

Erwin T. Lau

<https://ethlau.github.io>

Education

- Ph.D., Astronomy & Astrophysics, University of Chicago, Chicago, IL, USA, 2010
- M.S., Astronomy & Astrophysics, University of Chicago, Chicago, IL, USA, 2006
- B.S., Astronomy and General Physics, University of Michigan, Ann Arbor, MI, USA, 2004
- B.S.E., Engineering Physics, University of Michigan, Ann Arbor, MI, USA, 2004

Professional Research Experience

- Center for Astrophysics | Harvard & Smithsonian
Visiting Scientist, Jan 2021–present
Advisor: Akos Bogdán
- University of Miami, Department of Physics
Postdoctoral Associate, Jan 2018–Dec 2020
Advisor: Nico Cappelluti
- Yale University, Department of Physics, Yale Center for Astronomy & Astrophysics
Associate Research Scientist, 2015–2017
Postdoctoral Associate, 2011–2015
Advisor: Daisuke Nagai
- Shanghai Astronomical Observatory, Key Laboratory for Research in Galaxies and Cosmology
Postdoctoral Fellow, 2010–2011
Advisor: Xiaohu Yang
- University of Chicago, Department of Astronomy & Astrophysics
Graduate Research Assistant, 2005–2010
Advisor: Andrey V. Kravtsov
- University of Michigan, Department of Physics
Undergraduate Research Assistant, 2003–2004
Advisor: Tim A. McKay

References

Dr. Akos Bogdan	Center for Astrophysics Harvard & Smithsonian	abogdan@cfa.harvard.edu
Prof. Nico Cappelluti	University of Miami	ncappelluti@miami.edu
Prof. Daisuke Nagai	Yale University	daisuke.nagai@yale.edu
Prof. Andrey V. Kravtsov	University of Chicago	andrey@oddjob.uchicago.edu
Prof. Paolo Coppi	Yale University	paolo.coppi@yale.edu
Dr. Alexey Vikhlinin	Center for Astrophysics Harvard & Smithsonian	alexey@cfa.harvard.edu

Research Interests

Computational, theoretical, and statistical modeling of galaxy clusters, groups and massive galaxies, and on their observational signatures in X-ray and microwave. Galaxy clusters and groups as cosmological probes. Physical processes in the intracluster medium. Diffuse emissions from the Intergalactic Medium and the Circumgalactic Medium. Astronomical software development.

Awards

XSEDE Computing Research Allocation TG-AST190003, “Simulating Cosmic Weather in Galaxy Clusters” , 45k node hours

Professional Activities and Academic Services

Referee for:

- Nature Communications
- The Astrophysical Journal
- The Monthly Notices of the Royal Astronomical Society
- Astronomy & Astrophysics
- Research in Astronomy & Astrophysics

Peer Reviewer, *Chandra* Cycle 20 Peer Review, 2018

Organizer, Cosmology Seminar at Yale University, 2012–2014

Professional Societies

Member, American Astronomical Society

Member, International Astronomical Union

Selected Invited Talks

- 2022/1 Center for Astrophysics, Cambridge, MA, High Energy Astrophysics Seminar
- 2021/10 Boise State University, Boise, Idaho, Computing Colloquium
- 2019/6 INAF-OAS, Bologna, Italy, Cluster Talk
- 2017/9 Yale University, CT, USA, Astronomy Colloquium
- 2017/2 Rochester Institute of Technology, Rochester, NY, USA, Astrophysics Colloquium
- 2017/1 Kavli Institute for the Physics and Mathematics of the Universe, Kashiwa, Japan, Astrophysics Seminar
- 2017/1 Academia Sinica Institute of Astronomy and Astrophysics, Taipei, Taiwan, Special Seminar
- 2016/1 Shanghai Astronomical Observatory, Shanghai, China, Special Seminar
- 2016/1 Kavli Institute for Astronomy and Astrophysics, Peking University, Beijing, Lunch Seminar
- 2015/9 Kavli Institute for the Physics and Mathematics of the Universe, Kashiwa, Japan, Astrophysics Lunch Talk
- 2015/3 University of Hong Kong, Hong Kong, Physics Seminar
- 2014/3 University of Michigan, Ann Arbor, MI, USA, Cluster Seminar
- 2013/10 Brown University, Providence, RI, USA, Astrophysics Seminar
- 2012/8 Shanghai Astronomical Observatory, Shanghai, China, Cosmology Seminar
- 2012/4 Yale University, New Haven, CT, USA, Cosmology Seminar
- 2010/3 University of Colorado, Boulder, CO, USA, Cluster Seminar

Conference and Workshop Presentations

- 2022/6 “AGN Feeding and Feedback II”, Sesto, Italy
- 2022/4 Galaxy Cluster Symposium, STSci, Baltimore, MD, USA
- 2019/6 XMM Workshop on Extended X-ray Sources, ESAC, Madrid, Spain
- 2019/1 223th AAS meeting, Seattle, WA, USA
- 2018/12 “Miami 2018: Topical Physics Conference”, Fort Lauderdale, FL, USA
- 2018/10 “Accretion Histories of AGN Workshop”, Miami, FL, USA
- 2018/7 “Alpine Cosmology Workshop 2018”, Alagna Valsesia, Italy
- 2018/6 “AGN Feeding and Feedback”, Sesto, Italy
- 2017/8 “From Chandra to Lynx: Taking the Sharpest X-ray Vision Fainter and Farther”, Cambridge, MA, USA
- 2016/12 “Galaxy clusters: Physics Laboratories and Cosmological Probes”, Cambridge, UK
- 2015/6 “ICM Physics and Modelling”, Max Planck Institute for Astrophysics, Garching, Germany
- 2015/3 “Astroparticle View of Galaxy Clusters”, Hiroshima University, Hiroshima, Japan
- 2015/3 “SnowCluster 2015”, Snowmass, UT, USA
- 2014/6 “Cluster Paris 2014”, Paris, France
- 2013/3 “SnowCluster 2013”, Snowmass, UT, USA
- 2012/11 Galaxy Cluster Workshop, Ringberg, Germany
- 2012/8 28th IAU General Assembly, Beijing, China
- 2012/6 220th AAS Meeting, Anchorage, AK, USA
- 2012/3 “Turbulence in Cosmic Structure Formation”, ASU, Tempe, AZ, USA
- 2011/9 “Cosmology with X-ray and SZE Observations of Galaxy Clusters”, Huntsville, AL, USA
- 2011/3 “Astrophysics and Cosmology with Galaxy Clusters”, KITP, Santa Barbara, CA, USA
- 2010/7 “From Massive Galaxy Formation to Dark Energy”, IPMU, Kashiwa, Chiba, Japan
- 2010/6 10th “Great Lakes Cosmology Workshop”, Chicago, IL, USA
- 2010/1 215th AAS meeting, Washington, DC, USA
- 2007/2 “Clusters of Galaxies as Cosmological Probes”, Aspen, CO, USA

Mentoring and Teaching

Co-supervised undergraduate and graduate students with Prof. Daisuke Nagai at Yale University, and Prof. Nico Cappelluti at the University of Miami.

Amanda Butler Contreras: Yale Undergrad (2020-2022)

Senior Project: “Astrophysical Feedback in the WHIM and the Missing Baryon Problem”

Luis Fernando Machado:

Post-Baccalaureate (2020-2021) Project: “Modeling Gas Shapes in Galaxy Clusters and Groups”

Yale Undergrad (2016 - 2017) Project: “Modeling HST-COS Observations of Galaxy Cluster Outskirts”

Guanhua Chen: UMiami Undergrad (2019)

Project: “Semi-Analytic Modeling of X-ray and SZ Cross Power Spectra of Galaxy Clusters and Groups

Emil Öhman: Yale Undergrad (2015 - 2017)

Junior Project: “High resolution modeling of gas properties in galaxy cluster outskirts”

Senior Project: “Nature of gas streams and cold fronts in cosmological simulations of galaxy clusters”

Mari Kawakatsu: Yale Undergrad (2016 - 2017)

Senior Project: “Improving Galaxy Cluster Mass Measurements with Machine Learning Techniques”

Julia Menzel: Yale Undergrad (2015 - 2016)

Senior Project: “Streaming gas motions in galaxy clusters”

Joshua Burt, Yale Grad Student, Physics (2014-2015)

Summer Project: “Finding Gas Filaments in the Outskirts of Galaxy Clusters”

Christopher Cappiello: Yale Undergrad (2013 - 2015)

Awarded DeForest Pioneer Prize in Physics, Yale University, 2015

Senior Project: “Shapes of Galaxy Clusters”

Maya Fishbach: Yale Undergrad (2013 - 2015)

Awarded Howard L. Schultz Prize in Physics, Yale University, 2015

Senior Project: “Evolution of the filamentary gas flows in simulated galaxy clusters”

Junior Project: “Cluster Merger Simulations with Self-Interacting Dark Matter”

Hendrik Kits van Heyningen: Yale Undergrad (2013-2014)

Awarded DeForest Pioneer Prize in Physics, Yale University, 2014

Senior Project: “Modified Gravity & Dark Energy in Spherical Collapse Model”

Benjamin Elder, Yale Grad Student, Physics (2012-2013)

First Year Project: “Cosmological Simulations with Self-Interacting Dark Matter”

Dan Steinbrook: Yale Undergrad (Summer 2012)
Summer Project: “Effects of $f(R)$ gravity on the Shapes of Galaxy Clusters”

Elizabeth Peng: Yale Undergrad (2011-2012)
Senior Project: “Mock ASTRO-H Simulations of Galaxy Clusters”

Graduate Teaching Assistant, University of Chicago, 2004–2005, 2007

Refereed Publications

1. **Lau, E. T.**, Bogdán, A., Chadayammuri, U., Nagai, D., Kraft, R., Cappelluti, N., *The X-ray Angular Power Spectrum of Extended Sources in the eROSITA Final Equatorial Depth Survey*, 2022, MNRAS, accepted, arXiv:2204.13105
2. Moser, E., Battaglia, N., Nagai, D. **Lau, E.**, Machado Poletti Valle, L. F., Villaescusa-Navarro, F., Amodeo, S., Anglés-Alcázar, D., Bryan, G. L., Davé, R., Hernquist, L., Vogelsberger, M., *The Circumgalactic Medium from the CAMELS Simulations: Forecasting Constraints on Feedback Processes from Future Sunyaev-Zeldovich Observations*, 2022, ApJ, 933, 133, arXiv:2201.02708
3. Villaescusa-Navarro, Francisco; Genel, Shy; Angles-Alcazar, Daniel; Thiele, Leander; Dave, Romeel; Narayanan, Desika; Nicola, Andrina; Li, Yin; Villanueva-Domingo, Pablo; Wandelt, Benjamin; Spergel, David N.; Somerville, Rachel S.; Zorrilla Matilla, Jose Manuel; Mohammad, Faizan G.; Hassan, Sultan; Shao, Helen; Wadekar, Digvijay; Eickenberg, Michael; Wong, Kaze W. K.; Contardo, Gabriella; Jo, Yongseok; Moser, Emily; **Lau, Erwin T.**; Machado Poletti Valle, Luis Fernando; Perez, Lucia A.; Nagai, Daisuke; Battaglia, Nicholas; Vogelsberger, Mark, *The CAMELS Multifield Dataset: Learning the Universe’s Fundamental Parameters with Artificial Intelligence*, 2022, ApJS, 259, 61, arXiv:2109.10915
4. Walker, S., **Lau, E.**, *Cluster Outskirts and their Connection to the Cosmic Web*, 2022, book chapter in the Section “Galaxy Clusters” (Section Editors: E. Pointecouteau, E. Rasia, A. Simionescu) of the “Handbook of X-ray and Gamma-ray Astrophysics” (Editors in chief: C. Bambi and A. Santangelo), arXiv:2202.07056
5. Stapelberg, S., Tchernin, C., Hug, D., **Lau, E. T.**, Bartelmann, M., *Triaxiality in galaxy clusters: Mass versus Potential reconstructions*, 2021 A&A, 663, A17 arXiv:2012.13413
6. Aung, H., Nagai, D., **Lau, E. T.**, *Shock and Splash: Gas and Dark Matter Halo Boundaries around Λ CDM Galaxy Clusters*, 2021, MNRAS, 508, 2071, arXiv:2012.00977
7. Machado Poletti Valle, L. F., Avestruz, C., Barnes, D. J., Farahi, A., **Lau, E. T.**, Nagai, D., *SHAPing the Gas: Understanding Gas Shapes in Dark Matter Haloes with Interpretable Machine Learning*, 2021, MNRAS, 507, 1468 arXiv:2011.12987
8. **Lau, E. T.**, Hearin, A. P., Nagai, D., Cappelluti, N., *Correlations between Triaxial Shapes and Formation History of Dark Matter Haloes*, 2021, MNRAS, 500, 1029, arXiv:2006.09420
9. Simionescu, A.; Ettori, S.; Werner, N.; Nagai, D.; Vazza, F.; Akamatsu, H.; Pinto, C.; de Plaa, J.; Wijers, N.; Nelson, D.; Pointecouteau, E.; Pratt, G. W.; Spiga, D.; **Lau, E.**; Rossetti, M.; Gastaldello, F.; Biffi, V.; Bulbul, E.; den Herder, J. W.; Eckert, D. Fraternali, F.; Mingo, B.; Pareschi, G.; Pezzulli, G.; Reiprich, T. H.; Schaye, J.; Walker, S. A.; Werk, J., *Voyage through the Hidden Physics of the Cosmic Web*, 2021, Experimental Astronomy, 51, 1043, arXiv:1908.01778

10. Comparat, J., Eckert, D., Finoguenov, A., Schmidt, R., Sanders, J., Nagai, D., **Lau, E. T.**, Kaefer, F., Pacaud, F., Clerc, N., Reiprich, T. H., Bulbul, E., Ider Chitham, J., Chuang, C.-H., Ghirardini, Vi., Gonzalez-Perez, V., Gozaliasl, G., Kirkpatrick, C. C., Klypin, A., Merloni, A., Nandra, K., Liu, T., Prada, F., Ramos-Ceja, M. E., Salvato, M., Seppi, R., Tempel, E., Yepes, G., *Full-sky photon simulation of clusters and active galactic nuclei in the soft X-rays for eROSITA*, 2020, The Open Journal of Astrophysics, 3, 13, arXiv:2008.08404
11. Tchernin, C., **Lau, E. T.**, Stapelberg, S., Hug, D., Bartelmann, M., *Characterizing galaxy clusters by their gravitational potential: systematics of cluster potential reconstruction*, 2020, A&A, 644, A126, arXiv:2008.01107
12. Shirasaki, M., **Lau, E. T.**, Nagai, D., *Probing Cosmology and Cluster Astrophysics with Multi-Wavelength Surveys I. Correlation Statistics*, 2020, MNRAS, 491, 235, arXiv:1909.02179
13. Chen, H., Avestruz, C., Kravtsov, A. V., **Lau, E. T.**, Nagai, D., *Imprints of mass accretion history on the shape of the intracluster medium and the $T_X - M$ relation*, 2019, MNRAS, 490, 2380 arXiv:1903.08662
14. Shi, X., Nagai, D., **Lau, E. T.**, *Multiscale analysis of turbulence evolution in the density-stratified intracluster medium*, 2018, MNRAS, 481, 1075 arXiv:1806.05056
15. Shirasaki, M., **Lau, E. T.**, Nagai, D., *Modelling Baryonic Effects on Galaxy Cluster Mass Profiles*, 2018, MNRAS, 477, 2804, arXiv:1711.06366
16. ZuHone, J. A., Kowalik, K., Öhman, E., **Lau, E.**, Nagai, D., *The Galaxy Cluster Merger Catalog: An Online Repository of Mock Observations from Simulated Galaxy Cluster Mergers*, 2018, ApJS, 234, 4, arXiv:1609.04121
17. Zinger, E., Dekel, A., Birnboim, Y., Nagai, D., **Lau, E.**, Kravtsov, A. V., *Cold Fronts and Shocks Formed by Gas Streams in Galaxy Clusters*, 2018, MNRAS, 476, 56, arXiv:1609.05308
18. Ota, N., Nagai, D., **Lau, E. T.**, *Constraining hydrostatic mass bias of galaxy clusters with high-resolution X-ray spectroscopy*, 2018, PASJ, 70, 51, arXiv:1507.02730
19. **Lau, E. T.**, Gaspari, M., Nagai, D., Coppi, P., *Physical Origins of Gas Motions in Galaxy Cluster Cores: Interpreting Hitomi Observations of the Perseus Cluster*, 2017, ApJ, 849, 54, arXiv:1705.06280
20. Tchernin, C., Eckert, D., Ettori, S., Pointecouteau, E., Paltani, S., Molendi, S., Hurier, G., Gastaldello, F., **Lau, E. T.**, Nagai, D., Roncarelli, M., Rossetti, M., *The XMM Cluster Outskirts Project (X-COP): Physical conditions to the virial radius of Abell 2142*, 2016, A&A, 595, A42, arXiv:1606.05657
21. Avestruz, C., Nagai, D., **Lau, E. T.**, *Stirred, not Clumped: Evolution of Temperature Profiles in the Outskirts of Galaxy Clusters*, 2016, ApJ, 833, 227, arXiv:1605.01723
22. Shirasaki, M., Nagai, D., **Lau, E. T.**, *Covariance in the Thermal SZ-Weak Lensing Mass Scaling Relation of Galaxy Clusters*, 2016, MNRAS, 460, 3913, arXiv:1603.08609
23. Shi, X., Komatsu, E., Nagai, D., **Lau, E. T.**, *Analytical model for non-thermal pressure in galaxy clusters - III. Removing the hydrostatic mass bias*, 2016, MNRAS, 455, 2936, arXiv:1507.04338
24. Sembolini, F., Yepes, G., Pearce, F. R., Knebe, A., Kay, S. T., Power, C., Cui, W., Beck, A. M., Borgani, S., Dalla Vecchia, C., Davé, R., Elahi, P. J., February, S., Huang, S., Hobbs, A., Katz, N., **Lau, E.**, McCarthy, I. G., Murante, G., Nagai, D., Nelson, K., Newton, R. D. A., Perret, V., Puchwein, E., Read, J. I., Saro, A., Schaye, J., Teyssier, R., Thacker, R. J., *nIFTy galaxy cluster simulations - I. Dark matter and non-radiative models*, 2016, MNRAS, 457, 2063, arXiv:1503.06065
25. **Lau, E. T.**, Nagai, D., Avestruz, C., Nelson, K., Vikhlinin, A., *Mass Accretion and its Effects on the Self-similarity of Gas Profiles in the Outskirts of Galaxy Clusters*, 2015, ApJ, 806, 86, arXiv:1411.5361

26. Avestruz, C., Nagai, D., **Lau, E. T.**, Nelson, K., *Non-Equilibrium Electrons in the Outskirts of Galaxy Clusters*, 2015, ApJ, 808, 176, arXiv:1410.8142
27. Rasia, E., **Lau, E. T.**, Borgani, S., Nagai, D., Dolag K., Avestruz, C., Granato, G. L., Mazzotta, P., Murante, G., Nelson, K., Ragone-Figueroa, C., *Temperature Structure of the Intra-Cluster Medium from SPH and AMR simulation*, 2014, ApJ, 791, 96, arXiv:1406.4410
28. Zhuravleva, I., Churazov, E., Schekochihin, A. A., **Lau, E. T.**, Nagai, D., Gaspari, M., Allen, S. W., Nelson, K., Parrish, I. J. *The relation between gas density and velocity power spectra in galaxy clusters: qualitative treatment and cosmological simulations* 2014, ApJL, 788, L13, arXiv:1404.5306
29. Gaspari, M., Churazov, E., Nagai, D., **Lau, E. T.**, Zhuravleva, I., *The relation between gas density and velocity power spectra in galaxy clusters: high-resolution hydrodynamic simulations and the role of conduction*, 2014, A&A, 569, A67, arXiv:1404.5302
30. Nelson, K., **Lau, E. T.**, Nagai, D., *Hydrodynamic Simulation of Non-thermal Pressure Profiles of Galaxy Clusters*, 2014, ApJ, 792, 25, arXiv:1404.4636
31. Avestruz, C., **Lau, E. T.**, Nagai, D., Vikhlinin, A., *Testing X-ray Measurements of Galaxy Cluster Outskirts with Cosmological Simulations*, 2014, ApJ, 797, 117, arXiv:1404.4634
32. Wang, L., Yang, X., Shen, S., Mo, H. J., van den Bosch., F. C., Luo, W., Wang, Y., **Lau, E. T.**, Wang, Q. D., Kang, X., Li, R., *Measuring the X-ray luminosities of SDSS DR7 clusters from RASS*, 2014, MNRAS, 439, 611, arXiv:1312.7417
33. Harvey, D., Tittley, E., Massey, R., Kitching, T. D., Taylor, A., Pike, S. R., Kay, S. T., **Lau, E. T.**, & Nagai, D., *On the cross-section of Dark Matter using substructure infall into galaxy clusters*, 2014, MNRAS, 441, 404, arXiv:1310.1731
34. Nelson, K., **Lau, E. T.**, Nagai, D., Rudd, D. H., & Yu, L., *Weighing Galaxy Clusters with Gas. II. On the Origins of Hydrostatic Mass Bias in Λ CDM Galaxy Clusters*, 2014, ApJ, 782, 107, arXiv:1308.6589
35. Nagai, D., **Lau, E. T.**, Avestruz, C., Nelson, K., & Rudd, D. H., *Predicting Merger-Induced Gas Motions in Λ CDM Galaxy Clusters*, 2013, ApJ, 777, 137, arXiv:1307.2251
36. **Lau, E. T.**, Nagai, D., & Nelson, K., *Weighing Galaxy Clusters with Gas. I. On the Methods of Computing Hydrostatic Mass Bias*, 2013, ApJ, 777, 151, arXiv:1306.3993
37. Khedekar, S., Churazov, E., Kravtsov, A., Zhuravleva, I., **Lau, E. T.**, Nagai, D., & Sunyaev, R., *Bias from gas inhomogeneities in the pressure profiles as measured from X-ray and Sunyaev-Zeldovich observations*, 2013, MNRAS, 431, 954, arXiv:1211.3358
38. Zhuravleva, I., Churazov, E., Kravtsov, A., **Lau, E. T.**, Nagai, D., & Sunyaev, R., *Quantifying properties of ICM inhomogeneities*, 2012, MNRAS, 428, 3274, arXiv:1210.6706
39. **Lau, E. T.**, Nagai, D., Kravtsov, A. V., Vikhlinin, A., & Zentner, A. R., *Constraining Cluster Physics with the Shape of X-Ray Clusters: Comparison of Local X-Ray Clusters Versus Λ CDM Clusters*, 2012, ApJ, 755, 116, arXiv:1201.2168
40. Eckert, D., Vazza, F., Ettori, S., Molendi, S. Nagai, D., **Lau, E. T.**, Roncarelli, M., Rossetti, M., Snowden, S. L., & Gastaldello, F., *The Gas Distribution in the Outer Regions of Galaxy Clusters*, 2012, A&A, 541, A75, arXiv:1111.0020
41. **Lau, E. T.**, *Characterizing Galaxy Clusters with Gravitational Potential*, 2011, ApJ, 736, 145, arXiv:1009.2124
42. Nagai, D., & **Lau, E. T.**, *Gas Clumping in the Outskirts of Λ CDM Clusters*, 2011, ApJL, 731 L10, arXiv:1103.0280
43. **Lau, E. T.**, Nagai, D., Kravtsov, A. V., & Zentner, A. R., *Shapes of Gas, Gravitational Potential and Dark Matter in Λ CDM Clusters*, 2011, ApJ, 734, 93, arXiv:1003.2270

44. Shaw, L. D., Nagai, D., Bhattacharya, S., **Lau, E. T.**, *Impact of Cluster Physics on the Sunyaev-Zel'dovich Power Spectrum*, 2010, ApJ, 725, 1452, arXiv:1006.1945
45. **Lau, E. T.**, Nagai, D., & Kravtsov, A. V., *Effects of Baryon Dissipation on the Dark Matter Virial Scaling Relation*, 2010, ApJ, 708, 1419, arXiv:0908.2133
46. **Lau, E. T.**, Kravtsov, A. V., & Nagai, D., *Residual Gas Motions in the Intracluster Medium and Bias on the Hydrostatic Mass Profile*, 2009, ApJ, 705, 1129, arXiv:0903.4895
47. Becker, M. R., McKay, T. A., Koester, B., Wechsler, R. H., Rozo, E., Evrard, A., Johnston, D., Sheldon, E., Annis, J., **Lau, E.**, Nichol, R., & Miller, C., *The Mean and Scatter of the Velocity Dispersion–Optical Richness Relation for maxBCG Galaxy Clusters*, 2007, ApJ, 669, 905, arXiv:0704.3614

Unrefereed and Submitted Publications

1. Walker, S.; Nagai, D.; Simionescu, A.; Markevitch, M.; Akamatsu, H.; Arnaud, M.; Avestruz, C.; Bautz, M.; Biffi, V.; Borgani, S.; Bulbul, E.; Churazov, E.; Dolag, K.; Eckert, D.; Etti, S.; Fujita, Y.; Gaspari, M.; Ghirardini, V.; Kraft, R.; **Lau, E. T.**; Mantz, A.; Matsushita, K.; McDonald, M.; Miller, E.; Mroczkowski, T.; Nulsen, P.; Okabe, N.; Ota, N.; Pointecouteau, E.; Pratt, G.; Sato, K.; Shi, X.; Tremblay, G.; Tremmel, M.; Vazza, F.; Zhuravleva, I.; Zinger, E.; ZuHone, J., *Unveiling the Galaxy Cluster - Cosmic Web Connection with X-ray observations in the Next Decade*, 2019, Astro2020: Decadal Survey on Astronomy and Astrophysics, science white papers, no. 218; Bulletin of the American Astronomical Society, Vol. 51, Issue 3, id. 218, arXiv:1903.04550