Echo of the Big Bang wins US pair Nobel Prize (Update 4)

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John C. Mather and George F. Smoot.

The Nobel Prize in Physics goes to John C. Mather and George F. Smoot "for their discovery of the blackbody form and anisotropy of the cosmic microwave background radiation".

US space scientists John Mather and George Smoot were awarded the Nobel Physics Prize on Tuesday for a pioneering space mission which supports the "Big Bang" theory about the origins of the Universe.

The pair were the key minds behind a NASA mission to measure the aftershock of the cataclysmic explosion that occurred some 13.7 billion years ago and gave birth to the cosmos.

The unmanned spacecraft, the Cosmic Background Explorer (COBE) satellite, not only gave flesh to the skeletal notion of the "Big Bang," which had developed in academic circles in the late 1940s, but also offered clues as to how and when the first galaxies came into being.

The results from COBE were "the greatest discovery of the century, if not all times," the British physicist Stephen Hawking has said.

Gunnar Öquist (L), permanent secretary of the Royal Academy of Sciences, and Per Carlson, chairman of the Nobel committee

"These measurements... marked the inception of cosmology as a precise science," the Nobel jury said in its citation.

Mather, 60, is a senior astrophysicist at NASA's Goddard Space Flight Center in Maryland, while Smoot, 61, is a professor of physics at the University of California at Berkeley.

Mather was lauded for his work on so-called blackbody radiation -- a telltale pattern in the energy spectrum which comes from a body that is cooling down.

At its birth, the Universe was 3,000 degrees Celsius (5,432 degrees Fahrenheit). Since then, according to the Big Bang theory, the radiation has gradually cooled as the Universe has expanded.

This so-called cosmic microwave background (CMB) radiation -- the shockwave of energy that issued from the blast and is still radiating across the expanding skies as limits of the Universe are pushed back -- is barely 2.7 degrees above absolute zero, which is minus 273 degrees Celsius.

COBE was launched in November 1989.

The first results were received after nine minutes of observations, providing "a perfect blackbody spectrum," in other words -- as predicted -- a temperature profile of the Universe at that point after the Big Bang, the Nobel panel said.

When the curve was later shown at an astronomy conference, the results received a standing ovation.

"There really is not a good alternative explanation for having such a perfect black body spectrum. Many people looked, but no good explanation was found, so the Big Bang theory is confirmed by that spectrum," Mather said Tuesday in an interview with the Nobel Foundation.

Smoot's prize was for measuring tiny variations in the temperature of this radiation, thus proving the direction of the force of the Big Bang and the still-continuing expansion of the Universe.

These temperature differences also amount to fingerprints for cosmic sleuths, as they are the thresholds at which the matter in the infant Universe comes together.

Without this aggregation, nothing in today's Universe -- the galaxies, stars, life itself -- would exist.

Smoot, who as a child loved to read science fiction, said he was so surprised to receive a phone call from the prize committee telling him he had won the prestigious award that he had to check the Nobel Prize website.

"I got up and checked the website to make sure that it was real," he told Swedish public radio by telephone from his home in California, adding that he was "quite pleased and excited".

"It's a great honour and recognises the work of the whole COBE team," Smoot said.

Tuesday's award was a de-facto award for a space mission, the first time this has happened in the history of the Nobel Prize. More than a thousand researchers and engineers worked on the COBE project, which Mather also coordinated.

The two laureates will each receive a gold medal and a diploma and will share a cheque for 10 million Swedish kronor (1.07 million euros, 1.37 million dollars) at the formal prize ceremony held, as tradition dictates, on December 10, the anniversary of the death in 1896 of the prize's creator Alfred Nobel.

The Nobel prizes were first awarded in 1901.

On Monday, the Medicine Prize went to US research duo Andrew Fire and Craig Mello for their discovery of how to silence malfunctioning genes, a breakthrough which could lead to an era of new therapies to reverse crippling diseases.

The prize for chemistry will be announced on Wednesday, to be followed over the next 10 days by the awards for economics, literature and peace.

Pictures of a newborn Universe

This year the Physics Prize is awarded for work that looks back into the infancy of the Universe and attempts to gain some understanding of the origin of galaxies and stars. It is based on measurements made with the help of the COBE satellite launched by NASA in 1989.

The COBE results provided increased support for the Big Bang scenario for the origin of the Universe, as this is the only scenario that predicts the kind of cosmic microwave background radiation measured by COBE. These measurements also marked the inception of cosmology as a precise science. It was not long before it was followed up, for instance by the WMAP satellite, which yielded even clearer images of the background radiation. Very soon the European Planck satellite will be launched in order to study the radiation in even greater detail.

According to the Big Bang scenario, the cosmic microwave background radiation is a relic of the earliest phase of the Universe. Immediately after the big bang itself, the Universe can be compared to a glowing "body emitting radiation in which the distribution across different wavelengths depends solely on its temperature. The shape of the spectrum of this kind of radiation has a special form known as blackbody radiation. When it was emitted the temperature of the Universe was almost 3,000 degrees Centigrade. Since then, according to the Big Bang scenario, the radiation has gradually cooled as the Universe has expanded. The background radiation we can measure today corresponds to a temperature that is barely 2.7 degrees above absolute zero. The Laureates were able to calculate this temperature thanks to the blackbody spectrum revealed by the COBE measurements.

COBE also had the task of seeking small variations of temperature in different directions (which is what the term 'anisotropy' refers to). Extremely small differences of this kind in the temperature of the cosmic background radiation – in the range of a hundred-thousandth of a degree – offer an important clue to how the galaxies came into being. The variations in temperature show us how the matter in the Universe began to "aggregate". This was necessary if the galaxies, stars and ultimately life like us were to be able to develop. Without this mechanism matter would have taken a completely different form, spread evenly throughout the Universe.

COBE was launched using its own rocket on 18 November 1989. The first results were received after nine minutes of observations: COBE had registered a perfect blackbody spectrum. When the curve was later shown at an astronomy conference the results received a standing ovation.

The success of COBE was the outcome of prodigious team work involving more than 1,000 researchers, engineers and other participants. John Mather coordinated the entire process and also had primary responsibility for the experiment that revealed the blackbody form of the microwave background radiation measured by COBE. George Smoot had main responsibility for measuring the small variations in the temperature of the radiation.

Advanced Information (pdf): nobelprize.org/nobel_prizes/ph …es/2006/phyadv06.pdf

Sportsloving stargazer Smoot wins Nobel Physics Prize

George Smoot, one of two US physicists awarded the 2006 Nobel Prize for Physics, has been fascinated by the stars and distant galaxies since childhood when he devoured science fiction books.

George Fitzgerald Smoot III was born on February 20, 1945 in Yukon, Florida. His father, a hydrologist with the US Geological Survey, and mother, a science teacher and later a principal, instilled in their son a respect for learning and an interest in science and mathematics.

The young Smoot lapped up science fiction, engineering, and science books by Arthur C. Clarke.

He played football and athletics at junior high, but by the time he reached high school his interests had switched from sports to academia.

He majored in mathematics and physics at the Massachusetts Institute of Technology (MIT), where in 1970 he also earned a PhD in physics.

Smoot left MIT in 1970 for the University of California at Berkeley, where he worked with the 1968 Nobel Prizewinning physicist Luis Alvarez on the NASA-funded High-Altitude Particle Physics Experiment (HAPPE) at Lawrence Berkeley Laboratory.

The goal of HAPPE was to design an experiment to find evidence of the Big Bang, which had become the favoured explanation for the formation of the universe among scientists.

With NASA's help Smoot used a high-flying U-2 spy plane to study the cosmic background radiation in 1976.

Smoot and fellow Nobel laureate John Mather worked on the COBE satellite launched by NASA in 1989, whose results provided increased support for the Big Bang scenario, predicting the kind of cosmic

microwave background radiation measured by COBE.

Newsweek described their work on COBE as "the handwriting of god", while Michael Turner, an astrophysicist at the University of Chicago described the pair's findings as "the Holy Grail of cosmology."

Smoot was so focused on analysing the COBE finding that he let earthly concerns slip, he told the Guardian newspaper in 1992.

"I didn't open my mail, I let my car insurance lapse, and I let everything slide, because I was just trying to make sure it was right," Smoot said.

In October 1992, he told the Discovery science channel: "I really am betting my career on this."

He detailed the history of cosmology and his own experiences studying the universe in the 1993 book Wrinkles in Time, written with Keay Davidson.

"I chose to work on measuring cosmic background radiation partly because I knew this: Whatever we learned would be fundamental. Regardless of what we found, our observations would tell us about the earthly universe," he wrote.

It was this work that won Smoot, at 61, the 2006 Nobel Prize in Physics, along with Mather.

Smoot is a professor of physics at the University of California at Berkeley, where he is an astrophysics and cosmology specialist. He is unmarried and enjoys cross-country skiing and discussing philosophy.

Nobel laureates helped rewrite history of the Universe

The 2006 Nobel Physics prize has rewarded big science -- and arguably the biggest science of them all: probing the origin of the Universe itself.

Sketched in the late 1940s, contested at first by other scientists and still bitterly assailed by Christian fundamentalists, the "Big Bang" theory has moved from the margins to the centre of our conceptual architecture of the cosmos.

Two men who bear much of the credit for this transition are American astrophysicists John Mather and George Smoot, who were rewarded with the Nobel on Tuesday for their work with a NASA space probe, the Cosmic Background Explorer (COBE) satellite.

COBE's results were "the greatest discovery of the (20th) century, if not of all times," their great British contemporary, Stephen Hawking, said in 1992.

Launched in 1989, COBE sent back a ream of hard data to buttress the notion that the Universe was born from a cataclysmic blast, since calculated to be around 13.7 billion years ago.

From this explosion came the cosmic soup-to-nuts: galaxies, stars, planets, black holes, life -- everything.

The key to the Big Bang idea is a phenomenon called cosmic microwave background radiation, or CMB for short.

It is the shockwave of energy that issued from the blast and is still radiating across the expanding skies as limits of the Universe are pushed back.

It has been dubbed "the first light of the Universe", although it is in the microwave part of the energy spectrum and thus is invisible to the

human eye.

CMB had been proposed in the 1940s but its existence was only confirmed in 1964, thanks to a pair of physicists who took the trouble to investigate a blizzard of noise from a radio receiver (the duo, Arno Penzias and Robert Wilson, received the 1978 Nobel for their pains).

For astrophysicists, the CMB excites the same fascination as dinosaur bones for palaeontologists -- it is a fossil radiation, a treasure of secrets to tease out about the early Universe.

COBE's big achievement was to bear out two ideas about CMB.

According to the Big Bang scenario, the Universe was born in intense heat.

It took around 300,000 years for the Universe to cool down to a temperature at which atoms can form and for the CMB to be released from what had been a thick, opaque stew of neutrons and charged particles.

Over the billions of years, the CMB, which began at around 3,000 degrees Celsius, must have cooled down.

COBE radioed back a pattern of frequencies, the so-called blackbody spectrum, that showed the CMB had a temperature, as predicted, of 2.7 degrees above absolute zero.

The probe's other major work was to measure whether the CMB was a smooth wave in every direction.

Smoot's instruments showed that there were tiny variations in the CMB according to the direction where the radiation was measured -- a finding

that is far more than of arcane academic interest.

These "wrinkles," it is argued, helped matter to cluster together through gravity, eventually creating all the cosmic structures that we see today. Without them, the particles would spread out uniformly as a cosmic sludge, never aggregating into anything.

"These tiny differences measured by COBE were essential, because they point to the seeds of the Universe that follows," said Jean-Michel Alimi, director of the Laboratory of the Universe at the Paris-Meudon Observatory in the suburbs of the French capital. "They were the missing link."

Any space mission is a collective venture, and Mather and Smoot are likely to be seen as first among equals of around 1,000 engineers and scientists who took part in the COBE.

The pair are being singled out not just for their scientific prowess but for their ability, especially Mather's, to steer the project to its glittering conclusion over innumerable obstacles.

COBE was conceived by NASA in 1974, with the idea that it be launched by one of the US space shuttles.

But the probe was jeopardised by the loss of the shuttle Challenger in 1986 and it took Mather years to wheedle the agency into providing an Atlas rocket to send the precious satellite aloft.

COBE's mission ended in 1993, and the craft was superceded by another, more powerful probe, the Wilkinson Microwave Anisotropy Probe (WMAP), launched in 2001, with the goal of setting out the geometry and evolution of the Universe.

The European Space Agency (ESA) is to launch Planck, a lab to measure specific variations in the CMB, in 2007.

A list of Nobel Physics Prize winners over the past 10 years

2006: John C. Mather and George F. Smoot (US)

2005: Roy J. Glauber and John L. Hall (US), Theodor W. Haensch (Germany)

2004: David J. Gross, H. David Politzer, Frank Wilczek (US)

2003: Alexei A. Abrikosov (Russia-US), Vitaly L. Ginzburg (Russia) and Anthony J. Leggett (Britain-US)

2002: Raymond Davis and Riccardo Giacconi (US) and Masatoshi Koshiba (Japan)

2001: Eric Cornell, Carl Wieman (US) and Wolfgang Ketterle (Germany)

2000: Zhores Alferov (Russia), Herbert Kroemer (Germany) and Jack Kilby (US)

1999: Gerardus 't Hooft and Martinus Veltman (Netherlands)

1998: Robert Laughlin, Daniel Tsui (US) and Horst Stoermer (Germany)

1997: Steven Chu, William D. Phillips (US) and Claude Cohen-Tannoudji (France)