

Table 8: Suspension design parameters for the 40m prototype upgrade.

Parameter	ETM	ITM	BS	PRM	SRM	MCC	MCF1	MCF2
Pendulum freq. (Hz)	.800	.800	1.000	1.000	1.000	1.000	1.000	1.000
Pitch freq., (Hz)	.500	.500	.744	.744	.744	.744	.744	.744
Yaw freq., (Hz)	.600	.600	.856	.856	.856	.856	.856	.856
Violin freq., (Hz)	451	459	641	628	628	645	645	645
Vertical freq. (Hz)	11.79	11.59	16.23	16.57	16.57	16.12	16.12	16.12
d(pendulum) (cm)	38.80	38.80	24.80	24.8	24.8	24.80	24.80	24.80
d(pitch) (cm)	.1195	.1195	.09	.09	.09	.09	.09	.09
d(yaw) (cm)	2.13	2.13	1.57	1.57	1.57	1.57	1.57	1.57
d(standoff) (mm)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
d(margin) (mm)	.577	.577	.818	.818	.818	.818	.818	.818
wire dia (in)	.0036	.0036	.0017	.0017	.0017	.0017	.0017	.0017
susp height (mm)	425	425	417	417	417	417	417	417
susp transv. width (mm)	241	241	155	155	155	155	155	155
susp long. width (mm)	165	165	127	127	127	127	127	127
optic center height (mm)	140	140	140	140	140	140	140	140
optic dia (mm)	125	125	75	75	75	75	75	75
optic thickness (mm)	50	50	25	25	25	25	25	25
mass (kg)	1.276	1.320	.235	.225	.225	.238	.238	.238
wedge (deg)	2.5	1.0	1.0(s)	2.5	2.5	0.5	0.5(s)	0.5(s)
wedge orientation	left	right	right	right	left	left	right	left

the BS at 45°. Just to make sure, Material has been removed from the sensor/actuator brackets to increase the size of the aperture on all small optic suspensions.

The design parameters for all suspensions are summarized in Table 8. For more detail, see Ref. [39].

## 9.2 Suspension control

The suspension controllers for Initial LIGO [50] provide local velocity damping of the mirror motion, using information from the LED/PD pairs in the 5 OSEMs on each mirror optic, and/or information from optical levers viewing each mirror optic. Input from the global length and alignment sensing systems allow the mirror optics to be positioned at DC.

The Initial LIGO suspension controls have been redesigned [51] so that all feedback (local damping, and global control) is handled digitally.

This system is being essentially replicated for the 40m IFO, including all 10 suspended optics. Its ability to satisfy the design requirements is currently under study.

A preliminary (but pedagogically useful) design is presented in [31].

## 10 Control Electronics and photoelectronics

One of the primary motivations for the 40m upgrade is to spur the development of, and test the efficacy and robustness of, the control electronics. This includes: