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# Beamsplitter Substrate Design Long Lead Review



- **The proposed A+ Beamsplitter aspect ratio is presented here.**
- **Similarity to the aLIGO Beamsplitter design for all other design aspects reduces risk.**
- **Procurement of Suprasil 3001 blanks per D1900150 should not wait on full design and drawing package since material procurement times are long**

# Motivation for a new Beamsplitter size

## Configurations. from G1800155

(BS size, RM size, beam offset)

aLIGO

Case 1 (37,26,0),

Case 2 (37,26,6),

A+

Case 3 (45,26,0),

Case 4 (45,26,6),

Case 5 (45,30,0),

Case 6 (45,30,6),

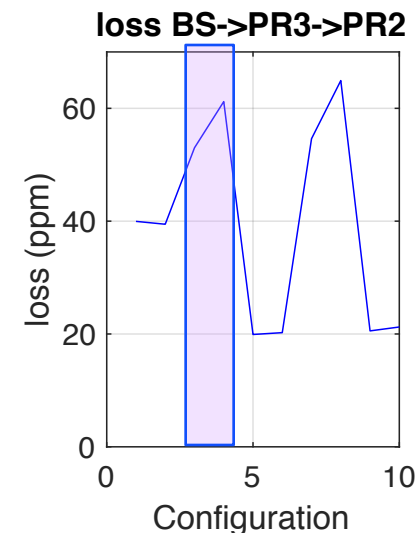
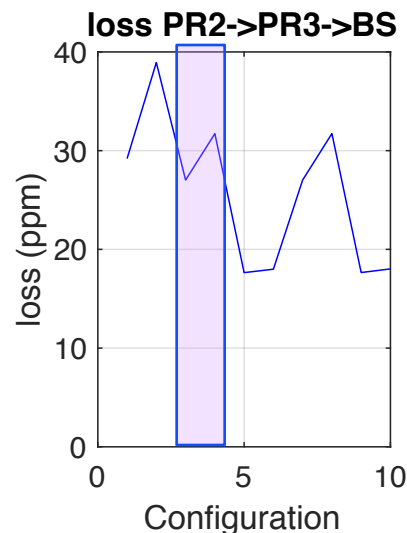
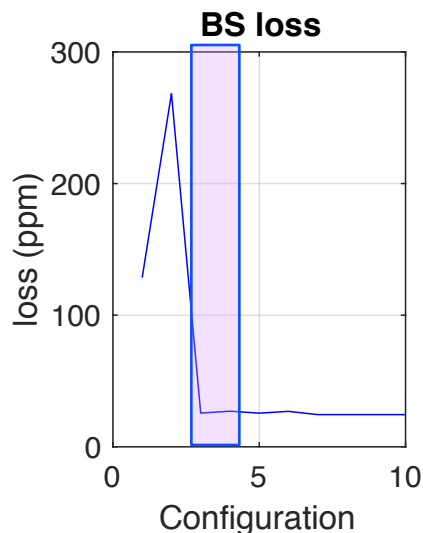
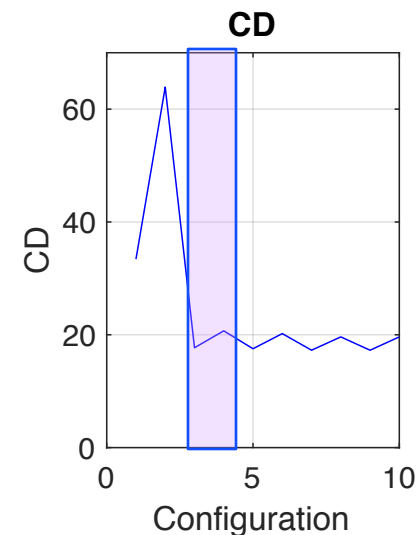
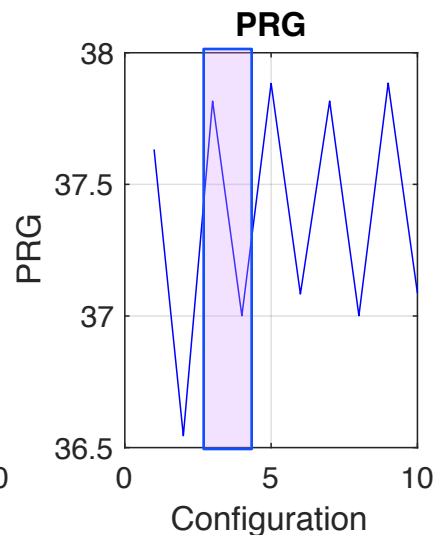
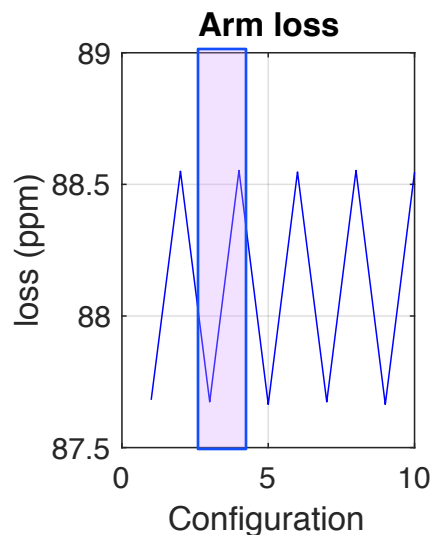
Case 7 (55,26,0),

Case 8 (55,26,6),

Case 9 (55,30,0),

Case 10 (55,30,6)

LIGO-G1901510-v1



# What is different from aLIGO?

- Diameter changes from 370 mm to 450 mm
  - » The central “clear” aperture will expand from 225-250 mm
    - Pertains to polishing and coating specifications only.
    - This is where we specify our best performance
    - 250 Is a round number that provides an additional  $\pm 8$  mm mis-centering of the IFO beams
      - Compare to the analysis of a 6 mm offset by Yamamoto in [G1800155](#) where a 450 mm diameter BS is shown to make the contrast defect much less sensitive to miss-centering.
      - The IFO will still suffer some performance loss with 6 mm miss-centering due to the limiting aperture of the recycling mirrors.

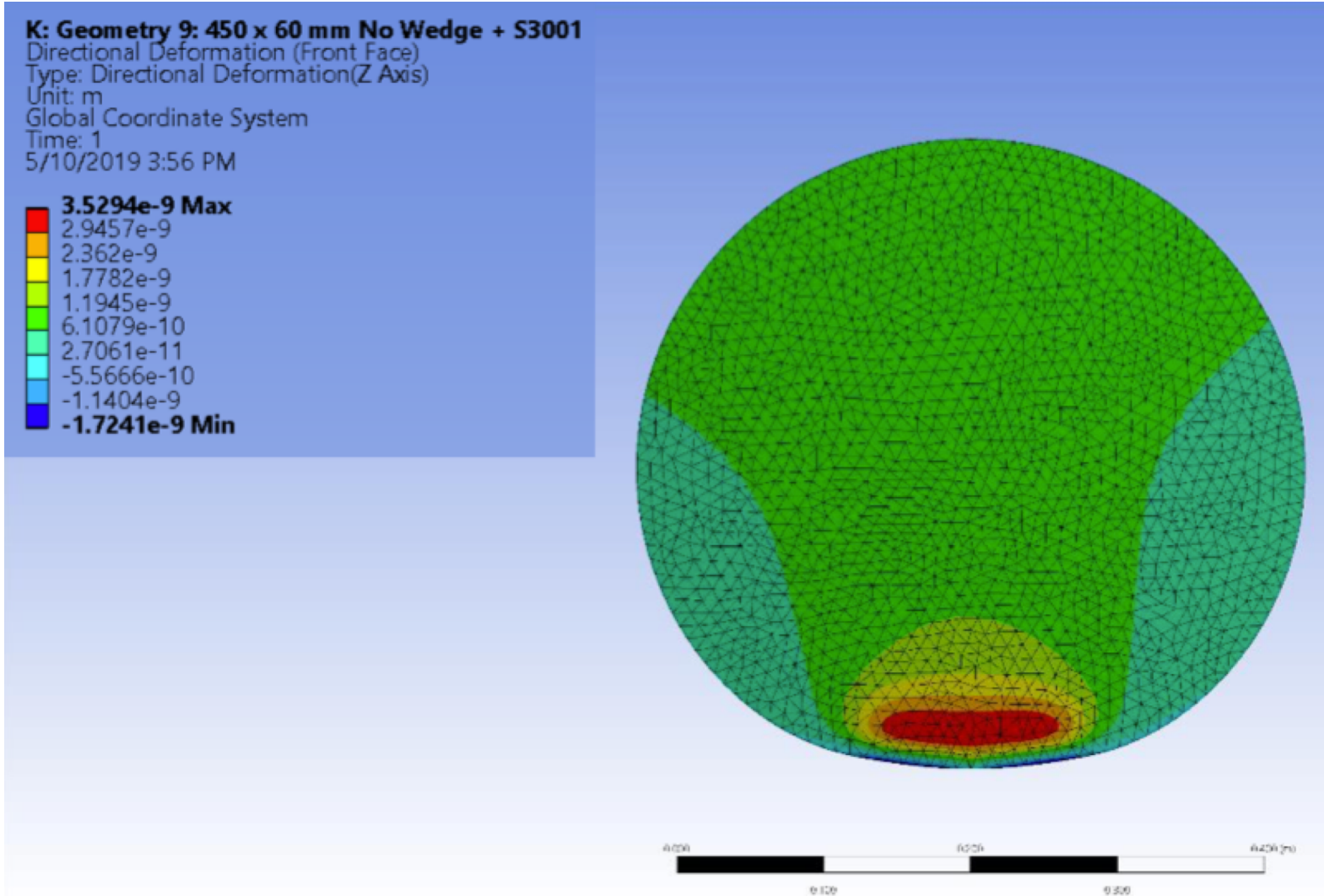
# No Change in Thickness or Wedge

- Minimize changes to the IFO system
  - » All lengths and positions stay the same
- What about the higher aspect ratio?
  - » Deformation of figure due to gravity is small compared to polishing error. Petterson, T1900258
  - » Coating stress must be compensated
    - Virgo Beamsplitter?
      - 550 mm x 65 mm
      - We have asked for results
    - CSIRO coating of FM06
      - HR stack was ~3x thicker than a beamsplitter

# Deformation due to gravity

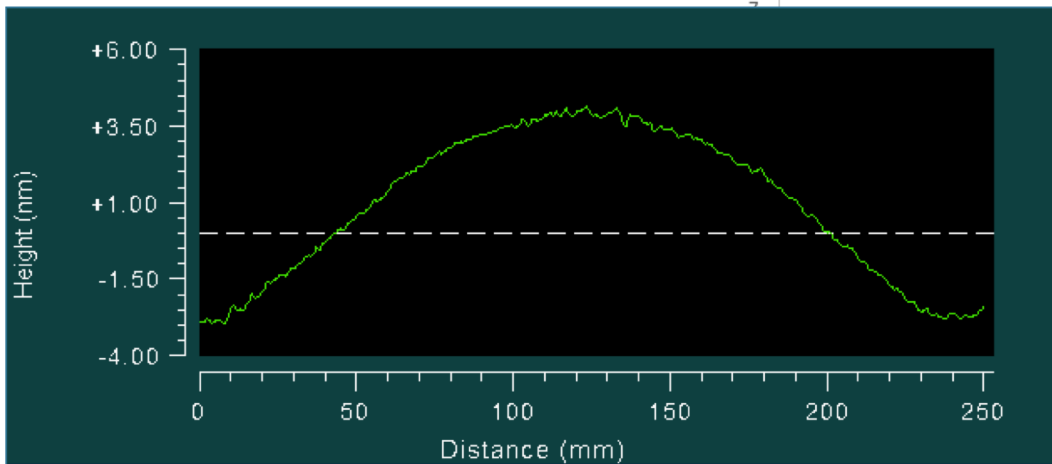
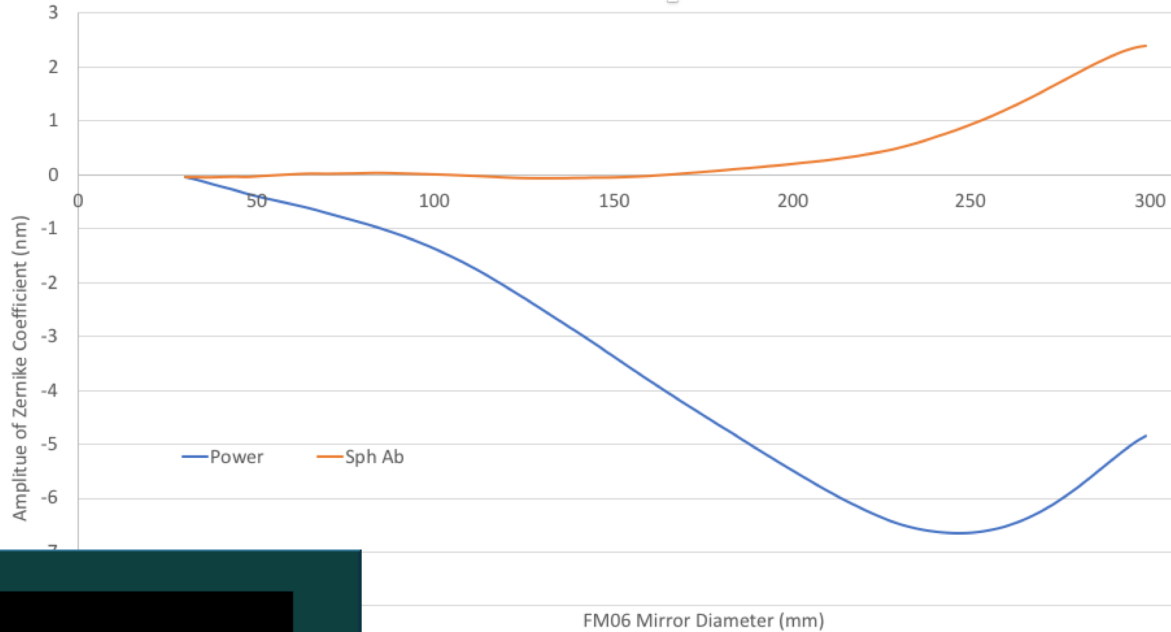


T1900258 Figure 7



# Coating uniformity and stress compensation demonstration

- FM06
- HR stack
- Coated by CSIRO
- Result: 7 nm sag at 250 mm diameter



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# What we know so far VIRGO BS coating uniformity

Uniformity HR BS Adv. VIRGO

—◆— C14038 (R=50% à 45°) Beamsplitter    
 —▲— C14039 (R=50% à 45°) Beamsplitter

Red text is commentary from G. Billingsley, measurements taken from the graph. 2 $\mu$ m coating design estimate is from aLIGO coating

