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Subject: Magnetic Field Measurement
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Hi Janeen,

This is the email I mentioned that is a summary of the presentation I gave in Dec. It was a response to an email that Dennis sent me, but, I could not find it in my sent-mail file so it may not have made it to Dennis, hence I am also sending it to Dennis.

Let me give you a summary of the short presentation that I made in Dec.:

1) Original scope: determine if generated field is of some concern or of no concern. If of some concern, schedule more detailed measurements. So, if we stick to the original scope, we should schedule more measurements and not rely heavily on what we got done in 2 days.

2) We generated fields with each of 4 actuators (1 of the 3 sets).

3) We measured V across one ohm resistor in series with actuator in order to set current through actuator to 1A (stage 0-1) or 0.3A (stage 1-2) Two different frequencies were tried, 380 Hz and 11 Hz.

4) I scanned the fields above the surface of the table (using a Bartington magnetometer set on foam that raised it about 10 cm above the surface of the table) and recorded only the highest value that I found. These values were then scaled according to the expected actuator currents that I obtained from Brian L. Thus, the highest measured field for stage 0-1 horizontal actuator driven with 1A at 11 Hz was about 1uT. Scaled down by 20, the expected worst field is about 50pT.

This was the largest expected field that I obtained, and the largest relative to the ambient background, which is generally in the tens of pT at this frequency.

5) The scale of spatial field variations was smaller than the minimum distance between 2 magnetometers, so I obtained gradients from differences between sequential field measurements using a single magnetometer at slightly different positions. A quick survey this way is impossible, so I assumed that the worst gradients would be found where the fields were greatest, and made gradient measurements only for the 0-1 horizontal actuator (at both 380 and 11 Hz). After scaling my measured values by

B.L.'s expected currents, I got a worst expected gradient of 100pT/m at
11
Hz. This is about 10 times the ambient field gradient backgrounds that
I
have measured at the sites.

6) The gradients above the actuators were so large that the optic support structure- produced gradients did not overwhelm them. Thus the optic support structures did not increase the estimated maximum expected gradient.

7) An approx 8.5x11 inch sheet of 0.004 inch mu-metal reduced fields at the level of the optic magnets by a factor of about 5 either when it was inserted into a space above the 0-1 horizontal actuator, or when it was placed on the bottom of an optic support structure.

8) Things to worry about:

a) I noticed that the table seemed to produce fields at about 59 Hz
that
were one or two orders of magnitude above ambient background 10 cm
above
the table. My interpretation was that this field (that was 1 or 2
orders
of magnitude smaller if I moved a meter or so from the table) was
produced
by motor-induced table motion relative to the earths magnetic field
(thereby modulating the earths field at 59 Hz). My concern is that
there
are large structures in the isolation system that can deform the earths
magnetic field and these structures are close to, and moving relative
to,
the magnets on the pendula. For example, in the HAM chamber,
the magnets on the optics will be only
decimeters away from stage 1 of the active isolation system. Stage 1
will be moving with the ground (albeit with some attenuation), while
the optic (along with the earths field) will be in a much more inertial
frame. Since stage 1 will be distorting the earths magnetic field and
moving, it will be modulating the earths field at the position of the
magnets. I dont know how important this "short" will be, but I think it
is
worth considering. Is there a possibility of a similar seismic "short"
associated with the static charge actuators?

b) I have not calculated the expected actuator fields at the resonant frequencies of the pendula.

Robert