



The Milky Way Panorama Credit: ESO / S. Brunier

Newsletter of A Cosmology Group - November 2020

ACG Editorial

If ACG is to start making progress toward its goals, a systematic examination of Λ CDM cosmology is absolutely necessary. One way this can be achieved is by studying the structure of the Big Bang model and identifying its weak points.

Its structure is built on a number of inferences listed on the [ACG webpage \(cosmology.info/index.html\)](http://cosmology.info/index.html). Its weak points will be identified using the papers reviewed in the ACG Newsletters. Where relevant, the inference that is challenged by an anomalous observation will be identified. Starting with this Newsletter, a compilation of inferences under suspicion will be given at the end of the editorial.

In this Newsletter: an adjustable parameter to save nucleosynthesis, the S_8 tension is getting worse, less probability that dark matter exists, a young galaxy in the old universe, more challenges to our understanding of the universe, and Einstein's abandoned steady-state model of the universe.

Suspicion level of Λ CDM inferences (from the publications reviewed in this Newsletter):

- | | |
|--|--|
| 8 × D: "GR applied to the universe," | 8 × F: "All galaxies follow the Hubble law," |
| 8 × G: "All universe expansion: Big Bang," | 5 × I: "Big Bang nucleosynthesis," |
| 5 × K: "Dark matter," | 4 × E: "Velocity and galactic recession," |
| 4 × J: "Galaxy and structure formation," | 2 × H: "CMB from the distant hot state," |
| 1 × M: "Dark energy." | |

Louis Marmet, November 28, 2020

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ACG - Leading Science into a New Cosmological Paradigm

Reviewed Publications¹



In the original cartoon Oliver says "Dark matter explains everything" – a forgivable error by Berkeley Breathed. However, everything is explained by any kind of *invisible fabulousness*. *Challenged Λ CDM inference: M.*

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

- Nucleosynthesis

“Big bang nucleosynthesis with stable ^8Be and the primordial lithium problem”

R.T. Scherrer, R.J. Scherrer, Phys. Rev. D 96, 083507, 2017

doi: [10.1103/PhysRevD.96.083507](https://doi.org/10.1103/PhysRevD.96.083507) and [arXiv:1707.03852](https://arxiv.org/abs/1707.03852)

Any change in the fundamental constants of nature could significantly alter Big bang nucleosynthesis (BBN). A particularly interesting possibility is that an appropriate change in the constants of nature might allow for the stability of ^8Be , which normally spontaneously fissions into $^4\text{He} + ^4\text{He}$ with a very short lifetime. Hypothetical changes in the constants of nature have [also] been invoked previously as a possible solution of the lithium problem.

We define the mass difference between a single ^8Be nucleus and two ^4He nuclei to be $B_8 = 2M(^4\text{He}) - M(^8\text{Be})$. Present-day measurements give $B_8 = 0.092$ MeV. However, if the constants of nature during BBN were sufficiently different so as to make B_8 positive, then ^8Be would be stable, significantly altering the reaction network.

B_8 is yet another adjustable parameter added to the theory. Obviously, it is possible to solve the lithium problem by fudging the constants of nature. Challenged ΛCDM inference I deduced from: D, F, G.

“Big-Bang Nucleosynthesis and Primordial Lithium Abundance Problem”

V. Singh, J. Lahiri, D. Bhowmick, D.N. Basu, Journal of Experimental and Theoretical Physics 128, 707712, 2019

doi: [10.1134/S1063776119040058](https://doi.org/10.1134/S1063776119040058)

Prediction of the primordial abundances of elements in the big-bang nucleosynthesis is one of the three strong evidences for the big bang model. There remains a yet-unexplained discrepancy of ^7Li abundance higher by a factor of ~ 3 when calculated theoretically. In the present work we have incorporated the most recent values of neutron lifetime and the baryon-to-photon ratio and further modified $^3\text{He}(^4\text{He}, \gamma)^7\text{Be}$ reaction rate which is used directly for estimating the formation of ^7Li as a result of $\beta+$ decay as well as the reaction rates for $t(^4\text{He}, \gamma)^7\text{Li}$ and $d(^4\text{He}, \gamma)^6\text{Li}$. We find that these modifications reduce the theoretically calculated abundance of ^7Li by $\sim 12\%$.

12% relative to a factor of $\sim 3 = 4\%$, I say that's a fail. Prediction of the primordial abundances of elements still gives strong evidence against the Big Bang model. Challenged ΛCDM inference I deduced from: D, F, G.

“An extremely metal-deficient globular cluster in the Andromeda Galaxy”

S.S. Larsen, A.J. Romanowsky, *et al.*, Science 370, Issue 6519, pp. 970-973, 20 Nov 2020

doi: [10.1126/science.abb1970](https://doi.org/10.1126/science.abb1970) and [arXiv:2010.07395](https://arxiv.org/abs/2010.07395)

We report a massive globular cluster (GC) in the Andromeda Galaxy that is extremely depleted in heavy elements. Its iron abundance is about 800 times lower than that of the Sun, and about three times lower than in the most iron-poor GCs previously known. It is also strongly depleted in magnesium. These measurements challenge the notion of a metallicity floor for GCs and theoretical expectations that massive GCs could not have formed at such low metallicities. *Challenged ΛCDM inferences I, J deduced from: D, E, F, G.*

- Large-Scale Structure

“Strong constraints on thermal relic dark matter from Fermi-LAT observations of the Galactic Center”

K.N. Abazajian, S. Horiuchi, *et al.*, Phys. Rev. D 102, 043012, 2020

doi: [10.1103/PhysRevD.102.043012](https://doi.org/10.1103/PhysRevD.102.043012) and [arXiv:2003.10416](https://arxiv.org/abs/2003.10416)

The detection more than a decade ago by the Fermi Gamma Ray Space Telescope of an excess of high-energy radiation in the center of the Milky Way convinced some physicists that they were seeing evidence of the annihilation of dark matter particles, but a team led by researchers at the University of California, Irvine has ruled out that interpretation. (From: phys.org/news/2020-08-dark-destruction-extra-galaxy-center.html)

Another possibility is eliminated: not much chance left for dark matter. Challenged ΛCDM inference: K.

- Old Systems

“Extremely Metal-poor Representatives Explored by the Subaru Survey (EMPRESS). I. A Successful Machine-learning Selection of Metal-poor Galaxies and the Discovery of a Galaxy with $M_* < 10^6 M_\odot$ and $0.016 Z_\odot$ ”

T. Kojima, M. Ouchi, M. Rauch, *et al.*, The Astrophysical Journal, Volume 898, Number 2, 2020
doi: [10.3847/1538-4357/aba047](https://doi.org/10.3847/1538-4357/aba047) and [arXiv:1910.08559](https://arxiv.org/abs/1910.08559)

Astronomers have discovered a nearby galaxy that has broken the record for having the lowest level of oxygen ever seen. The researchers measured its oxygen abundance at only 1.6 percent that of the Sun, suggesting the galaxy, named HSC J1631+4426, only recently started making stars.

Instead of an old galaxy in the young universe, this is a surprisingly young galaxy in the old universe. It is possible to find large quantities of matter that are metal-poor in the local universe.

Challenged Λ CDM inference J deduced from: D, E, F, G.

“A dynamically cold disk galaxy in the early Universe”

F. Rizzo, S. Vegetti, *et al.*, Nature 584, 201204, 2020
doi: [10.1038/s41586-020-2572-6](https://doi.org/10.1038/s41586-020-2572-6) and [eso2013a.pdf](#)

Astronomers using the Atacama Large Millimeter/submillimeter Array, in which the European Southern Observatory is a partner, have revealed an extremely distant and therefore very young galaxy that looks surprisingly like our Milky Way. The galaxy is dynamically cold, but a highly starforming, rotating disk in a galaxy at redshift $z = 4.26$, when the Universe was just 1.4 billion years old. Galaxy SPTS J0418394751.9 is also surprisingly unchaotic, contradicting theories that all galaxies in the early Universe were turbulent and unstable. This unexpected discovery challenges our understanding of how galaxies form, giving new insights into the past of our Universe. (From: www.eso.org/public/news/eso2013/) *Challenged inferences I, J deduced from: D, E, F, G.*

“Discovery of a galaxy cluster with a violently starbursting core at $z=2.506$ ”

T. Wang, D. Elbaz, *et al.*, The Astrophysical Journal 828, Number 1, 2016
doi: [10.3847/0004-637X/828/1/56](https://doi.org/10.3847/0004-637X/828/1/56) and [arXiv:1604.07404](https://arxiv.org/abs/1604.07404)

We report the discovery of a remarkable concentration of massive galaxies with extended X-ray emission at $z_{spec} = 2.506$, which contains 11 massive ($M_\odot \geq 10^{11} m_\odot$) galaxies in the central 80kpc region (11.6σ overdensity). Unlike other clusters discovered so far, this structure is dominated by star-forming galaxies in the core with only 2 out of the 11 massive galaxies classified as quiescent. The star formation rate in the 80kpc core reaches $\sim 3400 M_\odot/\text{yr}$ with a gas depletion time of ~ 200 Myr, suggesting that we caught this cluster in rapid build-up of a dense core. [...] The large integrated stellar mass at such high redshift challenges our understanding of massive cluster formation.

Challenged Λ CDM inference J deduced from: D, E, F, G.

- Cosmology

“KiDS-1000 cosmology: Cosmic shear constraints and comparison between two point statistics”

M. Asgari, C.-A. Lin, B. Joachimi, *et al.*, A&A, Forthcoming article 2020+
doi: [10.1051/0004-6361/202039070](https://doi.org/10.1051/0004-6361/202039070) and [arXiv:2007.15633](https://arxiv.org/abs/2007.15633)

We present cosmological constraints from a cosmic shear analysis of the fourth data release of the Kilo-Degree Survey (KiDS-1000), doubling the survey area with nine-band optical and near-infrared photometry with respect to previous KiDS analyses. Adopting a spatially flat Λ CDM model, and due to the tighter constraints of KiDS-1000, the tension in Σ_8 with Planck Collaboration has increased to 3.4σ , i.e. a 7 in 10000 chance of a mere statistical fluctuation between the low and high-redshift probes assuming Gaussian distributions (3σ in the less constrained S_8).

Another tension of concordance cosmology... Challenged Λ CDM inferences H, I deduced from: D, E, F, G.

“Einstein’s steady-state theory: an abandoned model of the cosmos”

C. ORaifeartaigh, B. McCann, *et al.*, Eur. Phys. J. H 39, 353-367, 2014

doi: [10.1140/epjh/e2014-50011-x](https://doi.org/10.1140/epjh/e2014-50011-x) and [arXiv:1402.0132](https://arxiv.org/abs/1402.0132)

Of historical interest We present a translation and analysis of an unpublished manuscript by Albert Einstein in which he attempted to construct a ‘steady-state’ model of the universe. The manuscript, which appears to have been written in early 1931, demonstrates that Einstein once explored a cosmic model in which the mean density of matter in an expanding universe is maintained constant by the continuous formation of matter from empty space. This model anticipates the later steady-state cosmology of Hoyle, Bondi and Gold in some ways. We find that Einstein’s steady-state model contains a fundamental flaw and suggest that it was abandoned for this reason. The manuscript is of historical interest because it reveals that Einstein debated between steady-state and evolving models of the cosmos decades before a similar debate took place in the cosmological community.

“The Universe at large: The Department of celestial magnetism. Part 2.

The larger the magnetic field, the stronger our ignorance.”

Virginia Trimble, SLAC Beam Line 26N1, p. 38, 1996

inspirehep.net/literature/434726 and www.slac.stanford.edu/pubs/beamline/26/1/26-1-trimble.pdf

An entertaining article about magnetic fields and the energy equipartition in the interstellar medium.

It greatly reduces the effort of remembering [...] that the energy density (or pressure) in magnetic field, cosmic rays, turbulent motion, and thermal kinetic energy are all about the same through much of the interstellar medium – about 1 eV/cm³. This is arguably not a coincidence, but rather the result of cosmic rays tugging on field lines tugging on clouds which collide and heat each other [...] I have never been sure whether it is a coincidence that the energy density of starlight near us is also about 1 eV/cm³. The present 2.7K cosmic microwave background radiation also contributes a bit less than 1 eV/cm³, everywhere, which is surely a coincidence. Isn’t it??

No, it’s not a coincidence! (See Assis and Neves, “History of the 2.7 K Temperature...” Apeiron 2, 1995)

We have an official paradigm* – *Within living memory, practicing scientists (won’t we ever learn how?) used “paradigm” the way Kuhn had meant it, to mean an experiment that set an example for the way things ought to be done. Its current usage comes closer to the “best buy model” of Consumer Reports.

Challenged Λ CDM inference H deduced from: D, F, G.

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 Λ CDM model and provides a critical examination² of the methods and investigations used in cosmology.

The *Newsletter* is published irregularly, editor’s schedule permitting, and when interesting papers are available. ACG subscribers³ 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](https://arxiv.org/) or [HAL](https://hal.archives-ouvertes.fr/)) is preferred. Current topics and research in cosmology will be discussed on the [ACG YouTube Channel](#).

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²When the thesis is supported by empirical evidence.

³ACG currently has 80 members.