

Minutes of the Core Optics Subgroup, 1/11/01 (Gari B reporting)

In attendance: many people

9 am PST US/Europe meeting

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1) review of possible coaters (Helena)

CSIRO - motivated, experienced, good track record in production mode, no large IBS equipment - **Helena would rank second**

Japan - Not currently doing large optics, don't appear to be interested in expanding.

VIRGO - have facilities in place already - **Helena would rank first**

Zeiss - not currently doing large or low loss, but would consider the work ... not a warm response

LZH - sounded interested, gave estimate, they would have to optimize their process

MLD - no written response, we will hear a presentation, next Thursday.

REO - received a formal response, they are quite expensive.

GO - don't have the metrology, facilities or relevant experience

Gary described the visit to the Lyon facilities by himself and David Shoemaker in early January; summarized interactions with Jean-Marie Mackowski and the VIRGO group regarding the possibility of having R&D as well as production coatings done at Lyon. **The overall impression of the facilities and willingness of the part of Lyon and the VIRGO folks to collaborate was very positive.** They have independent power and Uninterruptable Power Supplies. They still are installing DI water and the cleaning setup. Due to the facilities in place, Lyon has to be ranked #1. How to negotiate cost is the difficult part, as there are a lot of different interests on the table.

Jordan suggests coating absorption R&D in parallel with other vendors. Gary agreed if we can fund it, but commented that different techniques may not transfer (either due to proprietary information or to different coating approaches...) During Gary's visit JMM appeared to be concerned about technology transfer away from Lyon during a collaboration.

David Shoemaker noted that they did have "all the VIRGO" at the meeting; everyone (Lyon, LIGO, VIRGO) said all the right things and was definitely on the same page.

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2) Gari on polishing - CSIRO is currently polishing one of the 15 cm pieces (one side only for now). Before they attempt something on side 2 we need to know what specs we want them to shoot for. David and Gary pointed out that we need a review of specs for consistency (also pointed out by JMM at the Lyon visit).

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3) Sheila on Q - There does appear to be an effect on sapphire Q from coating, but the work is still in progress. One concern is that on their current sample, coating spreads over on to the barrel and definitely influences the Q. There are some pieces being shipped to Stanford from LIGO that have same aspect as LIGO 1 which will be measured as well.

This far, sapphire looks roughly consistent with fused silica loss with coating. Both substrates started at a Q of  $\sim 10e-7$ . They expect to be measuring LIGO 1 fused silica (coated and uncoated) optics at end of February.

(NB: After the meeting, this from Marty Fejer: The question regarding how to compare changes in Q for coated sapphire vs coated silica is addressed (in the half plane limit) in a draft paper that Norio has put together, which incorporates different elastic constants, density, and loss factor between coating and substrate. I will see if I can speed dissemination of that document.)

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4) Jordan reporting on outside material properties measurements - Roughly  $5.5 \times 10^{-6}/K$  is reported for the sapphire thermal expansion coefficient as measured by three independent labs, all give similar numbers. These are roughly 10% higher than expected (and will negative impact LIGO 2 astrophysics reach). The labs reported for both a and c axis material, the trend was the same in both. Thermal conductivity is coming soon. Initial results indicate that there may be no change in these numbers from the ones we have been carrying.

Ryan Lawrence (reported by Mike Zucker) is coming up with higher thermal cond. for the C axis piece. Thermal expansion (not sure which axis, not pure axis) is lower than the expected at  $\sim 5 \times 10^{-6}$ . MZ reports that the data fit is good, and he can't see anything wrong with it. We may need to resolve the differences in outside and internal measurements.

(NB: (Marty): Alex has seen a volume of sapphire with 15 ppm/cm absorption, and very low scatter loss. We are working with Crystal Systems to clarify the parameters that influenced this result.)

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5) Gary, in summary - NSF review last week of January, David S. in communication with those he wants present. There will be a plenary session Monday the 29th, in the morning, then working groups Monday afternoon and Tuesday.

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Minutes of Australia/US COC working group meeting 4:30 pm

UWA: John Winterflood, Darren Paget, Ju Li, David Blair  
CIT: Gari Billingsley, Helena Armandula, Gary Sanders

Helena, Gary and Gari reported as above.

In 94-97 David Blair reports that he had a collaboration with Lyon on a small sapphire cavity. This was viewed as "pretty successful", with a finesse of 100,000 in base cavity.

In other cavities they had small point defects. They couldn't tell if it was a CSIRO polish problem, or Lyon coating problem. Brillet was convinced it was a polishing problem.

DB raised the concern of using only a single source for coating.

GS responds that we will have to develop a pre-coating metrology which is comprehensive. We have the opportunity in the next year to work with JMM on metrology and coating development/shake down. There are proprietary concerns about development programs with more than one source, also process transfer between sources may not work due to different fundamental characteristics in chambers etc.. We MAY have to pursue dual sources, but there is a LOT of up front expense.

VIRGO expects LIGO to participate in "arrears" for infrastructure costs. It's clear that VIRGO and their funding agencies do want to collaborate with LIGO. Negotiations could slow the work, we need to make the choice on technical grounds first, then deal with the negotiations.

DB - raised the issue of the Australian "high power facility" how should they be moving forward with that. It would be useful to see the L2 coating and substrate specifications. Gari promised to send links to substrate and coating specs.

DB: There are a couple of Theses from UWA on sapphire properties, which report experimental coeff. For example Colin Taylor's (now at TAMA) thesis, however they're all focused on cryogenic measurements. He thinks there must be some data though that was taken at room temperature. DB promised to send links and any pertinent data

Gary summarized as before about the NSF review and pointed out that the LIGO lab program including r&d can be found on the web page.