A1900 BEAMLINE DIPOLE DESIGN PROGRESS

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Design of the coil bobbin package for the A1900 dipoles has been completed. Parts have been fabricated and are in house, with assembly ready to begin early in 1998. Magnetic calculations [1] were completed in 1996. Dimensions from these calculations were used to begin the layout of the steel yoke and pole tips. This established the coil bobbin cavity in the yoke and the coil bobbin structural design began. The distance between the coils had to be increased from 11 cm in the original calculations to 16.916 cm to allow space for the LN2 shield and cryostat beam line window tubes. Magnetic calculations with the new coil and steel configuration showed an increase in current density from 6000 A/sq. cm to 6450 A/sq. cm for a 2T field in the gap. The field in the coil decreased, giving a 20% decrease in the resultant coil forces. The direction of the resultant forces changed also such that the symmetric forces across the median plane increased 34%, and the forces in the median plane of bending decreased 38%. There is no influence on the support links that are used to center the bobbin vertically, because the coil forces perpendicular to the median plane are symmetric and relatively insensitive to small changes in coil position. The bobbin stiffness and horizontal support links resist the forces parallel to the median plane. The decrease of these forces allows for reduced horizontal link areas making them more cryogenically efficient, as well as smaller bobbin displacements. The bobbin walls will be 1/4-inch stainless steel plates, and there will be a LHe space between the two coils. Figure 1 shows a typical cross section of the coil package. The bobbin will have a helium dewar that will have a reserved capacity of approximately 110 liters with an estimated heat load of .551 watts and a boiloff rate of 0.887 liters LHe/hr at 1.2 atm. Because the first dipole will be in a high radiation area and may need to be repaired the dewar was placed at one end of the magnet (Figure 2) and could not overhang the upper yoke, for this would cause difficulties in disassembly if the magnet ever needed repair. Increasing the distance between the coils meant there had to be an increase in the thickness of the pole tips and center yoke steel. The additional steel brought the total weight of the dipole magnet to approximately 54 tons.

A design for a coil-winding fixture is complete. Parts have been fabricated and have been assembled. Coil winding is scheduled to start in March of 1998. The coil cross section dimensions are 3 cm by 5 cm. It will be a potted coil with a layer of epoxy

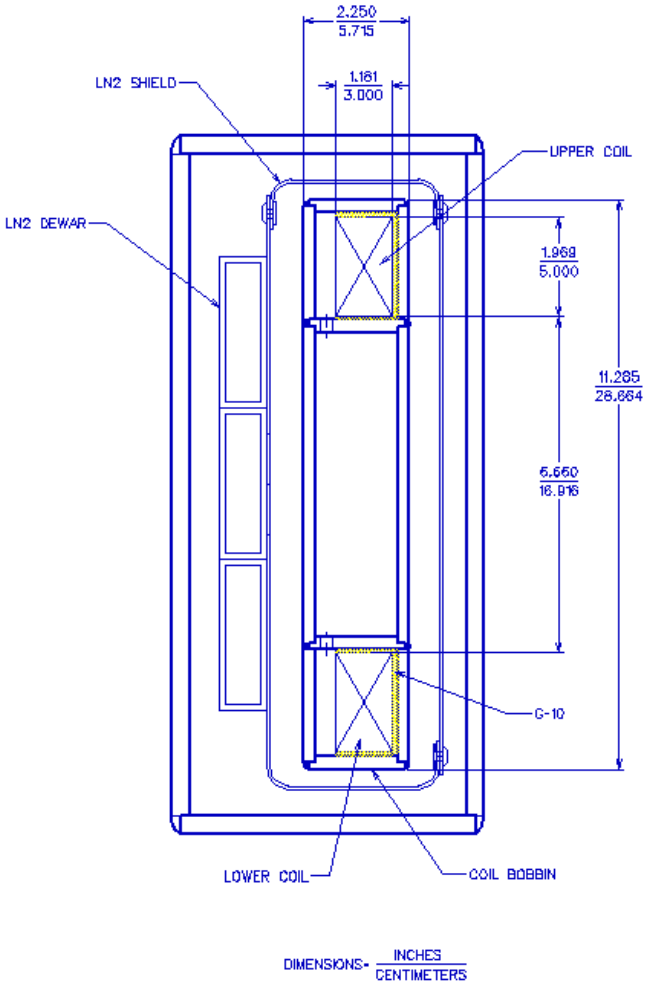

Figure 1: Typical cross section of A1900 beamline dipole cryostat, LN2 shield and coil bobbin.

coated paper between each layer. Since the coils are similar in size to the S800 spectrograph dipole coils, the same turntable will be used to wind the coils for the A1900 beamline dipoles.

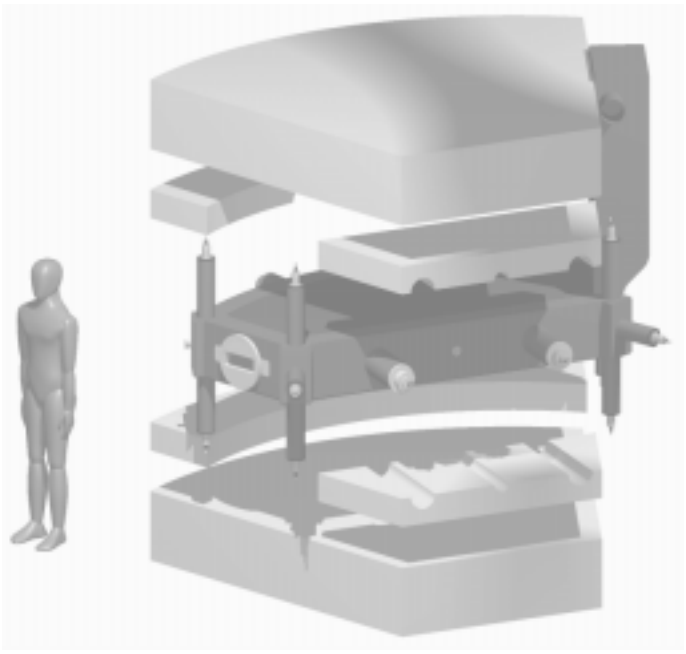

Figure 2: Exploded view of A1900 beamline dipole showing cryostat assembly and steel yoke slabs.

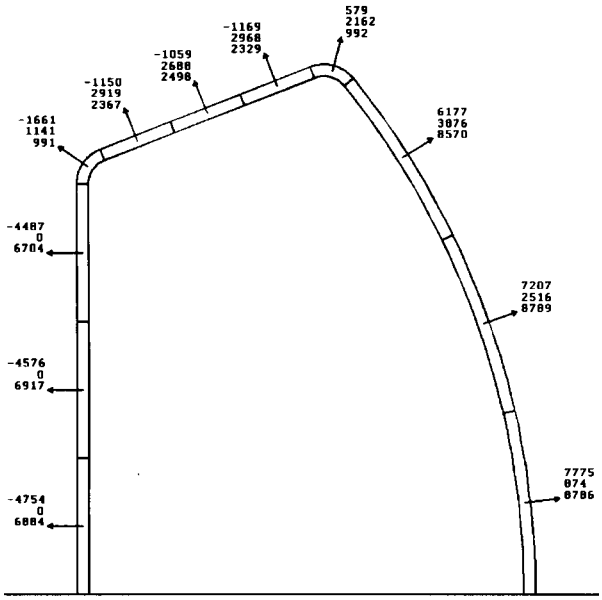

Figure 3: Top view of the dipole coil with forces in Newton's. The three numbers correspond to Fx, Fy, Fz with the z axis vertical coming out of the plane and x pointing to the right.

Ten G-10 tension links (8 vertical and 2 horizontal), similar to those used in the S800 quadrupole triplets [2], will be used to support and position the coil bobbin inside the cryostat. The four upper vertical links will carry a load of about 1500 lbs. each with the other six links used primarily for positioning the coil. Four horizontal G-10 tube compression links will also be needed to counteract outward coil forces during magnet operation. Each compression link will need to support 5,000 lbs.

The LN2 shield design is complete. There will be two LN2 dewars brazed to the outside copper plates along the curved and straight sections of the shield. Their construction will consist of three 1" x 3" stainless steel rectangular tubes (Figure 1) and will hold about 20 liters of LN2.

The cryostat design is nearly complete with only the NMR probe carriage and faraday bars yet to be designed.

With a total magnet weight of approximately 54 tons, the magnet exceeds the weight limit of our crane, and the dipole cannot be moved from its assembly area to its place in the beamline in one piece. The first step will be to place and position the lower yoke and lower center yoke slabs in the beamline. Next, the cryostat/pole tip assembly will be positioned on the lower yoke slab. The remaining upper yoke and center yoke slabs will then be installed.

References

1. Johnson, F. Marti "Magnetic Calculations of the A1900 Dipole I." April 1996
2. Wagner, J. DeKamp, A. Zeller, S. Alfredson, R. Swanson, R. Zink, B. Zang "S800 Beamline Magnets and Spectrograph Quads Progress Report", NSCL 1995 Annual Report.