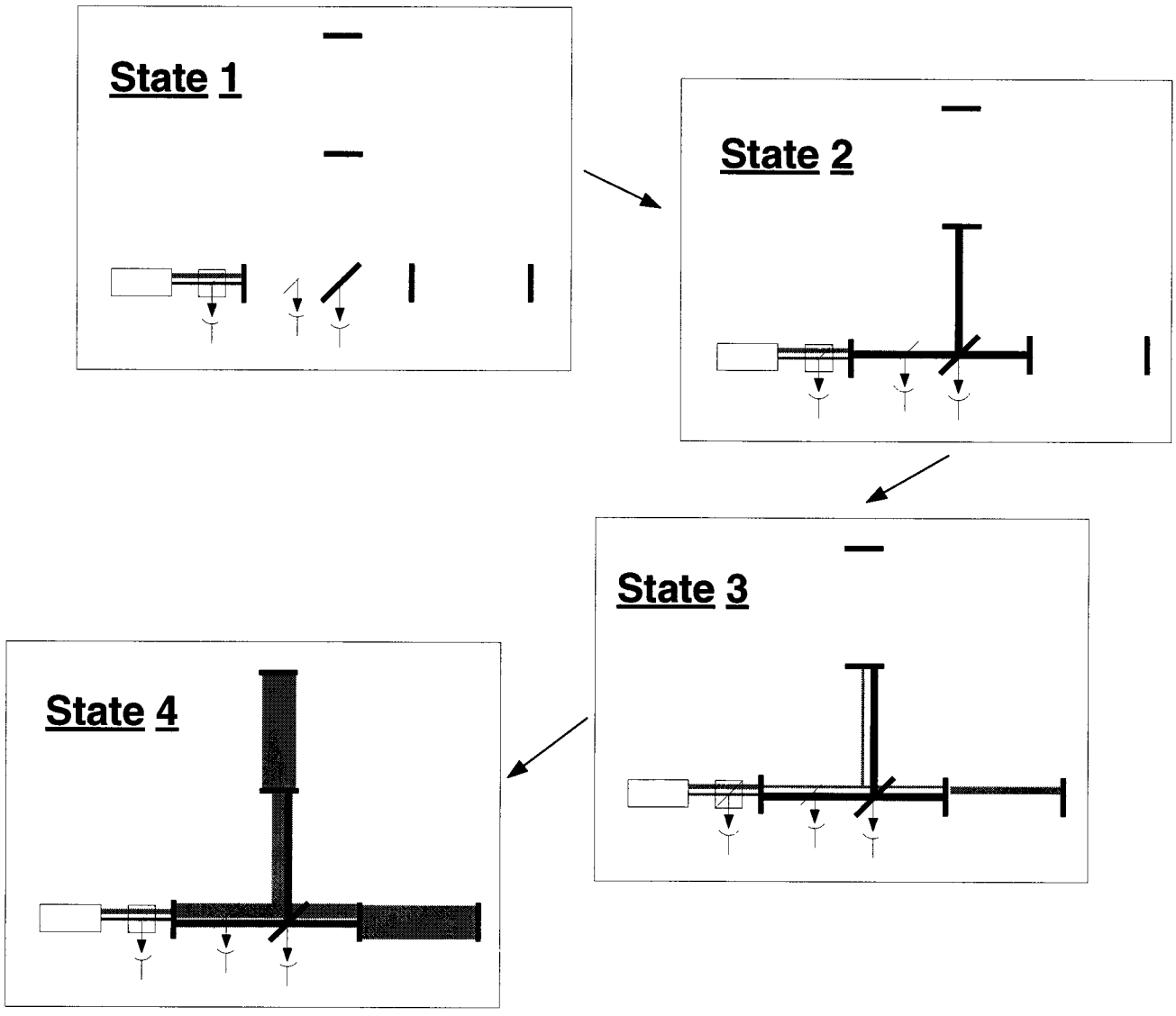
IFO Acquisition Modeling Results (LS 12/12/96)

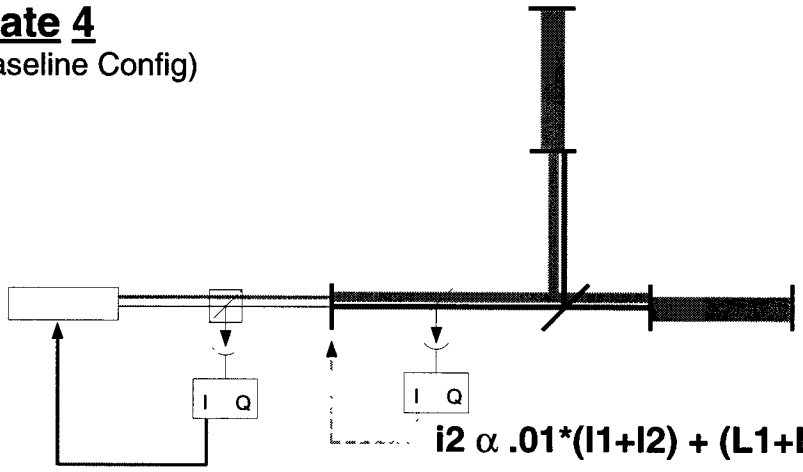
- Changes to baseline feedback configuration necessary for locking recycled ifo
- Design Issues
  - Speed of acquisition (threshold velocities)
    - LIGO
    - 40 m
  - Robustness of servo design (optical gain changes as sequence through acquisition)
    - LIGO
    - 40 m
- Conclusions

Allowed Locking Sequence For LIGO and 40 m



Why Won't Baseline Configuration Acquire Lock?

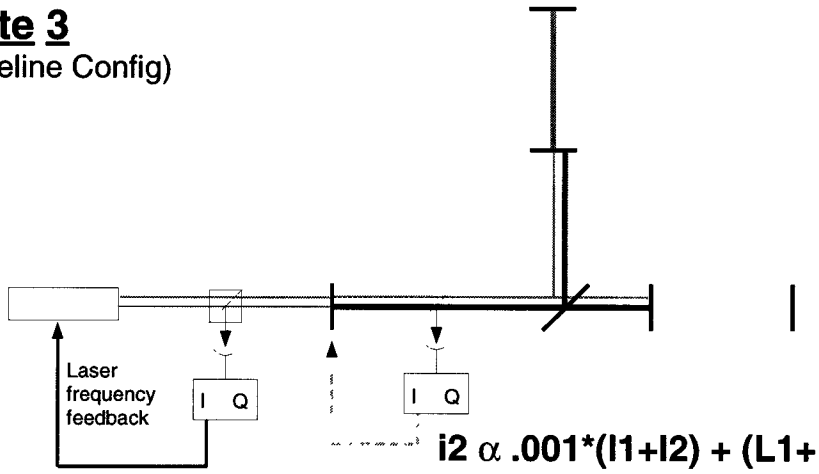
State 4
(Baseline Config)



i2 α .01*(l1+l2) + (L1+L2)

i1 α .03*(l1+l2) + (L1+L2)

State 3
(Baseline Config)

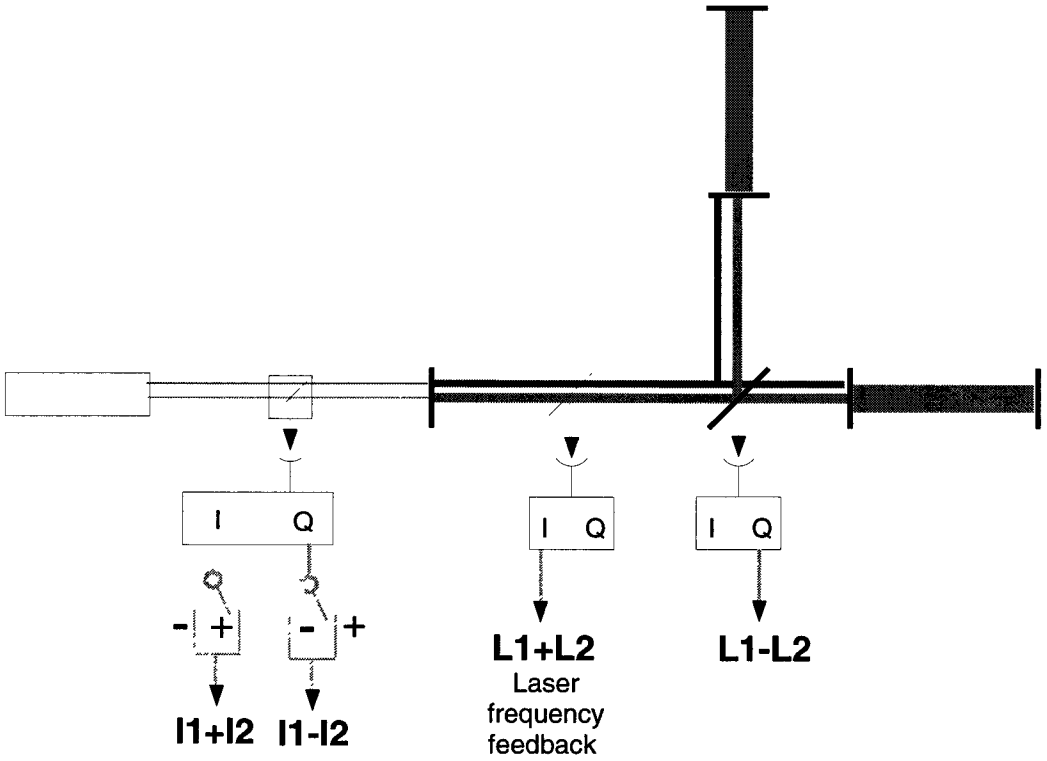


i2 α .001*(l1+l2) + (L1+L2)

i1 α (l1+l2) + .01*(L1+L2)

LIGO-G960245-00-D

Solution to Fundamental Locking Problem

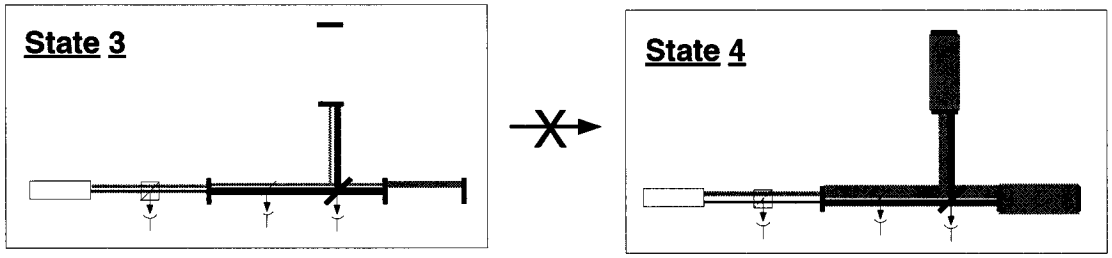


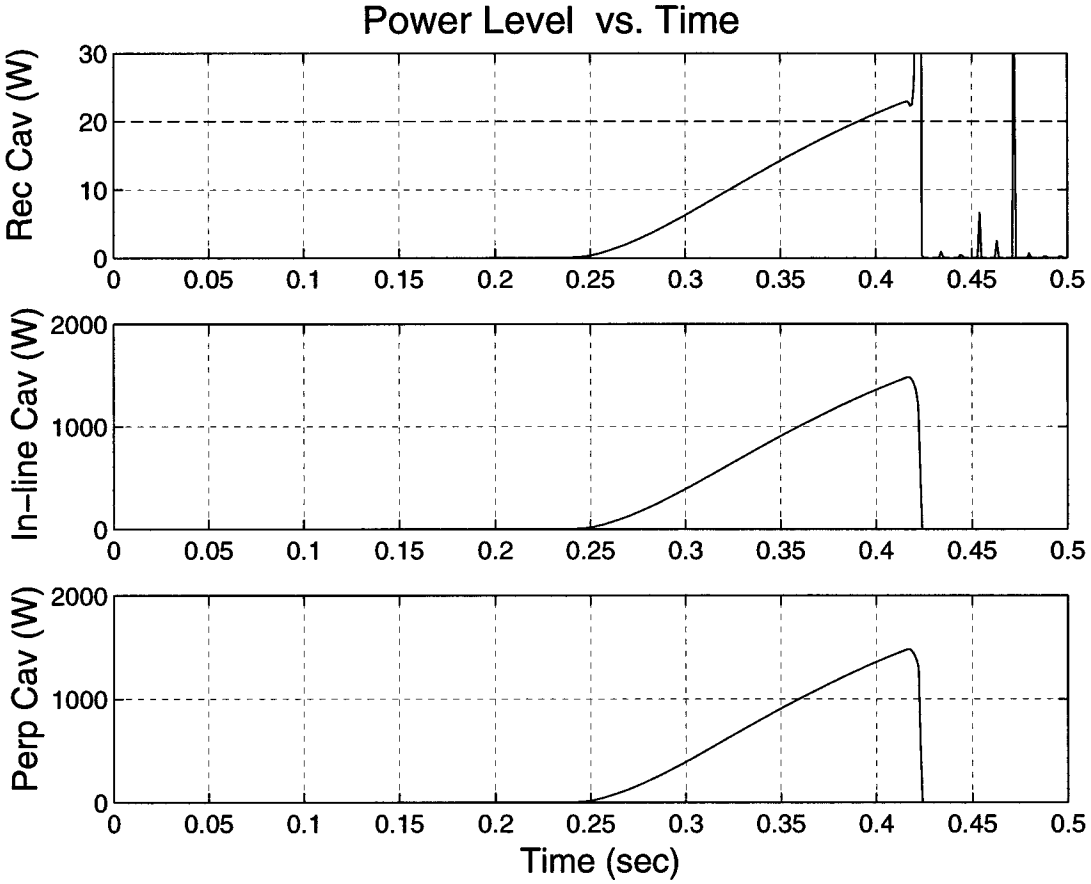
CHANGES TO BASELINE:

1) swapped roles of I1+I2 and L1+L2 sensing points

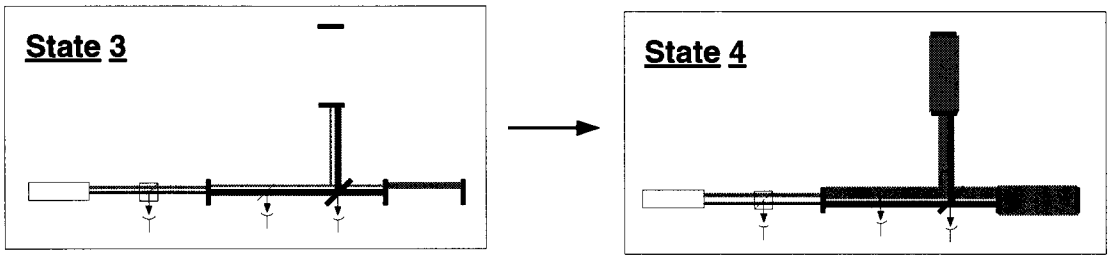
2) polarity switches added to I1+I2 and I1-I2 loops that trigger as second arm acquires lock

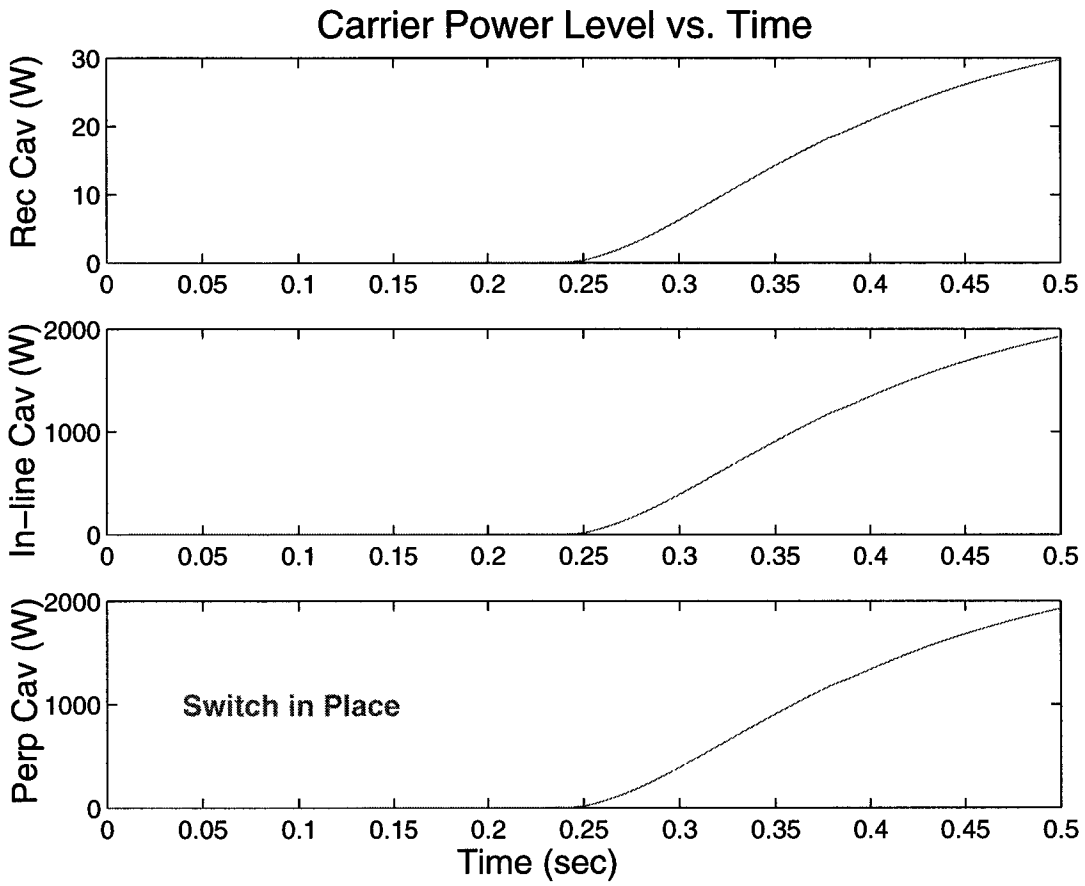
Model Results Assuming No Switches in Servo Design





Model Results with Switches in Servo Design





Threshold Velocity Predictions
(indicates speed of acquisition)

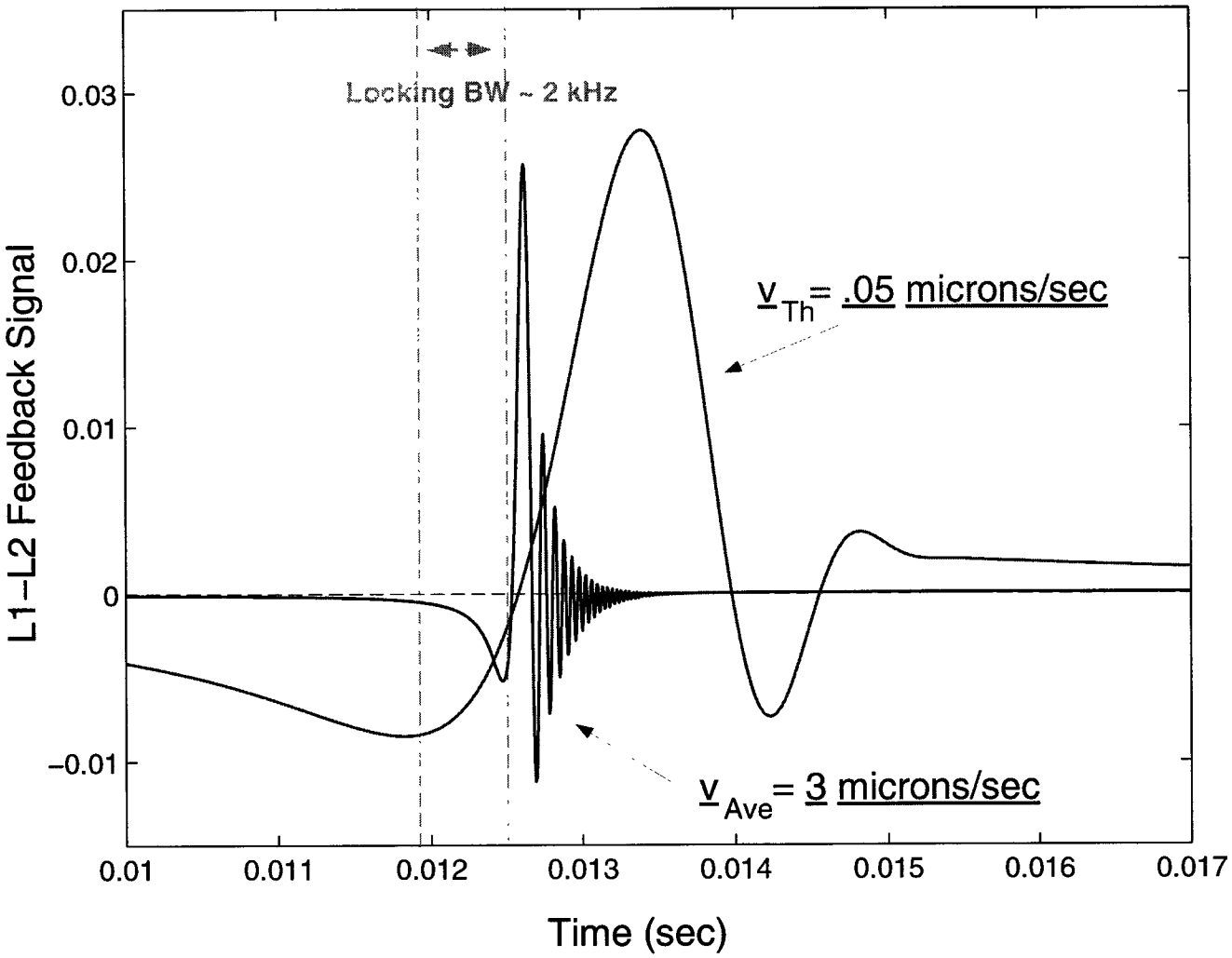
	L1+L2	l1+l2	L1-L2	l1-l2
BANDWIDTH	10^4 hz	55 hz	170 hz	22 hz
THRESHOLD VELOCITY	$4\lambda_1$/sec	λ_1/sec	λ_1/12/sec	λ_1/sec

LIGO ACQUISITION MODE SERVO DESIGN WITH SIMILAR BANDWIDTHS TO DETECTION MODE DESIGN (λ_1 = 1 micron)

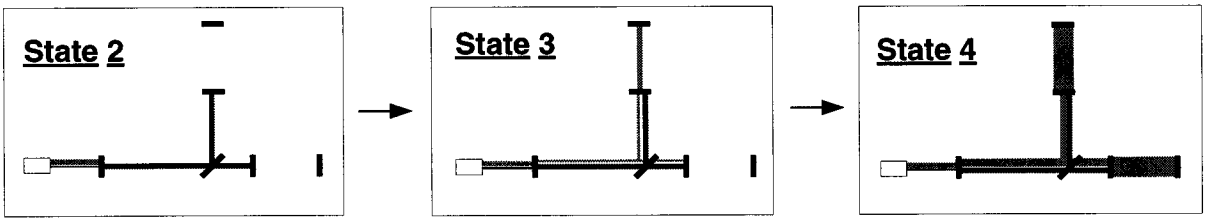
	L1+L2	l1+l2	L1-L2	l1-l2
BANDWIDTH			~ 1.5 khz	
THRESHOLD VELOCITY			~ λ_2/10/sec (Guided Lock Exp. showed λ_2/2.5/sec)	

40m ACQUISITION MODE SERVO DESIGN (λ_2 = .5 micron)

40 m Fringes for 2 Different Test Mass Velocities



Optical Gain Changes During Acquisition



	(L1+L2)	(l1+l2)	(L1-L2)	(l1-l2)
State 2 ---> State 3	NA	no change	NA	no change
State 3 ---> State 4	65 db	-10 db	NA	-9 db

LIGO Relative Optical Gain Changes During Acquisition

	(L1+L2)	(l1+l2)	(L1-L2)	(l1-l2)
State 2 ---> State 3	NA	no change	NA	no change
State 3 ---> State 4	35 db	-22 db	NA	-31 db

40m Relative Optical Gain Changes During Acquisition

What Have We Learned From Acquisition Modeling?

- LIGO
  - Baseline feedback configuration **can not** lock a LIGO IFO
  - Changes to baseline solve fundamental locking problem
  - "Guided lock acquisition" stategy probably necessary
  - Can probably acquire with no changes to servo gains
- 40 m
  - Planned feedback design **will not** lock 40 m
  - Hope to show that changes to baseline will solve fundamental locking problem
  - Time to lock will probably be somewhat worse than time to lock recombined configuration
  - Hope to show acquisition doesn't require real time changes to servo gains