New Folder Name Design Issues

Interferometer Design Issues, Highlighted by a Strawman LIGO Beam Layout

AA 15 February 1993

Summary: While working on a strawman LIGO beam layout, several interferometer design issues, needing further investigation, have been flagged.

1. The average distance between the recycling mirror and the input test masses (recycling cavity length) is $\sim 50\%$ longer for the interferometer with the beam splitter residing in the diagonal chamber[1]. Everything else being kept equal, the imbalance between the two arms has to be augmented by 50%[2], while the modulation frequency has to be decreased by one third.

2. The following aspects of light scattering need to be addressed in a systematic fashion:

   a. ~ 15 mW of green light are scattered from each test mass reflective coating. About a third of this is large angle scattering, such that the light would end up at the walls of the test mass chamber. The concept for a tentative solution[3] is presented in the enclosed sketch.

   b. ~ 10 mW will be scattered from the bulk of each test mass that acts as an input mirror for the 4 km resonators.

   c. Smaller, but still significant amounts of light are scattered from the reflective coating and the bulk of the beam splitter and the Mach-Zender pick-off, from the reflective coating of the recycling mirror, and from each anti-reflective coating inside the recycling cavity.

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1 compared with the interferometer using the vertex chamber

2 enough space is available in the TMC2 chambers

3 The nature of the problem needs to be better understood, though

3. We identified the need to draw up a list of signals[4] that have to be extracted. This will help answer questions like:

   a. Which reflected beams need to be photodetected.
   b. Which reflected beams have to be dumped.
   c. What are the reflectivities of various anti-reflective coatings, at components inside the recycling cavity. This, in turn, will help draw up an accurate stray beam count.

4. The beam splitter was assumed to be 12" in diameter and 2" thick. A detailed study of the relationship between optical power, beam diameter, and the resonances of the beam splitter appears to be desirable.

5. Some of the beams in the strawman layout are dumped at black, flat plates, or black baffles. A sufficiently absorbent, vacuum compatible material has yet to be selected and certified.

6. The requirements for and the design of the conical beam dumps have to be worked out in detail.

7. The design of photodetectors and associated optics, for large diameter beams[5], has yet to be carried out.

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[4] for frequency servos and alignment systems

[5] 6" in diameter, typically