

Rainer Weiss

Born: 1 June 1940, Logan, UT, USA

Affiliation at the time of the award: LIGO/VIRGO Collaboration, California Institute of Technology (Caltech), Pasadena, CA, USA

Prize motivation: "for decisive contributions to the LIGO detector and the observation of gravitational waves"



Rainer "Rai" Weiss; born September 29, 1932) is an American physicist, known for his contributions in gravitational physics and astrophysics. He is a professor of physics emeritus at MIT and an adjunct professor at LSU. He is best known for inventing the laser interferometric technique which is the basic operation of LIGO. He was Chair of the COBE Science Working Group.

He is a member of Fermilab Holometer experiment, which uses a 40m laser interferometer to measure properties of space and time at quantum scale and provide Planck-precision tests of quantum holographic fluctuation.

In 2017, Weiss was awarded the Nobel Prize in Physics, along with Kip Thorne and Barry Barish, "for decisive contributions to the LIGO detector and the observation of gravitational waves".

Rainer Weiss was born on September 29, 1932 in Berlin, Germany, the son of Gertrude Loesner and Frederick A. Weiss. His mother, a Christian, was an actress.^[12] His father, a physician, neurologist, and psychoanalyst, was forced out of Germany by Nazis because he was Jewish and an active member of the Communist Party. The family fled first to Prague, but Germany's occupation of Czechoslovakia after the 1938 Munich Agreement caused them to flee; the philanthropic Stix family of St. Louis enabled them to obtain visas to enter the United States. Weiss spent his youth in New York City, where he attended Columbia Grammar School. He studied at MIT and after

dropping out in his junior year returned to receive his S.B. degree in 1955 and Ph.D. degree in 1962 from Jerrold Zacharias. He taught at Tufts University in 1960–62, was a postdoctoral scholar at Princeton University from 1962 to 1964, then joined the faculty at MIT in 1964.

Achievements

Weiss brought two fields of fundamental physics research from birth to maturity: characterization of the cosmic background radiation, and interferometric gravitational wave observation.

He made pioneering measurements of the spectrum of the cosmic microwave background radiation, and then was co-founder and science advisor of the NASA COBE (microwave background) satellite. Weiss also invented the interferometric gravitational wave detector, and co-founded the NSF LIGO (gravitational-wave detection) project. Both of these efforts couple challenges in instrument science with physics important to the understanding of the Universe.

In February 2016, he was one of the four scientists of LIGO/Virgo collaboration presenting at the press conference for the announcement that the first direct gravitational wave observation had been made in September 2015.



Honors and Awards

Rainer Weiss has been recognized by numerous awards including:

- In 2006, with John C. Mather, he and the COBE team received the Gruber Prize in Cosmology.
- In 2007, with Ronald Drever, he was awarded the Einstein Prize for this work.
- For the achievement of gravitational waves detection, in 2016 and 2017 he received:
- The Special Breakthrough Prize in Fundamental Physics,
- Gruber Prize in Cosmology,
- Shaw Prize,
- Kavli Prize in Astrophysics
- The Harvey Prize together with Kip Thorne and Ronald Drever.
- The *Smithsonian* magazine's American Ingenuity Award in the Physical Science category, with Kip Thorne and Barry Barish.

- The Willis E. Lamb Award for Laser Science and Quantum Optics, 2017.
- Princess of Asturias Award (2017) (jointly with Kip Thorne and Barry Barish).
- The Nobel Prize in Physics (2017) (jointly with Kip Thorne and Barry Barish)

Selected Publications

- R. Weiss, H.H. Stroke, V. Jaccarino and D.S. Edmonds (1957). "Magnetic Moments and Hyperfine Structure Anomalies of Cs_{133} , Cs_{135} and Cs_{137} ". *Phys. Rev.* 105 (2): 590.
- R. Weiss (1961). "Molecular Beam Electron Bombardment Detector". *Rev. Sci. Instr.* 32 (4): 397.
- R. Weiss & L. Grodzins (1962). "A Search for a Frequency Shift of 14.4 keV Photons on Traversing Radiation Fields". *Physics Letters.* 1 (8): 342.
- Weiss, Rainer (1963). "Stark Effect and Hyperfine Structure of Hydrogen Fluoride". *Phys. Rev.* 131 (2): 659.
- R. Weiss & B. Block (1965). "A Gravimeter to Monitor the oS_o Dilational Model of the Earth". *J. Geophys. Res.* 70 (22): 5615.
- R. Weiss & G. Blum (1967). "Experimental Test of the Freundlich Red-Shift Hypothesis". *Phys. Rev.* 155 (5): 1412.
- R. Weiss (1967). "Electric and Magnetic Field Probes". *Amer. J. Phys.* 35 (11): 1047.
- R. Weiss and S. Ezekiel (1968). "Laser-Induced Fluorescence in a Molecular Beam of Iodine". *Phys. Rev. Lett.* 20 (3): 91.
- R. Weiss & D. Muehlner (1970). "A Measurement of the Isotropic Background Radiation in the Far Infrared". *Phys. Rev. Lett.* 24 (13): 742.
- R. Weiss (1972). "Electromagnetically Coupled Broadband Gravitational Antenna". Quarterly Progress Report, Research Laboratory of Electronics, MIT. 105: 54.
- R. Weiss & D. Muehlner (1973). "Balloon Measurements of the Far Infrared Background Radiation". *Phys. Rev. D.* 7 (2): 326.
- R. Weiss & D. Muehlner (1973). "Further Measurements of the Submillimeter Background at Balloon Altitude". *Phys. Rev. Lett.* 30(16): 757.
- R. Weiss & D.K. Owens (1974). "Measurements of the Phase Fluctuations on a He-Ne Zeeman Laser". *Rev. Sci. Instr.* 45 (9): 1060.
- R. Weiss, D.K. Owens & D. Muehlner (1979). "A Large Beam Sky Survey at Millimeter and Submillimeter Wavelengths Made from Balloon Altitudes". *Astrophysical Journal.* 231: 702.
- R. Weiss, P.M. Downey, F.J. Bachner, J.P. Donnelly, W.T. Lindley, R.W. Mountain and D.J. Silversmith (1980). "Monolithic Silicon Bolometers". *Journal of Infrared and Millimeter Waves.* 1.
- R. Weiss (1980). "Measurements of the Cosmic Background Radiation". *Annual Review of Astronomy and Astrophysics.* 18: 489.
- R. Weiss (1980). "The COBE Project". *Physica Scripta.* 21 (5): 670.
- R. Weiss, S.S. Meyer & A.D. Jeffries (1983). "A Search for the Sunyaev-Zel'dovich Effect at Millimeter Wavelengths". *Astrophys. J. Lett.* 271: L1.
- R. Weiss, M. Halpern, R. Benford, S. Meyer and D. Muehlner (1988). "Measurements of the Anisotropy of the Cosmic Background Radiation and Diffuse Galactic Emission at Millimeter and Submillimeter Wavelengths". *Astrophys. J.* 332: 596.
- R. Weiss, J.C. Mather, E.S. Cheng, R.E. Eplee Jr., R.B. Isaacman, S.S. Meyer, R.A. Shafer, E.L. Wright, C.L. Bennett, N.W. Boggess, E. Dwek, S. Gulkis, M.G. Hauser, M. Janssen, T. Kelsall, P.M. Lubin, S.H. Moseley Jr., T.L. Murdock, R.F. Silverberg, G.F. Smoot and D.T. Wilkinson (1990). "A Preliminary Measurement of the Cosmic Microwave Background Spectrum by the Cosmic Background Explorer (COBE) Satellite". *Astrophys. J.* 354: L37.
- R. Weiss, G. Smoot, C. Bennett, R. Weber, J. Maruschak, R. Ratliff, M. Janssen, J. Chitwood, L. Hilliard, M. Lecha, R. Mills, R. Patschke, C. Richards, C. Backus, J. Mather, M. Hauser, D. Wilkenson, S. Gulkis, N. Boggess, E. Cheng, T. Kelsall, P. Lubin, S. Meyer, H. Moseley, T. Murdock, R. Shafer, R. Silverberg and E. Wright (1990). "COBE Differential Microwave Radiometers: Instrument Design and Implementation". *Astrophys. J.* 360: 685.
- R. Weiss (1990). "Interferometric Gravitational Wave Detectors". In N. Ashby; D. Bartlett; W. Wyss. *Proceedings of the Twelfth International Conference on General Relativity and Gravitation.* Cambridge University Press. p. 331.
- R. Weiss, D. Shoemaker, P. Fritschel, J. Glaime and N. Christensen (1991). "Prototype Michelson Interferometer with Fabry-Perot Cavities". *Applied Optics.* 30 (22): 3133-8.