LSC Overview

October 25, 1999

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LIGO Scientific Collaboration Member Institutions

University of Adelaide ACIGA
Australian National University ACIGA
Caltech LIGO
Caltech Experimental Gravitation CEGG
Caltech Theory CART
University of Cardiff GEO
Cornell University
University of Florida (Gainesville) UF
Glasgow University GEO
University of Hannover GEO
Joint Institute of Laboratory Astrophysics JILA
LIGO Hanford Washington Site LIGOWA
LIGO Livingston Louisiana Site LIGOLA
Louisiana State University LSU
Louisiana Tech University LTU
Max Planck (Garching) GEO
Max Planck (Potsdam) GEO
MIT LIGO
University of Michigan UM
Moscow State University MSU
National Astronomical Observatory of Japan
University of Oregon UO
Pennsylvania State University Exp. PSUE
Pennsylvania State University Theory PSUT
(Russian) Institute of Applied Physics IAP
Stanford University ST
Syracuse University SU
University of Texas @ Brownsville
University of Western Australia ACIGA
University of Wisconsin (Milwaukee) UWM

Working groups of the LSC

- Technical Development Groups
  - Interferometer Configurations
    - Chair: Ken Strain, Glasgow University
  - Sensing Noise - Lasers and Optics
    - Chair: Eric Gustafson, Stanford University
  - Stochastic Forces - Isolation Systems and Suspensions
    - Chair: David Shoemaker, MIT

LSC White Paper on Detector Research and Development

September 1999

- Data Analysis Groups
  - Astrophysical Signatures
    - Chair: Bruce Allen, University of Wisconsin(Milwaukee)
    - Lab Liaison: Tom Prince, Caltech
  - Detector Characterization
    - Chair: Keith Riles, University of Michigan
    - Lab Liaison: Daniel Sigg, LIGO WA
  - Detection Confidence and validation
    - Interim Chair: Al Lazzarini, LIGO Caltech

LSC Data Analysis White Paper

Draft July 1999

LSC recommendation for the LIGO II Upgrade

Assumptions

- No detection is assured in LIGO I
- Compact binary coalescences will remain a major design driver
  but necessary to enhance search for all classes of sources
- Use technology that is in hand or within near term capability

Goals

- Make a significant improvement:
  - at region of maximum sensitivity
  - broaden the sensitive detection band
  - technology permitting, drive to fundamental or facility limits
- Minimize the down time of LIGO

Goals argue for an aggressive rather than an incremental program

LSC Commitment

- Upgrade program grew out of LSC committees
- Enabling research
- Hardware and software delivery to the Laboratory
- Managed through MOU and sub-contract with Laboratory

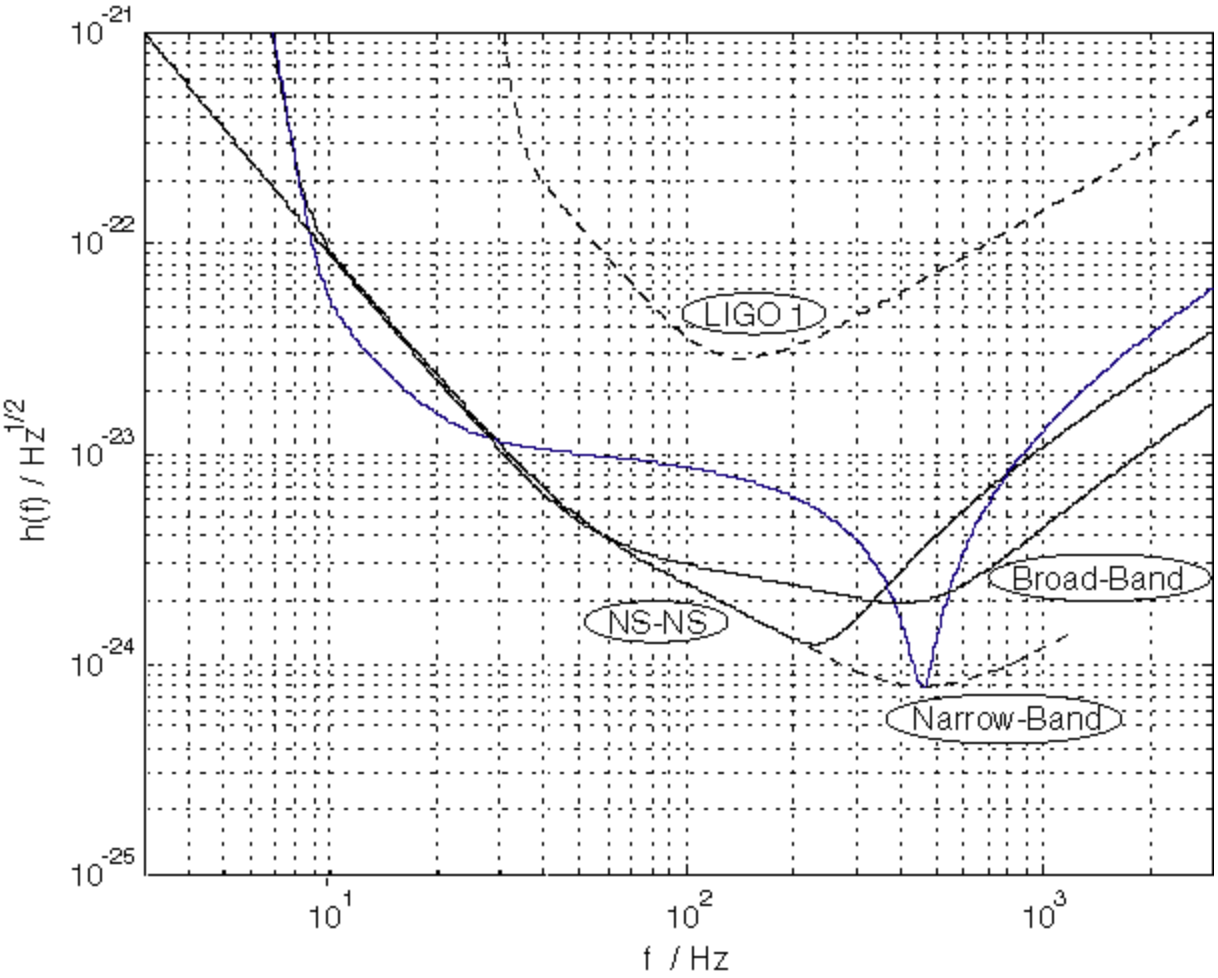
Evolution of the concept and choices

- **Noise Sources**
  - sensing noise
  - random forces
  - technical
    - different scaling relations and spectra
- **Steps in the concept**
  - ✳ Fused silica multiple element suspension
    - reduction in pendulum thermal noise
    - reduced coupling to isolation system thermal noise
    - reduction technical noise due to reduced control on test mass
    - improved Q of test mass and reduction of internal thermal noise
  - ✳ Increased light power
    - reduction in sensing noise
    - higher power laser
    - improved optical material (sapphire)
    - control of thermally induced distortions
  - ✳ Reduction in radiation pressure noise
    - increased test mass inertia
  - ✳ Reduction in internal thermal noise
    - sapphire - higher Q and test mass normal mode frequencies
  - ✳ New interferometer configuration
    - reduction in sensing noise
    - resonance of gravitational wave induced sidebands
    - trade off bandwidth to gain sensitivity in a flexible and tunable configuration
  - ✳ New isolation system
    - take advantage of reduced pendulum thermal noise
    - search toward lower frequencies - limited by the Newtonian gravitational fluctuations
    - reduction in test mass motion to ease control
    - reduction in amount of fluoro-elastomers

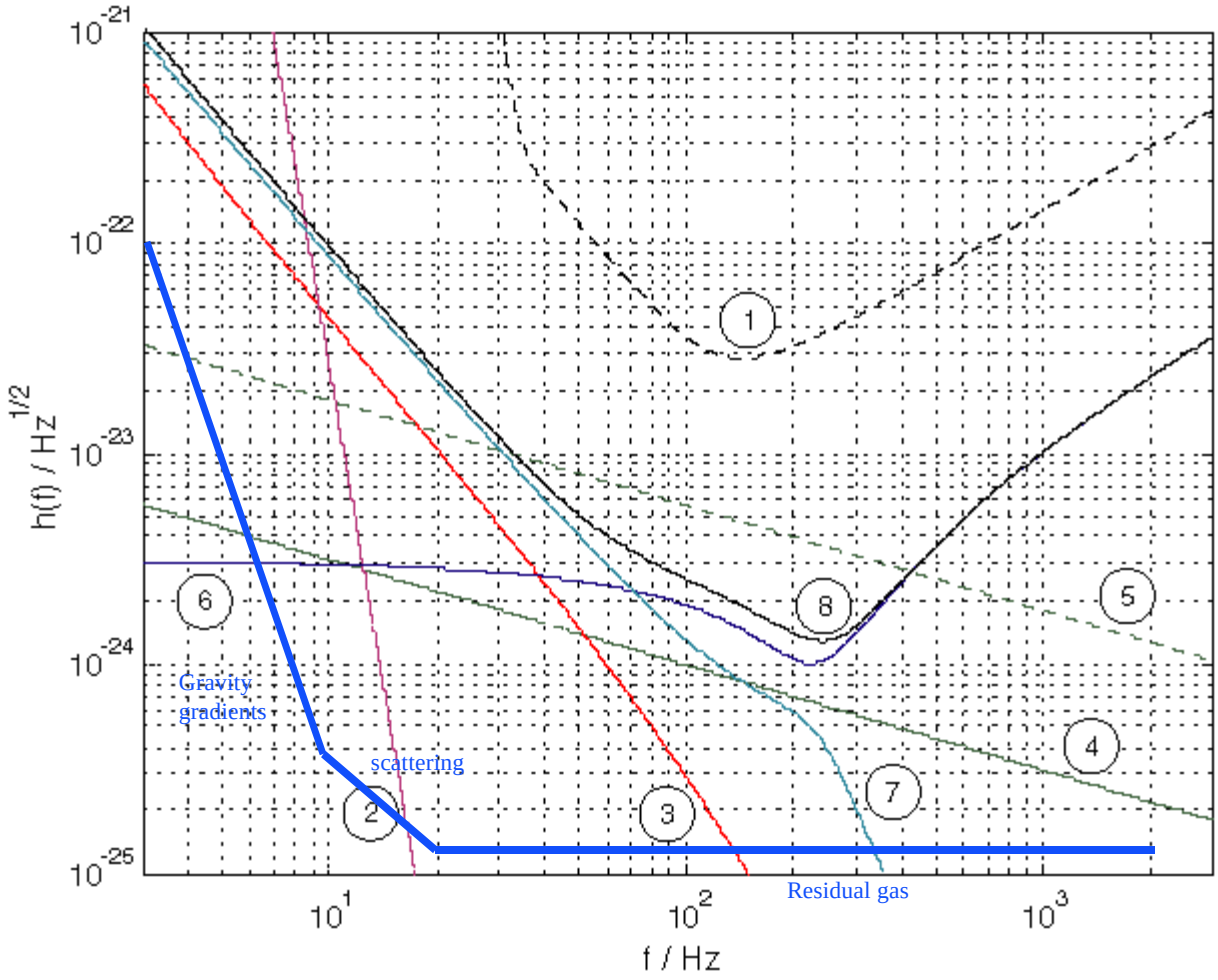
Arguments for the recommended program

- Significant enhancement in scientific capability for search or source diagnostics
- Recommended steps within technical reach in the time proposed but some steps (sapphire and seismic isolation) would benefit from additional R&D support before the MRE funds could flow
- Skilled scientific base available in the LSC - GEO intellectual contribution is strong
- The recommended program takes into account the interactive nature of the steps and the costs in observation time in executing any change

LIGO I and II Projected Sensitivity



LIGO II Noise Contributions



1 LIGO I total
2 Filtered seismic noise
3 Suspension thermal noise
4 Internal thermal noise - sapphire
5 Internal thermal noise - fused silica (fallback)
6 Shot noise
7 Radiation pressure noise
8 LIGO II total

Facility limits