



Adv. LIGO LSC Scheme for the 40m

Kirk McKenzie, for the 40m Team



Talk Contents

- Goal of the new LSC design for the 40m
- Constraints/tunable parameters
- Suggested Initial Layout
- Signals / noise budget
- Parameters / implications



The current LSC scheme at 40m

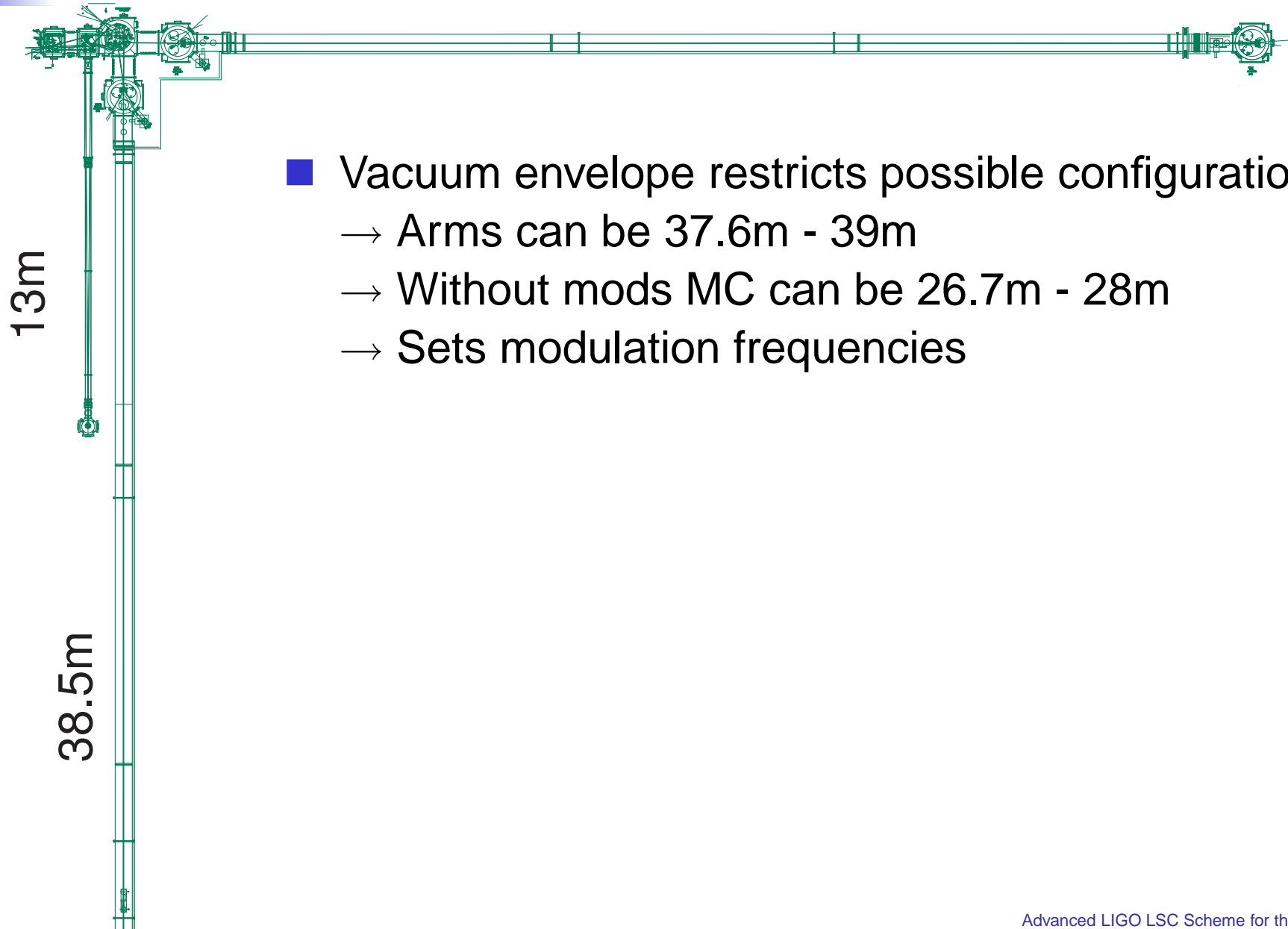
- Designed with the first incarnation of the Adv. LIGO LSC in mind
- Schnupp Asymmetry rather than Kentaro's idea to couple sidebands to the dark port.
- High modulation frequencies - $f_1 = 33\text{MHz}$, $f_2 = 166\text{MHz}$.
 - Too high modulation frequencies
 - Too different to LIGO, can't use the same electronics
- **Undercoupled** Power recycling cavity, unlike LIGO and Adv. LIGO
 - Different optical response
 - Changes signals for lock acquisition



Goals of a new LSC design

- Test Adv. LIGO control scheme
- Tuneable signal recycling cavity (SRC)
- Maybe only have one laser power operation
- Overcoupled power recycling cavity (PRC)
- Intra-cavity mode matching for PRC and SRC?

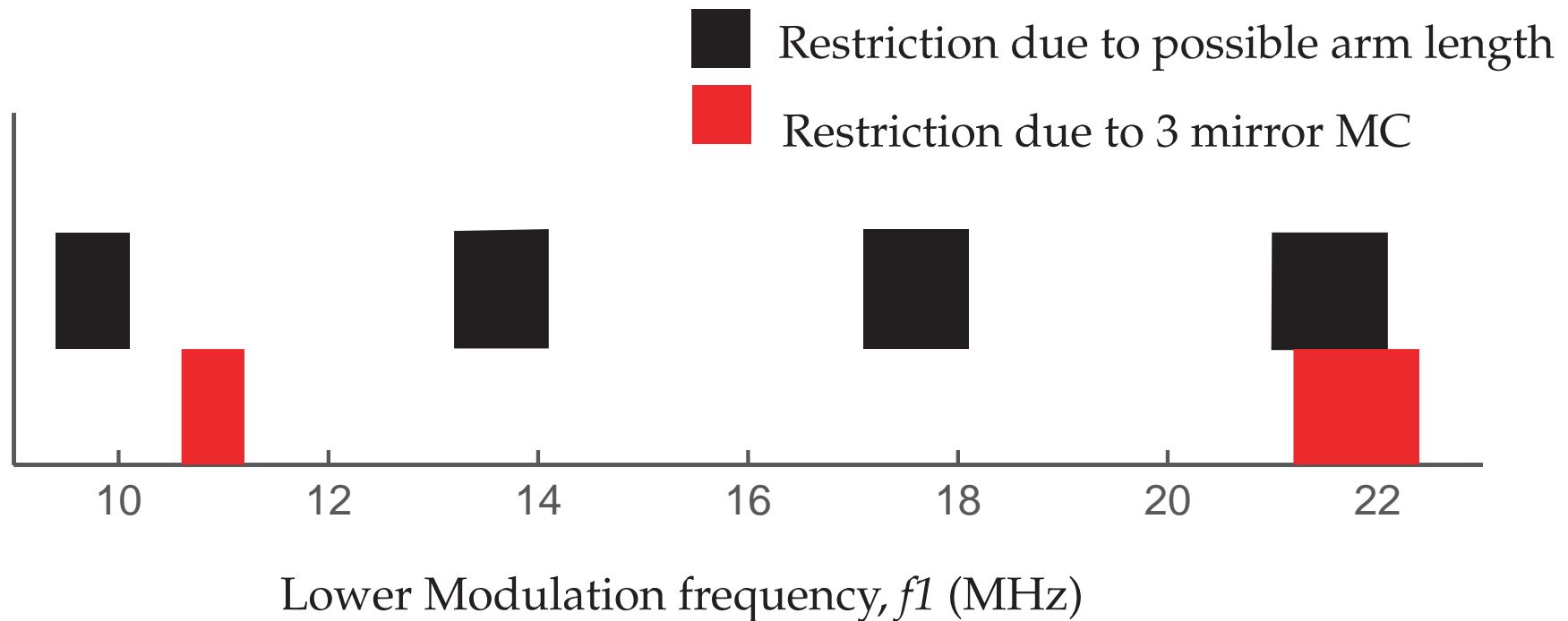
Vacuum Envelope



- Vacuum envelope restricts possible configurations
 - Arms can be 37.6m - 39m
 - Without mods MC can be 26.7m - 28m
 - Sets modulation frequencies

No or New Modecleaner ?

Allowed Modulation frequencies

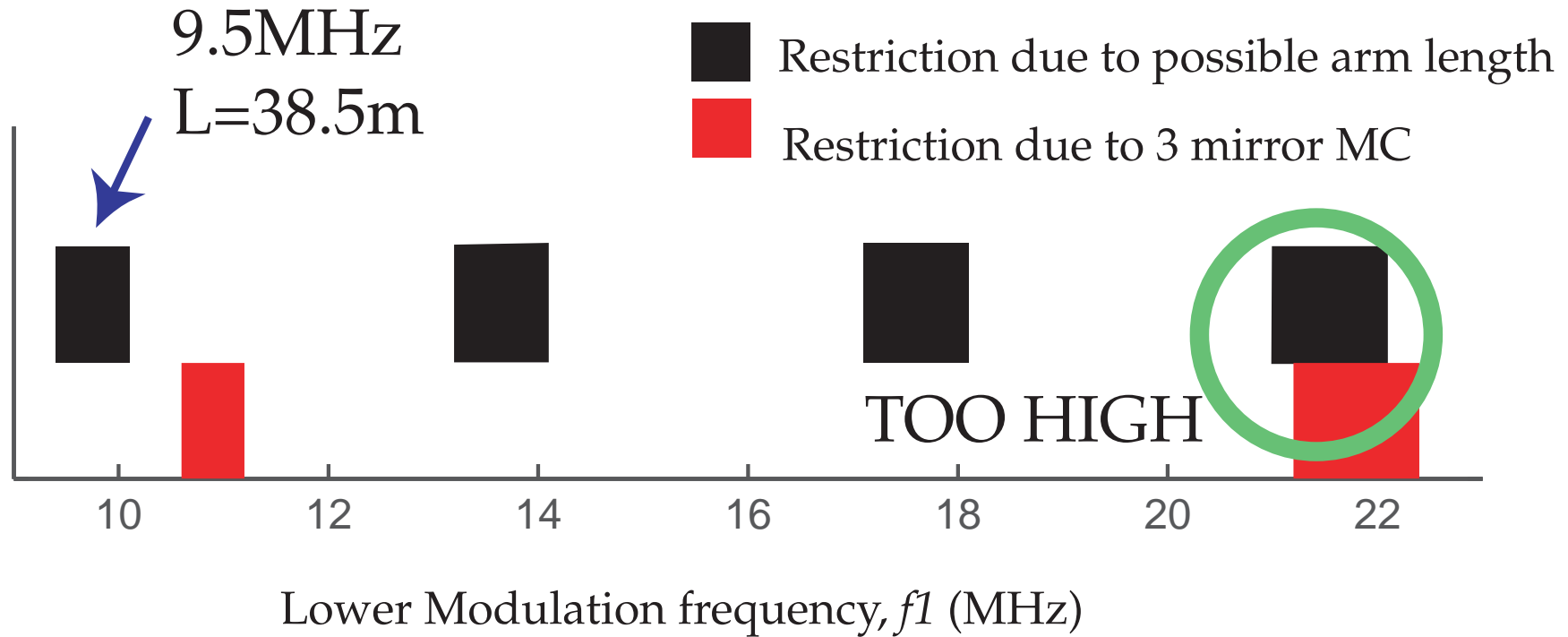


FSR of MC - $f_{mc} = \frac{c}{P_{mc}}$

Anti-resonant in arms $f_1 = (n + \frac{1}{2}) \frac{c}{2L}$

No or New Modecleaner ?

Allowed Modulation frequencies



FSR of MC - $f_{mc} = \frac{c}{P_{mc}}$

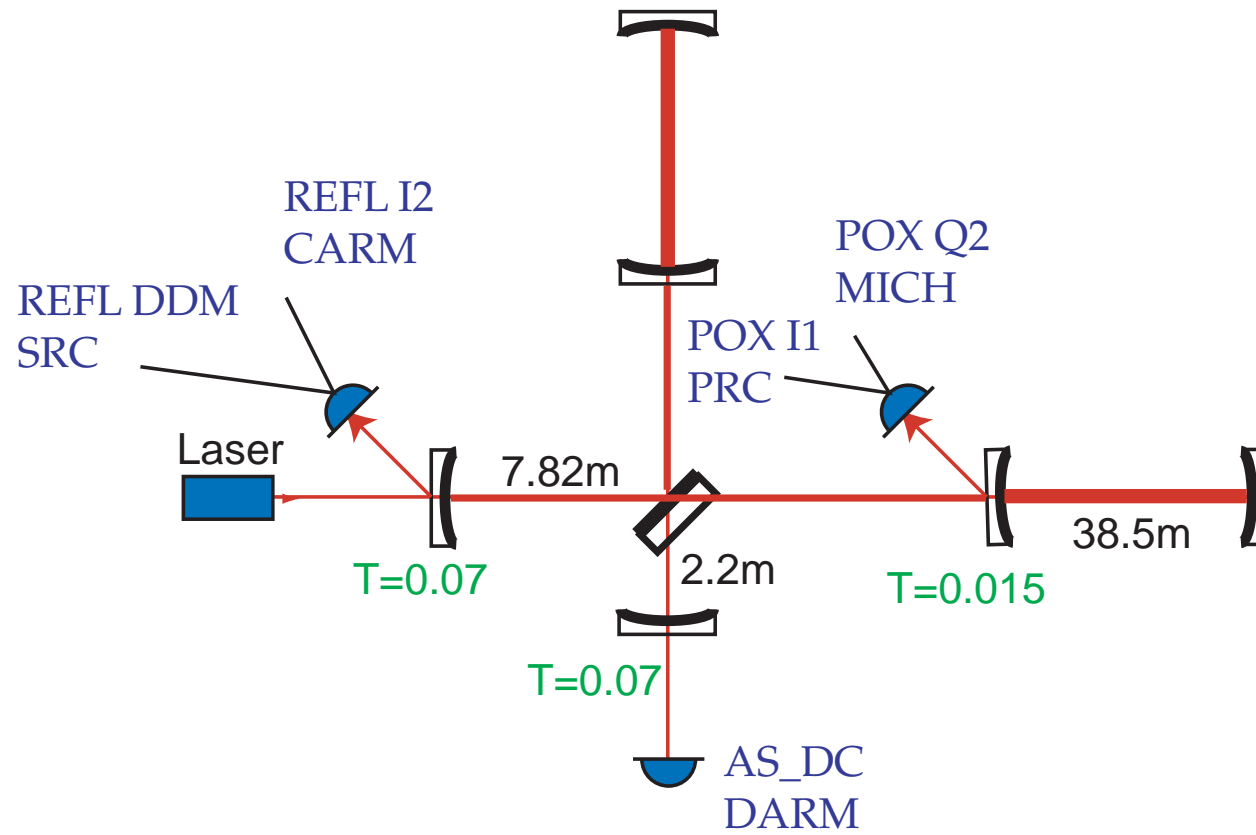
Anti-resonant in arms $f_1 = (n + \frac{1}{2}) \frac{c}{2L}$



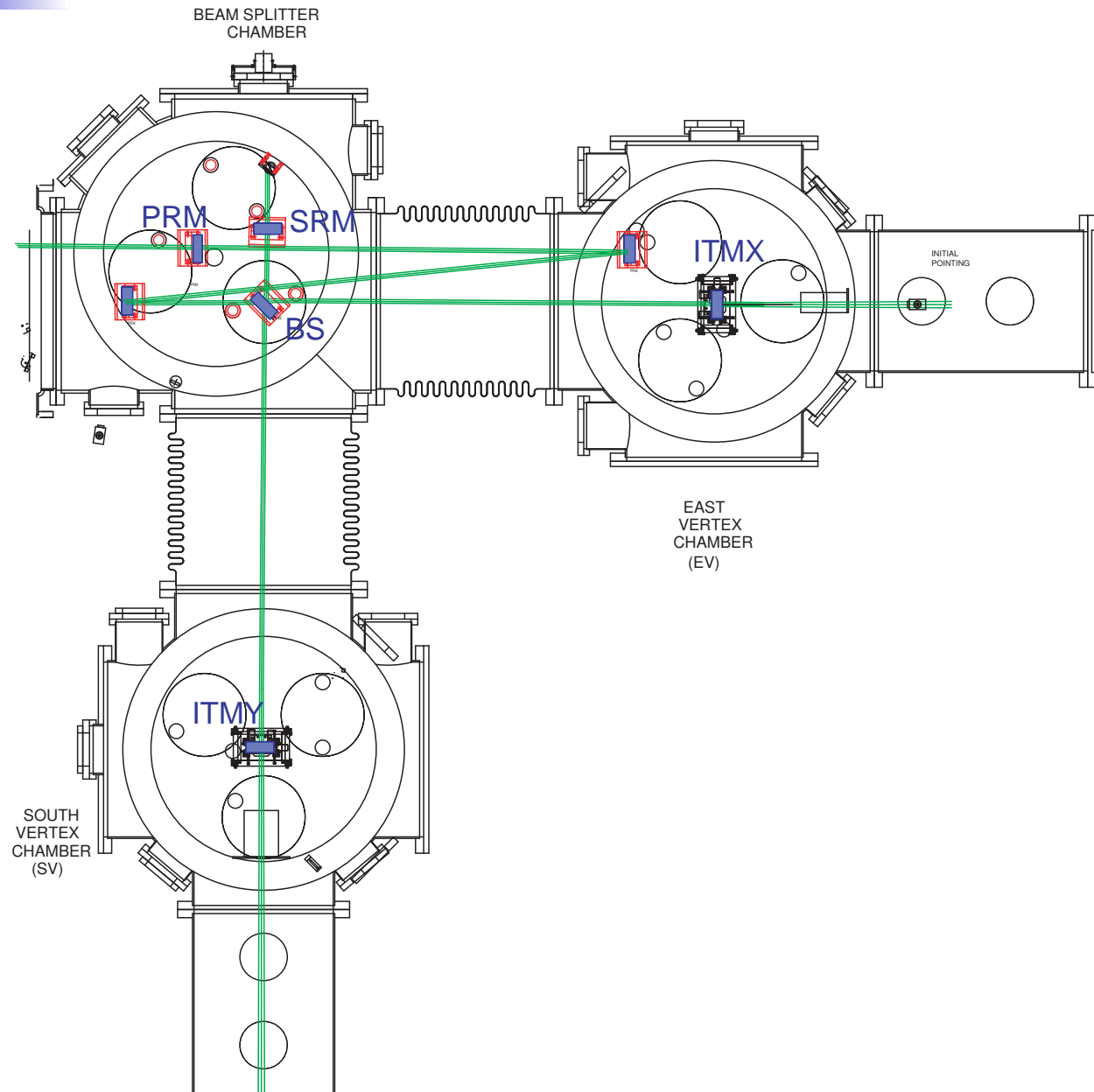
Some parameters

	Adv. LIGO	40m Old	40m New	units
L	3995	38.5	38.5	m
f_1	9.0	33.1	9.5	MHz
f_2	45.1	166.5	47.8	MHz
Δl	0.12	0.45	0.10	m
l_{PRC}	58.14	2.26	7.8184	m
l_{SRC}	56.54	2.16	2.2065	m
γ	0.2 / 0.8	0.3	0.5 / 0.8	
P_{in}	125 / 7	1	3 / 0.3	W
T_{itm}	0.005	0.005	0.015	

Layout

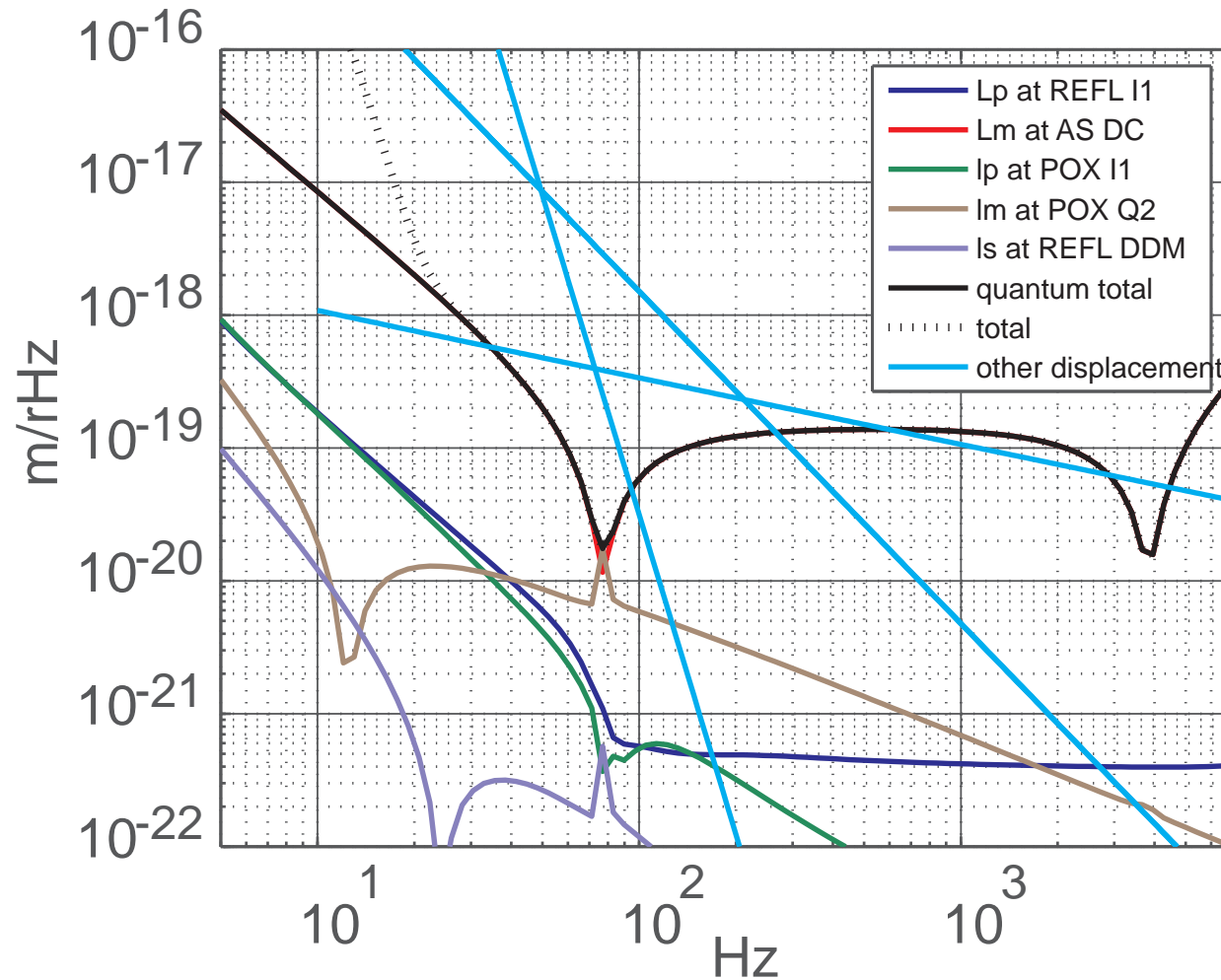


Layout of PRC and SRC



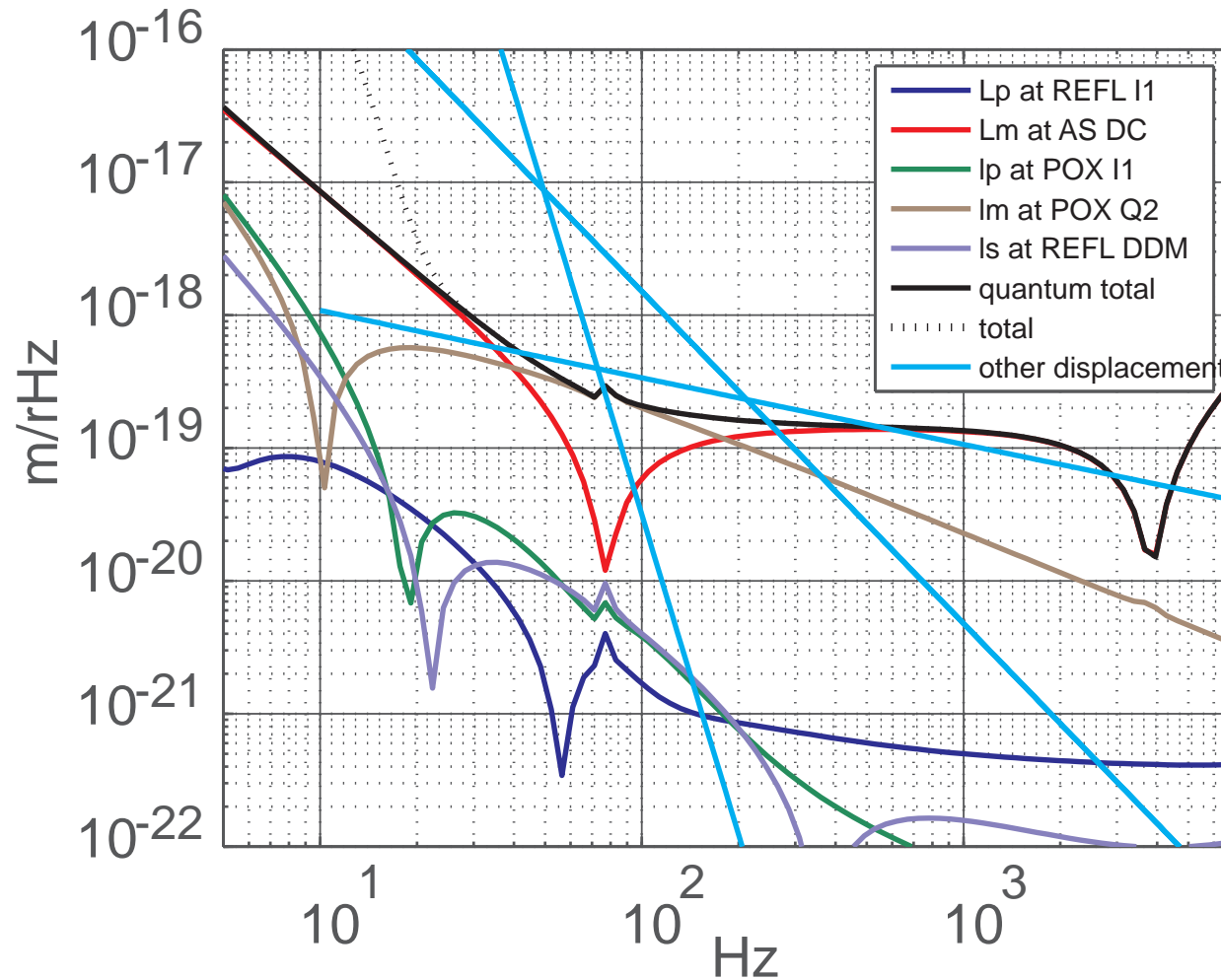
Noise Budget

Signal to noise with Isc coupling with feed forward



Noise Budget

Signal to noise with Isc coupling - no feed forward





Last Slide

The End.