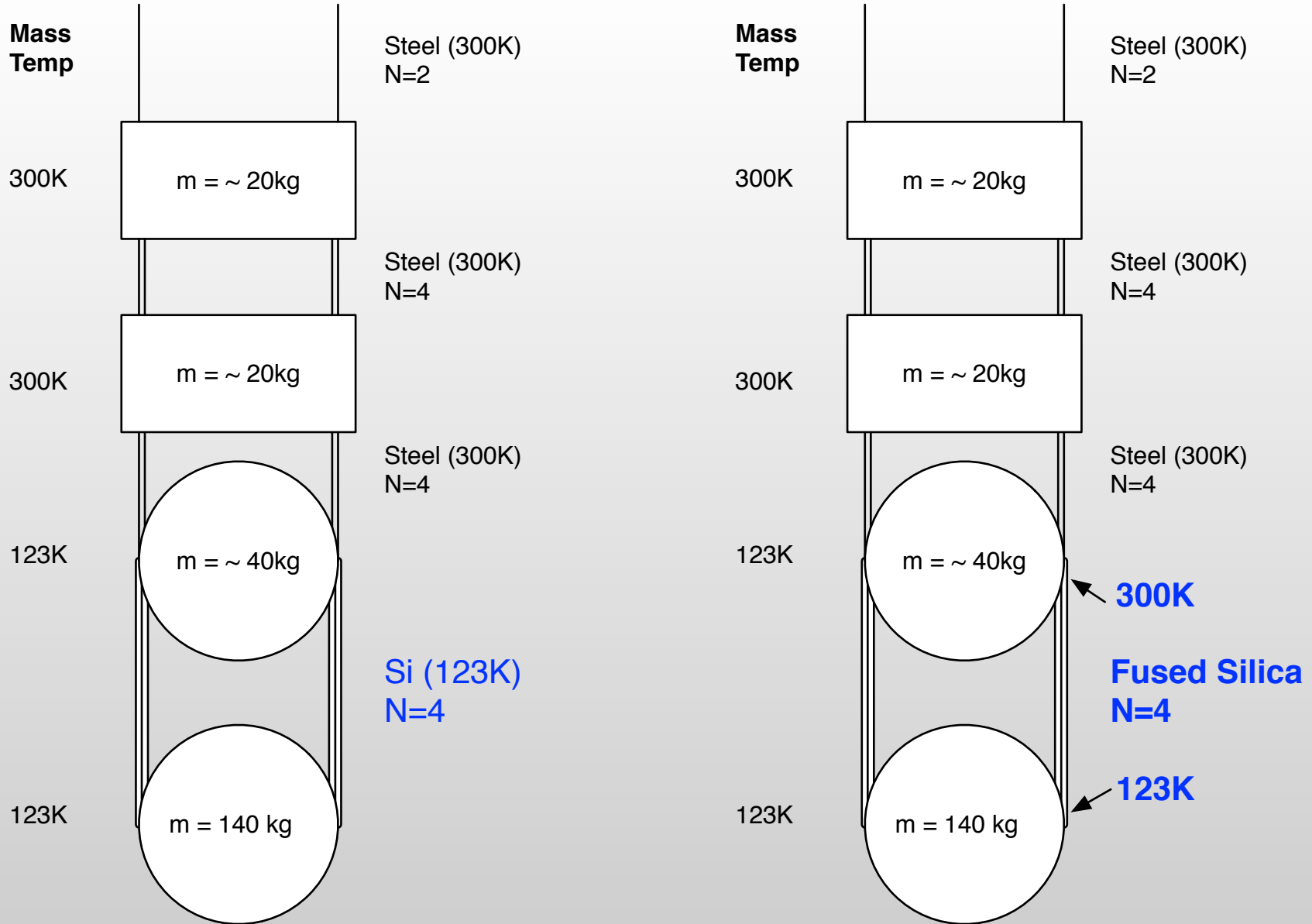


Hot/Cold hybrid suspension

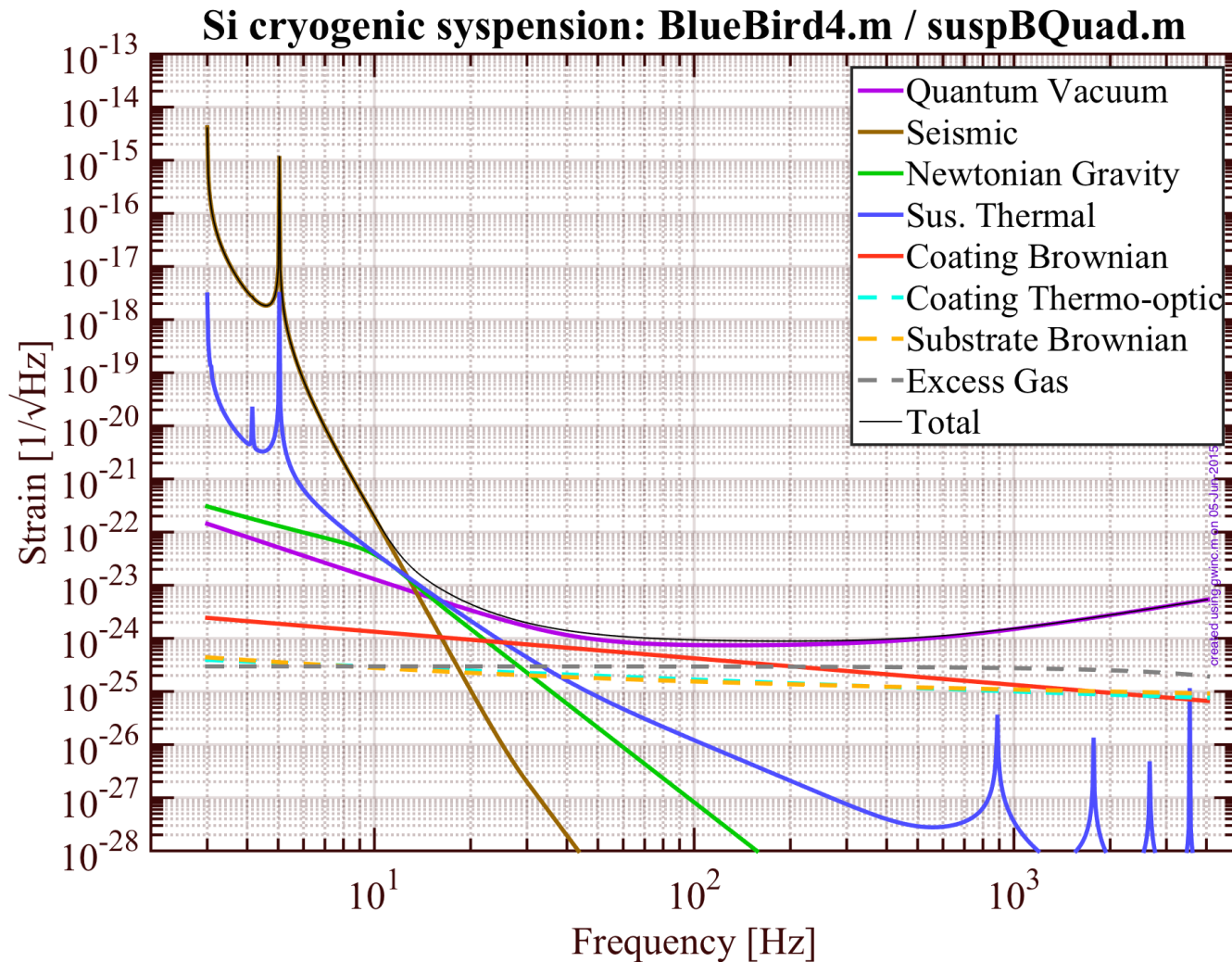
LIGO-G1500754
Koji Arai / Nicolas Smith



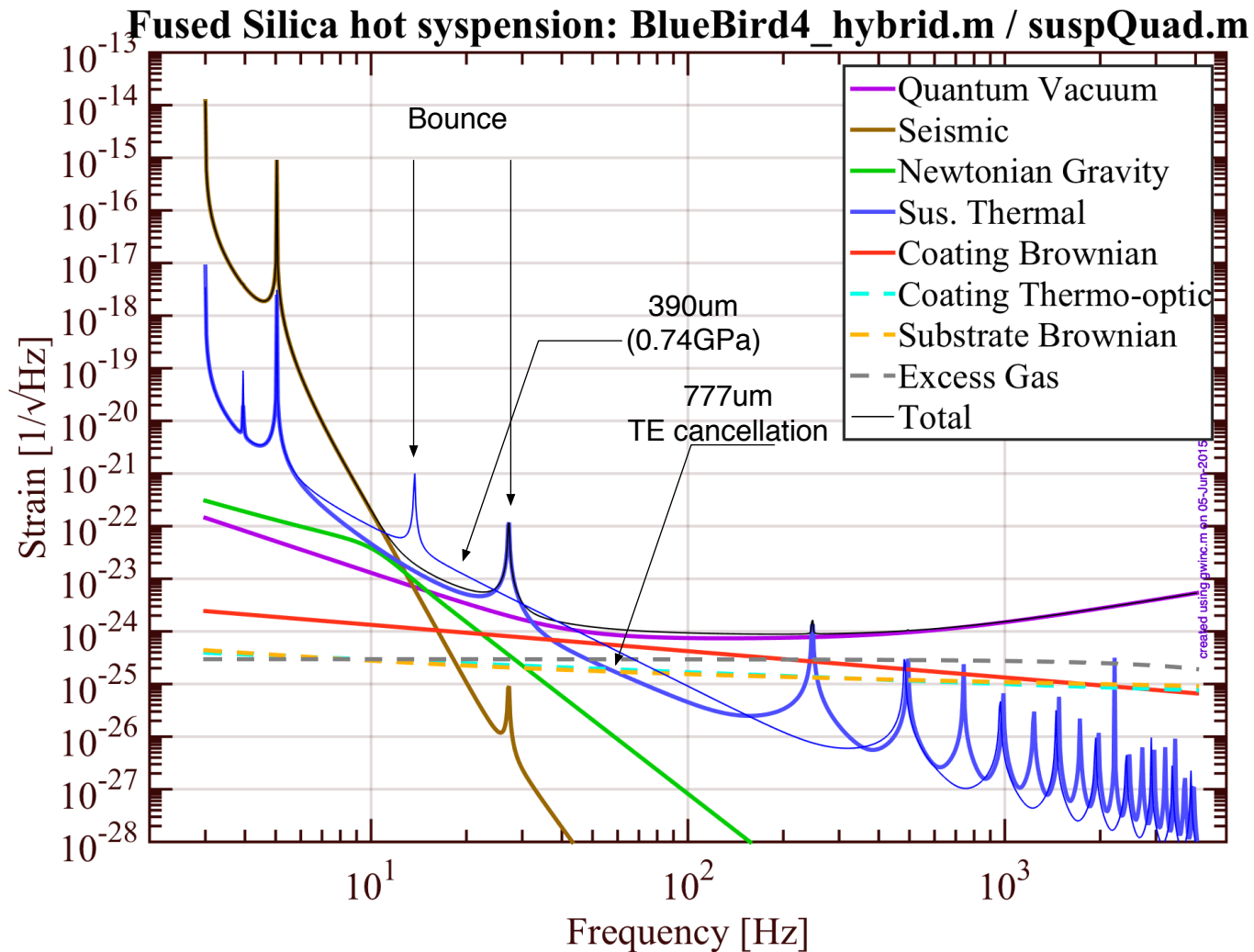
Cold Si suspension

Hot/Cold hybrid suspension

Cold Si suspension (BlueBird4)

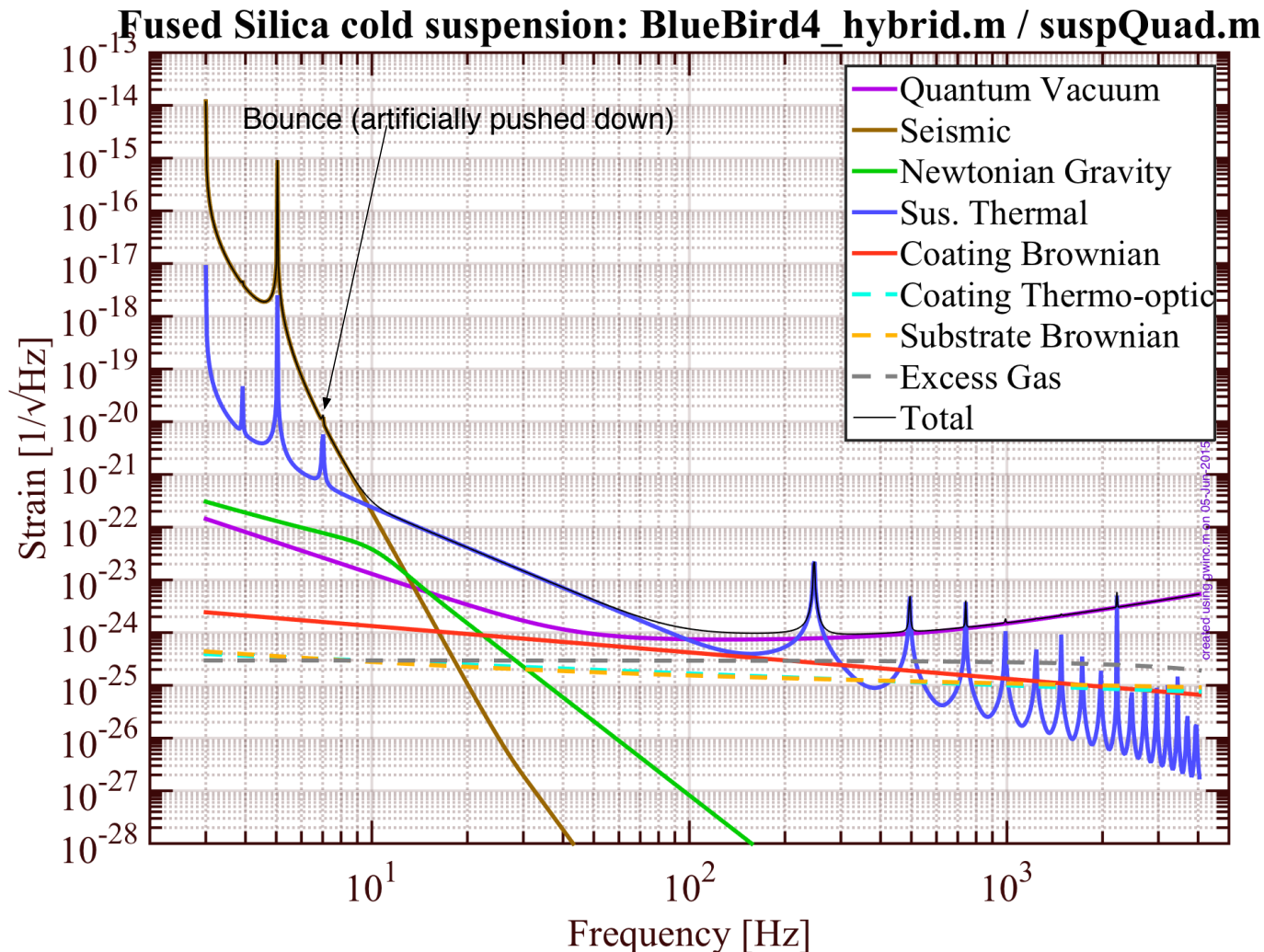


Uniformly HOT fused silica suspension



Uniformly COLD fused silica suspension

($r_{\text{fiber}} = 777\mu\text{m}$, but no TE, $\phi_{\text{FS}} = 2e-5$, $T=123\text{K}$)



Hot/Cold hybrid suspension

LIGO-G1500754

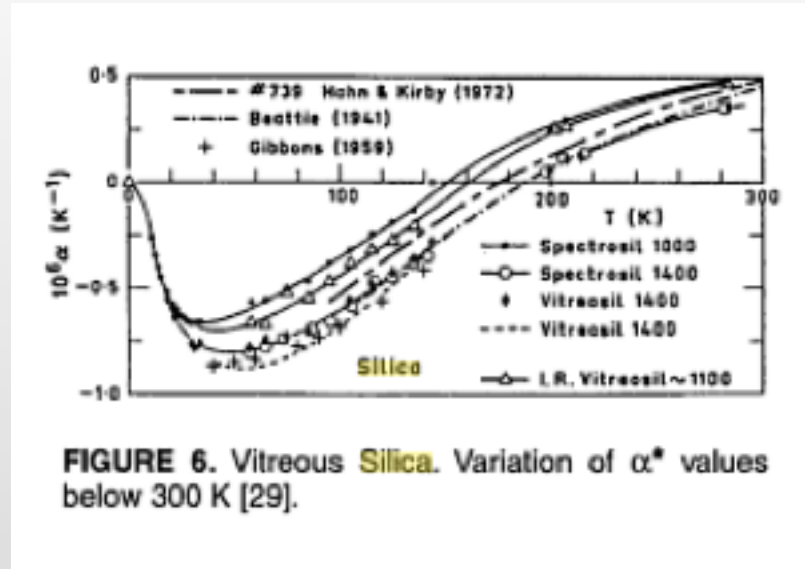
Koji Arai / Nicolas Smith

- We need the TE cancellation for the hot side
- TE cancellation at the cold side is not trivial as the CTE will become negative

Table 8*. Thermal Expansion Values for Vitreous Silica SRM 739 [28]. Values in brackets are extrapolations based on References 29, 30.

T (K)	α^* (10^{-6}K^{-1})	$\Delta\ell/\ell_{293}$ (10^{-6})	T (K)	α^* (10^{-6}K^{-1})	$\Delta\ell/\ell_{293}$ (10^{-6})
10	(-0.22)	(47)	293	0.48	0
20	(-0.58)	(43)	300	0.49	3.5
30	(-0.75)	(36.5)	320	0.53	13.5
40	(-0.80)	(29)	340	0.56	24.5
50	(-0.80)	(21.5)	360	0.58	36
60	(-0.78)	(14)	380	0.60	47.5
70	(-0.73)	(7)	400	0.61	59.5
80	-0.70	-1	450	0.63	91
90	-0.61	-7.5	500	0.63	122
100	-0.53	-13	550	0.61	153
120	-0.38	-22.5	600	0.59	183
140	-0.24	-28.5	650	0.55	212
160	-0.10	-32	700	0.53	238
180	0.02	-32.5	750	0.49	264
200	0.13	-31	800	0.47	288
220	0.23	-27.5	850	0.44	311
240	0.32	-22	900	0.41	332
260	0.39	-14.5	950	0.38	352
280	0.45	-6	1000	0.37	371

*M. Okaji et al. (Cryogenics, 35, 891, 1995) have measured SRM 739 from 6-273K with α values differing from above by $\approx 0.04 \times 10^{-6} \text{K}^{-1}$.



Thermal Expansion of Solids
Cho Yen Ho, Richard Erwin Taylor
ASM International, 1998

- In fact, the high loss angle at the cold side will be an issue.
- The bounce mode needs to be lowered by tapered fibers
- Other ideas?