



## **ICFO Colloquium JOHN MATHER 'From the Big Bang to the end of the universe, and how we?ll learn more with the James Webb Space Telescope.'**

**JOHN C. MATHER**

September 29, 2016

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Thursday, September 29, 12:00, ICFO Auditorium

### **JOHN C. MATHER**

Senior Astrophysicist and is the Senior Project Scientist for the James Webb Space Telescope at NASA's Goddard Space Flight Center in Greenbelt, MD. His research centers on infrared astronomy and cosmology. As an NRC postdoctoral fellow at NASA's Goddard Institute for Space Studies (New York City), he led the proposal efforts for the Cosmic Background Explorer (74-76), and came to GSFC to be the Study Scientist (76-88), Project Scientist (88-98), and the Principal Investigator for the Far IR Absolute Spectrophotometer (FIRAS) on COBE. With the COBE team, he showed that the cosmic microwave background radiation

has a blackbody spectrum within 50 parts per million, confirming the expanding universe model (aka the Big Bang Theory) to extraordinary accuracy, and initiating the study of cosmology as a precision science. The COBE team also made the first map of the hot and cold spots in the background radiation (anisotropy), now attributed to quantum fluctuations in an inflationary period in the first 10<sup>-36</sup> sec of the universe. These spots represent density fluctuations that are responsible for the existence of galaxies and clusters of galaxies, due to the action of gravity, and their discovery was called "the most important scientific discovery of the century, if not of all time" by Stephen Hawking. The COBE maps have been confirmed and improved by two succeeding space missions, the Wilkinson Microwave Anisotropy Probe (WMAP, built by GSFC with Princeton University), and the Planck mission built by ESA. Based on these maps, astronomers have now developed a "standard model" of cosmology and have built detailed numerical simulations that begin to match Hubble observations, and require the existence of both "dark matter" and "dark energy", neither of which has been detected or deduced in laboratory experiments. Dr. Mather is the recipient of numerous awards, including the Nobel Prize in Physics (2006) with George Smoot, for the COBE work, and the NASA Distinguished Service Medal (2007). He is a member of many professional societies including the National Academy of Sciences and the American Academy of Arts and Sciences.

Dr. Mather is now working with teams and committees to develop plans for a future great telescope capable of observing signs of life on planets orbiting other stars.

The James Webb Space Telescope, planned for launch in October 2018, will be the most powerful space telescope ever built. It will open new territories of astronomy, with observations ranging from the first stars, galaxies, and black holes, to the growth of galaxies, to the formation of stars and planetary systems, to the evolution of planetary systems and the conditions for life here on Earth, and perhaps elsewhere. I will show how we have learned about the history of the universe, how the Big Bang is a completely misleading name for the infinite expanding universe, and what new telescopes are being built now. I will illustrate with simulations of the formation of galaxies from the primordial material, and the possible evolution of the solar system through planetary orbit migration. The JWST telescope mirror has been assembled and the instrument module has been completely tested. After more tests at Goddard, the telescope/instrument combination will travel to Houston for



cryo-vacuum tests in Chamber A in 2017. I will show the design of the observatory and discuss the opportunities for future observers to prepare to use it.

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