New Folder Name Response to Paper re Diffraction Loss and Minimum Mirror Size
T950098

> Bob, I think I understand how to read your diff memo, but I do not
> understand the answer I get---if I scale N down to the 1.06 micron
> lambda for a given diameter, we go from 2.35 to 1.13. This takes us
> from about 10^-6 diff loss to about 5e-2---absolutely not a mirror. Do
> you believe this? Am I doing the right thing?
>
>
> d.
>

It's not that bad, since we are starting with even less than 1e-6 loss -- Table 1 shows that 1e-6 loss corresponds to 19.7 cm diameter curved mirror, not 25 cm.

More precisely, look at Figure 2. First, the x-axis should be rescaled for our flat-curved case, not the symmetric curved-curved that is plotted. The rescaling is done by multiplying the axis by sqrt(2). Then you see the g=.3 curve crossing 1e-6 at 19.7 cm (as per N=2.35 in Table 1). For doubled wavelength, rescale again by multiplying again by sqrt(2). (Everything we lose by doubling the wavelength we can gain back exactly by going to a curve-curve geometry.)

I get for 1.03 microns:

Dia	g	Loss (ppm)
20	.3	1800
20	.5	2100
23	.3	200
23	.5	150
24	.3	80
24	.5	65
25	.3	30
25	.5	17
26	.3	10
26	.5	5
27	.3	2
27	.5	1.5

Conclusions on use of 25 cm diameter mirrors for 1 micron:

1) 25 cm diameter end mirror is marginal in our flat-curve geometry. The coating would have to cover the mirror completely (though higher loss and poorer quality would be allowed near the edge). Still, small motions of the beam or mass from the centered configuration would change the losses significantly, which might be a source for operating-point fluctuation.

2) The losses can be readily reduced by a factor of 2 by changing the end mirror curvature. This corresponds to changing the mirror diameter by approximately 1 cm or less. (Assuming the g=0 case of a 4 km curvature end

mirror avoided)

3) 25 cm diameter would be fine with a symmetric or similar curve-curve geometry.

-- Bob

From dhs@tristan.mit.edu Sat Jun 3 06:03 PDT 1995
From: David Shoemaker <dhs@tristan.mit.edu>
Subject: Re: your diff memo
To: robert@ligo.caltech.edu (Robert Spero)

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but I think that the mirror should be making 1 or possibly 10 micron motions perpendicular to the beam during operation; of we have 50 ppm delta loss between 24 and 25 cm diamter, we could say that we will have certainly less than (50ppm/1cm)*10 microns = 0.5 ppm change---not something that shot noise will care about. I wonder, though, if there are phase shifts associated with this kind of motion?

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right; and I do not think that this will require a new coating chamber, and the fact that we already have three sizes of suspension

makes me think that if we had a special purpose suspension for the back mirrors it would not be an undue new burden for Seiji-sensei.

> 3) 25 cm diameter would be fine with a symmetric or similar curve-curve geometry.

yep, with Beamsplitter fears.

nice knot of prickly problems and plusses. d.