The Milky Way Panorama Credit: ESO / S. Brunier

Newsletter of ***A Cosmology Group*** - March 2020

ACG Editorial

The ACG website has been reorganized and its structure simplified into six sections: 1) The Newsletter, 2) Media (press releases, rapid publications, etc.), 3) Essays (member's contributions), 4) Resources (links to external papers, cosmologies, etc.), 5) Organization (information about ACG), and 6) Conferences.

A series of questions were sent to ACG members and the results are summarized here by Eric. It is certainly easier to obtain agreement on individual issues, such as "Redshift relationship", "Nucleosynthesis", "Forces that shape large scale structures", "Origin of CMB", "Dark Matter", etc., rather than try to agree on a complete cosmological model. Every member is invited to discuss these topics on 'ACG Alt Observable'.

In this Newsletter: fudging a blind analysis, discrepant redshift catalogues, large quantities of cold molecular hydrogen, MOND simulation, short-lived galaxy, gravitational waves or not, and still no explanation for the matter/antimatter imbalance after the Big Bang.

Regards,

Louis Marmet, March 5, 2020
redshift@cosmology.info

Any preference or suggestions for a tagline/slogan?
ACG - For a Modern Cosmology ACG - The Expansion of Knowledge is Accelerating

Reviewed Publications[1]

- Redshift, Hubble constant, Expansion

"Dark Energy Survey Year 1 Results: Cosmological Constraints from Cluster Abundances and Weak Lensing"
DES Collaboration: T. Abbott, M. Aguena, A. Alarcon *et al.*, arXiv:2002.11124
arXiv:2002.11124

This analysis follows the methodology described in [19], in which we develop our pipeline using the redMaPPer SDSS cluster catalog. This analysis was performed blind to the cosmological parameters to avoid confirmation bias. However, the large tension between our original unblinded results and multiple cosmological probes, including Planck CMB, and especially the DES 3x2pt results, motivated a careful review of our handling of systematics. This led us to revisit our estimates of the selection bias and, in turn, to re-analyse and update our results post-unblinding. The analysis presented in the main text of the paper make use of this post-unblinding correction.

As discussed in the paper, the post-unblinding correction, while reducing by 2σ the preferred σ_8 value, does not improve the consistency of our posteriors with either the Planck CMB or the DES 3x2pt results.

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

Translation kindly provided by Eric: "We did the analysis blind to show we were not just fudging to confirm the LCDM "right answer". But we got the wrong answer! So we tried to fudge it anyway. But we failed!"

Two earlier papers from the Dark Energy Survey: Y. Fang *et al.*, MNRASociety, Volume 490, Issue 3, December 2019, doi: 10.1093/mnras/stz2805, and arXiv:1909.01386, *and*, DES Collaboration: T. M. C. Abbott *et al.*, Phys. Rev. D 99, 123505 Published 7 June 2019, doi: 10.1103/PhysRevD.99.123505, and arXiv:1810.02499.

"Is there really a 'Hubble tension'?"
M. Rameez, S. Sarkar, arXiv:1911.06456
arXiv:1911.06456

We have earlier reported that the redshifts of over 100 Type Ia supernovae (SNe Ia) which are in common between the SDSSII-SNLS3 Joint Lightcurve Analysis (JLA) catalogue and the subsequent Pantheon compilation are discrepant - some by as much as $\Delta z \sim 0.1$. We study the impact of this on the inferred value of H_0 using calibrations of the supernova absolute magnitude via the 'local distance ladder'. For supernovae with $\Delta z > 0.025$, the JLA redshifts favour $H_0 \sim 72\,(\mathrm{km/s})/\mathrm{Mpc}$, while the Pantheon redshifts favour $H_0 \sim 68\,(\mathrm{km/s})/\mathrm{Mpc}$. For comparison the value inferred (assuming the flat ΛCDM model) from the Planck data on CMB anisotropies is $H_0 \sim 67.4 \pm 0.5\,(\mathrm{km/s})/\mathrm{Mpc}$. Thus the systematic uncertainties that apparently still plague the distance ladder measurement of H_0 undermine the significance of the discrepancy claimed by Riess *et al.*

- Large-Scale Structure

"Rotating Disk Galaxies without Dark Matter Based on Scientific Reasoning"
J.Q. Feng, Galaxies 8(1), 9, 2020
doi:10.3390/galaxies8010009, and www.mdpi.com/2075-4434/8/1/9

The most cited evidence for (non-baryonic) dark matter has been an apparent lack of visible mass to gravitationally support the observed orbital velocity of matter in rotating disk galaxies, yet measurement of the mass of celestial objects cannot be straightforward.

For convenience, most astronomers commonly assumed a constant mass-to-light ratio for estimation of the so-called "luminous" or "visible" mass, which would not likely be accurate. The mass determined from a rotation curve typically exhibits an exponential-like decline with galactrocentric distance, qualitatively consistent with observed surface brightness but often with a larger disk radial scale length. This fact scientifically suggests variable mass-to-light ratio of baryonic matter in galaxies without the need for dark matter.

"Molecular gas in the halo fuels the growth of a massive cluster galaxy at high redshift"
B.H.C. Emonts *et al.*, Science 354, Issue 6316, p. 1128, 2016
doi: 10.1126/science.aag0512, and arXiv:1612.00387

Astronomers studied an object called the Spiderweb Galaxy, which actually is not yet a single galaxy, but a clustering of protogalaxies more than 10 billion light-years from Earth. The presence of CO gas indicates a larger quantity of molecular hydrogen, which is much more difficult to detect. The astronomers estimated that the molecular gas totals more than 100 billion times the mass of the Sun. Not only is this quantity of gas surprising, they said, but the gas also must be unexpectedly cold, about minus-200 degrees Celsius. Such cold molecular gas is the raw material for new stars.

The Australia Telescope Compact Array observations revealed the total extent of the gas, and the VLA observations, much more narrowly focused, provided another surprise. Most of the cold gas was found, not within the protogalaxies, but instead between them.

This is a huge system, with this molecular gas spanning three times the size of our own Milky Way Galaxy, said Preshanth Jagannathan, of the National Radio Astronomy Observatory (NRAO) in Socorro, NM. *(from* https://public.nrao.edu/news/galaxy-cluster-gas/)

Large quantities of cold, difficult to detect ('dark') matter...

"The Formation of Exponential Disk Galaxies in MOND"
N. Wittenburg, P. Kroupa, B. Famaey, The Astrophysical Journal 890, Number 2, 2020
doi: 10.3847/1538-4357/ab6d73, and arXiv:2002.01941

To investigate how the formation and evolution of galaxies takes place in Milgromian gravity (MOND), we present full hydrodynamical simulations. These are the first-ever galaxy formation simulations done in MOND with detailed hydrodynamics, including star formation, stellar feedback, radiative transfer and supernovae. We also analyse how the addition of more complex baryonic physics changes the main resulting properties of the models and find this to be negligibly so in the Milgromian framework.

MOND is being taken more and more seriously. Rigorous simulations and predictions are the key if alternative theories are to become accepted for publication in peer reviewed journals.

- Old Systems

"An Extremely Massive Quiescent Galaxy at z=3.493: Evidence of Insufficiently Rapid Quenching Mechanisms in Theoretical Models"
B. Forrest, M. Annunziatella, G. Wilson *et al.*, The Astrophysical Journal Letters 890, Number 1, 2020
doi: 10.3847/2041-8213/ab5b9f, and arXiv:1910.10158

In this work we present spectra confirming the existence of a quiescent galaxy XMM-2599 at $z = 3.493$ with a stellar mass of $3.1 \times 10^{11}\,\mathrm{M}_\odot$. This galaxy's star-formation history suggests a period of intense star formation, $> 1000\,\mathrm{M}_\odot$/yr for several hundred Myr at $z \sim 6$, consistent with the most gas-rich dusty star-forming galaxies (DSFGs) observed at that epoch.

Simulations are able to reproduce the massive, star-forming DSFGs observed at high redshift that are considered possible progenitors for massive quenched galaxies such as XMM-2599. However they are still unable to reproduce massive, quiescent galaxies at $z \sim 4$. The specific mechanisms which enable the rapid transformation of these galaxies is unclear, and may in fact be the result of several concurrent events. This suggests the need for a more rapid quenching process than is currently prescribed, challenging our current understanding of how ultra-massive galaxies form and evolve in the early Universe.

Astronomers have discovered an ultramassive galaxy 12 billion light-years away from Earth. The unusual galaxy, named XMM-2599, formed stars at a very high rate and then died; why it suddenly stopped forming stars is unclear. (From http://www.sci-news.com/astronomy/extremely-massive-quiescent-galaxy-early-universe-08091.html)

- Cosmology

"GW190425 is inconsistent with being a binary neutron star born from a fast merging channel"
M. Safarzadeh, E. Ramirez-Ruiz, E. Berger, arXiv:2001.04502
arXiv:2001.04502

The LIGO/Virgo Scientific Collaboration recently announced the detection of compact object binary merger, GW190425, with total mass of $3.4\,\mathrm{M}_\odot$. This system lies five standard deviations away from the known galactic population of binary neutron stars. Assuming such systems are born from from a fast-merging channel, this would indicate that the delay time of such system is extremely short (less than 10 Myr). In order to be consistent with the reported merger rate of GW190425 from LIGO O3 data one concludes that the efficiency of formation of fast merging binary neutron star systems is in strong tension with the formation efficiency of fast merging binary neutron star systems from population synthesis models.

Moreover, the comparable merger rate challenges our understanding of supernova explosion in massive stars as more massive neutron stars are born from heavier progenitors such that the relative formation rate of massive to normal binary neutron star systems should be at least suppressed by an order of magnitude.

There is a lot more to understand before we can use gravitational wave detection as a cosmological probe.
"We have to go back to the drawing board." (from www.quantamagazine.org/radical-change-needed-after-latest-neutron-star-collision-20200220/)
Two articles by Alexander Unzicker are worth a read:
"One does not have to be an expert in signal analysis to realize that fishing for similarities with expected signals in a noisy background bears the danger of false-positive events." (from "Fake News from the Universe?" 2019-7-8 www.heise.de/tp/features/Fake-News-from-the-Universe-4464599.html)*, and:*
"Despite high expectations, the detectors LIGO and VIRGO have only been producing false alarms over the last ten months. This raises fundamental questions about the methodology." (from "Gravitational waves: silent fiasco" ***(in German)*** 2020-2-16 www.heise.de/tp/features/Gravitationswellen-Stilles-Fiasko-4659813.html)

"**Measurement of the permanent electric dipole moment of the neutron**"
C. Abel *et al.*, Phys. Rev. Lett. 124, 081803, 2020
doi: 10.1103/PhysRevLett.124.081803

We present the result of an experiment to measure the electric dipole moment (EDM) of the neutron using Ramsey's method of separated oscillating magnetic fields with ultracold neutrons. Our measurement stands in the long history of EDM experiments probing physics violating time-reversal invariance. The statistical analysis was performed on blinded datasets by two separate groups, while the estimation of systematic effects profited from an unprecedented knowledge of the magnetic field. The measured value of the neutron EDM may be interpreted as an upper limit of $|d_n| < 1.8 \times 10^{-26}\,\text{e}\cdot\text{cm}$ (90% C.L.).

Their research is part of an investigation into why there is matter left over in the universe, that is, why all the antimatter created in the Big Bang didn't just cancel out the matter. Supersymmetry theories about why there is matter left over predict that neutrons have an electric dipole moment, to a greater or lesser extent.
The small EDM disproves several predictions from Supersymmetry. (From m.phys.org/news/2020-02-universe.html)
There is still no explanation why matter dominates after the Big Bang.

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. 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. New cosmologies are listed on A Cosmology Model or can be presented at the next ACG Conference.

[2]When the thesis is supported by empirical evidence.
[3]ACG currently has 95 members.