

# Input Optics Installation

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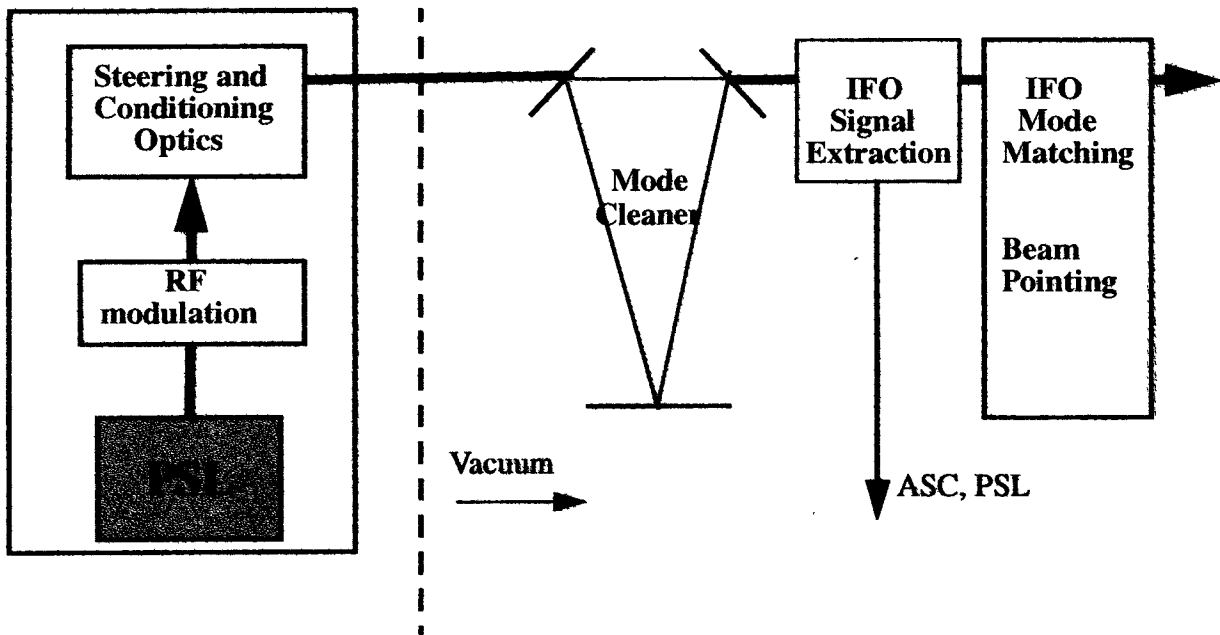
- Introduction to IO System
- Installation Progress and Status
- Problems and Solutions
- Upcoming

SCANNED



# Input Optics System

Pre-Stabilized Laser  $\diamond$  IO  $\diamond$  Interferometer



# Input Optics System (cont'd)

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- Laser beam steering and conditioning
  - ›› Beam waist size and position
  - ›› Wave front distortion and losses
  - ›› Polarization
  - ›› Beam pickoffs and for diagnostic
  - ›› Safety concerns
- RF phase modulation
  - ›› Three modulation frequencies
    - resonant side bands
    - non-resonant side bands
    - mode cleaner
  - ›› Alignment
  - ›› Thermal effect
  - ›› RFAM

# Input Optics System (cont'd)

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- Mode-Cleaner

- ›› Suspended 15m triangular cavity
  - Finesse = 1550, FSR ~ 10 MHz
- ›› Rejection of the higher order modes
- ›› Improve laser frequency stability
- ›› Suppression of intensity noise and beam wiggle

- Mode-matching Telescope

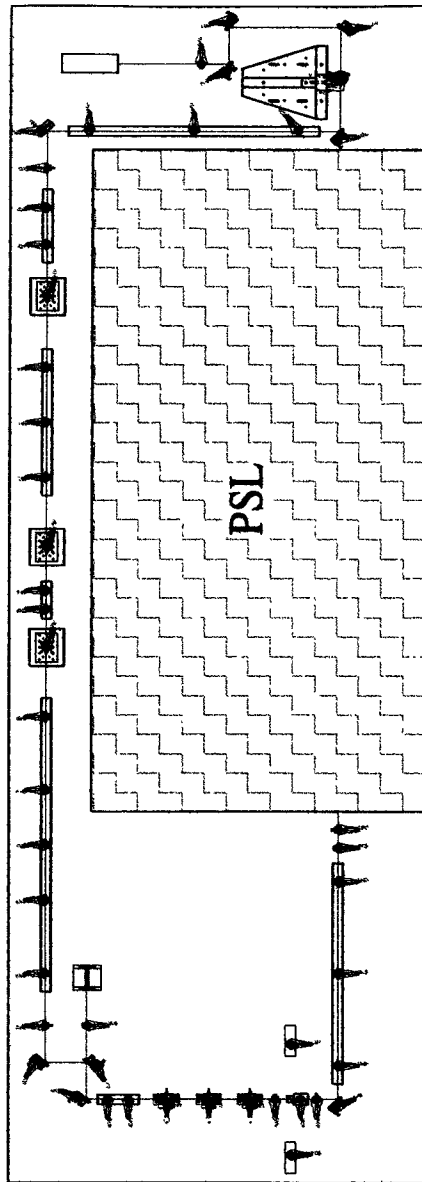
- ›› Three-element design with suspended mirrors
  - independent adjustment of waist size and position
  - beam steering into IFO

- Faraday Isolator and IFO Signal Extraction

- ›› In-Vacuum components
- ›› Thermal lensing and wave front distortion
- ›› depolarization and Isolation

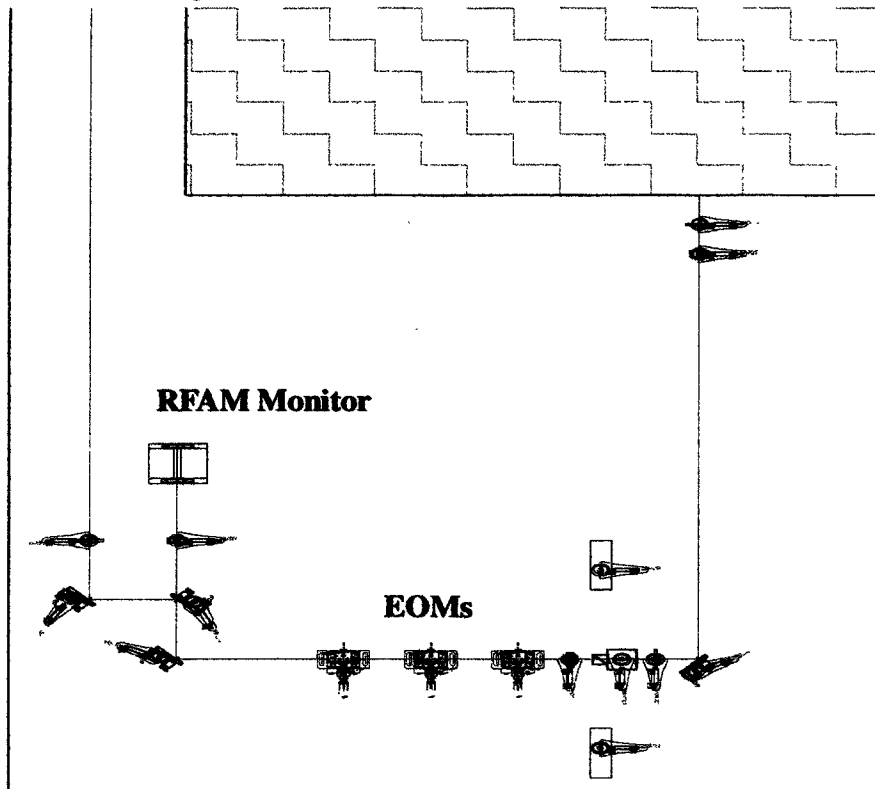
# PSL/IO Table Layout

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# PSL/IO Table Layout (cont'd)

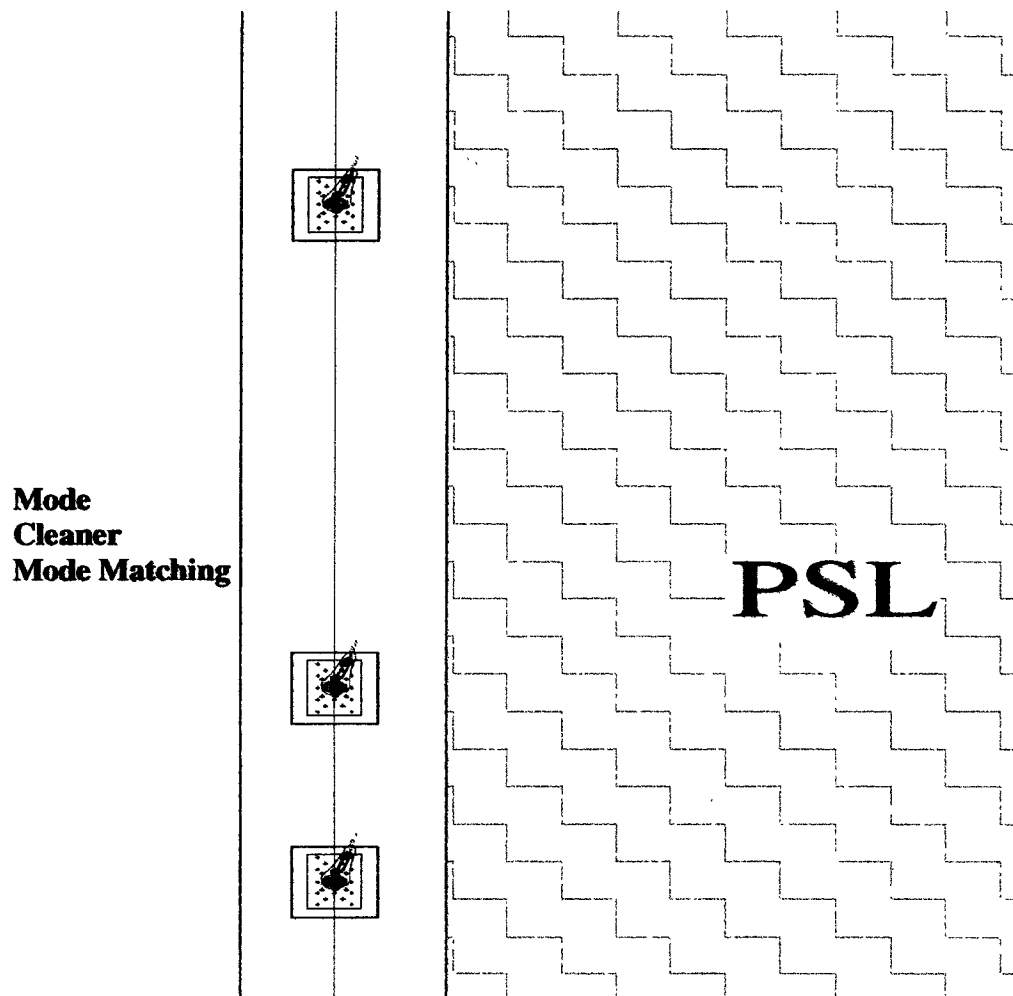
- Modulation Optics



# PSL/IO Table Layout (cont'd)

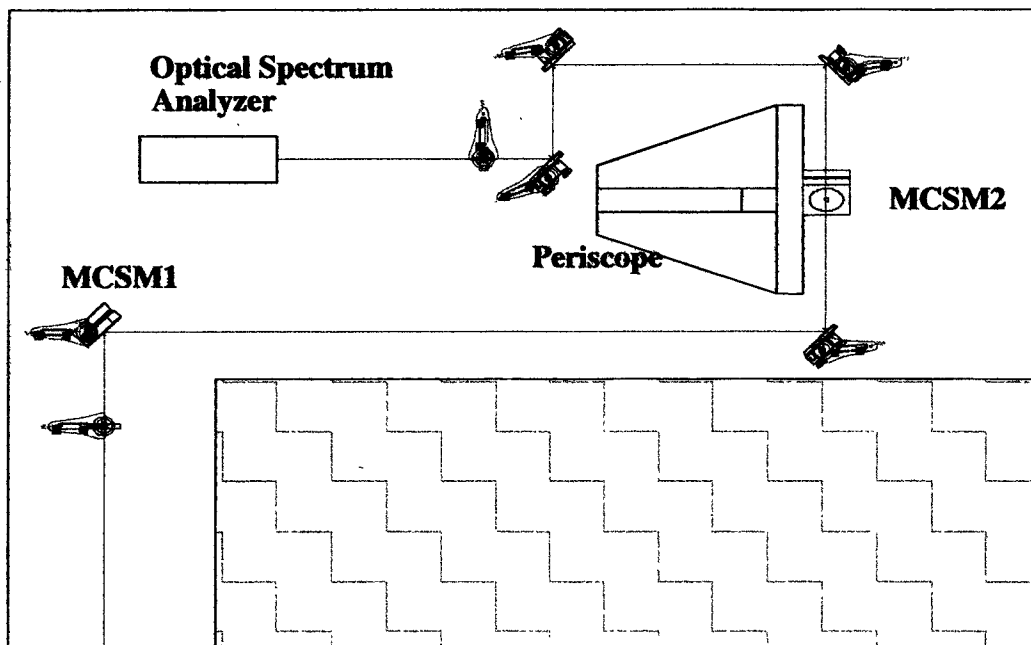
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- MC Mode Matching Telescope



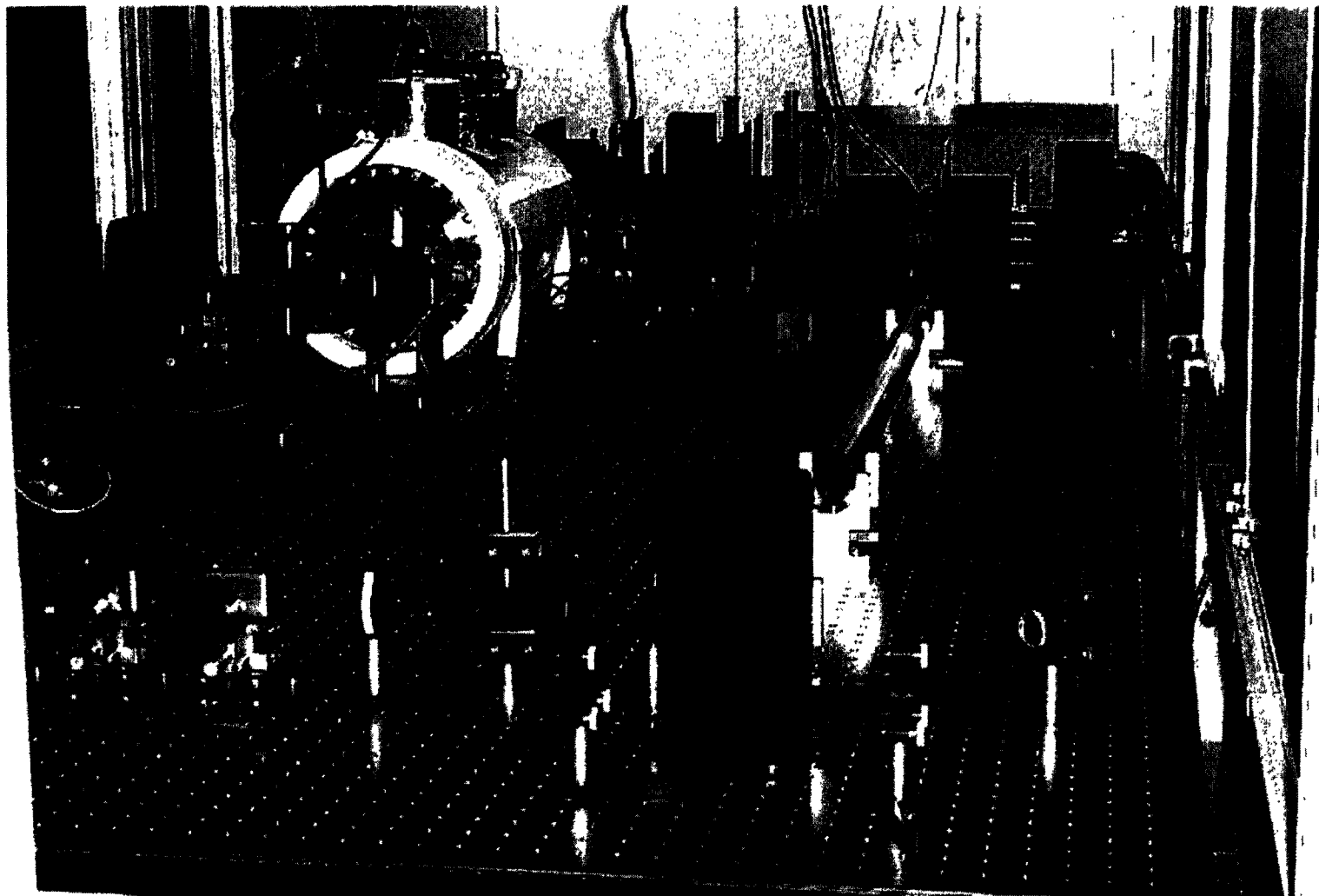
# PSL/IO Table Layout (cont'd)

- Periscope, MC Beam Actuators, OSA

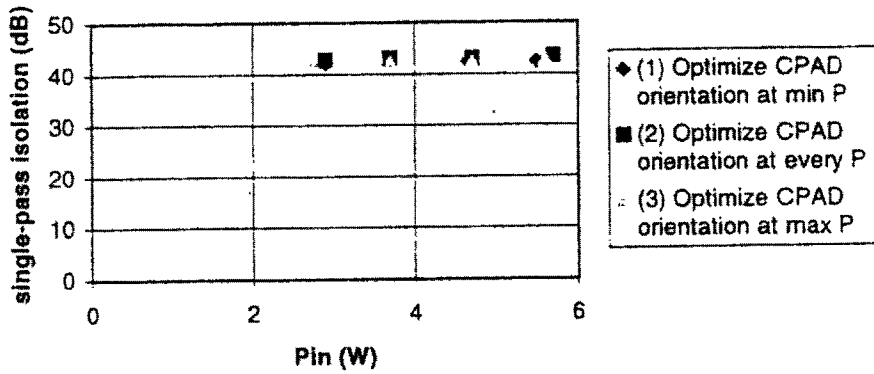




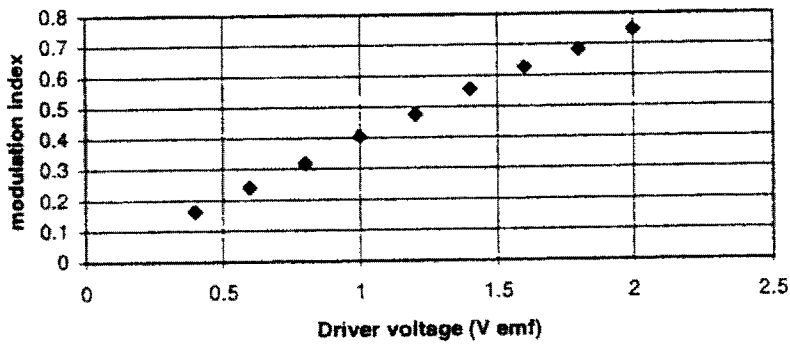
IO\_overviewR.jpg



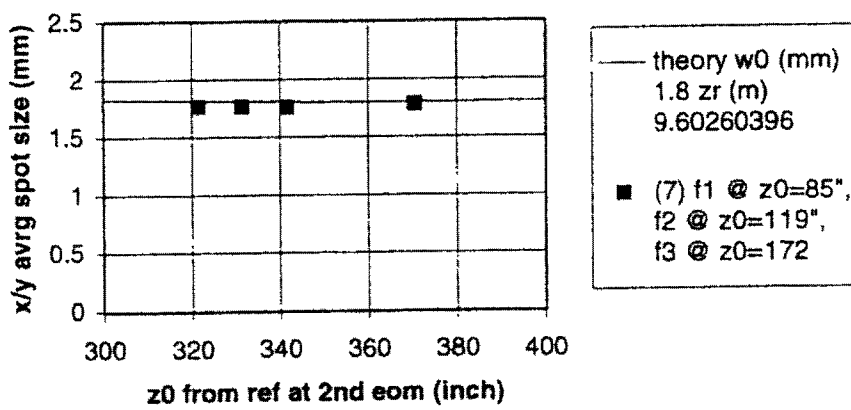
### 1-25-99 Single pass isolation



### 2-22-99 29.5 MHz EOM sensitivity

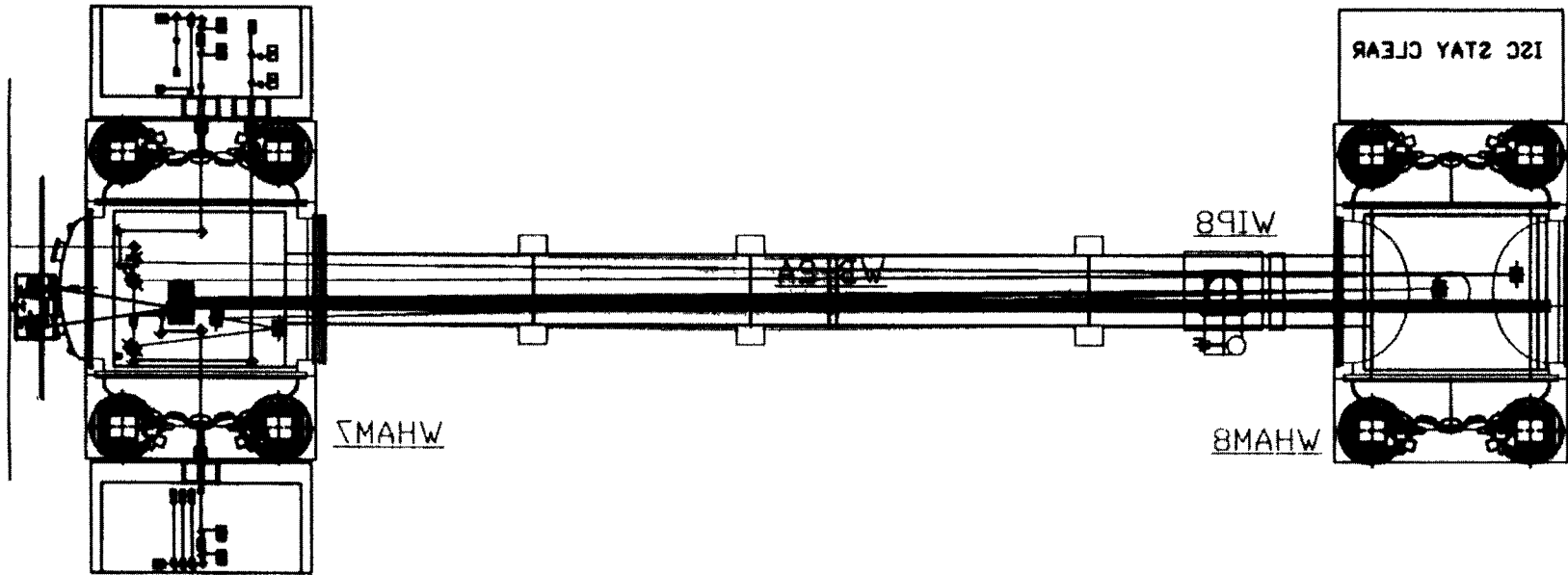


### 2-25-99 PSL profile around MC waist

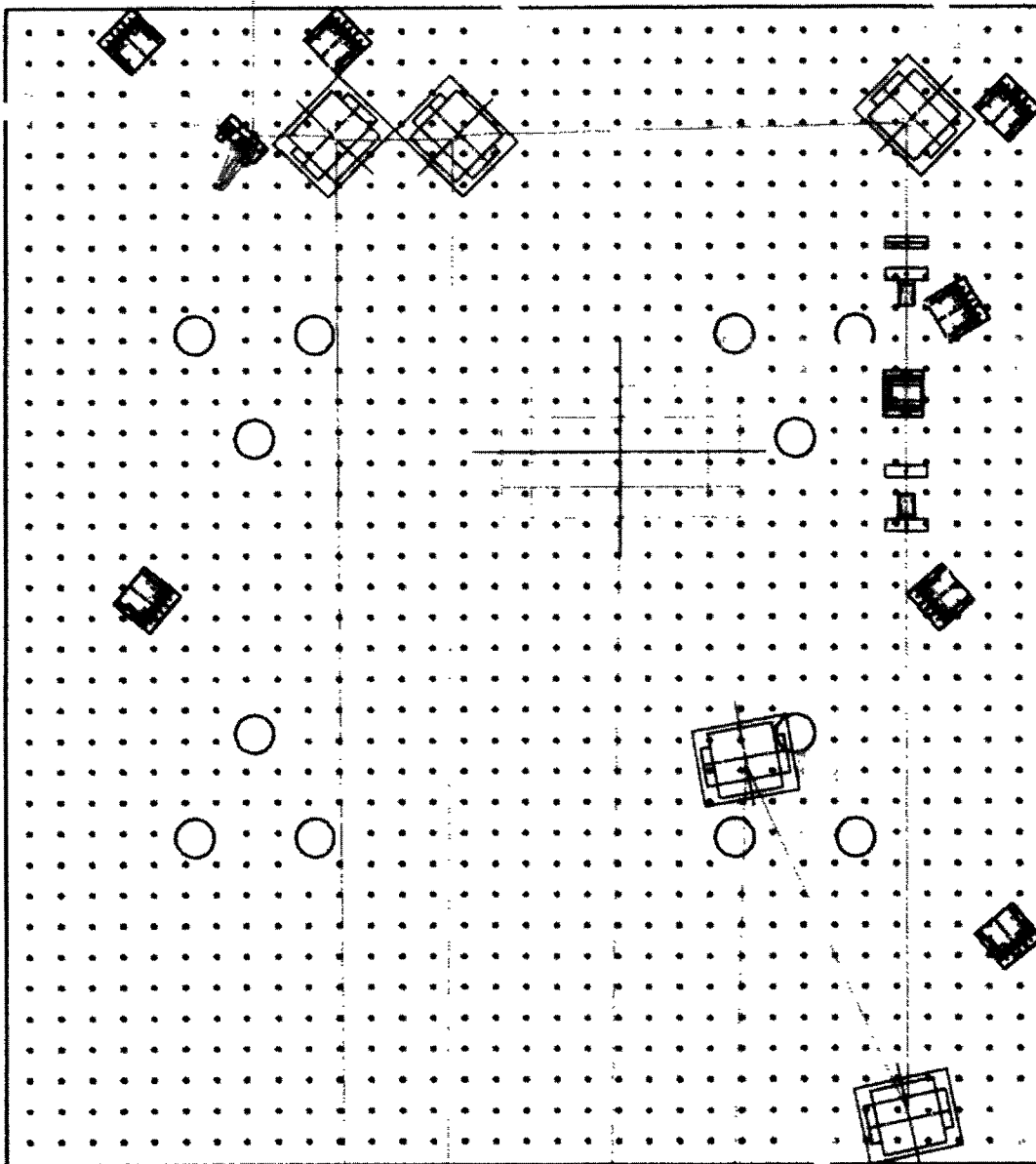


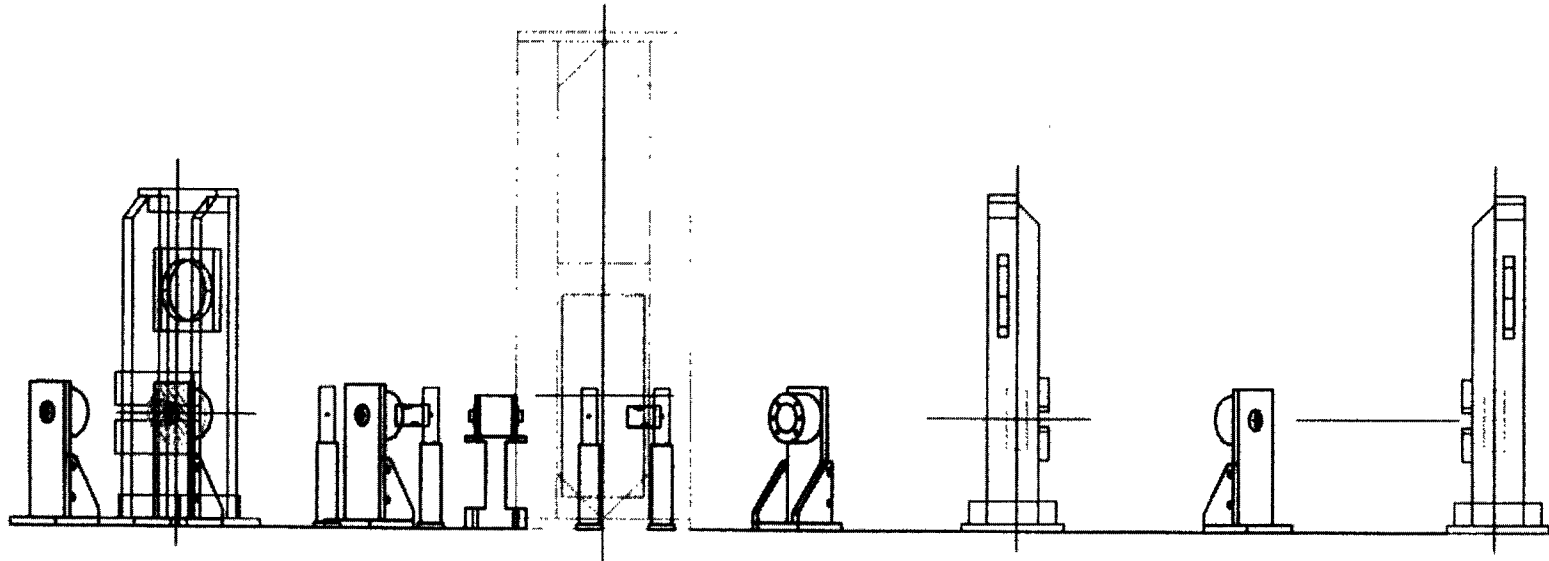
# In Vacuum Layout - HAM 7,8

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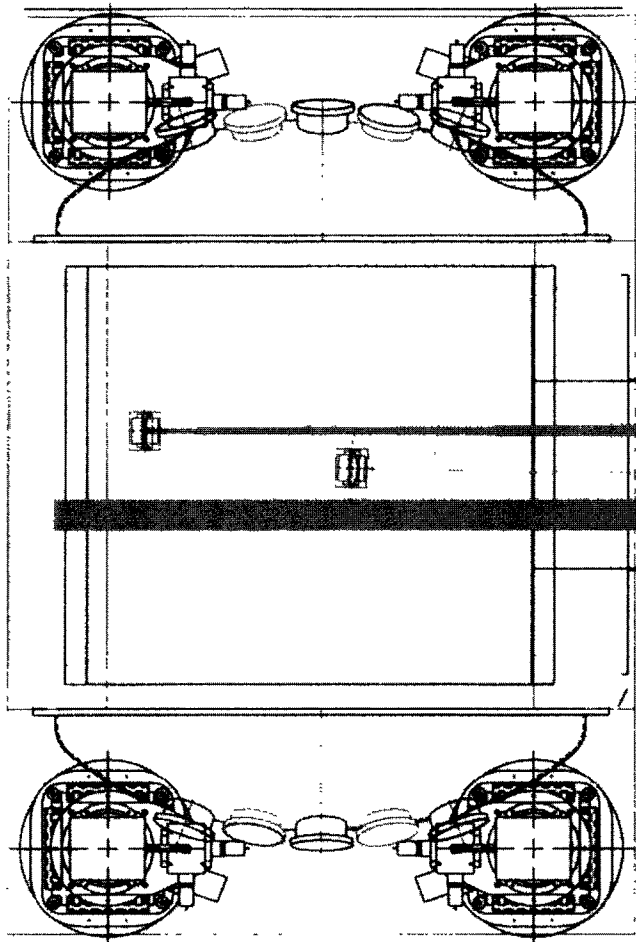
# HAM 7 Layout





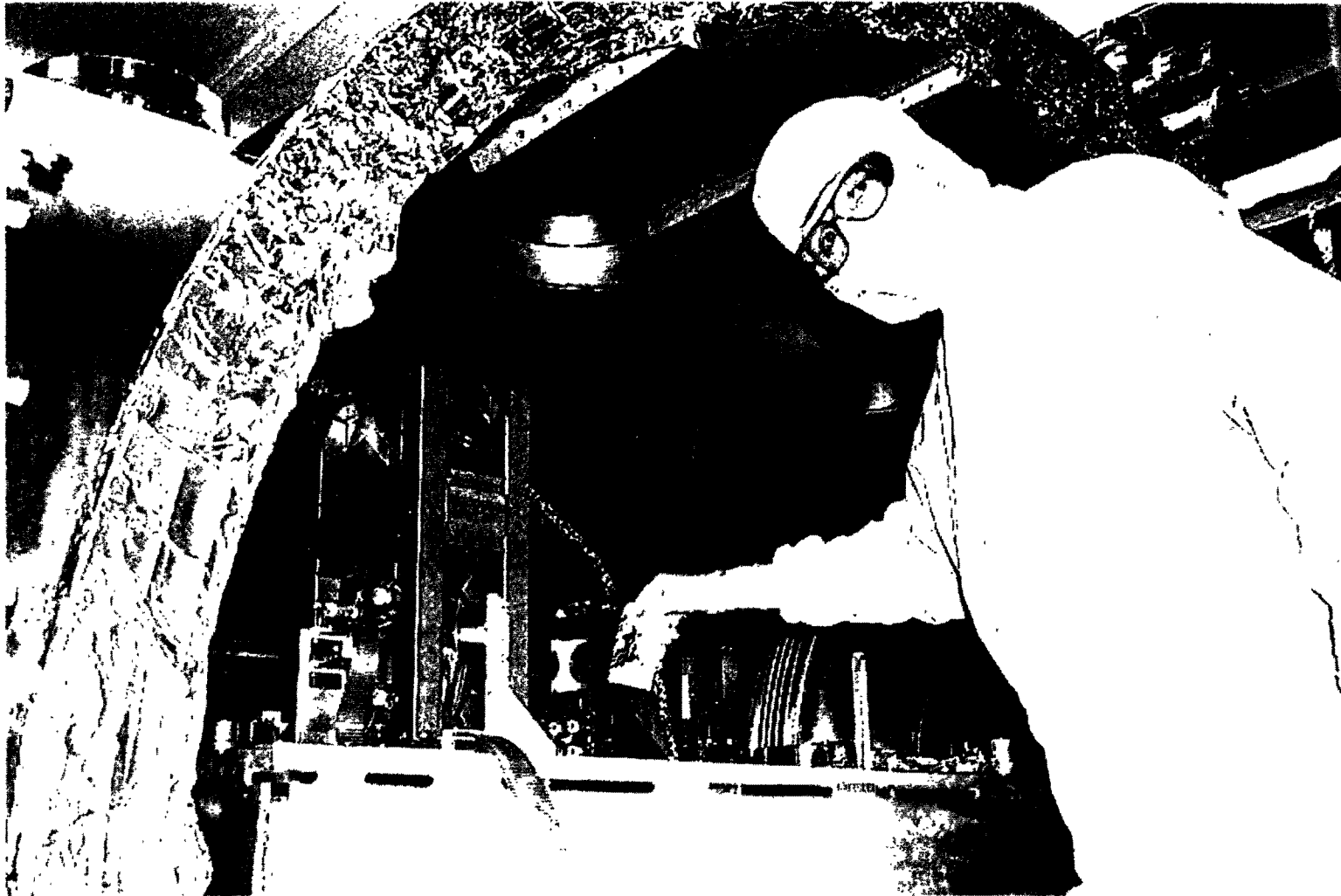
# HAM 8 Layout

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WILKINS

P0000432.jpg



# Magnet Bonding Problems

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- Bonding failures at various stages of the suspended optics installation
- One single failure delays the installation about a week on an average
- 112 glue joints in IO system (SOS) and the same number of joints in COC (LOS)
- Throughput <50%



# Possible Causes of the Bonding Problems

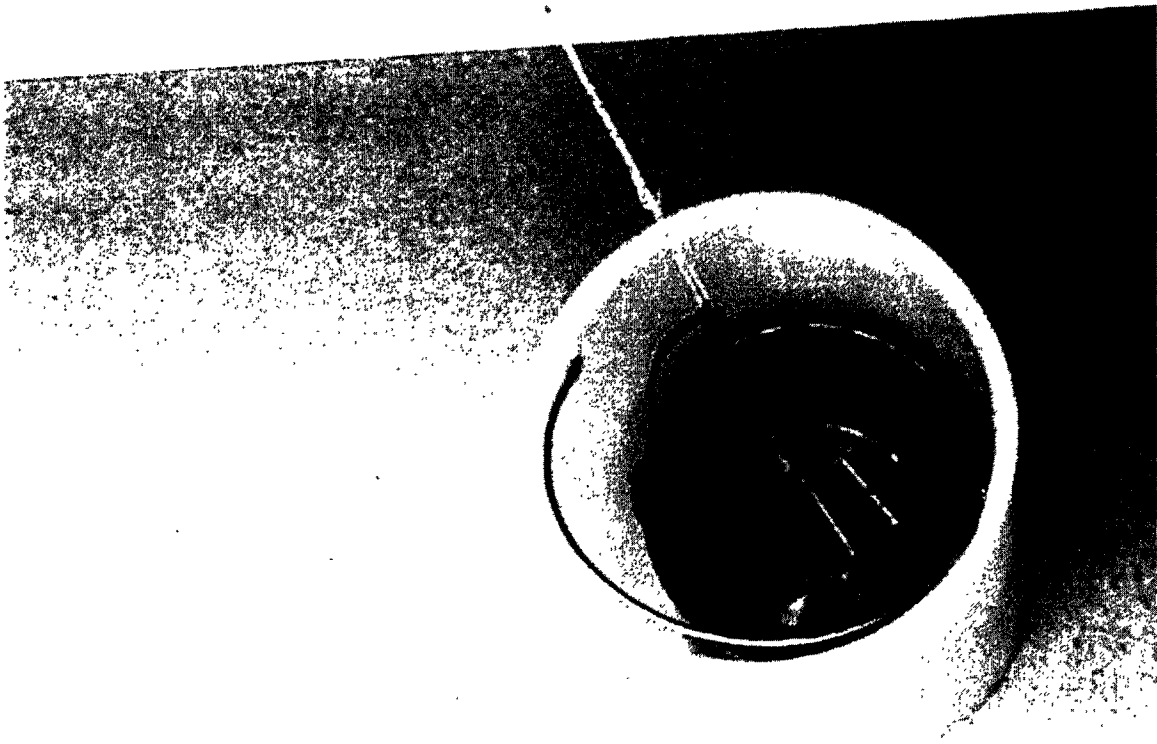
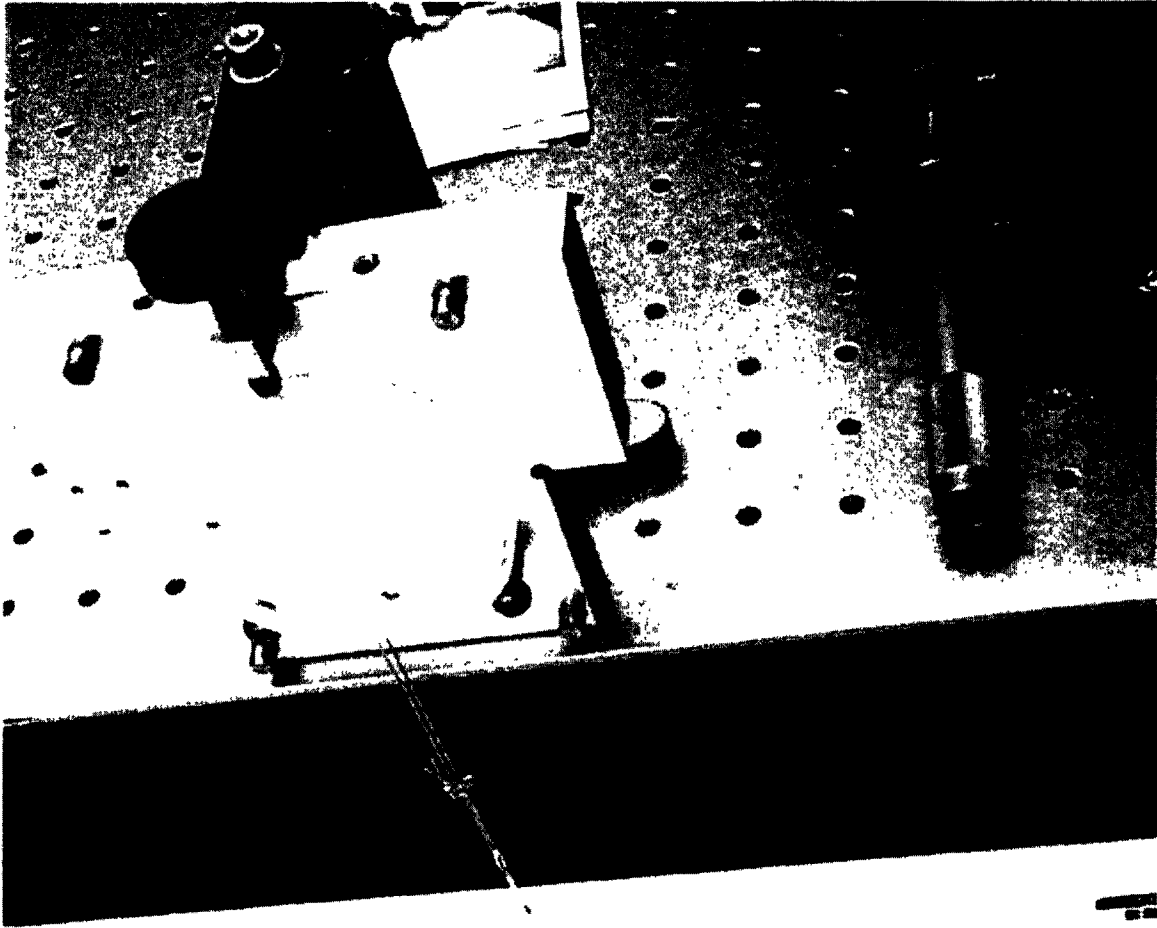
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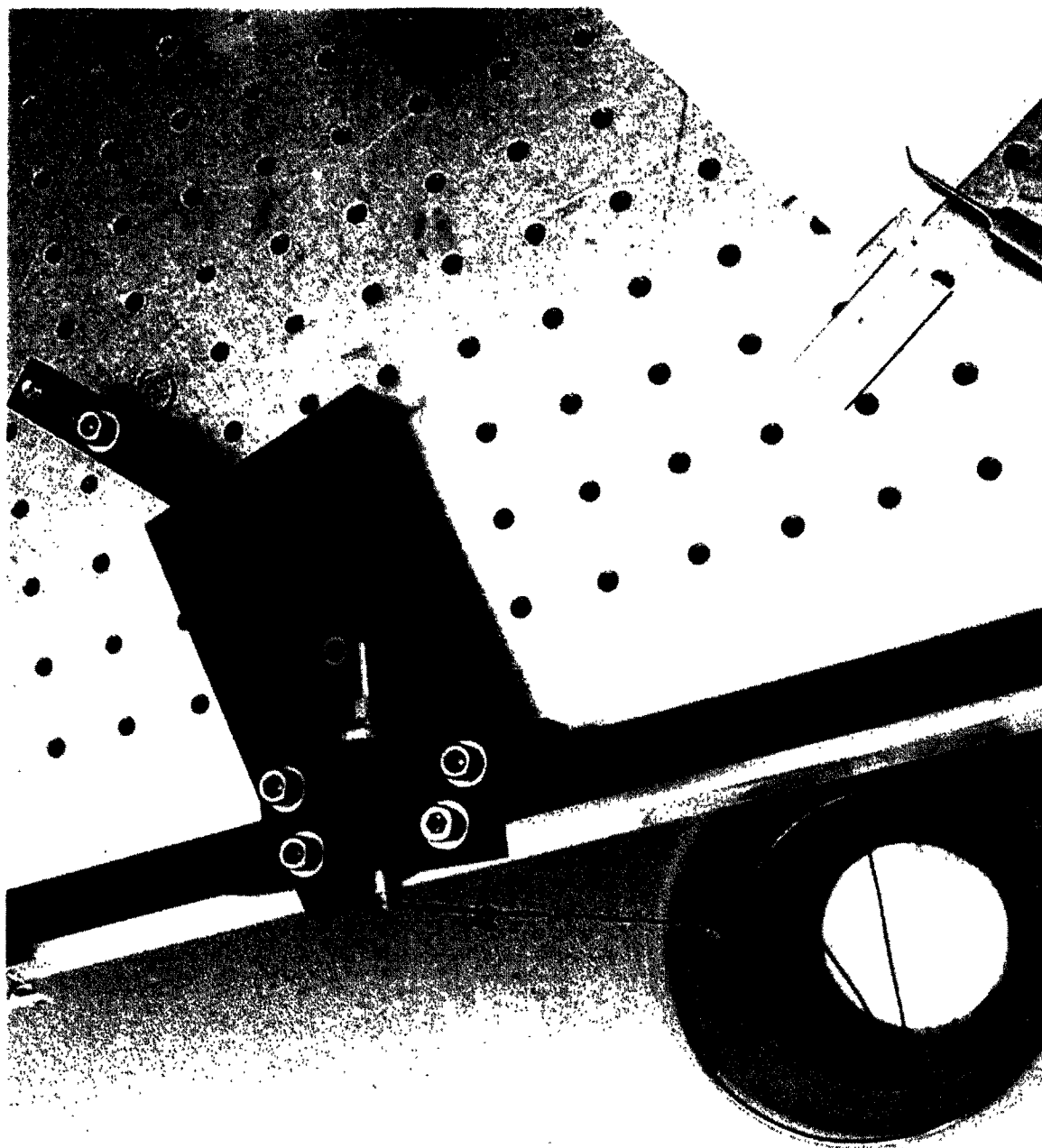
- Contamination
  - >>Gloves
  - >>Bonding/sanding fixture
  - >>Glue applicator
  - >>Silicone
  - >>...
- Thermal effects
  - >>Vacuum baking (80 C)
  - >>Post-bake cleaning (70 C)
- Chemical effects
  - >>Cleaning solution
  - >>DI water
- Epoxy (VacSeal) Degradation
- Process control ...

# Bonding Investigation

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- Tiger team
- Tests
  - ››cure Epoxy at elevated temperature
  - ››Indium bonding
  - ››silicate bonding





# Bonding Strength Tests for Epoxy Joints cured at 100° C

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- Test setup
- Test magnet-Al standoff joint and Al standoff-glass joint at various stages of the suspension preparation process
  - ›› after cure at 100°C for 2 hours
  - ›› before and after vacuum bake
  - ›› before and after cleaning process
- Results
  - ›› Both M-Al and Al-G joints are stronger than 3 kg before cleaning.
  - ›› Vacuum bake does not affect the strength at 3 kg level
  - ›› cleaning process weakens the bond. After cleaning,
    - M-Al joints break at 1.3-2.8 kg
    - 2 out of 9 Al-G joints break at 2.8 kg

# New Procedure (Solution)

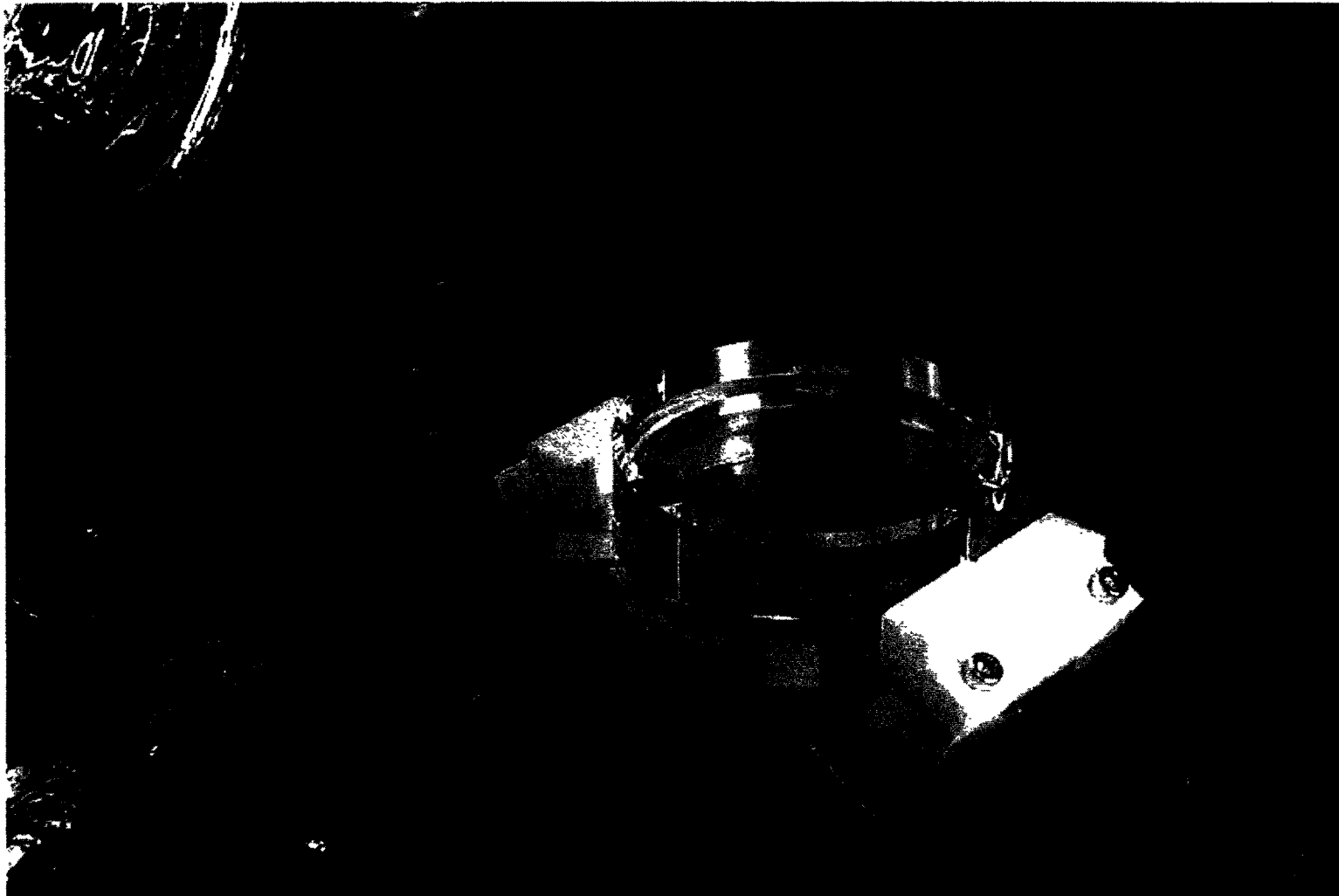
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- Eliminating all the contamination sources we can think of
- New Epoxy (VacSeal)
- Cure Epoxy at elevated temperature (100°C)
  - ››New gluing fixtures have been made
- New cleaning procedure
  - ››reduced soaking time
  - ››optical contamination tests

sanding.jpg



MirrorCure.jpg





# Upcoming

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- Finish three SOSs (MCCM, MCFM, MMT2)
  - ›› 2 weeks
- In-vacuum installation
  - ›› 1 week
- Finalize non-vacuum opto-mechanical parts installation
  - ›› depending on progress of RFAM measurements (ISC/IO)
- MC alignment
  - ›› 1-2 weeks
- Lock MC in air at low laser power (ISC/IO)