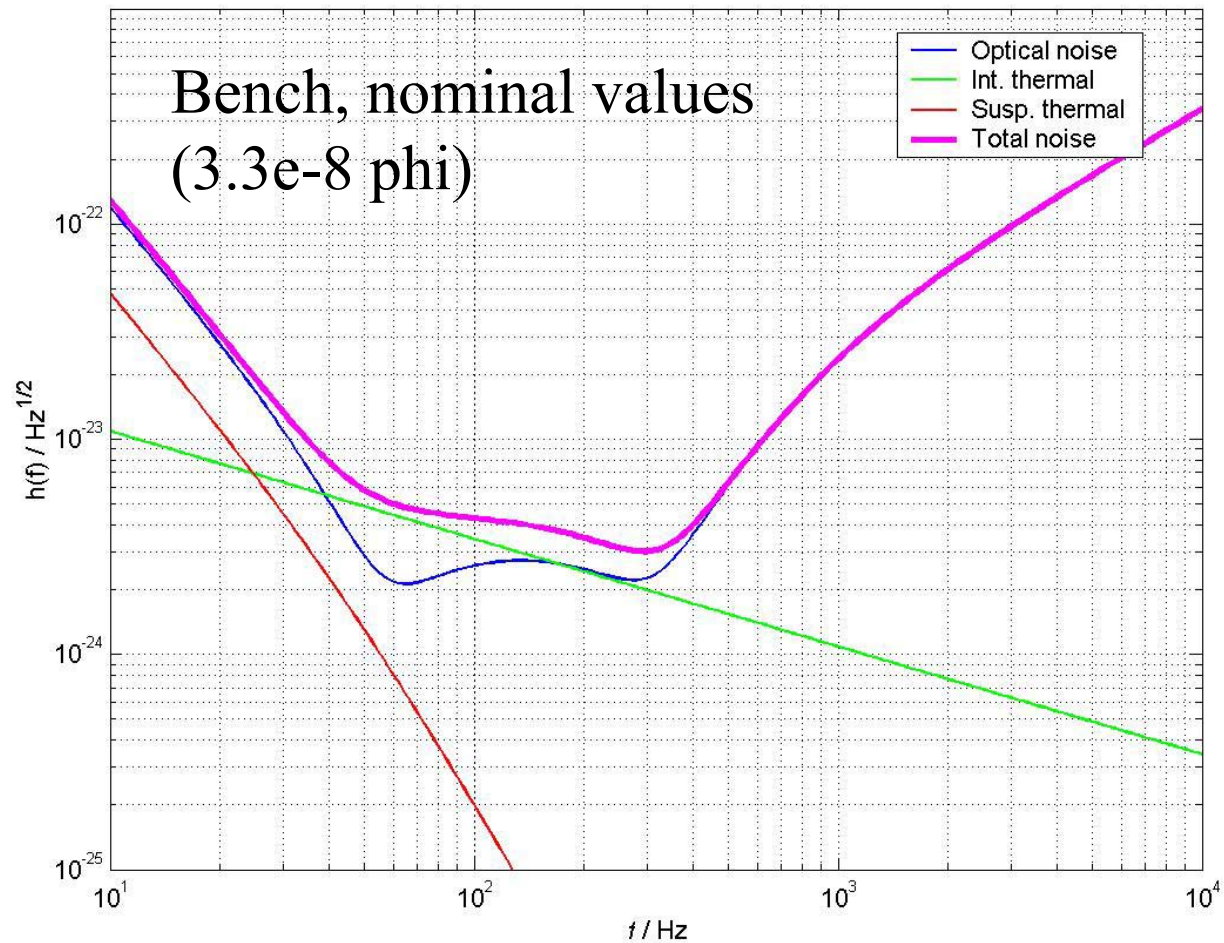# Coating mechanical losses – Impact and plans to address

Data and models from Stanford, Syracuse, Glasgow, Iowa
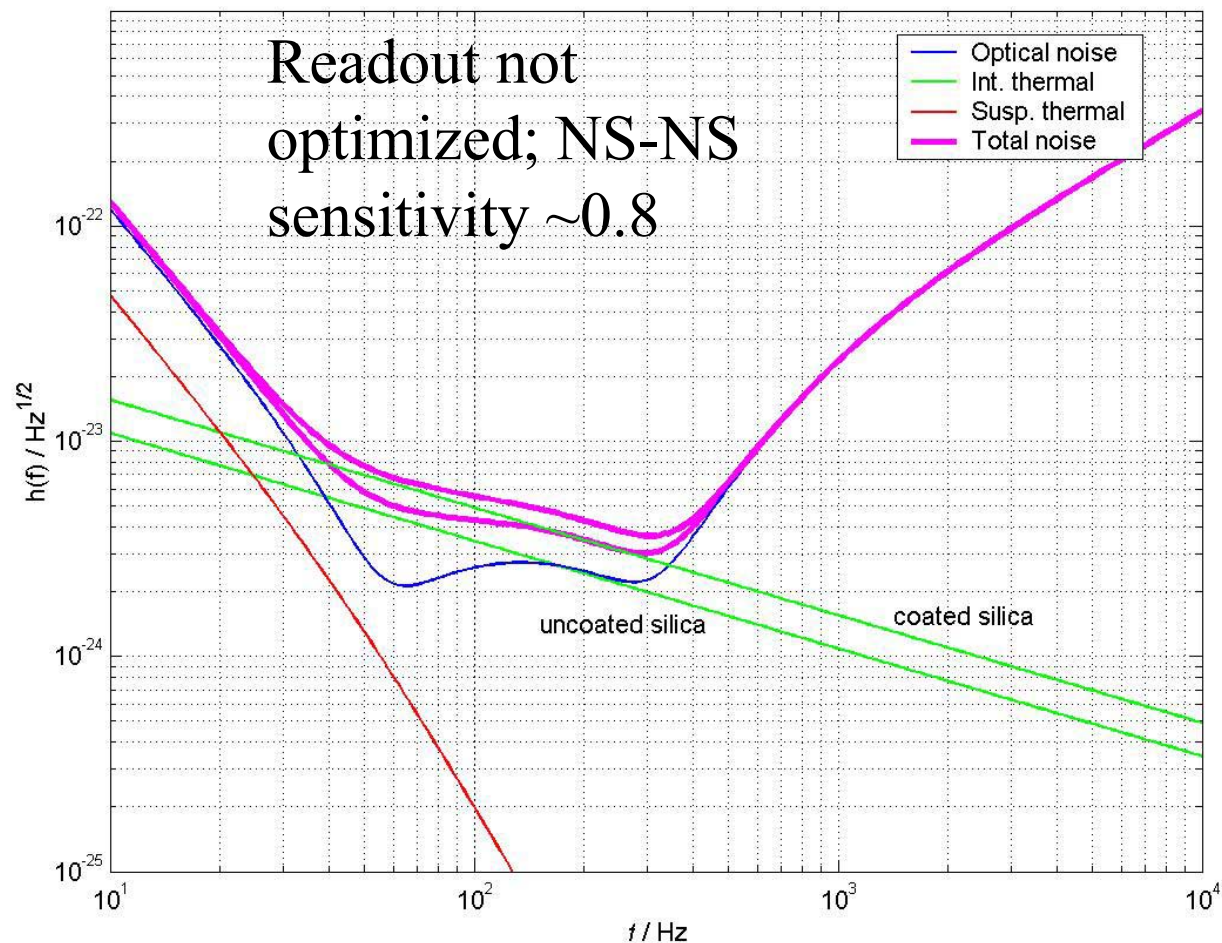
Gregg Harry – David Shoemaker

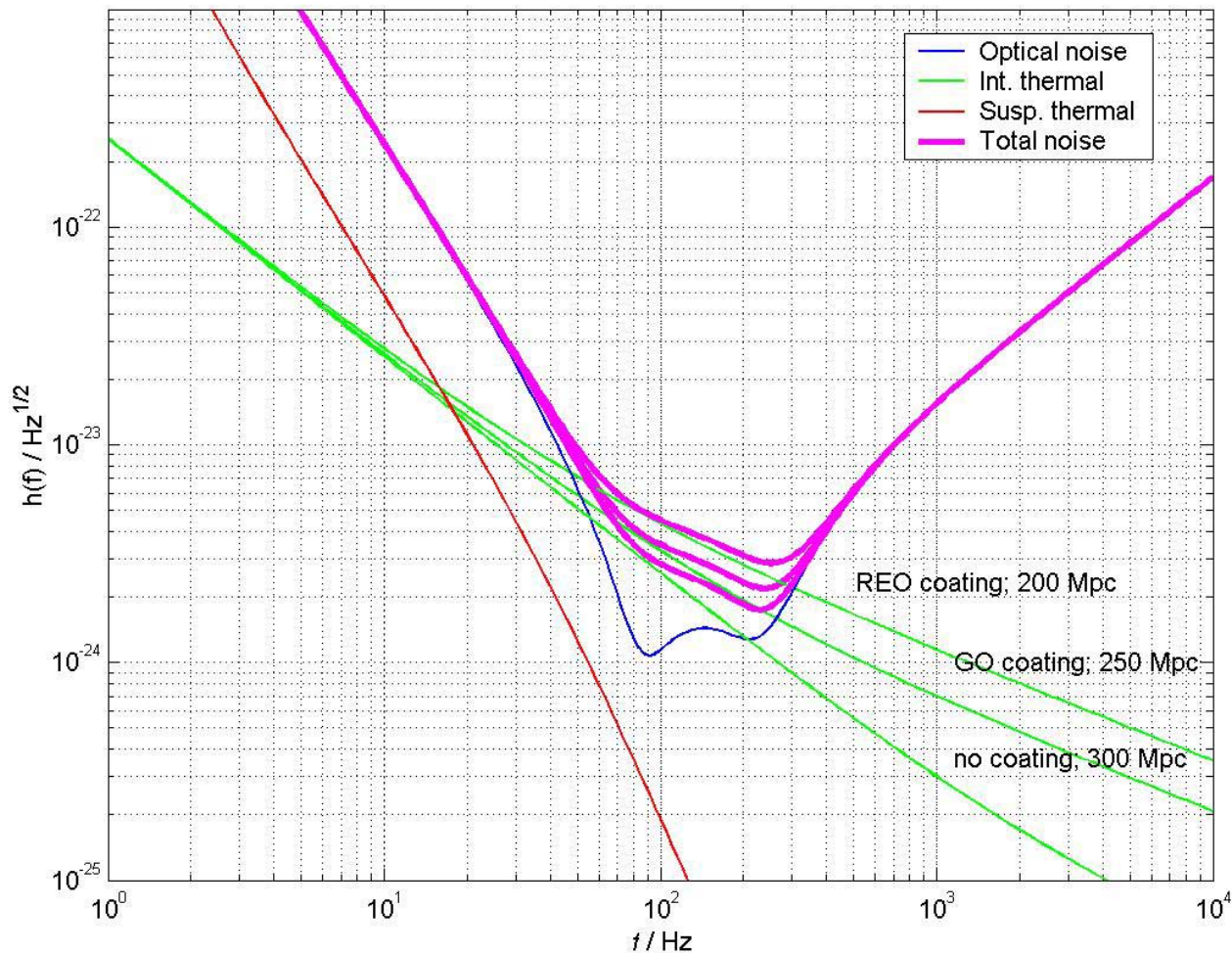## Aspen 7 Feb 01

Aspen 2001 - G010025-00-R

Nominal Advanced LIGO sensitivity; fused silica test masses

Adv LIGO sensitivity; fused silica test masses with inferred coating loss

Adv LIGO sensitivity; sapphire test masses with inferred coating loss (preliminary, one sample)

Impact on range

- Nota Bene: only one sapphire sample, and a range of data from several fused silica samples used

- More samples are needed before any decisions are made based on data!

- range for 1.4 M NS-NS goes from
    - Silica: 250 Mpc before, to 200 after
    - Sapphire: 300 Mpc before, to 250 after
      using 'GO' losses, or…   200 using 'REO' losses

Questions

- Coating material loss per se

- Process of coating – heating etc.

- Polishing process – either intrinsic losses, or in conjunction with coating

- Effect of substrate material (silica vs. sapphire) – anisotropy, greater stiffness of sapphire

- Modeling and inference of in-band noise from data

Steps to improve estimates –
for both fused silica and sapphire

- Ring down experiments on uncoated then coated samples with varying thicknesses of coating and ones with differing number of interfaces between layers.
- Ring down experiments on uncoated masses, first polished conventionally, then superpolished
- Ring down experiments on coating from different coaters/processes
- Continue modeling work.
- "Simple" characterization work, including light scattering experiments and any tests that suggest themselves from previous ringdown experiments.
- "Simple" direct phi measurements of coating materials that are direct extensions of current work. This could include ellipsometry experiment and ring down Q's of bulk coating materials

Further steps if warranted

- Experiments with different polishing technology including chemical treatments

- Ring down experiments with different coating techniques, including different coating materials, different annealing, and/or different methods of coating.

- "Difficult" characterization work. This would include tests deemed useful after a first round of ring down and characterization. It would also include expensive or destructive tests that we have questions about the utility.

- "Difficult" direct phi measurements. This would include experiments on coatings that prove too involved to do quickly and/or have serious questions about whether the results would be applicable to LIGO mirrors.