The Milky Way Panorama Credit: ESO / S. Brunier

# Newsletter of *A Cosmology Group* - September 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#`.

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

A few of these articles were discussed on the ACG Forum and are worth a read. Thanks to the members for the suggestions.

1) An "Impossible" White Dwarf Identified in Kepler Data (2019-8-15)
www.skyandtelescope.com/astronomy-news/impossible-white-dwarf-kepler/

2) A new theory of gravitation / Hoyle and Narlikar (1964-11-3)
ayuba.fr/mach_effect/hoyle-narlikar1964.pdf

3) Note on a Comment by Edward L. Wright / Hoyle, G. Burbidge, Narlikar (1994-12-14)
arxiv.org/abs/astro-ph/9412045

Many thanks to T. Andersen and others for review suggestions. This month: anomalies in the CMB are not resolved, no detection of dark energy forces, we don't understand spiral galaxies, too many dusty and massive galaxies in the early universe, and an improbable quasar pair.

Regards,

*Louis Marmet*, September 30, 2019
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[1] When the thesis is supported by empirical evidence.
[2] ACG has 51 subscribers to *ACG Notifications* and 61 followers on *Alt Cosmology Yahoo! Group*.

# Reviewed Publications[3]

## - Microwave Background

"**Planck 2018 results. VII. Isotropy and statistics of the CMB**"
Planck Collaboration: Y. Akrami *et al.*, A&A, Forthcoming article, Accepted: 03 May 2019
doi: 10.1051/0004-6361/201935201

Analysis of the Planck 2018 data set indicates that the statistical properties of the cosmic microwave background (CMB) temperature anisotropies are in excellent agreement with previous studies. In particular, they are consistent with the Gaussian predictions of the ΛCDM cosmological model, yet also confirm the presence of several so-called "anomalies" on large angular scales.

"The latest study does not rule out the potential relevance of the anomalies but they do mean astronomers must work even harder to understand the origin of these puzzling features." (from: m.phys.org/news/2019-06-planck-evidence-cosmic-anomalies.html)

## - Large-Scale Structure

"**Experiment to Detect Dark Energy Forces Using Atom Interferometry**"
D.O. Sabulsky *et al.*, Phys. Rev. Lett. 123, 061102, 2019
doi: 10.1103/PhysRevLett.123.061102

The accelerated expansion of the universe motivates a wide class of scalar field theories that modify general relativity (GR) on large scales. Such theories require a screening mechanism to suppress the new force in regions where the weak field limit of GR has been experimentally tested. We have used atom interferometry to measure the acceleration of an atom toward a macroscopic test mass inside a high vacuum chamber, where new forces can be unscreened. Our measurement shows no evidence of new forces, a result that places stringent bounds on chameleon and symmetron theories of modified gravity.

"**Galaxy Zoo: unwinding the winding problem observations of spiral bulge prominence and arm pitch angles suggest local spiral galaxies are winding**"
K.L. Masters *et al.*, Monthly Notices of the Royal Astronomical Society 487, Issue 2, pp. 18081820, August 2019
doi: 10.1093/mnras/stz1153

We use classifications provided by citizen scientists though Galaxy Zoo to investigate the correlation between bulge size and arm winding in spiral galaxies. There is at best a weak correlation between bulge prominence and spiral arm tightness. This observation may suggest that the winding problem could be solved by the constant reforming of spiral arms, rather than needing a static density wave. We further observe that galaxies exhibiting strong bars tend to have more loosely wound arms at a given bulge size than unbarred spirals. This observations suggests that the presence of a bar may slow the winding speed of spirals, and may also drive other processes (such as density waves) that generate spiral arms. It is remarkable that after over 170 years of observations of spiral arms in galaxies our understanding of them remains incomplete.

"**A radio ridge connecting two galaxy clusters in a filament of the cosmic web**"
F. Govoni *et al.*, Science 364, Issue 6444, pp. 981-984, 7 Jun 2019
doi: 10.1126/science.aat7500, and arXiv:1906.07584

We observed a ridge of radio emission connecting the merging galaxy clusters Abell 0399 and Abell 0401 with the Low-Frequency Array (LOFAR) telescope network at 140 megahertz. The observations imply that intergalactic

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

magnetic fields connect the two clusters and challenge theories of particle acceleration in the intergalactic medium.

"**A distance of 13 Mpc resolves the claimed anomalies of the galaxy lacking dark matter**"
I. Trujillo *et al.*, Monthly Notices of the Royal Astronomical Society 486, Issue 1, pp. 11921219, June 2019
doi: 10.1093/mnras/stz771, and arXiv:1806.10141

*Follow up on an earlier article:*
The claimed detection of a diffuse galaxy lacking dark matter represents a possible challenge to our understanding of the properties of these galaxies and galaxy formation in general. Here we carry out a careful analysis of all extant data and show that they consistently indicate a much shorter distance (13 Mpc) than previously indicated (20 Mpc). With this revised distance, the galaxy appears to be a rather ordinary low surface brightness galaxy with plenty of room for dark matter. At 13 Mpc, the luminosity and structural properties of the globular clusters around the object are the same as those found in other galaxies.
*Perhaps we could revise the distances to every galaxy to explain away dark matter!*

"**Dynamical history of the Local Group in ΛCDM II. Including external perturbers in 3D**"
I. Banik, H. Zhao, Monthly Notices of the Royal Astronomical Society 467, Issue 2, pp. 21802198, May 2017
doi: 10.1093/mnras/stx151

We attempt to fit the observed radial velocities (RVs) of $\sim 30$ Local Group (LG) galaxies using a 3D dynamical model of it and its immediate environment within the context of the standard cosmological paradigm, $\Lambda$ cold dark matter ($\Lambda$CDM). We find that there remains a tendency for observed RVs to exceed those predicted by our best-fitting model.

Our main finding is that including the 3D distribution of massive perturbing dark matter haloes is unlikely to help greatly with the high-velocity galaxy problem. The anomalously high RVs of several LG dwarfs may be better explained if the Milky Way (MW) and Andromeda (M31) were once moving much faster than in our models. Such a scenario is possible in some modified gravity theories, especially those that require the MW and M31 to have previously undergone a close flyby. In a $\Lambda$CDM context, however, this scenario is not feasible as the resulting dynamical friction would cause a rapid merger.

"**The visible matter - dark matter coupling**"
R. Sancisi, To appear in the proceedings of IAU Symposium 220, "Dark Matter in Galaxies", eds. S. Ryder, D.J. Pisano, M. Walker and K. Freeman, Publ. Astron. Soc. Pacific, 2003
arXiv:astro-ph/0311348

*This has been known for a while, but worth reading again.*
In the inner parts of spiral galaxies, of high or low surface brightness (LSB), there is a close correlation between rotation curve shape and light distribution. For any feature in the luminosity profile there is a corresponding feature in the rotation curve and vice versa. This implies that the gravitational potential is strongly correlated with the distribution of luminosity: either the luminous mass dominates or there is a close coupling between luminous and dark matter (DM).

These results bear on the debate on cusps in the mass profiles of the central regions of disk galaxies as predicted by CDM simulations. The amazing fact is that when the rotation curve indicates a concentration of mass -a cusp-, such a cusp shows up in the light. Then the following questions arise: if the baryons indeed dominate in the central regions of all spirals, LSBs included, how can the CDM profiles be compared with the observations? If, on the other hand, the baryons do not dominate but trace the DM distribution, why, in systems of comparable luminosity, are some DM halos cuspy (following the visible matter) and others (also following the visible matter) are not?

## - Old Systems

"**A dominant population of optically invisible massive galaxies in the early Universe**"
T. Wang *et al.*, Nature 572, pp. 211214, 2019
doi: 10.1038/s41586-019-1452-4, and arXiv:1908.02372

We report submillimetre (wavelength 870 micrometres) detections of 39 massive star-forming galaxies at $z > 3$, which are unseen in the spectral region from the deepest ultraviolet to the near-infrared. With a space density of about $2 \times 10^5$ per cubic megaparsec and star-formation rates of 200 solar masses per year, these galaxies represent the bulk population of massive galaxies that has been missed from previous surveys. Residing in the most massive dark matter haloes at their redshifts, they are probably the progenitors of the largest present-day galaxies in massive groups and clusters. Such a high abundance of massive and dusty galaxies in the early Universe challenges our understanding of massive-galaxy formation.

"**A quasar companion to the puzzling quasar SDSS J0927+2943**"
R. Decarli *et al.*, A&A 511, A27 February 2010
doi: 10.1051/0004-6361/200913760, and arXiv:1001.1086

We report the discovery of a quasar close to SDSS J0927+2943 ($z = 0.713$), which is a massive binary/recoiling black hole candidate. The companion quasar is at a projected distance of $125h_{70}^{-1}$ kpc and exhibits a radial velocity difference of $\sim 1400$ km/s with respect to the known quasar. The observations of the quasar pair presented here reveal a puzzling nature. We estimate that the probability to find a companion quasar with $m_b < 20$ and angular separation $< 20''$ at any redshift is $\sim 10^{-3}$. If we consider pairs with redshift difference $< 1500$ km/s, the probability drops by two orders of magnitude. Hence, at most one quasar pair with properties similar to those observed in the case of S0927 is expected among the $\sim 77000$ quasars in the SDSS catalogue. Therefore the chance superposition is very unlikely. We propose that the overall system is caught in the process of ongoing structure formation. *... This is the kind of observation Arp et al. have been reporting for years.*

## - Cosmology

"**Cluster counts : Tensions, massive neutrinos, and modified gravity. III**"
S. Ili, Z. Sakr, A. Blanchard, Submitted to A&A, 2019
arXiv:1908.00163

Despite the successes of the ΛCDM concordance model, a few tensions persist: most notably, the best-fit ΛCDM model largely overpredicts the abundance of Sunyaev-Zel'dovich (SZ) clusters when using their standard mass calibration. We find that there is no simple solution to the so-called clusters-CMB tension, which may be more accurately described as a tension between Planck data and the empirical calibration of the mass-SZ observable.

"**Alcock-Paczyński cosmological test**"
M. López-Corredoira, The Astrophysical Journal 781:96, Number 2, 1 Feb. 2014
doi: 10.1088/0004-637X/781/2/96, and arXiv:1312.0003

In order to test the expansion of the universe and its geometry, we carry out an AlcockPaczyński cosmological test, that is, an evaluation of the ratio of observed angular size to radial/redshift size. The main advantage of this test is that it does not depend on the evolution of the galaxies but only on the geometry of the universe.

We used six different models: concordance ΛCDM, Einstein-de Sitter, open-Friedman cosmology without dark energy, flat quasi-steady state cosmology, a static universe with a linear Hubble law, and a static universe with tired-light redshift. Only two of the six models above fit the data of the AlcockPaczyński test: concordance ΛCDM and static universe with tired-light redshift, whereas the rest of them are excluded at a $> 95\%$ confidence level.