Our Universe is 11 billion years old

Introduction and Relevance

In most publications, the universe is about 13.8 billion years old. The published age is based on a difficult to establish constant: the Hubble constant “H”. Most cosmologists estimate the Hubble constant “H” to be in the range from 68 to 80, averaged about 71 [km/s/Mpc]. This leads to an age of 13.8 billon years.

The determination of the Hubble constant “H” depends on the chosen cosmological model and on the measured observations. The above values come from the most popular Lambda-CDM model, and the measurements come from WMAP, the Planck mission, and a spectroscopic survey in 2016, which came to an estimate of only 68 [km/s/Mpc]. It would mean an older age of 14.5 billion years.

Over time, the Hubble constant “H” has come down from 558 (published by Hubble and Humason in 1931) to 68 (spectroscopic survey in 2016). This change in the determination of the Hubble constant means an age change of the universe from less than 2 billion years (in 1931) to more than 14 billion years (in 1916). Hubble and Humason used the wrong type of Cepheid star to determine the distance to galaxies, as we know now. The error of Hubble and Humason demonstrates how difficult it is to establish the Hubble constant in the first place.

The authors of this article have taken a different approach, which is consistent with Noether’s theorem and with the comoving coordinates of Robertson and Walker. As a consequence, the deceleration of massive objects within the universe amounts to c.H [m/s^2]. Since we know the speed of light “c” accurately, we can calculate the Hubble constant “H” from this measurement. The outcome of the only measurement we have (also described in this article), comes to a Hubble constant of 90 [km/s/Mpc]. When you take this Hubble constant, the age of the universe is about 11 billion years old (based on t = 1/ H). There is even more to it: based on Noether’s theorem and the comoving coordinates of Robertson and Walker, future observers will measure the same time!

Noether’s theorem and energy conservation

Emmy Noether published her theorem in 1918, but was largely ignored. The essence of her theorem is simple and brilliant at the same time. Her theorem in essence goes as follows: In order to prove momentum conservation, the reference frame used must be the same everywhere (homogenous) and the same in all directions (isotropic); in order to prove energy conservation, the laws of nature and the constants of nature must be invariant to time (stay the same).

In other words, the Hubble constant “H” must stay the same over time if energy conservation needs to be proven within the universal reference frame. The authors base their model of the universe on Noether’s theorem, ensuring energy and momentum conservation of the universe. It results in a surprising outcome. The strange thing is that the universe must be about 11 billion years old now, but the universe had this same age billions of years ago too! This seems to be a paradox: how can the universe remain 11 billion years old over the past, present, and future?

This is where the comoving coordinates of Robertson and Walker come in. The authors will argue that 5.5 billion years ago on our clock (halfway the Big Bang), the clock had a unit second that was half as long as our current unit second is. Intelligent creatures that may have lived 5.5 billion years ago on our clock, also considered the Big Bang at 11 billion year ago in their second that was half as much as ours. In other words, any universal observer in the cosmic past, present, and future will see the Big Bang as 11 billion years ago. We must conclude that the unit second gets longer over cosmic time.

Robertson and Walker's comoving coordinates

To cope with an expanding universe, Robertson and Walker had a brilliant idea in 1936: let the coordinate distances between galaxies remain the same, while the unit meter expands over cosmic time: comoving coordinates. In this way, the distance between galaxies without a speed relative to the Cosmic Microwave Background Radiation (CMBR), remains the same in coordinates and can be recorded for history, unhindered by an expanding universe.

The universal expansion in comoving coordinates is thus an expansion of the unit meter. At the Big Bang the unit meter was zero, while the unit meter 5.5 billion years ago was half of our current unit meter. According to Noether's theorem, the speed of light "c" has to remain the same over time to prove energy conservation. Consequently, the unit second must expand equally over cosmic time, assuming the amount of universal energy is conserved. So the unit meter and second were 5.5 billion years ago just half as long as the unit meter and second are now.

A smaller unit second means a faster clock. Time is measured on a (cesium) clock. In other words, a hypothetical cesium clock of the past was ticking much faster than ours. Close to the Big Bang (Hubble Horizon) the units meter and second must have been very small relative to our current units meter and second. The very small unit second is confirmed by the "cosmic inflation era", determined by the physicists Alan Guth of M.I.T., Andrei Linde of Stanford, and Paul Steinhardt of Princeton, for which they shared the prestigious Dirac Prize. However, the authors do not limit the cosmic inflation to a limited era, but extend the idea to all times: eternal cosmic inflation!

Eternal cosmic inflation and star formation

According to the authors, the eternal cosmic inflation amounts to cosmic redshift plus one. Redshift "z" is the relative shift in the absorption lines of hydrogen and helium compared to a source on earth, to a longer wavelength. The Hubble Space Telescope can measure dwarf galaxies in deep space with a redshift between seven and eleven. According to the authors, the cosmic inflation is eight to twelve (z + 1). The (hypothetical) cesium clocks at those dwarf galaxies thus tick eight to twelve times faster. Since the cesium clock is representative of the progress of physics, star formation in those dwarf galaxies is thus observed *about ten times faster* than in galaxies close by.

This is what ESA/NASA reported at "Hubble finds hundreds of young galaxies in the early Universe" at: www.nasa.gov/mission_pages/hubble/hst_young_galaxies_200604_prt.htm: "The findings also show that these dwarf galaxies were producing stars at a furious rate, about ten times faster than is happening now in nearby galaxies", *proving a cosmic inflation of z + 1*! So what does that mean for the age of the universe?

Measuring the Hubble constant

The cosmological model of the authors is an extension to Einstein's first model: the 3-sphere. Einstein's universal 3-sphere is the three-dimensional surface of a four-dimensional hypersphere. This 3-sphere has a four-dimensional radius "R_4". Einstein abandoned this model when he saw the work of Hubble and Humason. However, he could have combined his model with the expansion of the universe by increasing the radius "r_4" with time "t" (for the experts: $r_4 = c.t / \pi$). This the model of the authors: a 3-sphere *space-time*.

Our model abides by the perfect cosmological principle, being homogenous and isotropic in both space and time and is based on both Noether's theorem and the comoving coordinates of Robertson and Walker. Apart from the eternal cosmic inflation, the model also predicts a deceleration of mass-particles of c.H. This deceleration was actually measured on the trajectories of the Pioneer 10 and 11, the so called "Pioneer 10&11 anomaly".

In our model, this is no anomaly but a logical consequence of an expanding universe and amounts to c.H. The measured deceleration equaled a tiny 8.74×10^{-10} [m/s^2]; divided by the speed of light "c" it results in a Hubble constant "H" of 2.92×10^{-18} [Hz] or 90 [km/s/Mpc]. This puts the age of our universe to about 11 billion years ($t = 1 / H$).

Age of the universe

The universe is to all universal observers in the past, present, and future about 11 billion years old, the unit second was smaller in the past and is larger in the future, eternal cosmic inflation. Assuming the cesium clock is indeed representative of the progress of physics, the universe is infinitely old in real terms (in physics). In other words, the universe is 11 billion years old in current units second, but infinitely old in terms of real physics. The Big Bang is a horizon in time, better named the "Hubble Horizon" in honor of Hubble's work in cosmology.

Conclusion

We live surrounded by space, but on the edge of time in our 3-sphere space-time model. Einstein and Minkowski would be pleased to see space and time to have merged into some kind of a union, Noether would be pleased to see her theorem being applied, while Robertson and Walker would see their comoving coordinates playing such a great role. We are pleased to see initial observations coincide with our model.

More information?

Our book "Repairing Robertson-Walker's Solution" (www.loop-doctor.nl) describes the repair of the R&W in full detail and will deliver even more unexpected results. We hope you get as many "aha" experiences as we did,

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