
The Milky Way Panorama Credit: ESO / S. Brunier

Newsletter of ***A Cosmology Group*** - December 2021

ACG Editorial

The *JW–Space–Telescope* has been launched successfully and enough fuel is left for more than ten years of observations, conditional on the successful deployment of its sunshield and proper operation of every component of this complex observatory.

Many ACG members have expressed hopes that the JWST will see mature-sized galaxies beyond 13.8 billion light-years and that it will mean the death of the Big Bang model – echoing hopes expressed 30 years ago when the *Hubble Space Telescope* started its observations. Yet, *in the paradigm of a non-expanding universe & exponential photon energy loss*, galaxies observed at $z > 2$ are already beyond 14 Gly and are as large as local galaxies.

These distant galaxies were observed three decades ago and despite new observations of galaxies up to $z = 11$ by the HST, the expected collapse of Big Bang cosmology did not occur. Because mainstream cosmologists have their heads chained to ΛCDM, they can only look at the wall of *the Big Bang paradigm* on which they see small shadows of redshifted galaxies that appear very young. Observations by the JWST won't dethrone the Big Bang model, for it would be too painful for cosmologists to admit they are very skilled at describing an illusion. Instead, they will be surprised and will struggle to invent "new physics" that explains what they perceive as galaxies that appeared so early in the newly born universe.

Before 2022 is over, the JWST may observe a galaxy as far as 37 Gly in a non-expanding universe ($z = 16$), but my take on this is that ΛCDM will not die until the redshift illusion is explained.

In this Newsletter: A mixed relativistic/tired-light model of the universe, a better way to measure the distance to SN Ia, BICEP fails again, a strange cloud, and a 57-page paper on the challenges for ΛCDM.

Best wishes for 2022!

Louis Marmet, December 30, 2021
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ACG - Leading Astronomy into a New Cosmological Paradigm

Reviewed Publications[1]

- Redshift, Hubble parameter, Expansion

"Static and Dynamic Components of the Redshift"
R.P. Gupta, International Journal of Astronomy and Astrophysics **8**(3) September 2018
doi: 10.4236/ijaa.2018.83016

We analyse the possibility that the observed cosmological redshift may be cumulatively due to the expansion of the universe and the tired-light phenomenon. Using this approach we have developed a hybrid model combining the Einstein de Sitter model and the tired-light model that yields a slightly better fit to Supernovae Ia redshift

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

data using one parameter than the standard ΛCDM model with two parameters. The hybrid model yields Hubble constant $H_0 = 69.1 \pm 0.5$ km/s/Mpc. The component of Hubble constant responsible for expansion of the universe is 40% of H_0 and for the tired-light is 60% of H_0. A lot less dark matter is needed to make up the critical density. In addition, the best data fit yields the cosmological constant density parameter $\Omega_\Lambda = 0$. The tired-light effect may thus be considered equivalent to the cosmological constant in the hybrid model.

Dark matter and dark energy disappear, but two epicycles are added! The cause of the tired-light phenomenon is described as a generic cosmic drag model.

"**The Twins Embedding of Type Ia Supernovae II: Improving Cosmological Distance Estimates**"
K. Boone, G. Aldering, P. Antilogus, *et al.*, ApJ **912** 71 (2021)
doi: 10.3847/1538-4357/abec3b and arXiv:2105.02204

We show how spectra of Type Ia supernovae (SNe Ia) at maximum light can be used to improve cosmological distance estimates. In a companion article, we used manifold learning to build a three-dimensional parameterization of the intrinsic diversity of SNe Ia at maximum light that we call the "Twins Embedding." In this article, we discuss how the Twins Embedding can be used to improve the standardization of SNe Ia. With a single spectrophotometrically calibrated spectrum near maximum light, we can standardize our sample of SNe Ia with an rms of 0.101 ± 0.007 mag. Our techniques can standardize the full range of SNe Ia, including those typically labeled as peculiar and often rejected from other analyses.

We find that traditional light-curve width + color standardization such as SALT2 is not sufficient. The Twins Embedding identifies a subset of SNe Ia, including, but not limited to, 91T-like SNe Ia whose SALT2 distance estimates are biased by 0.229 ± 0.045 mag. These biases in traditional standardization methods could significantly impact future cosmology analyses if not properly taken into account.

Would this important work confirm SN Ia light-curve dilation? I haven't been able to contact David Crawford for comments, but this approach seems to resolve the problems associated with the SALT2 technique.

- Microwave Background

"**A measurement of the scale of homogeneity in the Early Universe**"
B. Camacho-Quevedo E. Gaztañaga, arXiv:2106.14303 (2021)
arXiv:2106.14303

We present the first measurement of the homogeneity index, $\mathcal{H}$, a fractal or Hausdorff dimension of the early Universe from the Planck CMB temperature variations δT in the sky. This characterization of the isotropy scale is model-free and purely geometrical, independent of the amplitude of δT. We find evidence of homogeneity ($\mathcal{H} = 0$) for scales larger than $\theta_{\mathcal{H}} = 65.9 \pm 9.2°$ on the CMB sky. This finding is at odds with the ΛCDM prediction, which assumes a scale invariant infinite universe. Such anomaly is consistent with the well known low quadrupole amplitude in the angular δT spectrum, but quantified in a direct and model independent way. This analysis is validated with an independent theoretical prediction of the covariance matrix based purely on data.

"**Improved Constraints on Primordial Gravitational Waves using Planck, WMAP, and BICEP/Keck Observations through the 2018 Observing Season**"
P.A.R. Ade *et al.* (BICEP/Keck Collaboration), Phys. Rev. Lett. **127** 151301 (4 October 2021)
doi: 10.1103/PhysRevLett.127.151301 and arXiv:2110.00483

Physicists still don't understand what happened in the instant after the Big Bang.[2] Ancient ripples in spacetime should have left a particular imprint on the sky, but searches have repeatedly come up short. If an inflating universe reverberated with gravitational waves – as most cosmologists still fully expect it did – it must have done

[2] "A key part of the Big Bang remains troublingly elusive", https://www.popsci.com/science/big-bang-theory-in-question/

so in a rather subtle way. *There was a Big Bang but it was quiet, so no gravitational waves are detected... Ironically, results from BICEP don't have enough muscle power to support the Big Bang model.*

- Nucleosynthesis

"**Earth factories: Creation of the elements from nuclear transmutation in Earth's lower mantle**"
M. Fukuhara, A. Yoshino, and N. Fujima, AIP Advances **11**, 105113 (2021)
doi: 10.1063/5.0061584

The Big Bang theory proposes that hydrogen, helium, and trace amounts of lithium were the only elements in existence when the universe first formed. Hotter and heavier stars then transmuted lighter elements into heavier elements. High mass star cores must collapse, resulting in supernovae. When supernovae explode, many neutrons passing through the outer regions of the stars collide with elements lighter than iron, resulting in elements heavier than iron. This theory is the basis of convention for the formation of all elements in our universe. It is generally believed that the terrestrial planets have formed by accretion of solid materials condensed from the solar nebula $\sim 4.5 \times 10^9$ years ago. As a result, whole-Earth geochemical models, which are primarily based on cosmochemical abundances, provide specific limits on the possible chemical composition of the Earth's deep interior.

In disagreement with this theory, Fukuhara proposed a model for the formation of nitrogen, oxygen, and water using circumstantial evidence based on the history of the Earth's atmosphere. Here, we propose that the formation of 25 elements with smaller atomic numbers than iron resulted from an endothermic nuclear transformation of two nuclei confined in the natural compound lattice core of the Earth's lower mantle at high temperatures and pressures. Our study suggests that the Earth itself has been able to create lighter elements by nuclear transmutation.

- Galaxy and Large-Scale Structure Formation

"**On the absence of backsplash analogues to NGC 3109 in the ΛCDM framework**"
I. Banik, M. Haslbauer, M.S. Pawlowski, *et al.*, MNRAS **503**, 6170-6186 (2021)
doi: 10.1093/mnras/stab751 and arXiv:2105.04575

The dwarf galaxy NGC 3109 is receding 105 km/s faster than expected in a ΛCDM timing argument analysis of the Local Group and external galaxy groups within 8 Mpc. If this few-body model accurately represents long-range interactions in ΛCDM, this high velocity suggests that NGC 3109 is a backsplash galaxy that was once within the virial radius of the Milky Way and was slingshot out of it. We find that backsplashers as massive and distant as NGC 3109 are extremely rare, with none having also gained energy during the interaction with their previous host. Since we identified 13225 host galaxies similar to the Milky Way or M31, we conclude that postulating NGC 3109 is a backsplash galaxy causes $> 3.96\sigma$ tension with the expected distribution of backsplashers in ΛCDM. We show that the dark matter only version of TNG300 yields much the same result, demonstrating its robustness to how the baryonic physics is modelled. We discuss a possible alternative scenario for NGC 3109 and the Local Group satellite planes in the context of MOND, where the Milky Way and M31 had a past close flyby 7-10 Gyr ago.

"**An Hα/X-ray orphan cloud as a signpost of intracluster medium clumping**"
C. Ge, R. Luo, M. Sun, *et al.*, MNRAS **505**, 4702 (2021)
doi: 10.1093/mnras/stab1569 and arXiv:2104.03993

A scientifically mysterious, isolated cloud bigger than the Milky Way has been found in a "no-man's land" for galaxies. The cloud was discovered in a cluster of galaxies bound together with tenuous hot gas with temperatures of about 100 MK existing between them, says Dr. Sun, associate professor of physics at UAH.

"However, the cloud is not associated with any galaxy and is in a 'no-galaxy's land,' " the cloud most likely originated from a large, unknown galaxy in the cluster, and survived for hundreds of millions of years after removal from its host galaxy. "This surprising longevity is poorly understood but may have something to do with the magnetic field in the cloud".

(Ref. 'Lonely cloud' bigger than Milky Way found in a galaxy 'no-man's land', https://phys.org/news/2021-07-lonely-cloud-bigger-milky-galaxy.html)

"The local environment of flat galaxies"
Suman Sarkar, A. Banerjee, D. Makarov, arXiv:2109.13526 (Sep. 2021)
arXiv:2109.13526

The existence of flat or bulgeless galaxies poses a challenge to the hierarchical structure formation scenario advocated by modern cosmology. We determine the geometrical environment of a sample of 315 flat galaxies and 15,622 non-flat galaxies using 'local dimension' D, which, on a given length scale, quantifies the dimension of the cosmic structure in which a galaxy is embedded. For galaxies residing in filaments, nodes and sheets, $D \sim 1$, ~ 1.5, and ~ 2 respectively; $D \sim 3$ represents field galaxies. We find that the median values of D for the flat and the non-flat galaxies are 2.2 and 1.8 respectively, implying that flat galaxies are located in a relatively sparser environment compared to non-flat galaxies.

A large fraction of the at galaxies is found to have local density way below the mean density and have a local dimension of $D > 2$ which implies that these galaxies grow in isolation and rarely experience a major merger in their lifetime.

- Cosmology

"Challenges for ΛCDM: An update"
L. Perivolaropoulos and F. Skara, arXiv:2105.05208 (May 2021)
arXiv:2105.05208

A number of challenges of the standard ΛCDM model has been emerging during the past few years as the accuracy of cosmological observations improves. We discuss in a unified manner many existing signals in cosmological and astrophysical data that appear to be in some tension ($> 2\sigma$) with the standard ΛCDM model as defined by the Planck18 parameter values. We discuss such signals as the Hubble tension, the growth tension and the lensing amplitude AL anomaly, cosmic dipoles, CMB asymmetries, BAO Lyα tension, age of the Universe issues, the Lithium problem, small scale curiosities like the core-cusp and missing satellite problems, quasars Hubble diagram, oscillating short range gravity signals etc.

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 Standard Cosmology through a critical examination[3] of the methods and investigations of cosmology. The *ACG Newsletter* highlights observational results that are anomalous in terms of the Big Bang paradigm.

The *Newsletter* is published irregularly, editor's schedule permitting, and when interesting papers are available. ACG subscribers[4] 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.

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[3] When the thesis is supported by empirical evidence.
[4] ACG currently has 68 members.