High Power Test Facility

Report

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ACIGA

LSC Meeting, November 203.

- LIGO-G030643-00-Z

Purpose

- Diagnose cavity operation, stability and ***dynamics*** at A/LIGO circulating power (~ 1MW)
- Investigate thermal deformation and control in high power cavities
- Investigate 'cold' lock up to full operating power, including changes to control and alignment signals
- field test a high power (>100 W) laser.
- field test high power conditioned input optics
- validate optical cavity modelling codes
- integrate a high power laser system with a high power handling input optics system, a core optics system and a high power photo detection system.

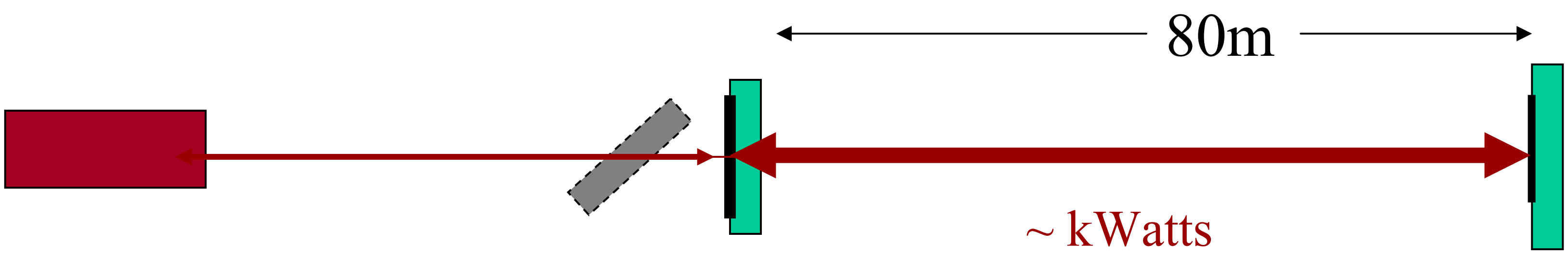
Status

- Major funding commenced January 2002
- Staff:
  - 1 Res. Fellow; 1 Engineer; 5 techs; grad students; academic staff; LIGO 3 person months p.a.
- LIGO commitment:
  - core (2) and PR & MC optics; Suspensions and controllers; high power optical modulators, isolators.
- Completed
  - Central laboratory end stations at 80m + pipe + vacuum
  - 1 vacuum chamber processed
  - Laboratory has now gone clean
- Current
  - Slagmolen, Jacobs

Optical Design

- Rationale
  - Should be as A/LIGO like as possible
  - Input power, circulating power, spot sizes, cavity stability (g factors), cavity lengths
- Allow results to apply to A/LIGO
  - Simple scaling
  - Model validation

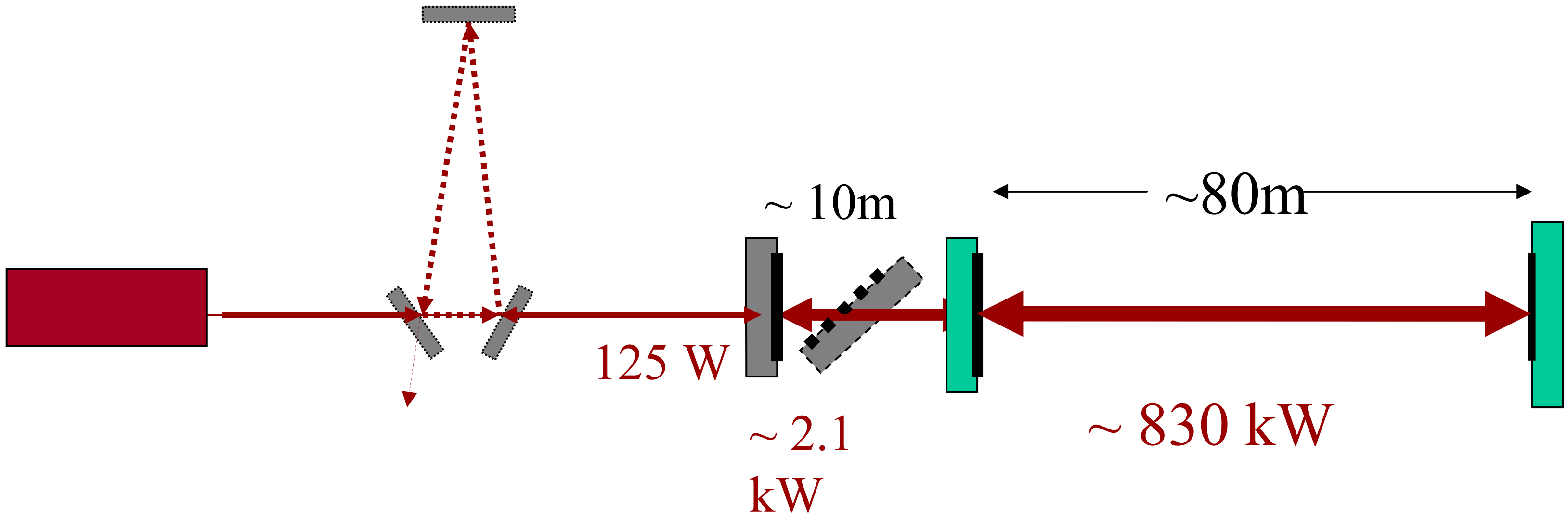
Step 1: arm cavity
See Bram, John



- 80 m stable cavity (g1 g2 > 0.8?)
- 10 W laser
- include thermal readout; AOC

Step 2:
- reverse ITM
- increase laser power, 50W?

Steps 3: PR arm cavity



ACIGA/LIGO High Power Test Program: Milestones and deliverable

Milestone	By end of	FROM	TO
DAS cluster	03/02	Supplier	ANU
Suspension systems delivered	10/03	*LIGO, CIT*	GRF
Vacuum envelope including washing and baking	12/03	UWA	GRF
Isolation with wiring and local control + clean environment	01/04		
Input Optics system with fixed spacer mode cleaner (MC) to handle 10W	01/04	UWA	GRF
10 W laser	12/03	AU	GRF
Mode cleaner for 100 W down select	12/03	AU	
Sapphire test masses (order to be placed 06/02) (fused silica dummies?)	*01/04*	*LIGO*	*GRF*
Hartmann sensor + actuation (compensation plate)	01/04	*AU, ANU, LSC*	GRF
Auto alignment system	02/04	ANU	GRF
10 W power photo detection	02/04	ANU	GRF
Locked 80 m cavity with internal ITM substrate, dummy optics, pumped by MISER.	02/04	UWA, ANU, AU, LSC	GRF
Locked 80 m cavity with internal ITM substrate, pumped by 10W, with auto alignment and AOC.	04/04	UWA, ANU, AU, LSC	GRF
Test 1 Completed: Locked 80 m cavity with internal ITM substrate, pumped by 10 W, circulating power 2.1 kW. Analysis reported:	*05/04*	*GRF*	*LIGO, LSC*
Test 2 installation begins: Locked 80 m cavity with external ITM substrate; 10 W pump.	05/04	ACIGA	GRF
100 W class laser installed.	06/04	AU	GRF
High power optical mod and isolators delivered	*06/04*	*UF*	*GRF*
High power IOO & detection system installed	08/04	*LSC, ACIGA*	GRF
Test 2 Completed: Locked 80 m cavity with external ITM substrate, pumped by 50 W, circulating power 100 kW. All sensors operational Analysis reported:	*02/05*	*GRF*	*LSC*
Test 3 installation begins: power recycled single FP; 100W pump	03/05	ACIGA	
New sapphire ITM + fused silica PRM (ordered 10/04)	*03/05*	*LIGO*	*GRF*
Test 3 Completed: Locked PR FP cavity; 100W input; 8 kW in PRC; 400kW in FP; full sensing and control; cold to hot operation. Diagnosis completed and report compiled.	11/05	ACIGA	LIGO, LSC.