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Advanced LIGO: From Discovery to A-sharp and Voyager

Abstract

The Laser Interferometer Gravitational-wave Observatory (LIGO) detectors observed gravitational waves from a binary black hole merger on 14 September 2015. Since this first observing run (O1), LIGO, joined by Virgo and KAGRA, has alternated upgrades to improve sensitivity and observing runs. Currently the collaboration is engaged in observing run 4 (O4). The sensitivity has increased to such an extent that the rate at which mergers are detected has increased from one every 2-3 months to typically 10 per month. The upgrade for O5 is expected to double the sensitivity of LIGO and the O5 run is planned to last more than two years. After this there are at least two visions for further improvements. A# (A-sharp) includes better (crystalline) optical coatings, 2.5x heavier test masses, new suspensions, increased circulating power, and improved squeezing. LIGO Voyager would use crystalline silicon, cooled to 124 K, as the test mass material, longer wavelength laser, and similar squeezing levels.

The University of Florida instrument science group built the input optics for both initial and Advanced LIGO, developed low-loss Faraday isolators for the O4 squeezer, studied higand has demonstrated a 2.09 micron LIGO-style laser.

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