

# SS 2019

## Cosmology and Large-scale-structure Seminars: Presentation Topics

Luca Amendola, ITP Heidelberg University  
l.amendola@thphys.uni-heidelberg.de

(use of previous material originally presented by C. Pfrommer and J. Hennawi)

- 1. Supernovae and cosmology
- 2. Cold Dark Matter and numerical cosmology
- 3. From dark matter halos to galaxies
- 4. Alternatives to a cosmological constant
- 5. Cosmic Microwave Background
- 6. Gravitational Lensing
- 7. Gravitational Lensing of the CMB
- 8. CMB polarisation and GW from inflation
- 9. Galaxy clusters as cosmological probes
- 10. The Sunyaev-Zel'dovich effect
- 11. Strong gravitational lensing
- 12. Non-einsteinian gravity
- 13. Gravitational waves and cosmology
- 14. Galaxy clustering and baryon acoustic oscillations
- 15. The Lyman-alpha Forest & the Intergalactic Medium
- 16. First Light & Cosmic Reionization
- 17. Cosmological tests of gravity
- 18. Growth of linear cosmological fluctuations
- 19. Baryogenesis
- 20. Reheating in inflation

### **1. Supernovae and Cosmology**

Nobel Prize: [http://www.nobelprize.org/nobel\\_prizes/physics/laureates/2011/#](http://www.nobelprize.org/nobel_prizes/physics/laureates/2011/#)

SCP Website: <http://supernova.lbl.gov>

Popular Article: *Supernovae, Dark Energy, and the Accelerating Universe*  
Perlmutter, S. 2003, Physics Today, 56, 040000  
<http://supernova.lbl.gov/PDFs/PhysicsTodayArticle.pdf>

Review Article: *Measuring Cosmology with Supernovae*  
Perlmutter, S., & Schmidt, B.~P. 2003, *Supernovae and Gamma-Ray Bursters*, 598, 195  
<http://www.springerlink.com/content/9116g28114206078/fulltext.pdf>  
<http://arxiv.org/abs/astro-ph/0303428>

Article: *Observational Evidence from Supernovae for an Accelerating Universe and a Cosmological Constant*

Riess, A. G., Filippenko, A. V., Challis, P., et al. 1998, *AJ*, 116, 1009  
<http://adsabs.harvard.edu/abs/1998AJ....116.1009R>

Article: *Measurements of Omega and Lambda from 42 High-Redshift Supernovae*

Perlmutter, S., Aldering, G., Goldhaber, G., et al. 1999, *ApJ*, 517, 565  
<http://adsabs.harvard.edu/abs/1999ApJ...517..565P>

Review Article: *The Cosmological Constant*

Carroll, S. M. 2001, *Living Reviews in Relativity*, 4, 1  
<http://adsabs.harvard.edu/abs/2001LRR.....4....1C>

## **2. Cold Dark Matter & Numerical Cosmology**

Millennium simulation web site:

<http://www.mpa-garching.mpg.de/galform/virgo/millennium/>

Mare Nostrum simulation web site:

<http://astro.ft.uam.es/marenostrum/universe/index.html>

Review Article:

*Numerical simulations of the dark universe: State of the art and the next decade*  
Kuhlen, Michael; Vogelsberger, Mark; Angulo, Raul, 2012 *Physics of the Dark Universe*, Volume 1, Issue 1, p. 50-93.

<http://adsabs.harvard.edu/abs/2012PDU.....1...50K>

Article for the millennium simulation:

Springel, V., White Simon, et al. 2005, *Nature*, 435, 629  
<http://adsabs.harvard.edu/abs/2005Natur.435..629S>

Seminal Article: *The evolution of large-scale structure in a universe dominated by cold dark matter*

Davis, M., Efstathiou, Frenk C., White S.D.M, 1985, *ApJ*, 292, 371  
<http://adsabs.harvard.edu/abs/1985ApJ...292..371D>

## **3. From Dark Matter Halos to Galaxies**

Seminal paper: *Core condensation in heavy halos - A two-stage theory for galaxy formation and clustering*

White, S.D.M & Rees M., 1978, *MNRAS*, 183, 341

<http://adsabs.harvard.edu/abs/1978MNRAS.183..341W>

Seminal paper: *Galaxy formation through hierarchical clustering*

White S.D.M & Frenk, C., 1991, *ApJ*, 379, 52

<http://adsabs.harvard.edu/abs/1991ApJ...379...52W>

Review Article: *A primer on hierarchical galaxy formation: the semi-analytical approach* C.M. Baugh, 2006, Rep. Prog. Phys. 69, 3101 <http://adsabs.harvard.edu/abs/2006RPPh...69.3101B>

Review Article: *Understanding Galaxy Formation and Evolution*  
Avila-Reese, 2007, Ap&SS, 115  
<http://arxiv.org/abs/astro-ph/0605212>

Review Article: *Galaxy Formation Theory*  
Benson, A. J. 2010, Phys. Rep, 495, 33  
<http://adsabs.harvard.edu/abs/2010PhR...495...33B>

Review Article: *Physical Models of Galaxy Formation in a Cosmological Framework*  
Somerville, R. S. & Dave, R. 2015, ARAA, 53, 51  
<http://adsabs.harvard.edu/abs/2015ARA%26A..53...51S>

## **4. Alternatives to a Cosmological Constant**

**Note:** All articles are quite technical and theory oriented. We do not expect you to master the complex math of this field but to give a general overview of the alternatives to simple cosmological constant and their possible effect on structure formation.

Review Article: *The Cosmological Constant*  
Carroll, S. M. 2001, Living Reviews in Relativity, 4, 1  
<http://adsabs.harvard.edu/abs/2001LRR.....4....1C>

Review Article: *Dark matter and dark energy proposals: maintaining cosmology as a true science?*  
George Ellis 2009, EAS Publications Series, Volume 36, 2009, pp.325-336  
<http://adsabs.harvard.edu/abs/2009EAS....36..325E>

Journal Article: *Dark energy and inhomogeneity*  
George Ellis 2008, Journal of Physics: Conference Series, Volume 189, Issue 1  
<http://adsabs.harvard.edu/abs/2009JPhCS.189a2011E>

Review Article: *Dark energy and dark gravity: theory overview*  
Ruth Durrer, Roy Maartens, 2008,  
General Relativity and Gravitation, Volume 40, Issue 2-3, pp. 301-328  
<http://adsabs.harvard.edu/abs/2008GReGr..40..301D>  
(very technical, look mainly to page 314 tp 320)

Review Article: *Dark Energy simulations*  
Marco Baldi 2012, Physics of the Dark Universe, Volume 1, Issue 1, p. 162-193  
<http://adsabs.harvard.edu/abs/2012PDU.....1..162B>

## **5. Cosmic Microwave Background**

WMAP Website: <http://map.gsfc.nasa.gov>

Movies: Sensitivity of CMB power spectrum to cosmological parameters, Martin White  
<http://astro.berkeley.edu/~mwhite/movies.html>

CMB Tutorial: Introduction to the CMB Tutorial, Wayne Hu  
<http://background.uchicago.edu/~whu/beginners/introduction.html>

Online Notes: Wayne Hu's Notes on CMB Fundamentals  
[http://background.uchicago.edu/~whu/Papers/cmbfun\\_hr.pdf](http://background.uchicago.edu/~whu/Papers/cmbfun_hr.pdf)

Popular Article: *The Cosmic Symphony*  
M. White & W. Hu, Scientific American, 2003  
[http://astro.berkeley.edu/~mwhite/sciam03\\_short.pdf](http://astro.berkeley.edu/~mwhite/sciam03_short.pdf)

Review Article: *Cosmic Microwave Background Anisotropies* Hu, W., & Dodelson, S. 2002, ARAA, 40, 171  
<http://adsabs.harvard.edu/abs/2002ARA%26A..40..171H>

Review Article: *The Cosmic Microwave Background*  
Jones, A., & Lasenby, A. 1998, Living Reviews in Relativity, 1, 11  
<http://adsabs.harvard.edu/abs/1998LRR.....1...11J>

Article: *First-Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Determination of Cosmological Parameters*  
Spergel, D. N., Verde, L., Peiris, H. V., et al. 2003, ApJS, 148, 175  
<http://adsabs.harvard.edu/abs/2003ApJS..148..175S>

Article: *Three-Year Wilkinson Microwave Anisotropy Probe (WMAP) Observations: Implications for Cosmology*  
Spergel, D. N., Bean, R., Dore, O., et al. 2007, ApJS, 170, 377  
<http://adsabs.harvard.edu/abs/2007ApJS..170..377S>

Article: Planck 2013 results. XVI. Cosmological parameters  
Planck Collaboration, arXiv:1303.5076  
[http://www.aanda.org/index.php?option=com\\_article&access=doi&doi=10.1051/0004-6361/201321591](http://www.aanda.org/index.php?option=com_article&access=doi&doi=10.1051/0004-6361/201321591)

## **6. Weak Gravitational Lensing**

**Euclid** mission (ESA web site):  
<http://sci.esa.int/science-e/www/area/index.cfm?fareaid=102>  
<http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=46661>

**Euclid** consortium web page:  
<http://www.euclid-imaging.net/>

Book (really long!): *Euclid Imaging Consortium Science Book*  
Refregier et al. 2010  
<http://arxiv.org/abs/1001.0061>

Review Article: *Weak Gravitational Lensing and its Cosmological Applications*

Hoekstra H. & Jain B., 2008, 85, 93  
<http://www.annualreviews.org/doi/abs/10.1146/annurev.nucl.58.110707.171151>

Review Article: *Weak Gravitational Lensing*  
Bartelmann, M. & Schneider P. 2001, 340, 291  
<http://xxx.lanl.gov/abs/astro-ph/9912508>

Review Article: Cosmology with weak lensing survey Dipak M, et al.  
2008, PhRv, 462, 67 [http://adsabs.harvard.edu/cgi-bin/bib\\_query?arXiv:astro-ph/0612667](http://adsabs.harvard.edu/cgi-bin/bib_query?arXiv:astro-ph/0612667)

## **7. Gravitational Lensing of the CMB**

Review Article: *Weak Lensing of the CMB*  
Hanson, D., Challinor, A., & Lewis, A. 2010, General Relativity and Gravitation, 42, 2197  
[http://adsabs.harvard.edu/cgi-bin/bib\\_query?arXiv:0911.0612](http://adsabs.harvard.edu/cgi-bin/bib_query?arXiv:0911.0612)

Review Article: *Weak gravitational lensing of the CMB*  
Lewis, A., & Challinor, A. 2006, Phys. Rep., 429, 1  
[http://adsabs.harvard.edu/cgi-bin/bib\\_query?arXiv:astro-ph/0601594](http://adsabs.harvard.edu/cgi-bin/bib_query?arXiv:astro-ph/0601594)

Article: *Planck 2013 results. XVII. Gravitational lensing by large-scale structure*  
Planck Collaboration, arXiv:1303.5077  
[http://adsabs.harvard.edu/cgi-bin/bib\\_query?arXiv:1303.5077](http://adsabs.harvard.edu/cgi-bin/bib_query?arXiv:1303.5077)

Article: *Detection of the Power Spectrum of Cosmic Microwave Background Lensing by the Atacama Cosmology Telescope*  
Das, S., Sherwin, B. D., Aguirre, P., et al. 2011, Physical Review Letters, 107, 021301  
[http://adsabs.harvard.edu/cgi-bin/bib\\_query?arXiv:1103.2124](http://adsabs.harvard.edu/cgi-bin/bib_query?arXiv:1103.2124)

Article: *The Atacama Cosmology Telescope: Cross-correlation of cosmic microwave background lensing and quasars*  
Sherwin, B.D., Das, S., Hajian, A., et al. 2012, PRD, 86, 083006  
<http://adsabs.harvard.edu/abs/2012PhRvD..86h3006S>

## **8. CMB Polarization, and Gravity Waves from Inflation**

Online Tutorial on CMB Polarization, by Wayne Hu:  
<http://background.uchicago.edu/~whu/polar/webversion/polar.html>

Review Article: *A CMB Polarization Primer*  
White, M. & Hu, W.  
<http://arxiv.org/pdf/astro-ph/9706147.pdf>  
<http://ads.ari.uni-heidelberg.de/abs/1997NewA....2..323H>

Article: *Signature of Gravity Waves in the Polarization of the Microwave Background*  
Seljak, U & Zaldarriaga, Matias, 1997, Physical Review Letters, 78, 2054 <http://ads.ari.uni-heidelberg.de/abs/1997PhRvL..78.2054S>

Article: *Planck* 2013 results. XXII. Constraints on inflation, Planck Collaboration  
Planck Collaboration, 2013, arXiv:1303.5082  
<http://www.aanda.org/articles/aa/pdf/forth/aa21569-13.pdf>  
See in particular the “Lighting Review of Inflation” in Section 2  
Article: *Detection of B-Mode Polarization at Degree Angular Scales by BICEP2*  
Planck Collaboration  
<http://ads.ari.uni-heidelberg.de/abs/2014PhRvL.112x1101A>

Article: *Planck intermediate results. XXX. The angular power spectrum of polarized dust emission at intermediate and high Galactic latitudes*  
Planck Collaboration, arXiv: 1409.5738  
<http://arxiv.org/abs/1409.5738>

Commentary: *Big Bang blunder bursts the multiverse bubble*  
Steinhardt, P. 2014, Nat, 510, 9  
<http://www.nature.com/news/big-bang-blunder-bursts-the-multiverse-bubble-1.15346>  
<http://adsabs.harvard.edu/abs/2014Natur.510....9S>

Article: *A joint analysis of Planck and BICEP2 B modes including dust polarization uncertainty*  
Mortonson, M. J., & Seljak, U. 2014, arXiv:1405.5857  
<http://ads.ari.uni-heidelberg.de/abs/2014arXiv1405.5857M>

Article: *Toward an understanding of foreground emission in the BICEP2 region*  
Flauger, R, Hill, J. C., & Spergel, D. N, 2014, JCAP, 8, 39 <http://ads.ari.uni-heidelberg.de/abs/2014JCAP...08..039F>

## **9. Galaxy Clusters as Cosmological Probes**

### ***X-ray* Satellites**

Chandra satellite: <http://chandra.si.edu/about/>  
XMM-Newton satellite: <http://sci.esa.int/science-e/www/area/index.cfm?fareaid=23>

Review Article: *Tracing cosmic evolution with clusters of galaxies* Voit,  
G. M. 2005, Reviews of Modern Physics, 77, 207  
[http://rmp.aps.org/abstract/RMP/v77/i1/p207\\_1](http://rmp.aps.org/abstract/RMP/v77/i1/p207_1)

Review Article: *Cosmology with Clusters of Galaxies*  
Borgani, S.: 2008, LNP, 740, 287  
<http://adsabs.harvard.edu/abs/2008LNP...740..287B>

Review Article: *Formation of Galaxy Clusters* Kravtsov,  
A. V. & Borgani, S. 2012, ARAA, 50, 353  
<http://adsabs.harvard.edu/abs/2012ARA%26A..50..353K>

Review Article: *Cosmological Parameters from Observations of Galaxy Clusters* Allen,  
S. W., Evrard, A. E., & Mantz, A. B. 2011, ARAA, 49, 409  
<http://adsabs.harvard.edu/abs/2011ARA%26A..49..409A>

Article: *Chandra Cluster Cosmology Project III: Cosmological Parameter Constraints*  
Vikhlinin, A., et al. 2009, ApJ, 692, 1060  
<http://adsabs.harvard.edu/abs/2009ApJ...692.1060V>

## **10. The Sunyaev-Zel'dovich Effect**

South Pole Telescope: <http://pole.uchicago.edu>

Atacama Cosmology Telescope: <http://www.physics.princeton.edu/act>

Planck Satellite: <http://sci.esa.int/planck/>

Review Article: *Cosmology with the Sunyaev-Zel'dovich Effect* Carlstrom,  
J. E., Holder, G. P., & Reese, E. D. 2002, ARAA, 40, 643  
<http://adsabs.harvard.edu/abs/2002ARA%26A..40..643C>

Review Article: *Formation of Galaxy Clusters* Kravtsov,  
A. V. & Borgani, S. 2012, ARAA, 50, 353  
<http://adsabs.harvard.edu/abs/2012ARA%26A..50..353K>

Review Article: *Cosmological Parameters from Observations of Galaxy Clusters* Allen,  
S. W., Evrard, A. E., & Mantz, A. B. 2011, ARAA, 49, 409  
<http://adsabs.harvard.edu/abs/2011ARA%26A..49..409A>

Article: *The Atacama Cosmology Telescope: Cosmology from Galaxy Clusters Detected via the Sunyaev-Zel'dovich Effect*  
Sehgal, N., Trac, H., Acquaviva, V., et al. 2011, ApJ, 732, 44  
<http://adsabs.harvard.edu/abs/2011ApJ...732...44S>

Article: *A Sunyaev-Zel'dovich-selected Sample of the Most Massive Galaxy Clusters in the 2500 deg<sup>2</sup> South Pole Telescope Survey*  
Williamson, R., Benson, B. A., High, F. W., et al. 2011, ApJ, 738, 139  
<http://adsabs.harvard.edu/abs/2011ApJ...738..139W>

Article: *Discovery and Cosmological Implications of SPT-CL J2106-5844, the Most Massive Known Cluster at  $z > 1$*   
Foley, R. J., Andersson, K., Bazin, G., et al. 2011, ApJ, 731, 86  
<http://adsabs.harvard.edu/abs/2011ApJ...731...86F>

Article: *Planck 2013 results. XX. Cosmology from Sunyaev-Zeldovich cluster counts*  
Planck Collaboration 2013, arXiv:1303.5080  
<http://adsabs.harvard.edu/abs/2013arXiv1303.5080P>

## **11. Strong Gravitational Lensing**

Book: *Gravitational Lensing: Strong, Weak, and Micro* Schneider, P,  
Kochanek, C., Wambsganss, 2006  
<http://link.springer.com/book/10.1007/978-3-540-30310-7/page/1>

Saas-Fee Advanced Course. Entire book available for download. Lots of theoretical details, but instead focus on Part 2 by C.S. Kochanek, on the different types of lenses observed, and primary observational results.

Review Article: *Cluster Lenses*

Kneib, J. P., Natarajan, P. 2011, A&ARv, 19, 47

<http://link.springer.com/article/10.1007/s00159-011-0047-3>

Review Article: *Arc Statistics*

Meneghetti, M., Bartelmann, M., Dahle, H., & Limousin, M. 2013, SSRv, 177, 31

<http://link.springer.com/article/10.1007%2Fs11214-013-9981-x>

Review Article: *Applications of Gravitational Lensing in Cosmology*

Bartelmann, M. 2006, Astrophysics Update 2, 213

[http://link.springer.com/chapter/10.1007/3-540-30313-8\\_7](http://link.springer.com/chapter/10.1007/3-540-30313-8_7)

Article: *Characterizing the Cluster Lens Population*

Hennawi, J. F., Dalal, N., Bode, P., & Ostriker, J. P. 2007, ApJ, 654, 714

<http://adsabs.harvard.edu/abs/2007ApJ...654..714H>

Article: *CLASH: The Concentration-Mass Relation of Galaxy Clusters*

Merten, J., Meneghetti, M., Postman, M., et al. 2015, ApJ, 806, 4

<http://adsabs.harvard.edu/abs/2015ApJ...806....4M>

Review Article: *Strong Lensing by Galaxies*

Treu, T. 2010, ARA&A 48, 87

<http://www.annualreviews.org/doi/full/10.1146/annurev-astro-081309-130924>

## **12. Non-Einsteinian Gravity**

Book: *Dark Energy. Theory and Observations.* L. Amendola & S. Tsujikawa (2010)

## **13. Gravitational waves and cosmology**

<https://arxiv.org/pdf/1807.09241.pdf>

<https://phys.org/news/2018-10-gravitational-dark.html>

<https://arxiv.org/pdf/1710.05893.pdf>

<https://arxiv.org/pdf/1801.06683.pdf>

## **14. Galaxy Clustering & Baryon Acoustic Oscillations**

SDSS Web Site: <http://www.sdss.org>



Martin White's BAO Page: <http://astro.berkeley.edu/~mwhite/bao/>

Review Article: *Baryon Acoustic Oscillations*

Basset, B. & Hlozek, R., chapter contributed to the book "Dark Energy", Ed. P. Ruiz-Lapuente, Cambridge University Press

<http://arxiv.org/abs/0910.5224>

Review Article: *Dark Energy and Cosmic Sound*

Eisenstein, D. J. 2005, NAR, 49, 360

<http://adsabs.harvard.edu/abs/2005NewAR..49..360E>

Article: *Detection of the Baryon Acoustic Peak in the Large-Scale Correlation Function of SDSS Luminous Red Galaxies*

Eisenstein, D. J., Zehavi, I., Hogg, D. W., et al. 2005, ApJ, 633, 560

<http://adsabs.harvard.edu/abs/2005ApJ...633..560E>

Review Article: *Measuring our Universe from Galaxy Redshift Surveys*

Lahav, O., & Suto, Y. 2004, Living Reviews in Relativity, 7, 8

<http://adsabs.harvard.edu/abs/2004LRR.....7....8L>

## **15. The Ly $\alpha$ Forest & the Intergalactic Medium**

Review Article: *The physics of the intergalactic medium*

Meiksin, A. A. 2009, Reviews of Modern Physics, 81, 1405

<http://adsabs.harvard.edu/abs/2009RvMP...81.1405M>

Review Article: *The Lyman Alpha Forest in the Spectra of QSOs*

Rauch, M. 1998, ARAA, 36, 267

<http://adsabs.harvard.edu/abs/1998ARA%26A..36..267R>

Review Article: *The Ly $\alpha$  Forest as a Cosmological Tool*

Weinberg, D. H. et al. 2003, The Emergence of Cosmic Structure, 666, 157

<http://arxiv.org/abs/astro-ph/0301186>

Article: *Can Sterile Neutrinos Be the Dark Matter?*

Seljak, U., Makarov, A., McDonald, P., & Trac, H. 2006, PRL, 97, 191303

<http://adsabs.harvard.edu/abs/2006PhRvL..97s1303S>

Article: *Cosmological parameters from combining the Lyman- $\alpha$  forest with CMB, galaxy clustering and SN constraints*

Seljak, U., Slosar, A., & McDonald, P. 2006, JCAP, 10, 14

<http://adsabs.harvard.edu/abs/2006JCAP...10..014S>

Article: *The Thermal Memory of Reionization History*

Hui, L., & Haiman, Z. 2003, ApJ, 596, 9

<http://adsabs.harvard.edu/abs/2003ApJ...596...9H>

Article: *Constraints from the Ly $\alpha$  Forest Power Spectrum*

Zaldarriaga, M., Hui, L., & Tegmark, M. 2001, ApJ, 557, 519

<http://adsabs.harvard.edu/abs/2001ApJ...557..519Z>

Review Article: *The Evolution of the Intergalactic Medium*

McQuinn, M. 2015, ARAA, to be submitted (pre-submission version, do not distribute)

[https://www.dropbox.com/s/sbjtjd690haebps/IGM\\_review.pdf?dl=0](https://www.dropbox.com/s/sbjtjd690haebps/IGM_review.pdf?dl=0)

## **16. First Light & Cosmic Reionization**

Popular Article: *The First Stars in the Universe and Cosmic Reionization*

Barkana, R. 2006, Science, 313, 931

<http://www.sciencemag.org/content/313/5789/931.full.pdf>

Review Article: *Observational Constraints on Cosmic Reionization* Fan,

X., Carilli, C. L., & Keating, B. 2006, ARAA, 44, 415

<http://adsabs.harvard.edu/abs/2006ARA%26A..44..415F>

Review Article: *In the beginning: the first sources of light and the reionization of the universe*

Barkana, R., & Loeb, A. 2001, Phys. Rep., 349, 125

<http://adsabs.harvard.edu/abs/2001PhR...349..125B>

Review Article: *The physics and early history of the intergalactic medium*

Barkana, R., & Loeb, A. 2007, Reports on Progress in Physics, 70, 627

<http://adsabs.harvard.edu/abs/2007RPPh...70..627B>

Article: *A luminous quasar at a redshift of  $z = 7.085$*

Mortlock, D. J., Warren, S. J., Venemans, B. P., et al. 2011, Nature, 474, 616

<http://adsabs.harvard.edu/abs/2011Natur.474..616M>

Article: *Constraining the Evolution of the Ionizing Background and the Epoch of Reionization with  $z \sim 6$  Quasars. II. A Sample of 19 Quasars*

Fan, X., Strauss, M. A., Becker, R. H., et al. 2006, AJ, 132, 117

<http://adsabs.harvard.edu/abs/2006AJ....132..117F>

Article: *Lower-Luminosity Galaxies could reionize the Universe: Very Steep Faint-End Slopes to the UV Luminosity Functions at  $z >= 5-8$  from the HUDF09 WFC3/IR Observations*

Bouwens, R. J., Illingworth, G. D., Oesch, P. A., et al. 2011, arXiv:1105.2038

<http://adsabs.harvard.edu/abs/2011arXiv1105.2038B>

Article: *New Constraints on Cosmic Reionization from the 2012 Hubble Ultra Deep Field Campaign*

Robertson, B. E., Furlanetto, S. R., Schneider, E., et al. 2013, ApJ, 768, 71

<http://adsabs.harvard.edu/abs/2013ApJ...768...71R>

Article: *Cosmic Reionization after Planck: Could Quasars Do It All?*

Madau, P. & Haardt, F. 2015, arXiv:1507.07678

<http://adsabs.harvard.edu/abs/2015arXiv150707678M>

Review Article: *The Evolution of the Intergalactic Medium*

McQuinn, M. 2015, ARAA, to be submitted (pre-submission version, do not distribute)  
[https://www.dropbox.com/s/sbjtjd690haebps/IGM\\_review.pdf?dl=0](https://www.dropbox.com/s/sbjtjd690haebps/IGM_review.pdf?dl=0)

## **17. Cosmological tests of gravity**

Review Article: *Measuring gravity at cosmological scales*  
Amendola, L. et al. 2019  
<http://inspirehep.net/record/1720827>

## **18. Growth of linear fluctuations**

## **19. Baryogenesis**

Review Article: *Baryogenesis*  
J. Cline  
<https://arxiv.org/abs/hep-ph/0609145>

Review: *Baryogenesis*  
C. Balazs  
<https://arxiv.org/pdf/1411.3398.pdf>

Review: *Baryogenesis and Leptogenesis*  
M. Trodden  
<http://www.slac.stanford.edu/econf/C040802/papers/L018.PDF>

## **20. Reheating in inflation**

Review: *Reheating after inflation*  
D. Baumann  
<http://www.damtp.cam.ac.uk/user/db275/TEACHING/INFLATION/Reheating.pdf>

Article: *Reheating after inflation*  
Kofman, Linde, Starobinski  
<http://adsabs.harvard.edu/abs/1994PhRvL..73.3195K>