

1 Einstein on Dark Energy

When Einstein applied his general theory of relativity to the universe for the first time in 1917, he believed the universe was unchanging. His equations didn't allow this, so he added a "dark energy" (which he called the cosmological term) to his equations to permit a static universe.

In 1927 Abbé Georges Lemaître discovered that Einstein's mathematical static universe was unstable, and would spontaneously expand.

With Hubble's 1929 discovery that the universe was indeed expanding, Einstein quickly abandoned both his static universe and the "dark energy" in favor of Lemaître's expanding universe.

In 1931, Lemaître published his proposal that the universe began its expansion from a point in which all its matter and energy were concentrated: the Big Bang.

"If the world has begun with a single quantum, the notions of space and time would altogether fail to have any meaning at the beginning; they would only begin to have a sensible meaning when the original quantum had been divided into a sufficient number of quanta. If this suggestion is correct, the beginning of the world happened a little before the beginning of space and time.... The whole matter of the world must have been present at the beginning, but the story it has to tell may be written step by step."

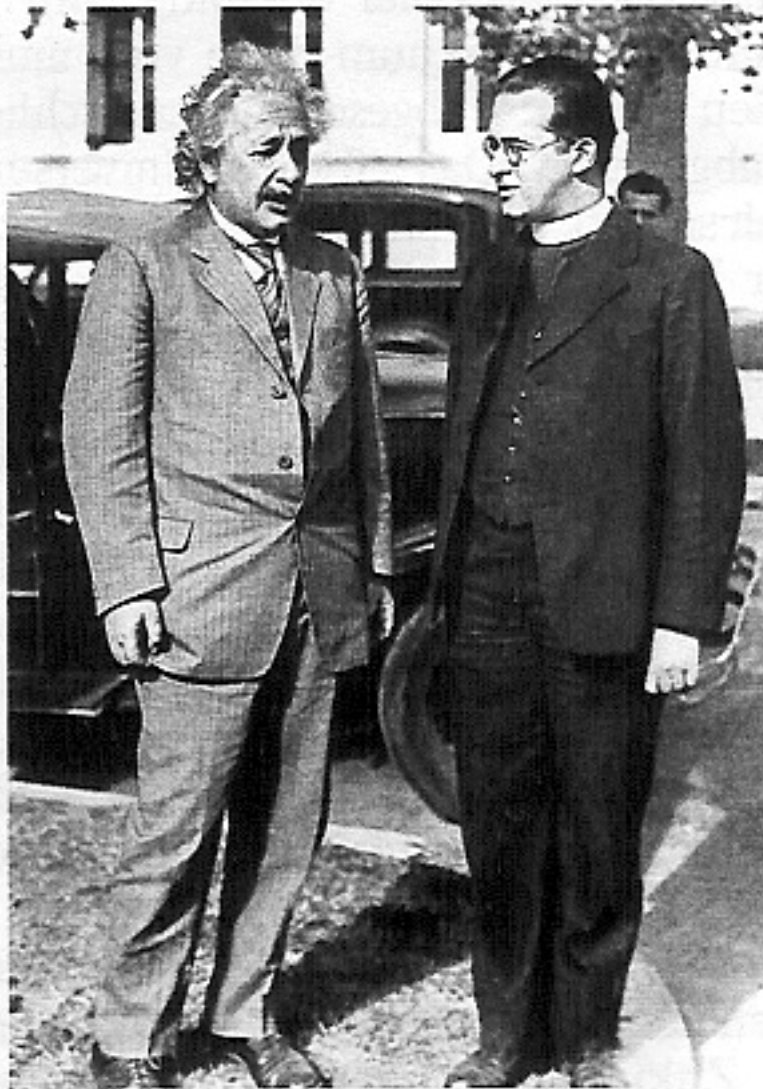
[*Nature* 127, 706 (May 9, 1931)]

However, Hubble's early estimates of the rate of expansion of the universe were systematically in error (due to a poor understanding of stars at the time), and it appeared that the universe was younger than the earth. Lemaître showed that this could be fixed by reintroducing the "dark energy". But Einstein would not accept this solution:

On Sept 26, 1947, Einstein wrote to Lemaître:

"Since I have introduced this term I had always a bad conscience.... I found it very ugly indeed that the field law of gravitation should be composed of two logically independent terms which are connected by addition... I cannot help to feel it strongly and I am unable to believe that such an ugly thing should be realized in nature."

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Himmelforscher Einstein, Lemaître
Sanfter Tod des Kosmos

p 155

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Photo ?? from cover of New York Times Magazine for Feb 19, 1933? QB 980.B54.1984 p 359 reproduces it, says in Le Coq Belgium. A photo, including Millikan, dated Jan 10, 1933, is in Caltech archives, <http://www.caltech.edu/pictures/arc>

1.1 Georges Lemaître (1894-1966)

1913 BA in engineering, University of Louvain.

1914-1918 service in Belgian infantry and artillery during WWI.

1920 PhD in mathematics, University of Louvain.

1920 entered seminary Maison Saint Rombaut

1923 ordained a Roman Catholic priest.

1923-4 Cambridge University

1924-5 Harvard College Observatory and MIT.

1925 PhD in physics from the Massachusetts Institute of Technology.

1925 appointed Professor at the University of Louvain, Belgium.

1927 publishes discovery that Einstein's static universe is unstable, and will spontaneously begin to expand, made connection between redshifts of galaxies and expansion of the universe, and (2 years before Hubble) used available data to estimate the expansion rate

1931 proposes the universe had a beginning when all its matter and energy were concentrated at a point: the Big Bang.

1933 Einstein and Lemaître visit Hubble at the California Institute of Technology.

1933 Lemaître tells audiences around the US: "There is no conflict between religion and science" [quoted by Duncan Aikman, New York Times Magazine, Feb 19, 1933].

1933 publishes analysis of growth of small initial density fluctuations into galaxies, and definitive description of Big Bang theory.

1935 made canon of the cathedral of Malines

1936 inducted into the Pontifical Academy of Sciences by Pope Pius XI.

Lemaître was president of the Academy from 1960 until his death.

1944 12 May, blown out of his 3rd floor apartment in occupied Louvain by a stray US Air Force bomb.

1958 Lemaître on the Big Bang's religious aspects:

“As far as I can see, such a theory remains entirely outside any metaphysical or religious question.

It leaves the materialist free to deny any transcendental Being. He may keep, for the bottom of space-time, the same attitude of mind he has been able to adopt for events occurring in non-singular places of space-time.

For the believer, it removes any attempt to familiarity with God, as were Laplace's chiquenaude or Jeans' finger. It is consonant with Isaias speaking of the Hidden god, hidden even in the beginning of creation.”

June 1958, XIth Solvay conference, quoted by A. Deprit in *The Big Bang and Georges Lemaître*, A. Berger ed. 1984, p 388.

1945-65 later work principally in cosmic rays, celestial mechanics, numerical analysis, and the development of scientific computing. He was the first (1962) to teach a course in ALGOL at Louvain.

—27 Mar 2002, E.S. Phinney, Caltech