Non-Biceps Cosmology

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1404.5633

Dark matter-baryons separation at the lowest mass scale: the Bullet Group We report on the X-ray observation of a strong lensing selected group, SL2S J08544-0121, with a total mass of 2.4pm0.6*1014 Msun which revealed a separation of 12420 kpc between the X-ray emitting collisional gas and the collisionless galaxies and dark matter (DM), traced by strong lensing. This source allows to put an order of magnitude estimate to the upper limit to the interaction cross section of DM of 10 cm2 g1. It is the lowest mass object found to date showing a DM-baryons separation and it reveals that the detection of bullet-like objects is not rare and confined to mergers of massive objects opening the possibility of a statistical detection of DM-baryons separation with future surveys.

1404.5636

The abundance of Bullet-groups in LCDM We estimate the expected distribution of displacements between the two dominant dark matter (DM) peaks (DM-DM displacements) and between DM and gaseous baryon peak (DM-gas displacements) in dark matter halos with masses larger than 1013 Msun/h. We use as a benchmark the observation of SL2S J08544-0121, which is the lowest mass system (1.01014 Msun/h) observed so far featuring a bi-modal dark matter distribution with a dislocated gas component. We find that (50pm10)percent of the dark matter halos with circular velocities in the range 300 km/s to 700 km/s (groups) show DM-DM displacements equal or larger than 186pm30 kpc/h as observed in SL2S J08544-0121. ..... These results open up the possibility for a new statistical test of LCDM by looking for DM-gas displacements in low mass clusters and groups.

1403.4250

Constraints on the Progenitor System of the Type Ia Supernova 2014J from Pre-Explosion Hubble Space Telescope Imaging We constrain the properties of the progenitor system of the highly reddened Type Ia supernova (SN) 2014J in Messier 82 (M82; d 3.5 Mpc). We determine the SN location using Keck-II K-band adaptive optics images, and we find no evidence for flux from a progenitor system in pre-explosion near-ultraviolet through near-infrared Hubble Space Telescope (HST) images. Our upper limits exclude systems having a bright red giant companion, including symbiotic novae with luminosities comparable to that of RS Ophiuchi. While the flux constraints are also inconsistent with predictions for comparatively cool He-donor systems (T ¡ 35,000 K), we cannot preclude a system similar to V445 Puppis. The progenitor constraints are robust across a wide range of RV and AV values, but significantly greater values than those inferred from the SN light curve and spectrum would yield proportionally brighter luminosity limits. Pre-explosion HST infrared

1402.6842

Type Ia supernova bolometric light curves and ejected mass estimates from the Nearby Supernova Factory We present a sample of normal type Ia supernovae from the Nearby Supernova Factory dataset with spectrophotometry at sufficiently late phases to estimate the ejected mass using the bolometric light curve. We measure 56Ni masses from the peak bolometric luminosity, then compare the luminosity in the 56Co-decay tail to the expected rate of radioactive energy re- lease from ejecta of a given mass. We infer the ejected mass in a Bayesian context using a semi-analytic model of the ejecta, incorporating constraints from contemporary numerical models as priors on the density structure and distribution of 56Ni throughout the ejecta. We find a strong correlation between ejected mass and light curve decline rate, and consequently 56Ni mass, with ejected masses in our data ranging from 0.9-1.4 M. Most fast-declining (SALT2 x1¡1) normal SNe Ia have significantly sub-Chandrasekhar ejected masses in our fiducial analysis.

1403.2389

A thousand shadows of Andromeda: rotating planes of satellites in the Millennium-II cosmological simulation In a recent contribution, Bahl & Baumgardt investigated the incidence of planar alignments of satellite galaxies in the Millennium-II simulation, and concluded that vast thin planes of dwarf galaxies, similar to that observed in the Andromeda galaxy (M31), occur frequently by chance in -Cold Dark Matter cosmology. However, their analysis did not capture the essential fact that the observed alignment is simultaneously radially extended, yet thin, and kinematically unusual. ..... We find that 0.04% of host galaxies display satellite alignments that are at least as extreme as the observations, when we consider their extent, thickness and number of members rotating in the same sense. ..... This analysis confirms that it is highly unlikely that the observed structure around the Andromeda galaxy is due to a chance occurrence.

1402.2301

Detection of An Unidentified Emission Line in the Stacked X-ray spectrum of Galaxy Clusters We detect a weak unidentified emission line at E=(3.55-3.57)+/-0.03 keV in a stacked XMM spectrum of 73 galaxy clusters spanning a redshift range 0.01-0.35. MOS and PN observations independently show the presence of the line at consistent energies. When the full sample is divided into three subsamples (Perseus, Centaurus+Ophiuchus+Coma, and all others), the line is significantly detected in all three independent MOS spectra and the PN "all others" spectrum. It is also detected in the Chandra spectra of Perseus with the flux consistent with XMM (though it is not seen in Virgo). However, it is very weak and located within 50-110eV of several known faint lines, and so is subject to significant modeling uncertainties. On the origin of this line, we argue that there should be no atomic transitions in thermal plasma at this energy. An intriguing possibility is the decay of sterile neutrino, a long-sought dark matter particle candidate. Assuming that all dark matter is in

1404.5618

A measurement of the Alcock-Paczynski test using cosmic voids in the SDSS We perform an Alcock-Paczynski test using stacked cosmic voids identified in the SDSS Data Release 7 main sample and Data Release 10 LOWZ and CMASS samples. We find 1,500 voids out to redshift 0.6 using a heavily modified and extended version of the watershed algorithm ZOBOV, which we call VIDE (Void IDentification and Examination). ..... After correcting for systematic effects we find that our Alcock-Paczynski measurement leads to a preference of our best-fit value of M0.15 over M=1.0 by a likelihood ratio of 10. Likewise, we find a factor of 4.5 preference of the likelihood ratio for a CDM M=0.3 model and a null measurement. Taken together, we find substantial evidence for the Alcock-Paczynski signal in our sample of cosmic voids. Our assessment using realistic mocks suggests that measurements with future SDSS releases and other surveys will provide tighter cosmological parameter constraints.

1310.6810

Using the topology of large-scale structure in the WiggleZ Dark Energy Survey as a cosmological standard ruler

We present new and accurate measurements of the cosmic distance-redshift relation, spanning $0.2 < z < 1$, using the topology of large-scale structure as a cosmological standard ruler. Our results derive from an analysis of the Minkowski functionals of the density field traced by the WiggleZ Dark Energy Survey..... .....Our distance measurements are consistent with standard models which describe the cosmic expansion history, and with previous analyses of baryon acoustic oscillations (BAOs) detected by the WiggleZ Survey, with the topological results yielding a higher distance precision by a factor of 2. However, the full redshift-space power-spectrum shape is required to recover the topological distances

1310.4278

Horizon Run 3: Topology as a Standard Ruler

We study the Physically Self Bound Cold Dark Matter Halo distribution which we associate with the massive galaxies within the Horizon Run 3 to estimate the accuracy in determination of the cosmological distance scale measured by the topology analysis. We apply the routine "Contour 3D" to 108 Mock Survey of π steradians out to redshift z $= 0.6$, which effectively correspond to the SDSS-III BOSS survey, and compare the topology with that of a Gaussian Random Phase Field. We find that given three separate smoothing lengths $\lambda = 15$, 21, and 34 $h^{-1}\mathrm{Mpc}$, the least χ^2 fit genus per unit volume g yields a 1.7 % fractional uncertainty in smoothing length and angular diameter distance to $z = 0.6$. This is an improvement upon former calibrations of and presents a competitive error estimate with next BAO scale techniques. We also present three dimensional graphics of the Horizon Run 3 spherical mock survey to show a wealth of large-scale structures of the universe that are predicted in

1308.3240

Precision measures of the primordial.... deuterium

We report the discovery of deuterium absorption in the very metal-poor ([Fe/H] = -2.88) damped Lyman-alpha system at zabs = 3.06726 toward the QSO SDSS J1358+6522. On the basis of 13 resolved D I absorption lines and the damping wings of the H I Lyman alpha transition, we have obtained a new, precise measure of the primordial abundance of deuterium. Furthermore, to bolster the present statistics of precision D/H measures, we have reanalyzed all of the known deuterium absorption-line systems that satisfy a set of strict criteria. We have adopted a blind analysis strategy..... we obtain a weighted mean of $(D/H)_p = (2.53 +/- 0.04)x10^-5$, corresponding to a Universal baryon density100 $Omega_b h^2 = 2.202 +/- 0.046$ for the standard model of Big Bang Nucleosynthesis. By combining our measure of $(D/H)_p$ with observations of the cosmic microwave background, we derive the effective number of light fermion species, $Neff = 3.28 +/- 0.28$.

1308.2100

Primordial 4He abundance: a determination based on the largest sample of HII regions with a methodology tested on model HII regions

.....With these improvements we used our updated empirical method to derive the 4He abundances and to test corrections for several systematic effects in a sample of 1610 spectra of low-metallicity extragalactic HII regions, the largest sample used so far. ..... The derived value of Yp is higher at the 68% confidence level (CL) than that predicted by the standard big bang nucleosynthesis (SBBN) model, possibly implying the existence of different types of neutrino species in addition to the three known types of active neutrinos. Using the most recently derived primordial abundances $D/H = (2.60 +/- 0.12)x10^{-5}$ and Yp = 0.254+/-0.003.... we found that the best agreement between abundances of these light elements is achieved in a cosmological model with baryon mass density $Omegabh^2 = 0.0234 +/- 0.0019(68\%CL)$ and an effective number of the neutrino species Neff = 3.51+/-0.35 (68% CL).

1403.1644

Constraint on the cosmic age from the solar r-process abundances
The cosmic age is an important physical quantity in cosmology. Based on the radiometric method, a reliable lower limit of the cosmic age is derived to be 15.681.95 Gyr by using the r-process abundances inferred for the solar system and observations in metal-poor stars. This value is larger than the latest cosmic age 13.8130.058 Gyr from Planck 2013 results, while they still agree with each other within the uncertainties. The uncertainty of 1.95 Gyr mainly originates from the error on thorium abundance observed in metal-poor star CS 22892-052, so future high-precision abundance observations on CS 22892-052 are needed to understand this age deviation.

1310.1904

Theories relating baryon asymmetry and dark matter

The nature of dark matter and the origin of the baryon asymmetry are two of the deepest mysteries of modern particle physics. In the absence of hints regarding a possible solution to these mysteries, many approaches have been developed to tackle them simultaneously leading to very diverse and rich models. We give a short review where we describe the general features of some of these models and an overview on the general problem. We also propose a diagrammatic notation to label the different models.

1312.6991

Dipolar Dark Matter and Cosmology: Luc Blanchet, David Langlois

The phenomenology of the modified Newtonian dynamics (MOND) can be recovered from a mechanism of "gravitational polarization" of some dipolar medium playing the role of dark matter. We review a relativistic model of dipolar dark matter (DDM) within standard general relativity to describe, at some effective level, a fluid polarizable in a gravitational field. At first order in cosmological perturbation theory, this model is equivalent to the concordance cosmological scenario, or Lambda-cold dark matter (CDM) model. At second order, however, the internal energy of DDM modifies the curvature perturbation generated by CDM. This correction, which depends quadratically on the dipole, induces a new type of non-Gaussianity in the bispectrum of the curvature perturbation with respect to standard CDM. Recent observations by the Planck satellite impose stringent constraints on the primordial value of the dipole field.

1312.5069

Current signatures and search for Pop. III stars in the Local Universe

Recent numerical studies argue that low-mass stars can be formed even at zero-metallicity environment. These low-mass Population III(Pop. III) stars are thought to be still shining and able to be observed in the Local Universe. Most low-mass Pop. III stars are thought to be formed as secondary companions in binary systems. They can be escaped from their host mini-halos when their primary companions explode as supernovae. In this paper, we estimate the escape probability of the low-mass Pop. III stars from their host mini-halos. We find that ~ 100 Pop. III stars are expected. We also compute spatial distribution of these escaped Pop. III survivors by means of the semi-analytic hierarchical chemical evolution model. Typically, they are distributed around ~ 2Mpc away from the Milky Way but $5 - 35\%$ of the escaped stars fall into the Milky Way halo. These escaped Pop. III stars are possibly detected by very large scaled surveys being planned.

1404.3909

A particle dark matter footprint on the first generation of stars Dark matter particles with properties identical to dark matter candidates that are hinted at by several international collaborations dedicated to experimental detection of dark matter (DAMA, COGENT, CRESST and CDMS-II, although not, most notably, by LUX), and which also have a dark matter asymmetry identical to the observed baryon asymmetry (Planck and Wilkinson Microwave Anisotropy Probe), may produce a significant impact on the evolution of the first generation of low-metallicity stars. ..... The annihilations of dark matter particles affect the interior of the star in such a way that the 3reaction becomes less efficient in the production of carbon and oxygen. This dark matter effect contradicts the excess of carbon and other metals observed today in stars of low mass and low metallicity. Hence, we can impose an upper limit on the dark matter halo density, and therefore on the redshift, at which the first generation of low-metallicity stars formed.

1404.2933

The Photon Underproduction Crisis We examine the statistics of the low-redshift Lyman-alpha forest from smoothed particle hydrodynamic simulations in light of recent improvements in the estimated evolution of the cosmic ultraviolet background (UVB) and recent observations from the Cosmic Origins Spectrograph (COS). We find that the value of the metagalactic photoionization rate required by our simulations to match the observed properties of the low-redshift Lyman-alpha forest is a factor of 5 larger than the value predicted by state-of-the art models for the evolution of this quantity. ..... We examine potential resolutions to this mismatch and find that either conventional sources of ionizing photons (galaxies and quasars) must be significantly elevated relative to current observational estimates or our theoretical understanding of the low-redshift universe is in need of substantial revision.

1310.7031

What Next-Generation 21 cm Power Spectrum Measurements Can Teach Us About the Epoch of Reionization

A number of experiments are currently working towards a measurement of the 21 cm signal from the Epoch of Reionization. Whether or not these experiments deliver a detection of cosmological emission, their limited sensitivity will prevent them from providing detailed information about the astrophysics of reionization. In this work, we consider what types of measurements will be enabled by a next-generation of larger 21 cm EoR telescopes. To calculate the type of constraints that will be possible with such arrays, we use simple models for the instrument, foreground emission, and the reionization history..... Ultimately, we find that 0.1 km^2 of collecting area is enough to ensure a very high significance ($\gtrsim 30\sigma$) detection of the reionization power spectrum in even the most pessimistic scenarios. This sensitivity should allow for meaningful constraints on the reionization history and astrophysical parameters, especially if

1404.2284

Cosmological Constant from the Emergent Gravity Perspective

Observations indicate that our universe is characterized by a late-time accelerating phase, possibly driven by a cosmological constant , with the dimensionless parameter L2P10122, where LP=(G/c3)1/2 is the Planck length..... ..... (i) the field equations of gravity are invariant under the addition of a constant to the matter Lagrangian and (ii) the cosmological constant appears as an integration constant in the solution. The numerical value of this integration constant can be related to another dimensionless number (called CosMIn) that counts the number of modes inside a Hubble volume that cross the Hubble radius during the radiation and the matter dominated epochs of the universe. The emergent gravity paradigm suggests that CosMIn has the numerical value 4pi, which, in turn, leads to the correct, observed value of the cosmological constant. Further, the emergent gravity paradigm .... interprets the expansion of the universe itself as a quest towards holographic equipartition. We discuss the implications of this

1312.3253

General Relativity from a Thermodynamic Perspective. I show that the gravitational dynamics in a bulk region of space can be connected to a thermodynamic description in the boundary of that region, thereby providing clear physical interpretations of several mathematical features of classical general relativity: (1) The Noether charge contained in a bulk region, associated with a specific time evolution vector field, has a direct thermodynamic interpretation as the gravitational heat content of the boundary surface. (2) This result, in turn, shows that all static spacetimes maintain holographic equipartition; in these spacetimes, the number of degrees of freedom in the boundary is equal to the number of degrees of freedom in the bulk. (3) In a general, evolving spacetime, the rate of change of gravitational momentum is related to the difference between the number of bulk and boundary degrees of freedom. It is this departure from the holographic equipartition which drives the time evolution of the spacetime. (4) When the equations of motion hold, the (naturally

1312.6043

Thought Experiments on Gravitational Forces

Donald Lynden-Bell, Joseph Katz

Large contributions to the near closure of the Universe and to the acceleration of its expansion are due to the gravitation of components of the stress-energy tensor other than its mass density. To familiarise astronomers with the gravitation of these components we conduct thought experiments on gravity, analogous to the real experiments that our forebears conducted on electricity. By analogy to the forces due to electric currents we investigate the gravitational forces due to the flows of momentum, angular momentum, and energy along a cylinder. Under tension the gravity of the cylinder decreases but the 'closure' of the 3-space around it increases. When the cylinder carries a torque the flow of angular momentum along it leads to a novel helical interpretation of Levi-Civita's external metric and a novel relativistic effect. Energy currents give gravomagnetic effects in which parallel currents repel and antiparallel currents