The Milky Way Panorama   Credit: ESO / S. Brunier

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

More mysteries of the universe are presented below, hoping that it will help everyone's research interests. For this 1st anniversary of my first ACG NewsLetter, I couldn't resist at the chance to poke fun at another experiment which fails (and will fail again) to detect dark matter.

Regards,

Louis Marmet, March 30, 2019
redshift@cosmology.info

Reviewed Publications

Text quoted below is adapted from the original article, except for my emphasis and *my comments.*

- Redshift

"No obvious change in the number density of galaxies up to $z \approx 3.5$"
Y.-H. Sanejouand, Research Gate, Feb. 2019
doi: 10.13140/RG.2.2.34513.99688,
researchgate.net/publication/331099853_No_obvious_change_in_the_number_density_of_galaxies_up_to_z_35

The analysis of the cumulative count of sources of gamma-ray bursts as a function of their redshift strongly suggests that the number density of starforming galaxies is roughly constant, up to $z \approx 3.5$. [...] the overall

[1] When the thesis is supported by empirical data.
[2] The ACG has 53 subscribers to *ACG Notifications* and 65 followers on *Alt Cosmology Yahoo! Group* and *Twitter*.

number density of galaxies is constant as well, up to $z \approx 2$ at least. A redshift-age relationship based on the Milne model is able to handle the ages of the oldest known objects and allows to show, based on safe grounds, that the number density of galaxies is roughly constant, up to $z = 2 - 3.5$.

"Do Galaxies Change in Size ? An Angular Size Test at Low Redshift with SDSS Data"
A. Unzicker, K. Fabian, arXiv:1011.4956 [physics.gen-ph] 2010
arXiv:1011.4956

We find a slight decrease of average galaxy size with redshift ($z < 0.2$), corresponding to a growth in time. The fact that this decrease is less pronounced at higher redshifts is more difficult to interpret. It is however very interesting to see that the trend in size change is reversed when taking into account the luminosity evolution. We cannot decide which of the two puzzling effects, size or luminosity change, is real.

With respect to other results regarding size evolution, our finding of a slight increase in time would correspond to the observation of too small galaxies at very high redshift, though a quantitative agreement cannot be deduced yet. It is clear that those results challenge the angular-size-redshift-relation of the ΛCDM model in particular at high redshift. We observe an anomalous density, a luminosity evolution and unexpected changes in size. It is not evident how a comprehensive understanding of these effects can be obtained within standard cosmology.

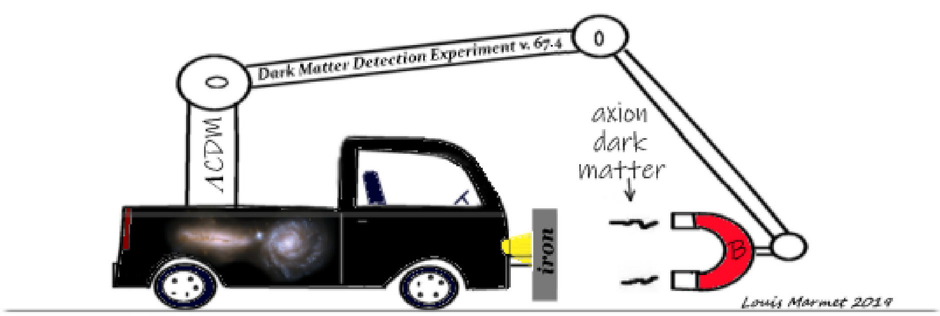
It's an older paper, but nothing would seem to fit then. Only published on arXiv.

- Large-Scale Structure

"Design and implementation of the ABRACADABRA-10 cm axion dark matter search"
J.L. Ouellet *et al.*, Phys. Rev. D 99, 052012, 2019
doi: 10.1103/PhysRevD.99.052012, arXiv:1810.12257

ABRACADABRA is a new experimental program to search for axion dark matter over a broad range of masses, $10^{-12} \leq m_a \leq 10^{-6}$ eV. ABRACADABRA-10 cm is a small-scale prototype for a future detector that could be sensitive to QCD axion couplings. In the presence of a static magnetic field B_0, axion dark matter generates an oscillating magnetic field as if sourced by an effective AC current density parallel to B_0. We observe no evidence of an axion signal in the mass range 3.1×10^{-10} eV - 8.3×10^{-9} eV and place an upper limit on the axion-photon coupling $g_{a\gamma\gamma}$ of at least 3.3×10^{-9} GeV^{-1} over the full mass range.

It's a beautiful experiment and it is very sensitive: they try to measure a magnetic field inside a toroidal solenoid where there should be none, unless an axion passes by... Unfortunately they are wasting their time and money on a hypothetical particle invented to resolve a problem caused by the inadequacy of the Big Bang theory.



*In the presence of a static magnetic field, axion dark matter (ADM) generates an oscillating magnetic field which is detected with an iron plate. The presence of ADM will produce a forward force on the truck. No evidence of an axion signal is observed in the mass range $[1.3 - 3.8] \times 10^{27}$ TeV and upper limits on the axion-photon coupling $g_{a\gamma\gamma}$ are at least 6.7×10^{-55} TeV^{-1} in this mass range. Future upgrades for the **H**igh **O**ersted **C**osmic **U**nit **S**illy-**P**article **O**bservation **C**rane as the **U**ltimate **S**ensor (HOCUS-POCUS) program will include larger mag wheels to reduce friction and weight, and construction of a larger magnet.*

"A Second Galaxy Missing Dark Matter in the NGC 1052 Group"
P. van Dokkum *et al.*, The Astrophysical Journal Letters 874, No. 1, 2019
doi: 10.3847/2041-8213/ab0d92, arXiv:1901.05973

This discovery was reviewed in last month's NewsLetter, but the comments from van Dokkum are relevant to this Group's discussions.

> This shocking discovery drew some criticism when the team first announced their results in March of 2018. "It was a little stressful at times," said van Dokkum. "On one hand, this is how the scientific process is supposed to work; you see something interesting, other people disagree, you obtain new data, and in the end you learn more about the universe. On the other hand, although the majority of the critiques were constructive and polite, not all of them were. Every time a new critique came out we had to scramble and figure out if we had missed something."
>
> Van Dokkum says he's proud of his team for pulling together in those tough moments. Their hard work has paid off, with the universe cooperating and giving more reason to look for other UDGs like DF2 and DF4.
>
> (from m.phys.org/news/2019-03-unusual-galaxies-defy-dark-theory.html)

From the paper: "We conclude that NGC1052-DF2 is not an isolated case but that a class of such objects exists. The origin of these large, faint galaxies with an excess of luminous globular clusters and an apparent lack of dark matter is, at present, not understood." *The word* apparent *must have been added as a requirement for publication.*

"A Tale of Two Paradigms: the Mutual Incommensurability of LCDM and MOND"
S.S. McGaugh, Canadian Journal of Physics 93, 250, 2015
doi: 10.1139/cjp-2014-0203, arXiv:1404.7525

"Laboratory test of Newton's law of gravity for small accelerations"
S. Little, M. Little, Classical and Quantum Gravity, Volume 31, Number 19, 195008, 2014
doi: 10.1088/0264-9381/31/19/195008

I have these two articles side by side to highlight a healthy exchange happening between experimentalists and theorists. Clearly, MOND is accepted enough to warrant experimental investigation, but experiments contradict the predictions of MOND at low accelerations! One objection has been that the experiment was performed in Earth's gravitational acceleration, which is much higher than 10^{-10} *m/s*^{2}.

Despite considerable effort, the concordance model of cosmology does not at present provide a satisfactory description of small scale structure and the dynamics of bound objects like individual galaxies. In contrast, MOND provides a unique and predictively successful description of galaxy dynamics. Critical outstanding issues are the development of an acceptable relativistic parent theory for MOND, and the reality of the non-baryonic dark matter of LCDM. Do suitable dark matter particles exist, or are they a modern aether?

The rotation curves of spiral galaxies suggest that either a considerable fraction of the galactic mass must be dark matter, or that one of Newton's laws needs revision at accelerations $< 10^{-10}\,\mathrm{m/s^2}$. We have endeavored to search for evidence of the latter in a terrestrial laboratory. A sensitive torsion balance was employed to measure small accelerations due to gravity. No deviations from the predictions of Newton's law were found down to $10^{-12}\,\mathrm{m/s^2}$.

- Old Systems

"Discovery of the First Low-luminosity Quasar at z > 7"
Y. Matsuoka *et al.*, The Astrophysical Journal Letters, Volume 872, Number 1, L2, 2019
doi: 10.3847/2041-8213/ab0216

This Letter is the seventh in a series of publications presenting the results from the SHELLQs project, a search for low-luminosity quasars at $z \gtrsim 6$ based on the deep multiband imaging data produced by the HSC-SSP survey.

Astronomers at the Subaru Telescope have discovered 83 quasars. This quasar, HSC J124353.93 +010038.5, has an order of magnitude lower luminosity than do the other known quasars at $z > 7$.

It is interesting that the luminosity distribution of quasars seems independent of redshift. This remains to be verified, but no quasar evolution could be a problem for ΛCDM. "It is remarkable that such massive dense objects were able to form so soon after the Big Bang," said Princeton Universitys Prof. Michael Strauss (from Sci News).

"The multiple merger assembly of a hyperluminous obscured quasar at redshift 4.6"
T. Díaz-Santos *et al.*, Science, Vol. 362, Issue 6418, p. 1034, 2018
doi: 10.1126/science.aap7605, arXiv:1811.05992

We report spectroscopic imaging of a multiple merger event in the most luminous known galaxy, WISE J224607.56 -052634.9, a dust obscured quasar at redshift 4.6. Far-infrared dust continuum observations show three galaxy companions around W2246-0526 with disturbed morphologies, connected by streams of dust likely produced by the dynamical interaction. The dominant mechanism supplying the material necessary to sustain such high luminosities remains unknown.

It is also surprising that a merger of four galaxies is observed, as this should be statistically very improbable.

"A Remarkably Luminous Galaxy at z = 11.1 Measured with Hubble Space Telescope Grism Spectroscopy"
P.A. Oesch *et al.*, The Astrophysical Journal, Volume 819, Number 2, 2016
doi: 10.3847/0004-637X/819/2/129, arXiv:1603.00461

We present Hubble WFC3/IR slitless grism spectra of a remarkably bright $z \geq 10$ galaxy candidate, GN-z11, identified initially from CANDELS/GOODS-N imaging data. A significant spectroscopic continuum break is detected at $\lambda = 1.47 \pm 0.01\mu$m. This continuum break is the Lyα break redshifted to $z_{grism} = 11.09^{+0.08}_{-0.12}$, just ~ 400 Myr after the Big Bang. This observation extends the current spectroscopic frontier by 150 Myr to well before the Planck (instantaneous) cosmic reionization peak at $z \sim 8.8$, demonstrating that galaxy build-up was well underway early in the reionization epoch at $z > 10$. GN-z11 is remarkably and unexpectedly luminous for a galaxy at such an early time: its UV luminosity is $3\times$ larger than L^* measured at $z \sim 6 - 8$. The Spitzer IRAC detections up to 4.5μm of this galaxy are consistent with a stellar mass of $\sim 10^9 M_\odot$.

According to ΛCDM cosmology the angular distance at a redshift $z = 11.1$ is the same as for $z = 0.25$. It is no surprise that a ridiculous half-light radius of 0.6 ± 0.3 kpc is given to the galaxy! A non-expanding cosmology would estimate a half-light radius of ~ 50 kpc for GN-z11, a reasonable size for the large galaxy that can be seen from 13.3 billion light-years away.

"An ultra-luminous quasar with a twelve-billion-solar-mass black hole at redshift 6.30"
X.-B. Wu *et al.*, Nature, volume 518, p. 512, 2015
doi: 10.1038/nature14241, arXiv:1502.07418

So far, roughly 40 quasars with redshifts greater than $z = 6$ have been discovered, each containing a black hole with a mass $\sim 10^9$ $M_\odot$. The existence of such black holes when the Universe was $< 10^9$ years old presents substantial challenges to theories of the formation and growth of black holes and the coevolution of black holes and galaxies.

Here we report the discovery of an ultra-luminous quasar, SDSS J010013.02+280225.8, at redshift $z = 6.30$ *(884-million years old)*. It has an optical and near-infrared luminosity a few times greater than those of previously known $z > 6$ quasars. We estimate that the black hole has a mass of ~ 12 billion solar masses, which is consistent with the ~ 13 billion solar masses derived by assuming an Eddington-limited accretion rate.

This presents substantial challenges, increased by an order of magnitude, to theories of the coevolution of black holes and galaxies.