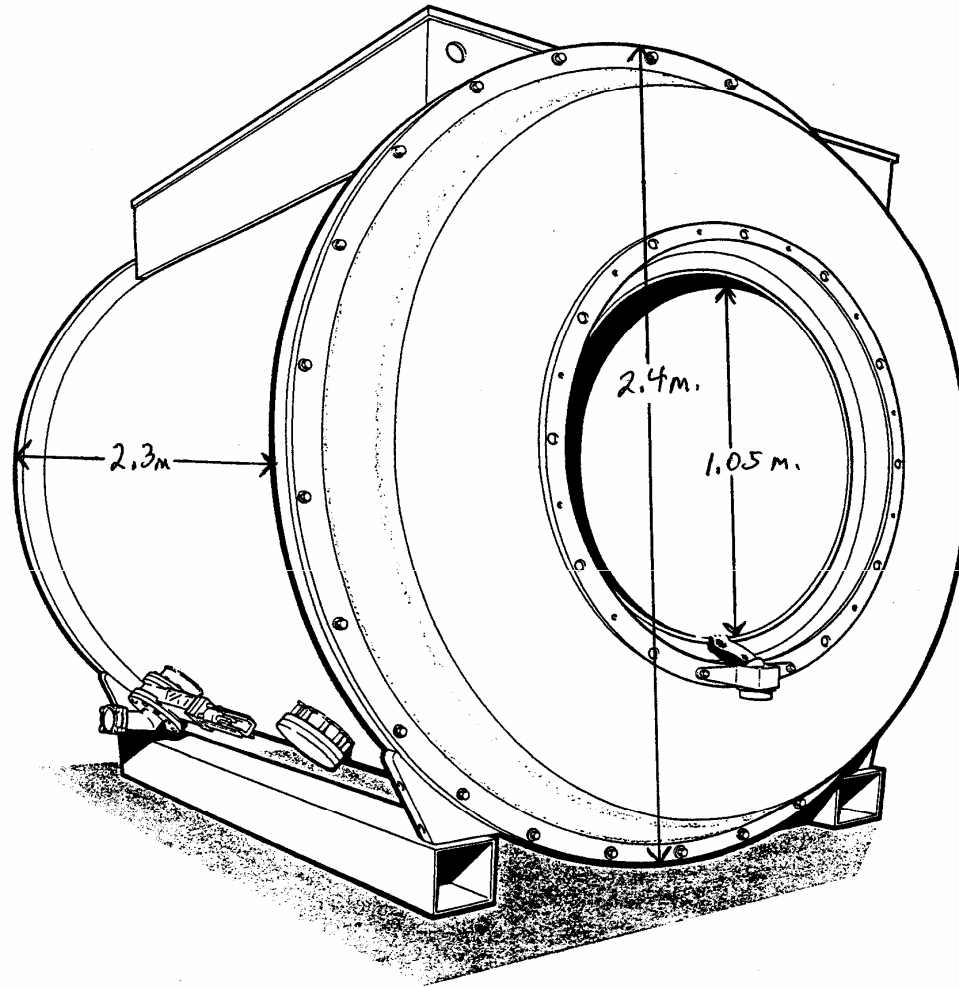


FIELD MAPPING THE “TWIST SOLENOID” WITH THE CUSTOM MAGNET MAPPER.

Doug Evans, Glen Marshall, Dave Morris, Mike Barnes - Triumf

The Twist Solenoid is a large bore 2.2 Tesla Superconducting Solenoid which was initially surveyed with a manually moved hall probe array and subsequently with an automated magnet mapper. This mapper was custom designed for this particular project as the magnet was too large to be mapped in the normal magnet mapping area and so was done in it's final experimental position in the beamline. This magnet mapper was built to carry two hall probe arms with a total of 12 hall probes as well as an NMR probe. The magnet mapper and the results will be discussed.

MAGNET SPECIFICATIONS



Weight: 7800 kg.

I(max): 242 amps

B(max): 2.1 T.

TWIST SOLENOID ARRIVES AT TRIUMF.



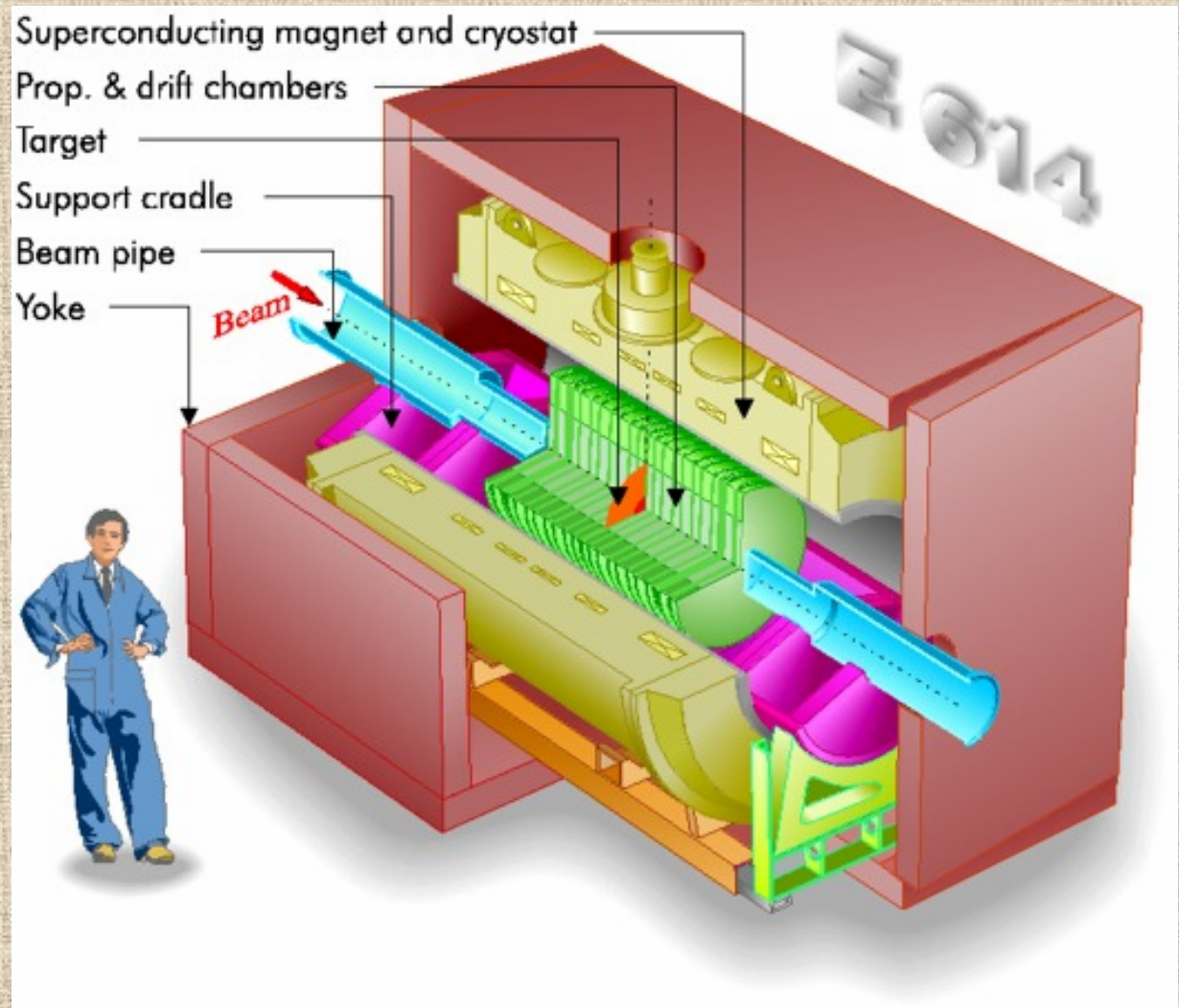
TWIST SOLENOID PLACED INSIDE YOKE STEEL

- YOKE STEEL REQUIRED TO CONTAIN FRINGE FIELD.



TWIST - “TRIUMF WEAK INTERACTION SYMMETRY TEST”.

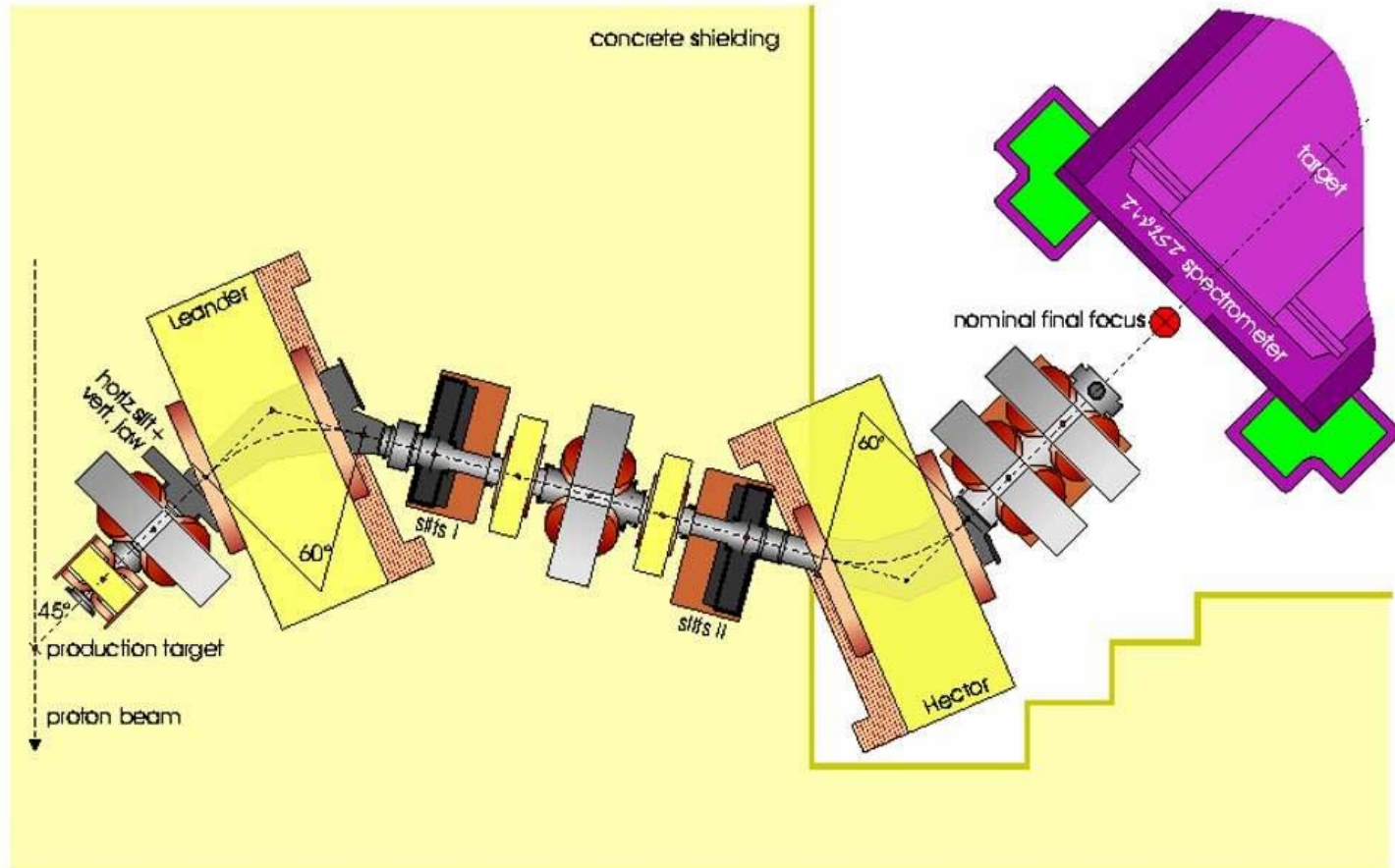
- Experiment to measure decay distributions of polarized muons to high precision. (3 to 10 times higher than achieved before).
- UBC
- Triumf
- KIAE (Russia)
- Texas A & M
- U of Alberta
- U of Northern BC
- U of Montreal
- U of Regina
- U of Saskatchewan
- Valparaiso University



FIELD MEASUREMENTS REQUIRED UPSTREAM TO THE LAST QUAD.



The M13 beam line used for *TWIST* at TRIUMF

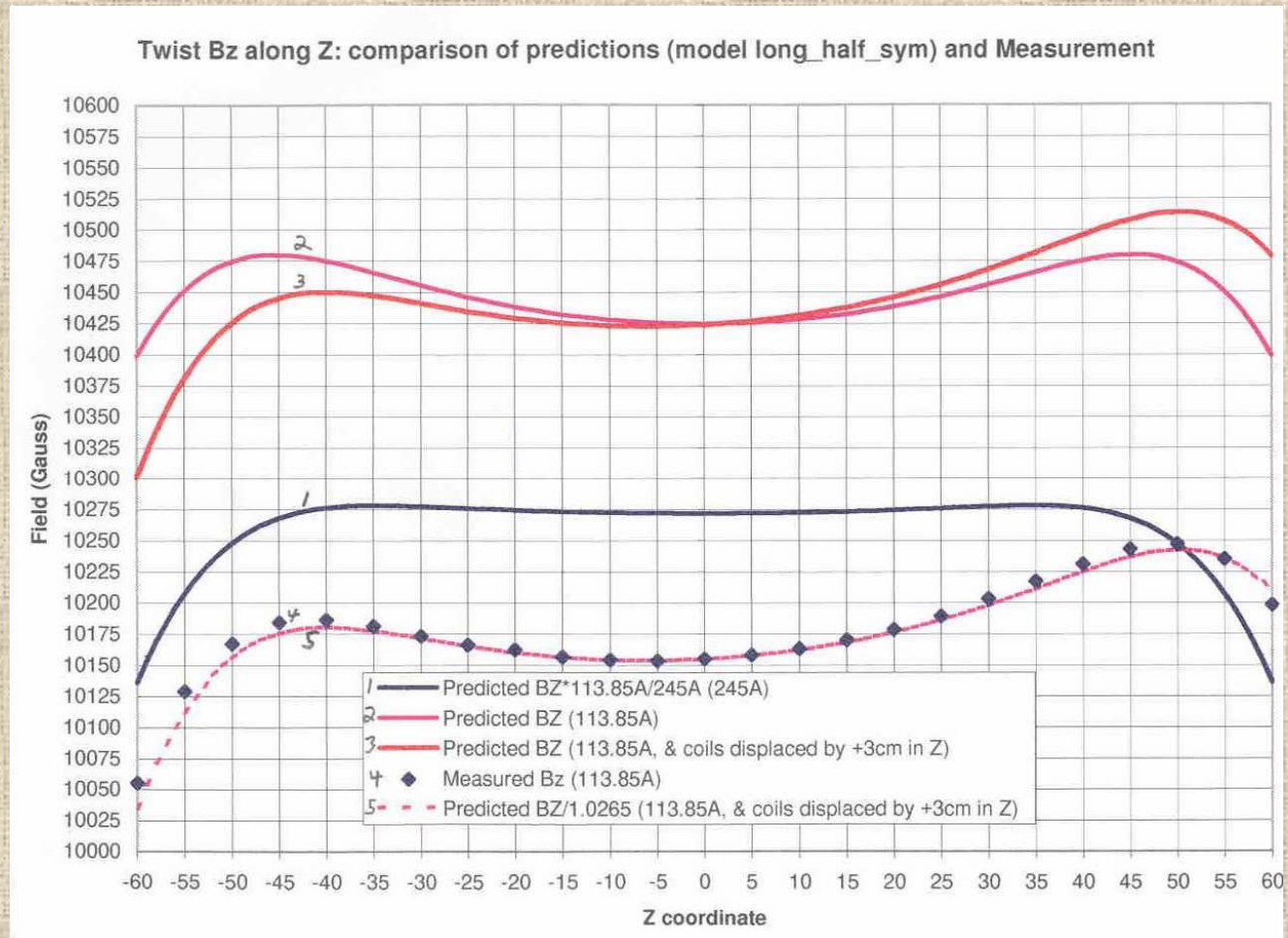


- PRELIMINARY SURVEYS WERE DONE MANUALLY WITH 6 HALL PROBES SPACED ON A STATIC APPARATUS.
- PROBES PULLED ALONG Z AXIS AND SCANNED AT 5 CM. INCREMENTS.

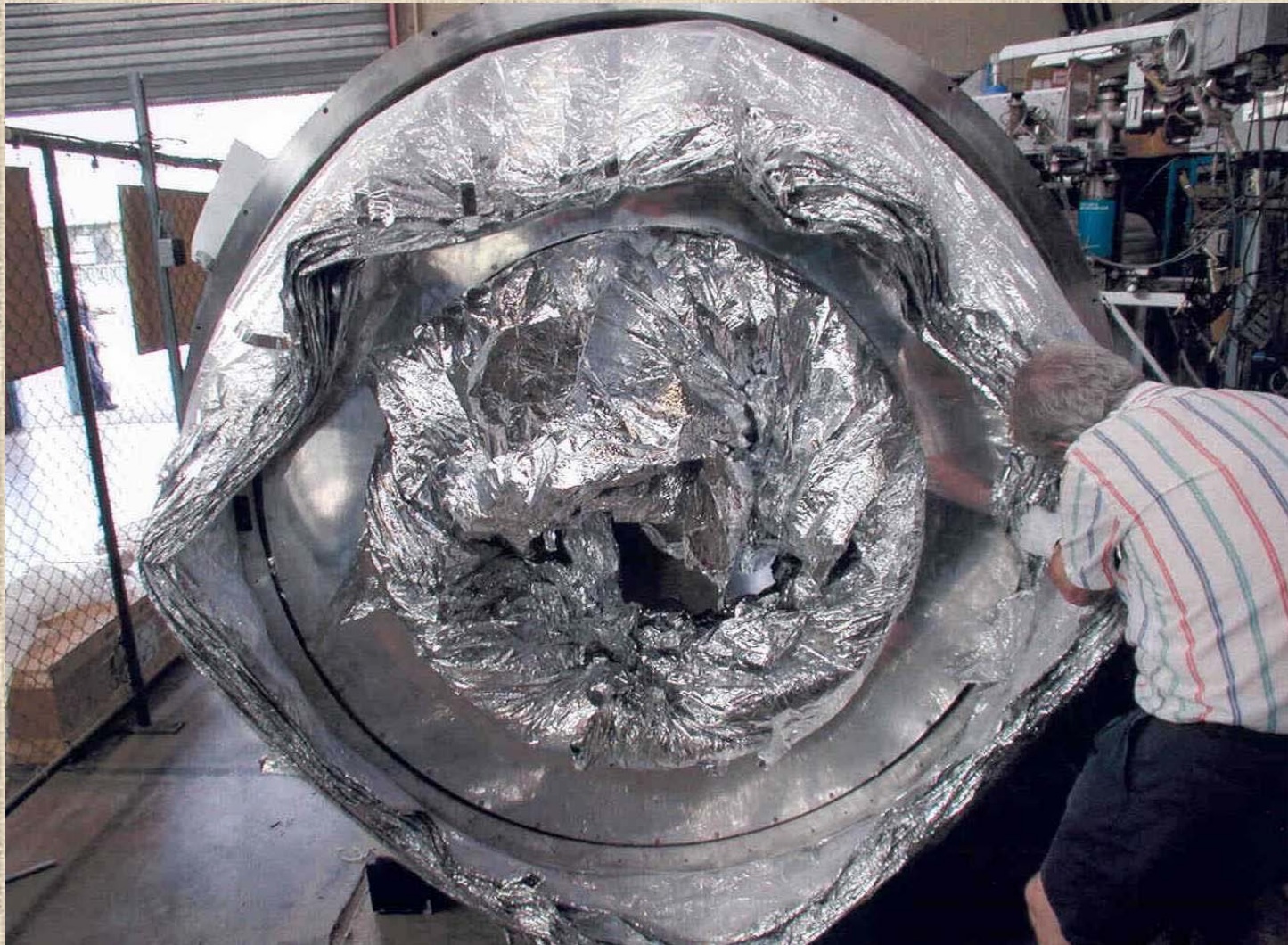


PRELIMINARY RESULTS

- Z ASYMMETRY
- COILS MOVING UNDER POWER?

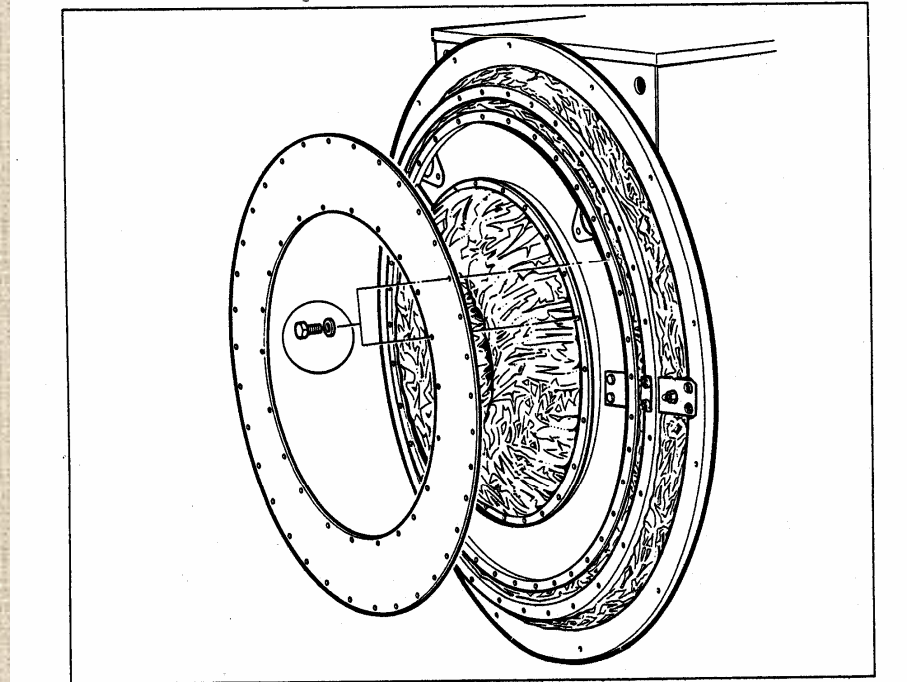
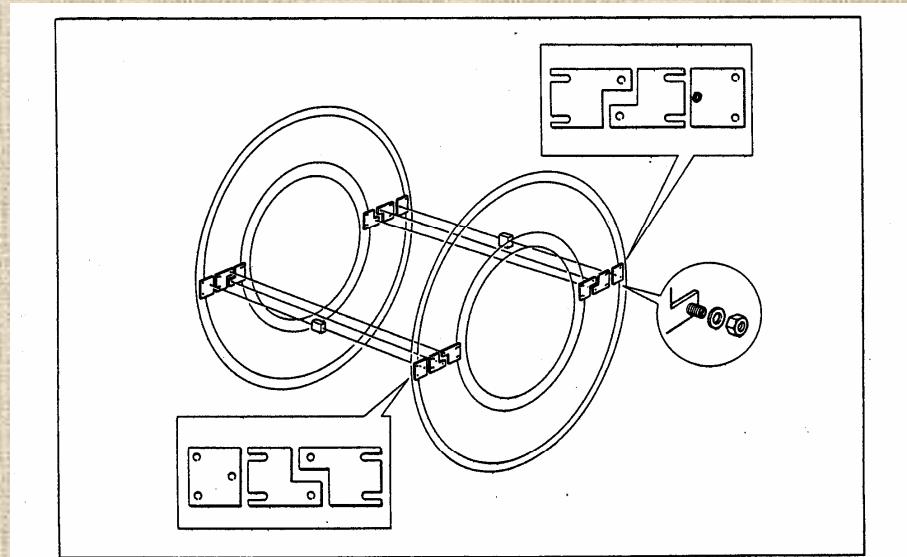


**-REMOVED MAGNET FROM YOKE AND
OPENED IT UP TO LOOK FOR PROBLEMS.**



SOLENOID ROD CLAMPING SYSTEM.

- HELIUM VESSEL
EASY TO MOVE!
- ONE ROD
MISSING!!!
- ANOTHER NUT
MISSING!
- REPLACED,
TIGHTENED AND
PUT BACK
TOGETHER.



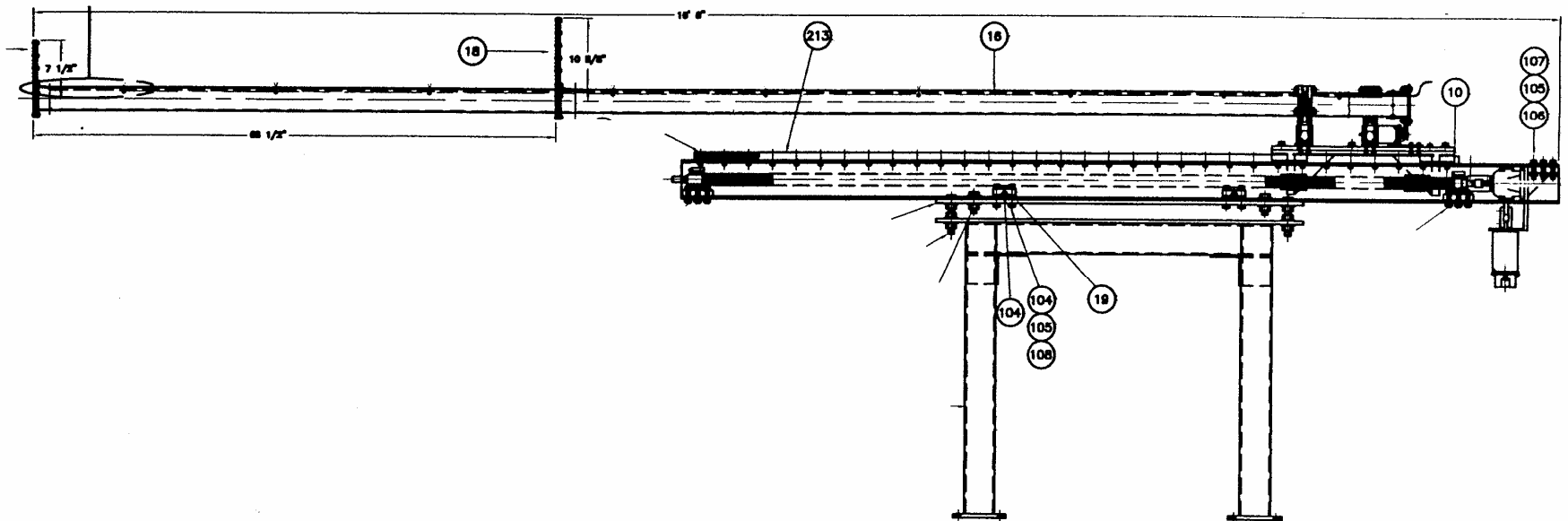
TWIST AUTOMATED MAGNET MAPPER

~ 2 meters of Z travel.

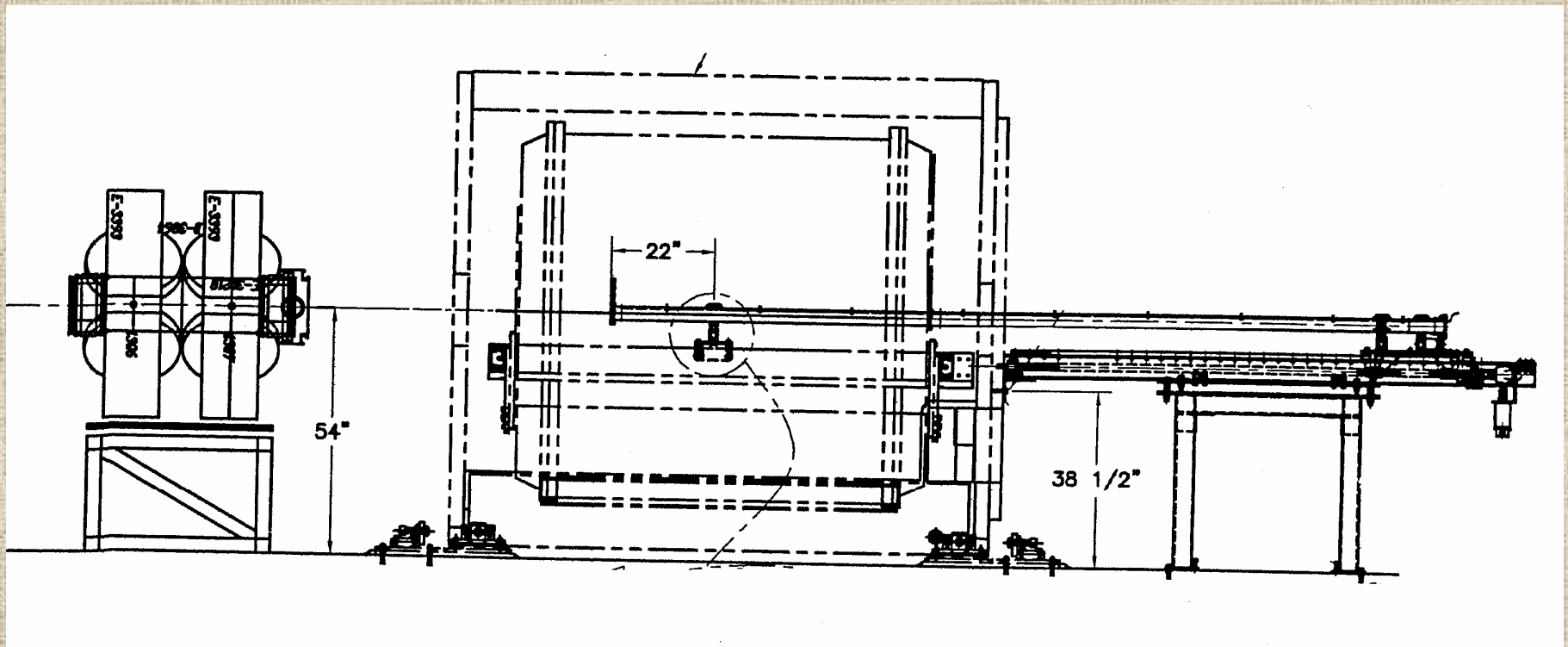
Probe arms are 1.74 meters apart.

5 probes on upstream arm.

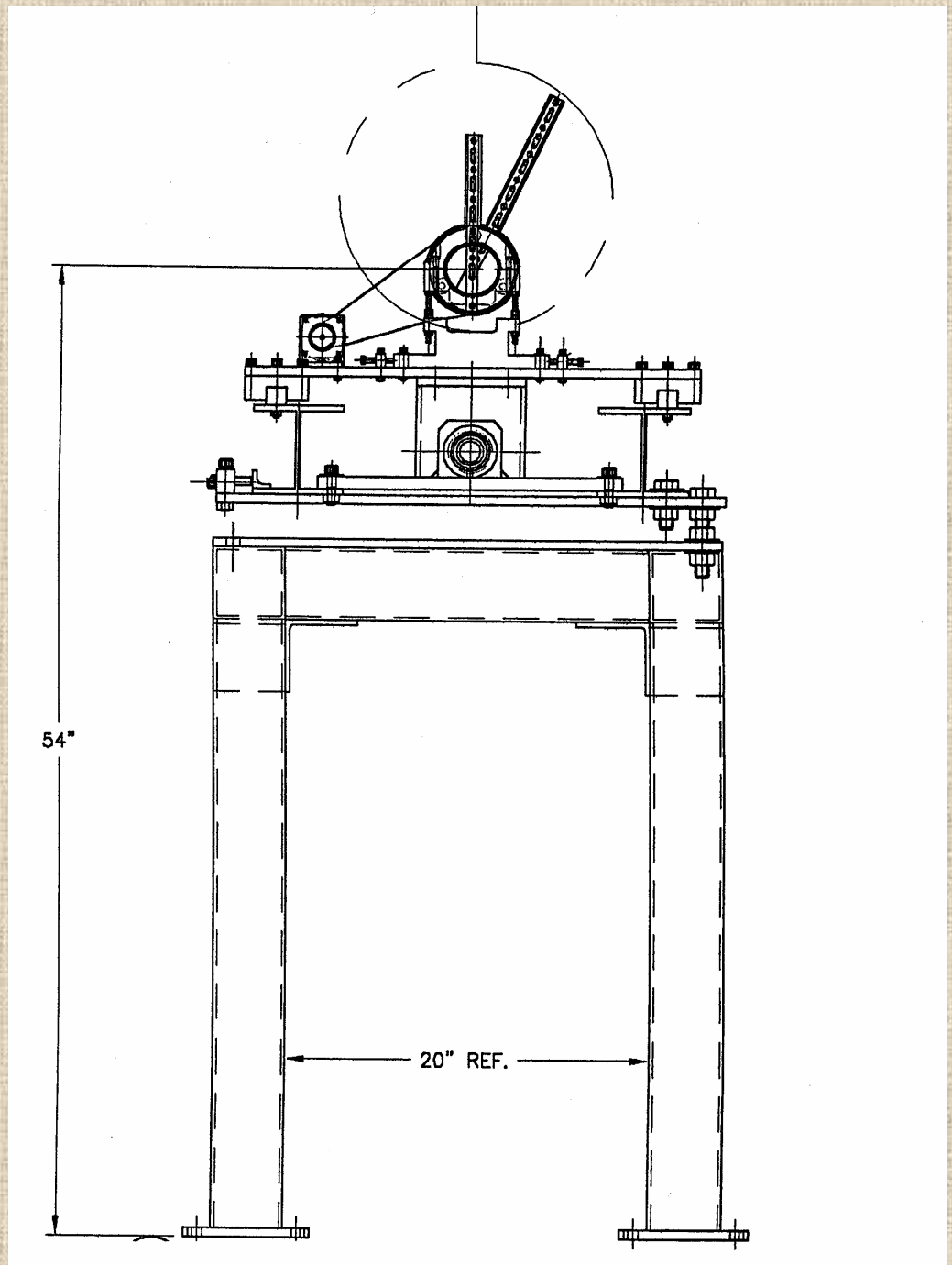
7 probes on downstream arm.



- Upstream end rides on moving support on detector rails.
- Upstream probe arm fits through hole in yoke to measure outside magnet.
- Measurements done at 1.96 T., 2.0 T., and 2.04 T.
- measurements taken every 25 mm in Z direction.
- Rotation from 0 deg. to 345 deg. in 15 deg. increments at each Z.

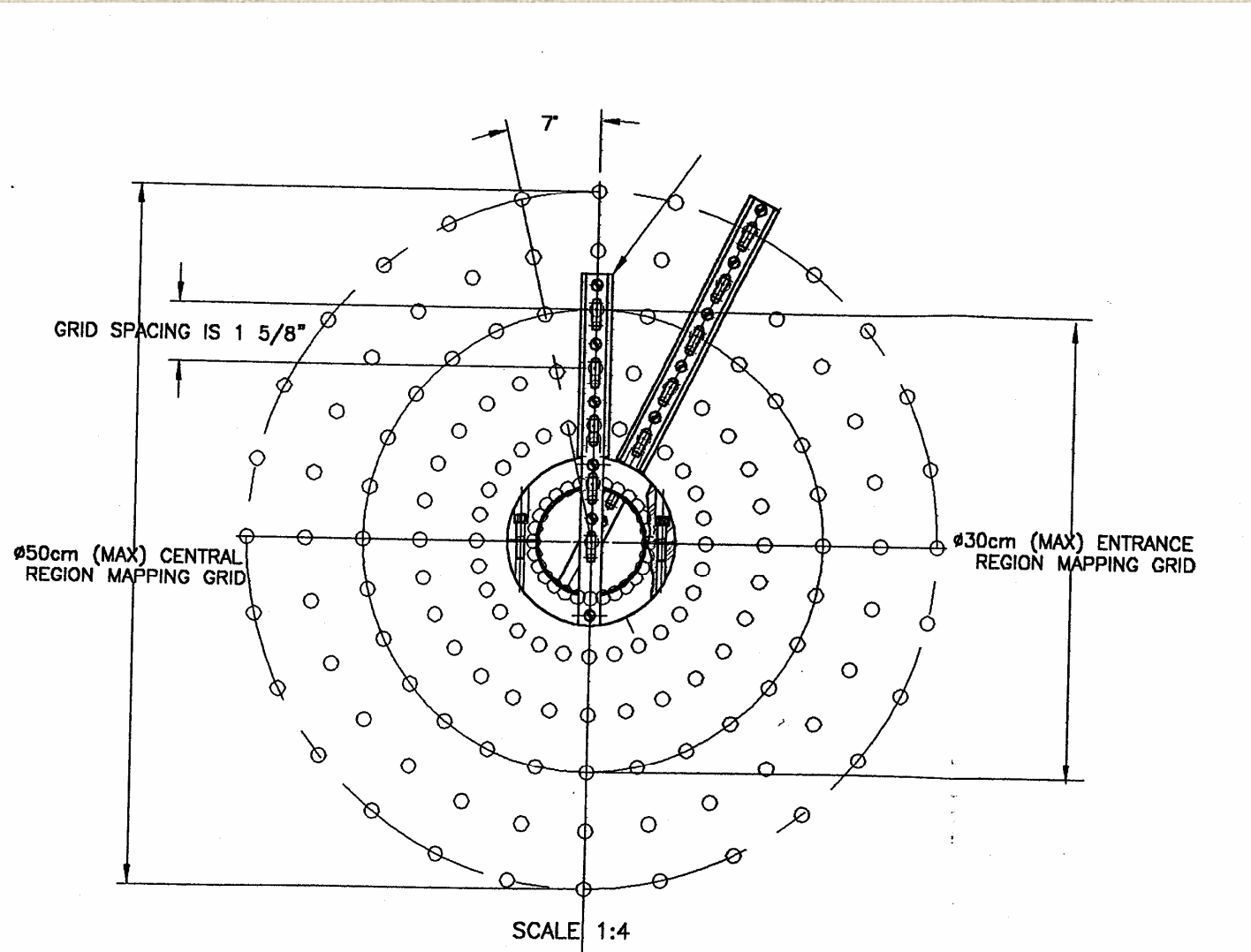


- ROTATIONAL DRIVE SYSTEM.
- LOOKING FROM UPSTREAM END.
- UPSTREAM PROBE ARM SHORTER TO FIT THROUGH HOLE IN YOKE.



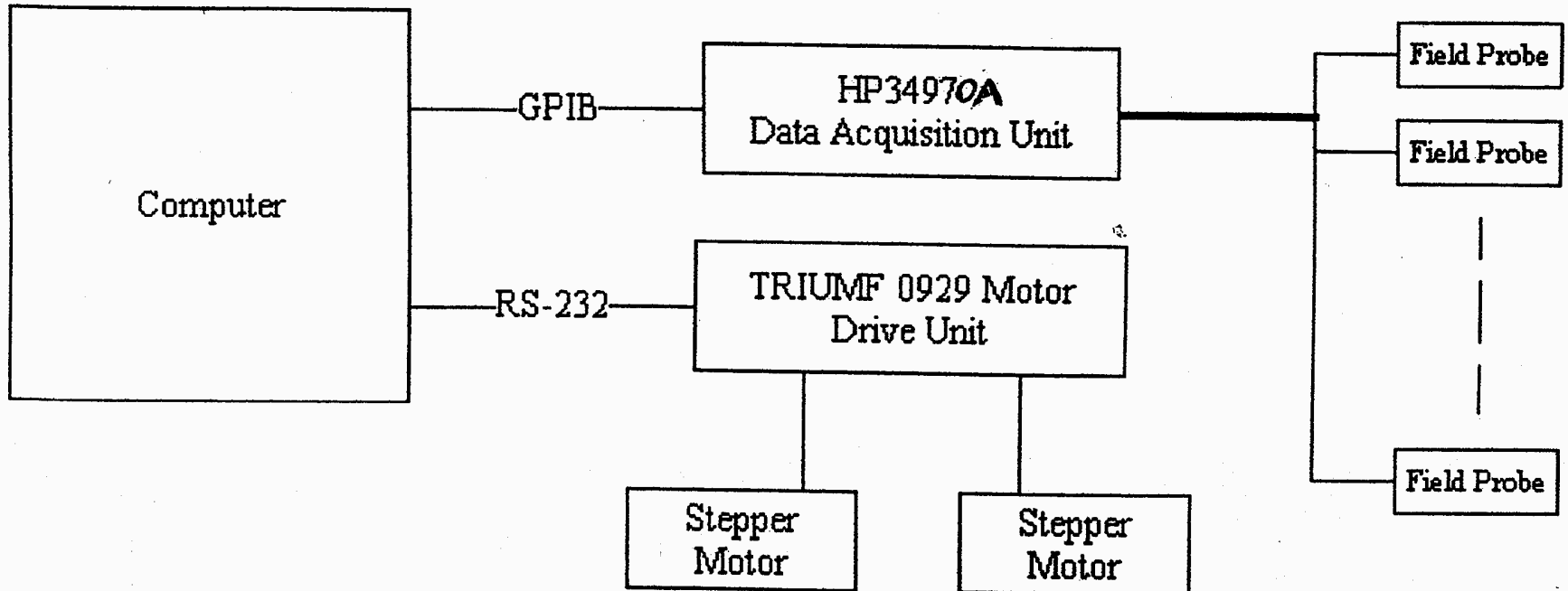
SURVEY GRID

- PROBES ARE 41.3 mm apart.
- Measured diameter is 50 cm. inside magnet and 33 cm. upstream outside the magnet.
- Measurements done with angular increments of 15 degrees or 7.5 degrees.



TWIST SURVEY SYSTEM ELECTRONIC HARDWARE.

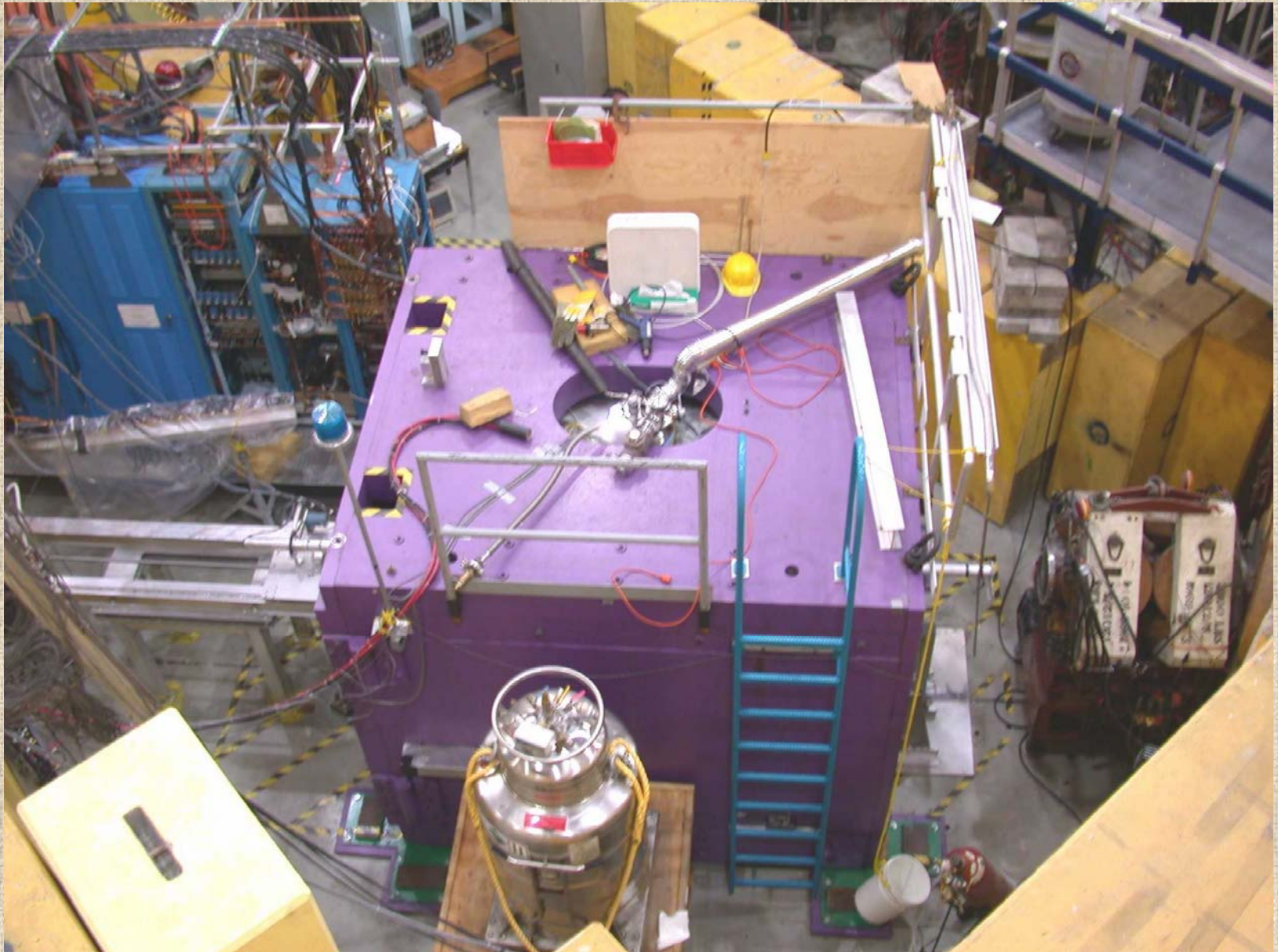
- Hall Probes are Bell bht-910 (12 probes).



SYSTEM INFO

- **I) *HARDWARE*:** PC with National Instruments PCI-GPIB interface. Data acquisition by HP 34970 data acquisition unit. Motor control using Triumf built motor control system based on Oregon Microsystems PC68 Stepping Motor Controllers.
- **II) *SOFTWARE*:** Written in JAVA using Sun Microsystems JDK 1.3. Development tools include Sun's Forte for Java CE and Microsoft Visual C++ 6.0. Object oriented, using class diagrams to define static class relationships and sequence diagrams to define the dynamic model. Interface layer written in C to link JAVA to the existing device driver library for GPIB communication.

TWIST SOLENOID WITH MAPPER INSTALLED



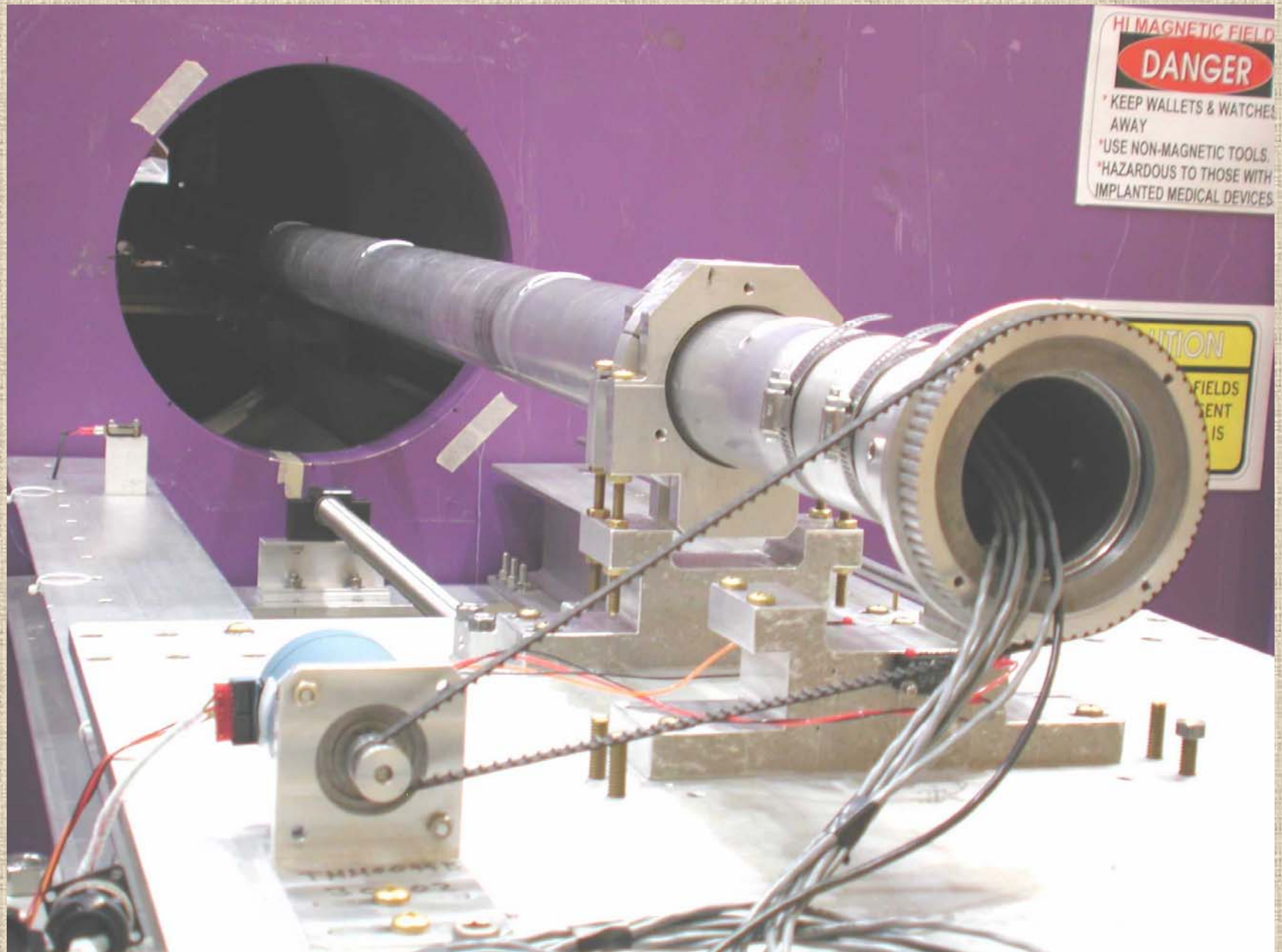
SURVEY SYSTEM DRIVE TABLE



LOOKING UPSTREAM FROM DRIVE TABLE



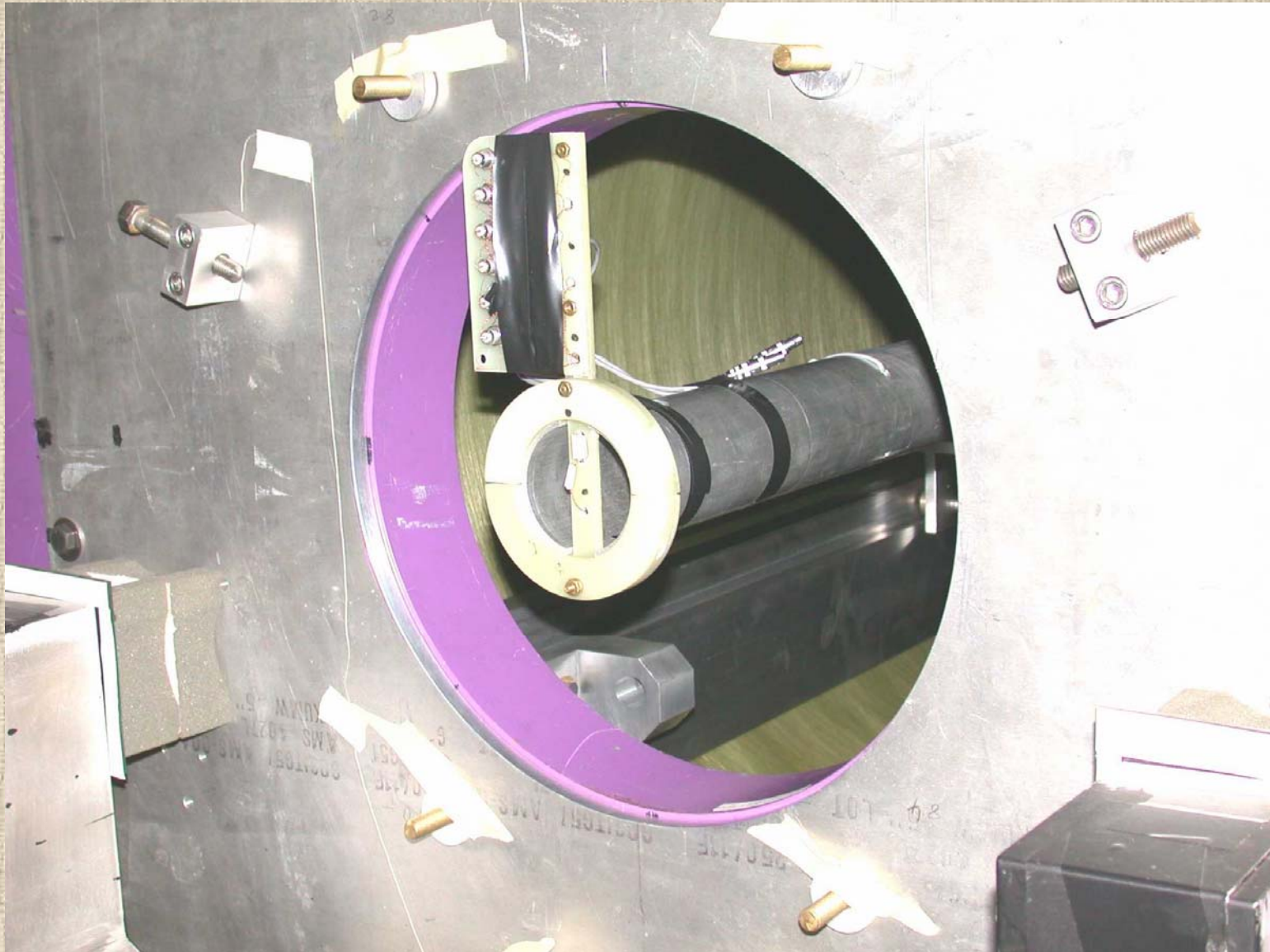
ROTATIONAL DRIVE BY TOOTHED BELT



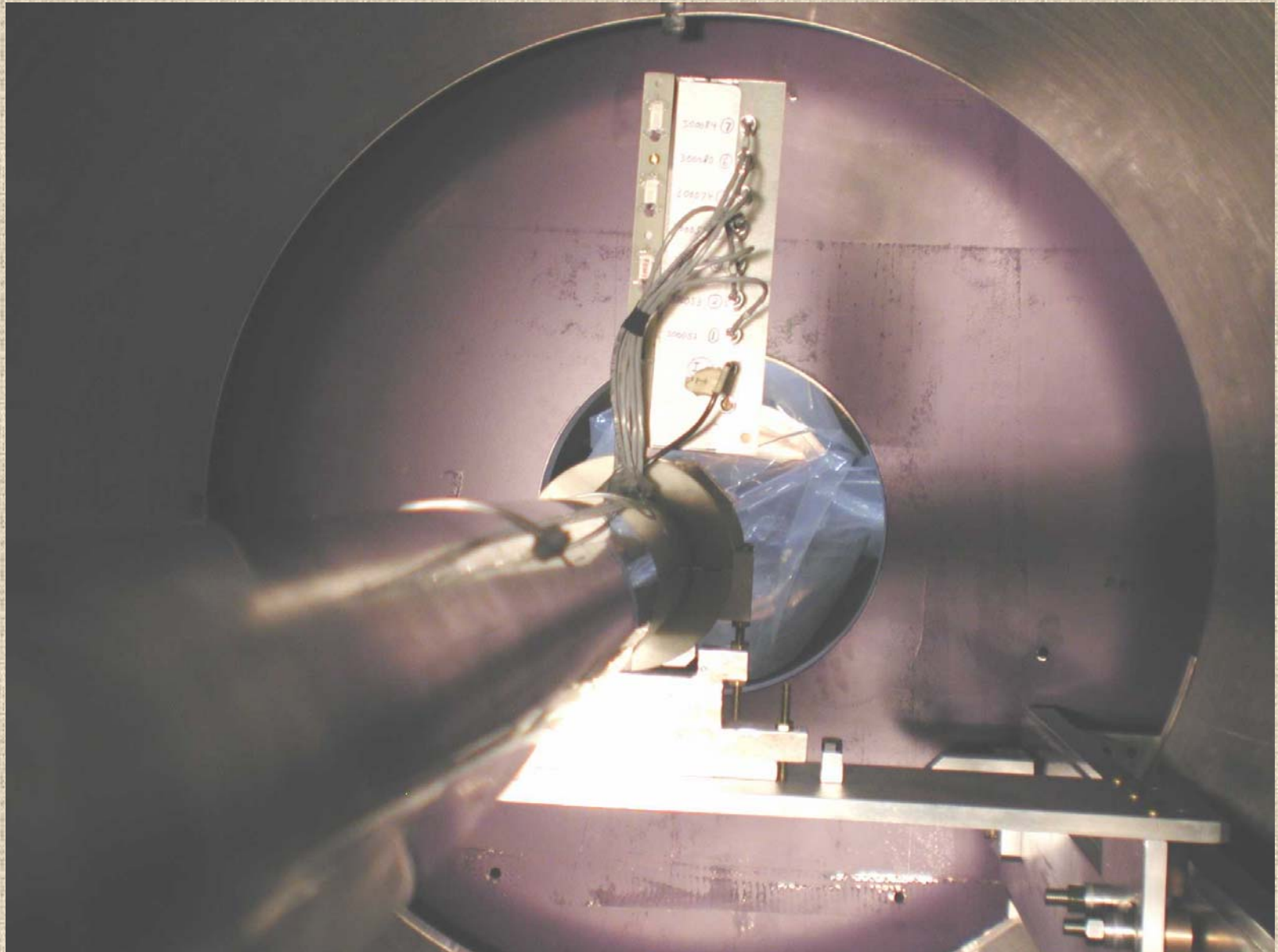
UPSTREAM PROBE ARM SURVEYING AREA BETWEEN TWIST SOLENOID AND FINAL QUADRUPOLE.



UPSTREAM PROBE ARM INSIDE 40 cm. dia. VERTICAL YOKE PLATE HOLE.



LOOKING UPSTREAM AT THE INTERIOR
PROBE ARM WITH 7 HALL PROBES.



LOOKING DOWNSTREAM INSIDE MAGNET VOLUME

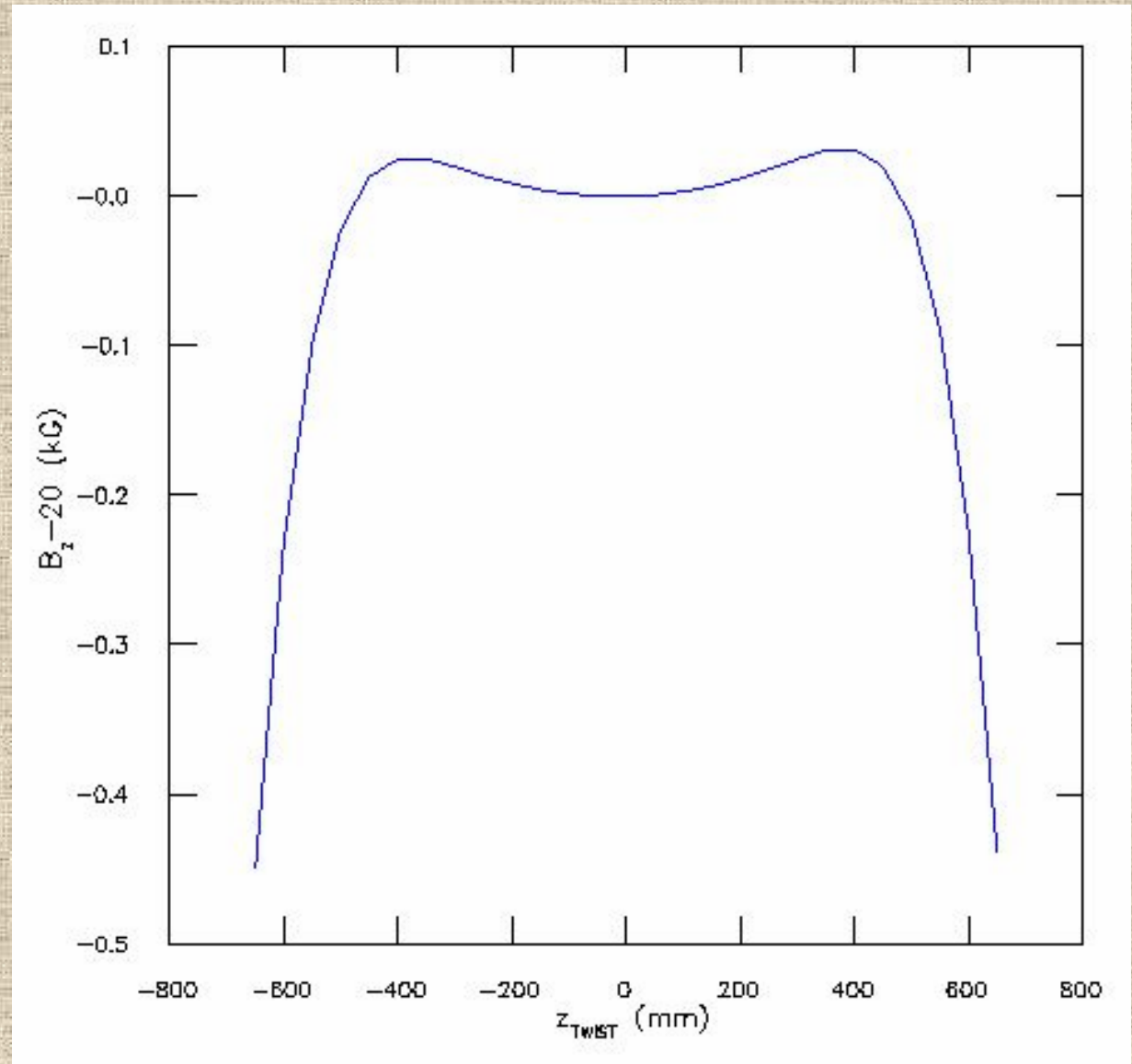
- METROLAB NMR PROBE INSTALLED 150 mm. UPSTREAM OF INTERIOR HALL PROBE ARM.
- NMR MUST BE MANUALLY ADJUSTED FOR OTHER RADII.
- NMR POSITION AND DATA INCORPORATED INTO DATA ACQUISITION SYSTEM.
- SUPPORT CART MOVES ON DETECTOR TRACK.



INTERIOR RESULTS

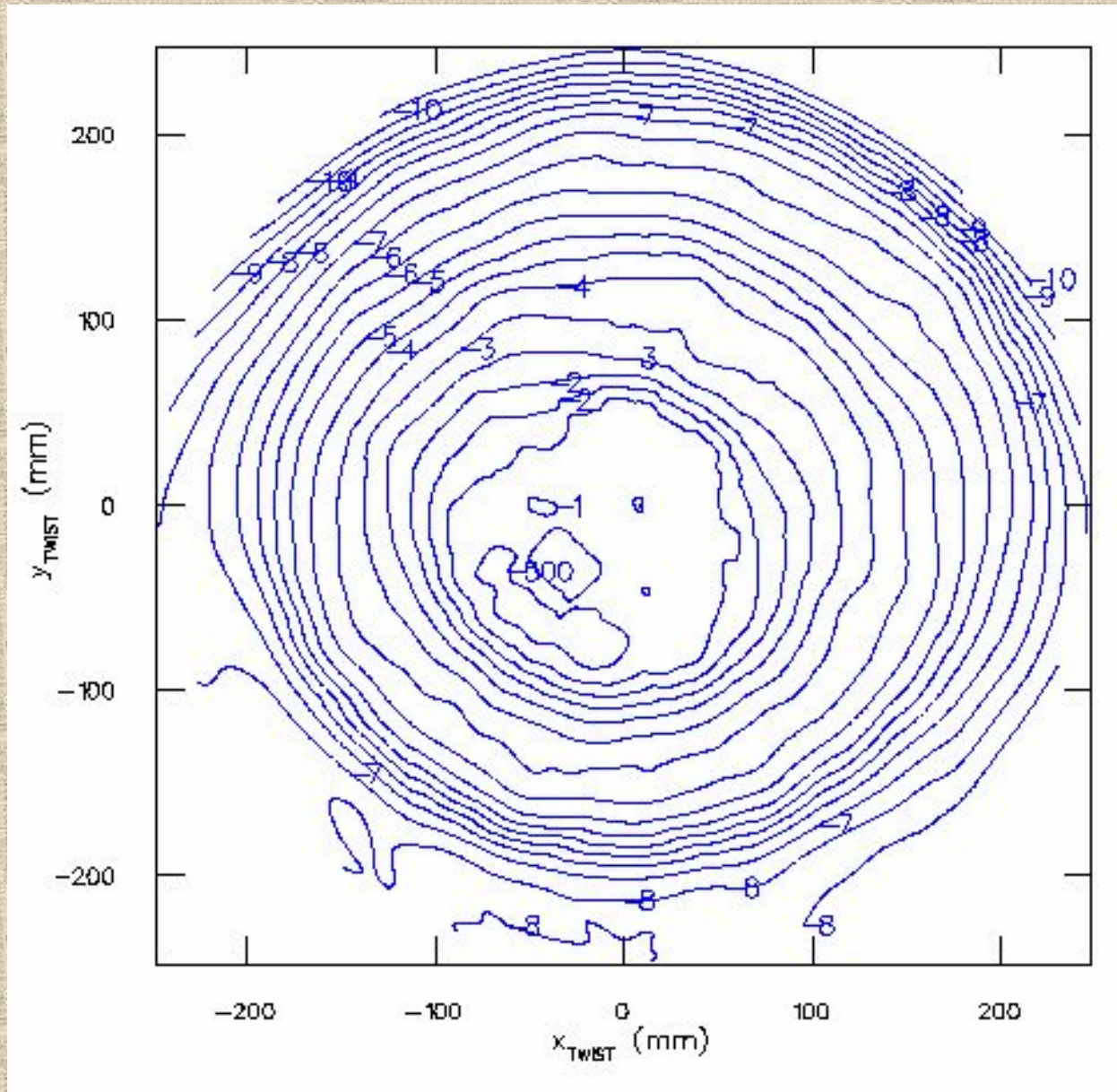
I) Plot of B vs. Z position on center axis.

- Z asymmetry has been reduced from 0.6% to 0.03% of full field since magnet reassembled.



II) CONTOUR PLOT AT Z=0 (CENTER OF MAG.)

- 0.5 g. contours
- 10 cm. diameter center area homogenous to 1 gauss achieved.



UPSTREAM RESULTS

PLOT OF B vs. Z ON CENTER AXIS.

- Upstream hole in yoke is between $Z = -1392$ mm. And $Z = -1472$ mm.
- B outside magnet is small.

