



# Science & Engineering Runs Plans & Schedule

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## *Plan to Reach Science Run*

- March 9-12
  - » E3 (engineering run): coincidence run between LHO PEM and single arm at LLO
- mid-March to mid-May
  - » LHO 4k, complete installation, lock mode cleaner
  - » LHO 4k, checkout digital suspension controls & new mode cleaner servo electronics
  - » LHO 2k, repair, suspension sensor replacement, resurrect PRM
    - Estimated completion mid-May
  - » LLO 4k, lock full interferometer, sensitivity/robustness
- May 11-14
  - » E4 run: LLO 4 km, operating in recombined mode (recycling?) + LHO PEM
- May - June
  - » LHO 2k, bring full interferometer back on-line, sensitivity studies
  - » LLO 4 k suspension sensor replacement, bring back on-line
    - This is the last planned entry into the vacuum system
  - » LHO 4k, PRM locking (no arms yet)
  - » 'sneak' peek down LHO 4k arms to check alignment



## *Plan to Reach Science Run, Part 2*

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- July
  - » E5: LHO 2k in full recycled configuration, LLO 4k in full recycled configuration(?), LHO 4k in PRM mode
- July - Sept
  - » LLO 4k, improve full interferometer lock, sensitivity studies
  - » LHO 2km sensitivity studies, 4k lock full interferometer
  - » Install digital suspension controls in LHO 2k and LLO 4k
- late Sept – early Oct
  - » E6: triple coincidence run with all 3 interferometers in final optical configuration (“upper limit run”)
- Oct – early 2002
  - » Improve sensitivity and reliability
  - » Alternate diagnostic testing with engineering runs

- Upgrades in progress
  - » Redesigned Damping Sensor/Actuator Heads (increased immunity from the laser light)
    - Installed in LHO 4k
    - LHO 2k: IO installed, 2/3 of the large optics have new heads installed
    - To be installed in the LLO 4k starting ~ 5/21
  - » Digital Suspension Controllers (frequency dependent diagonalization)
    - Installed in LHO 4k vertex
    - Check-out of 4k vertex controls this week at LHO
    - ETMx has been installed & tested extensively
    - Installation in LLO and for LHO 2k in July-Sept



## *Upgrades to Initial Detector*

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- Planned detector upgrades
  - » Improved interferometer sensing & control servo electronics (noise reduction)
  - » Servo-control and diagnostic software modifications (continuous)
    - Modifications to electronics & SW for noise reduction is a process of discovery through the commissioning effort
  - » On-line system identification (enable controls improvement)
  - » Adaptive interferometer control (for improved control robustness)
    - Plan for system id & adaptive control (more or less sequential efforts) is in process
    - Schedule Highlights
      - 4Q02: System identification for the initial LIGO detector
      - 4Q03: Adaptive control for the initial LIGO detector
      - 1Q04: Application to 40m configuration testbed
      - 2Q05: System identification for the advanced LIGO configuration

- Possible Future Detector Upgrades
  - » Modulated damping sensor electronics (increased immunity to laser light)
    - Re-designed heads may be sufficient; should know before the end of the year
    - Two approaches have been prototyped; comparisons & improvements continue
  - » Improved laser frequency stabilization servo electronics (noise reduction)
    - Modified mode cleaner servo electronics installed last week; characterization pending
  - » Redesigned pre-mode cleaner (enable higher bandwidth control)
  - » Additional physics environment monitoring (PEM) sensors (after correlation analyses indicate useful deployment)
  - » TBD -- as commissioning and characterization studies determine needs



# Initial Detector Milestones

