LIGO

Core Optics

LIGO Lab

April 5, 2001

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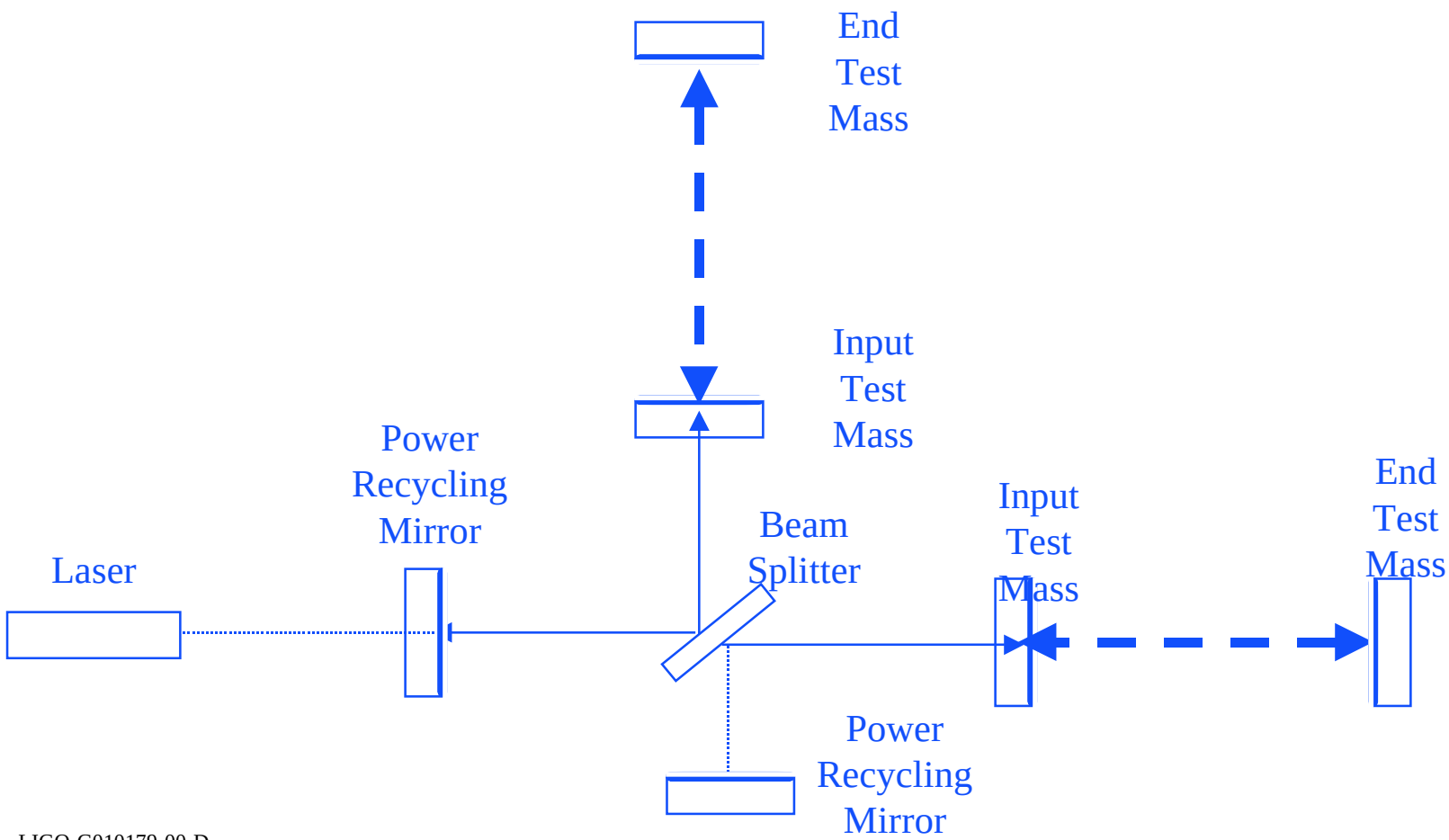
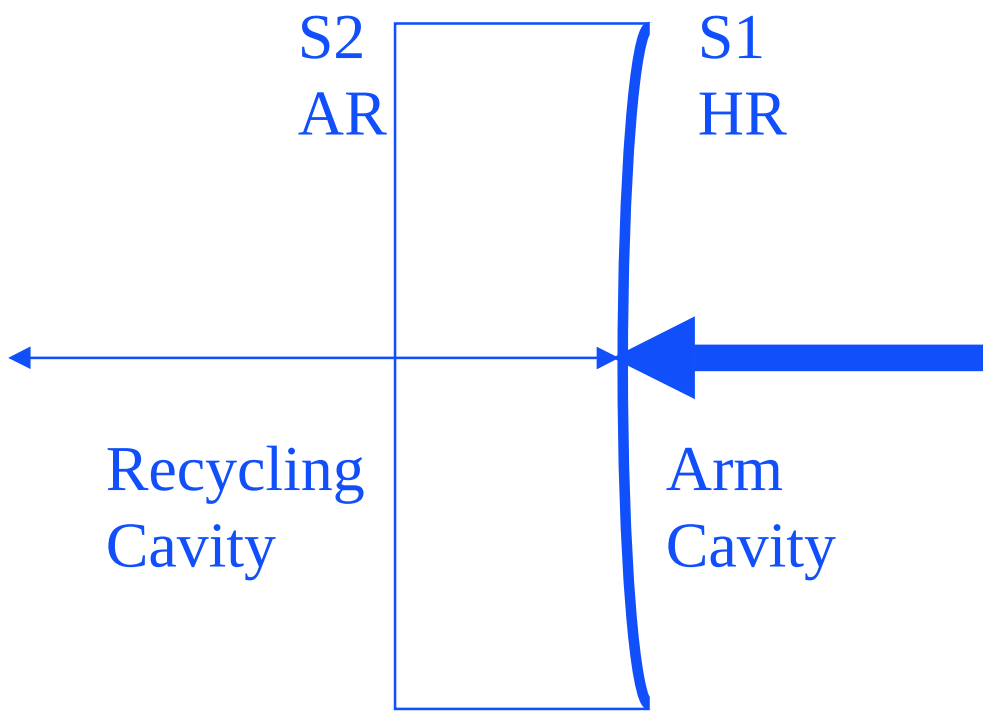
Advanced LIGO Core Optics



Input Test Mass

- S1 is a mirror for two Seperate Resonant Cavities
- ITM Design Drivers
  - » High Mass
  - » Minimal Mechanical Loss
  - » Minimal Absorption
  - » Good Thermal Condictivity
  - » Excellent Optical Properties



Current Specification
Figure over 200mm diameter

Surface 1: Spherical, concave.

Sagitta: Amplitude of the Zernike coefficient Z 2,0 as defined in Born and Wolf, 42 nm ± 5 nm

Astigmatism: Amplitude of the Zernike coefficient Z 2,2 as defined in Born and Wolf, < 5 nm

Surface 2 - Bulk homogeneity compensation: Nominally flat.

Figuring of surface 2 is intended for compensation of bulk inhomogeneity. There is no explicit requirement for the surface alone, only in combination with the bulk material.

Measured in transmission through Side 2, passing through the material, reflected from Side 1.

Sagitta: Amplitude of the Zernike coefficient Z 2,0 as defined in Born and Wolf, 73 nm ± 8 nm

Astigmatism: Amplitude of the Zernike coefficient Z 2,2 as defined in Born and Wolf, < 8 nm

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Current Specification
Low Frequency Error

The following root mean square standard deviation (rms) values are calculated from the phase maps which are to be provided with each optic. For this calculation the amplitude for the best fit Zernike terms Z 0,0 , Z 1,1, Z 2,0 and Z 2,2 is subtracted from the phase map. σ rms for the resultant phase map is defined as the square root of the mean of the square of each pixel value. Known bad pixels may be excluded from this calculation.

Surface 1, Frequency Band: < 4.3 cm -1

Measured over the central 200 mm diameter aperture: σ rms <0.8 nanometers

Measured over the central 120 mm diameter aperture: Goal for optimum LIGO system performance σ rms < 0.4 nanometers

Requirement for this procurement σ rms < 0.8 nanometers

Surface 2 - bulk homogeneity compensation, Frequency Band: < 4.3 cm -1

Measured in transmission through Side 2, passing through the material, reflected from Side 1

Over the central 200 mm diameter aperture: Goal for optimum LIGO system performance σ rms < 10 nanometers

Requirement for this procurement σ rms < 20 nanometers

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Suggested Specification

Compensated homogeneity:

(Where 2b1map is the phase map of a beam passing through side 2, the bulk material and reflecting off side1. S1flip is the measurement of side1 from the front, flipped about the Y axis, to represent Side1 as viewed from the back)

Measured through side2, bulk and reflecting off side1

(S2 and bulk) = -(2b1map + nS1flip) should be < 10nm rms goal, < 20 nm rms requirement

High Spatial Frequency

Surface 1 and Surface 2, Frequency Band: 4.3 - 7,500 cm -1

Goal for optimum LIGO system performance σ rms < 0.1 nanometers

Requirement for this procurement σ rms < 0.4 nanometers