Biographical Encyclopedia of Astronomers

Lemaître, Georges Henri-Joseph-Edouard

Born Charleroi, Belgium, 17 July 1894

Died in Charleroi, Belgium, on 20 June 1966

Belgian mathematician and theoretical cosmologist Georges Lemaître was the first to recognize that several things now taken to be important and obvious must be true about a general-relativistic universe (including the fact that it must expand). He was the son of Joseph Lemaître and Marguerite Lannoy and received his basic education at a Jesuit school in Louvain, Belgium. He enrolled in 1911 as an engineering student at the city's Catholic University, but with the outbreak of World War I, he was called to service as an artillery officer, for which he was decorated. Returning to Louvain, Lemaître received a first degree in mathematics and physics in 1920, then enrolled in the Malines seminary. He was ordained a priest in 1923 and was thereafter often referred to as Abbé Lemaître. Following his 1936 election to the Pontifical Academy of Sciences, he was addressed as Monseigneur

Lemaître spent the year 1923/1924 at Cambridge, England, studying solar physics and other topics with Arthur Eddington, and the years 1924-1926 in the United States, traveling widely, but primarily at Harvard University and the Massachusetts Institute of Technology [MIT]. His Ph.D. dissertation, awarded for the degree at Louvain in 1927, was partially prepared at MIT. It included early forms of a number of the ideas in relativity and cosmology that he

published over the next decade. Lemaître was appointed to a professorship at Louvain and remained there for the rest of his career, keeping some work in physics and astronomy alive during the very difficult years of World War II, when the staff was sometimes reduced to starvation wages. From the mid-1930s onward, he remained an authority on cosmology, but focused increasingly on topics like celestial mechanics and the motion of charged particles in the magnetic fields of the Earth and galaxy. These problems could be solved only by numerical methods, and Lemaître and his students did pioneering work in the exploitation of electronic computers and in setting up a computer laboratory in Louvain.

Lemaître scored a large number of firsts in relativity and cosmology between 1927 and 1934

(1) He recognized that what is now called the Schwarzschild radius or horizon (for Karl Schwarzschild) at $R = 2GM/c^2$ is not a real singularity, so that physical objects can exist inside and outside of it. His thesis included a version of what is now called the Tolman-Oppenheimer-Volkoff equation of state, which permits calculating the structure of such objects.

(2) He demonstrated that the static universe of Albert Einstein is unstable and will eventually begin a runaway expansion or contraction. At various times, he supposed that the initial state of the Universe was close to this static model; at other times, he contemplated many billions of years of alternating expansion and contraction, with us living in an expansion epoch extending for the past nine billion years or so.

(3) He wrote down the equations describing expanding space-time, in somewhat the same form as Alexander Friedmann, but also recognized that these equations could pertain to the real, physical Universe.

(4) He incorporated the redshifts measured by Vesto Slipher into these equations and so found a value of 600 km/s/Mpc in 1927 for what is now called the Hubble constant. Edwin Hubble's own, first, 1929 value for this was about 500 km/s/Mpc, and modern ones are in the range of 55–70 km/s/Mpc.

(5) He pioneered the idea that physical conditions in the early Universe must have been very different, suggesting a cosmic egg or primordial atom, with a mass equal to the total mass of the Universe as then understood (enough to make a few billion galaxies of a few billion stars each) and density equal to that of an atomic nucleus, hence a "primordial atom." It would have had a radius only about 30 times that of the Sun

(6) He was the first to show that Einstein's cosmological constant had a physical interpretation as a vacuum energy density that would exert negative pressure, and he held onto the idea that this was likely to be important in the real universe when Einstein and nearly everybody else abandoned the idea of a cosmological constant after 1929. It is part of modern cosmology, including Lemaître's negative-pressure interpretation.

Lemaître, in collaboration with Mexican physicist Manuel Vallarta, had suggested that cosmic rays (very high energy particles that pervade the galaxy) might be remnants of the primordial atom. It is now thought that they are largely accelerated by supernovae and their remnants. But Lemaître lived to hear from his successor at Louvain about the discovery of the 2.7 K cosmic microwave background radiation, which really is such a relic

Lemaître received the prestigious Belgian Prix Franqui and was the first Eddington Medalist of the Royal Astronomical Society (London) in 1951. He served as president of the Pontifical Academy of Sciences from 1960 to 1966.

As a priest and cosmologist, Lemaître was very aware of the problematic relationship between the Christian dogma of a world created by God and the scientific theory of a universe starting in a Big Bang. However, contrary to some other cosmologists (as well as theologians), he was careful not to confuse science and theology and not to use one of the fields as legitimization for the other. Lemaître believed that science and theology were separate fields and that cosmology neither confirmed nor refuted the Christian notion of a world created by God. He made this clear in his address to the 1958 Solvay meeting, where he pointed out that theoretical cosmology "remains entirely outside any metaphysical or religious question."

Helge Kragh

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