

Curriculum Vitæ

MARIA PAOLA LOMBARDO

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Academic Positions

2002 – today Senior Scientist, INFN, tenured
2015 - *Abilitazione Scientifica Nazionale* as full professor in Theoretical Physics
April 2012 – May 2012 Guest Professor, Universität Bielefeld
April 2011 – September 2011 Guest Professor, Humboldt Universität zu Berlin
1998 - 2002 Senior Scientist, INFN
1996 - 1998 Wissenschaftliche Mitarbeiterin, BAT IB, ZiF, Universität Bielefeld
1994 - 1996 Wissenschaftliche Mitarbeiterin BAT IB, DESY, KFA-HLRZ , Juelich
1991 - 1994 Research Associate, University of Illinois at Urbana-Champaign
1988 - 1992 Junior Scientist, INFN

Professional Preparation

1986-1988 INFN National Training Fellowship, Advisor Giorgio Parisi
1985 *Laurea in Fisica*, Università di Pisa, 110/110 *e lode*, Advisor Paolo Grigolini

Synergistic Activities - Scientific Centers and Commissions of Trust (selection)

2018 – today Access Committee, PRACE, Partnership for Advanced Computing in Europe, Member
2018 – today Scientific Advisory Committee, CRC-TR11 *Strong-interaction matter under extreme conditions*, Member
2017 – today Science Communications Manager, COST Action CA-15213 THOR,
2016 – today Management Committee of European COST Action CA-15213 THOR, Member
2016 – today Scientific Council, CMTP, Center for Mathematics and Theoretical Physics, Roma, Member
2018–2019 Review Panel NT-3, Natural and Engineering Sciences, Swedish Research Council, Member
2018 Review panel Clusters of Excellence on Complex Systems and Structure of Matter, DFG, Member
2017–2018 Evaluation Panel the for assessment of Ken Wilson Award for Excellence in Lattice Field Theory, Member
2018 Committee for the Nuclear Physics A award at Quark Matter 2018, co-Chair
2016–2017 Long Range Plan for Nuclear Physics, Working Group 1 *Hadron Physics*, Member
2016, June to September, *Mathematics and Physics at the Crossroads*, INdAM Research Period, Italy, LNF Coordinator
2012–2015 Scientific Board of ECT*, European Center for Theoretical Studies in Nuclear Physics and related areas, Member
2011–2016 Co-operation agreement between INFN and CMTP, INFN Scientist-in-charge
1996–1998 Research Group Multi Scale Phenomena, ZiF, Bielefeld, Coordinator.

Grants and Awards (selection)

2019 – 2023 IWP17_NA6 Lattice Hadrons, Project STRONG-2020, INFN Coordinator
2019 – 2021 IS CRA High Performance Computing Allocation PCHSHT, Principal Investigator
2009 – 2014 MIUR Project of national relevance (PRIN) 20093BMNPR, co-PI and INFN National Coordinator
2000 – 2018 INFN Iniziative Specifiche , co-PI and LNF IS Coordinator
2010 – 2012 IS CRA High Performance Computing Allocations: IsB2_SCGT and IsBSGTII Principal Investigator
2012 – 2013 PRACE High Performance Computing Allocation: Pra05_1110, Principal Investigator
1996 – 1997 NATO Collaborative Research Grant CRG950896, Project Coordinator

My research focusses on strong interactions within and without the standard model. I am particularly interested in phase transitions and in the high temperature phase of Quantum Chromodynamics, mostly studied with numerical methods.

Computational physics affords many opportunities of cross-fertilization with other fields. In my early days with the APE collaboration a consistent effort was made to apply APE computers to environmental problems: under the leadership of Nicola Cabibbo APE computers were installed at ENEA, the national agency for energy and environment. I have been invited back in Italy in 1998 to coordinate a computational effort at the Laboratori Nazionali del Gran Sasso, with the involvement of meteorologists and seismologists. The main idea was to find common methods and strategies in earth sciences. Nowadays, at the dawn of the exascale epoch and the start of the EuroHPC initiative (<https://eurohpc-ju.europa.eu/>) I feel that it becomes crucial to exploit all possible synergies among different disciplines

Strong dense matter is one of my main interests, due to the fascinating range of applications and methodological challenges. I am credited for being one of the proposers of one successful method to study the phases of QCD at high density, analytic continuation from an imaginary chemical potential. My work on the subject, mostly with Massimo D'Elia, has spawned a significant activity and it has produced some of the most significant results including the shape of the critical line. With John Kogut and other collaborators I have pioneered the study of gauge models without the sign problem, like QCD with two colors, as a powerful tool to investigate dense matter from first principles.

The physics of the Quark Gluon Plasma, the intricacies of the dynamics of the transition, and their phenomenology are a constant interest. The need of a close interaction among theorists using different approaches has motivated the European Action THOR, Theory of Ultrarelativistic Heavy Ion Collisions, in which I have several responsibilities.

I have proposed NRQCD as a viable tool at finite temperature for the analysis of bottomonium in the plasma. The FAST-SUM collaboration with Gert Aarts, Chris Allton, Simon Hands, Seyong Kim, Sinead Ryan, Jon-Ivar Skullerud, and others has now developed into one of the leading groups worldwide. We have clearly demonstrated the sequential suppression of bottomonium, an important property at the core of experimental observations at the LHC and BNL. Hot NRQCD is now the method of choice for many groups. Still on the plasma properties, Andrey Kotov, Anton Trunin and I have shown that only the non-anomalous component of the η' survives at the transition, in a lattice study which is so far unique. Topology fits naturally in this scenario: with the late Michael-Müller-Preussker, Anton Trunin, Ernst-Michael Ilgenfritz I have paved the way to full fledged studies of topology in the plasma with dynamical fermions, presenting the first high statistics lattice results.

I have pioneered lattice studies for studies beyond the standard model and dark matter. In the context of composite Higgs model building, with Elisabetta Pallante and junior collaborators I have shown that the conformal transition in QCD is the zero temperature limit of the finite temperature transition, proposed a successful line of attack to the assessment of conformality based on finite temperature, and have presented the first measure of the anomalous dimension from the mass scaling of the spectrum. In short we have established the existence of the conformal window of QCD, as well as the separation of scale in the preconformal region – the key ingredient for model builders interested in composite Higgs – by proposing and exploiting our own strategies. Our early controversial results are now confirmed by other studies. Still 'beyond the standard model', and in the context of dark matter, I have studied the QCD axion with Anton Trunin and other collaborators, building on the results on topology and we have just completed an invited review on the subject.

My work is recognized by plenary talks at major conferences like Lattice Field Theory, Quark Matter, Extreme QCD, and by a constant presence in their IACs. I am serving as advisor to a number of topical workshops, and I am regularly invited to give talks, lectures and seminars. I have had a leading role in the organization of several international conferences, and have edited eight volumes of proceedings. As of June 2020 I have written 168 papers, with 6840 citations and h-index 40 (Google Scholar), and I am enlisted among Italian Top Scientists, <http://www.topitalianscientists.org/top-italian-scientists>.

As I have no regular teaching duties, my lecturing activities are very much related to my research work. One of My main goals - together with a careful and objective presentation of the matter at hand - is to give the students the critical tools to frame these necessarily advanced topics in a broader scheme. Luckily, I am usually rewarded by an attentive and appreciative audience.

PhD Courses

Lattice Field Theory, PhD course, Corsi 2019/2020 XXXV Ciclo, Università di Firenze

Phases of Gauge Theories, PhD Course, Corsi 2019/2020 XXXV Ciclo, Università di Firenze

QCD at high temperature and density, Universität Bielefeld, Sommer Semester 2012. This course has been subjected to an official evaluation by the Dekanat, with the final mark 9.5/10, ranking first ex-aequo among 22 courses offered during the semester.

Lattice Field Theory and QCD under extreme conditions, Humboldt Universität Berlin, Sommer Semester 2011

Fisica Computazionale, Lectures at Scuola di Dottorato, Università dell'Aquila, April-May 2001 [This general Computational Physics Course has been invited by Guido Visconti, as part of the joint activities between INFN and Earth Science.](#)

Gauge Theories at Finite Temperature and Density, Lectures at Scuola di Dottorato, Università della Calabria, 2001

International Schools

Phases of QCD, Topology and Axions, Lectures at the Dubna International Advanced School of Theoretical Physics and Helmholtz International Summer School Hadron Structure, Hadronic Matter and Lattice QCD, JINR, Dubna, August 2017

Dense Matter from lattice QCD, GGI, Firenze, Introductory lectures to the GGI program The structure and signals of neutron stars, from birth to death, March 2014

Phases of QCD and critical point from the lattice, Lectures at the Dubna International Advanced School of Theoretical Physics DM2010, August 2010

QCD at finite temperature and density on the lattice, Lectures at the Helmholtz International Summer School Dense Matter in Heavy Ions Collisions and Astrophysics, JINR DUBNA, July 2008

Lattice QCD at Finite Temperature and Density, Lectures at Guangzhou School on LGT, China, 2005 [Writeup available, quoted on Wikipedia on the Lattice QCD page \[https://en.wikipedia.org/wiki/Lattice_QCD\]\(https://en.wikipedia.org/wiki/Lattice_QCD\)](#)

Lattice QCD at non-zero temperature and density, Lectures at INFN Catania and Laboratori Nazionali del Sud, February 2002

Field Theory and Phase Transitions, Lectures for the ICTP School on Astroparticle Physics and Cosmology, 2001, published in ICTP Lecture Note Series, vol IV Astroparticle Physics and Cosmology, G. Senjanovic, A. Yu. Smirnov and G. Thompson eds, p. 119 [Writeup available, enlisted on the NET ADVANCE OF PHYSICS, Review Articles and Tutorials in an Encyclopedic Format, <http://web.mit.edu/redingtn/www/netadv/>](#)

Coordination

In 2015 I have coordinated the yearly Doctoral Training Program of ECT*. My proposed topic was Computational Nuclear Physics. The general scheme I had in mind was a complete overview of the calculational schemes apt to describe any matter bound by strong forces within the standard model. An outstanding set of lecturers and a motivated group of students made the program a success. Together with one of the lecturers, Morten Hjorth-Jensen, and a colleague on the Board, Ubirajara van Kolck we have then decided to prepare a volume based on the program, supplementing the material from the doctoral program with material from the Talent School in Nuclear Physics.

The volume *An advanced course in Computational Nuclear Physics bridging the scales from quarks to neutron stars*, Springer Lecture Notes in Physics, edited with Morten Hjorth-Jensen and Ubirajara van Kolck, ISBN 978-3-319-53336-0 appeared in April 2017. According to the Publisher on June 2019 since its online publication there have been a total of 11860 chapter downloads and the book was among the top 25% most downloaded eBooks in its respective eBook Collection in 2018.

[Editorial activity and volumes:](#)

Quark Matter 2018 (Guest Editor for Nuclear Physics A), editor con E. Scapparini, A. Dainese e V. Greco

An advanced course in Computational Nuclear Physics bridging the scales from quarks to neutron stars, Springer Lecture Notes in Physics, editor with Morten Hjorth-Jensen and Udiraj van Kolck, ISBN 978-3-319-53336-0, April 2017

QCD at Finite Baryon Density, Nucl.Phys. A642 ,1998; editor con F. Karsch

Quantum Monte Carlo: recent advances and common problems in condensed matter and particle physics, Proceedings of the Collaboration Meeting held at ECT*, Trento, July 3d to July 6th, 2001 (ETS, Pisa, 2001), editor con M. Campostrini and F. Pederiva

Quark Gluon Plasma and Heavy Ion Collisions (World Scientific, 2002) editor con W. Alberico and M. Nardi

Heavy quarkonium physics with N. Brambilla et al. [Quarkonium Working Group], CERN Yellow Report, CERN-2005-005, editor of the Chapter Quarkonium in Media with D. Kharzeev, C. Lourenco, M. Rosati, H. Satz

XII International Conference on Hadron Spectroscopy, Proceedings of the Conference held at the Laboratori Nazionali di Frascati, 7-13 October 2007, (Frascati Physics Series, 2008) editor with L. Benussi, M. Bertani, S. Bianco, C. Bloise, R. de Sangro, P. de Simone, P. di Nezza, P. Gianotti, S. Giovanella, S. Pacetti

The XXVIII International Symposium on Lattice Field Theory , Proceedings of the Conference held in Villasimius, June 14-20 2010, editor con G.C Rossi et al., PoS 2011

[Invited talks and lectures \(selection\)](#)

Topological susceptibility and related quantities on the lattice, ZOOM version of invited talk for Applications of Gauge Topology, Holography and Strong Models to QCD, Simons Center for Geometry and Physics, June 2020

Symmetries, topology and the fate of the η in the QCD, The II International Workshop on Theory of Hadronic Matter Under Extreme Conditions, Dubna, JINR, September 2019

Symmetries and Topology of strong interactions, between the QCD and the EW transition, RMT in sub-atomic physics and beyond, Trento, ECT*, August 2019

Axions and topology in QCD, Interdisciplinary approach to QCD-like composite dark matter, Trento, ECT*, October 2018

QCD topology and axion cosmology from lattice simulations , HIC for FAIR Colloquium , Giessen, Novembre 2017

Scale separation, walking dynamics and approach to criticality in QCD with varying number of flavors, review a Gauge Fields Topology, Simons Center, Stonybrook, July 2015

How many scales in many-flavour QCD? Strong Coupling Gauge Theories Beyond the Standard Model, Kobayashi-Maskawa Institute, Nagoya, Marzo 2014

Quarkonia in the quark gluon plasma, Opening plenary talk at Strong and Electroweak Matter, Swansea, July 2012

High Temperature QCD, Plenary talk at Lattice 2012, Cairns, July 2012

Strong interactions and finite baryon density, Opening plenary talk Strong Interactions in the 21st century , Baha Memorial Workshop , Mumbai, February 2010

QCD at finite density, Plenary talk at Quark Matter 2008, Jaipur, February 2008

Outreach and dissemination

Dissemination Board Member, European Action Strong-2020, 2019 –

Science communications manager, European COST (COoperation in Science and Technology) Action CA-15213 THOR - Theory of Hot Matter and Relativistic Heavy Ions Collisions, 2018 –

Concept and coordination for the graphic novel THOR and the plasma of quark and gluons, with Simone Gabrielli of the Scuola Romana del Fumetto

Quantum Field Theories at Finite Temperature, invited essay for Visions of Oneness (diretto ad un pubblico scientifico generico), Ignazio Licata editor, Aracne Editrice, Roma, Italy , 2013

Equal rights and diversity issues

Member of the INFN CUG (committee for equal opportunities) 2019–2020

Member of the national council of ANPRI, the national union of research personnel 2019 –

Advisor on matter of harassment and discriminations, following IUPAPP recommendations, Quark Matter 2018

Promoter and chair of the first Quark Matter plenary session devoted to diversity in physics, in collaboration with the CERN Diversity Office