Monday, January 12, 2026

Hubble Trouble Presentation Jan 6 2026

Summary of key ideas

- A defining equation for the “Hubble constant” was introduced. By just knowing what each symbol stands for, we can gain some understanding what it all about
- $H(t) = (da(t)/dt)/a(t)$
- H(t) is commonly but inappropriately called the Hubble constant. The (t) means that this quantity is not actually a constant but depends on cosmological time after the big bang. The proper name for it is “Hubble - Lemaitre Parameter”.
- a(t) represents the scale factor of the observable universe. It compares the relative size of the observable universe in the past, now and in the future. Looking at the equation tells us when a(t) was smaller in the past, H(t) was bigger. It is a dimensionless quantity with no units.
- da/dt tells us how quickly the scale factor and space itself is expanding. It is sometimes called “the expansion rate”. Its units are 1/s. Therefore the units of H(t) are 1/s. You can think of it as the speed at which space is getting bigger. In 1929, Edwin Hubble used the largest telescope in the world at the time, the Hooker 100 inch at Mt Wilson, to show the universe is expanding and carrying far-away galaxies away from us. Ever since this time, astronomers have used improving technology, better telescopes both on the ground and in space, and better theoretical models to measure H(t), in particular H_0, the value of the Hubble parameter now. The more we know about H_0, the more we can explain and predict how the universe behaves. It was asserted that the quest to accurately measure H_0 is the story of modern cosmology
- Taking the reciprocal of H_0 gives us an approximation for the age of the universe. Try it yourself with today’s current Hubble parameter value of 70 km/s/Mpc or 2.2 X 10^-18 1/s. Your answer should be 14 billion years! Hint: 1 Mpc = 3.26 million light years. See Dr Burns worked calculation from his cosmology presentation one to check or Bruce can help you with if you want!

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- Because of the mathematical nature of the presentation, it was deemed prudent to stop before members might be overloaded! Some new ideas were quickly introduced without much explanation. **Future power point presentations will clarify such notions** as km/s/Mpc, Henrietta Leavitt Law of Period-Luminosity for Cepheid variables, parallax, parsec, cosmic distance ladder, standard candles, type 1a supernova, Hubble's law and the connection with scale factor , and recession speed from spectra.
- The best measurements of H_0 in the last five years were stated:

73.0 km/s/Mpc +/- 1.0 by Adam Reis of John Hopkins SH_0ES

70.4 km/s/Mpc +/- 2.1 by Wendy Freedman of Carnegie Chicago Hubble program

67.4 km/s/Mpc +/- 0.5 by observing baryon sound resonances in the early universe, Planck satellite data on cosmic microwave background

Note there is very little overlap in the uncertainties in the measurements! Astrophysicists are trying to resolve reasons why there is **real scientific disagreement** in the measurements. Is it systematic experimental errors, a need for better modelling of entities like dark matter or dark energy, or maybe new physics? This is called **Hubble Tension!**