The Milky Way Panorama Credit: ESO / S. Brunier

Newsletter of *A Cosmology Group* - April 2019

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[1] 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[2] receive notifications of *Newsletter* publications. You can subscribe to *ACG Notifications* either by sending a request to `redshift@cosmology.info`, by joining the ACG Forum 'Alt Cosmology' on *Yahoo! Groups* at `groups.yahoo.com/neo/groups/altcosmology/info#`, or by following `@CosmologyGroup` on *Twitter*.

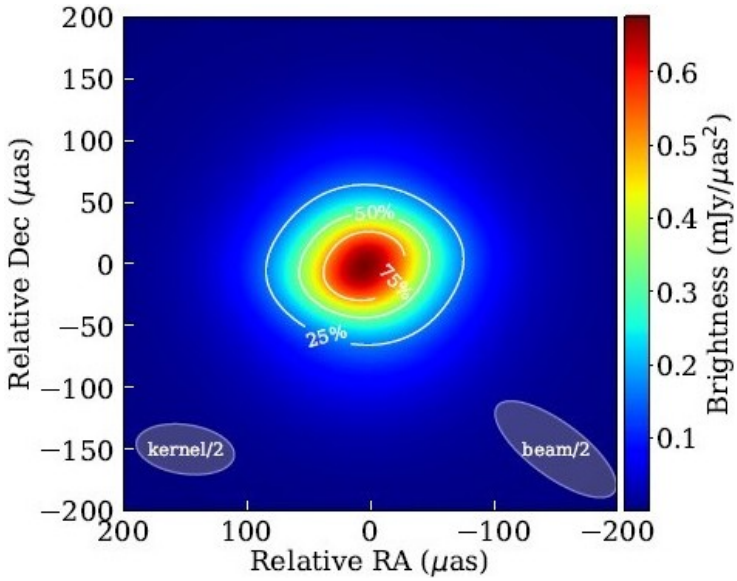
If you would like to suggest a paper for review, please send a direct reference to `redshift@cosmology.info`. Published work in a refereed journal and with open access (e.g. a preprint on `arXiv` or `HAL`) is preferred. Summaries of new cosmologies are collected on A Cosmology Model or can be presented at the next ACG Conference.

ACG Editorial

While we ponder the implications black holes have on cosmology, I am copying a less publicized image of a very dense object observed by ALMA at the center of our galaxy. Sgr A*: adapted from arXiv:1901.06226.

Regards,

Louis Marmet, April 16, 2019
redshift@cosmology.info



"The essential result of this investigation is a clear understanding as to why the "Schwarzschild singularities" do not exist in physical reality. Although the theory given here treats only clusters whose particles move along circular paths it does not seem to be subject to reasonable doubt that more general cases will have analogous results. The "Schwarzschild singularity" does not appear for the reason that matter cannot be concentrated arbitrarily. And this is due to the fact that otherwise the constituting particles would reach the velocity of light." Albert Einstein, Annals of Mathematics, Vol. 40, No. 4, October 1939.

"The absence of event horizons means that there are no black holes - in the sense of regimes from which light can't escape to infinity." Stephen Hawking arXiv:1401.5761.

[1] When the thesis is supported by empirical data.
[2] The ACG has 48 subscribers to *ACG Notifications* and 69 followers on *Alt Cosmology Yahoo! Group* and *Twitter*.

Reviewed Publications[3]

- Redshift

"**Large Magellanic Cloud Cepheid Standards Provide a 1% Foundation for the Determination of the Hubble Constant and Stronger Evidence for Physics Beyond LambdaCDM**"
A.G. Riess *et al.*, submitted to ApJL, 2019
arXiv:1903.07603

Riess' value for the Hubble constant is still increasing... beyond ΛCDM.
We present an improved determination of the Hubble constant (H_0) from Hubble Space Telescope observations of 70 long-period Cepheids in the Large Magellanic Cloud (LMC). Combining the LMC Detached Eclipsing Binaries, masers in NGC 4258 and Milky Way parallaxes yields our best estimate: $H_0 = 74.03 \pm 1.42$ km/s/Mpc, including systematics. The difference between H_0 measured locally and the value inferred from Planck CMB+LCDM is 6.6 ± 1.5 km/s/Mpc or 4.4σ (P=99.999% for Gaussian errors) in significance, raising the discrepancy beyond a plausible level of chance. We summarize independent tests which show this discrepancy is not readily attributable to an error in any one source or measurement, increasing the odds that it results from a cosmological feature beyond LambdaCDM.

New physics is suggested: time-dependent dark energy, nonzero curvature, dark matter interaction, early dark energy or additional relativistic particles.

"**Cosmological constraints from the Hubble diagram of quasars at high redshifts**"
G. Risaliti, E. Lusso, Nature Astronomy, Vol. 3, p. 272, 2019
doi: 10.1038/s41550-018-0657-z, and arXiv:1811.02590

The concordance (ΛCDM) model is poorly tested in the redshift interval between the farthest observed Type Ia supernovae and that of the Cosmic Microwave background. We present new measurements of the expansion rate of the Universe in the range $0.5 < z < 5.5$ based on a Hubble diagram of quasars. The quasar distances are estimated from their X-ray and ultraviolet emission, following a method developed by our group. The distance modulus-redshift relation of quasars at $z < 1.4$ is in agreement with that of supernovae and with the concordance model. Yet, a deviation from the ΛCDM model emerges at higher redshift, with a statistical significance of $\sim 4\sigma$. If an evolution of the dark energy equation of state is allowed, the data suggest a dark energy density increasing with time.

- Nucleosynthesis

" **"K^-pp", a $\bar{K}$-Meson Nuclear Bound State, Observed in ^{3}He$(K^-, \Lambda p)n$ Reactions**"
J-PARC E15 collaboration, S. Ajimura *et al.*, Physics Letters B789, p. 620, 10 February 2019
doi: 10.1016/j.physletb.2018.12.058, and arXiv:1805.12275

In a discovery that could provide new insights into the origin of mass in the universe following the Big Bang, scientists from the international J-PARC E15 Collaboration, led by researchers from the RIKEN Cluster for Pioneering Research have used experiments with kaons and helium-3 to experimentally demonstrate, for the first time, the existence of an exotic nucleus containing two protons and a bound kaon. (riken.jp/en/pr/press/2019/20190124_2/)

"**Extreme chemical abundance ratio suggesting an exotic origin for an ultra-diffuse galaxy**"
I. Martin-Navarro *et al.*, Monthly Notices of the Royal Astronomical Society 484, Issue 3, p. 3425, April 2019
doi: 10.1093/mnras/stz252, and arXiv:1901.08068

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

Ultra diffuse galaxies are a population of extended galaxies but with relatively low luminosities. The origin of these objects remains unclear, largely due to the observational challenges. We present here a detailed stellar population analysis of a relatively isolated ultra diffuse galaxy, DGSAT I. We find a very high [Mg/Fe] abundance ratio, which is extreme even in the context of the highly alpha-enhanced massive ellipticals and ultra-faint dwarfs. The [Mg/Fe]-enhancement of DGSAT I appears to be 10 times higher than the most magnesium-enhanced stellar systems discovered to date, and suggests that the chemical enrichment of this object was dominated by core-collapse supernovae. Intriguingly, this breaks the canonical relation between [Mg/Fe] and star formation timescale. With a measured velocity dispersion of 56 ± 10 km/s, DGSAT I also shows a high mass-to-light ratio, which indicates that it is highly dark matter-dominated. The metal-poor conditions of DGSAT I may have enhanced the formation of massive stars, while at the same time, additional mechanisms are needed to prevent iron-rich yields from being recycled into stars.
Although dark matter is invoked, additional mechanisms *are needed to explain observations.*

"**High-resolution Spectroscopy of Extremely Metal-poor Stars from SDSS/SEGUE. III. Unevolved Stars with [Fe/H] $\lesssim$ -3.5**"
T. Matsuno *et al.*, The Astronomical Journal, Volume 154, Number 2, 2017
doi: 10.3847/1538-3881/aa7a08, and arXiv:1706.04712

Measurement of the Li abundance on very rare low-metallicity stars as an attempt to resolve the lithium problem. The current sample size of turn-off stars with $-4.0 <$ [Fe/H] < -3.5 with available Li measurements is still small, $\sim$10 according to the SAGA database. The purpose of this study is to determine chemical abundances, including Li, for turn-off stars with [Fe/H] < -3.5.

We conclude that all stars in our sample with [Fe/H] < -3.5 have lower Li abundance than the Spite Plateau, by $\sim$0.3 dex, with no scatter within the measurements errors. *(That's only a factor of two lower, not enough to explain the factor of three in Li deficiency, but it shows some lithium destruction.)* The Li abundances are almost flat or slightly decreasing from [Fe/H] ~ -3.5 to -4.5, with relatively small scatter.
The Spite plateau *remains difficult to explain.*
The model needs fine tuning to reproduce the Spite Plateau, and it is not yet clear whether it can account for our finding that all stars below [Fe/H] $= -3.5$ have lower Li abundances, with a small scatter.

Lithium abundances of all seven stars below [Fe/H] $= -3.5$ are lower than the Spite Plateau, without significant scatter. This result could provide a constraint on proposed Li-depletion mechanisms.

"**The Origin of Helium and the Other Light Elements**"
G. Burbidge, F. Hoyle, The Astrophysical Journal 509:L1, December 1998
doi: 10.1086/311756,
researchgate.net/publication/231085010_The_Origin_of_Helium_and_the_Other_Light_Elements

The energy released in the synthesis of cosmic ^{4}He from hydrogen is almost exactly equal to the energy contained in the cosmic microwave background radiation. This result strongly suggests that the ^{4}He was produced by hydrogen burning in stars and not in the early stages of a big bang. In addition, we show that there are good arguments for believing that the other light isotopes, D, ^{3}He, ^{6}Li, ^{7}Li, ^{9}Be, ^{10}B, and ^{11}B, were also synthesized in processes involving stars. By combining these results with the earlier, much more detailed work of Burbidge et al. and of Cameron, we can finally conclude that all of the chemical elements were synthesized from hydrogen in stars over a time of about 10^{11} yr.

- Old Systems

"**Detection of a Lensed $z \approx 11$ Galaxy in the Rest-Optical with Spitzer/IRAC and the Inferred SFR, Stellar Mass, and Physical Size**"
D. Lam *et al.*, Submitted to ApJ, 2019
arXiv:1903.08177

We take advantage of new 100-hour Spitzer/IRAC observations available for MACS0647-JD, a strongly lensed $z \approx 11$ galaxy candidate, to provide improved constraints on its physical properties. Thanks to the high $\approx 2-6\times$ lensing magnification of the multiple images of MACS0647-JD, we can use the sensitive Spitzer/IRAC data to probe the rest-frame optical fluxes of MACS0647-JD and investigate its physical properties including the age and the stellar mass. Assuming a constant star formation rate, the age and stellar mass we estimate for MACS0647-JD are $\log_{10}(age/yr) = 8.6^{+0.1}_{-2.1}$, and $log_{10}(M_\star/M_\odot) = 9.1^{+0.2}_{-1.4}$, respectively. We also find that its radius, 105 ± 28 pc, is a factor of ≈ 2 smaller than the mean size in a separate simulation project DRAGONS. Interestingly enough, the observed size is similar to the small sizes seen in very low-luminosity $z \approx 6-10$ galaxies behind lensing clusters.

A very small radius of 0.1 kpc is measured for MACS0647-JD. If it is spherical, that corresponds to a density of $\sim 100 M_\odot/pc^3$*, which is similar to the density at the core of a globular cluster. Are* $10^{8.6} = 400$ *million years enough to produce such an object containing* ~ 1.2 *billion solar masses?*

From the point of view of the steady state universe such a small radius is not realistic. Instead, the angular distance always increases with z and the radius should be of a few tens of kpc.
However, from the point of view of ΛCDM *the universe at* $z = 10$ *is 10 times smaller, so the matter density is 1000 times larger and allows smaller galaxy sizes. (E.g. "Redshift* $\sim 7-10$ *sources are expected to have virial radius of the order of* $\lesssim 1$ *kpc" [from doi: 10.1051/0004-6361:20040065 or arXiv:astro-ph/0403025].)*

- Cosmology

"**Cosmology and convention**"
D. Merritt, Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics 57, p. 41, February 2017
doi: 10.1016/j.shpsb.2016.12.002, and arXiv:1703.02389

I argue that dark matter and dark energy are auxiliary hypotheses that were invoked in response to observations that falsified the standard model as it existed at the time. The use of conventionalist stratagems in response to unexpected observations implies that the field of cosmology is in a state of 'degenerating problemshift'. I show that the 'concordance' argument, often put forward by cosmologists in support of the current paradigm, is weaker than the convergence arguments that were made in the past in support of the atomic theory of matter or the quantization of energy.

Nothing in the present work is intended as prescriptive: neither the content of the current model of cosmology, nor the methodology that led to that content, are being critiqued here. *However, the paper can be used by ACG for exactly that purpose: a critique of* ΛCDM*.*

As the experimental limits have become tighter, cosmologists have postulated ever more extreme properties for the dark matter particles. [...] In the case of dark matter, it was argued that a critical experiment would be one that was sensitive to the presence of the dark matter particles. Can one imagine designing a similar experiment that tests the dark energy hypothesis? The straightforward answer is "no".

"**Is everything we know about the universe wrong?**"
U. Sawangwit, T. Shanks, Astronomy & Geophysics 51, Issue 5, p. 5.14, October 2010
doi: 10.1111/j.1468-4004.2010.51514.x

"In the first of a pair of articles, Utane Sawangwit and Tom Shanks play devil's advocate, wondering if the standard cosmological model is missing something." *That's the 'abstract' according to the SAO/NASA ADS Astronomy Abstract Service. Indeed, they discuss the 'axis of evil'. The article doesn't directly answer the question in the title, but what seemed problematic in 2010 is still not resolved by* ΛCDM*.*