



Proposal for baseline change from ribbons to fibres in monolithic stage

Mark Barton for the IGR Monolithic Team

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Current baseline

- Conceptual design: T010103-05, N. Robertson
- Requirements: T010007-03, M. Barton
- Baseline is 1.15 mm x 0.115 mm ribbon
- Meets noise requirements via flexibility -> good dissipation dilution
- Not optimized for thermoelastic noise - further improvement possible
- Dumbbell fibres as suggested by Phil Willems also mentioned as viable -> reopen issue

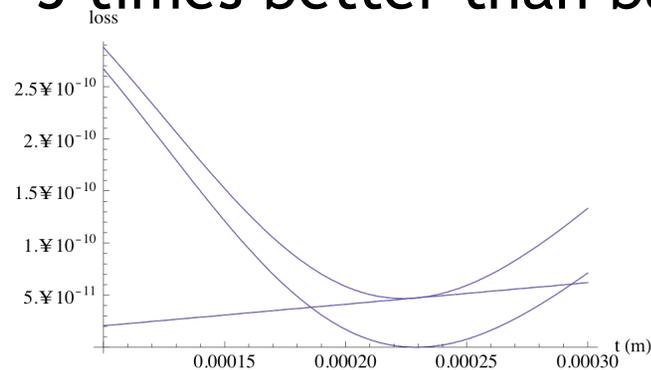


Thermal Noise Optimization

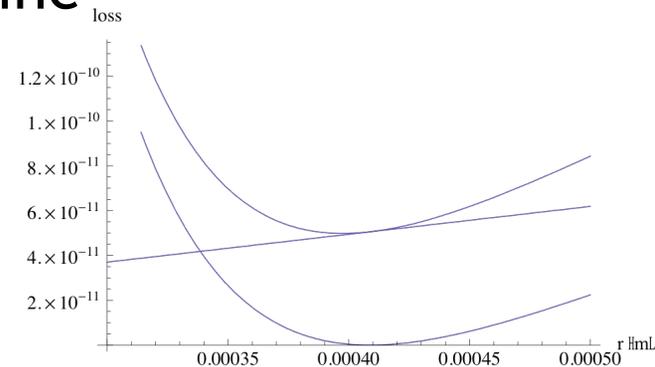
- Noise sources
 - Thermoelastic (dominant if not optimized; can be zeroed by sizing ribbon/fibre to give suitable static stress)
 - Surface (worse for ribbons)
 - Bulk (negligible)
- Dissipation dilution
 - Better for ribbons
 - Also function of dimensions of ribbon/fibre
 - Leads to slightly smaller optimum dimensions in presence of surface loss
 - Also leads to slight frequency dependence - choose 20 Hz to optimize at

Loss Results

- Parameters from Bench except spec sheet Y and C and measured α
- Almost identical loss for optimized ribbons and optimized fibres - 6% difference
- 5 times better than baseline



4.68×10^{-11} @
 $t_{\text{opt}} = 0.224 \text{ mm}$



4.98×10^{-11} @
 $r_{\text{opt}} = 0.398 \text{ mm}$

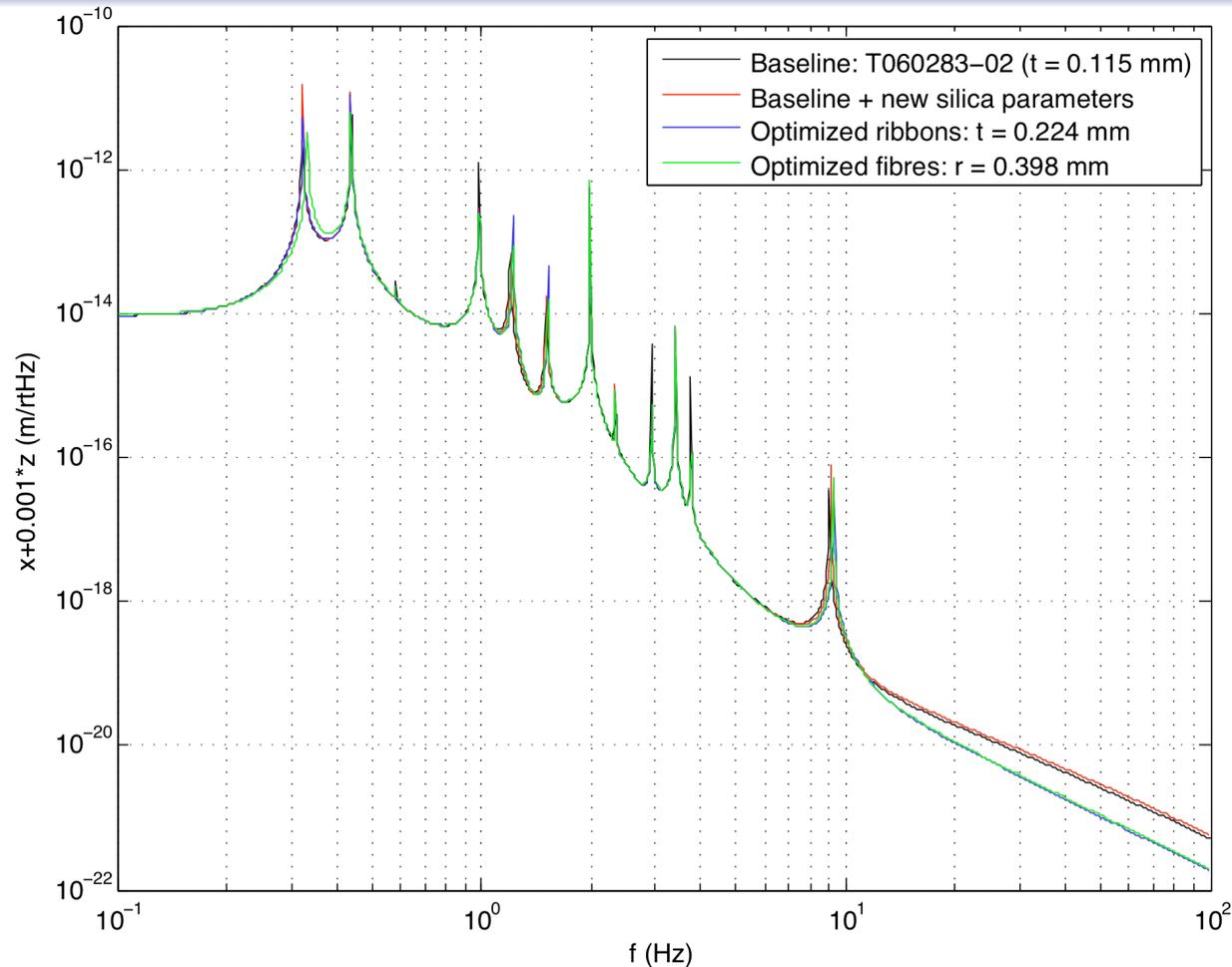


Violin and Bounce Modes

- Optimum dimensions for noise are thicker but only required near ends
- Violin and bounce mode requirements can be met by dumbbelling for either optimized ribbons or fibres
 - Neck region -> 1.5 cm (about 5 flexure lengths)
 - Rest of ribbon/fibre same area as baseline ribbon
- Bounce mode increases slightly:
 - 9.0->9.2 Hz
 - Still OK
- Violin mode also increases slightly
 - Trivial improvement



Noise Results



$x+0.001z$ noise curves from Mathematica model, T060283-02 parameters except as noted, dumbbelling





Practical Considerations

- Ribbons and fibres give essentially identical performance for ideal necks.
- Current ribbons are strong enough, but recipe is fiddly and may be hard to reproduce at LASTI.
- Also, current neck shape is far from ideal (-> poor dissipation dilution) and will take extra work to perfect.
- Relatively little work to move to fibres
 - Pulling machine also does fibres, parts already at LASTI
 - Modest revisions to other tooling
 - Successful welding tests already done
 - Short fibre necks easier to produce





Impacts

- Extensive analysis of impacts in T080091.
- Highlights:
 - Current ears usable but not optimum - need redesign for stiffness in any case so incorporate fixes after NP time frame.
 - Pulling machine clamps, “fuse” gluing jig, welding fixture - minor rework required, not rate-limiting.
 - Ribbons OK for strength but fibres probably even better due to higher pulling temperatures possible and lack of sharp corners on stock.
 - Some promising welding tests done with both fibres and ribbons - probably comparable work to perfect.





Recommendation

- Fibres should have comparable or better performance and schedule and somewhat less technical risk.
- Recommend changing baseline to fibres for both forthcoming NP build and production suspensions.