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General Information:

Hall-D Tagged Photon Spectrometer Magnet Technical Description

General Description:

1. Dipole magnets and coils.

The Hall-D Tagger consists of either one or two "C" type nearly identical dipole magnets. The decision whether or not to build one long magnet or two shorter magnets will depend on the availability of magnet iron and the capabilities of existing manufacturing companies. The magnet design is a conventional room temperature design with copper conductor coils. The magnet(s) have rectangular pole faces and all the magnet yokes are made from simple rectangular shapes. The operating field will be 1.5 Tesla but enough margins have been left for operating at 1.8 T if required in the future. A 30 mm pole gap is used in the design. If it is decided to construct two magnets then they will be placed in series, and the separation between them will be 40 cm. Our present conceptual drawing for the magnet is shown in figure 1. A single magnet would be 6.2m long while if it was decided to manufacture 2 magnets then each would be 3.1m long.

The pole shoes have a simple rectangular shape with rounded edges. Due to space considerations the magnet poles are integrated into the vacuum chamber forming the top and bottom of the chamber. There is a small step around each pole shoe, which provides a sealing surface between the pole shoe and the vacuum chamber. A Purcell filter of 1.0 to 1.5 mm is assumed between pole shoes and yokes. Material and fixations, e.g. bolt positions, have to be chosen such that the requirements listed in items 5 to 10 below can be met. Therefore, high quality steel (AISI 1006 or equivalent) is assumed for the pole shoes.

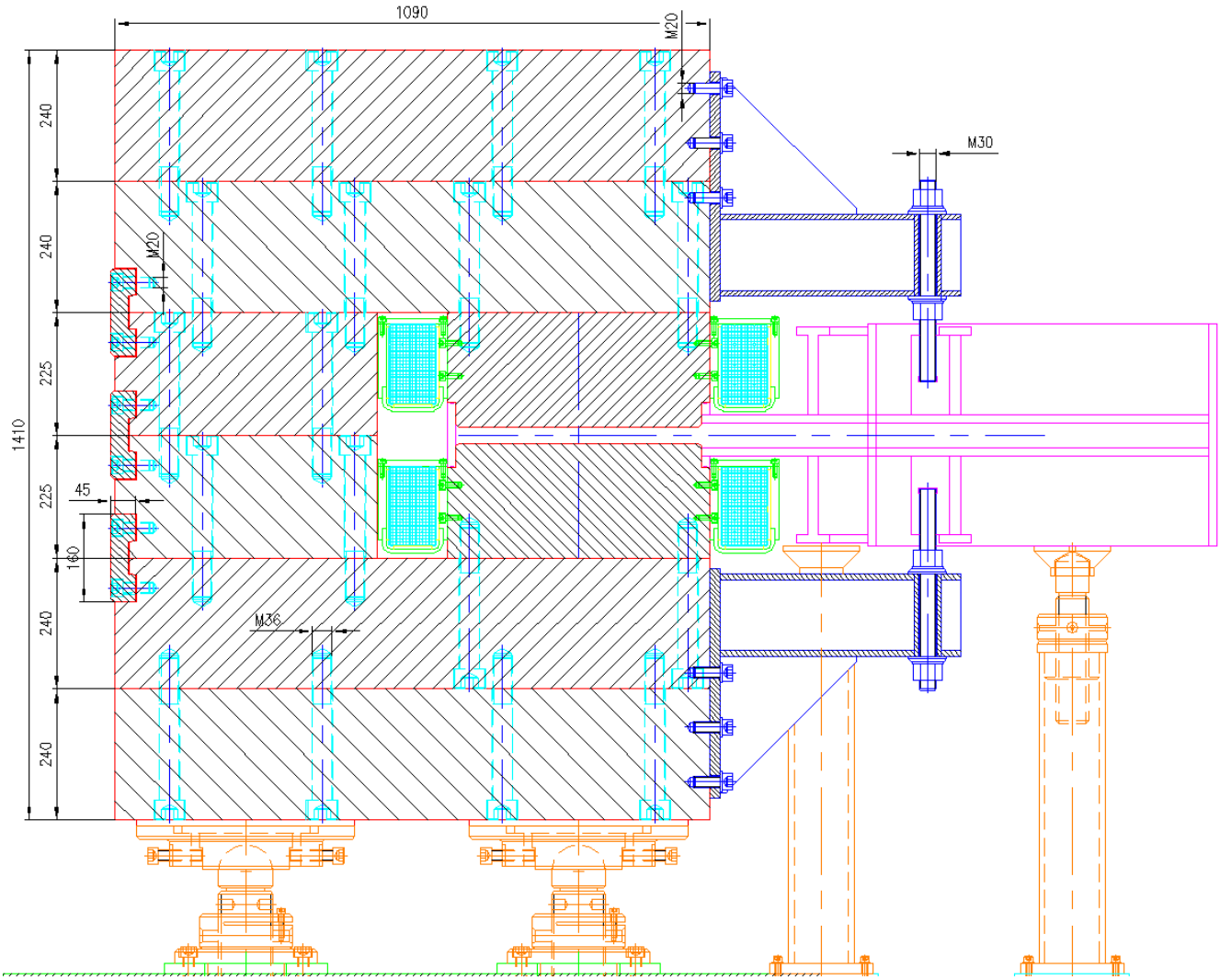

Figure 1: Sketch of proposed dipole.

Specifications

1. Magnetic field: 15.0 kGauss

2. Pole gap: 30 mm

3. Proposed coil parameters (two magnet design):

There are a total of 4 racetrack shaped coils for the two dipole magnets, which are connected in series. These coils are constructed from square section copper conductor (11×11) mm^2 with a central water channel 7 mm in diameter. The total number of ampere turns is chosen to provide a maximum field of 18 kGauss. The coils should be vacuum impregnated.

Total number of ampere turns for each magnet	61560
Conductor configuration of each coil	7×12
Current density for 61560 amp turns	4.44 amp /mm^2
Electrical resistance of each coil	0.124 Ω
Current in conductor	366.43 amps
Voltage drop across 4 coils connected in series	181.7 volts
Total power consumption	67 kWatt
Cooling circuits per coil	7
Total flow rate for 20 deg. Centigrade rise	80 l/min
Water supply pressure drop	2.0 atmos
Outside dimension of each coil	(92×152) mm^2

4. The pole shoe edges should be rounded with a radius of at least three times the O-ring diameter used to provide the vacuum seal.

5. The gap between the pole edge and the inner surface of the coils is 20 mm and should vary by less than ± 2mm.

6. At 1.5 T, the magnetic field in homogeneity should be better than 1 part in 10^4 along any 100 mm length lying inside an area defined by a line drawn around a pole surface which is two gaps in from the pole stem. Within this area the maximum variation in the magnetic field should be less than 1 percent.

7. The pole faces should have a parallelism such that the variation in the pole gap should be less than 0.02 mm along any 100mm length on a pole surface. The variation in gap size should be less than 0.2 mm over the complete area of the poles.

8. The pole surfaces, which form part of the vacuum system, should have a protective covering, e.g. Ni impregnation.

9. The poles for both magnets should have small alignment holes defining the input, output and central ray trajectories: i.e. 3 trajectories per magnet.

10. The variation in the pole gap between zero field and a field of 15 KGauss should be less than 0.2 mm at any point on the pole surface.

11. There should be tapped holes for attaching jacking supports to the dipole yokes for use in the assembly and disassembly of the dipoles.

12. A non-magnetic gap (Purcell filter) of 1.0 to 1.5 mm is assumed between pole shoes and yoke.

Summary of requested dimensions and tolerances for the two magnet option

Rotation of first magnet from normal to the primary beam	5.90deg
Length of dipole magnets (2 magnet design)	3.09m
Separation distance of dipole magnets	0.40m
Rotation of second dipole from normal to the primary beam	6.792deg
Accuracy of final positioning of the magnets	0.2mm
Gap between pole edge and inner surface of coils	20mm ± 2mm
Pole gap	30mm
Variation of pole gap over complete area of the poles	< 0.2mm
Variation of pole gap between fields of 0.T and 1.5T	< 0.2mm
Variation of vacuum chamber gap between fields of 0.T and 1.5T	< 2.0mm