LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

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Available Height above the HAM Optics Table

Dennis Coyne

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This is an internal working note
of the LIGO Project.

California Institute of Technology
LIGO Project – MS 18-34
1200 E. California Blvd.
Pasadena, CA 91125
Phone (626) 395-2129
Fax (626) 304-9834
E-mail: info@ligo.caltech.edu

Massachusetts Institute of Technology
LIGO Project – NW17-161
175 Albany St
Cambridge, MA 02139
Phone (617) 253-4824
Fax (617) 253-7014
E-mail: info@ligo.mit.edu

LIGO Hanford Observatory
P.O. Box 1970
Mail Stop S9-02
Richland WA 99352
Phone 509-372-8106
Fax 509-372-8137

LIGO Livingston Observatory
P.O. Box 940
Livingston, LA 70754
Phone 225-686-3100
Fax 225-686-7189

http://www.ligo.caltech.edu/

Abstract

Advanced LIGO configurations will employ multiple pendulum suspensions which have a greater vertical extent than the single suspensions in the initial LIGO configuration. The available height above the optics table in the HAM (Horizontal Access Module) chambers, in particular, may constrain the length of the multiple pendulum designs for the input mode cleaner, output mode cleaner, power recycling and single recycling suspensions. The elevation view for the optomechanical in-chamber layout drawing, D970309, gives a non-precise indication of the height available. This technical note documents the available height above the HAM optics table, as a function of the elevation of the HAM optics, (which at the time of this report is a variable parameter for advanced LIGO configurations). It is anticipated that this information will be used to make a decision on the proper elevation of the HAM optics tables and on the appropriate length of the multiple pendulums.

1 HAM Chamber Geometry

The geometry of the HAM shell is basically the intersection of two cylindrical shells:

- a 84.25" ID cylinder with an axis set perpendicular to the laser beam axis and 200 mm below the global x-y plane
- a 60.50" ID cylinder with an axis set parallel to the laser beam axis and 100 mm below the global x-y plane

However, there are internal attachment brackets welded to the interior of the 84.25 ID shell every 30 degrees. A conservative approach is to assume a shell which is reduced in radius by the depth of these brackets, i.e. 1.5" In addition there are two 10" nozzles and one 14" nozzle on the top of the chamber which add small niches, but I would advise against attempts to use this space as well.

The coordinate system used in this note is parallel to the LIGO global coordinate axes but centered horizontally in the HAM chamber. The global x-y plane is defined as a best fit to the centerline of the beam tubes:

- LIGO-1 HAM tables are 200 mm below the global x-y plane
- LIGO-1 BSC tables are 500 mm above the global x-y plane
- BSC chambers have their door nozzle centers in the global x-y plane
- HAM chamber "laser beam" nozzles have centers which are 100 mm below the global x-y plane

The HAM Chambers dimensions are taken from the following PSI Drawings:

V049-4-128, HAM Shell Weldment

V049-4-002, HAM Assembly

In additon, the HAM Seismic Isolation (SEI) optics table will mate to the existing HAM Support Tube. Interfacing to this support tube helps to define a limit on the lowest position of the table. The support tube drawing is:

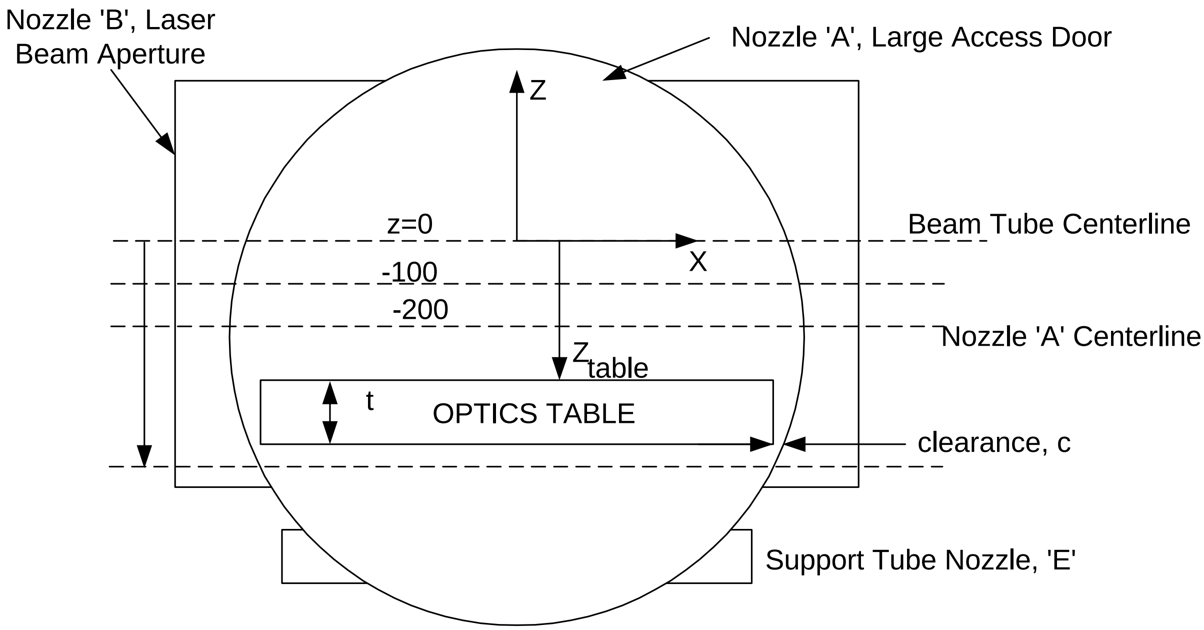
D972610-G, HAM Support Tude Weldment

In order to establish a reasonable lower bound on the lowest elevation of an optics table for advanced LIGO configurations, the thickness of the initial LIGO optics table was assumed to be representative:

D972

The HAM Chamber and optics table geometry is shown schematically in Figure 1.

Figure 1 HAM Chamber and Optics Table Geometry
(dimensions in mm)



2 Height Contours

Due to the intersection of the two principal shells, uniform headroom is not available above the optics table, as indicated in the height contour plot of Figure 2. The contours form a region on the table in the form of a cross, whose dimensions (indicated in Figure 3) are dependent upon the elevation of the optics table and the desired height above the optics table for the multiple pendulum suspensions. The variation in the parameters which define the layout area, with table elevation and desired height above the table, are given in Figures 4, 5 and 6.

Figure 2 HAM Optics Table and HAM Shell Intersection Curves
(dimensions in mm)

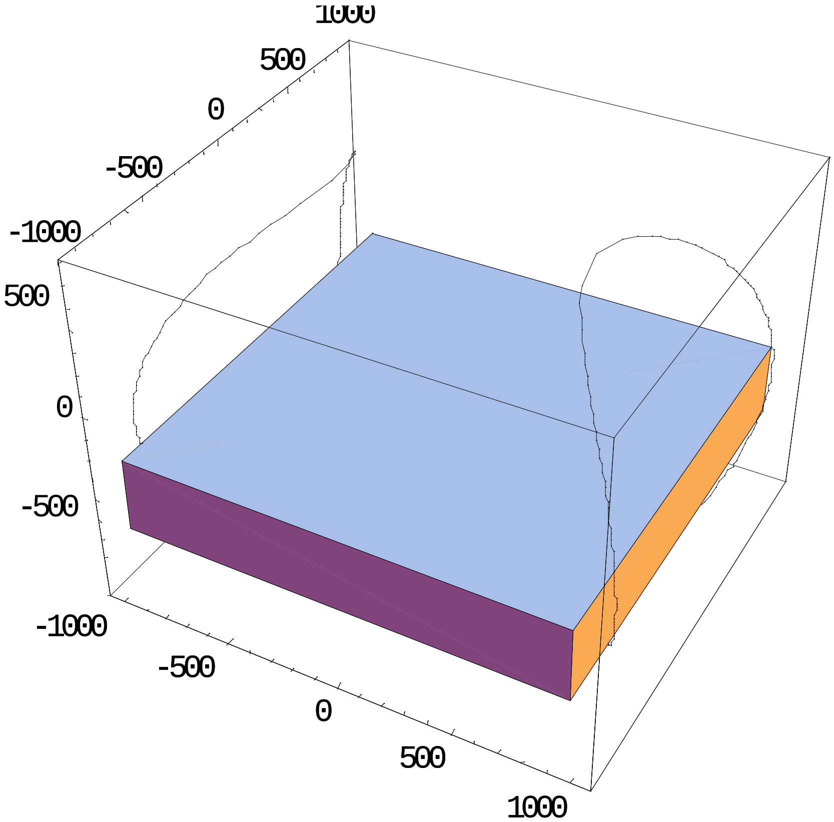


Figure 2 HAM Optics Table Exclusion Zone Contours
(dimensions in mm)

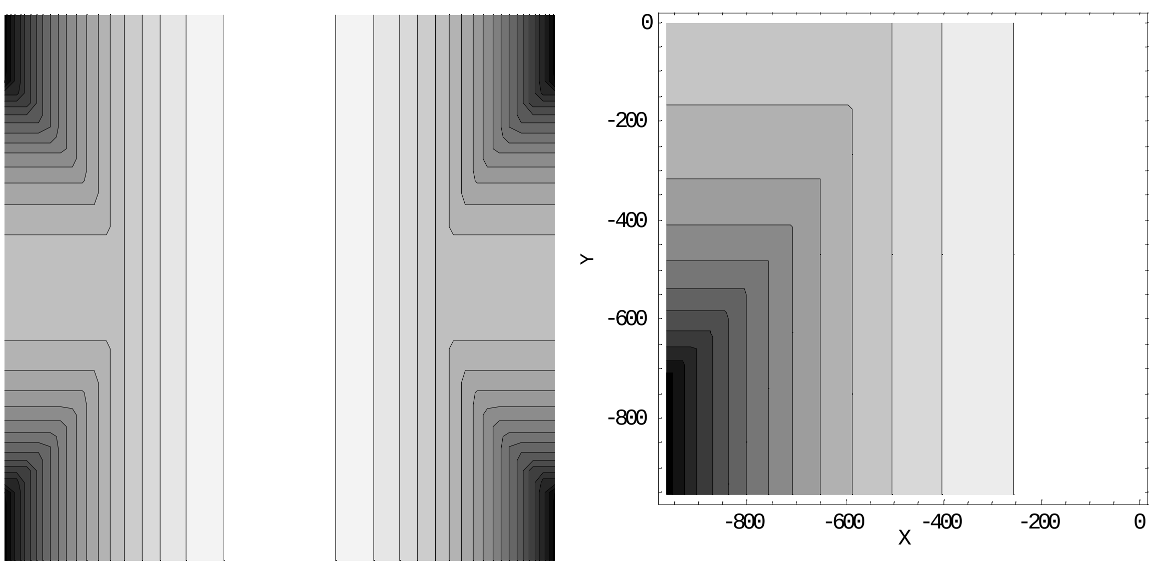


Figure 3 HAM Optics Table Exclusion Zone Geometry

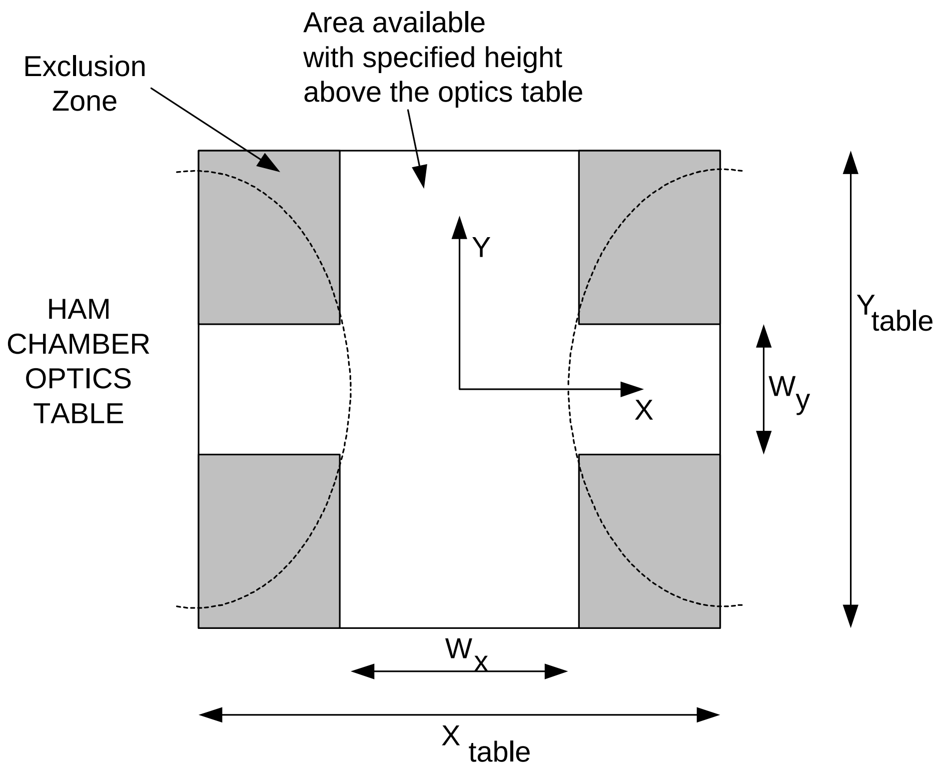


Figure 4 W_x as a function of Elevation above the Optics Table and Parameterized by Optics Table Elevation

[Top line is for Z_{table} = -200 mm. Each succeeding line is for the table set lower by 100 mm, so that the bottom, 6th line is at an elevation of -700mm]

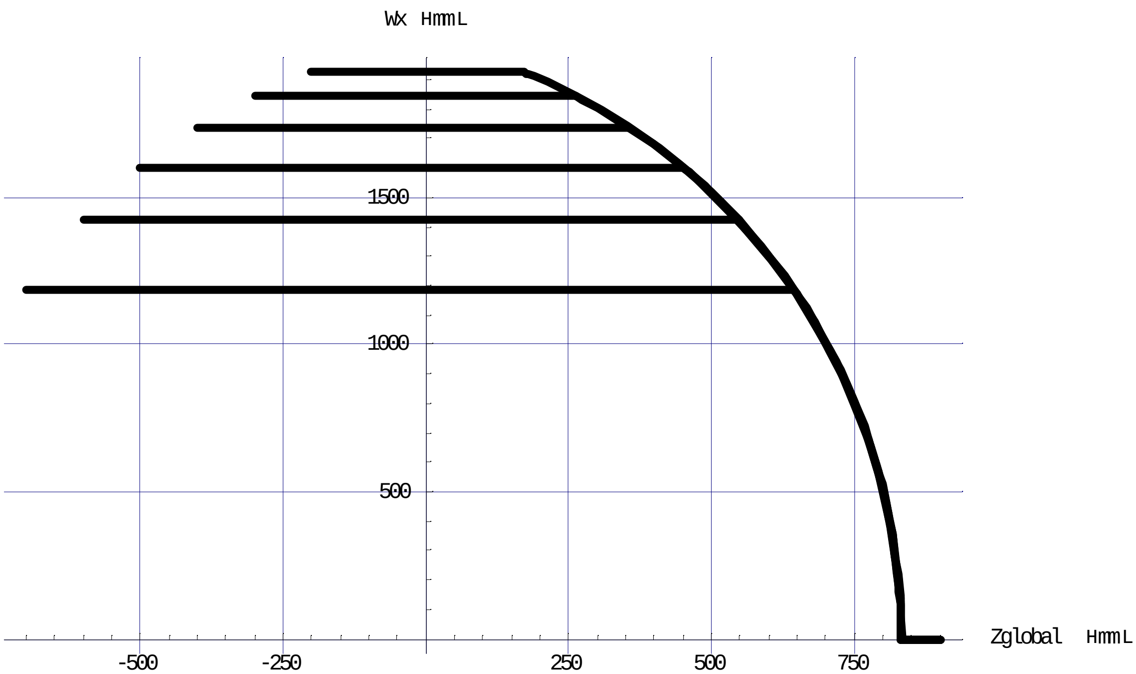


Figure 5 W_y as a function of Elevation above the Optics Table and Parameterized by Optics Table Elevation

[Top line is for Z_{table} = -200 mm. Each succeeding line is for the table set lower by 100 mm, so that the bottom, 6th line is at an elevation of -700mm]

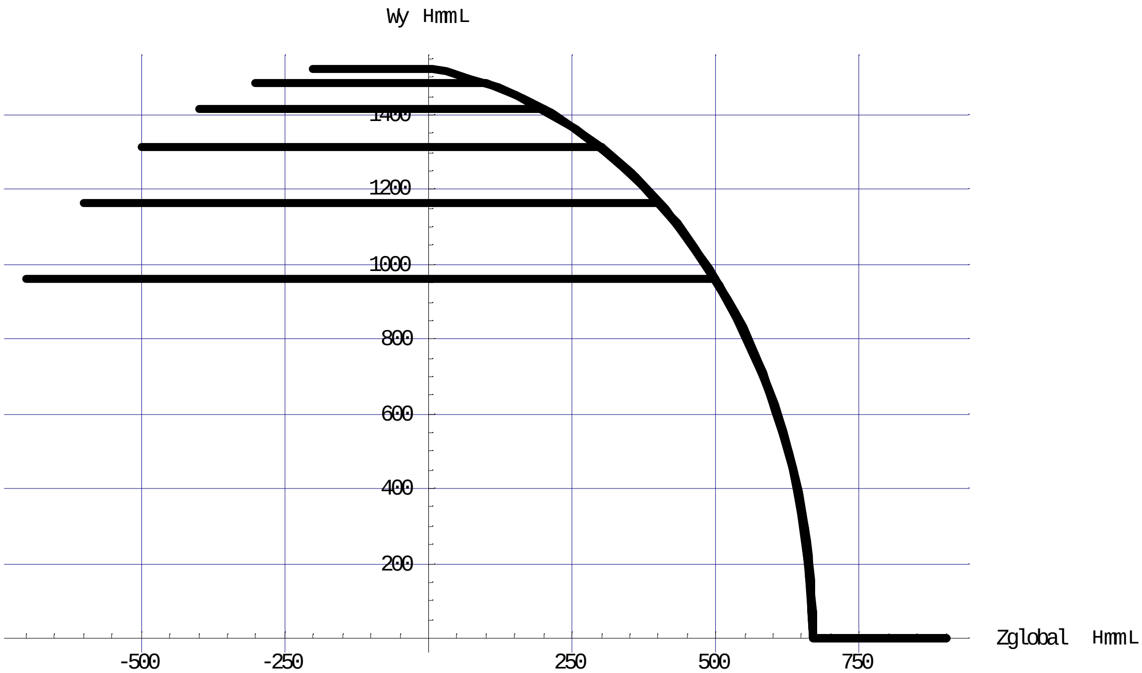


Figure 6 Layout Area (m^2)as a function of Elevation above the Optics Table and Parameterized by Optics Table Elevation

[Top line is for Z_{table} = -200 mm. Each succeeding line is for the table set lower by 100 mm, so that the bottom, 6th line is at an elevation of -700mm]