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**Analysis of the LMA coating profile
with new mask position**

Hiro Yamamoto

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of the LIGO Project.

California Institute of Technology
LIGO Project – MS 100-36
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 – NW22-295
185 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/>

1 Introduction

LMA changed the mask position to reduce the spiral pattern on the coating, which induces back scattered noise and could compromise the aLIGO sensitivity. This note analyzes the change of the coating profile measured on a larger optic, in 260mm aperture.

In the new coating, the dip at the center in the old coating is gone, and the fall off of the thickness starts at larger radius. The net effect is that the higher order mode in the cavity caused by the profile is better than the original coating.

2 Maps used for this analysis

In this analysis, following maps are used to evaluate the new coating profile by placing these maps for the ETM in a aLIGO FP arm cavity.

1. T1 : phasemap based on the measurements along 4 lines (45° separation) on a coated surface with the new mask position. The data is given within 260mm aperture, and filled by 0 outside.
2. T1sym : based on the same data as T1, but the map is assumed to be axi-symmetric.
3. ETM12 : ETM12 phasemap of the coated surface measured on the full surface.
4. ETM12C : ETM12 map, but is set to 0 outside of 260mm aperture.
5. ETM12LC : ETM12 map is fitted by Zernike(1,m) functions within the aperture of 300mm, and this is the summation up to $l = 16$. The map is 0 outside of 260mm aperture

Tilt and power terms calculated in 160mm central region are removed in the following analysis.

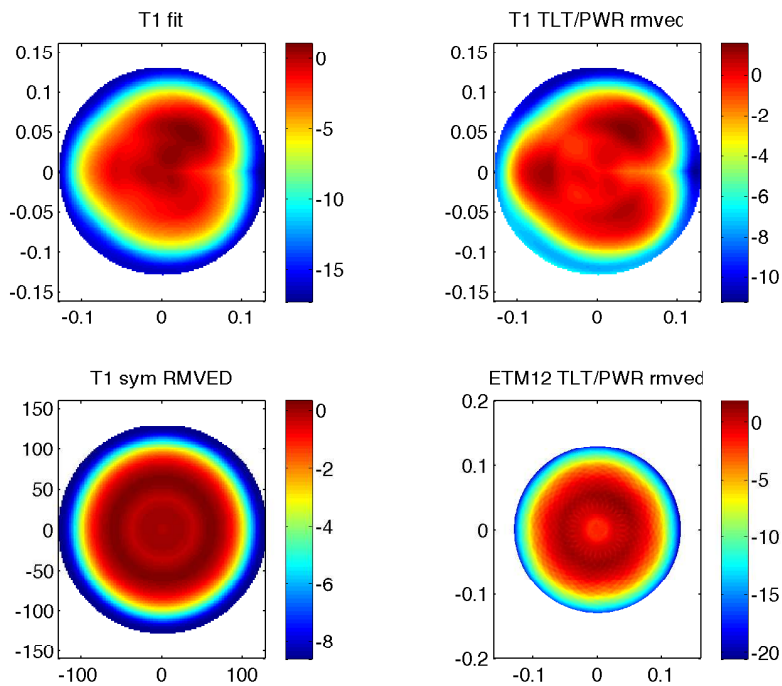


Figure 1 2D map profiles

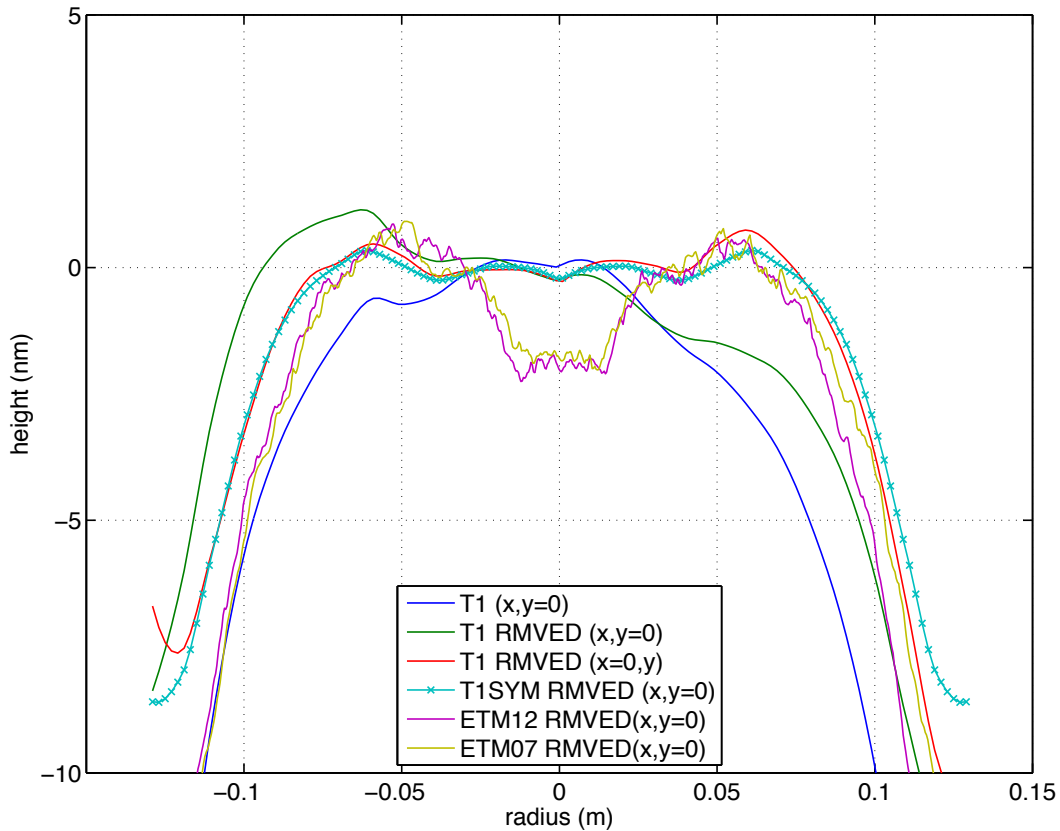


Figure 2 1D profiles

3 Analysis

These maps are placed in a FP cavity with $\text{RoC}(\text{ITM}) = 1934\text{m}$, $\text{RoC}(\text{ETM})=2245\text{m}$, $L_{\text{cav}}=3994.5\text{m}$, and the quantities in the following table were calculated.

ETM12C is used to see the size of the effect by using only the central 260mm region, and ETM12L is used to see the effect without high frequency components, like spiral structures.

	T1	T1 sym	ETM12	ETM12 C	ETM12 LC
HOM on ETM	67	25	87	89	86
L20 frac on ETM	4	4	37	31	31
L30 frac on ETM	0.3	0.3	18	32	34
L40 frac on ETM	8	9	5	3	1
L50 frac on ETM	4	3	2	0.7	1
Round Trip Loss	24	13	15	19	11

Table 1 Field contents in FP with ETM maps (in ppm)

The major concern of the original coating was the large lower order LG terms, like LG20 and LG30. These components are suppressed.

The round trip loss is harder to discuss without a real 2D map.

Based on the existing ETM coatings, the coating is quite axi-symmetric and the true map will be somewhere between T1 and T1-sym, closer to T1-sym.