

# Allan Sandage, Astronomer, Dies at 84; Charted Cosmos's Age and Expansion



Bart Bartholomew

Allan R. Sandage in 1991. He was an assistant to Edwin Hubble, and carried on his work.

By [DENNIS OVERBYE](#)

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Allan R. Sandage, who spent his life measuring the universe, becoming the most influential astronomer of his generation, died Saturday at his home in San Gabriel, Calif. He was 84.

The cause was pancreatic cancer, according to an announcement by the [Carnegie Observatories](#), where he had spent his whole professional career.

Over more than six decades, Dr. Sandage was like one of those giant galaxies that sit at the center of a cluster of galaxies, dominating cosmic weather. He wrote more than 500 papers, ranging across the cosmos, covering the evolution and behavior of stars, the birth of the Milky Way galaxy, the age of the universe and the discovery of the first quasar, not to mention the Hubble constant, a famously contested number that measures the rate of expansion of the universe. Dr. Sandage pursued the number with his longtime collaborator, Gustav Tammann of the University of Basel in Switzerland.

In 1949, Dr. Sandage was a young Caltech graduate student, a self-described “hick who fell off the turnip truck,” when he became the observing assistant for Edwin Hubble, the Mount Wilson astronomer who discovered the expansion of the universe.

Hubble had planned an observing campaign using a new 200-inch telescope on Palomar Mountain in California to explore the haunting questions raised by that mysterious expansion. If the universe was born in a Big Bang, for example, could it one day die in a Big Crunch? But Hubble died of a heart attack in 1953, just as the telescope was going into operation. So Dr. Sandage, a fresh Ph.D. at 27, inherited the job of limning the fate of the universe.

“It would be as if you were appointed to be copy editor to Dante,” Dr. Sandage said. “If you were the assistant to Dante, and then Dante died, and then you had in your possession the whole of ‘The Divine Comedy,’ what would you do?”

Dr. Sandage was a man of towering passions and many moods, and for years, you weren’t anybody in astronomy if he had not stopped speaking to you. In later years, beset by controversy, Dr. Sandage withdrew from public view. But even after retiring from the Carnegie Observatories and becoming ill, he never stopped working; he published a paper on variable stars only last June.

In 1991, Dr. Sandage was awarded the Crafoord Prize in astronomy, the closest thing to a Nobel for a stargazer, worth \$2 million.

Wendy Freedman, his boss as director of Carnegie as well as a rival in the Hubble constant question, referred to him on Tuesday as the last giant of 20th-century observational cosmology. “Even when we had our scientific differences, I got a kick out of him,” she said. “His passion for his subject was immense.”

James Gunn, an astronomer at Princeton, said of Dr. Sandage in an e-mail message, “He was probably (rightly) the greatest and most influential observational astronomer of the last half-century.”

Allan Rex Sandage was born in Iowa City, Iowa, on June 18, 1926, the only child of an advertising professor, Charles Harold Sandage, and a homemaker, Dorothy Briggs Sandage. The stars were one of his first loves; his father bought him a commercial telescope.

After two years at [Miami University](#), where his father taught, Allan was drafted into the Navy; he resumed his education at the [University of Illinois](#), earning a degree in physics.

In 1948 he entered graduate school at the [California Institute of Technology](#), where an astronomy program had been started in conjunction with the nearby Mount Wilson Observatory, home of Hubble, among others.

As a result, Dr. Sandage learned the nuts and bolts of observing with big telescopes from the founders of modern cosmology, Hubble; Walter Baade, who became his thesis adviser, and Milton Humason, a former mule driver who had become Hubble’s right-hand man.

In the years before World War II, there had been a revolution in the understanding of the nature and evolution of stars as thermonuclear furnaces burning hydrogen into helium and elements

beyond. Astronomers could now read the ages of star clusters from the colors and brightness of the stars in them.

For his thesis, Dr. Sandage used this trick to date a so-called globular cluster, known as Messier 3, as being 3.2 billion years old, which meant that the universe itself could not be younger than that. In fact, Hubble's own measurements of the cosmic expansion suggested an age of about four billion years — remarkably, even miraculously, consistent.

At the time, astronomers were also still debating whether the universe had had a Big Bang and a beginning at all, not to mention whether it would have an ending as well. An opposing view championed by the British cosmologist Fred Hoyle held that the universe was eternal and in a “steady state,” with new matter filling in the void as galaxies rushed away from one another.

Choosing between these models was to be the big task of 20th-century astronomy, and of Dr. Sandage. In 1961 he published a paper in *The Astrophysical Journal* showing how it could be done using the 200-inch telescope. He described cosmology as the search for two numbers: one was the cosmic expansion rate, known as the Hubble constant; the other, called the deceleration parameter, tells how fast the expansion is being braked by cosmic gravity.

That paper, [“The Ability of the 200-inch Telescope to Discriminate Between Selected World Models,”](#) may well have been “the most influential paper ever written in any field even close to cosmology,” Dr. Gunn said. It was to set the direction of observational cosmology for 40 years, ruling out the Steady State and the Big Crunch and culminating in the surprise discovery in 1998 that the expansion is not slowing down at all but speeding up.

Meanwhile, Dr. Sandage investigated the birth of the galaxy. By analyzing the motions of old stars in the Milky Way, he, Olin Eggen of Caltech and Donald Lynden-Bell of Cambridge showed in a 1962 paper that the Milky Way formed from the collapse of a primordial gas cloud probably some 10 billion years ago. That paper still forms the basis of science's understanding of where the galaxy came from, astronomers say.

In 1959, Dr. Sandage married another astronomer, Mary Connelly, who was teaching at Mount Holyoke and had studied at Indiana University and Radcliffe, but did not pursue further research. He is survived by her and two sons, David and John.

It was measuring the cosmic expansion that was the most backbreaking part of fulfilling Hubble's legacy. In an expanding universe, the speed with which a galaxy flies away from us is proportional to its distance. The constant of proportionality, the Hubble constant, is given in the mind-numbing terms of kilometers per second per megaparsec. Hubble's original estimate of his constant of 530 meant that for every million parsecs (3.26 million light years) a galaxy was farther away from us, it was retreating 530 kilometers per second (around 300 miles per second) faster.

Hubble's original estimate, however, corresponded to an age for the universe of only 1.8 billion years, at odds with both geological calculations of the Earth's age and Dr. Sandage's later estimate of the ages of star clusters.

But Hubble had made mistakes — he saw bright patches of gas as stars, for example — and as Dr. Sandage and Dr. Tammann delved into the subject in a series of papers, the problematic constant came down and the imputed age of the universe rose.

In 1956, Dr. Sandage suggested that the Hubble constant could be as low as 75 kilometers per second per megaparsec. By 1975 the value, they said, was all the way down to 50, corresponding to an age of as much as 20 billion years, comfortably larger than the ages of galaxies and globular clusters.

This allowed them to conclude that the universe was not slowing down enough for gravity to reverse the expansion into a Big Crunch. That was in happy agreement with astronomers who had found that there was not enough matter in the universe to generate the necessary gravity.

As Dr. Sandage wrote in *The Astrophysical Journal* in March 1975, “(b) the Universe has happened only once, and (c) the expansion will never stop.”

“So the universe will continue to expand forever,” Dr. Sandage said in an interview, “and the galaxies will get farther and farther apart, and things will just die. That’s the way it is. It doesn’t matter whether I feel lonely about it or not.”

Shortly thereafter, however, their results on the Hubble constant came under attack by rival astronomers, who said that Dr. Sandage and Dr. Tammann had overestimated the distances to galaxies — a crucial part of the equation for the constant — making the universe appear bigger and older than it really was. The universe, they said, was really about 10 billion years old.

Stung by the criticisms, Dr. Sandage retreated from public view, even while he and Dr. Tammann redoubled their efforts to measure the troublesome constant, always getting a low value. As the groups shot back and forth at each other, the universe, as reflected in newspaper headlines, boomeranged back and forth from 10 billion to 20 billion years.

In 2001, a team led by Dr. Freedman, using the [Hubble Space Telescope](#), reported a value of 72 kilometers per second per megaparsec, in good agreement with measurements of relic radiation from the Big Bang that give an age of 13.7 billion years for the cosmos full of [dark energy](#) and [dark matter](#), and a Hubble constant of 71, which most astronomers now accept.

To the frustration of colleagues, Dr. Sandage, also using Hubble, kept getting a lower value.

We may never know the fate of the universe or the Hubble constant, he once said, but the quest and discoveries made along the way were more important and rewarding than the answer anyway.

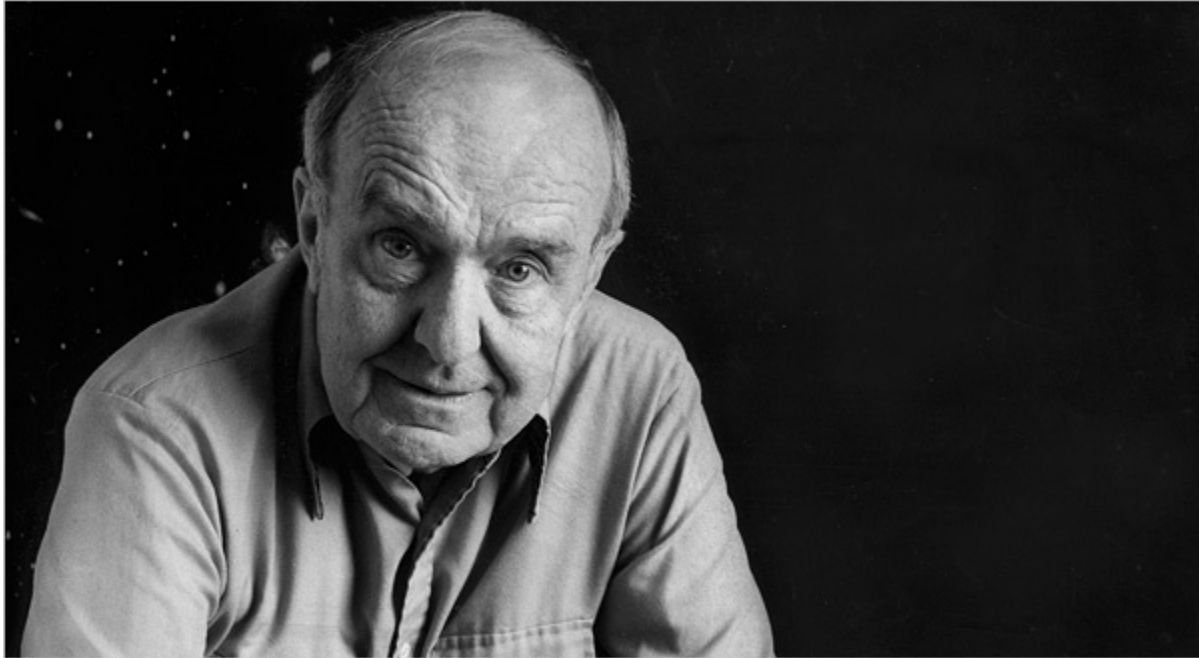
“It’s got to be fun,” Dr. Sandage told an interviewer. “I don’t think anybody should tell you that he’s slogged his way through 25 years on a problem and there’s only one reward at the end, and that’s the value of the Hubble constant. That’s a bunch of hooey. The reward is learning all the wonderful properties of the things that don’t work.”

This article has been revised to reflect the following correction:

**Correction: November 18, 2010**

An obituary on Wednesday about the astronomer Allan R. Sandage misidentified a university he attended. It is Miami University in Oxford, Ohio — not the University of Miami. The obituary also misstated the name of a university his wife, Mary Connelly, attended. It is Indiana University, not the University of Indiana.

# He Was Mr. Universe, but He Was Really in Love With the Stars



Bart Bartholomew

**EMINENT** The cosmologist Allan R. Sandage in 1991. He died Nov. 13 at 84.

By [DENNIS OVERBYE](#)

Published: November 22, 2010

The first time I met the eminent cosmologist Allan R. Sandage, who died Nov. 13 at 84, he refused to talk to me.

## Related

- [Allan Sandage, Astronomer, Dies at 84; Charted Cosmos's Age and Expansion](#) (November 17, 2010)

In the late 1970s I was junior editor at Sky & Telescope magazine. An astronomer had just made some remarkable measurements of quasars that dovetailed with recent work by Dr. Sandage I'd read about in this newspaper, indicating that the expanding universe would eventually close in on itself and collapse in a Big Crunch. If true, that was big news, so I called him up.

Dr. Sandage answered — a newsworthy event in itself — but he said there was nothing to talk about. The newspaper reporters had screwed it up again and mistakenly interpreted his observations. In fact he was on the other line with The New York Times demanding a correction. “So you see,” he said cheerily, “you have no story.”

And just like that I was ushered off the line, feeling very junior indeed.

At the time we didn't talk, Dr. Sandage was a little over 50, much younger than I am now, but he had already been Mr. Universe, the man the newspapers called for the latest word on the state of the cosmos, for nearly three decades.

He had inherited that role at the age of 27 from Edwin Hubble, the astronomer who first showed that blurs in the sky were galaxies beyond our own and then went on to show that they were all flying away from us.

At the time, our conception of the universe was almost as young as Dr. Sandage, who was born in 1926, three years before Hubble discovered the cosmic expansion. During his life, Dr. Sandage saw the debates over the Big Bang and Steady State theories of the universe give way to [dark energy](#) and [dark matter](#); astronomers went from wearing electrically heated flight suits to ride in a telescope all night to downloading pictures from the [Hubble Space Telescope](#).

Once upon a time, women weren't allowed to work on Mount Wilson, where the galaxies had been discovered; today a woman, [Wendy L. Freedman](#), is the director of Carnegie Observatories, as Mount Wilson Observatory in Pasadena, Calif., came to be called. Once upon a time, there was only one cosmologist in the world: Dr. Sandage. By the time he died, there were thousands, most of them following the program and techniques he had laid out in the 1950s and '60s to find the few sacred numbers that would spell out the size, age and fate of the universe.

Measuring the universe took its toll on Dr. Sandage. The cosmos quaked every time he got more data on the distant galaxies and gave another interview, and so he stopped giving them after he had been wrong a few times, as any scientist will be. His isolation grew when he became embroiled in a seemingly endless and bitter controversy now known as the Hubble wars, about the Hubble constant, a number that told how big and old the universe was. Depending on whom you talked to, the universe was either 10 billion or 20 billion years old, with no room to compromise — which was weird since the stars themselves were 12 to 15 billion years old.

A decade after our first nonconversation, I eventually did get Dr. Sandage to talk to me. Over years of lunches and dinners, I wheedled his life story out of him. They were the hardest and most rewarding interviews I've ever done. Dr. Sandage complained often that he didn't know why he was talking to me — only bad could come of it — but he kept talking.

What came out of it was a [book](#) he swore he would never read. I was terrified he would go back to not talking to me, but he still kept talking anyway; no trip to Los Angeles was ever complete without a long lunch with Uncle Allan. He could, as he thought the occasion warranted, charm, tease, curse like a sailor, excoriate his rivals or discuss philosophy and theology like a minister. On his bad days, Dr. Sandage would sometimes deny that he had ever been a cosmologist. His real love was the stars. "Cosmology is a boring burden of pride," he once said, adding that he had only been dragged into it out of duty.

But he never lost his enthusiasm for the delights of the sky, and he could go giddy with glee over some nugget of starry lore. I loved the guy because he had seen everything; to me he was a King Lear of the cosmos.

His office at the Carnegie Observatories was a shrine to Hubble's day, when data came not in computer files but on glass photographic plates that astronomers squinted at with magnifiers, like jewelers sifting gems. His plate reader was hung with a clove of garlic, his shelves and filing cabinets were full of marked-up photographs of galaxies. Sitting around in yellowing envelopes were photographic plates taken half a century earlier by the pioneering giants of cosmology. Sometimes it seemed that those guys — and they were all guys — were in the room with us.

Dr. Sandage once spent an evening taking me through a recent compilation of data — some of it dating back to those old plates — on nearby galaxies. At the end as we charted it, the hair rose on the back of my neck: there, rising out of a scruff of dots on a graph was the expansion of the universe, the cosmic riddle itself.

It's dangerous for a journalist to get too sympathetic with any side in a genuinely scientific debate; in fact, I liked everybody on both sides of the Hubble wars, including John Huchra, a Harvard professor who became one of Dr. Sandage's challengers in the 1970s and who died in October. As the gap between estimates of the age of the universe narrowed in recent times from an embarrassing factor of 2 to about 15 percent — enough to accommodate the stars' ages — I hoped, as did many astronomers, that Dr. Sandage would just declare victory and go on with the rest of his illustrious career.

It was not to be.

The Hubble wars are over now. The universe and cosmology might make a little more sense now, at least numerically, but we still don't know where we came from and where the galaxies are going. Trying to find out won't be quite as much fun again without Uncle Allan.

*Astronomer Allan Rex Sandage took it as his life's work to find out how old and how large the universe is. His work led him to conclude the universe is 15 billion to 20 billion years old. Sandage is credited with the discovery of quasars, small blue cosmic objects that may be places where stars are born.*

## Became a Stargazer

Born on June 18, 1926, [Sandage](#) was an only child. His father was a business professor at Miami (Ohio) University and his mother was the daughter of the president of a Church of Jesus Christ of Latter Day Saints (Mormon) school. On quiet Ohio nights, Sandage enjoyed watching the stars through a friend's telescope. Soon he was keeping an eye on the skies day and night. As a teenager, he kept a record of [sunspots](#) he observed over a period of four years. Young Sandage read writings by British astronomer and mathematician Arthur Stanley Eddington and *The Realm of the Nebulae* (1936) by Edwin P. Hubble.

After studying physics and philosophy at Miami University, Sandage served in the U.S. Navy as an electronics specialist during World War II. After the war, he earned a bachelor's degree in physics from the University of Illinois in 1948 and a Ph.D. from the California Institute of Technology in 1953.

While still a student, Sandage worked at the [Palomar Observatory](#) with astronomers Hubble and Walter Baade, trying to discover the secrets of the universe through the world's largest telescope at that time. Sandage later used the 100-inch Hooker telescope on Mount Wilson and the 200-inch Hale telescope on Mount Palomar to uncover mysteries such as the evolution of stars.

## Measured the Universe

In 1952, Sandage joined Carnegie Observatories, where he became involved in investigating the origins of the universe. During his first year, he equated the [luminosity](#) of the globular clusters M92 and M3 to the luminosity of the sun. He found that stars in those globular clusters were as much as 12 [billion](#) years old.

In September 1953, Hubble died of a heart attack. Sandage continued the [painstaking](#) work that Hubble had begun. He found that gathering data and eliminating errors were daunting tasks. Still, after much analysis, he found that Hubble's original estimates of the universe's age were more conservative than the data seemed to indicate. Sandage's results in 1958 seemed to show that the universe was 7 to 13 billion years old, much greater than Hubble had thought. By 1975, Sandage began to think the universe was even more ancient, perhaps 15 or 20 billion years old.

To determine the age of a star, Sandage looked at a classic color-magnitude diagram. He plotted the brightness of stars against their colors or temperatures. How bright a star is depends on its age, mass, and chemical makeup. Sandage looked at the relationships between stars that belong to younger clusters and stars that belong to older clusters to find clues to stellar evolution.

Working with Gustav Tammann, of the University of Basel, Switzerland, and Dr. Abijit Saha, of Kitt Peak National Observatory, Sandage found that the universe is expanding at a speed of

about 55 kilometers/second/ [megaparsec](#). This speed indicates that the universe is about 14 billion years old. Some stars have since been calculated to be about 15 billion years old, which bolsters Sandage's theory.

As an observational cosmologist, Sandage built on the work Hubble began in the 1920s and 1930s. Before long, Sandage was known as Mr. Cosmology, or the Super Hubble. Hubble-Sandage variable stars take their name from the energetic astronomer and his mentor.

### Discovered Quasars

In 1964, Sandage and his colleague Thomas Matthews discovered sources of concentrated radio energy in distant space. They called them [quasars](#), short for [quasi](#) stellar radio sources. The center of a quasar is thought to be a black hole that sucks in gases and other materials that form the [discus](#) shape associated with quasars. Quasars are very bright, probably about 1,000 times brighter than the Milky Way Galaxy. They are thought to be the most distant objects in the universe: in 1968 Maarten Schmidt found that they are located on the edge of the known universe.

### Wrote on Religion

Unlike some scientists who see religion and science as opposed, Sandage believes they are [complementary](#). In an article he wrote for *Truth Journal*, Sandage said science should take religion seriously and religion should respect science. "Science makes explicit the quite incredible natural order, the interconnections at many levels between the laws of physics, the chemical reactions in the biological processes of life, etc.," he wrote. "But science can answer only a fixed type of question. It is concerned with the *what*, *when*, and *how*. It does not, and indeed cannot, answer within its method (powerful as that method is), *why*."

### Defended Theories

Observational cosmologists disagree on how to measure distances between Earth and the stars. Critics have often attacked Sandage's premise that the universe is always expanding, and others have questioned his findings. But time proved Sandage's measurements to have validity, even if they were not accepted at first by all his peers.

When Sandage and Tammann found that some scientists were selecting stars and galaxies that were too bright to represent "standard candles" - a measurement scientists use to determine distances between Earth and celestial objects - Sandage found new ways to take measurements. While critics ignored Sandage's findings, he and his team looked into Type 1A supernovas to correlate galactic rotational velocities with brightness.

Sandage's skirmishes with his colleagues and critics over the expansion rate of the universe were so heated at times that they were sometimes called the "Hubble Wars." Despite all the controversy over his work, Sandage was always regarded as one of the top observational cosmologists in the world.

Sandage's book *Lonely Hearts of the Cosmos*, was published in 1991. In retirement, Sandage lives in Pasadena, California, with his wife, Mary Lois. They have two sons, David and John.

Read more: <http://www.answers.com/topic/allan-sandage#ixzz164Lv6Z5N>