOWLEDGEMENTS

This work is supported in part by the U.S. Department of Energy under contract DE-AC02-76ER03069.


7/20/80
SCALE