Final Technical Report DE-SC0013718

We have developed and applied methods of large-scale structure from galaxy redshift surveys to the study of dark energy. This program supported my group's development of the baryon acoustic method and our participation in the Dark Energy Spectroscopic Instrument (DESI) survey. In addition to my leadership role in the DESI collaboration, my group at Harvard focused on several topics addressing key needs of the DESI science program. 1) We continued our design, validation, and documentation of DESI target selection of the luminous red galaxy and emission-line galaxy samples. 2) We applied simulations from our novel and extremely fast N-body code to make DESI catalogs. With these, we will search for possible systematic shifts in the acoustic scale due to clustering bias with an unprecedented volume of simulations. 3) We extended our method for the fast construction of covariance matrices for correlation functions. 4) We developed new large-scale structure methods, including density-field reconstruction and three-point function analysis.

This report focuses on activities in the three years of the most recent renewal of this grant (April 2018 to June 2021). We have been active on many fronts:

DESI: PI Eisenstein served as co-Spokesperson of the DESI collaboration from 2014 through August 2020. In this role, he led the collaboration through the critical construction and commissioning periods. He contributed to numerous aspects of collaboration management and led the development of several key collaboration policies. He also managed the Working Group leadership, guided the development of the Science Readiness Plan, and represented the collaboration in numerous project reviews.

In the last year, he focused on the observational program, taking numerous observing shifts and providing user feedback to the operations group. In April 2021, he became active with the focal plane group, helping to track the performance of the fiber positioners and searching each morning for failing positioners. Group members Tanveer Karim and Claire Lamman also took observing shifts and have been active in the DESI Outreach group.

For the period of the grant, Eisenstein and his group have been active in the design of DESI target selection and survey strategy. He has been substantially involved in three different target classes: luminous red galaxies, emission-line galaxies, and bright galaxy. For LRGs, he created an early draft of the selection algorithm; for bright galaxies, he developed the star-galaxy separation algorithm based on comparison of Gaia photometry with that of the Legacy Survey. For all 3 target classes, he was active in the assessment of performance in the survey validation period.

Eisenstein and Harvard graduate students Jae Hyeon Lee and Tanveer Karim studied emission-line galaxies (ELGs). Lee conducted an observing program with the 6.5-meter MMT to gather spectroscopy of prototype ELG selection. Karim finalized the analysis of this sample; the paper describing this work has been published.

Eisenstein and Harvard graduate student Claire Lamman tested the DESI fiber selection algorithms, trying to determine the fiber assignment rates as a function of target density. These studies informed discussion of survey design as regards sample completeness and the need for filler samples.

Over the course of this 6-year grant, DESI has gone from the early stages of construction to full survey operations, with spectacular on-sky performance. While this is the result of many people's combined effort, PI Eisenstein and his group are very happy to have been able to contribute to this success.

Cosmological Simulations: During the course of this grant, we have developed our novel cosmological N-body code, Abacus, and utilized it to produce a wide range of cosmological simulations. Most recently, we were able to use the Summit supercomputer at OLCF to produce a mammoth set of simulations, AbacusSummit, designed to meet and exceed the cosmological N-body simulation requirements adopted by DESI.

AbacusSummit comprises nearly 60 trillion particles covering 97 different cosmologies, using 300K Summit node-hours provided by the ALCC program. Most simulations are 330 billion particles in 2 Gpc/h boxes with particle mass of 2e9 Msun/h and force softening of 7 proper kpc/h. This is by a large margin the largest suite of high force-accuracy cosmological N-body simulations ever published. We produced an extensive set of data products: halo catalogs at a variety of redshifts, particle subsamples, light cones, merger trees, and initial condition summaries. The resulting data total 2 petabytes and is now available publically on the OLCF Constellation archive, and much of it is spinning at NERSC for use by DESI and other NERSC-based cosmology collaborations. An abridged set of the outputs, more suited to downloads of smaller subsets, is also available via a web portal at NERSC. Just after the completion of this grant, we released the 6 papers that document AbacusSummit.

Our code Abacus has been under development for over a decade, with intensive work during the period of this grant. To our knowledge, Abacus is the fastest high-accuracy cosmological N-body code in the world. Eisenstein works with Harvard graduate students Nina Maksimova, and Boryana Hadzhiyska, as well as post-doc Sownak Bose, undergraduate Thomas Satterwaithe, and recent Harvard graduate Lehman Garrison (now at Flatiron), in this effort.

Getting the code ready for AbacusSummit was a large undertaking. We had to complete the parallel implementation of Abacus and rewrite the on-the-fly halo-finding algorithm. We also improved the output products, adding light cones and more halo statistics. We found a number of additional speed optimizations. The code ended up faster than we hoped when we proposed, such that we could exceed the 35 trillion particles that we proposed and the 14T particles that DESI requires.

In a paper led by Lehman Garrison, we studied how one might warp the halo positions from one simulation to match that of a nearby cosmology. The intended application is to be able to produce multiple epochs of blinded mock challenges from a single set of N-body simulations, i.e., that one could shift the cosmology just a bit, so that groups analyzing the outputs couldn't guess the right answer even if they know the cosmology of the original simulation. We present an initial method that can match the two-point functions of the halos.

Eisenstein and Garrison with Sorbonne professor Michael Joyce have used Abacus to study the small-scale accuracy of N-body simulations using scale-free simulations. Although N-body is supposed to simulate the gravitational clustering of collisionless dark matter, it is difficult to prove the accuracy of the method as there is no analytic solution in the non-linear small-scale limit. Scale-free simulations offer a numerical approach to demonstrate convergence to the continuum limit. Here, one uses a power-law initial power spectrum and a power-law expansion history, so that there is no scale in the problem save those imposed by the numerical technique, e.g., particle mass, box size, force softening, time stepping. By using the simulation results at different output epochs and comparing rescaled statistics, one can demonstrate convergence. We have advanced drafts of two papers, one on the matter clustering and a second on the clustering of halo, as well as several other analyses in progress. We have shown that Abacus does achieve a converged answer at key scales.

Covariance matrices: Eisenstein worked with Harvard special student Oliver Philcox on various extensions of our work on rapid computation of the covariance matrix of correlation functions. These methods are based on direct Monte-Carlo integration of the covariance matrix in the actual survey geometry, using a clustering model of a Gaussian random field and Poissonian shot noise.

The results match extremely well to mock catalog based covariances on large scales, yet require orders of magnitude less computation. We published several papers and released a code repository called RascalC. The method is now based on random particle samples of the survey geometry, allowing it to run on the same input data sets used for clustering analyses in modern surveys. It uses jackknife samples of the data to set tuning parameters (currently just one parameter to rescale the shot noise contributions). We also extended it to provide auto and cross-correlations between two-point functions and three-point functions and between the two-point correlation functions of multiple tracers (e.g., to study DESI LRG and ELG samples together).

Philcox and Eisenstein also investigated an alterative method to compute power spectra using pair counts instead of fourier transforms. While pair counts can be slower in some applications (primarily the small wavenumber limit), the method has some advantages: it is unbiased by the survey geometry, and it automatically removes shot noise. And because it is based on pair counts, we can use RascalC to compute covariances between these power spectra and the correlation functions.

We believe that these covariance matrix techniques will be of considerable use to DESI and other spectroscopic surveys.

Cosmological analysis methods: Eisenstein and Harvard graduate student Sihan (Sandy) Yuan published their paper on curious approximations to the covariances of the small-scale correlation functions, in which the inverse matrix features only a small number of non-zero off-diagonal terms. For example, we show that simple convolutional transformations of the correlation function leave the result nearly uncorrelated between scales.

Eisenstein and Yuan, with Alexie Leauthaud (Santa Cruz) also investigated the mismatch between the measured level of weak lensing around CMASS galaxies in the SDSS Baryon Oscillation Spectroscopic Survey and the level predicted by models of the two-point projected clustering. We found that our extended models of the halo occupation distribution, including an assembly bias term, were unable to explain this observational tension, despite a search over the full cosmology grid of the AbacusCosmos simulation suite. Essentially, having measured the host halo masses with weak lensing, we continue to find that these halos must be more clustered than is predicted by the N-body simulations.

Faced with this ongoing tension, Eisenstein has been collaborating with Sownak Bose, Boryana Hadzhiyska, Lars Hernquist, and David Spergel to investigate the halo occupation models in the state-of-the-art hydrodynamic galaxy formation simulation IllustrisTNG. While such simulations are surely not perfect, they are an example of how realistic treatments of gas physics and stellar feedback could set the properties of galaxies. In Bose et al., we match the simulated galaxies to halos in a matching dark-matter-only simulation and study the occupation of the halos as a function of mass and several other second parameters. We find non-negligible second parameter dependencies.

In Hadzhiyska et al., we show that the clustering of galaxies from the full-physics IllustrisTNG simulation does not match to the clustering that results from shuffling the galaxy occupations around halos of equal mass in the dark matter simulation. The clustering is larger, even at scales of 10 Mpc, and the result persists whether we use friends-of-friends or Rockstar halo catalogs. Note that this is in the same sense as the observed weak lensing tension. We believe this result is quite important: it means that the galaxies in the IllustrisTNG simulation do not follow the ansatz of the base halo occupation model, namely that halo mass predicts the galaxy occupation, and moreover that the breakdown of the model happens in a way that substantially changes the galaxy clustering. We show that using certain second parameters can restore the clustering agreement, but the usual choices of halo formation time or concentration do not. We expect that this result will force a substantial alteration to how galaxies are modeled in cosmological surveys.

Eisenstein and Tohoku graduate student Ryuichiro Hada published their new density-field reconstruction method, based on an iterative solution to recover the initial large-scale density field. Notably, this method handles redshift-space distortions much more cleanly than the original method; we anticipate that this will be useful for the DESI application. We are currently studying the covariance matrix of the correlation function that results from the reconstruction.

Eisenstein and Boston University graduate student Duan Yutong published our paper studying systematics in the measurement of the acoustic scale induced by variations in HOD mock catalogs in the Abacus simulations. We generally found excellent stability of the acoustic peak, with the largest trends correlating with changes in the intermediate-scale quadrupole.

Eisenstein and Harvard post-doc Michelle Ntampaka published a paper investigating how convolutional neural nets could be used to estimate cosmological parameters from three-dimensional galaxy maps. In particular, we constructed a hybrid network in which the measured power spectrum was input in addition to the pixelized map. This allows the net to learn all it can from the conventional two-point statistic, while it looks for higher-point patterns in the map. We trained the net using a wide variety of cosmologies and halo occupations, then showed that it could recover cosmological parameters on previously unseen examples. This was an initial foray into the method and proof of principle; we plan to extend this work with the new Summit simulations.

Eisenstein and Harvard graduate student Tanveer Karim have been preparing for the study of the lensing of the cosmic microwave background by DESI emission-line galaxies (ELG). The ELG sample will be our largest spectroscopic sample at redshift above 1, where the lensing of the CMB is strongest. Eventually we expect that this lensing will calibrate the galaxy-mass cross-correlation function and thereby allow estimation of the matter power spectrum amplitude from the galaxy auto-correlations. This in turn is important for the study of neutrino masses and the effects of dark energy on the growth of structure. Thus far, we are preparing for an analysis using the photometric ELG sample.

Eisenstein and Harvard graduate student Claire Lamman are studying the contamination of the redshift-space distortion measurement of luminous red galaxies by intrinsic alignment of their major axes. LRGs are known to have a small trend to point toward their neighbors, and since DESI preferentially selects higher surface brightness galaxies whose major axes are along the line-of-sight, there will be an unintended enhancement of neighbors in the line-of-sight direction. We have successfully measured the intrinsic alignment in the DESI LRG sample and are now working to determine the impact on the clustering quadrupole.

To conclude, we have achieved important progress on numerous fronts: contributing to the maturation of the DESI project, providing the world's largest suite of cosmological N-body simulations, and developing numerous new methods for the quantification of cosmological large-scale structure. Numerous students and post-doctoral fellows have been involved in this work, and we have published our results in numerous journal papers and made our N-body simulations public through the OLCF Constellation archive.

This research program will continue under a different grant number.

Publications

1. Hadzhiyska, B., Eisenstein, D., Bose, S., Garrison, L. H., Maksimova, N., "COMPASO: A new halo finder for competitive assignment to spherical overdensities", 2022, Monthly Notices of the Royal Astronomical Society, 509, 501–521, arXiv:2110.11408, DOI: 10.1093/mnras/stab2980

2. Maksimova, N. A., Garrison, L. H., Eisenstein, D. J., Hadzhiyska, B., Bose, S., Satterthwaite, T. P., "ABACUSSUMMIT: a massive set of high-accuracy, high-resolution N-body simulations", 2021, Monthly Notices of the Royal Astronomical Society, 508, 4017–4037, arXiv:2110.11398, DOI: 10.1093/mnras/stab2484

3. Hadzhiyska, B., Liu, S., Somerville, R. S., Gabrielpillai, A., Bose, S., Eisenstein, D., Hernquist, L., "Galaxy assembly bias and large-scale distribution: a comparison between IllustrisTNG and a semi-analytic model", 2021, Monthly Notices of the Royal Astronomical Society, 508, 698–718, arXiv:2108.00006, DOI: 10.1093/mnras/stab2564

4. Garrison, L. H., Eisenstein, D. J., Ferrer, D., Maksimova, N. A., Pinto, P. A., "The ABACUS cosmological N-body code", 2021, Monthly Notices of the Royal Astronomical Society, 508, 575–596, arXiv:2110.11392, DOI: 10.1093/mnras/stab2482

5. Hadzhiyska, B., Garrison, L. H., Eisenstein, D., Bose, S., "The halo light cone catalogues of ABACUSSUMMIT", 2021, Monthly Notices of the Royal Astronomical Society,-, arXiv:2110.11413, DOI: 10.1093/mnras/stab3066

6. Garrison, L. H., Joyce, M., Eisenstein, D. J., "Good and proper: self-similarity of N-body simulations with proper force softening", 2021, Monthly Notices of the Royal Astronomical Society, 504, 3550–3560, arXiv:2102.08972, DOI: 10.1093/mnras/stab1096

7. Zarrouk, P., Rezaie, M., Raichoor, A., Ross, A. J., Alam, S., Blum, R., Brookes, D., Chuang, C.-H., Cole, S., Dawson, K. S., Eisenstein, D. J., Kehoe, R., Landriau, M., Moustakas, J., Myers, A. D., Norberg, P., Percival, W. J., Prada, F., Schubnell, M., Seo, H.-J., Tarlé, G., Zhao, C., "Baryon acoustic oscillations in the projected cross-correlation function between the eBOSS DR16 quasars and photometric galaxies from the DESI Legacy Imaging Surveys", 2021, Monthly Notices of the Royal Astronomical Society, 503, 2562–2582, arXiv:2009.02308, DOI: 10.1093/mnras/stab298

8. Hadzhiyska, B., Tacchella, S., Bose, S., Eisenstein, D. J., "The galaxy-halo connection of emission-line galaxies in IllustrisTNG", 2021, Monthly Notices of the Royal Astronomical Society, 502, 3599–3617, arXiv:2011.05331, DOI: 10.1093/mnras/stab243

9. Yuan, S., Hadzhiyska, B., Bose, S., Eisenstein, D. J., Guo, H., "Evidence for galaxy assembly bias in BOSS CMASS redshift-space galaxy correlation function", 2021, Monthly Notices of the Royal Astronomical Society, 502, 3582–3598, arXiv:2010.04182, DOI: 10.1093/mnras/stab235

10. Ruiz-Macias, O., Zarrouk, P., Cole, S., Baugh, C. M., Norberg, P., Lucey, J., Dey, A., Eisenstein, D. J., Doel, P., Gaztañaga, E., Hahn, C., Kehoe, R., Kitanidis, E., Landriau, M., Lang, D., Moustakas, J., Myers, A. D., Prada, F., Schubnell, M., Weinberg, D. H., Wilson, M. J., "Characterizing the target selection pipeline for the Dark Energy Spectroscopic Instrument Bright Galaxy Survey", 2021, Monthly Notices of the Royal Astronomical Society, 502, 4328–4349, arXiv:2007.14950, DOI: 10.1093/mnras/stab292

11. Leroy, M., Garrison, L., Eisenstein, D., Joyce, M., Maleubre, S., "Testing dark matter halo properties using self-similarity", 2021, Monthly Notices of the Royal Astronomical Society, 501, 5064–5072, arXiv:2004.08406, DOI: 10.1093/mnras/staa3435

12. Joyce, M., Garrison, L., Eisenstein, D., "Quantifying resolution in cosmological N-body simulations using self-similarity", 2021, Monthly Notices of the Royal Astronomical Society, 501, 5051–5063, arXiv:2004.07256, DOI: 10.1093/mnras/staa3434

13. Hadzhiyska, B., Bose, S., Eisenstein, D., Hernquist, L., "Extensions to models of the galaxy-halo connection", 2021, Monthly Notices of the Royal Astronomical Society, 501, 1603–1620, arXiv:2008.04913, DOI: 10.1093/mnras/staa3776

14. Hou, J., Sánchez, A. G., Ross, A. J., Smith, A., Neveux, R., Bautista, J., Burtin, E., Zhao, C., Scoccimarro, R., Dawson, K. S., de Mattia, A., de la Macorra, A., du Mas des Bourboux, H., Eisenstein, D. J., Gil-Marín, H., Lyke, B. W., Mohammad, F. G., Mueller, E.-M., Percival, W. J., Rossi, G., Vargas Magaña, M., Zarrouk, P., Zhao, G.-B., Brinkmann, J., Brownstein, J. R., Chuang, C.-H., Myers, A. D., Newman, J. A., Schneider, D. P., Vivek, M., "The completed SDSS-IV extended Baryon Oscillation Spectroscopic Survey: BAO and RSD measurements from anisotropic clustering analysis of the quasar sample in configuration space between redshift 0.8 and 2.2", 2021, Monthly Notices of the Royal Astronomical Society, 500, 1201–1221, arXiv:2007.08998, DOI: 10.1093/mnras/staa3234

15. Karim, T., Lee, J. H., Eisenstein, D. J., Burtin, E., Moustakas, J., Raichoor, A., Yèche, C., "Validation of emission-line galaxies target selection algorithms for the Dark Energy Spectroscopic Instrument using the MMT Binospec", 2020, Monthly Notices of the Royal Astronomical Society, 497, 4587–4601, arXiv:2007.14484, DOI: 10.1093/mnras/staa2270

16. Hadzhiyska, B., Bose, S., Eisenstein, D., Hernquist, L., Spergel, D. N., "Limitations to the 'basic' HOD model and beyond", 2020, Monthly Notices of the Royal Astronomical Society, 493, 5506–5519, arXiv:1911.02610, DOI: 10.1093/mnras/staa623

17. Yuan, S., Eisenstein, D. J., Leauthaud, A., "Can assembly bias explain the lensing amplitude of the BOSS CMASS sample in a Planck cosmology?", 2020, Monthly Notices of the Royal Astronomical Society, 493, 5551–5564, arXiv:1907.05909, DOI: 10.1093/mnras/staa634

18. Ntampaka, M., Eisenstein, D. J., Yuan, S., Garrison, L. H., "A Hybrid Deep Learning Approach to Cosmological Constraints from Galaxy Redshift Surveys", 2020, The Astrophysical Journal, 889,-, arXiv:1909.10527, DOI: 10.3847/1538-4357/ab5f5e

19. Philcox, O. H. E., Eisenstein, D. J., "Computing the small-scale galaxy power spectrum and bispectrum in configuration space", 2020, Monthly Notices of the Royal Astronomical Society, 492, 1214–1242, arXiv:1912.01010, DOI: 10.1093/mnras/stz3335

20. Philcox, O. H. E., Eisenstein, D. J., O'Connell, R., Wiegand, A., "RASCALC: a jackknife approach to estimating single- and multitracer galaxy covariance matrices", 2020, Monthly Notices of the Royal Astronomical Society, 491, 3290–3317, arXiv:1904.11070, DOI: 10.1093/mnras/stz3218

21. Philcox, O. H. E., Eisenstein, D. J., "Estimating covariance matrices for two- and three-point correlation function moments in Arbitrary Survey Geometries", 2019, Monthly Notices of the Royal Astronomical Society, 490, 5931–5951, arXiv:1910.04764, DOI: 10.1093/mnras/stz2896

22. Duan, Y., Eisenstein, D., "Tests of acoustic scale shifts in halo-based mock galaxy catalogues", 2019, Monthly Notices of the Royal Astronomical Society, 490, 2718–2731, arXiv:1906.04262, DOI: 10.1093/mnras/stz2578

23. O'Connell, R., Eisenstein, D. J., "Large covariance matrices: accurate models without mocks", 2019, Monthly Notices of the Royal Astronomical Society, 487, 2701–2717, arXiv:1808.05978, DOI: 10.1093/mnras/stz1359

24. Yuan, S., Eisenstein, D. J., "Decorrelating the errors of the galaxy correlation function with compact transformation matrices", 2019, Monthly Notices of the Royal Astronomical Society, 486, 708–724, arXiv:1901.05019, DOI: 10.1093/mnras/stz899

25. Sullivan, J. M., Wiegand, A., Eisenstein, D. J., "The clustering of galaxies in the SDSS-III Baryon Oscillation Spectroscopic Survey: evolution of higher-order correlations demonstrated with Minkowski functionals", 2019, Monthly Notices of the Royal Astronomical Society, 485, 1708–1719, DOI: 10.1093/mnras/stz498

26. Garrison, L. H., Eisenstein, D. J., "Generating approximate halo catalogues for blind challenges in precision cosmology", 2019, Monthly Notices of the Royal Astronomical Society, 485, 2407–2416, arXiv:1902.09475, DOI: 10.1093/mnras/stz600

27. Garrison, L. H., Eisenstein, D. J., Pinto, P. A., "A high-fidelity realization of the Euclid code comparison N-body simulation with ABACUS", 2019, Monthly Notices of the Royal Astronomical Society, 485, 3370–3377, arXiv:1810.02916, DOI: 10.1093/mnras/stz634

28. Dey, A., Schlegel, D. J., Lang, D., Blum, R., Burleigh, K., Fan, X., Findlay, J. R., Finkbeiner, D., Herrera, D., Juneau, S., Landriau, M., Levi, M., McGreer, I., Meisner, A., Myers, A. D., Moustakas, J., Nugent, P., Patej, A., Schlafly, E. F., Walker, A. R., Valdes, F., Weaver, B. A., Yèche, C., Zou, H., Zhou, X., Abareshi, B., Abbott, T. M. C., Abolfathi, B., Aguilera, C., Alam, S., Allen, L., Alvarez, A., Annis, J., Ansarinejad, B., Aubert, M., Beechert, J., Bell, E. F., BenZvi, S. Y., Beutler, F., Bielby, R. M., Bolton, A. S., Briceño, C., Buckley-Geer, E. J., Butler, K., Calamida, A., Carlberg, R. G., Carter, P., Casas, R., Castander, F. J., Choi, Y., Comparat, J., Cukanovaite, E., Delubac, T., DeVries, K., Dey, S., Dhungana, G., Dickinson, M., Ding, Z., Donaldson, J. B., Duan, Y., Duckworth, C. J., Eftekharzadeh, S., Eisenstein, D. J., Etourneau, T., Fagrelius, P. A., Farihi, J., Fitzpatrick, M., Font-Ribera, A., Fulmer, L., Gänsicke, B. T., Gaztanaga, E., George, K., Gerdes, D. W., Gontcho, S. G. A., Gorgoni, C., Green, G., Guy, J., Harmer, D., Hernandez, M., Honscheid, K., Huang, L. W., James, D. J., Jannuzi, B. T., Jiang, L., Joyce, R., Karcher, A., Karkar, S., Kehoe, R., Kneib, J.-P., Kueter-Young, A., Lan, T.-W., Lauer, T. R., Le Guillou, L., Le Van Suu, A., Lee, J. H., Lesser, M., Perreault Levasseur, L., Li, T. S., Mann, J. L., Marshall, R., Martínez-Vázquez, C. E., Martini, P., du Mas des Bourboux, H., McManus, S., Meier, T. G., Ménard, B., Metcalfe, N., Muñoz-Gutiérrez, A., Najita, J., Napier, K., Narayan, G., Newman, J. A., Nie, J., Nord, B., Norman, D. J., Olsen, K. A. G., Paat, A., Palanque-Delabrouille, N., Peng, X., Poppett, C. L., Poremba, M. R., Prakash, A., Rabinowitz, D., Raichoor, A., Rezaie, M., Robertson, A. N., Roe, N. A., Ross, A. J., Ross, N. P., Rudnick, G., Safonova, S., Saha, A., Sánchez, F. J., Savary, E., Schweiker, H., Scott, A., Seo, H.-J., Shan, H., Silva, D. R., Slepian, Z., Soto, C., Sprayberry, D., Staten, R., Stillman, C. M., Stupak, R. J., Summers, D. L., Sien Tie, S., Tirado, H., Vargas-Magaña, M., Vivas, A. K., Wechsler, R. H., Williams, D., Yang, J., Yang, Q., Yapici, T., Zaritsky, D., Zenteno, A., Zhang, K., Zhang, T., Zhou, R., Zhou,

Z., "Overview of the DESI Legacy Imaging Surveys", 2019, The Astronomical Journal, 157,-, arXiv:1804.08657, DOI: 10.3847/1538-3881/ab089d

29. Hada, R., Eisenstein, D. J., "Application of the iterative reconstruction to simulated galaxy fields", 2019, Monthly Notices of the Royal Astronomical Society, 482, 5685–5693, arXiv:1810.05026, DOI: 10.1093/mnras/sty3137

30. Yuan, S., Eisenstein, D. J., Garrison, L. H., "Exploring the squeezed three-point galaxy correlation function with generalized halo occupation distribution models", 2018, Monthly Notices of the Royal Astronomical Society, 478, 2019–2033, arXiv:1802.10115, DOI: 10.1093/mnras/sty1089

31. Hada, R., Eisenstein, D. J., "An iterative reconstruction of cosmological initial density fields", 2018, Monthly Notices of the Royal Astronomical Society, 478, 1866–1874, arXiv:1804.04738, DOI: 10.1093/mnras/sty1203

32. Slepian, Z., Eisenstein, D. J., "A practical computational method for the anisotropic redshift-space three-point correlation function", 2018, Monthly Notices of the Royal Astronomical Society, 478, 1468–1483, arXiv:1709.10150, DOI: 10.1093/mnras/sty1063

33. Patej, A., Eisenstein, D. J., "Analysing baryon acoustic oscillations in sparse spectroscopic samples via cross-correlation with dense photometry", 2018, Monthly Notices of the Royal Astronomical Society, 477, 5090–5103, arXiv:1709.03514, DOI: 10.1093/mnras/sty870

34. Garrison, L. H., Eisenstein, D. J., Ferrer, D., Tinker, J. L., Pinto, P. A., Weinberg, D. H., "The Abacus Cosmos: A Suite of Cosmological N-body Simulations", 2018, The Astrophysical Journal Supplement Series, 236,-, arXiv:1712.05768, DOI: 10.3847/1538-4365/aabfd3

35. Abolfathi, B., Aguado, D. S., Aguilar, G., Allende Prieto, C., Almeida, A., Ananna, T. T., Anders, F., Anderson, S. F., Andrews, B. H., Anguiano, B., Aragón-Salamanca, A., Argudo-Fernández, M., Armengaud, E., Ata, M., Aubourg, E., Avila-Reese, V., Badenes, C., Bailey, S., Balland, C., Barger, K. A., Barrera-Ballesteros, J., Bartosz, C., Bastien, F., Bates, D., Baumgarten, F., Bautista, J., Beaton, R., Beers, T. C., Belfiore, F., Bender, C. F., Bernardi, M., Bershady, M. A., Beutler, F., Bird, J. C., Bizyaev, D., Blanc, G. A., Blanton, M. R., Blomqvist, M., Bolton, A. S., Boquien, M., Borissova, J., Bovy, J., Bradna Diaz, C. A., Brandt, W. N., Brinkmann, J., Brownstein, J. R., Bundy, K., Burgasser, A. J., Burtin, E., Busca, N. G., Cañas, C. I., Cano-Díaz, M., Cappellari, M., Carrera, R., Casey, A. R., Cervantes Sodi, B., Chen, Y., Cherinka, B., Chiappini, C., Choi, P. D., Chojnowski, D., Chuang, C.-H., Chung, H., Clerc, N., Cohen, R. E., Comerford, J. M., Comparat, J., Correa do Nascimento, J., da Costa, L., Cousinou, M.-C., Covey, K., Crane, J. D., Cruz-Gonzalez, I., Cunha, K., da Silva Ilha, G., Damke, G. J., Darling, J., Davidson, J. W., Dawson, K., de Icaza Lizaola, M. A. C., de la Macorra, A., de la Torre, S., De Lee, N., de Sainte Agathe, V., Deconto Machado, A., Dell'Agli, F., Delubac, T., Diamond-Stanic, A. M., Donor, J., Downes, J. J., Drory, N., du Mas des Bourboux, H., Duckworth, C. J., Dwelly, T., Dyer, J., Ebelke, G., Davis Eigenbrot, A., Eisenstein, D. J., Elsworth, Y. P., Emsellem, E., Eracleous, M., Erfanianfar, G., Escoffier, S., Fan, X., Fernández Alvar, E., Fernandez-Trincado, J. G., Fernando Cirolini, R., Feuillet, D., Finoguenov, A., Fleming, S. W., Font-Ribera, A., Freischlad, G., Frinchaboy, P., Fu, H., Gómez Maqueo Chew, Y., Galbany, L., García Pérez, A. E., Garcia-Dias, R., García-Hernández, D. A., Garma Oehmichen, L. A., Gaulme, P., Gelfand, J., Gil-Marín, H., Gillespie, B. A., Goddard, D., González Hernández, J. I., Gonzalez-Perez, V., Grabowski, K.,

Green, P. J., Grier, C. J., Gueguen, A., Guo, H., Guy, J., Hagen, A., Hall, P., Harding, P., Hasselquist, S., Hawley, S., Hayes, C. R., Hearty, F., Hekker, S., Hernandez, J., Hernandez Toledo, H., Hogg, D. W., Holley-Bockelmann, K., Holtzman, J. A., Hou, J., Hsieh, B.-C., Hunt, J. A. S., Hutchinson, T. A., Hwang, H. S., Jimenez Angel, C. E., Johnson, J. A., Jones, A., Jönsson, H., Jullo, E., Khan, F. S., Kinemuchi, K., Kirkby, D., Kirkpatrick, C. C., Kitaura, F.-S., Knapp, G. R., Kneib, J.-P., Kollmeier, J. A., Lacerna, I., Lane, R. R., Lang, D., Law, D. R., Le Goff, J.-M., Lee, Y.-B., Li, H., Li, C., Lian, J., Liang, Y., Lima, M., Lin, L., Long, D., Lucatello, S., Lundgren, B., Mackereth, J. T., MacLeod, C. L., Mahadevan, S., Maia, M. A. G., Majewski, S., Manchado, A., Maraston, C., Mariappan, V., Marques-Chaves, R., Masseron, T., Masters, K. L., McDermid, R. M., McGreer, I. D., Melendez, M., Meneses-Goytia, S., Merloni, A., Merrifield, M. R., Meszaros, S., Meza, A., Minchev, I., Minniti, D., Mueller, E.-M., Muller-Sanchez, F., Muna, D., Muñoz, R. R., Myers, A. D., Nair, P., Nandra, K., Ness, M., Newman, J. A., Nichol, R. C., Nidever, D. L., Nitschelm, C., Noterdaeme, P., O'Connell, J., Oelkers, R. J., Oravetz, A., Oravetz, D., Ortíz, E. A., Osorio, Y., Pace, Z., Padilla, N., Palanque-Delabrouille, N., Palicio, P. A., Pan, H.-A., Pan, K., Parikh, T., Pâris, I., Park, C., Peirani, S., Pellejero-Ibanez, M., Penny, S., Percival, W. J., Perez-Fournon, I., Petitjean, P., Pieri, M. M., Pinsonneault, M., Pisani, A., Prada, F., Prakash, A., Queiroz, A. B. de A., Raddick, M. J., Raichoor, A., Barboza Rembold, S., Richstein, H., Riffel, R. A., Riffel, R., Rix, H.-W., Robin, A. C., Rodríguez Torres, S., Román-Zúñiga, C., Ross, A. J., Rossi, G., Ruan, J., Ruggeri, R., Ruiz, J., Salvato, M., Sánchez, A. G., Sánchez, S. F., Sanchez Almeida, J., Sánchez-Gallego, J. R., Santana Rojas, F. A., Santiago, B. X., Schiavon, R. P., Schimoia, J. S., Schlafly, E., Schlegel, D., Schneider, D. P., Schuster, W. J., Schwope, A., Seo, H.-J., Serenelli, A., Shen, S., Shen, Y., Shetrone, M., Shull, M., Silva Aguirre, V., Simon, J. D., Skrutskie, M., Slosar, A., Smethurst, R., Smith, V., Sobeck, J., Somers, G., Souter, B. J., Souto, D., Spindler, A., Stark, D. V., Stassun, K., Steinmetz, M., Stello, D., Storchi-Bergmann, T., Streblyanska, A., Stringfellow, G. S., Suárez, G., Sun, J., Szigeti, L., Taghizadeh-Popp, M., Talbot, M. S., Tang, B., Tao, C., Tayar, J., Tembe, M., Teske, J., Thakar, A. R., Thomas, D., Tissera, P., Tojeiro, R., Tremonti, C., Troup, N. W., Urry, M., Valenzuela, O., van den Bosch, R., Vargas-González, J., Vargas-Magaña, M., Vazquez, J. A., Villanova, S., Vogt, N., Wake, D., Wang, Y., Weaver, B. A., Weijmans, A.-M., Weinberg, D. H., Westfall, K. B., Whelan, D. G., Wilcots, E., Wild, V., Williams, R. A., Wilson, J., Wood-Vasey, W. M., Wylezalek, D., Xiao, T., Yan, R., Yang, M., Ybarra, J. E., Yèche, C., Zakamska, N., Zamora, O., Zarrouk, P., Zasowski, G., Zhang, K., Zhao, C., Zhao, G.-B., Zheng, Z., Zheng, Z., Zhou, Z.-M., Zhu, G., Zinn, J. C., Zou, H., "The Fourteenth Data Release of the Sloan Digital Sky Survey: First Spectroscopic Data from the Extended Baryon Oscillation Spectroscopic Survey and from the Second Phase of the Apache Point Observatory Galactic Evolution Experiment", 2018, The Astrophysical Journal Supplement Series, 235,-, arXiv:1707.09322, DOI: 10.3847/1538-4365/aa9e8a

36. Ata, M., Baumgarten, F., Bautista, J., Beutler, F., Bizyaev, D., Blanton, M. R., Blazek, J. A., Bolton, A. S., Brinkmann, J., Brownstein, J. R., Burtin, E., Chuang, C.-H., Comparat, J., Dawson, K. S., de la Macorra, A., Du, W., du Mas des Bourboux, H., Eisenstein, D. J., Gil-Marín, H., Grabowski, K., Guy, J., Hand, N., Ho, S., Hutchinson, T. A., Ivanov, M. M., Kitaura, F.-S., Kneib, J.-P., Laurent, P., Le Goff, J.-M., McEwen, J. E., Mueller, E.-M., Myers, A. D., Newman, J. A., Palanque-Delabrouille, N., Pan, K., Pâris, I., Pellejero-Ibanez, M., Percival, W. J., Petitjean, P., Prada, F., Prakash, A., Rodríguez-Torres, S. A., Ross, A. J., Rossi, G., Ruggeri, R., Sánchez, A. G., Satpathy, S., Schlegel, D. J., Schneider, D. P., Seo, H.-J., Slosar, A., Streblyanska, A., Tinker, J. L., Tojeiro, R., Vargas Magaña, M.,

Vivek, M., Wang, Y., Yèche, C., Yu, L., Zarrouk, P., Zhao, C., Zhao, G.-B., Zhu, F., "The clustering of the SDSS-IV extended Baryon Oscillation Spectroscopic Survey DR14 quasar sample: first measurement of baryon acoustic oscillations between redshift 0.8 and 2.2", 2018, Monthly Notices of the Royal Astronomical Society, 473, 4773–4794, arXiv:1705.06373, DOI: 10.1093/mnras/stx2630

37. Slepian, Z., Eisenstein, D. J., Blazek, J. A., Brownstein, J. R., Chuang, C.-H., Gil-Marín, H., Ho, S., Kitaura, F.-S., McEwen, J. E., Percival, W. J., Ross, A. J., Rossi, G., Seo, H.-J., Slosar, A., Vargas-Magaña, M., "Constraining the baryon-dark matter relative velocity with the large-scale three-point correlation function of the SDSS BOSS DR12 CMASS galaxies", 2018, Monthly Notices of the Royal Astronomical Society, 474, 2109–2115, arXiv:1607.06098, DOI: 10.1093/mnras/stx2723

38. du Mas des Bourboux, H., Le Goff, J.-M., Blomqvist, M., Busca, N. G., Guy, J., Rich, J., Yèche, C., Bautista, J. E., Burtin, É., Dawson, K. S., Eisenstein, D. J., Font-Ribera, A., Kirkby, D., Miralda-Escudé, J., Noterdaeme, P., Palanque-Delabrouille, N., Pâris, I., Petitjean, P., Pérez-Ràfols, I., Pieri, M. M., Ross, N. P., Schlegel, D. J., Schneider, D. P., Slosar, A., Weinberg, D. H., Zarrouk, P., "Baryon acoustic oscillations from the complete SDSS-III Lyα-quasar cross-correlation function at z = 2.4", 2017, Astronomy and Astrophysics, 608,-, arXiv:1708.02225, DOI: 10.1051/0004-6361/201731731

39. Yuan, S., Eisenstein, D. J., Garrison, L. H., "Using galaxy pairs to investigate the three-point correlation function in the squeezed limit", 2017, Monthly Notices of the Royal Astronomical Society, 472, 577–590, arXiv:1705.03464, DOI: 10.1093/mnras/stx2032

40. Alam, S., Ata, M., Bailey, S., Beutler, F., Bizyaev, D., Blazek, J. A., Bolton, A. S., Brownstein, J. R., Burden, A., Chuang, C.-H., Comparat, J., Cuesta, A. J., Dawson, K. S., Eisenstein, D. J., Escoffier, S., Gil-Marín, H., Grieb, J. N., Hand, N., Ho, S., Kinemuchi, K., Kirkby, D., Kitaura, F., Malanushenko, E., Malanushenko, V., Maraston, C., McBride, C. K., Nichol, R. C., Olmstead, M. D., Oravetz, D., Padmanabhan, N., Palanque-Delabrouille, N., Pan, K., Pellejero-Ibanez, M., Percival, W. J., Petitjean, P., Prada, F., Price-Whelan, A. M., Reid, B. A., Rodríguez-Torres, S. A., Roe, N. A., Ross, A. J., Ross, N. P., Rossi, G., Rubiño-Martín, J. A., Saito, S., Salazar-Albornoz, S., Samushia, L., Sánchez, A. G., Satpathy, S., Schlegel, D. J., Schneider, D. P., Scóccola, C. G., Seo, H.-J., Sheldon, E. S., Simmons, A., Slosar, A., Strauss, M. A., Swanson, M. E. C., Thomas, D., Tinker, J. L., Tojeiro, R., Magaña, M. V., Vazquez, J. A., Verde, L., Wake, D. A., Wang, Y., Weinberg, D. H., White, M., Wood-Vasey, W. M., Yèche, C., Zehavi, I., Zhai, Z., Zhao, G.-B., "The clustering of galaxies in the completed SDSS-III Baryon Oscillation Spectroscopic Survey: cosmological analysis of the DR12 galaxy sample", 2017, Monthly Notices of the Royal Astronomical Society, 470, 2617–2652, arXiv:1607.03155, DOI: 10.1093/mnras/stx721

41. Slepian, Z., Eisenstein, D. J., Brownstein, J. R., Chuang, C.-H., Gil-Marín, H., Ho, S., Kitaura, F.-S., Percival, W. J., Ross, A. J., Rossi, G., Seo, H.-J., Slosar, A., Vargas-Magaña, M., "Detection of baryon acoustic oscillation features in the large-scale three-point correlation function of SDSS BOSS DR12 CMASS galaxies", 2017, Monthly Notices of the Royal Astronomical Society, 469, 1738–1751, arXiv:1607.06097, DOI: 10.1093/mnras/stx488

42. Slepian, Z., Eisenstein, D. J., "Modelling the large-scale redshift-space 3-point correlation function of galaxies", 2017, Monthly Notices of the Royal Astronomical Society, 469, 2059–2076, arXiv:1607.03109, DOI: 10.1093/mnras/stx490

43. Friesen, B., Patwary, M. M. A., Austin, B., Satish, N., Slepian, Z., Sundaram, N., Bard, D., Eisenstein, D. J., Deslippe, J., Dubey, P., Prabhat, “Galactos: Computing the Anisotropic 3-Point Correlation Function for 2 Billion Galaxies”, 2017, arXiv e-prints,-, arXiv:1709.00086, DOI:

44. Bautista, J. E., Busca, N. G., Guy, J., Rich, J., Blomqvist, M., du Mas des Bourboux, H., Pieri, M. M., Font-Ribera, A., Bailey, S., Delubac, T., Kirkby, D., Le Goff, J.-M., Margala, D., Slosar, A., Vazquez, J. A., Brownstein, J. R., Dawson, K. S., Eisenstein, D. J., Miralda-Escudé, J., Noterdaeme, P., Palanque-Delabrouille, N., Pâris, I., Petitjean, P., Ross, N. P., Schneider, D. P., Weinberg, D. H., Yèche, C., “Measurement of baryon acoustic oscillation correlations at z = 2.3 with SDSS DR12 Lyα-Forests”, 2017, Astronomy and Astrophysics, 603,-, arXiv:1702.00176, DOI: 10.1051/0004-6361/201730533

45. Slepian, Z., Eisenstein, D. J., Beutler, F., Chuang, C.-H., Cuesta, A. J., Ge, J., Gil-Marín, H., Ho, S., Kitaura, F.-S., McBride, C. K., Nichol, R. C., Percival, W. J., Rodríguez-Torres, S., Ross, A. J., Scoccimarro, R., Seo, H.-J., Tinker, J., Tojeiro, R., Vargas-Magaña, M., “The large-scale three-point correlation function of the SDSS BOSS DR12 CMASS galaxies”, 2017, Monthly Notices of the Royal Astronomical Society, 468, 1070–1083, arXiv:1512.02231, DOI: 10.1093/mnras/stw3234

46. Wiegand, A., Eisenstein, D. J., “The clustering of galaxies in the SDSS-III Baryon Oscillation Spectroscopic Survey: higher order correlations revealed by germ-grain Minkowski functionals”, 2017, Monthly Notices of the Royal Astronomical Society, 467, 3361–3378, arXiv:1609.08613, DOI: 10.1093/mnras/stx292

47. O'Connell, R., Eisenstein, D., Vargas, M., Ho, S., Padmanabhan, N., “Large covariance matrices: smooth models from the two-point correlation function”, 2016, Monthly Notices of the Royal Astronomical Society, 462, 2681–2694, arXiv:1510.01740, DOI: 10.1093/mnras/stw1821

48. Garrison, L. H., Eisenstein, D. J., Ferrer, D., Metchnik, M. V., Pinto, P. A., “Improving initial conditions for cosmological N-body simulations”, 2016, Monthly Notices of the Royal Astronomical Society, 461, 4125–4145, arXiv:1605.02333, DOI: 10.1093/mnras/stw1594

49. DESI Collaboration, Aghamousa, A., Aguilar, J., Ahlen, S., Alam, S., Allen, L. E., Allende Prieto, C., Annis, J., Bailey, S., Balland, C., Ballester, O., Baltay, C., Beaufore, L., Bebek, C., Beers, T. C., Bell, E. F., Bernal, J. L., Besuner, R., Beutler, F., Blake, C., Bleuler, H., Blomqvist, M., Blum, R., Bolton, A. S., Briceno, C., Brooks, D., Brownstein, J. R., Buckley-Geer, E., Burden, A., Burtin, E., Busca, N. G., Cahn, R. N., Cai, Y.-C., Cardiel-Sas, L., Carlberg, R. G., Carton, P.-H., Casas, R., Castander, F. J., Cervantes-Cota, J. L., Claybaugh, T. M., Close, M., Coker, C. T., Cole, S., Comparat, J., Cooper, A. P., Cousinou, M.-C., Crocce, M., Cuby, J.-G., Cunningham, D. P., Davis, T. M., Dawson, K. S., de la Macorra, A., De Vicente, J., Delubac, T., Derwent, M., Dey, A., Dhungana, G., Ding, Z., Doel, P., Duan, Y. T., Ealet, A., Edelstein, J., Eftekharzadeh, S., Eisenstein, D. J., Elliott, A., Escoffier, S., Evatt, M., Fagrelius, P., Fan, X., Fanning, K., Farahi, A., Farihi, J., Favole, G., Feng, Y., Fernandez, E., Findlay, J. R., Finkbeiner, D. P., Fitzpatrick, M. J., Flaugher, B., Flender, S., Font-Ribera, A., Forero-Romero, J. E., Fosalba, P., Frenk, C. S., Fumagalli, M., Gaensicke, B. T., Gallo, G., Garcia-Bellido, J., Gaztanaga, E., Pietro Gentile Fusillo, N., Gerard, T., Gershkovich, I., Giannantonio, T., Gillet, D., Gonzalez-de-Rivera, G., Gonzalez-Perez, V., Gott, S., Graur, O., Gutierrez, G., Guy, J., Habib, S., Heetderks, H., Heetderks, I., Heitmann, K., Hellwing, W. A., Herrera, D. A., Ho, S., Holland, S., Honscheid, K., Huff, E.,

Hutchinson, T. A., Huterer, D., Hwang, H. S., Illa Laguna, J. M., Ishikawa, Y., Jacobs, D., Jeffrey, N., Jelinsky, P., Jennings, E., Jiang, L., Jimenez, J., Johnson, J., Joyce, R., Jullo, E., Juneau, S., Kama, S., Karcher, A., Karkar, S., Kehoe, R., Kennamer, N., Kent, S., Kilbinger, M., Kim, A. G., Kirkby, D., Kisner, T., Kitanidis, E., Kneib, J.-P., Koposov, S., Kovacs, E., Koyama, K., Kremin, A., Kron, R., Kronig, L., Kueter-Young, A., Lacey, C. G., Lafever, R., Lahav, O., Lambert, A., Lampton, M., Landriau, M., Lang, D., Lauer, T. R., Le Goff, J.-M., Le Guillou, L., Le Van Suu, A., Lee, J. H., Lee, S.-J., Leitner, D., Lesser, M., Levi, M. E., L'Huillier, B., Li, B., Liang, M., Lin, H., Linder, E., Loebman, S. R., Lukić, Z., Ma, J., MacCrann, N., Magneville, C., Makarem, L., Manera, M., Manser, C. J., Marshall, R., Martini, P., Massey, R., Matheson, T., McCauley, J., McDonald, P., McGreer, I. D., Meisner, A., Metcalfe, N., Miller, T. N., Miquel, R., Moustakas, J., Myers, A., Naik, M., Newman, J. A., Nichol, R. C., Nicola, A., Nicolati da Costa, L., Nie, J., Niz, G., Norberg, P., Nord, B., Norman, D., Nugent, P., O'Brien, T., Oh, M., Olsen, K. A. G., Padilla, C., Padmanabhan, H., Padmanabhan, N., Palanque-Delabrouille, N., Palmese, A., Pappalardo, D., Pâris, I., Park, C., Patej, A., Peacock, J. A., Peiris, H. V., Peng, X., Percival, W. J., Perruchot, S., Pieri, M. M., Pogge, R., Pollack, J. E., Poppett, C., Prada, F., Prakash, A., Probst, R. G., Rabinowitz, D., Raichoor, A., Ree, C. H., Refregier, A., Regal, X., Reid, B., Reil, K., Rezaie, M., Rockosi, C. M., Roe, N., Ronayette, S., Roodman, A., Ross, A. J., Ross, N. P., Rossi, G., Rozo, E., Ruhlmann-Kleider, V., Rykoff, E. S., Sabiu, C., Samushia, L., Sanchez, E., Sanchez, J., Schlegel, D. J., Schneider, M., Schubnell, M., Secroun, A., Seljak, U., Seo, H.-J., Serrano, S., Shafieloo, A., Shan, H., Sharples, R., Sholl, M. J., Shourt, W. V., Silber, J. H., Silva, D. R., Sirk, M. M., Slosar, A., Smith, A., Smoot, G. F., Som, D., Song, Y.-S., Sprayberry, D., Staten, R., Stefanik, A., Tarle, G., Sien Tie, S., Tinker, J. L., Tojeiro, R., Valdes, F., Valenzuela, O., Valluri, M., Vargas-Magana, M., Verde, L., Walker, A. R., Wang, J., Wang, Y., Weaver, B. A., Weaverdyck, C., Wechsler, R. H., Weinberg, D. H., White, M., Yang, Q., Yeche, C., Zhang, T., Zhao, G.-B., Zheng, Y., Zhou, X., Zhou, Z., Zhu, Y., Zou, H., Zu, Y., "The DESI Experiment Part II: Instrument Design", 2016, arXiv e-prints,-, arXiv:1611.00037, DOI:

50. DESI Collaboration, Aghamousa, A., Aguilar, J., Ahlen, S., Alam, S., Allen, L. E., Allende Prieto, C., Annis, J., Bailey, S., Balland, C., Ballester, O., Baltay, C., Beaufore, L., Bebek, C., Beers, T. C., Bell, E. F., Bernal, J. L., Besuner, R., Beutler, F., Blake, C., Bleuler, H., Blomqvist, M., Blum, R., Bolton, A. S., Briceno, C., Brooks, D., Brownstein, J. R., Buckley-Geer, E., Burden, A., Burtin, E., Busca, N. G., Cahn, R. N., Cai, Y.-C., Cardiel-Sas, L., Carlberg, R. G., Carton, P.-H., Casas, R., Castander, F. J., Cervantes-Cota, J. L., Claybaugh, T. M., Close, M., Coker, C. T., Cole, S., Comparat, J., Cooper, A. P., Cousinou, M.-C., Crocce, M., Cuby, J.-G., Cunningham, D. P., Davis, T. M., Dawson, K. S., de la Macorra, A., De Vicente, J., Delubac, T., Derwent, M., Dey, A., Dhungana, G., Ding, Z., Doel, P., Duan, Y. T., Ealet, A., Edelstein, J., Eftekharzadeh, S., Eisenstein, D. J., Elliott, A., Escoffier, S., Evatt, M., Fagrelius, P., Fan, X., Fanning, K., Farahi, A., Farihi, J., Favole, G., Feng, Y., Fernandez, E., Findlay, J. R., Finkbeiner, D. P., Fitzpatrick, M. J., Flaugher, B., Flender, S., Font-Ribera, A., Forero-Romero, J. E., Fosalba, P., Frenk, C. S., Fumagalli, M., Gaensicke, B. T., Gallo, G., Garcia-Bellido, J., Gaztanaga, E., Pietro Gentile Fusillo, N., Gerard, T., Gershkovich, I., Giannantonio, T., Gillet, D., Gonzalez-de-Rivera, G., Gonzalez-Perez, V., Gott, S., Graur, O., Gutierrez, G., Guy, J., Habib, S., Heetderks, H., Heetderks, I., Heitmann, K., Hellwing, W. A., Herrera, D. A., Ho, S., Holland, S., Honscheid, K., Huff, E., Hutchinson, T. A., Huterer, D., Hwang, H. S., Illa Laguna, J. M., Ishikawa, Y., Jacobs, D., Jeffrey, N., Jelinsky, P., Jennings, E., Jiang, L., Jimenez, J., Johnson, J., Joyce, R., Jullo, E.,

Juneau, S., Kama, S., Karcher, A., Karkar, S., Kehoe, R., Kennamer, N., Kent, S., Kilbinger, M., Kim, A. G., Kirkby, D., Kisner, T., Kitanidis, E., Kneib, J.-P., Koposov, S., Kovacs, E., Koyama, K., Kremin, A., Kron, R., Kronig, L., Kueter-Young, A., Lacey, C. G., Lafever, R., Lahav, O., Lambert, A., Lampton, M., Landriau, M., Lang, D., Lauer, T. R., Le Goff, J.-M., Le Guillou, L., Le Van Suu, A., Lee, J. H., Lee, S.-J., Leitner, D., Lesser, M., Levi, M. E., L'Huillier, B., Li, B., Liang, M., Lin, H., Linder, E., Loebman, S. R., Lukić, Z., Ma, J., MacCrann, N., Magneville, C., Makarem, L., Manera, M., Manser, C. J., Marshall, R., Martini, P., Massey, R., Matheson, T., McCauley, J., McDonald, P., McGreer, I. D., Meisner, A., Metcalfe, N., Miller, T. N., Miquel, R., Moustakas, J., Myers, A., Naik, M., Newman, J. A., Nichol, R. C., Nicola, A., Nicolati da Costa, L., Nie, J., Niz, G., Norberg, P., Nord, B., Norman, D., Nugent, P., O'Brien, T., Oh, M., Olsen, K. A. G., Padilla, C., Padmanabhan, H., Padmanabhan, N., Palanque-Delabrouille, N., Palmese, A., Pappalardo, D., Pâris, I., Park, C., Patej, A., Peacock, J. A., Peiris, H. V., Peng, X., Percival, W. J., Perruchot, S., Pieri, M. M., Pogge, R., Pollack, J. E., Poppett, C., Prada, F., Prakash, A., Probst, R. G., Rabinowitz, D., Raichoor, A., Ree, C. H., Refregier, A., Regal, X., Reid, B., Reil, K., Rezaie, M., Rockosi, C. M., Roe, N., Ronayette, S., Roodman, A., Ross, A. J., Ross, N. P., Rossi, G., Rozo, E., Ruhlmann-Kleider, V., Rykoff, E. S., Sabiu, C., Samushia, L., Sanchez, E., Sanchez, J., Schlegel, D. J., Schneider, M., Schubnell, M., Secroun, A., Seljak, U., Seo, H.-J., Serrano, S., Shafieloo, A., Shan, H., Sharples, R., Sholl, M. J., Shourt, W. V., Silber, J. H., Silva, D. R., Sirk, M. M., Slosar, A., Smith, A., Smoot, G. F., Som, D., Song, Y.-S., Sprayberry, D., Staten, R., Stefanik, A., Tarle, G., Sien Tie, S., Tinker, J. L., Tojeiro, R., Valdes, F., Valenzuela, O., Valluri, M., Vargas-Magana, M., Verde, L., Walker, A. R., Wang, J., Wang, Y., Weaver, B. A., Weaverdyck, C., Wechsler, R. H., Weinberg, D. H., White, M., Yang, Q., Yeche, C., Zhang, T., Zhao, G.-B., Zheng, Y., Zhou, X., Zhou, Z., Zhu, Y., Zou, H., Zu, Y., "The DESI Experiment Part I: Science,Targeting, and Survey Design", 2016, arXiv e-prints,-, arXiv:1611.00036, DOI:

51. Patej, A., Eisenstein, D., "Quantifying the colour-dependent stochasticity of large-scale structure", 2016, Monthly Notices of the Royal Astronomical Society, 460, 1310–1317, arXiv:1510.01737, DOI: 10.1093/mnras/stw635

52. Cuesta, A. J., Vargas-Magaña, M., Beutler, F., Bolton, A. S., Brownstein, J. R., Eisenstein, D. J., Gil-Marín, H., Ho, S., McBride, C. K., Maraston, C., Padmanabhan, N., Percival, W. J., Reid, B. A., Ross, A. J., Ross, N. P., Sánchez, A. G., Schlegel, D. J., Schneider, D. P., Thomas, D., Tinker, J., Tojeiro, R., Verde, L., White, M., "The clustering of galaxies in the SDSS-III Baryon Oscillation Spectroscopic Survey: baryon acoustic oscillations in the correlation function of LOWZ and CMASS galaxies in Data Release 12", 2016, Monthly Notices of the Royal Astronomical Society, 457, 1770–1785, arXiv:1509.06371, DOI: 10.1093/mnras/stw066

53. Eisenstein, D., "Mapping the Universe's Ancient Sound Waves", 2016, Sky and Telescope, 131, 22-, DOI:

54. Slepian, Z., Eisenstein, D. J., "A simple analytic treatment of linear growth of structure with baryon acoustic oscillations", 2016, Monthly Notices of the Royal Astronomical Society, 457, 24–37, arXiv:1509.08199, DOI: 10.1093/mnras/stv2889

55. Slepian, Z., Eisenstein, D. J., "Accelerating the two-point and three-point galaxy correlation functions using Fourier transforms", 2016, Monthly Notices of the Royal Astronomical Society, 455, L31–L35, arXiv:1506.04746, DOI: 10.1093/mnrasl/slv133

56. Reid, B., Ho, S., Padmanabhan, N., Percival, W. J., Tinker, J., Tojeiro, R., White, M., Eisenstein, D. J., Maraston, C., Ross, A. J., Sánchez, A. G., Schlegel, D., Sheldon, E., Strauss, M. A., Thomas, D., Wake, D., Beutler, F., Bizyaev, D., Bolton, A. S., Brownstein, J. R., Chuang, C.-H., Dawson, K., Harding, P., Kitaura, F.-S., Leauthaud, A., Masters, K., McBride, C. K., More, S., Olmstead, M. D., Oravetz, D., Nuza, S. E., Pan, K., Parejko, J., Pforr, J., Prada, F., Rodríguez-Torres, S., Salazar-Albornoz, S., Samushia, L., Schneider, D. P., Scóccola, C. G., Simmons, A., Vargas-Magana, M., "SDSS-III Baryon Oscillation Spectroscopic Survey Data Release 12: galaxy target selection and large-scale structure catalogues", 2016, Monthly Notices of the Royal Astronomical Society, 455, 1553–1573, arXiv:1509.06529, DOI: 10.1093/mnras/stv2382

57. Slepian, Z., Eisenstein, D. J., "Computing the three-point correlation function of galaxies in $O(N\hat{2})$ time", 2015, Monthly Notices of the Royal Astronomical Society, 454, 4142–4158, arXiv:1506.02040, DOI: 10.1093/mnras/stv2119