

Paper Reviewed: Variable Transmission Mirror for Recycling 19 August 1988, by Alex Abramovici

This Review: 30 September 1988 by Jeff Livas

Summary

The memo on a *Variable Transmission Mirror for Recycling* is a useful compendium of formulae and a demonstration of the practicability of an implementation of the device as a Fabry Perot. One important point that is not addressed but that is within the scope of the memo and should be addressed is the issue of the potential difficulties to be encountered when actually constructing a variable mirror. Another important point, not within the scope of the memo but which does need to be addressed for the design of a full scale receiver, is the calculation/justification of the amount of light which must be split from the main beam for modulation and control of the interferometer.

General Comments

The internal memo outlining the design equations for a *Variable Transmission Mirror for Recycling* is a much needed step toward solving an important problem in the design of a large scale gravity antenna. The thrust of the discussion in the memo is explicitly toward a recycling mirror, but there may be a need for such a mirror to allow precise matching of the parameters of the cavities in each arm of the interferometer as well. The memo explains the theoretical issues involved and also demonstrates the practicability of the mirror with real numbers based on explicitly stated assumptions. The explicit statement of the assumptions is a particularly useful feature.

In the opinion of this reviewer, the document is useful as it stands but leaves out one important aspect which should be discussed - the practical issues associated with a real world design. The usefulness of a variable transmission mirror is uncontested; it is important to actually try to build one in the laboratory. An assessment of the potential difficulties by someone with experience constructing cavities would be a very useful prelude to the design and construction of a real prototype. The reviewer would like to urge that a discussion of the pitfalls and/or a design of a variable transmission be added to the present document (where it would be most useful) or at least that the design issues be addressed in a subsequent document which is cross-referenced to this one. Some of the practical issues which occur to this reviewer are thermal noise, power handling capability, longitudinal and radial mode spacing, spatial mode filtering, and bulk internal resonances of the mirrors and the active elements used to control the spacing (presumably PZT's).

The assumptions used to calculate the parameters of a typical variable transmission mirror are all reasonable numbers. However, it occurred to this reviewer that one assumption needs to be substantiated before a real design of a full scale interferometer can be said to be complete. Assumption (v.), that 1% of the light is picked off at the beam splitter for modulation purposes, can be justified by a calculation of the amount of light needed for proper fringe interrogation and control. The justification of this assumption is outside the scope of the document being reviewed, but it is important that the issue not be overlooked in the final design of receivers for the LIGO. The assumption of a 1% value for demonstration purposes is reasonable.