Application Note 1070-204

Stray Magnetic Fields and Quantum Design Cryostats

The superconducting magnets used in the Quantum Design PPMS, MPMS, and VersaLab cryostats produce very strong three dimensional magnet fields that will permeate the laboratory. Please read carefully about magnet and cryogen safety precautions in the relevant hardware manual before working with these magnets. This application note discusses the stray fields that will be seen in the laboratory for a given magnet when charged to its maximum rated field. Table 1 lists the radius of the 5 gauss line along either the horizontal or vertical axis of the dewar for each QD cryostat (the 1 gauss line can be extrapolated from the 5 gauss data using the far-field equation for a magnetic dipole $B \propto r^{-3}$ where r is the distance to the dipole). Note that we are referring to the *total magnitude of the magnetic field* here. For generality, the horizontal radius $R_{horizontal}$ is measured from the center of the magnet and at the height of the center of the magnet. However, $R_{vertical}$ is measured from the top plate of the dewar. Table 2 lists the dewar radius R_{dewar} defined as the radial distance from the center of the magnet to the edge of the dewar, for various Quantum Design dewars. Thus, to obtain the horizontal distance from the edge of the dewar to the 5 gauss line, subtract the appropriate dewar radius from the horizontal distance listed in Table 1. All dimensions are visually defined in Figure 1 below.

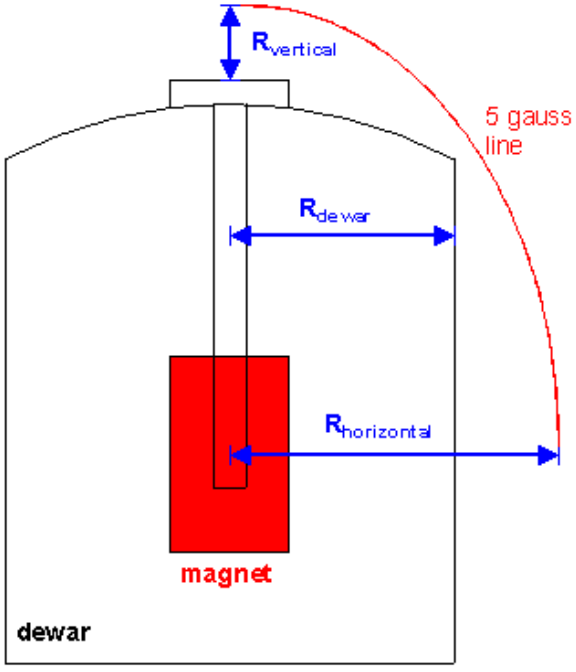

Figure 1

Table 1. Location of 5 gauss line in meters.

Magnet	$R_{horizontal}$ (m) 5 gauss	$R_{vertical}$ (m) 5 gauss
MPMS XL 5T	0.71	top of dewar
MPMS XL 5T shielded	inside shield	*inside shield*
MPMS 7T	0.76	0.05
MPMS 7T shielded	inside shield	*inside shield*
PPMS 7T	1.07	0.61
MPMS SQUID VSM	0.51	0.28
PPMS 7T shielded	0.41	*inside shield*
PPMS 9T	1.27	0.76
PPMS 9T shielded	0.46	0.30
PPMS 14T	1.83	1.35
PPMS 14T shielded	1.22	0.81
PPMS 16T	2.77	3.00
PPMS 16T shielded	1.75	2.01
PPMS 7T transverse [1,2]	2.54	0.84
PPMS 9T DynaCool [3]	0.63	0.30
PPMS 12T DynaCool [3]	1.60	1.5
PPMS 14T DynaCool [3]	2.25	2.20
VersaLab 3T	inside skin	0.06

Table 2. Dewar/cryostat radius in meters.

Dewar/Cryostat Type	R_{dewar}
standard	0.24
nitrogen jacketed	0.27
high capacity nitrogen jacketed, 14T, 16T, 7T transverse	0.36
MPMS SQUID VSM	0.38
DynaCool Cryostat	0.33

Notes on Table 1:

1. In the case of the 7T transverse magnet, the field axis is horizontal, while for all others it is vertical. Horizontal measurements for 7T transverse were made along the axis of the magnetic field which points toward the front of the dewar; field strength along the other axes are approximately half as strong.
2. The vertical 5 gauss line for the 7T transverse magnet below the dewar is located 1.2m below the floor (the magnet center is 0.38m above the floor).
3. The PPMS DynaCool cryostat does not have a "dewar top plate". In this case, the distance of the 5 gauss line in the vertical direction is measured relative to the chamber KF flange without a centering ring or blanking plate installed. For comparison, the KF flange is approximately 7.5 cm above the dewar top plate on a standard PPMS. The top of the DynaCool enclosure is within 1 cm of the KF flange, so the vertical 5 gauss line is approximately the same as measured from the KF flange and the top of the enclosure.

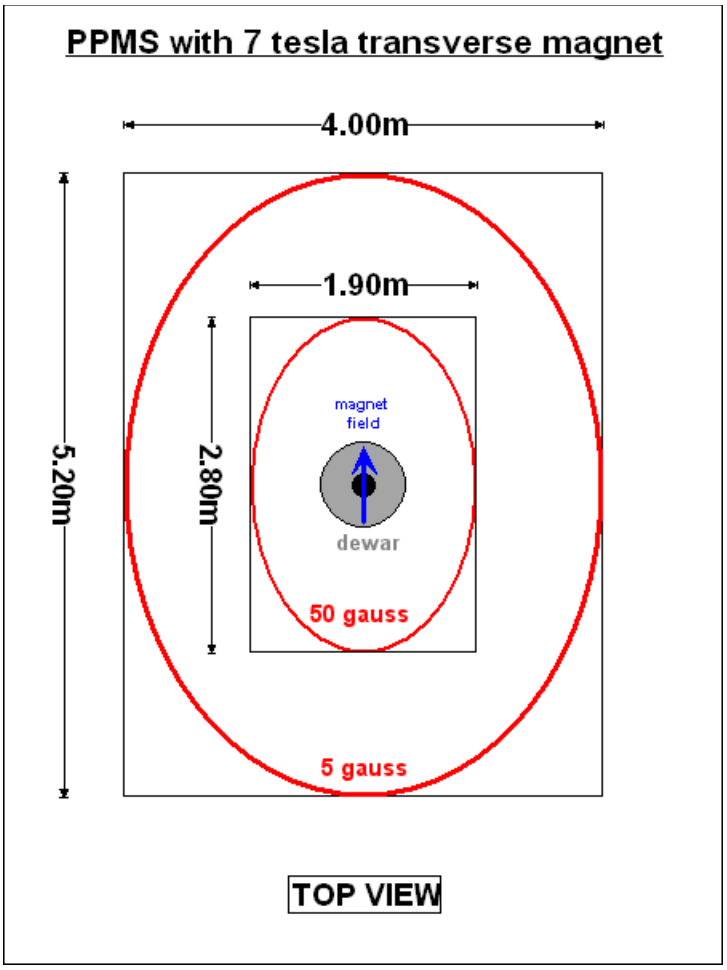

Figure 2

Stray field map for the 7T transverse PPMS. The 5 gauss line is relevant to safety considerations. All PPMS electronics that is external to the dewar must be outside the 50 gauss line.