

Gianluca Colò

CURRICULUM VITAE

Brief overview

I am currently appointed as Full Professor at the Department of Physics, University of Milano. Since October 1st, 2017, I am the deputy director of the Department.

My research activity has been focused on nuclear structure physics, yet with interests in nuclear reactions and in the application of nuclear methods to atomic and molecular physics: in this respect, I am author of a monograph on molecular clusters. I have more than 200 publications on refereed journals and on conference and school proceedings, with more than 4000 citations (without self-citations) and a resulting *h*-index equal to 40 (source: Web of Science, September 2018).

My national leadership in the field is testified by the fact that I have been invited to give an overview about all the theoretical activities within nuclear structure, in Italy, already in the year 2002. In 2014, I have been invited as a plenary speaker to the yearly conference of the Italian Physical Society (SIF) to give a general talk on low-energy nuclear physics, both experimental and theoretical. I have been invited as well to a large number of international conferences and schools, and in particular I have been a key speaker in conferences on Collective Motion in Nuclei, and on the nuclear Symmetry Energy.

I have served in Scientific and Program Advisory Committees of different laboratories, as detailed below. I have been invited as examiner in thesis discussions, and participated also in committees for higher qualifications (“HDR, Habilitation à Diriger des Recherches” in France). I have been in advisory committees of several international meetings; in particular, I have been appointed as main organizer of a long-term workshop at the Kavli Institute for Theoretical Physics in Beijing, China.

I have many international collaborations in Europe, USA, and Asia. I lead a group of few students and post-docs. In 2012, I have started a process to ask the Department to open a position in nuclear theory, in order to give a new boost to the nuclear theory group. The opening has been endorsed by the Department in 2013 and approved by the University, so that now the group includes a new member, Dr. Xavier Roca-Maza, who is qualified as Associate Professor and currently on a tenure-track position.

In general, I consider myself committed to the promotion of nuclear structure research in several other fashions. I have strong collaboration with experimental groups, with whom I have co-authored several papers. I have participated to working groups aimed at proposing new experimental facilities like IRIDE (for the production of high intensity polarized photon beams), and SPES (a radioactive beam facility now fully financed by INFN).

I teach regularly both at the level of B.Sc. and M.Sc.; lately, I have regularly delivered the course of Nuclear Physics (48 hours in one semester). I consider teaching extremely important, and I am gratified by the high score that students have often given to my lectures. I also provide lectures to Ph.D. students, and recently these have been incorporated into a course that is in common between the Ph.D. schools of Milano and Padova Universities.

Last but not least, I have been involved in continuous collaboration with the direction of our Department and helped managing in different ways. In particular, I have contributed to defining the criteria for the evaluation of the Department research, I have been carrying out a project to encourage access to Physics for students with a job, I have been one of the webmasters and seminar coordinator, before becoming deputy Director.

Research interests and main achievements

I am a theoretical physicist, and my focus is on the quantum theory of many-body systems, in particular those that are composed by nucleons (atomic nuclei, nuclear matter and neutron stars). Nonetheless, for some time I have also been working on electronic systems like molecules, clusters and solids.

As is well known, nuclei are amenable to effective theory descriptions, in which the effective interaction is related to the specific many-body framework and not immediately transferable to other frameworks. My specific expertise is on effective forces for self-consistent mean-field and on Density Functional Theory. I have contributed to developing new, increasingly accurate functionals, and I am the main author of a published computer code for linear response theory (Hartree-Fock plus Random Phase Approximation or RPA) based on Skyrme forces or functionals. I am also author of the first fully self-consistent charge-exchange RPA formalism.

I have been intensively studying the properties of nuclear collective vibrations, and the extraction of the parameters for the nuclear equation of state. Among my main achievements, the determination of accurate values for the nuclear incompressibility from the giant monopole resonance, and of the density dependence on the symmetry energy from the dipole response, should be highlighted.

In general, I have a strong background in the study of isovector nuclear properties: isospin symmetry in nuclei with its breaking and restoration at finite temperature, isospin mixing due to Coulomb and other forces, charge-changing transitions including those which are relevant for particle physics and astrophysics (β -decay, electron capture and neutrino reactions). Controlling isovector properties of nuclear models is of paramount importance for the study of exotic nuclei and compact objects like neutron stars, and these systems have been also object of my interest. In most of the cases, the goal has been to achieve a consistent description of the observed phenomena based on as few as possible free parameters.

I am author of a review paper on exotic modes of excitation of nuclei, and of two review papers on the status of our understanding about specific terms of the nuclear functionals, that is, on tensor terms and on isovector vs. isoscalar nuclear pairing.

I have worked on pairing properties of nuclei in different manners, e.g. by means of fully self-consistent quasi-particle RPA calculations. I am author of the paper that demonstrates for the first time the validity of the dielectric theorem in this case.

I have been the first developer of a fully microscopic model based on Skyrme forces that goes beyond the mean field, or DFT, description of nuclear properties. This model is based on the particle-vibration coupling (PVC) idea, and with various refinements along the years it has been eventually shown to be able to account well for diverse phenomena related to the fragmentation of single-particle and collective strength; it has been employed to calculate the nucleon states around an even-even core (low-lying spectroscopy of odd nuclei), the particle-phonon multiplets, the width of giant

resonances and their particle- and γ -decay. Recently, I have been interested in the renormalization of effective interactions when used beyond mean-field.

I have also worked on simple models for nuclear reactions, although most of my efforts have been in coupling microscopic nuclear structure models with realistic descriptions of the reaction mechanism (like, for instance, adapting the RPA input for Distorted Wave Born Approximation calculations).

Higher education

- M.Sc. in Physics (it. Laurea in Fisica), 1989, Università degli Studi di Milano, 110/110 *cum laude* (thesis: “Neutron direct decay from the nuclear giant resonances”, advisors: R.A. Broglia, P.F. Bortignon, A. Bracco)
- Ph.D. in Physics, 1992, Università degli Studi di Milano (thesis: “Microscopic structure of the nuclear giant resonances”, supervisor: R.A. Broglia)

Professional record

- Post-doctoral position, 10-12/1993, ECT* (European Center for Theoretical Nuclear Physics and Related Areas), Trento, Italy
- Post-doctoral position, 1994, IPN (Institut de Physique Nucléaire), Orsay, France. Contract within the CEE supported network “Many-Body theory of correlated fermion systems”
- Post-doctoral position, 01-06/1995, Università degli Studi di Milano
- Assistant Professor, 06/1995-09/2006, Università degli Studi di Milano
- Associate Professor, 10/2006-02/2017, Università degli Studi di Milano
- Full Professor, 03/2017-present, Università degli Studi di Milano

Bibliometric data

I am author of more than 200 scientific publications and one book, having more than 4800 citations (more than 4000 without self-citations), with an *h*-index of 40 (source: ISI Web of Science, September 2018). The complete list of papers is available at: www0.mi.infn.it/~colo/listapub.pdf

Talks

More than 120 invited talks and seminars in the years 2004-2018.

Visiting positions

- Visiting researcher, 2000, RIKEN (Wako-City), University of Aizu-Wakamatsu, Tohoku University (Sendai) and Yukawa Institute (Kyoto), Japan.
- Visiting professor (fr. Professeur invité), 2015, Université Claude Bernard, Lyon (France)

Teaching experience

Because of my strong research background, I have been assigned the Nuclear Physics course of the M.Sc. program. Nonetheless, I have been teaching all aspects of general physics, both in general and laboratory courses, with a particular emphasis on electromagnetism. At present, I am teaching the general electromagnetism course (compulsory for B.Sc. students in Physics at their second year).

- General Physics II, 1995-2001, Exercises and exams (B.Sc. students in Physics)
- Experimental Physics I, 1999-2001, 50 hours course (B.Sc. students in Physics)
- Physics Laboratory I, 2001-2006, 50 hours course (B.Sc. students in Physics)
- Nuclei under extreme conditions, 2004-2009, 40 hours course (M.Sc. students in Physics)
- General Physics, 2007-2010, 48 hours course (B.Sc. students in Computer Science)
- Nuclear Physics, 2010-present, 48 hours course (M.Sc. students in Physics)
- Electromagnetism, 2011-present, 80 hours course (B.Sc. students in Physics)

I have been supervisor of many B.Sc. and M.Sc. works, and of several Ph.D. students (S. Fracasso, A. Soldi, J. Li, M. Brenna).

Istitutional roles in the University

- Project Coordinator, 2001-2002, Teaching project “Appropriate teaching conditions for working students”
- Member of the Direction Board of the Department, 2001-2004
- Member of the Direction Board of the Department, 2010-present (special delegate of the Director for informatic systems, web pages, seminars)
- Deputy Director, 10/2017-present

Serving in National and International Committees

- Member of the Program Advisory Committee (B-PAC) for the Ring Cyclotron, RCNP, Osaka, Japan during 2008-2010
- Member of the Study Group for the special project INFN-SPES (Selective Production of Exotic Species, i.e. a new Radioactive Beam Facility to be complete at Legnaro, Italy) from May 2008 to now
- Member of the Program Advisory Committee (PAC) of LNL (Laboratori Nazionali di Legnaro, Italy) from January 2012 to 2017
- Member of the Scientific Advisory Committee (SAC) of SPES from 2016
- Member of several Ph.D. thesis (and Habilitation Thesis in France) committees

Referee and evaluator

- Referee for many international journals: Reviews of Modern Physics, Physical Review C, Physical Review Letters, Physical Review B, Journal of Physics G, Nuclear Physics A, Physics Letters B, Computer Physics Communications, European

Physical Journal A, European Physics Letters, Progress in Theoretical Physics, Acta Physica Polonica, International Journal of Physics E, Physica Scripta, Classical and Quantum Gravity, Canadian Journal of Physics.

- Project evaluator for the European Commission, Italian Ministry for Education and Research (MIUR), Japan Society for the Promotion of Science (JSPS), Croatian Science Foundation (HRZZ), NAFOSTED (Vietnam).

Research Project coordination

- Local coordinator of the network “Asia Link in Nuclear Physics and Astrophysics”, involving eight institutions in Italy, France, Germany, P.R. China and Vietnam, granted by the EU.
- Deputy general coordinator of the network “Many-body theory of nuclear systems and implications on the physics of neutron stars”, granted by the Italian Ministry for Education and Research.
- Local coordinator of the network “ENSAR2”, granted by the EU.

Conference and workshop organization

- “Topical Conference on Giant Resonances”, Varenna, May 11th-16th, 1998
- “ISGDR mini-workshop”, Milano, March 16th, 2002
- “Nuclear Response Under Extreme Conditions”, Trento, October 20th-24th, 2003
- Long-term workshop “Dynamics and Correlations in Exotic Nuclei (DCEN2011)”, Kyoto (Japan), September 20th-October 28th, 2011
- “From nucleon structure to nuclear structure and compact astrophysical objects”, Beijing, June 11th-July 20th, 2012 (Chair)
- International Nuclear Physics Conference INPC2013, Florence (Italy), June 2nd-7th, 2013
- Topical Workshop on Modern Aspects in Nuclear Structure, Bormio (Italy), February 19th-22nd, 2014
- Second SPES International Workshop, Legnaro (Italy), May 26th-28th, 2014
- Topical Workshop on Modern Aspects in Nuclear Structure, Bormio (Italy), February 22nd-26th, 2016
- Third SPES International Workshop, Legnaro (Italy), October 10th-12th, 2016
- Topical Workshop on Modern Aspects in Nuclear Structure, Bormio (Italy), February 19th-25th, 2018