



Advanced LIGO R&D Review

The PSL

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Advanced LIGO PSL Schedule

- High power laser design decision: Aug. 2002
 - » Selection criteria currently being formulated.
 - » Nov. through Dec. 2002, evaluation of different designs.
 - » Decision deferred to Dec. 2002.
- Design Requirements Review: Sept. 2002
- Preliminary Design Review: Jan. 2004
- Final Design Review: Jun. 2005
- Pathfinder shipment to LASTI: Sept. 2005
- Shipment to LLO: Nov. 2006



The AdLIGO PSL Team

- The AdLIGO PSL effort combines personnel
 - » experienced in high-power laser design
 - University of Adelaide, Laser Zentrum Hannover (LZH) and Stanford
 - » experienced with power and frequency stabilization
 - GEO600 and LIGO Lab
- Effort being led by LZH/University of Hannover



Design Approaches

- Three different designs are being evaluated.
 - » University of Adelaide
 - stable/unstable slab oscillator
 - ~75 W achieved with system to date
 - various problems experienced with delivery fibers, out-of-spec. crystal
 - » Stanford
 - master-oscillator-power-amplifier (MOPA)
 - 72 W achieved with system to date
 - problems experienced with thermal lensing
 - » Laser Zentrum Hannover
 - rod oscillator
 - 97 W achieved



Technical Issues & Challenges

- Demonstration of reliable single-mode, single-frequency 200-W operation
- Relative intensity noise requirement at 10 Hz
 - » $RIN \sim 2 \times 10^{-9} 1/\sqrt{\text{Hz}}$
- Development of shot-noise limited photodetector for 150 mW
 - » variations in the photodiode surface may be a problem
 - » possibly in-vacuum and suspended
 - » may require some degree of pointing stabilization



Schedule Issues

- planned for late 2002
 - » technology transfer of VxWorks/EPICS environment
 - » current generation frequency stabilization electronics fabricated and tested
- planned for 2003 through 2004
 - » procure long lead items for the LASTI prototype and LIGO Testbed
 - laser pump diodes
 - gain media
 - » frequency stabilization of high power laser brassboard
 - » intensity stabilization of high power laser brassboard



Cost Baseline & Issues

- costs to be borne by LZH with the exception of the LASTI Prototype and LIGO Testbed
 - » LASTI prototype located at MIT
 - » LIGO Testbed located at Caltech, doubles as a LASTI spare in the event of a laser malfunction
- large fraction of laser development hardware cost is the price of laser pump diodes and associated hardware used to deliver the pump power
 - » estimated 60 required per laser @ \$7500 ea.
 - » long-lead time of 18 weeks
 - » pump diode controllers, estimated 12 required @ \$6000 ea.



Cost Baseline & Issues

- computer control hardware for laser also expensive due to quantities involved
- fabrication of each laser is estimated to take ~5 months
 - » coupled with lead time of laser diodes means items must be purchased ~10 months before delivery
 - » for LASTI, all items should be ordered by Oct. 2003



Staffing Baseline

- staffing at LZH is still a work in progress
 - » staffing plan as of Oct. 2002 called for, not all positions listed are full time
 - 2 scientists LZH and 2 from GEO600
 - 1 electrical engineer, University of Hannover
 - 2 scientists, one each from LIGO Lab and Stanford/Adelaide
 - 1 electrical engineer, LIGO Lab
 - workshop support from University of Hannover, CDS
- to date the LIGO Lab contribution has been the part-time contribution of 1 scientist and 1 electronics engineer, mostly for fabrication and testing of current LIGO frequency stabilization electronics



Staffing Baseline (cont.)

- LIGO staffing model, based on experience gained with LIGO PSL
 - » 1 scientist and 1 electronics engineer
 - » 1 technician and 1 electronics technician
 - » 1 technician, part-time for assisting in fabrication of electronics modules