

Andrea Cimatti – Curriculum Vitae (August 2024)

Personal Information

First name - Family name: Andrea Cimatti

Nationality: Italian

Date of Birth: July 31st 1964

Academic website: <https://www.unibo.it/sitoweb/a.cimatti>

Current Position

2006 – present: *Professore Ordinario* (SSD FIS/05, SC 02/C1). *Full Professor*
University of Bologna, Department of Physics and Astronomy *Augusto Righi*
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EDUCATION

- 1990 – Master degree in Astronomy (110/100 *cum laude*), University of Bologna (Italy).
- 1993 – Studentship at European Southern Observatory (Garching, Germany).
- 1994 – PhD in Astronomy, University of Florence (Italy).

CAREER

- 1994 – Associate position at ESO (Garching, Germany).
- 1995-1996 – Postdoc at University of California (Livermore and Berkeley).
- 1994-2003 – Research Astronomer, INAF - Osservatorio Astrofisico di Arcetri (Italy).
- 2003-2006 – Associate Astronomer, INAF - Osservatorio Astrofisico di Arcetri (Italy).
- 2006-present – Full professor at University of Bologna (Italy).
- 2020-present – Director of the professional Master in *Space Missions Science, Design and Applications* (SPICES) at University of Bologna.
- 2020-2022 – Visiting professor, *Gran Sasso Science Institute* (GSSI), L'Aquila (Italy).
- 2021-present – Head of the Department of Physics and Astronomy *Augusto Righi*, University of Bologna.

OTHER ROLES AT UNIVERSITY OF BOLOGNA

- 2021-2024 – Member of the Academic Senate and of the *Gruppo Senato Ricerca*.
- 2017-2021 – Member of *Gruppo Tematico di Ateneo "Space"*
- 2017-present – Member of *Comitato di Gestione Accordo Quadro ASI-UNIBO*.
- 2017-2020 – Member of Panel 02 for the Valutazione della Ricerca di Ateneo (VRA).
- 2017-2021 – Member of the Scientific Committee of *1088press*.
- 2014-2021 – Member of the Centro Interdipartimentale Ricerca Industriale (CIRI) *Aerospace*.
- 2014-present – Collegio Superiore - Member of the Scientific Council.
- 2019-2020 – Member of the Working Group on the interdisciplinary “Minor” course *Viaggio attraverso lo spazio e il tempo (VAST)*.

MAIN ROLES IN SCIENTIFIC COMMITTEES AND SOCIETIES

- 1999-2005 – Italian representative in the ESO *Scientific Technical Committee (STC)*.
- 2000-2001 – Member of the STC Working Group on *2nd generation VLT instruments*.
- 2002-2003 – Chairperson of the ESO-STC committee *La Silla 2006+*.
- 2003 – Coordinator of the Italian GTO (*High-z Universe and AGN*) for the ESO VLT spectrograph *X-shooter*.
- 2003-2005 – Member of the OPTICON Science Working Group on *Extremely Large Telescopes*.
- 2010-2012 – Member of the ESO Science Working Group on *European ELT*.
- 2008-2011 – Member of the Scientific Council of the Istituto Nazionale di Astrofisica.
- 2014-present – Member of the *Gruppo 2003 for the scientific research*.
- Member of Scientific Organizing Committees of several international conferences.
- 2007-2010 – Member of the following ESA committees for the DUNE, SPACE and *Euclid* missions:
 - European Dark Energy Mission – Concept Advisory Team (EDEM-CAT).
 - *Euclid* Interim Science Working Team (EISWT).
 - *Euclid* Optimization Advisory Team (EOAT).
 - *Euclid* Study Science Team (ESST).
- 2010-present – Italian representative in the *Euclid Consortium Board*.
- 2011-present – Member of the ESA *Euclid Science Team*.
- 2011-present – Coordinator of the SWG on *Galaxy and AGN Evolution (Euclid Consortium)*.
- 2023-2024 – Member of the Science Team and co-lead of the Cosmology Working Group of the project for an innovative 12-m class wide-field spectroscopic telescope (WST).

AWARDS AND ACHIEVEMENTS

- 1995 – *Livio Gratton* Prize for the best PhD Thesis in Astronomy in Italy in 1994.
- 2006 – *Bessel Prize* of the Alexander von Humboldt Foundation (Germany).
- 2016 – *Premio L. Tartufari* of the Accademia dei Lincei.
- 2017 – Commendatore Ordine al Merito della Repubblica Italiana.
- 2016-2018 – *Highly Cited Researcher* of Thomson-Reuters/Clarivate.
- 2022-present – Member of the Accademia delle Scienze dell'Istituto di Bologna.
- 2024-present – Member of the Accademia dei Lincei - Scienze Fisiche, Matematiche e Naturali.

KEY AND MANAGEMENT ROLES IN SCIENTIFIC PROJECTS

- Principal Investigator (PI) of 3 ESO-VLT Large Programmes:
 - 1999 – A stringent test on the formation of early-type and massive galaxies.
 - 2002 – The nature and evolution of infrared galaxies: bridging optical and SIRTf-SWIRE data with near-infrared observations of the ELAIS-S1 field.
 - 2005 – GMASS: the galaxy mass assembly ultra-deep spectroscopic survey.
- 2007-2008 – PI of the *SPACE* mission for the ESA *Cosmic Vision 2015-2025*.
- 2008-2011 – PI of the *NIS* spectroscopic instrument of the ESA *Euclid* mission.
- 2007-present – Development of the *Euclid* mission at national and international level (science cases, simulations, achievement of leading roles, community growth, networking, relations with ESA, ASI, partners and industries, education and training of students and young scientists, outreach and promotion of *Euclid* awareness).
- 2004 – Co-Investigator in cosmological surveys with ESA *Herschel* PACS GTO.
- PI and Co-I of several projects with ESO telescopes, Keck, JCMT, SEST, IRAM, HST.
- 2008-2011 – National PI of MUR PRIN project *Dark energy and cosmology with large galaxy surveys*.
- 2011-2013 – National PI of MUR PRIN project *The dark Universe and the cosmic evolution of baryons: from current surveys to Euclid*.
- 2013-2016 – National PI of MUR PRIN project *Cosmology and Fundamental Physics: illuminating the Dark Universe with Euclid*.
- 2017-2023 – National PI of MUR PRIN project *Opening the ALMA window on the cosmic evolution of gas, stars and supermassive black holes*.
- 2008-present – Responsible of the ASI funding for the *Euclid* activities at University of Bologna.

- 2022-present – Responsible of the University of Bologna Research Unit DIFA-ET of the PNRR Research Infrastructure ETIC – *Einstein Telescope Infrastructure Consortium* led by INFN.
- 2022-present – Responsible of the University of Bologna Research Unit of the PNRR Research Infrastructure CTA+ – *Cherenkov Telescope Array Plus* led by INAF.
- 2022-present – Responsible of the University of Bologna Research Unit of the PNRR Research Infrastructure STILES – *Strengthening the Italian leadership in ELT and SKA* led by INAF.
- 2023-present – Member of the Steering Committee and responsible for the University of Bologna of the development and management of EC funding for the project of an innovative 12-m class wide-field spectroscopic telescope (WST).

TEACHING

- 2006-2008 – Analysis of Astronomical Data (University of Bologna).
- 2006-2009 – Astronomy II (University of Bologna).
- 2006-2008 – Galaxy Clusters (University of Bologna).
- 2006-2008 – Physics of Diffuse Matter (University of Bologna).
- 2011-2012 – Fundamental Astronomy for Mathematics (University of Bologna).
- 2013-2014 – Interazione radiazione-materia: principi fisici dal fotovoltaico all'astrofisica. Collegio Superiore (University of Bologna).
- 2015-2016 – Luce, materia e vita. Collegio Superiore (University of Bologna).
- 2020-2022 – Observational Cosmology (Gran Sasso Science Institute).
- 2021-2022 – L'universo oscuro – Le grandi domande della cosmologia moderna. Collegio Superiore (University of Bologna).
- 2022 – Origine, evoluzione e destino dell'universo. In VAST – *Viaggio attraverso lo spazio e il tempo* (interdisciplinary "Minor" course, University of Bologna).
- 2008-present – Galaxy Formation and Evolution (University of Bologna).
- 2013-present – Astronomy (University of Bologna).

TEXTBOOKS

- *Introduction to Galaxy Formation and Evolution - From Primordial Gas to Present-Day Galaxies*. A. Cimatti, F. Fraternali, C. Nipoti, Cambridge University Press (2019).
- Curatorship of the italian version of *Fundamental Astronomy* (Springer): *Fondamenti di Astronomia* (A. Cimatti, P. Focardi), UTET Università (2023).

OUTREACH

- Author of the popular science book *L'universo oscuro. Viaggio astronomico tre i misteri del cosmo*, edited by Carocci (2017, 2020). The 2017 edition was awarded with the *Premio Nazionale Divulgazione Scientifica "Giancarlo Dosi"* in the category of Mathematical, Physical and Natural Sciences.
- Speaker at several scientific dissemination talks open to the general public.

MAIN SCIENTIFIC ACTIVITY AND HIGHLIGHTS

Andrea Cimatti has research interests in galaxy formation and evolution and observational cosmology. His main activities can be summarized as follows.

High-redshift Radiogalaxies – In the early 1990's the main activities were focused on unveiling the physical and evolutionary properties of high-redshift radio galaxies that were the most distant galaxies known at that time in addition to QSOs. For these studies, Andrea Cimatti had the privilege to use also the Keck telescopes that were the first 10m-class telescopes available before the advent of the ESO VLTs. The results, based on deep optical spectroscopy, photometry and polarimetry, were fundamental to shed light on these distant galaxies, further constraining the AGN Unified Model and understanding the composite nature of the stellar populations and interstellar medium present in these systems.

Dust-obscured Cosmic Star Formation – In late 1990's, the research activities were concentrated on the nature of the mysterious galaxies called Extremely Red Objects (EROs) that became evident thanks to the advent of the first imaging surveys with panoramic near-infrared detectors. Being EROs too faint for optical/NIR spectroscopy, Andrea Cimatti pioneered their observation at submm/mm wavelengths and discovered that a fraction of them consisted in high-redshift starburst galaxies heavily obscured by dust and rich of molecular gas. These findings highlighted the importance of multiwavelength observations to fully unveil the evolution of the star formation density of the universe. This research line continued throughout the years also with the *Herschel* and *Spitzer* space telescopes, and was recently revived by searching for dust-obscured galaxies completely invisible in the optical/NIR, but detected at radio wavelengths. This allowed to further constrain the substantial contribution of dust-obscured systems to the cosmic star formation density up to very high redshifts.

Formation and Evolution of Massive Galaxies in Λ CDM Cosmology – Since early 2000's, the main activities were focused on the big question on when and how massive systems formed and evolved into the present-day spheroidal galaxies, and how such observational results could place stringent constraints on the theoretical models of

structure formation in the framework of Λ CDM cosmology. This vast project was mostly based on pioneering deep spectroscopic surveys of NIR-selected samples of galaxies carried out with the ESO VLT, namely the K20 and the GMASS Large Programmes. The results showed the existence of a substantial population of massive galaxies at $z > 1.5$ that were absent in the model predictions available at that time. A fraction of these galaxies consisted in old, passive/quiescent spheroidal, very dense systems formed rapidly at high redshifts ($z > 2-4$) based on their stellar ages and star formation histories. These findings opened key questions on massive galaxy formation and invoked a revision of the physical processes driving the evolution of baryons within dark matter halos as well as the need for AGN feedback to explain the rapid quenching of star formation in quiescent galaxies. The search for quiescent galaxies at higher redshifts continued until the present days also with HST and JWST, and showed that these systems were already in place at $z > 4-5$, still posing a significant challenge to the theory of galaxy formation in the standard cosmology framework. The NIR-selected samples of galaxies were also exploited for the first time to investigate the clustering properties of massive galaxies at $z > 1$. Based on the angular and spatial clustering, these pioneering results showed a high level of clustering with a correlation length expected for massive DM halos and compatible with that of present-day massive galaxies. Moreover, samples of star-forming galaxies selected from the K20 and GMASS surveys were observed with the VLT equipped with integral-field spectrographs assisted by Adaptive Optics. This allowed us to derive for the first time spatially-resolved kinematics and the velocity fields of galaxies at $z > 1.5$ and to discover an unexpected large fraction of massive, possibly unstable, disks.

SPACE and Euclid missions – In 2007, the concept of a new space mission called SPACE (Spectroscopic All-sky Explorer; PI A. Cimatti) was submitted to ESA in response to the *Cosmic Vision 2015-2025* call. SPACE was designed to address the key open questions of cosmology and fundamental physics (dark energy, dark matter, modified gravity, neutrino properties, ...) and to trace with unprecedented accuracy the formation and evolution of structures on all astrophysical scales through an all-sky deep spectroscopic survey. The SPACE proposal was selected together with another mission (DUNE) that had similar scientific objectives, but was based on a complementary approach (weak gravitational lensing). The two concepts were then merged by ESA into the current *Euclid* mission that, after 16 years of development, was successfully launched in July 2023. *Euclid* has been and still is an extraordinary strategic investment. Its development has been crucial and successful in several areas at national and international level: definition of science cases, development of data simulations, algorithms and software tools, achievement of leading roles in Italy, community growth, networking, relations with ESA, ASI, partners and space industries, education and

training of students and young scientists, outreach and promotion of *Euclid* awareness to the general public.

The Oldest Stars as Cosmological Probes – Another quite recent area of active research regarded the exploitation of passive spheroidal galaxies as cosmic chronometers. Tracing the evolution of their stellar ages is a powerful method to constrain the Hubble parameter as a function of redshift and the value of the Hubble constant with an approach complementary to and independent from other cosmological probes. The pioneering results obtained so far allowed us to derive the evolution of $H(z)$ up to $z \sim 1.5$ and to obtain new constraints on H_0 . Along the lines of exploiting old stellar ages as cosmological probes, it was also revisited how accurately the oldest stars in the present-day universe (Milky Way, Local Group) can constrain the Hubble Constant and other cosmological parameters. The first results clearly showed the great potential of the oldest stars as independent and competitive cosmological probes not limited to just the Hubble constant, and paved the way for unprecedented synergies between stellar evolution and cosmology.

Gravitational waves – Last but not least, a recent area of interest regarded gravitational waves. The development of this new field at University of Bologna (DIFA) was started with the involvement in several projects such as *Einstein Telescope*, ETIC (PNRR), ENGRAVE and GRAWITA. The main activities include (1) the exploitation of GWs in several science cases (e.g. cosmology), (2) R&D with a heterogeneous computing platform for algorithm design, AI models, simulations and tests, (3) experimental research on the optical and mechanical properties of materials for coating ET mirrors in order to minimize noise sources and maximize the sensitivity of gravitational wave detection, (4) education and training of students and young scientists.

PUBLICATION GENERAL STATISTICS

Source: SAO/NASA ADS (16/08/2024)

- Total number of refereed publications (1989-2024): 653.
- Total number of citations (all publications): 43712.
- Total number of refereed publications (1989-2024): 419.
- Total number of citations (refereed publications): 39814.
- H-index (all refereed papers): 102 (105 with Google Scholar).

SELECTED PUBLICATIONS

- Cimatti et al. 1996, *Keck Spatially Resolved Spectropolarimetry of the Distant Radio Galaxy 3C 324*, ApJ, 465, 145.

- Cimatti et al. 1998, *Vigorous star formation hidden by dust in a galaxy at a redshift of 1.4*, **Nature**, 392, 895.
- Cimatti et al. 2002, *The K20 survey. I. Disentangling old and dusty star-forming galaxies in the ERO population*, A&A, 381, L68.
- Cimatti et al. 2002, *The K20 survey. IV. The redshift distribution of $K_s < 20$ galaxies: A test of galaxy formation models*, A&A, 391, L1.
- Cimatti et al. 2004, *Old galaxies in the young Universe*, **Nature**, 430, 184.
- Cimatti, Daddi & Renzini 2006, *Mass downsizing and top-down assembly of early-type galaxies*, A&A, 453, L29.
- Genzel R., Tacconi L. J., Eisenhauer F., Förster Schreiber N. M., Cimatti A., Daddi E., Bouché N., Davies R., Lehnert M.D., Lutz D., Nesvadba N., Verma A., Abuter R., Shapiro K., Sternberg A., Renzini A., Kong X., Arimoto N., Mignoli, M., 2006, *The rapid formation of a large rotating disk galaxy three billion years after the Big Bang*, **Nature**, 442, 786.
- Cimatti et al. 2008, *GMASS ultradeep spectroscopy of galaxies at $z \sim 2$. II. Superdense passive galaxies: how did they form and evolve?*, A&A, 482, 21.
- Laureijs et al. 2011, *Euclid Definition Study Report*, eprint arXiv:1110.3193.
- Moresco, Cimatti et al., 2012, *Improved constraints on the expansion rate of the Universe up to $z \sim 1.1$ from the spectroscopic evolution of cosmic chronometers*, JCAP, 08, 006.
- Cimatti et al. 2013, *Active Galactic Nucleus Feedback at $z \sim 2$ and the Mutual Evolution of Active and Inactive Galaxies*, ApJ, 779, L13.
- Moresco, Pozzetti, Cimatti et al. 2016, *A 6% measurement of the Hubble parameter at $z \sim 0.45$: direct evidence of the epoch of cosmic re-acceleration*, JCAP, 05, 014.
- Carnall A.C., McLure R.J., Dunlop J.S., McLeod D.J., Wild V., Cullen F., Magee D., Begley R., Cimatti A., Donnan C.T., Hamadouche M.L., Jewell S.M., Walker S., 2023, *A massive quiescent galaxy at redshift 4.658*, **Nature**, 619, 716.
- Cimatti A. & Moresco M., 2023, *Revisiting the Oldest Stars as Cosmological Probes: New Constraints on the Hubble Constant*, ApJ, 953, 149.
- Borghi N., Mancarella M., Moresco M., Tagliazucchi M., Iacovelli F., Cimatti A., Maggiore M., 2024, *Cosmology and Astrophysics with Standard Sirens and Galaxy Catalogs in View of Future Gravitational Wave Observations*, ApJ, 964, 191.