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FAX Cover Sheet

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Date:	Jan 3, 1996
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MESSAGE:

Dear Bill,
I hope this is helpful.

Best regards,
Peter

Notes on meeting at Corning, Inc.
October 14, 1994

Attending from Syracuse Physics Department: Peter Saulson and Eric Schiff
Attending from Corning: Dr. Donald M. Trotter, Jr. (trotter_dm@corning.com)
Senior Research Scientist, our contact
Dr. Daniel R. Sempolinski (607)974-3210
Senior Development Scientist
Dr. Thomas P. Seward (seward_tp@corning.com)
Senior Research Associate
Dr. Roger Miller
Paul M. Schermerhorn, Project Engineer
Larry J. Sutton, Sr. Sales Engineer

The meeting began with PRS giving a quick overview of LIGO, mainly aimed at explaining where fused silica is crucial, and why internal friction of fused silica is important.

Much of the rest of the time involved brainstorming about possible mechanisms for internal friction in fused silica at room temperature. In a way this was disappointing, because it immediately became apparent that there was no proprietary knowledge at Corning on the subject -- they were guessing as much as Eric and I were. On the other hand, there was evident enthusiasm on the part of the Corning people. Perhaps this was a combination of recognition that LIGO is potentially a good customer, that gravitational waves are an "entertaining" (Trotter's word) thing to be a part of, and that it might be exciting to explore another aspect of fused silica than this team had been interested in before.

The favorite culprit for the internal friction mechanism during the discussion at the meeting was the existence of chemical impurities. Motion of impurities is one possible loss mechanism, while another is the fact that impurities would "open up the structure", and allow motion of other degrees of freedom. This idea was the favorite hypothesis in spite of the fact that the low temperature mechanism is believed to be a universal feature of glassy structures independent of the impurity concentration (and indeed even of the chemical identity of the glass itself.) It is,however, believed that the rise of losses at temperatures above room temperature is due to the motion of impurities; this makes sense since the mobility of impurity atoms rises with temperature.

Of all impurities, water (specifically the OH radical) was considered the obvious one to vary first. This fits with old published research correlating internal friction with OH concentration, as measured by infrared absorption. Corning is especially excited about this possibility since they invented a process (that never led to a commercial product) for producing very "dry" fused silica. The one possible difficulty is that this ultra-low OH glass will have some excess of Cl, since the latter is used as the drying agent in the process.

The Corning people were very interested in what was known already about Q of fused silica, and especially in Fred Raab and Aaron Gillespie's measurements of Q's of modes of fused silica test mass blanks. They asked if it would be possible for them to receive a summary of those measurements.

The following proposal for cooperative research emerged from the discussion. Corning could supply "small" (sub-kg to kg scale) samples of a variety of formulations of fused silica. LIGO and/or Syracuse would measure Q's of the lowest internal modes. The latter would typically be somewhat higher in frequency than for LIGO scale test masses, but this might still be the fastest and easiest way to survey many recipes, because the small pieces are the natural size produced by the research furnace. If the Q is approximately frequency-independent, the higher frequency is not so bad. Depending on what was learned in this initial stage, larger samples of the interesting formulas could be produced later.

Corning could supply fused silica with the following variations on the composition: low OH vs. high OH (low OH might also be accompanied by high vs. low Cl), low vs. high mass density, low vs. high concentrations of a variety of other impurities, oxidizing vs. reducing flame in the fusing process, low vs. high fictive temperature, fused silica especially "packed" with H or with He (the only two substances which diffuse well through fused silica). Some of these variants already exist as samples in the Corning research lab, while others would probably have to be made to order.

Action items from the meeting: SU will send copies of research literature on internal friction in fused silica, and will ask LIGO for information from Gillespie and Raab to be sent to Corning. Corning will prepare an inventory of existing samples of interesting variants of fused silica.

For future discussion: Who will measure Q's of samples that Corning produces? What procedure will be followed in producing samples not in Corning inventory? At what stage would money have to change hands, and how much? Is a larger effort warranted in the future?

PRS impression of the meeting: Corning people were enthusiastic. Don Trotter gave us a tour of research lab after the meeting, during which we encountered Dan Sempolinski hunting through his storage cabinets for samples to include in the Q measurements. Trotter also said that, at the appropriate point, Corning would be glad to assist in the writing of proposals to NSF or whomever for support of larger research effort. Trotter said that Sempolinski and Seward would be the main workers on the Corning side. Sempolinski in particular seemed like a first-rate scientist, but Seward also asked good questions.