

Barry C Barish

Barry Barish earned his B.A. in physics (1957) and Ph.D. in experimental particle physics (1962) at the University of California, Berkeley. He came to Caltech as a postdoc in 1963, where he has pursued his academic and research careers and is currently the Maxine and Ronald Linde Professor of Physics, Emeritus.

Barish's primary research interest has been the Laser Interferometer Gravitational-wave Observatory (LIGO), since he became Principal Investigator in 1994 and Director in 1997. He led the effort through the final design stages, approval for funding by the NSF National Science Board in 1994, and then the construction and commissioning of the LIGO interferometers in Livingston, LA and Hanford, WA. In 1997, he created the LIGO Scientific Collaboration (LSC), which now enables more than 1000 collaborators world-wide to participate in LIGO.

Suspended mass laser interferometers search for gravitational wave signals by monitoring motions of test masses separated by four kilometer baselines to a precision of less than 10^{-18} meters. The Initial LIGO detectors reached design sensitivity and set many significant limits on astrophysical sources of gravitational waves. A proposal for a more sensitive detector, Advanced LIGO, was developed from 1999 to 2003, while Barish was Director, and it was approved by the NSF in 2003. Advanced LIGO was funded as a major research project (MREFC) by Congress several years later. This project incorporated major new technological developments from the LIGO R&D efforts, including an active seismic isolation system to reduce seismic noise, a multiple suspension system with a large fused silica test mass to reduce thermal noise and a 200 watt NiYAG laser to reduce shot noise, as well as incorporate improved and a more flexible optics system. Advanced LIGO will improve the sensitivity by x10 over Initial LIGO, increasing the sensitive volume of the universe for detections of most gravitational wave sources by a factor of x1000.

Barish has continued to play a leadership role in the implementation of Advanced LIGO, including serving on the LIGO Scientific Collaboration Executive Committee. On Sept 14, 2015, during the first Advanced LIGO data run, the merger of two ~30 solar mass black holes were detected and reported in a Physical Review Letters on Feb 11, 2016, one hundred years after Einstein's prediction of gravitational waves. This dramatic observation represents the first direct detection of gravitational waves and the first ever observation of the merger of a pair of black holes. Impressively, this single observed event has uncovered new astrophysics in the existence of heavy 30 solar mass stellar black holes, shown that they exist in pairs and that they merge within the lifetime of the universe. New tests of general relativity in the strong field limit have also already been performed. The future of this new field is exceptionally bright, as LIGO will continually increase its sensitivity and event rates in future years. Concepts for next generation gravitational wave detectors are also being developed.

Earlier in his research career, Barish performed other noteworthy experiments, especially those at Fermilab using high-energy neutrino collisions to reveal the quark substructure of the nucleon. These experiments were among the first to observe the weak neutral current, a linchpin of the electroweak unification theories of Glashow, Salam and Weinberg. Following the neutrino

experiment, Barish developed an ambitious international effort to open up a new field of particle astrophysics. The experiment, MACRO, located in the Gran Sasso Tunnel in Italy produced the most sensitive search for the heavy magnetic monopoles that are predicted in Grand Unified Theories. MACRO also studied penetrating cosmic rays, including neutrino measurements that provided important confirmatory evidence that neutrinos have mass and oscillate.

Barry Barish is also the former Director of the Global Design Effort for the International Linear Collider (ILC). The ILC is the highest priority future project for particle physics worldwide, as it promises to complement the Large Hadron Collider at CERN in understanding the recent Higgs-like particle discovery and other new phenomena at the TeV energy scale. The ILC is a major challenge, both in terms of accelerator science to produce and collide nanometer scale beams, as well as technically to develop high-gradient superconducting accelerating cavities. The design effort was uniquely coordinated globally, representing a major step in international collaboration, beginning with collaboration in developing the concept, designing and building the project and carrying out the science. The global design effort resulted in a Technical Design Report in 2013 that is presently under consideration by the Japanese government as a Japanese hosted international project.

Dr. Barish has served on many important science committees, including co-chairing the High Energy Physics Advisory Panel subpanel that developed a long-range plan for U.S. high energy physics in 2001. He has also chaired the Commission of Particles and Fields and the U.S. Liaison committee to the International Union of Pure and Applied Physics (IUPAP) and has been very active in international collaboration for physics.

In 1991, Barish was named the Maxine and Ronald Linde Professor of Physics at Caltech. In 2002, he received the Klopsteg Award of the American Association of Physics Teachers and was elected to the National Academy of Sciences the same year. Dr. Barish was given a Presidential appointment and served on the National Science Board; the 24-member board that oversees the National Science Foundation (NSF) and advises the President and the Congress on policy issues related to science, engineering, and education. Barish is an elected member of the American Academy of Arts and Sciences, and is a fellow of both the American Association for the Advancement of Science (AAAS) and the American Physical Society (APS). He was elected and served as President of the APS, the member society of 50,000 members, in 2011. Barish has been honored by the University of Bologna (2006), the University of Florida (2007) and the University of Glasgow (2013) with honorary doctorates.