Large Optic Suspension Assemblies (LOS)

Summary:

- We have successfully installed 2 optics in the 2k interferometer. The Mode Matching Telescope 3rd Component and the Recycling Mirror.
- We went through a learning curve with these installations and designed improvements for the next series. Problem areas included:
  - ››Tooling malfunctions and adjustment limitations
  - ››The magnet bonding process required overhauling
  - ››Control actuators developed shorts and had to be replaced in situ
- Preparing and transporting of the LOS to the installation location while maintaining cleanliness

LIGO-G990007-00-W

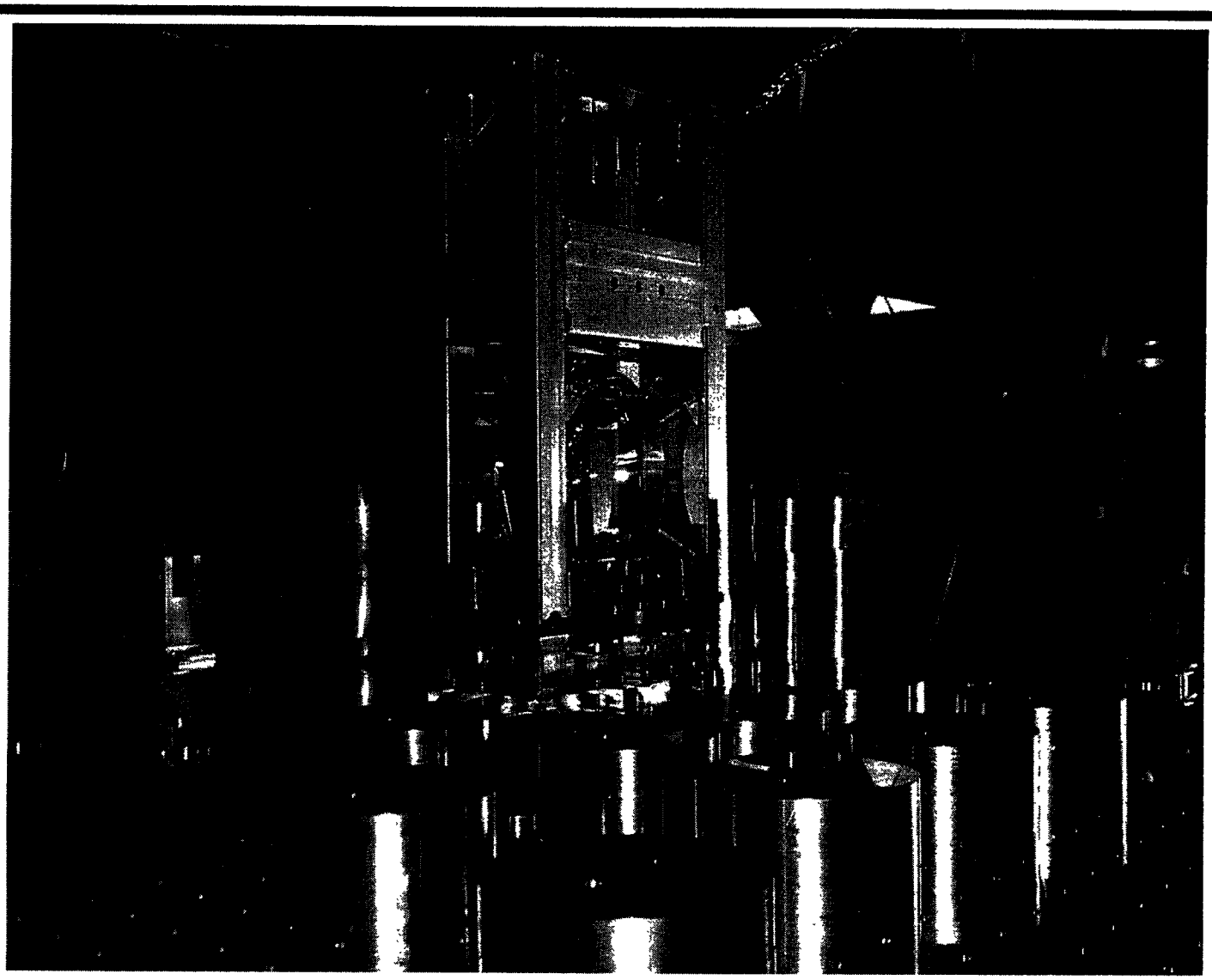
D. Cook

LOS Installation summary continued

- Next Optics to be Processed and Installed for the 2k interferometer will be the Input Test Mass and the Folding Mirror
- Placing the LOS assembly onto the HAM optic tables and/or suspending them from the BSC optic tables.
  - ››Contamination controls
  - ››Fixtures and Tooling used
  - ››Misc

Mode Matching Telescope Mirror

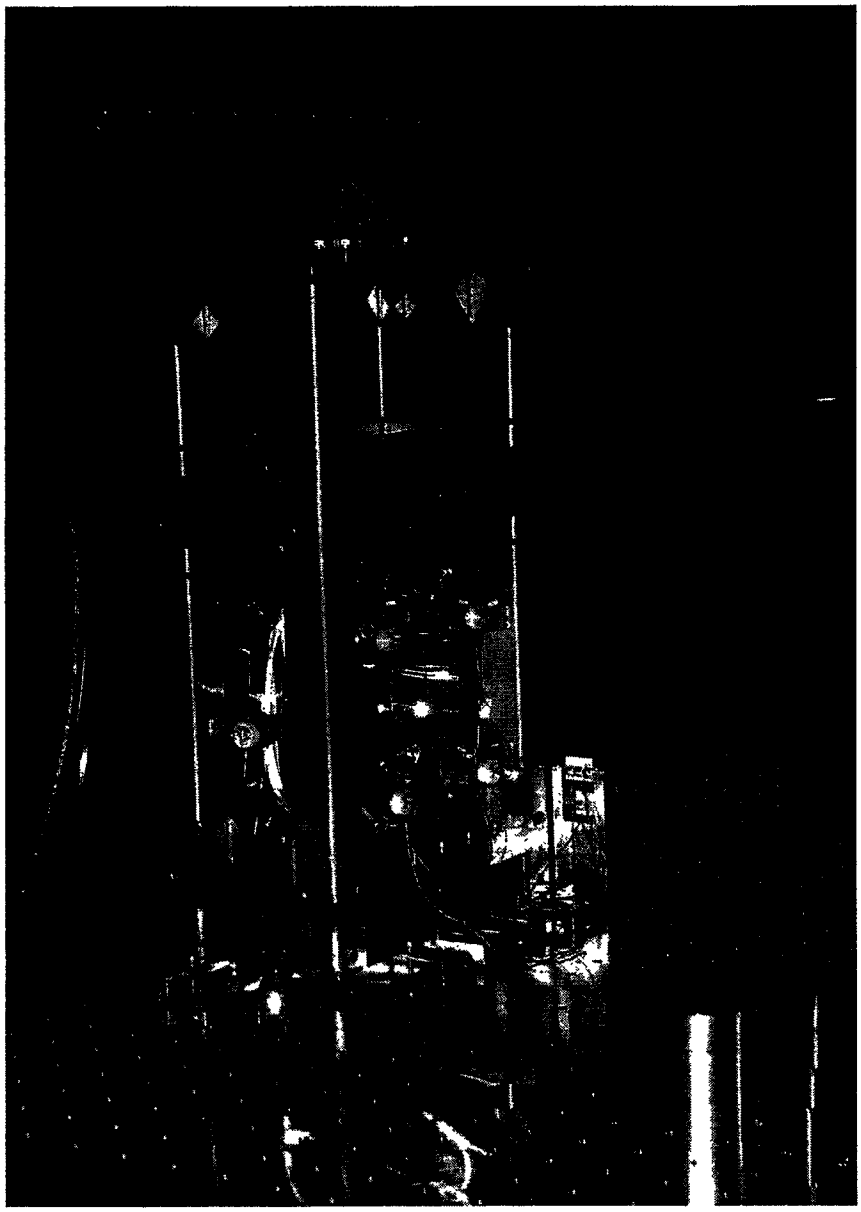
(MMT3 -The last optic in the IOO Mode Matching Telescope)



Viewed through West side of HAM7 prior to any additional Input/Output Optics being installed. In the foreground are counterweights which are accurately positioned to maintain the optic table balance, height and level. These weights are repositioned or removed as new components are placed on the table

LIGO

Recycling Mirror Y arm-2k IFO (RMy-2k)



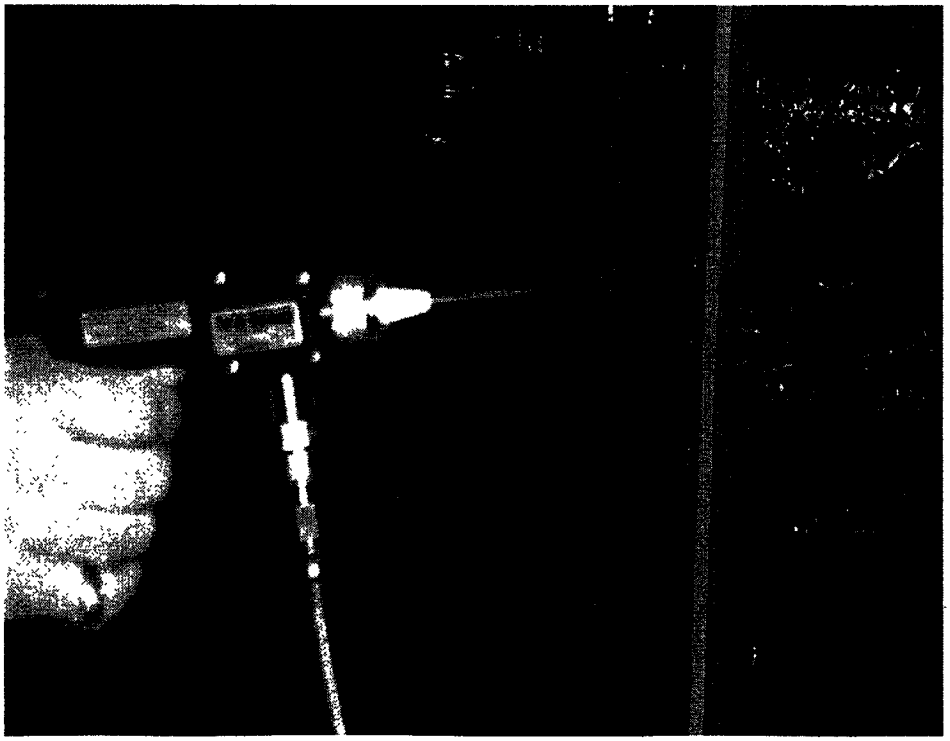
Viewed from the East side of HAM 9

There are 5 actuator sensing heads to control Pitch, Yaw and Side motions of the optics, as well as overall dampening of unwanted motions.

LIGO

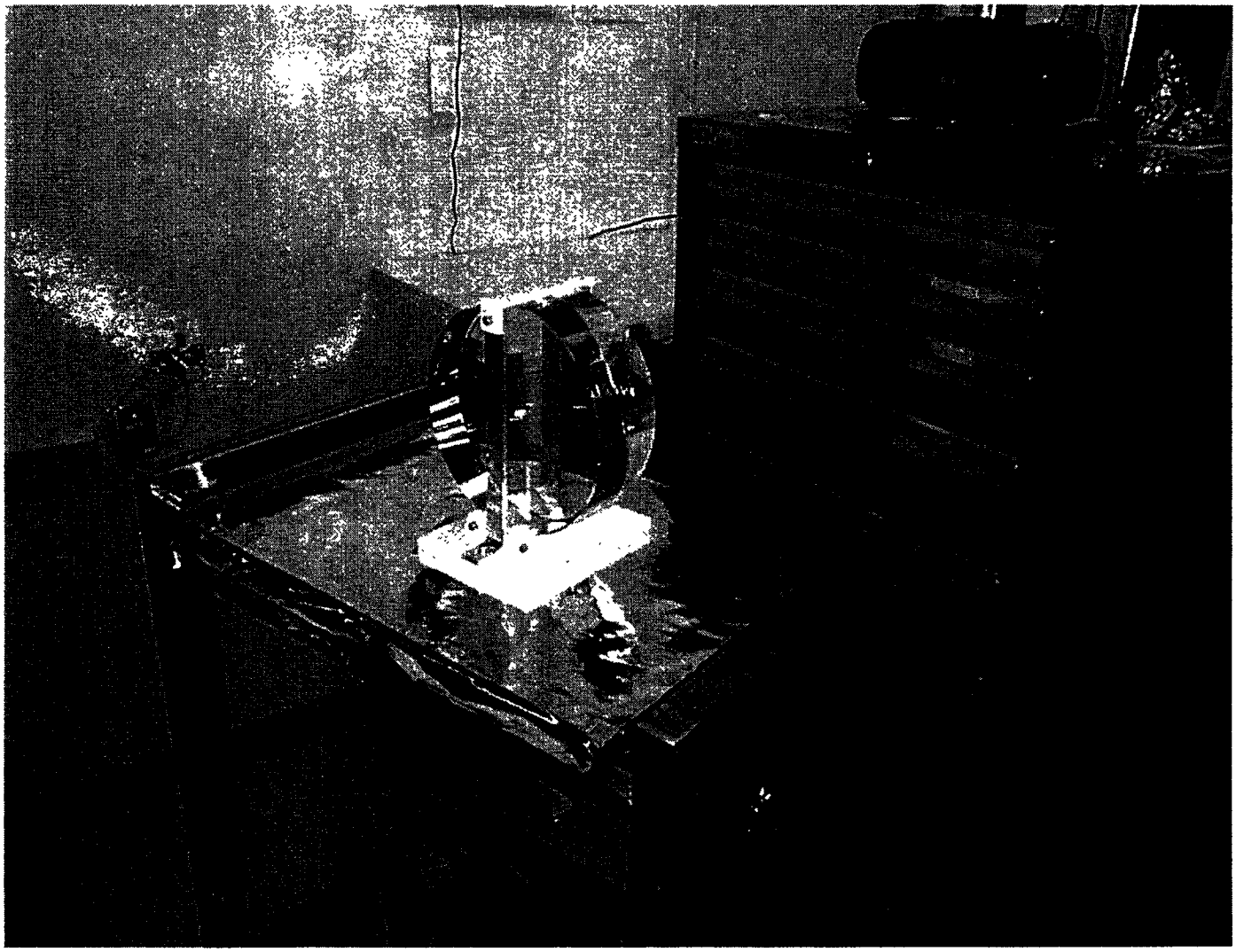
Installing LOS Assemblies Fixtures and Tooling

- Installation begins when the optic has been recleaned after vacuum baking, rehung in it's structure, the tilt angle reconfirmed and the OSEMs checked for proper balancing and dampening.
- The optic is loaded onto the transport cart from the optics table, cleaned one last time with the CO2 "snow" gun and N2 Ionizing gun to remove any dust which may have settled on it.



LIGO

Core Optic Componets (COC)

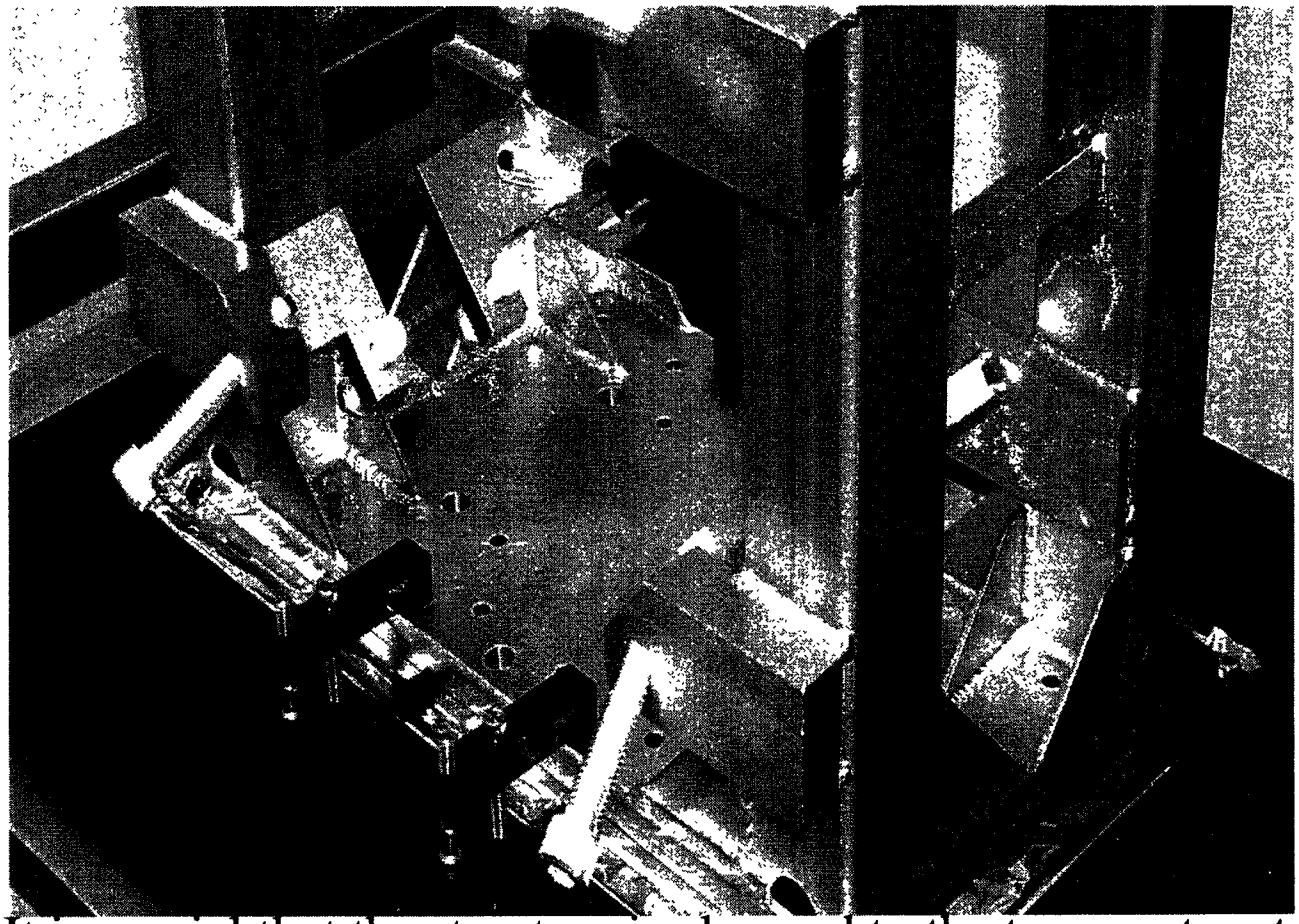


The typical COC specs:

Material: Fused Quartz with several specalized coatings (typically 39 different layers); Weight: approx. 25lbs-------- (125lbs if you become nervous while lifting); Size: 10 inch dia. X 4 inch thick.

LIGO

"Dog" Clamps and Safety Stops

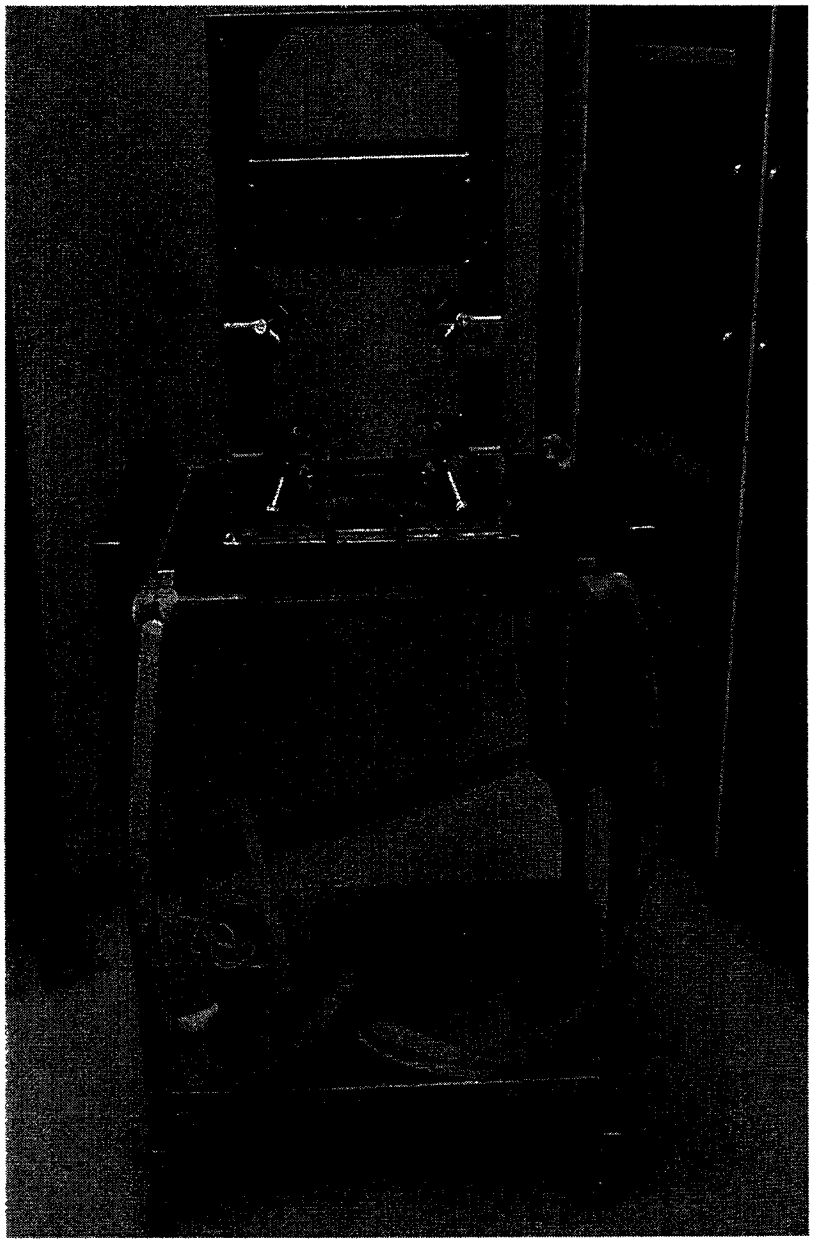


It is crucial that the structure is clamped to the transport cart as in several cases the cart is craned over the beam tube to the installation site. There are several Viton and Teflon tipped safety stops which support and capture the optic during transportion and installation. This prevents damaging the optic or breaking off the magnets which protrude into the OSEMs. The stops are later retracted to less than 1mm from the optic to allow it to hang freely.

LIGO

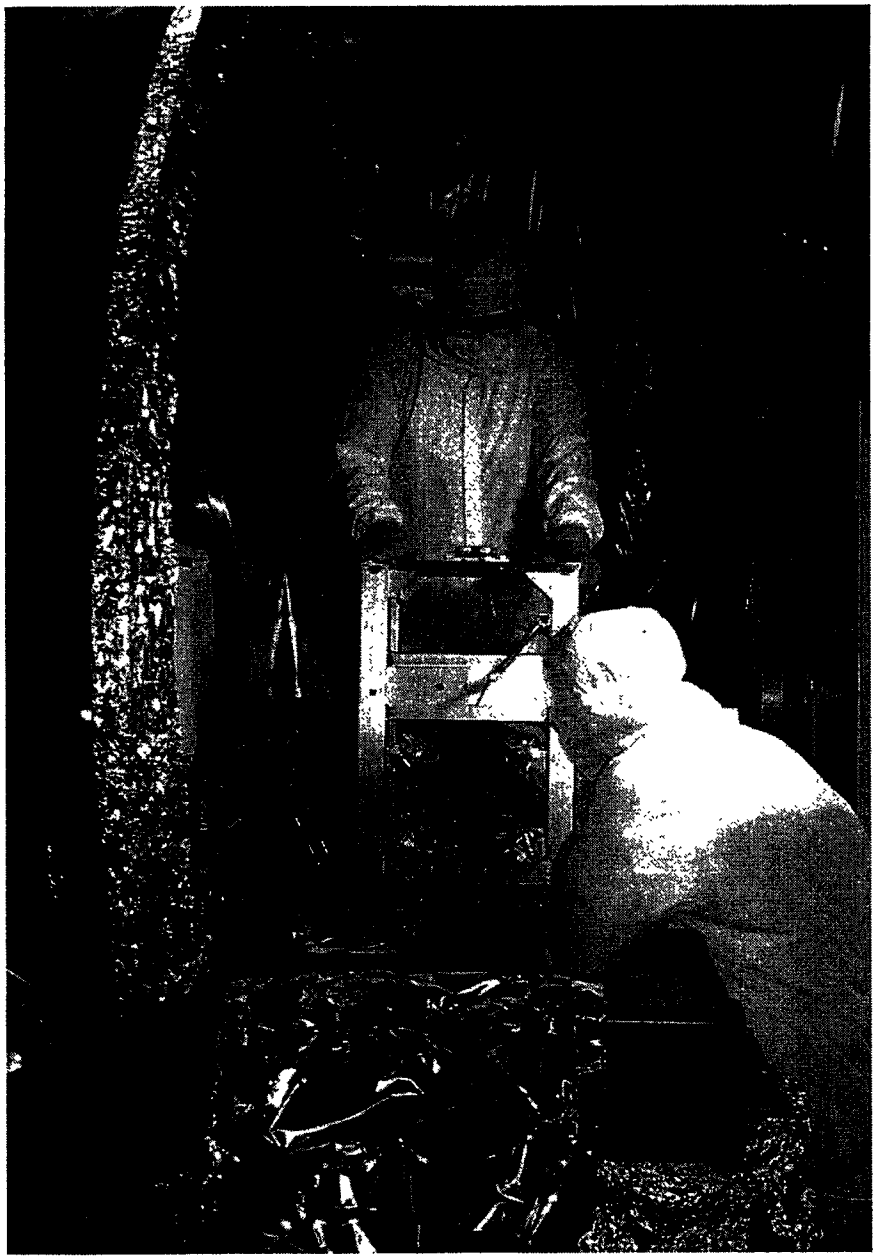
Transport Cart with shock absorbing casters

Slings are used to crane the cart over the beam tube when required.



LIGO

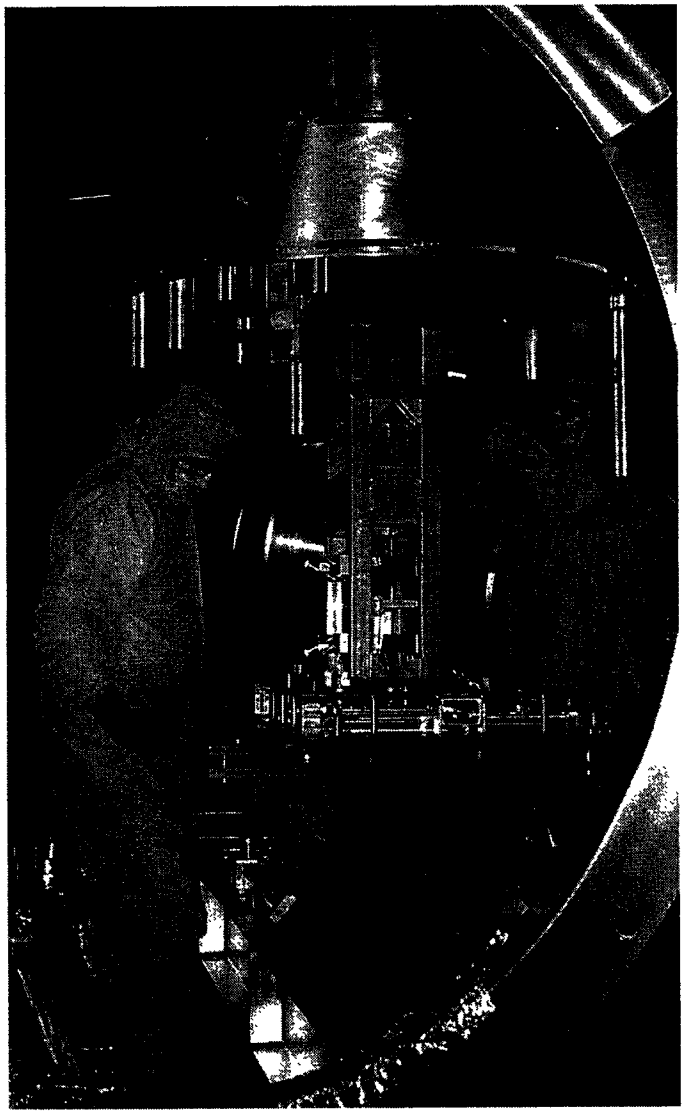
Contamination and Controls



To provide reasonable assurance against the inadvertent introduction of contaminants to the optics, fixturing and/or the vacuum envelope, all personnel assisting with LOS installations must be familiar with the LIGO Hanford Observatory Contamination Control Plan

LIGO

Lift Table, Support Beam with Shuttle and Alignment Fixture



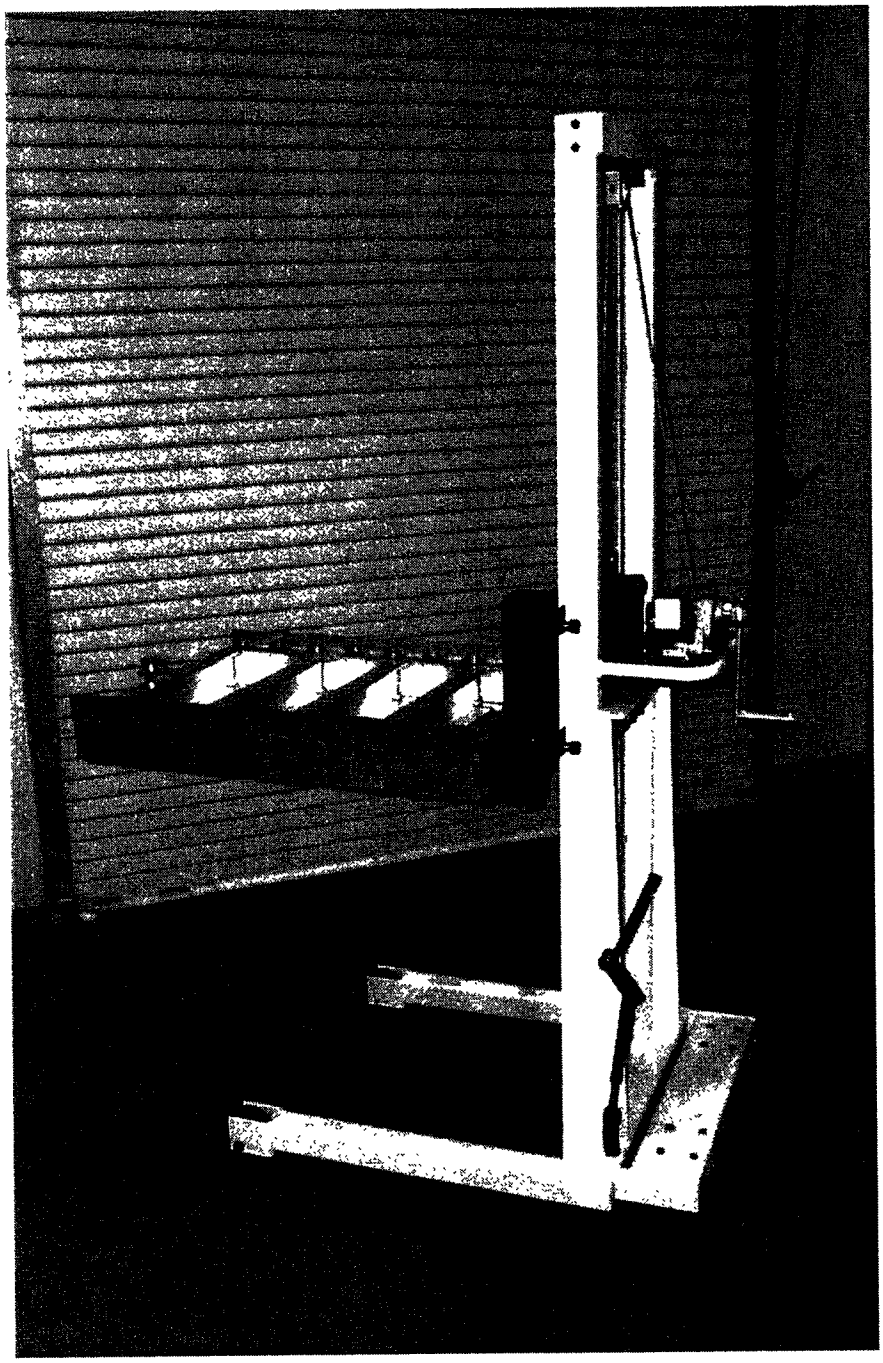
This is the first attempt at installing the Folding Mirror for the 2k interferometer. The alignment fixture lacked enough adjustment to locate the structure to its position.

Counter weights had to be shuffled to clear a path across the optic table.

Maintaining a proper level of both the optic table and the fixturing proved to be critical. An out of level fixture will cause the optic to swing when released from its stops. Stops need to be within 1mm of the optic.

LIGO

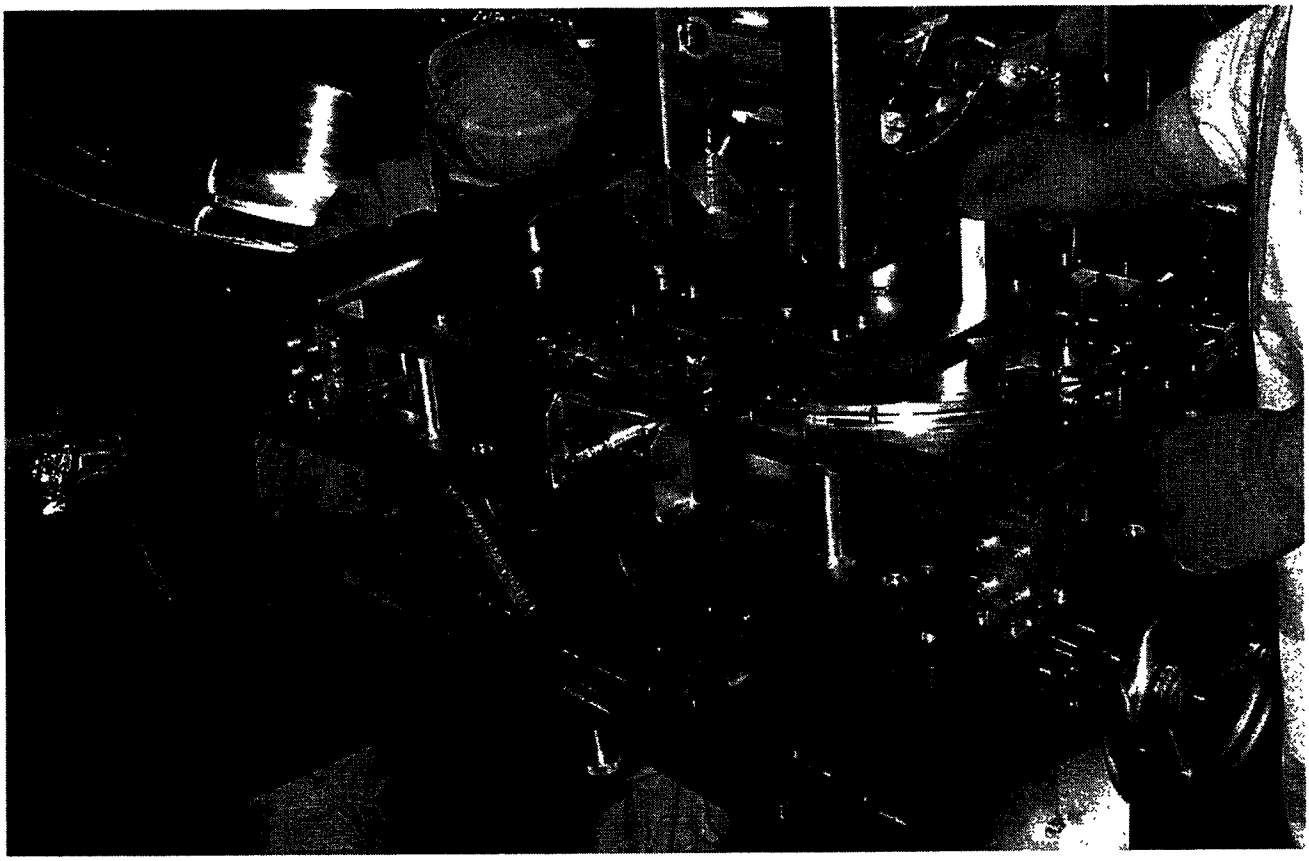
Straddle



The straddle lift was modified from its original version to elliminate the hydraulic cylinder, (Hydrocarbon source). This lift is used to transfer the LOS and some of the heavy tooling to the optic tables in the HAM chambers or to the support beam and shuttle in the BSC chambers. The combined weight of the Core Optic Component, Structure and Height Adapter is approximately 150 lbs. The roller platform switches out with an optical bread board for loading the LOS assembles.

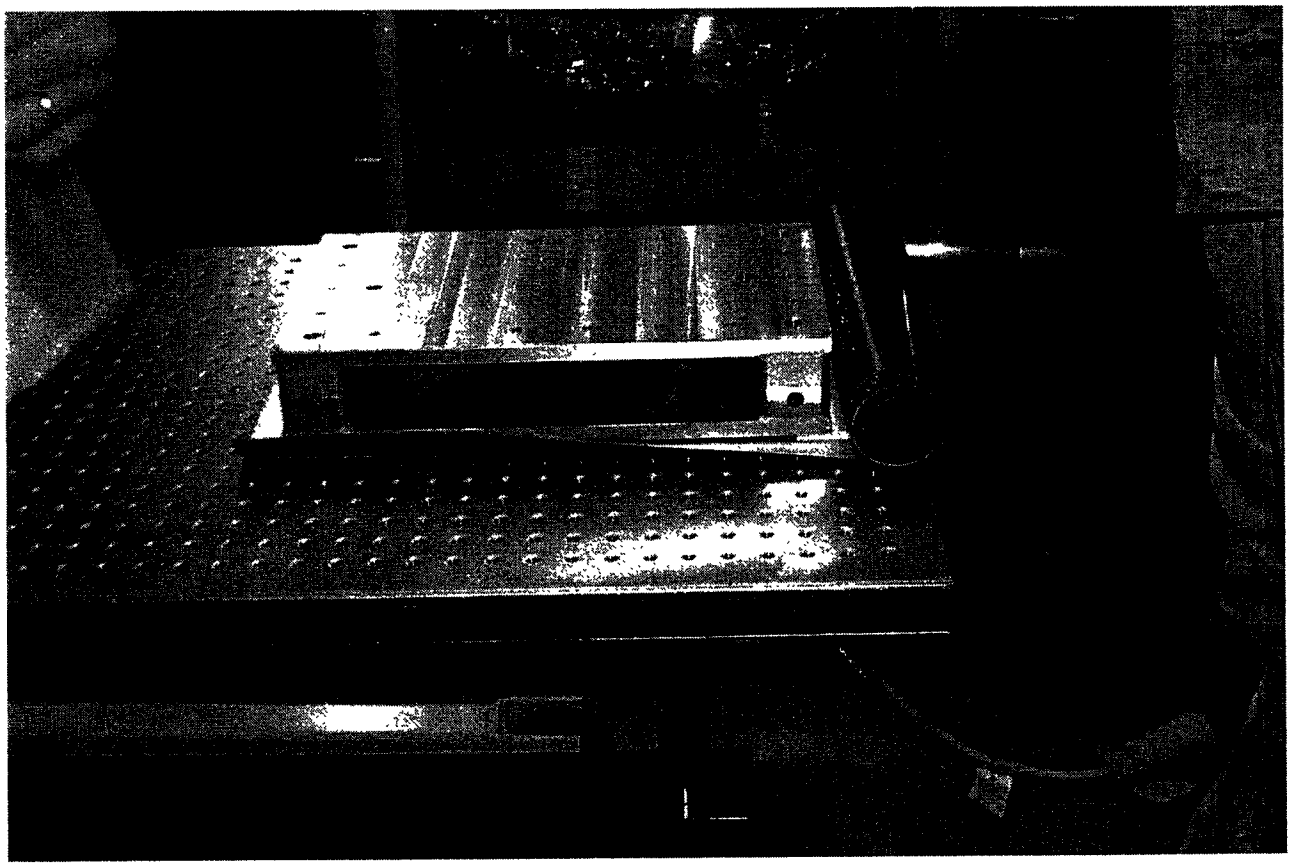
LIGO

Alignment Fixture



This fixture did not prove effective for either HAM or BSC installations.

Height Adapter
HAM



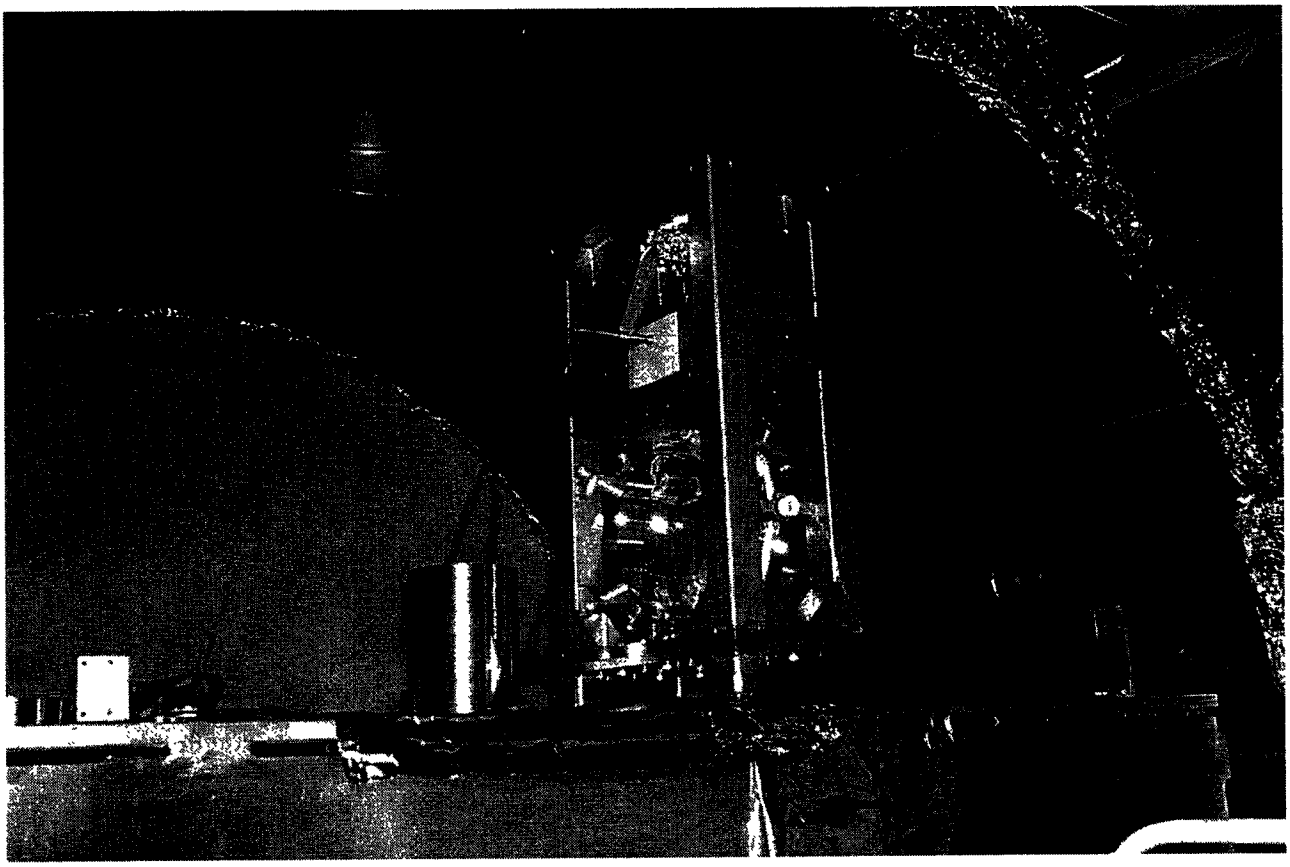
HAM - LOS height adapter sitting on Teflon blocks and Teflon highway on the straddle lift. This is set up to transfer the LOS structure from the transport cart.

LIGO

Mounting Structure to Height Adapter (HAM)

LIGO

"Teflon Highway"

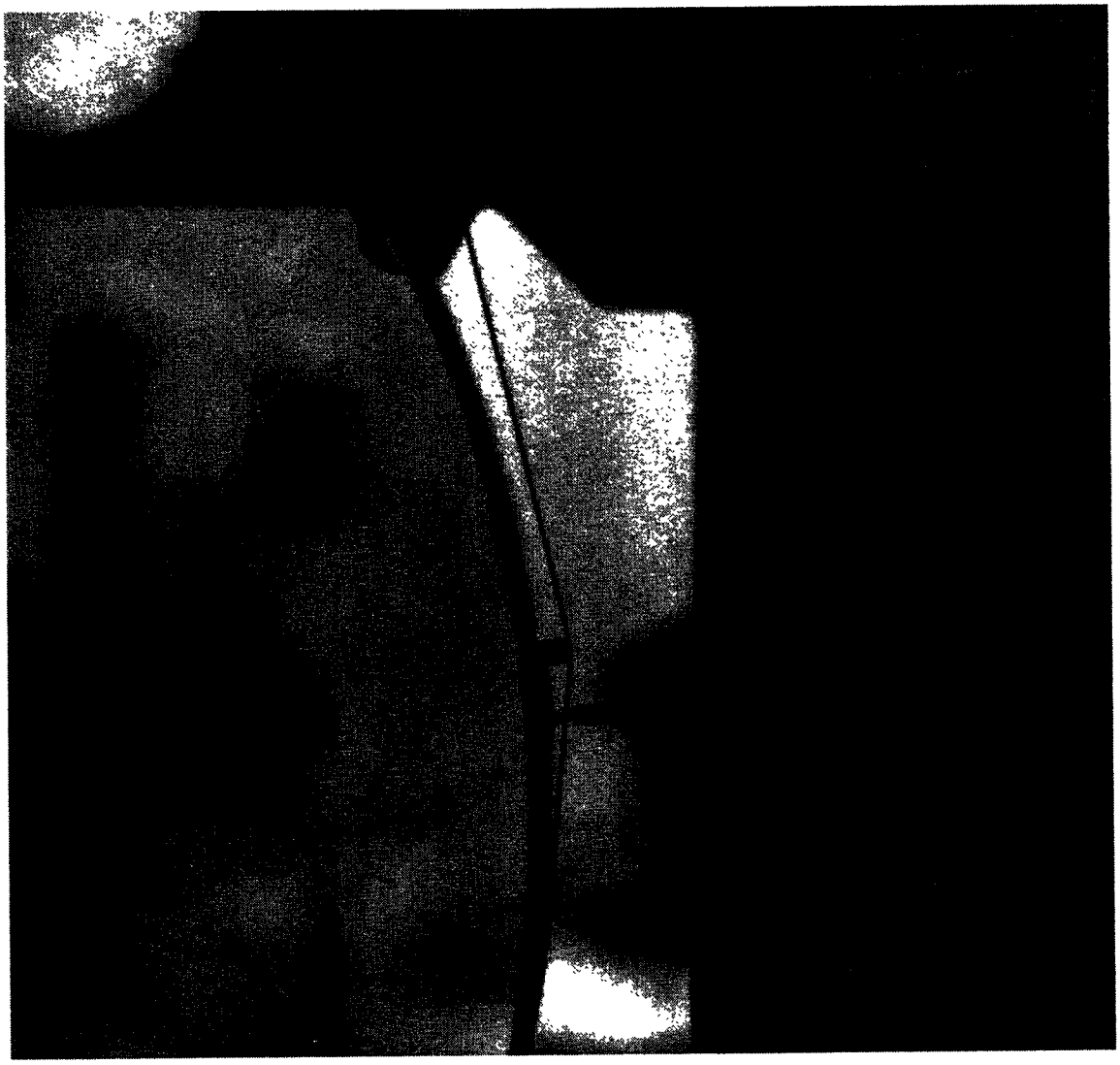


The LOS structure rests on two Teflon blocks which are sitting on a thin roll of Teflon sheeting (Highway). The LOS is pushed along the highway close to its destination. A lifting fixture then raises the LOS to remove the Teflon pieces. Then final alignment is obtained by "pusher screws" threaded through brass blocks clamped to the optic table. The screws push against the structure base.

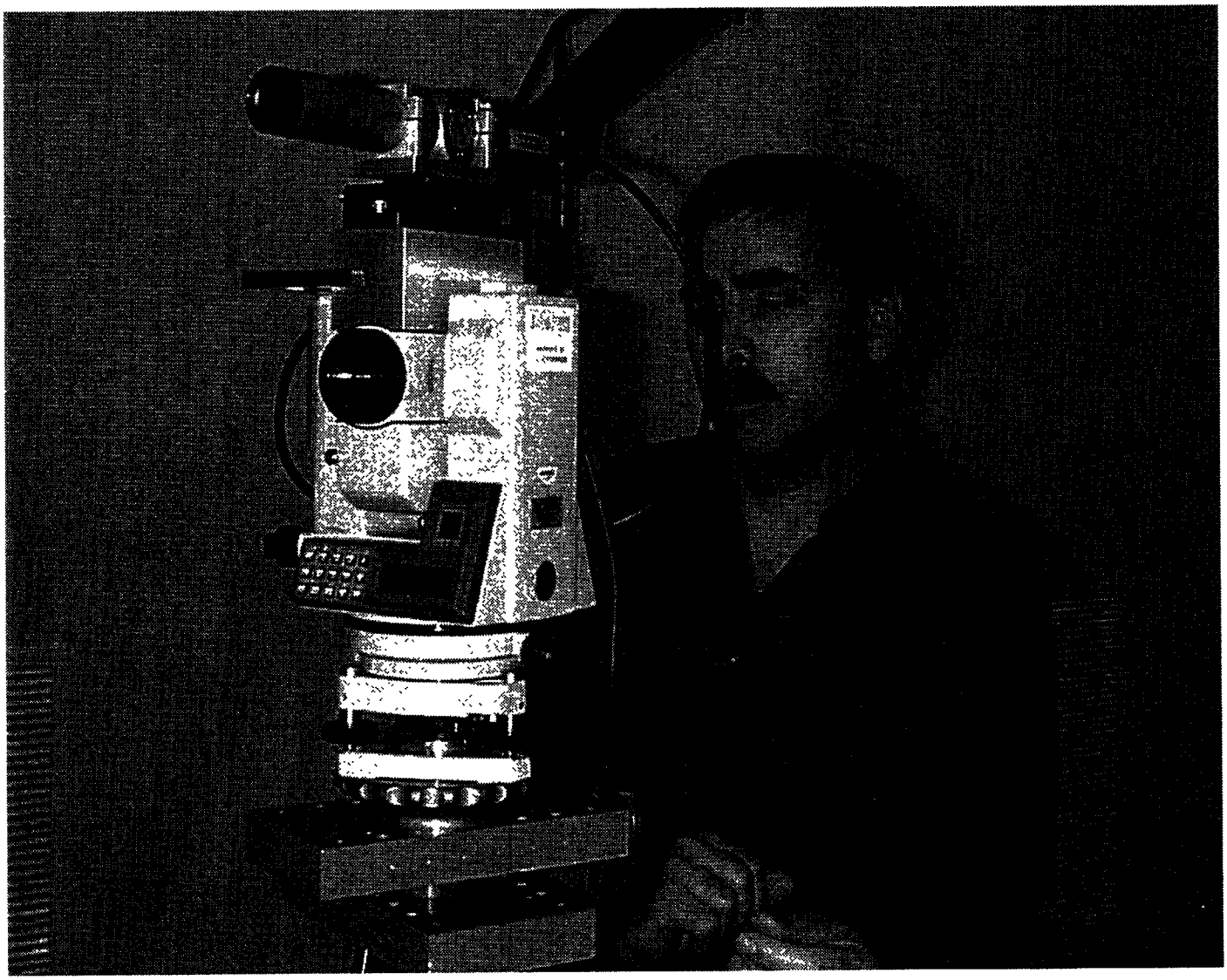
The LOS was transferred from the breadboard on the straddle in the same fashion.

LIGO

Wire Standoff



Laser Autocolimator



LIGO