

# Dr. Marco Baldi

## Curriculum Vitae et Studiorum

February 22, 2018

### — PRESENT STATUS —

At present I am a fixed-term researcher at the Physics and Astronomy Department of the University of Bologna. My scientific interests are mainly related to the **investigation of alternative cosmological models**, as e.g. **Dark Energy, Modified Gravity, non-standard Dark Matter candidates, massive neutrinos, and deviations from the standard model of primordial inflation**, in particular in relation to **their impact on structure formation**. More specifically, my present work consists on **designing and using suitable N-body algorithms** to investigate the effects of various non-standard cosmological models on linear and nonlinear structure formation processes. I also work on investigating the **possible observational degeneracies** of these models with other cosmologically relevant phenomena (such as baryonic physics or galaxy populations bias), or with each other. In 2015 I have been **awarded an individual 3-years research grant of 530 k Euro from the Italian Ministry of Research and Education** (the SIR project, see [www.sir.miur.it](http://www.sir.miur.it)) for a proposal called SIMCODE specifically devoted to **investigate these degeneracies using cosmological N-body simulations**. I am a **member of the Euclid Consortium** in the *Theory, Cosmological Simulations*, and *CMB cross-correlation* Science Working Groups and in the *Galaxy Clustering Validation* Work Package of the Science Ground Segment. Within the *Cosmological Simulations* Working Group I hold the role of **Coordinator for the development of numerical tools for non-standard cosmological models**. I have recently **obtained the National Scientific Habilitation (Abilitazione Scientifica Nazionale) for the role of Associate Professor**.

### — EDUCATION AND RESEARCH ACTIVITIES —

23 SEPTEMBER 2015 - PRESENT

**Researcher** at the Department of Physics and Astronomy of the Alma Mater University of Bologna as P.I. of the SIMCODE project under the SIR national funding scheme.

28 MARCH 2017

**Habilitation to the role of Associate Professor** for italian universities (Abilitazione Scientifica Nazionale).

NOVEMBER 2014 - SEPTEMBER 2015

**Post-Doc researcher** at the Department of Physics and Astronomy of the Alma Mater University of Bologna.

NOVEMBER 2012 - OCTOBER 2014

**Marie-Curie Fellow** at the Department of Physics and Astronomy of the Alma Mater University of Bologna.

DECEMBER 2009 - OCTOBER 2012

**Post-Doc researcher** at the Excellence Cluster Universe in Garching, working with Prof. J. Weller on simulations of generalized **Dark Energy and Modified Gravity models and Large-Scale Structures**.

APRIL 2009 - OCTOBER 2009

**Transregio Post-Doctoral Fellow** at the Institute for Theoretical Physics in Heidelberg, working with Prof. C. Wetterich on interacting dark energy models.

20 MARCH 2009

**Ph.D. in Astronomy (Dr.Rer.Nat.)** with the grade **MAGNA CUM LAUDE** at the Ludwig-Maximilians University in Munich, with the research thesis “**Interactions between Dark Energy and Dark Matter**”, held under the supervision of Prof. Dr. Simon D. M. White.

SEPTEMBER 2005 - MARCH 2009

**PhD Student** at the Max-Planck-Institut für Astrophysik within the framework of the International Max Planck Research School on Astrophysics (IMPRS). **Member of the Transregio collaboration** of the German Physical Society (DPG) about the investigation of The Dark Universe.

JANUARY 2005 - AUGUST 2005

Collaboration with the Institute for Space Astrophysics and Cosmic Physics (IASF) in Bologna, working with Dr. Fabio Finelli and Prof. Sabino Matarrese on inflationary models.

17 DECEMBER 2004

**Laurea in Physics** with the maximum mark of **110/110 CUM LAUDE** at the Bologna University, with the research thesis “**Evolution of perturbations in cosmological models with dynamic dark energy**”, held under the supervision of Prof. Sabino Matarrese, Prof. Lauro Moscardini and Dr. Fabio Finelli.

SEPTEMBER 1998 - DECEMBER 2004

**Undergraduate studies in Physics** at the Bologna University, with the General Theoretical Physics curriculum.

— FELLOWSHIPS AND GRANTS —

**2017** - Principal Investigator of the **European Tier-0 PRACE project SIMCODE1**: 12 million CPU hours on the Tier-0 machines Marconi (Cineca Supercomputing Center) and MareNostrum4 (Barcelona Supercomputing Center).

**2015** - Awarded a **SIR individual research grant** (success rate  $\sim 2.7\%$ ) from the Italian Ministry of Research and Education (MIUR). The grant amounts to **EUR 530,552.00** for a period of 36 months.

**2015** - Principal Investigator of the **European EUDAT pilot project SIMCODE-DS**: 300 TB of long-term storage on the Pico Data Repository machine at Cineca Supercomputing Center.

**2012** - Principal Investigator of the **European Tier-0 PRACE project SIBEL1**: 8.4 million CPU hours on the Tier-0 machine MareNostrum3 at the Barcelona Supercomputing Center.

**2012** - Awarded a **Marie Curie Intra European Fellowship** in the context of the seventh framework program of the European Commission. The grant amounts to **EUR 185,763.60** for a period of 24 months.

**2011** - Awarded the **HPC-Europa2 Visiting Grant nr. 985**: 6 weeks of visiting time at European institutes and 80 thousand CPU hours on high-performance computing systems.

**2011** - Awarded the **HPC-Europa2 Visiting Grant nr. 589**: 8 weeks of visiting time in European institutes and 150 thousand CPU hours on high-performance computing systems.

**2006** - Awarded the **IMPRS PhD Fellowship** (3 years of PhD fellowship) from the International Max Planck Research School on Astrophysics in Garching (Germany).

**2005** - Awarded an **Early Stage Researcher Fellowship** (8 months of PhD fellowship) under the Marie Curie Actions of the European 6th Framework Programme.

— INVITED TALKS —

- 28-29 June 2018 - International Conference “79 and counting: a Large-Scale Tribute to Silvio Bonometto, Trieste (Italy)
- 22 May 2018 - Invited Astrophysics Seminar at SISSA, Trieste (Italy)
- 29 November 2017 - Invited Cosmology Seminar at Institute for Theoretical Physics, University of Heidelberg (Germany)
- 27 April 2017 - International Conference “PONT – Progresses on Old and New Themes in Cosmology”, Avignon (France)
- 1 September 2015 - International Workshop “From Inflation to Galaxies: a workshop in honor of Sabino Matarrese”, Castiglioncello (Italy)
- 3 July 2015 - International Conference “Cosmological Simulations: from galaxies to large scales”, Sexten Center for Astrophysics, Sesto Pusteria (Italy)
- 23 April 2015 - Invited Seminar, Institute for Theoretical Physics, Heidelberg University (Germany)
- 19 February 2015 - Invited Institute Seminar, Physics Department, Ferrara University (Italy)
- 15 December 2014 - International Conference “The Quest for Dark Energy II”, Ringberg (Germany)
- 3 July 2014 - International Workshop “Non-Linear Structure in the Modified Universe”, Lorentz Center, Leiden (The Netherlands) - **Invited Discussion Leader**
- 29 November 2013 - International GRAVASCO Conference “Origin of cosmic structures”, Paris (France)
- 9 May 2013 - 57th Congress of the Italian Astronomical Society, Bologna (Italy)
- 14 March 2013 - International conference “Cosmological tests of gravity”, Oxford (UK)
- 25 June 2012 - International conference “The quest for Dark Energy”, Ringberg (Germany) - **Invited Review Talk**
- 4 October 2011 - International conference “The Dark Universe”, Heidelberg (Germany)
- 16 May 2011 - Invited Institute Seminar, Astronomical Observatory, Trieste University (Italy)
- 28 April 2011 - Invited Institute Seminar, Astronomy Department, Bologna University (Italy)
- 12 October 2010 - Invited Institute Seminar, Institute for Theoretical Astrophysics, Oslo University (Norway)
- 16 June 2010 - Invited Institute Seminar, S.I.S.S.A., Trieste (Italy)
- 21 October 2009 - Invited Institute Seminar, ICG, Portsmouth University (UK)
- 13 October 2009 - Excellence Cluster Science Week, Munich (Germany)
- 8 July 2009 - Invited Institute Seminar, CAUP, Porto University (Portugal);
- 18 June 2009 - Invited Institute Seminar, Astronomy Department, Bologna University (Italy);
- 27 November 2008 - Invited Institute Seminar, ICE, Barcelona University (Spain).

— CONTRIBUTED TALKS AND CONFERENCES —

- 2 May 2015 - International Conference “Theoretical Cosmology in the Era of Large Surveys”, Galileo Galilei Institute, Arcetri, Florence (Italy)
- 1 October 2014 - International Workshop “Dark Energy Interactions”, NORDITA (Norway)
- 9-11 April 2014 - International Workshop “Modified Gravity Simulations”, Garching (Germany) **(Talk)**
- 8-13 September 2013 - International Conference “Exascale Computing in Astrophysics”, Ascona (Switzerland) **(Talk)**
- 17 January 2013 - *Physics and Astronomy Department*, University of Bologna (Italy), **(Talk)**
- 16-22 September 2012, International Conference “Particles and the Universe”, Corfu (Greece), **(Talk)**
- 13-17 June 2011 International Conference “Advances in Computational Astrophysics”, Cefalù (Italy), **(Talk)**
- 18 January 2011 - *Cahill Center for Astrophysics*, CALTECH, Pasadena (USA), **(Talk)**
- 10-14 January 2011- International Conference “Essential Cosmology for the Next Generation”, Puerto Vallarta (Mexico), **(Talk)**
- 4-8 October 2010 - International Conference “Cosmology meets Particle Physics”, Bad Honnef (Germany), **(Talk)**
- 28 June-1 July 2010 - International Conference “Modified Gravity approaches to the Dark Sector”, Strasbourg (France), **(Talk)**
- 29-31 March 2010 - “5th IberiCos Cosmology Conference”, CAUP, Porto (Portugal), **(Talk)**
- 7-11 September 2009 - International Conference “Cosmo 09”, CERN, Geneva (Switzerland), **(Talk)**
- 2-4 March 2009 - International Conference “Dark Energy”, Galileo Galilei Institute, Florence (Italy), **(Talk)**
- 7-11 October 2008 - *Third Biannual Leopoldina Conference on Dark Energy*, Munich (Germany), **(Talk)**
- 8-12 September 2008 - International Conference “Cosmology Across Cultures”, Granada (Spain)
- 23-25 June 2008 - International Conference “Symmetries and Phases in the Universe”, Kloster Irsee (Germany), **(Poster)**

- 30 September - 3 October 2007 - Second Transregio Meeting “*The Dark Universe*”, Bad Honnef (Germany), **(Poster)**
- 7-8 November 2006 - First Transregio Meeting “*The Dark Universe*”, Heidelberg (Germany), **(Poster)**
- 7-11 November 2005 - International Conference “*Einstein’s Legacy*”, Munich (Germany)
- 30 June - 2 July 2005 - 9th Paris Cosmology Colloquium “*Daniel Chalonge*”, Paris (France)

— PUBLIC OUTREACH TALKS —

- 29 September 2017 - Lecture “*L’universo è come un iceberg*”, at the European Researchers Night, Opificio Golinelli, Bologna (Italy)
- 19 May 2014 - Lecture “*The Dark Side of the Universe: Materia Oscura, Energia Oscura e Gravità Modificata*”, at the public high school *Liceo Scientifico Augusto Righi*, Bologna (Italy)
- 10 October 2013 - Public Conference “*The scales of the Universe*”, Chieti (Italy)
- 27 September 2013 - Speaker of the international public event “*Origins 2013*” within the “Speed-Dating” initiative held in Bologna (Italy)
- 1 December 2010 - Speaker of the international public initiative “*Dark Matter Awareness Week*” at the Excellence Cluster Universe building in Garching (Germany)

— INTERNATIONAL COLLABORATIONS —

- **Member** of the LSST collaboration in the DESC group since 2018.
- **Member** of the Cosmology Group of the Square Kilometre Array (SKA) collaboration since 2017.
- **Task Coordinator** of the Euclid Simulations WG for the implementation of non-standard cosmologies.
- **Coordinator** of the Euclid Joint Theory+Simulations WP for the for the definition and selection of non-standard cosmologies.
- Member of the *Theory, Simulations* and *CMB cross-correlation* WGs of the **Euclid collaboration**
- Member of the **Transregio Collaboration** (<http://darkuniverse.uni-hd.de/view/Main/WebHome>) on the “Dark Universe” from 2006 to 2012

— ADVISORY BOARD, CONFERENCE ORGANIZATION, AND OTHER DUTIES —

- **Referee of the international journals:** Monthly Notices of the Royal Astronomical Society (MNRAS), Monthly Notices of the Royal Astronomical Society Letters (MNRAS-L), Physical Review D (PRD), The Astrophysical Journal (ApJ), Journal of Cosmology and Astroparticle Physics (JCAP), Physics Letters B (PLB), Physics of the Dark Universe (PDU).
- **Member of the Scientific Organising Committee** of the international conference “From Dark Energy to Bright Synergies”, Sesto Pusteria (Italy), 23-27 July 2018;
- **Member of the Steering Committee** of the yearly national cosmology meeting “UniVersum”;
- **Member of the Scientific Organizing Committee** of the international workshop “The quest of Dark Energy II: theory and simulations confront observations”, Ringberg Castle (Germany), 14-19 December 2014;
- **Invited external member of two Ph.D. defence committees** of the *Physics and Astronomy Department, Aarhus University, Denmark (September 2014)*;
- **Invited external reviewer** of the Ph.D. thesis of Antonio Bibiano at Swinburne University (Australia);
- **Member of the reviewing panels** of: *French National Research Agency (Call 2012)*; *Polish National Science Center (Call 2013)*; PRACE Time Assignment Committee (8th Call and 15th Call); NASA Post-Doctoral Fellowships (Call 2014);
- **Member of the Scientific Organizing Committee** of the international workshop “The quest of Dark Energy: when theory meets simulations”, Ringberg Castle (Germany), 24-29 June 2012;
- **Member of the Local Organizing Committee** of all the five editions of the Transregio Winter School on Cosmology, from 2007 to 2011;

— TEACHING EXPERIENCE —

- 2018: **Teaching the undergraduate course General Physics B-II** (thermodynamics) at the Aerospace Engineerings faculty, Bologna University;
- 2015-2018: **PhD Advisor** of the thesis of Mr. Matteo Nori at the Physics and Astronomy Department, Bologna University (thesis to be submitted in 2018);
- 2017: **Invited Lecturer** for the PRACE school “*HPC Methods for Computational Fluid Dynamics and Astrophysics*” (see <https://events.prace-ri.eu/event/659/>) at the Cineca supercomputing center, Bologna (Italy)
- 2016: **Invited Lecturer** for the PRACE school “*HPC Methods for Computational Fluid Dynamics and Astrophysics*” (see <https://events.prace-ri.eu/event/516/>) at the Cineca supercomputing center, Bologna (Italy)
- 2015: **Invited Lecturer** for the Ph.D. school “*Astrophysical Probes of fundamental Physics*” at the University of Ferrara, Department of Physics and Earth Science (see <http://fst.unife.it/eventi/phd-school-astrophysics-1>);
- 2014: **Teaching Assistant** for the undergraduate courses of “Informatics” and “Scientific Computing for Astronomy”, University of Bologna;
- 2014: **Supervision of the Master Thesis in Physics** of Enrico Garaldi on “Zoomed simulations of halo segregation in cosmological models with two species of coupled dark matter”;
- 2013 - 2014: **Supervision of the Master Thesis in Astrophysics and Cosmology** of Giorgia Pollina on “Statistical and structural properties of voids in cosmological simulations of interacting Dark Energy”;
- 2012 - 2013: **Supervision of the Diploma Thesis in Physics** of Santiago Casas on “Large scale structure formation and the nonlinear power spectrum in cosmological simulations of coupled Dark Energy”;
- 2011 - 2012: **Supervision of the Diploma Thesis in Physics** of Ludwig Schrobenhauser on “Analysis of simulated data for interacting Dark Energy models”;
- 2011: **Assistant of Prof. Jochen Weller** for the Summer Semester Astrophysics Students Seminars at the Ludwig-Maximilians-University, Munich (Germany);
- 13 October 2010: **Lecture on “N-body techniques for interacting scalar field cosmologies”** held at the Institute for Theoretical Astrophysics, University of Oslo (Norway)

— SPOKEN LANGUAGES —

**Italian** (Native Speaker), **English** (Excellent), **Spanish** (Good), **French** (Basic), **German** (Basic)

— COMPUTER SKILLS —

- Good knowledge of the main operating systems: **Unix**, **Mac**, **Windows**.
- Programming languages: **Fortran**, **C**, **IDL**. Editing tools:  $\text{\LaTeX}$ .
- Special purpose numerical codes: good knowledge of the use of the cosmological simulation codes GADGET-2 and GADGET-3.
- Long experience in the use of large parallel supercomputing systems, including: “OPA”, “VIP”, and “Hydra” clusters (RZG, Germany); “SP6” and “Fermi” clusters (CINECA, Italy); Linux Cluster (LRZ, Germany); “SCIAMA” Computing Center (ICG, UK); “MareNostrum3” cluster (BSC, Spain).