Advanced LIGO Construction Proposal Submission

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LSC Meeting

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Overall Strategy

- How to optimize chance to observe gravitational waves?
- Initial LIGO – “plausible” observation, maybe unlikely ?
- Advanced LIGO – “likely” detection ?
- Minimize gap between mature exploitation of initial LIGO and commissioning advanced LIGO argues for rapid transition to upgrade
- On to the LIGO facility limit…
- Field may be healthier with vigorous progression
- Field may be under pressure if long period of searching takes place without detection
- These issues are still valid
- **March LSC meeting indicated community sense of urgency**
- **Proposal submission must go forward in a supportive climate**

Advanced LIGO Conceptual Proposal - 1999

- Lab & LSC submitted White Paper and Conceptual Project Book in late 1999
- Requested MRE funding in FY2002 to commence support of increased and vigorous R&D
- Planned to install in the vacuum system in 2005
- Cost about $114 million (FY2000) without accounting for contributions from operations budget and international partnerships
- Peoples panel gave favorable review
- **NSF decision to support R&D through design from operating funds (R&RA) in renewal proposal**

Renewal Proposal Scenario (1 – 2 years ago)

- Vigorous LSC and Lab R&D in motion
  - » Large equipment expenses to come through Lab
- R&D including most design through final design included in proposed work
  - » Consistent with new rules
- Some long lead acquisitions included
  - » Not consistent with new rules
  - » **Reduced award level prevents these purchases**

Under discussion now

- MRE funds required in proposal to start in FY2004
  - » MRE proposal submission assumed at beginning of 2002
  - » **PAC 11 agreed with our plan to delay submission one year**
- Installation in vacuum system delayed until early 2006

NSF Funding/MRE Situation Two Years Ago

- NSF enjoyed bipartisan support for budget doubling in 5 years with two years of the trend in place
  - » FY2001 funding increased >13%
- MRE account was transitioning to a versatile but undefined capability for NSF
  - » Proposals were invited and encouraged
  - » In the absence of a defined process, OMB and Congress were critical of NSF management process on projects
- LIGO construction success viewed as sufficient to propel MRE upgrade proposal (?)

Evolution at NSF During 2001

- MRE proposal logjam
  - » ALMA, HIAPER, NEON, Terascale, NEES, RSVP, Ice Cube,…
- Bush administration threatened NSF budget growth
- Internal NSF MRE process criticized by Congress and OMB
  - » NSF drafts MRE/large facility process under OMB/Congressional pressure

NSF Situation in 2002

- Vic Cook retires
  - » Tom Lucatorto in place
- Rich Isaacson retires
  - » Beverly Berger in place
- Bob Eisenstein has left
  - » John Hunt acting as Assistant Director, has knowledge of LIGO
- NSF awards $28 million to LIGO in first year of new cooperative agreement
  - » This award level has impacts on individual investigator awards
  - » Thus LIGO has earned unfortunate visibility

Congress and NSF

- In late 2001, Congress partly relieves MRE logjam by approving, for FY2002, ALMA, NEES, HIAPER, Terascale, Ice Cube
  - » NEON and RSVP still waiting
  - » Homestake NUSL and IceCube now the subject of a National Academy review of neutrino physics
  - » Congress requests a priority ordered MRE process at NSF
- **This year**, Congressional authorization bill (not the appropriation bill) passed with very broad bipartisan support for doubling NSF budget in ~5 years
- …and Senate has now voted an equally good appropriation bill

PAC 11 and PAC 12 Advice

- PAC 11 – November 2001
  - » Agreement with delay in submission beyond end of 2001
  - » Submit in 2002
- PAC 12 – June 2002
  - » "…We agree that a prerequisite for submission of the request in November is a successful science run S1…"
  - » "It is clear that achieving approval of Advanced LIGO construction funding is critical to both the scientific vitality of the LSC and to maintaining the active international collaboration. The MRE proposals should be submitted as soon as the LIGO management feels confident of success."

Some Reasons to Submit Now

- Detecting gravitational waves is compelling and advanced LIGO “appears” crucial to detection
- Our developmental program is in concerted motion
- Delaying submission likely to linearly extend the course of our search for GW
- We are reasonably well prepared
  - » Reference design
  - » R&D in motion
  - » Could complete a cost estimate and schedule plan with a burst of effort
- Many LSC groups have focused on Adv. LIGO development
- International partners prefer that we move forward
  - » PPARC review of Glasgow/Birmingham/Rutherford proposal last month

"GEO+" Role in Advanced LIGO

- GEO is in LSC
- German group has taken a lead role in Advanced LIGO PSL development and delivery
- UK groups (Glasgow, Birmingham, RAL) have taken a lead role in:
  - » suspensions and recycling R&D
- UK groups have submitted project funding proposal for ~$9 million to fund, now under PPARC review:
  - » Delivery of suspensions
  - » Delivery of some sapphire substrates (long lead purchases)
  - » Proposal assumes UK funds start 1Q04
- German group will also submit project support proposal

Upgrade Options

- Phased Upgrades
  - » High power first
  - » Separate addition of signal recycling
  - » Low frequency first (most logical phasing choice)
- Full interferometer upgrades – to desired sensitivity directly
  - » 3 IFOs
  - » 2 IFOs - what physics loss?
- MRE account vs. program funds
- Planned option – 3 interferometer upgrade
- Submission by late this year with request for long lead purchase funds
- Proposal coordinated or jointly submitted by LIGO/LSC/GEO/ACIGA

Current Baseline Schedule

- Construction proposal submitted late 2002
- Construction funding available April 2005
- Supplemental funds available for core optics blanks purchase April 2004
- Select test mass substrate December 2002
- Select laser technology December 2002
- Install at LLO November 2006
- Install at LHO July 2007
- LLO operational September 2008
- LHO operational May 2009

Discussion at:
http://www.ligo.caltech.edu/~coyne/adv_ligo/uk_proposal/ligo_lab_input_to_UK_proposal.htm

The Required Steps

- Initial LIGO must have **successful S1** and S2 runs
  - » Produce results
  - » Make good interferometer progress
- Work with Tom Lucatorto and Beverly Berger
- Work with Joe Dehmer
- NSF leadership must be thoroughly briefed and supportive
- FY2003 funding for LIGO operations must be good
- When we submit, we have to be confident of success