TÜBİTAK Public Lecture Series

Opening the Infrared Treasure Chest with James Webb Space Telescope (JWST)

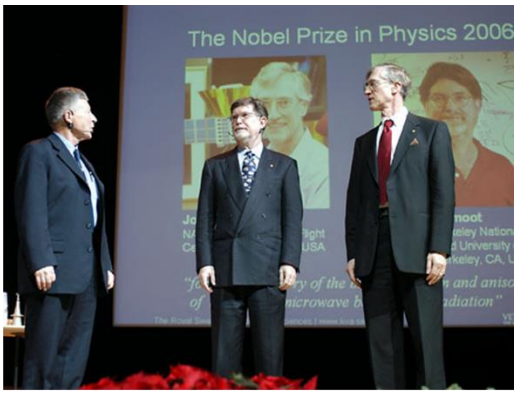
The James Webb Space Telescope was launched on Dec. 25, 2021, and commissioning was completed in early July 2022. With its 6.5 m golden eye, and cameras and spectrometers covering 0.6 to 28 μm, Webb is already producing magnificent images of galaxies, active galactic nuclei, star-forming regions, and planets. Scientists are hunting for some of the first objects that formed after the Big Bang, the first black holes (primordial or formed in galaxies), and beginning to observe the growth of galaxies, the formation of stars and planetary systems, individual exoplanets through coronography and transit spectroscopy, and all objects in the Solar System from Mars on out. Except for small planets, asteroids, comets, and dust grains, all targets are plasmas, with temperatures ranging from a few K to millions of K. Plasma processes control the growth of stars, planets, and black holes, and the release of rotational energy through jets from protostars and active galactic nuclei (accreting black holes). I will show how we built the Webb and what we have learned so far. The greatest surprise, still not explained, is that the first galaxies grew faster, hotter, larger, brighter, and more massive than we had predicted. Webb is a joint project of NASA with the European and Canadian Space Agencies.

About Dr. John C. Mather, Winner of the 2006 Nobel Prize for Physics and Senior Project Scientist Emeritus for James Webb Space Telescope

Dr. John C. Mather is a Civil Servant and Senior Astrophysicist in the Observational Cosmology Laboratory located at NASA's Goddard Space Flight Center, Greenbelt, MD. Until 2023, he served as the Senior Project Scientist on the James Webb Space Telescope, extending the scientific discoveries of the Hubble Space Telescope to look farther out in space and farther back in time. He grew up in rural New Jersey living on a scientific research facility where his father studied dairy cows. He attended public schools, learned calculus from a book, received a bachelor's degree in physics from Swarthmore College in Pennsylvania, and wanted to be like Richard Feynman. But his doctorate in physics from the University of California, Berkeley led him into observations of the Big Bang, with an unsuccessful thesis project that nevertheless inspired the COBE satellite and a Nobel Prize.

As a National Research Council postdoctoral fellow at the Goddard Institute for Space Studies, New York City, he led the proposal efforts for the Cosmic Background Explorer mission (1974-76), and moved to Goddard Space Flight Center to be the lead scientist for the mission. Mather and the COBE team showed that the cosmic microwave background radiation has a blackbody spectrum within 50 parts per million (ppm), confirming the expanding universe concept (Big Bang theory) to extraordinary accuracy. The team also measured hot and cold spots in the heat radiation – Steven Hawking said it was the greatest scientific discovery of the century, if not of all time. As Senior Project Scientist (1995-2023) for the James Webb Space Telescope, Mather led the science team, and represented scientific interests within the project management.

As winner of the 2006 Nobel Prize for Physics, chosen by the Royal Swedish Academy of Sciences, Mather shares the prize with George F. Smoot of the University of California for their work using the COBE satellite to measure the heat radiation from the Big Bang. Mather put the prize money into the John and Jane Mather Foundation for Science and the Arts. Mather also sponsors summer interns to work on science policy on Capitol Hill, through the Society of Physics Students.


The Nobel Prize in Physics 2006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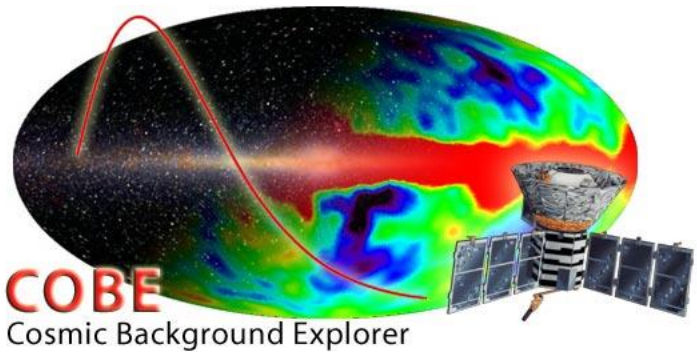
COBE
Cosmic Background Explorer