Florence, October 9, 2024

Curriculum Vitae of Andrea Cappelli

PERSONAL DETAILS

Cappelli, Andrea. ORCID: 0000-0003-1306-4698
Born on October 27, 1958 in Florence, Italy. Married with one son. E-mail: andrea.cappelli@fi.infn.it
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Education and key qualifications

03/06/1987	PhD in Theoretical Physics, University of Florence, Italy, (with extended research activity at Institut de Physique Theorique, CEA Saclay, France). Supervisors: M. Ciafaloni, C. Itzykson, J. B. Zuber
1977 – 1983	Laurea in Physics, University of Florence, Italy, maximum marks *cum laude*. Supervisor: M. Ciafaloni
2014 - present	Italian National scientific qualification of full professor in theoretical physics

Main teachers in theoretical physics : M. Ademollo, M. Ciafaloni (Florence); C. Itzykson, J-B. Zuber (Saclay, France); D. Friedan (Rutgers, USA)

Main topics of early education: Quantum Field Theory, Gauge Theories, Exactly Solvable Models in Statistical Mechanics, Two-Dimensional Conformal Field Theory, String Theory.

Current position

2001 - present	Director of Research, INFN, Section of Florence

Previous positions

1996 – 2001	First Researcher, INFN, Florence
1988 – 1996	Researcher (permanent position), INFN, Florence
1991 – 1992	Research fellow, Theory Division, CERN, Geneva
1989 – 1990	Post-doctoral fellow, Niels Bohr Institute, Copenhagen
1986 – 1988	Post-doctoral fellow, Service de Physique Theorique, CEA Saclay, France

RESEARCH ACTIVITY

Ten representative publications

(1) A. Cappelli, L. Maffi, R. Villa, Bosonization of 2+1 dimensional fermions on the surface of topological insulators, arXiv:2406.01787, accepted in JHEP
(2) A.G. Abanov, A. Cappelli, Hydrodynamics, anomaly inflow and bosonic effective field theory, JHEP 08 (2024) 057
(3) C. Bonanno, A. Cappelli, M. Kompaniets, S. Okuda, K.J. Wiese, Benchmarking the Ising uni-

versality class in $3 \leq d < 4$ dimensions, SciPost Phys. 14 (2023) 135
(4) R. Arouca, A. Cappelli and T.H. Hansson, Quantum Field Theory Anomalies in Condensed Matter Physics, SciPost Phys. Lect. 62 (2022) 1
(5) A. Cappelli, L. Maffi, W-infinity Symmetry in the Quantum Hall Effect Beyond the Edge, JHEP 05 (2021) 120
(6) A. Cappelli, M. Huerta, G. R. Zemba, Thermal Transport in Chiral Conformal Theories and Hierarchical Quantum Hall States, Nucl. Phys. B 636 (2002) 568
(7) A. Cappelli and G.R. Zemba, Modular invariant partition functions in the quantum Hall effect, Nucl. Phys. B 490 (1997), 595
(8) A. Cappelli, C. A. Trugenberger, G. R. Zemba, Infinite symmetry in the quantum Hall effect, Nucl. Phys. B396 (1993) 465
(9) A. Cappelli, D. Friedan, J. I. Latorre, C-theorem and spectral representation, Nucl. Phys. B352 (1991) 616
(10) A. Cappelli, C. Itzykson, J. B. Zuber, The ADE Classification of Minimal and A_1 Conformal Invariant Theories, Commun. Math. Phys. 113 (1987) 1

Books
– A. Cappelli, E. Castellani, F. Colomo, P. Di Vecchia, Ed., The Birth of String Theory, Cambridge University Press (2012), Cambridge, UK
– A. Cappelli, G. Mussardo, Ed., Statistical Field Theories, proceedings of the NATO Advanced Research Workshop, Como, 18-23 June 2001, Kluwer Acad. Publ. (2002), Dordrecht, NL

Bibliometrics
Andrea Cappelli wrote more than 65 papers in international scientific journals and edited two books, which received about 4400 citations, with two papers having more that 700 citations.

Description of main achievements
Andrea Cappelli is an expert in two-dimensional conformal field theory, where he achieved the classification of so-called minimal models, a major scientific result (Ref. (10) of publication list). He also worked in many subjects of advanced quantum field theory, in particular on the irreversibility of the renormalization group flow (the c-theorem) and its relation with conformal anomalies (9). From the Nineties, he developed the conformal theories describing edge excitations in the quantum Hall effect (7), in particular those having non-Abelian fractional statistics. He proposed that the incompressible Hall fluids of electrons possess the symmetry under area-preserving diffeomorphisms of the plane, the W-infinity symmetry (8,5). From the analysis of this symmetry, he obtained an independent derivation of the hierarchical Hall states. He also showed that the thermal Hall conductivity is determined by the gravitational anomaly of edge excitations (6), a result which has been verified experimentally.

In the last fifteen years, he developed the effective field theory description of topological insulators in three and four spacetime dimensions, applying the methods of topological theories, anomalies, and conformal invariance already employed in the quantum Hall effect. He recently wrote a comprehensive review on the use of anomalies in condensed matter physics (4). He also applied topological theories for developing hydrodynamics of fermionic fluids (2). One recurrent theme is establishing the correspondence between fermionic and bosonic theories (1). Another constant interest is in con-

formal invariance above two dimensions, which he recently studied using the numerical method of the conformal bootstrap (3).

Current interests

– Understanding topological phases of matter in three and four dimensions, of associated anomalies and topological field theories.
– Interplay with generalized symmetries, and applications to gauge theories of fundamental forces.
– Hydrodynamics of fermionic fluids with anomalies.

Scientific visits

Andrea Cappelli has been visiting several Universities and laboratories, and participated to scientific programs, with stays of some weeks to some months. In the United States and Canada (Chicago, MIT, Montreal, Princeton, Rutgers, Santa Barbara, Stony Brook), in Europe (Amsterdam, Bruxelles, Cern, École Normale, IHP and Saclay in Paris, Cambridge, Stockholm, Wien), in Israel (Weizmann) and South America (Bariloche ARG, Natal BR).

Invited contribution to conferences and extended programs

Every year Andrea Cappelli presents his work to some international conferences. In recent years:
– 2024 at Exotic quantum matter from quantum spin liquids to novel field theories, Pollica Physics Centre, Pollica, Italy
– 2024 at Mathematical Physics for Quantum Science, Institute for Advanced Study at Zhejiang University, Hangzhou, China.
– 2023 at Landau Week: Frontiers in Theoretical Physics, University of Yerevan, Yerevan, Armenia
– 2023 at Geometric and analytic aspects of the quantum Hall effect, SwissMAP Research Station, Les Diablerets, Switzerland
– 2023 at Great Lessons from Exact Techniques and Beyond 2023, University of Calabria, Tropea, Italy
– 2022 at Geometrical Aspects of Topological Phases of Matter: Spatial Symmetries, Fractons and Beyond, Simons Center for Theoretical Physics, Stony Brook, USA
– 2022 at Topological Quantum Phases of Matter Beyond Two Dimensions, University of Paris, Jussieu, France
– 2022 at Conformal field theory and quantum many-body physics, Centre de Recherches Mathematiques, Montreal, Canada

TEACHING ACTIVITY

– Since 2005 teacher of 'Quantum Field Theory II', in the Master courses in Physics, University of Florence
– Since 2001 Teacher of the PhD school in Physics, University of Florence. Courses delivered on 'Advanced Quantum Field Theory', 'Introduction to String Theory', 'Statistical Field Theory', 'Conformal Field Theory in Two Dimensions', 'Topological States of Matter'.
– Lecturer in several PhD schools in Italy and abroad. Last course delivered on 'Quantum Field Theory Anomalies in Condensed Matter Physics', at the school SFT 2024 - Lectures on Statistical

Field Theories, G. Galilei Institute, Florence

Thesis advisor and students' careers
Advisor of 9 PhD theses and 6 Master theses in Theoretical Physics at the University of Florence: 2 ex-students now hold academic positions, 3 are researchers in private companies, 3 are high-school teachers, 2 are postdocs.

RESEARCH COORDINATION AND ACADEMIC ACTIVITIES

– Organizer of more than 20 international conferences and scientific programs in Italy and abroad (most recent ones: 2021 and 2016, G.Galilei Institute, Florence; 2019, T.D. Lee Institute, Shanghai)
– From 1992 to 2015, Coordinator of one team in five research networks of the European Community.
– Participant in five PRIN Italian networks funded by the Italian Ministery of University and Research (MUR)
– Editor of Journal of High-Energy Physics (JHEP) and Journal of Statistical Physics (JSTAT) from their beginning. Referee of several journals and scientific projects for MUR in Italy, ANR in France, and NSF in the US.
– From 1998 to 2016, Coordinator of three INFN national research networks: the last one, still running, is called 'Statistical Field Theory, Low-Dimensional Systems, Integrable Models and Applications'.
– From 2005 to 2012 and from 2018 to 2024, member of the local organizing committee of the G. Galilei Institute for Theoretical Physics, Florence.
– From 2001 to 2023, member of the Board of Teachers of PhD Courses in Physics, University of Florence.
– From 2014 to the present, organizer and advisor of the annual PhD school 'SFT - Lectures on Statistical Field Theories', at the G. Galilei Institute, Florence.
– From 2006 to 2013, member of the Italian delegation to the Program Committee of the European Research Council.

Contribution to building an international community
Andrea Cappelli helped develop a scientific community in Europe over the last thirty years dealing with low-dimensional condensed matter and statistical mechanics systems and using interdisciplinary approaches. These are the methods of quantum field theory, conformal field theory and other techniques first introduced in high-energy physics and string theory. Participation to several European networks was instrumental in establishing this community, involving theoreticians, experimentalists of condensed matter physics, mathematical physicists and experts in integrable models. In 2014 Andrea Cappelli promoted and organized the PhD School 'SFT - Lectures in Statistical Field theories' at the G. Galilei Institute for Theoretical Physics, Florence, which takes place every year and helps continue the community.