Andrea Ravenni | Curriculum Vitae

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Work address Via Marzolo 8, I-35131, Padova (PD), Italy
Born 13 February 1991 in Rome, Italy.

Education and Research Positions

Post-doctoral research fellow. **1 Dec 2021 – present**
Università degli Studi di Padova, Italy.

Research associate in Theoretical Cosmology. 1 Oct 2018 – 30 Sep 2021
University of Manchester, UK.

Ph.D. student in Physics. 1 Oct 2015 – 30 Sep 2018
Università degli Studi di Padova, Italy.
Ph.D. awarded *cum laude* the 13 Dec 2018.
Thesis: *"Glimpsing at the primordial perturbation field".*
Advisors: Prof. Nicola Bartolo and Prof. Michele Liguori.

Visitor at the University of Manchester. 1 Jan 2018 – 30 Jun 2018
Mentor: Prof. Jens Chluba.

Master in Theoretical Physics. 1 Dec 2013 – 23 Sep 2015
Università degli Studi di Padova, Italy.
Title awarded with grade 110/110 *cum laude* the 23 Sep 2015.
Thesis: *"Reconstructing the primordial power spectrum: implications for cosmological models"*.
Supervisors: Prof. Nicola Bartolo, Prof. Michele Liguori and Prof. Licia Verde.

Exchange student at the ICC, Universidad de Barcelona, Spain. 1 Apr 2015 – 30 Jun 2015
Mentor: Prof. Licia Verde. *Erasmus+ for traineeship* grant.

Bachelor in Physics. 1 Oct 2010 – 10 Dec 2013
Università degli Studi di Padova, Italy.
Title awarded with grade 98/110 the 10 Dec 2013.
Thesis: *"Oscillation in Particle Physics"*.
Supervisor: Prof. Stefano Rigolin.

Areas of expertise

Analysis of cosmological datasets and simulations.
- Machine learning-driven analysis of N-body and hydrodynamical simulations.
- Extraction of spectra and sky maps from *Planck* data and N-body simulations.
- Development of likelihoods for mock datasets.
- Component separation with internal linear combination and various generalizations.

Inference and regression.
- Bayesian and frequentist inference.
- Markov chain Monte Carlo posterior approximation.
- Moment network and simulation based inference.
- Quantile regression.
- Feature importance analysis.

Cosmological thermalization and cosmological evolution.
- Cosmic microwave background spectral distortions.
- Electron-photon interactions in astrophysical plasma.
- First and second order perturbation theory.
- Primordial non-Gaussianity.

Large scale structures.
- Halo-model-based calculation of n-point correlation functions.
- Sunyaev-Zeldovich effect.

Publications

Author page on inspire-hep: `https://inspirehep.net/authors/1621072`

[1] G. Jung, A. Ravenni, M. Liguori, et al., *Quijote-PNG: Optimizing the summary statistics to measure Primordial non-Gaussianity*, arXiv:2403.00490.

[2] E. Fondi, L. Verde, F. Villaescusa-Navarro, et al., *Taming assembly bias for primordial non-Gaussianity*, *JCAP* **02** (2024) 048, [arXiv:2311.10088].

[3] M. Peron, A. Ravenni, S. Libanore, M. Liguori, and M. C. Artale, *Clustering of binary black hole mergers: a detailed analysis of the eagle + mobse simulation*, *Mon. Not. Roy. Astron. Soc.* **530** (2024), no. 1 1129–1143, [arXiv:2305.18003].

[4] G. Jung et al., *Quijote-PNG: The Information Content of the Halo Mass Function*, *Astrophys. J.* **957** (2023), no. 1 50, [arXiv:2305.10597].

[5] T. Kite, A. Ravenni, and J. Chluba, *Spectro-spatial evolution of the CMB. Part III. Transfer functions, power spectra and Fisher forecasts*, *JCAP* **11** (2023) 028, [arXiv:2212.02817].

[6] J. Chluba, A. Ravenni, and T. Kite, *Spectro-spatial evolution of the CMB. Part II. Generalised Boltzmann hierarchy*, *JCAP* **11** (2023) 027, [arXiv:2210.15308].

[7] J. Chluba, T. Kite, and A. Ravenni, *Spectro-spatial evolution of the CMB. Part I. Discretisation of the thermalisation Green's function*, *JCAP* **11** (2023) 026, [arXiv:2210.09327].

[8] A. Rotti, A. Ravenni, and J. Chluba, *Non-Gaussianity constraints with anisotropic μ distortion measurements from Planck*, *Mon. Not. Roy. Astron. Soc.* **515** (2022), no. 4 5847–5868, [arXiv:2205.15971].

[9] M. Remazeilles, A. Ravenni, and J. Chluba, *Leverage on small-scale primordial non-Gaussianity through cross-correlations between CMB E-mode and μ-distortion anisotropies*, *Mon. Not. Roy. Astron. Soc.* **512** (2022), no. 1 455–470, [arXiv:2110.14664].

[10] T. Kite, J. Chluba, A. Ravenni, and S. P. Patil, *Clarifying transfer function approximations for the large-scale gravitational wave background in ΛCDM*, *Mon. Not. Roy. Astron. Soc.* **509** (2021), no. 1 1366–1376, [arXiv:2107.13351].

[11] T. Kite, A. Ravenni, S. P. Patil, and J. Chluba, *Bridging the gap: spectral distortions meet gravitational waves*, *Mon. Not. Roy. Astron. Soc.* **505** (2021), no. 3 4396–4405, [arXiv:2010.00040].

[12] A. Ravenni, M. Rizzato, S. Radinović, et al., *Breaking degeneracies with the Sunyaev-Zeldovich full bispectrum*, *JCAP* **06** (2021) 026, [arXiv:2008.12947].

[13] J. Chluba, A. Ravenni, and S. K. Acharya, *Thermalization of large energy release in the early Universe*, *Mon. Not. Roy. Astron. Soc.* **498** (2020), no. 1 959–980, [arXiv:2005.11325].

[14] A. Ravenni and J. Chluba, *The double Compton process in astrophysical plasmas*, *JCAP* **10** (2020) 025, [arXiv:2005.06941].

[15] G. Jung, F. Oppizzi, A. Ravenni, and M. Liguori, *The integrated angular bispectrum*, *JCAP* **06** (2020) 035, [arXiv:2004.03574].

[16] J. Chluba, A. Ravenni, and B. Bolliet, *Improved calculations of electron–ion bremsstrahlung Gaunt factors for astrophysical applications*, *Mon. Not. Roy. Astron. Soc.* **492** (2020), no. 1 177–194, [arXiv:1911.08861].

[17] J. Chluba et al., *New horizons in cosmology with spectral distortions of the cosmic microwave background*, *Exper. Astron.* **51** (2021), no. 3 1515–1554, [arXiv:1909.01593].

[18] J. Delabrouille et al., *Microwave spectro-polarimetry of matter and radiation across space and time*, *Exper. Astron.* **51** (2021), no. 3 1471–1514, [arXiv:1909.01591].

[19] J. Chluba et al., *Spectral Distortions of the CMB as a Probe of Inflation, Recombination, Structure Formation and Particle Physics: Astro2020 Science White Paper*, *Bull. Am. Astron. Soc.* **51** (2019), no. 3 184, [arXiv:1903.04218].

[20] T. Haga, K. Inomata, A. Ota, and A. Ravenni, *Exploring compensated isocurvature perturbations with CMB spectral distortion anisotropies*, *JCAP* **08** (2018) 036, [arXiv:1805.08773].

[21] A. Ravenni, M. Liguori, N. Bartolo, and M. Shiraishi, *Primordial non-Gaussianity with μ-type and y-type spectral distortions: exploiting Cosmic Microwave Background polarization and dealing with secondary sources*, *JCAP* **09** (2017) 042, [arXiv:1707.04759].

[22] **CORE** Collaboration, J. Delabrouille et al., *Exploring cosmic origins with CORE: Survey requirements and mission design*, *JCAP* **04** (2018) 014, [arXiv:1706.04516].

[23] **CORE** Collaboration, F. Finelli et al., *Exploring cosmic origins with CORE: Inflation*, *JCAP* **04** (2018) 016, [arXiv:1612.08270].

[24] A. Ravenni, L. Verde, and A. J. Cuesta, *Red, Straight, no bends: primordial power spectrum reconstruction from CMB and large-scale structure*, *JCAP* **08** (2016) 028, [arXiv:1605.06637].

Talks

"*Optimizing the summary statistics to measure primordial non-Gaussianity*" Mar 2024
Seminar, ICCUB Barcelona.

"*Circumventing the f_{NL} degeneracies thanks to the halo mass function*" Oct 2023
Talk, *Asiago Cosmology Dedicated Meeting (ACDM) 2023*, Asiago.

"*Understanding the clustering of binary black hole mergers*" Apr 2023
Seminar, ITA Oslo.

"*Understanding the clustering of binary black hole mergers*" Feb 2023
Talk, *UniVersum 2023*, Trento.

"*Prospects for parameter estimation from the Sunyaev-Zeldovich bispectrum*" Nov 2020
Invited seminar, MPA Garching.

"*Breaking the tSZ degeneracies*" Oct 2020
Invited talk, Simons Observatory Sunyaev-Zeldovich analysis working group.

"*Spectral distortions meet gravitational waves*" Oct 2020
Invited seminar, University of Padova.

"$f(R)$ *constraints from Sunyaev-Zeldovich angular distribution*" Jul 2018
Invited talk, *"From Dark Energy to Bright Synergies"*, Sexten.

"*Test inflation with CMB spectral distortions*" Apr 2018
Internal colloquium, *JBO Science Tea*, Manchester.

"*Early Universe Physics with CMB spectral distortions*" Feb 2018
Invited talk, *ASI/COSMOS "Early Universe"*, Padova.

"*Primordial non-Gaussianity and y-distortions: dealing with secondary sources*" Nov 2017
Talk, *"CMB from A to Z"*, Cargèse.

"*Constraining fundamental Physics using CMB spectral distortions*" Sep 2017
Internal seminar, Padova.

"*Making the most of PIXIE to constrain f_{NL}*" Apr 2017
Talk, *UniVersum 2017*, Torino.

"*How to use y distortions to constrain primordial non-Gaussianity*" Nov 2017
Talk, *IDEAS/CosmoClassic*, Paris.

Activities and collaborations

Organizer of the Asiago Cosmology Dedicated Meeting 2022[1] and 2023[2] for the Padova Cosmology group.

Chair of the Spectral Distortion session of the 16th Marcel Grossmann Meeting.[3]

Coordination role in the preparation of the CMB spectro-polarimeter white paper for the Voyage 2050 ESA call, and in the related activities.[4]

Former member of ASI-COSMOS (Cosmic Orbital and Suborbital Microwave ObservationS), a network of italian research centres created to promote the international role of the Italian CMB community.[5]

Former member of CosmoClassic, a collaborative project between several leading Cosmology research centers in Europe.[6]

Referee for Monthly Notices of the Royal Astronomical Society, The Astrophysical Journal, Journal of Cosmology and Astroparticle Physics.

Teaching

Group supervisor of the Graph Moment Network project for the Laboratory of Computational Physics B course of the Physics of Data master, Apr 2024 – present.

Teaching assistant for the Mathematical and Numerical Methods course of the Astrophysics and Cosmology master, Oct 2023 – Jan 2024.

Co-supervisor of master student Suprio Dubey, Sep 2023 – present.

Co-supervisor of master student Alberto Fragomeni, Dec 2022 – Jul 2023, now in the private sector.

Co-advisor of graduate student Matteo Peron, Jan 2022 – Sep 2022, now Ph.D. student at University of Parma.

[1] https://indico.dfa.unipd.it/event/cosmogroupmeeting22
[2] https://indico.dfa.unipd.it/event/cosmogroupmeeting23
[3] https://indico.icranet.org/event/1/
[4] https://sites.google.com/view/microwave-spectro-polarimetry/home
[5] http://www.cosmosnet.it/
[6] https://sites.google.com/a/g.harvard.edu/cosmoclassic/home

Co-advisor of Ph.D. student Thomas Kite, Dec 2019 – Sep 2021, now Researcher at Massachusetts General Hospital.

Co-supervisor of master student Andrea Fiorilli, Mar 2021 – Dec 2021, now Ph.D. student at LMU Munich.

Co-supervisor of master student Marienza Caldarola, Mar – Sep 2021, now Ph.D. student at ITP Madrid.

Co-supervisor of master student Slađana Radinović, Mar – Sep 2018, now Ph.D. student at the University of Oslo.

Co-supervisor of master student Vikram Upadhyay, Mar – Sep 2017, now in the private sector.

Outreach

Scientific advisor for *"The stairs of the Universe"* Mar 2023 – Feb 2024
Project in collaboration with the art high school "A. Modigliani" to paint the stairs of the Padova Physics department with the history of the universe.

"CMB beyond its anisotropies" Apr 2017
Colloquium, AISF *Sei spritz facili*, Padova.

"Is there a collider in the sky?" Jan 2017
Colloquium, *Science beer*, Padova.

Personal Skills

Languages
Italian: mother tongue.
English: fluent.

Programming languages
C/C++: advanced knowledge.
Python: advanced knowledge.
Fortran: basic knowledge.
HTML: basic knowledge.

Scientific software
CLASS, Monte Python, Cobaya: advanced knowledge.
SONG (Second Order Non-Gaussianity): good knowledge.
CosmoTherm: developer.
Mathematica: good knowledge.
Tensorflow, Keras: advanced knowledge.
LaTeX, Gnuplot, and Matplotlib: advanced knowledge.
SQL: good knowledge.