Newsletter of *A Cosmology Group* - July 2020

ACG Editorial

$\mathcal{A}$ new measurement of the Hubble parameter (arXiv:2007.08991) adds a new twist to the "Hubble-tension saga." The measurement is based on the latest SDSS/eBOSS data release containing the spectroscopic redshift of 4 million galaxies up to $z = 3$, or an impressive lookback time of 11.5 billion years. (A review of the work is given in this 40-minute presentation on YouTube "Cosmology Talks" S9PL1Heis5E.)

An analysis of the spatial distribution of these galaxies, interpreted as Baryon Acoustic Oscillations (BAO), in combination with Big Bang Nucleosynthesis (BBN) gives a value $H_0 \simeq 68\,\mathrm{km/s/Mpc}$ that is in agreement with Cosmological Microwave Background (CMB) results, *without using any CMB information.*

With such a confirmation of the CMB model using data from the late universe, the Hubble-tension is dismissed as being a problem of fitting H_0 to observations using the assumptions of ΛCDM. The value $H_0 \simeq 68\,\mathrm{km/s/Mpc}$ is believed to be 'correct' and it is suggested that the problem can be resolved with 'new physics' in the late universe.

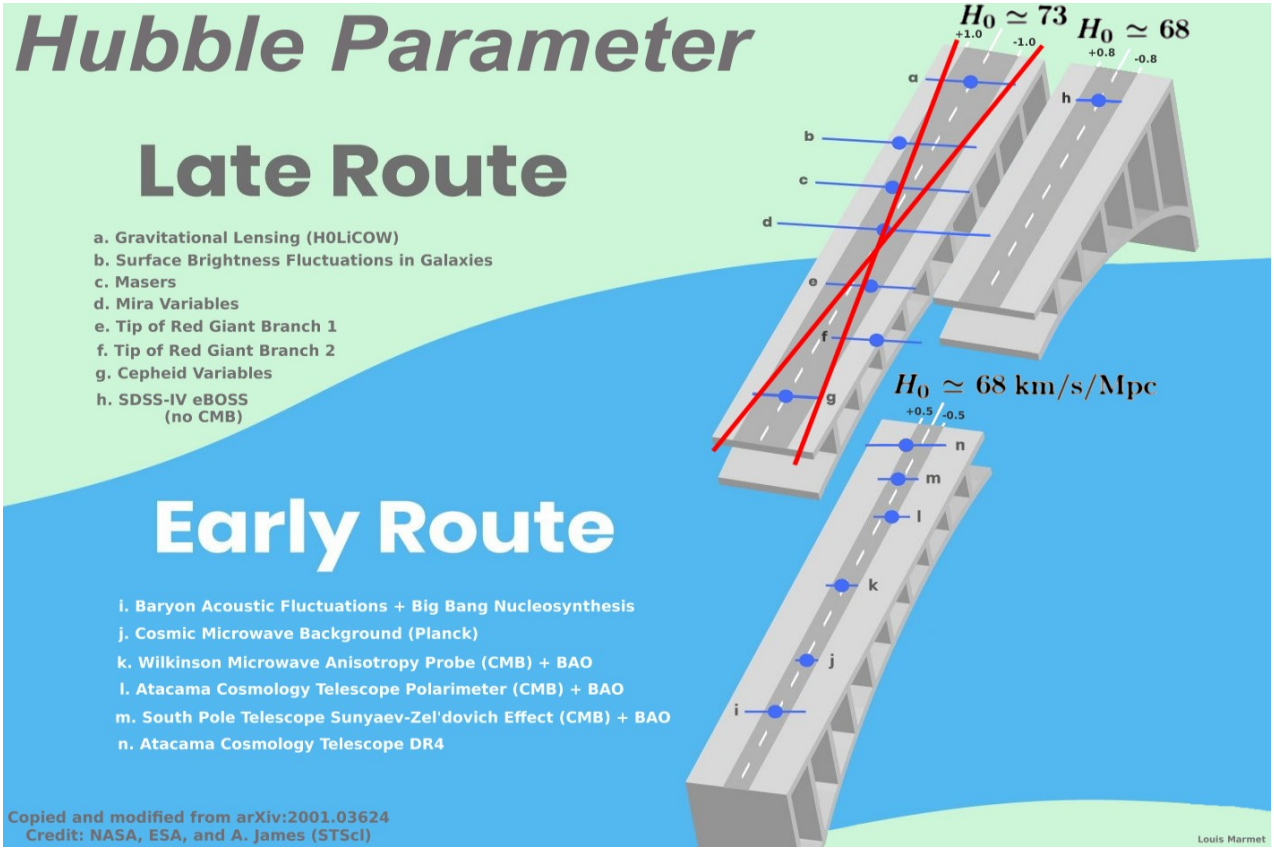

Figure 1. The bridge linking the late and early universe materializes in favour of CMB, BAO and BBN. The incomplete bridge at $H_0 \simeq 73\,km/s/Mpc$ is a problem with ΛCDM that could be resolved with 'new physics'.

However, a different point of view can give a totally different interpretation of the Hubble-tension. Distance ladder measurements of the Hubble parameter are all based on empirical observations. These are:

- the trivial observation that an object will appear dimmer and smaller if it is farther away,
- Henrietta Leavitt's observation that brighter Cepheid stars have longer oscillation periods,
- Edwin Hubble's observation that more distant galaxies have larger redshifts, and
- the observation that fewer details can be seen on the surface of more distant galaxies.

Taken together these empirical observations give $H_z \equiv H_0/c \simeq 0.245/\text{Gpc}$, *independently of any cosmology.*

On the other hand, the values of H_0 given by CMB, BAO and BBN are all derived from theoretical models. Although these appear 'independent' they all contain parameters that have been tweaked to fit within the larger picture of the Big Bang model. It is therefore not a surprise that they all agree with $\simeq 0.227/\text{Gpc}$.

With increasingly precise measurements, the Hubble-tension can be interpreted as the failure of the Big Bang model to explain empirical observations.

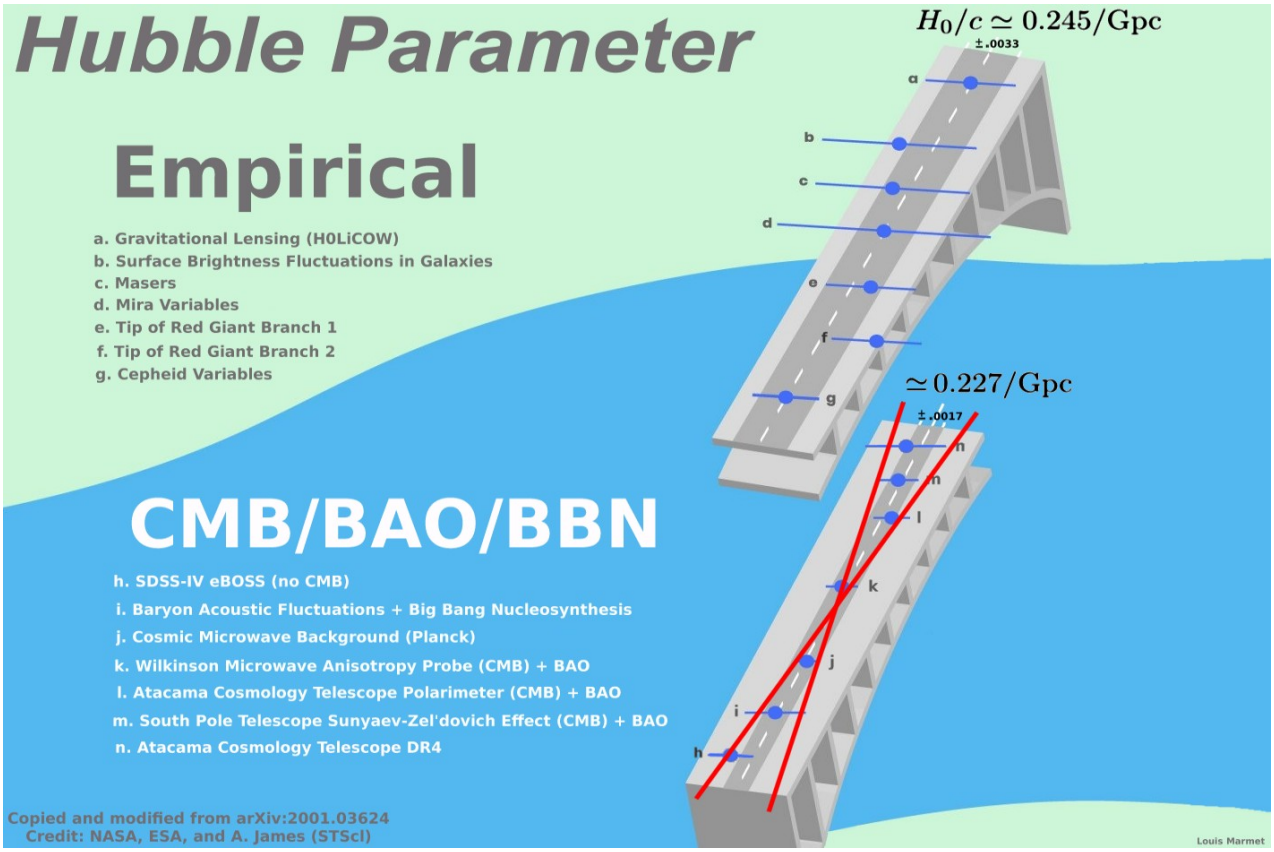

Figure 2. Empirical measurements of the Hubble parameter produce the very reliable value $H_z \simeq 0.245/Gpc$. This falsifies theoretical models of the early universe based on CMB, BAO and BBN.

Sadly, cosmologist Jean-Claude Pecker passed away in February. He writes at the end of a short analysis of his career: "*I had a keen interest in the cosmological debate during the 1950's, to which I have devoted numerous publications. I regularly expressed doubts about the standard model (called the "big bang") and suggested alternative, but partial, solutions. I still think that we are very far from a coherent solution of cosmological problems.*" [My translation]

As a supporter of the Open Letter, he would have been an asset to ACG. I invited him two years ago to join our Group, but he felt that his age (he was 95 years old then) would significantly limit his involvement with us.

In this Newsletter: another measurement of the Hubble parameter (not included in the graphs above), adding epicycles to get a relativistic MOND, Population III stars and the *sterile neutrino* can't be found, and a quasar so big and so young it challenges models of supermassive black hole growth.

Louis Marmet, July 30, 2020
redshift@cosmology.info
ACG - Leading Science into a New Cosmological Paradigm

Reviewed Publications[1]

- Redshift, Hubble parameter, Expansion

"**Using The Baryonic Tully-Fisher Relation to Measure H_0**"
J. Schombert, S. McGaugh, F. Lelli, The Astronomical Journal **160**, 2, p. 71, 2020
doi: 10.3847/1538-3881/ab9d88 and arXiv:2006.08615

The classic Tully-Fisher (TF) relation links the rotation velocity of a disk galaxy to its stellar mass and/or luminosity in a given photometric band. It is one of the strongest *empirical* correlations in extragalactic astronomy. Using 50 galaxies with accurate distances from Cepheids or tip magnitude of the red giant branch, we calibrate the baryonic TF relation (bTFR) on a scale independent of H_0. We then apply this calibrated bTFR to 95 independent galaxies from the SPARC sample, using CosmicFlows-3 velocities, to deduce the local value of H_0.

As expected, their result agrees with all other empirical measurements (see Fig. 2 above):

$$H_z \equiv H_0/c = 0.251 \pm 0.008\,(\text{stat}) \ \pm 0.005\,(\text{sys})\ \text{Gpc}^{-1}$$

The paper concludes: "the best techniques rely on as little modeling as possible."

- Large-Scale Structure

"**A new relativistic theory for Modified Newtonian Dynamics**"
C. Skordis, T. Złosnik, arXiv:2007.00082, 2020
arXiv:2007.00082

The authors build a relativistic version of MOND they call RelMOND and show that this mathematical model can fit cosmological observations. But RelMOND is a piecemeal construction built to fit five phenomenological facts: (i) it must return to GR when $\vec{\nabla}\Phi \gg a_0$ in quasistatic situations, (ii) reproduce the MOND law when $\vec{\nabla}\Phi \ll a_0$. It should also (iii) be in harmony with cosmological observations including the CMB and matter power spectra, (iv) reproduce the observed gravitational lensing of isolated objects without dark matter halos, and (v) propagate tensor mode gravitational waves at the speed of light.

According to Quanta Magazine's "An Alternative to Dark Matter Passes Critical Test", "constructing the new theory takes four new moving mathematical parts, while ΛCDM handles dark matter with just one."

This is not good news for MOND, as many more epicycles are being added to make it work.

"**An eV-scale sterile neutrino search using eight years of atmospheric muon neutrino data from the IceCube Neutrino Observatory**"
M. G. Aartsen, R. Abbasi, *et al.*, arXiv:2005.12942, 2020
arXiv:2005.12942

The results of a 3+1 sterile neutrino search using eight years of data from the IceCube Neutrino Observatory are presented. Neutrino events are analyzed in reconstructed energy-zenith space to test for signatures of a matter-

[1] Quoted text is adapted from the original articles: underlined text is my emphasis, *italicized text are my comments.*

enhanced oscillation that would occur given a sterile neutrino state with a mass-squared differences between $0.01\,\mathrm{eV}^2$ and $100\,\mathrm{eV}^2$. The best-fit point is found to be consistent with the no sterile neutrino hypothesis with a p-value of 8.0%. *Eight years of sterile data, no dark matter...*

- Old Systems

"**UV Spectral-Slopes at z = 6 − 9 in the Hubble Frontier Fields: Lack of Evidence for Unusual or Pop III Stellar Populations**"
R. Bhatawdekar, C.J. Conselice, Submitted to MNRAS, arXiv:2006.00013, 2020
arXiv:2006.00013

These results suggest that even with the deepest HST imaging possible, we are still not reaching the first stars and galaxies at $z \sim 9$. It is clear that galaxy and structure formation predates even this very early redshift, showing that many galaxies will be found at even higher redshifts. JWST will certainly provide a clearer picture of this when it examines galaxies at even higher z where ultimately Pop III stellar populations will be discovered.

"Hubble Makes Surprising Find in Early Universe," the surprise is that the HST doesn't see the first stars and galaxies, even only 500 million years after the Big Bang. A lack of evidence for the Big Bang itself?

"**Pōniuā'ena: A Luminous z=7.5 Quasar Hosting a 1.5 Billion Solar Mass Black Hole**"
J. Yang, F. Wang, X. Fan, *et al.*, The Astrophysical Journal Letters **897**, Number 1, p. L14, 2020
doi: 10.3847/2041-8213/ab9c26 and arXiv:2006.13452

We report the discovery of a luminous quasar, J1007+2115 at $z = 7.515$ ("Pōniuā'ena"), from our wide-field reionization-era quasar survey. J1007+2115 is the second quasar now known at $z > 7.5$, deep into the reionization epoch. The quasar is powered by a $(1.5\pm0.2)\times10^9\,\mathrm{M}_\odot$ supermassive black hole (SMBH). The SMBH in J1007+2115 is twice as massive as that in quasar J1342+0928 at $z = 7.54$, the current quasar redshift record holder. The existence of such a massive SMBH just 700 million years after the Big Bang significantly challenges models of the earliest SMBH growth. Model assumptions of Eddington-limited accretion and a radiative efficiency of 0.1 require a seed black hole of $\geq 10^4\,\mathrm{M}_\odot$ at $z = 30$. This requirement suggests either a massive black hole seed as a result of direct collapse or earlier periods of rapid black hole growth with hyper-Eddington accretion and/or a low radiative efficiency.

A Cosmology Group

A Cosmology Group draws its mandate from the *Open Letter to the Scientific Community* to engage scientists in an open exchange of ideas beyond the framework of a Big Bang cosmology. The *ACG Newsletter* highlights observational results that are anomalous in terms of the ΛCDM model and provides a critical examination[2] of the methods and investigations used in cosmology.

The *Newsletter* is published irregularly, editor's schedule permitting, and when interesting papers are available. ACG subscribers[3] receive notifications of *Newsletter* publications and a few additional announcements. You can subscribe to *ACG* by sending a request to `redshift@cosmology.info`.

If you would like to suggest a paper for review, please send a direct reference to `redshift@cosmology.info`. Published work in a refereed journal and with open access (e.g. a preprint on `arXiv` or `HAL`) is preferred. Current topics and research in cosmology will be discussed on the ACG YouTube Channel.

[2] When the thesis is supported by empirical evidence.
[3] ACG currently counts 69 members.