Status of MDCIII in Hawaii

F. A. Harris
University of Hawaii

June 14, 1999

MDC III

MDC-II was repaired by reconfiguring the HV distribution so that no feed through has to stand off more than ∼2kV. The reconfigured chamber has operated sufficiently well to permit measurements of R_{had} in 1998 and 1999. Nevertheless, the repair of MDC-II is at best a temporary solution. In order to ensure the continuation of the BES physics program, it was deemed necessary to construct a new drift chamber.

MDC-III will be a copy of MDC-II, thus saving engineering time and costs. The division of labor for the MDC-III project is as follows:

Colorado State:	feed throughs and solder pins
Hawaii:	endplates, outer cylinder preamplifiers
IHEP:	inner cylinder, chamber assembly alignment, stringing, installation

Endplates

The Engineering Shop Facility (ESF) of the University of Hawaii's School of Ocean and Earth Science and Technology (SOEST) is being used to fabricate the endplates. The ESF has experience with building large projects in support of SOEST's deep sea and environmental research program.

The specified tolerance requires that the maximum deviation from the specified center of any of the 23,000 feed through holes will be no more than 50 μm. This requires the thermal control of the workspace to better than ±1.5°C. Perpendicularity of the holes and the hole diameter must also be closely controlled.

For the endplate disks, two pieces of 2024-T3 aluminum stock with inner and outer radii machined and surfaces Blanchard ground to specifications were obtained from a mainland supplier. The drilling is being accomplished with the disk rigidly held on a custom-made support fixture with the center axis of the disk horizontal. A schematic view of the drilling fixture is provided in Fig. 1. A special CNC drilling fixture is used to position a production high speed drill head in both the x- and y-axis; the drill head is positioned by digital stepping motors and moved by ball screws on a precision traverse. Linear encoders are used to maintain the required level of precision. These traverses position a production drill head, a small compact high speed unit with a canned drilling cycle and load sensing ability. Custom-made drills are used in order to maintain accuracy and a high production rate. Repositioning is accomplished by unclamping the disk and rotating it to the next position. In this operation, the position accuracy will be maintained by means of a rotary optical encoder with a precision of 0.6 arc-sec.

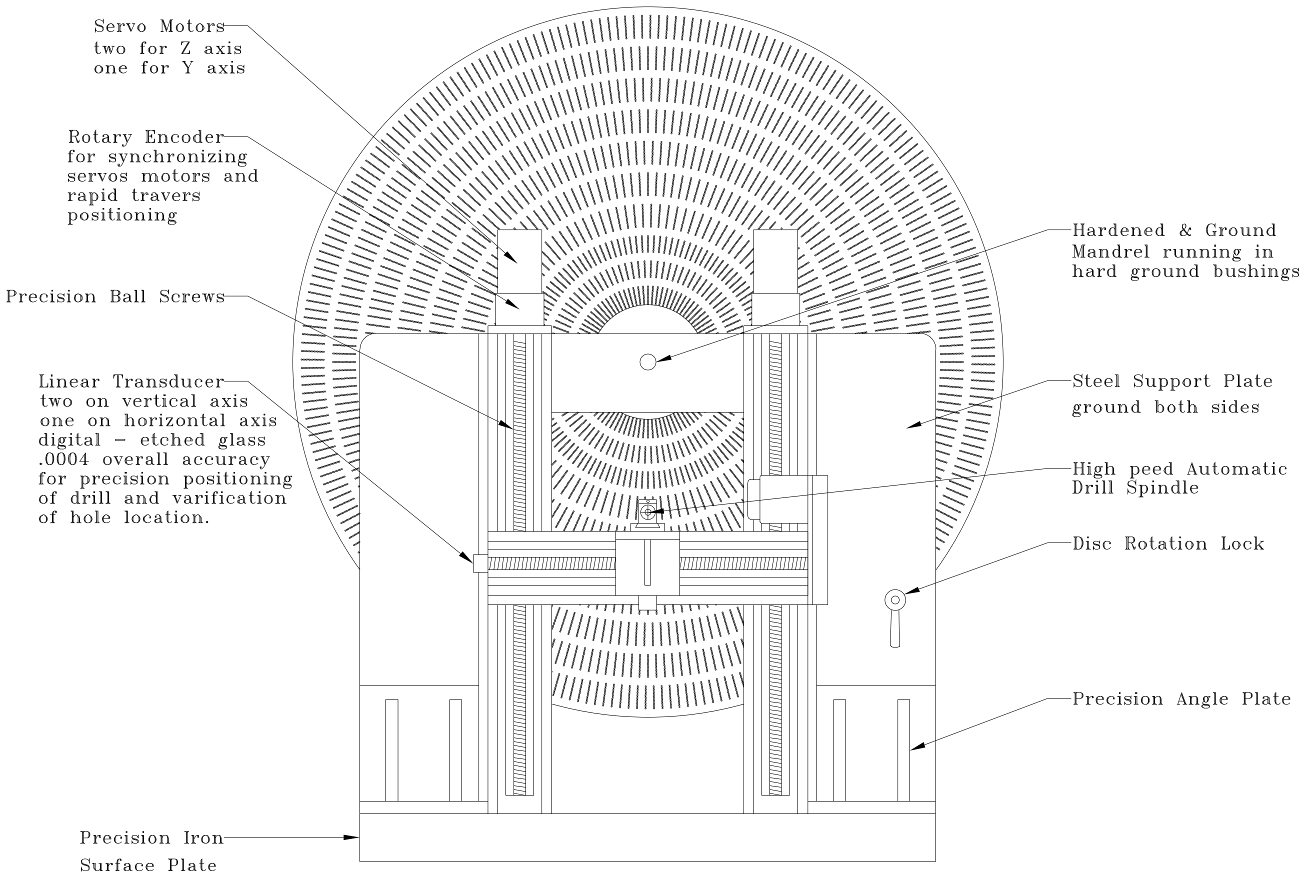

Figure 1: The custom made fixture that will be used for the endplate drilling.

The drilling machine has been assembled with the help of Shen Benwei, Yang Yun, and Liu Rongguang. The basic design was made by Tom Conlin. A view of the machine is shown in Fig. 2. Production drilling started on June 9. More than 600 holes were drilled. Initially only field wire and potential wire holes were drilled, since the positions of the sense wires are more critical. The positions of the holes were then carefully measured to check the performance of the machine. This lead to a series of improvements to the drilling machine, including better vertical and horizontal alignment and calibration of the rotary encoder. The improved machine has now been tested, and production drilling should proceed very soon. Although it is difficult to make a good projection at this time, the drilling should take on the order of a few months.

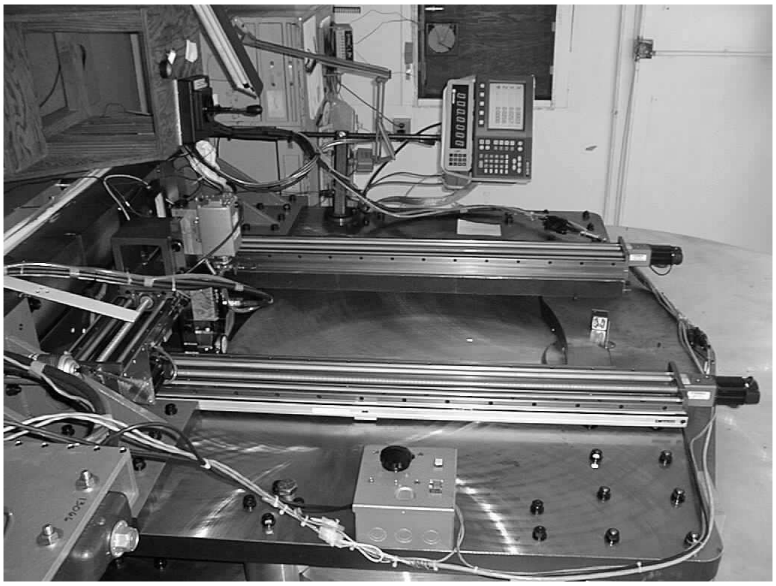

Figure 2: The custom made fixture in real life.

Outer Cylinder

The outer aluminum cylinder is 1.27 cm thick and 2.3 m long. It is being fabricated at Bear Machinery in Kaneohe, Hawaii. The cylinder is constructed from six aluminum plates, in which windows are cut to allow for wire stringing. After machining, the plates and the window covers are bent to the proper curvature, and the plates are then riveted together to form the cylinder. The design was checked by a professional engineer. Figure 3 shows one of the plates being machined. A picture of a test prototype is shown in Fig. 4. At present the plates are being bent. They will then be attached to two aluminum collars. The outer cylinder will be finished within approximately two months.

Preamplifiers

Signals on the sense wires of the existing MDC-II are amplified by preamplifiers that are mounted directly on the endplate of the drift chamber. These devices use the NH19-6112 hybrid amplifier that was developed by NIKHEF for the L3 experiment. The NH19-6112 hybrid is a single channel amplifier that converts an input current signal into an AC coupled, 50 ohm differential pair output with a gain of $2 \times 12.5\text{mV}/\mu\text{A}$, and with an input noise level less that $0.01\mu\text{A}$. In BES, these preamps are used four-to-a-card, one card per cell, in a configuration where cross-talk signals from neighboring sense wires are corrected by voltage dividers connected between the input lines.

In applications at CERN, the NH19-6112 hybrid has been superseded by a new hybrid, the FBPANIK-04, which has four channels on a single wafer, each with four times the gain of the NH19-6112. These improved hybrids are available from the METALLUX in Mendrisio, Switzerland for 17 CHF ($\sim$ \$12) per 4-channel wafer.

For MDC-III, we are replacing the MDC-II front-end preamp cards with new units that

Figure 3: One of the six plates which will be used to form the outer cylinder being machined.

Figure 4: Prototype test.

incorporate modified versions of the FBPANIK-04 hybrid wafer and have on-board HV decoupling capacitors since the inventory of spare NH19-6112 preamplifiers at IHEP is quite low. If we continue to use these on MDC-III, we will be vulnerable to failure of these hybrids. The proposed preamps will be smaller than the existing MDC-II preamps and will preclude the need for the extra HV decoupling cards for layers 4 through 10. This will reduce the congestion in the chamber endplate region, facilitating maintenance and repair.

The new preamplifier card are functionally similar to the new layer 1 through 3 cards that the Hawaii group has prepared for MDC-II. Varner has modified two resistors on the FBPANIK-04 hybrids to produce similar rise-time and gain as the existing MDC-II amplifiers. This change allows operating with similar high voltage and the same post amplifiers that are used for MDC-II. The preamp card design is shown in Fig. 5. Prototype boards have been manufactured and tested in Hawaii and have now been shipped to IHEP for tests of the mounting scheme.

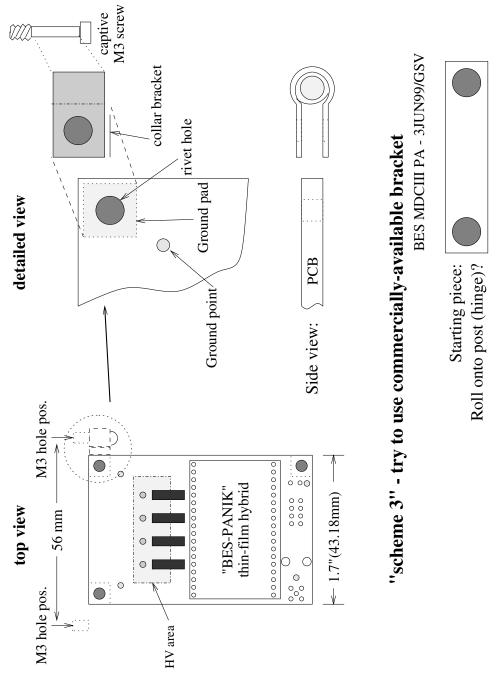

Figure 5: Drawing of the new MDC-III preamplifier board.

Summary

The MDC II repair was a success, but it is uncertain how long it will last. Proposals to build a new MDC III have been approved and construction is well underway. It is being built under a collaboration between IHEP, the University of Hawaii, and Colorado State University.