



LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
RECORD OF DECISION/AGREEMENT (RODA)

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| Document | LIGO-M0900025-Y |
| Date: | 11 February 2009 |
| Title: | RODA: Decision to reduce the beam size on the ITMs to 5.3 cm |
| To the Attention of: | Aligo_sys, aligo_coc, aligo_aos, aligo_io |
| cc: | |
| From: | Name/Title: Peter Fritschel, Systems Scientist Name/Title: Garilynn Billingsley, COC Leader Name/Title: Mike Smith, AOS Leader Name/Title: Dave Reitze, IO Leader Name/Title: Dennis Coyne, Systems Engineer |
| Nature/ Scope: | Design Decision |
| Subsystem(s) affected | COC, IO, AOS |
| Primary Contacts | Peter Fritschel, SYS |
| Reference Documents: | G0810029-v4, "Beam Size Effect on Signal Loss" T0900043-v1, "Optical Layout and Parameters for the Advanced LIGO Cavities" |

DECISION/AGREEMENT STATEMENT:

The beam size on the ITMs is being changed from 5.55 cm to 5.3 cm (size refers to the $1/e^2$ power radius). The beam size on the ETMs remains at 6.2 cm. The size reduction is made by changing the radii-of-curvature (ROC) of the ITMs and ETMs. Changes to the ROC of the mirrors in the recycling cavities are also made to mode match to the new beam size. The ITM and ETM ROCs for the straight and folded interferometers will be the same, even though this leads to small differences in the test mass beam sizes due to the arm length difference between the two cases. For the actual ROC values refer to T0900043.

Motivation. A smaller beam on the ITMs and the other vertex COC reduces the signal loss due to diffraction, reduces the contrast defect, and gives more margin for beam decentering. These effects have been modeled as reported in G0810029-v4. The only disadvantage of a smaller beam is increased thermal noise from the ITM coatings. This noise increase is very small given the magnitude of the change and the fact that the overall test mass thermal noise is dominated by the ETMs. The total test mass thermal noise increase due to this beam size change is calculated to be about 1%.