

CURRICULUM DELL'ATTIVITA' SCIENTIFICA E DIDATTICA

(redatto ai sensi degli Artt. 46 e 47 del D.P.R. 28.12.2000, n. 445)

Francesco Cappuzzello

e-mail: cappuzzello@lns.infn.it

Office Address: Via S. Sofia 64, Catania, Italy

tel.: +39 095 542384

Present position

From 2018 onwards: Associate Professor of experimental nuclear physics at the Department of Physics and Astronomy, University of Catania

Main academic and scientific degrees

2013 Invited researcher at the Universidade Federal Fluminense, Niteroi, Brazil

2006 Researcher of experimental nuclear physics at the Department of Physics and Astronomy, University of Catania

2005 Annual post-doc fellowship from the University of Catania

2001 Four-year post-doc fellowship from INFN

1999 Ph.D. at University of Catania defending the Thesis cum Laude

1996 Master Degree in Physics at University of Catania with vote 110/110 cum Laude

Main specific professional experiences in research activity

- **Magnetic spectrometry:** I have contributed to the field of magnetic spectrometry. The main achievement is the design and construction of the MAGNEX large acceptance magnetic spectrometer, which has strongly characterized the first part of my career. The spectrometer is installed at the INFN-LNS laboratory and it is nowadays a unique device worldwide, conjugating large solid angle and large momentum acceptance with high energy, mass and angular resolution. As a consequence, it is attracting many research groups from abroad (almost half of the beam time delivered in recent years at the INFN laboratory and more than 50 researchers per year from abroad have proposed and performed experiments with MAGNEX). Part of this activity is presented in two review papers

The MAGNEX spectrometer: Results and perspectives F. Cappuzzello et al., European Physical Journal A (2016) 52: 167. DOI 10.1140/epja/i2016-16167-1

MAGNEX: an innovative large acceptance spectrometer for nuclear reaction studies F. Cappuzzello, D. Carbone, M. Cavallaro and A. Cunsolo, in: *Magnets: Types, Uses and Safety*, Nova Publisher Inc., New York, 2011, pp 1-63.

- **Transfer reactions:** I participated and organized, often acting as spokesperson, several experiments in various international laboratories studying nucleon and cluster transfer reactions. The major achievement has been the discovery of signatures of the long searched Giant Pairing Vibrations in atomic nuclei. Such finding has permitted to overcome a fundamental problem of symmetries in quantum-mechanics arising from the not observation for several decades of this collective mode

Signatures of the Giant Pairing Vibration in the ^{14}C and ^{15}C atomic nuclei, F. Cappuzzello et al., *Nature Communications*, Article number: 6743 (2015). DOI:10.1038/ncomms7743.

New structures in the continuum of ^{15}C populated by two-neutron transfer, F. Cappuzzello et al. *Physics Letters B* 711 (2012) 347-352. DOI: 10.1016/j.physletb.2012.04.012

- **Elastic and inelastic scattering:** I am spokesperson of an extensive collaboration with IFUSP of San Paolo and IFUFF of Niteroi (Brazil), which is focused on these issues. We have already shown that the phenomenon of nuclear rainbow is also present in collisions between heavy nuclei

Nuclear rainbow in the $^{16}\text{O}+^{27}\text{Al}$ system: The role of couplings at energies far above the barrier, D. Pereira et al., *Physics Letters B* 710 (2012) 426-429. DOI: 10.1016/j.physletb.2012.03.032

- **Charge exchange reactions:** subject of the degree and Ph.D. theses. These studies have shown that the heavy-ion induced charge exchange cross sections are connected to the strength of the corresponding beta-decay, with major consequences in both nuclear physics and astrophysics. A large collaboration on these items has been established between our group and the RCNP laboratory of the Osaka University.

Analysis of the $^{11}\text{B}(^7\text{Li},^7\text{Be})^{11}\text{Be}$ reaction at 57 MeV in a microscopic approach F. Cappuzzello et al. *Nuclear Physics A* 739 (2004) 30-56. DOI: 10.1016/j.nuclphysa.2004.03.221

- **Double Charge Exchange reactions:** I proposed the first pioneering experiments showing that the matrix elements of double beta decay can be extracted, under specific conditions, from cross sections of double charge exchange at zero degrees. This has triggered the NUMEN project of INFN, aiming at determining data-driven matrix elements for neutrino-less double beta decay. First results are found in

Heavy-ion double charge exchange reactions: A tool toward $0\nu\beta\beta$ nuclear matrix elements F. Cappuzzello et al., *European Physical Journal A* (2015) 51: 145. DOI 10.1140/epja/i2015-15145-5.

- **Structure of light nuclei:** I have proposed and participated to several experiments in Italy, France, Brazil, Japan and Canada to study the structure of various light nuclei

Excited states of ^{11}Be F. Cappuzzello et al., *Physics Letters B* 516 (2001) 21-26 DOI: 10.1016/S0370-2693(01)00940-6

Investigation of the ^{10}Li shell inversion by neutron continuum transfer reaction, M. Cavallaro, M. De Napoli, F. Cappuzzello et al., *Phys. Rev. Lett.*, 118, 012701 (2017). DOI 10.1103/PhysRevLett.118.012701

Main responsibilities

- Spokesperson of SPEME experiment of INFN (2010-2011) (about 100k€/year, about 10 researchers)
- Spokesperson of DREAMS experiment of INFN (2012-2015) (about 100k€/year, about 15 researchers)
- Spokesperson of a MOU between INFN–LNS and IN2P3-IPN-Orsay (France) (2011-2017) (26 researchers)
- Spokesperson of a MOU between INFN–LNS, IFUSP (San Paolo, Brazil), IFUFF (Niteroi, Brazil) (2011-2018) (27 researchers)
- Co-Spokesperson of a MOU between INFN–LNS and Akdeniz University (Turkey) (2016-2018) (100 k€, 20 researchers)
- Spokesperson of the NUMEN project of INFN (2016-2018) (2M€, more than 100 researchers)
- Local Responsible of the WP15 - JRA7 TechIBA “Technologies for High Intensity Beams and Applications”. Grant Agreement number: 654002 — ENSAR2 — H2020-INFRAIA-2014-2015/H2020-INFRAIA-2014-2015 (100 k€, 3 researchers) (2016-2020)
- Principal Investigator of the project “Studio dell'elemento di matrice del doppio decadimento beta mediante reazioni nucleari”, University of Catania, Fondi FIR 2014 (project code: D41BCC, budget 15 k€, 8 researchers) (2015-2017)
- Proposer and academic contact of the “*Inter-Institutional Agreement 2019-2021*” between University of Catania and University of Akdeniz, within ERASMUS+ program, Key Action 1 - mobility for learners and staff

Main publications and editorial activity

- Total papers: 3 review papers, more than 165 articles ISI or SCOPUS, $H = 27$
- Reviewer of Nature Physics, Nuclear Physics A, Nuclear Instrument and Methods A, European Physics Journal A, Journal of Physics G, Few-Body Systems, Advances in High Energy Physics, Physics in Medicine and Biology, International Journal of Modern Physics E, Journal of Physics Conference Series.

International conferences, workshops and schools

- **Chairman** of the International Conference on Neutrino and Nuclear Physics, 15-21 October 2017, Catania, Italy (<https://agenda.infn.it/conferenceDisplay.py?confId=12166>)
- **Chairman** of the International Workshop NUMEN 2015 – Challenges in the investigation of double charge-exchange nuclear reactions: towards neutrino-less double beta decay, 1-2 December 2015, Catania, Italy (<https://agenda.infn.it/conferenceDisplay.py?confId=10196>)
- **Chairman** of the International Workshop MAGNET 2010 – Nuclear Physics with Modern Magnetic Spectrometers, 14-16 December 2010, Catania, Italy (<https://agenda.infn.it/internalPage.py?pageId=0&confId=2935>) and (<https://agenda.infn.it/event/2935/overview#preview:35878>)
- **Organizer** of the forthcoming workshop Neutrino Nuclear Responses 2019 (NNR19) for Double Beta Decays and Astro Neutrinos 8-9 May, 2019 (<https://indico.rcnp.osaka-u.ac.jp/e/NNR19>)

- **Member of the International Advisory Committee** of the Conference Nuclear Reaction Mechanisms, from the 14th edition 15-19 June 2015, Varenna, Italy (<http://www.fluka.org/Varenna2015/>) and (<https://indico.cern.ch/event/675816/page/12216-international-advisory-committee>)
- **Member of the International Advisory Committee** of the *Mexican Symposium on Nuclear Physics*, from the 40th edition held in Cocoyoc, Morelos, 5-9 January 2017, Mexico (<http://www.fisica.unam.mx/Cocoyoc2017/committees.php.html>), (<http://www.fisica.unam.mx/Cocoyoc2018/committees.php.html>) and (<http://www.fisica.unam.mx/Cocoyoc2019/committees.php.html>)
- **Member of the International Advisory Committee** of the 12th *International Spring Seminar on Nuclear Physics “Current Problems and Prospects for Nuclear Structure”*, 15-19 May 2017, Sant’Angelo d’Ischia, Italy (<https://agenda.infn.it/event/12021/page/680-advisory-committee>)
- **Member of the International Advisory Committee** of the African Nuclear Physics Conference to be held at Kruger National Park, South Africa, 1-5 July 2019 (<http://anpc2019.tlabs.ac.za/international-advisory-committee/>)
- **Member of the International Advisory Committee** of the IV International Conference on Nuclear Structure and Dynamics NSD2019 to be held in Venice on May 13-17, 2019 (<https://agenda.infn.it/event/16348/page/2179-committees-and-organizers>)
- **Member of the International Advisory Committee** of the *Conference on Neutrino and Nuclear Physics*, from 1st edition 15-21 October 2017, Catania, Italy (<https://agenda.infn.it/conferenceDisplay.py?confId=12166>)
- **Panel member** for *Workshop on Nuclear Physics in South Africa*, at i-Themba LABS (Cape Town) October 26-28 2016, Cape Town, South Africa
- **Speaker** of 98 talks in Conferences, Schools, Workshops, Colloquia and Seminars, 77 of which invited **Invited Chair of 6 Sessions** in International Conferences

Proposed experiments in international research laboratories

- Approved experiments proposed as Spokesperson: 26

Reviewer for international institutions

- Referee of research projects for the *Natural Sciences and Engineering Research Council of Canada* (NSERC)
- Referee of research projects for the *Croatian Science Foundation* (CSF)
- Member of the *Panel of International Experts* for the *Long Range Plan* of the i-Themba LABS, South Africa.

Prices and awards

- Awarded for *Outstanding Contribution in Reviewing* from Nuclear Physics A in 2015

Didactic activity

2007-2009 *General Physics I* for the Master Degree in Computing Sciences and Earth Sciences

2009-2011 *Nuclear Spectroscopy* for the Master Degree in Physics

2009-2011 *Heavy-Ion Physics* for the Master Degree and Ph.D. in Physics

2016 Lecturer of the 3rd International Nuclear Physics Summer School (NUBA-2016) held on May 29–June 5, 2016 in Antalya, Turkey

2013-2017 Member of the Ph.D. course *Dottorato di Ricerca in Fisica* of the University of Catania

From 2017 *General Physics I* for the Master Degree in Chemistry

From 2012 *Nuclear Structure* for the Master Degree and Ph.D. in Physics

From 2015 *Search of New Physics Beyond the Standard Model in $\beta\beta$ Decay* for Ph.D. in Physics

Participation to international didactic committees

- Invited “Jury de These”, Service des Etudes Doctorales, Université Paris-Sud 11, Orsay, 3 Dec. 2010
- Invited member of the “7 Member Examination Committee of the Ph.D thesis of Dr. Basileios Soukeras, University of Ioannina, 4 May 2017
- Invited external member of the “PhD Committee in Physics of the University of Napoli Federico II and Université Paris-Saclay” 15 January 2017

Tutoring responsibilities

I had and have the pleasure and responsibility to train and introduce to research activity several young students from different countries (13 Master, 12 Ph.D., 11 Post-Doc, 5 ERASMUS+ fellows). Some of them have already completed their training and are now approaching their activity in public research or in private companies.

Outreach activities

- Co-Author of three articles published by the "La Sicilia" newspaper distributed in Italy
- Co-Author of three articles published by the “Il Sole 24 ore” (main newspaper for economics in Italy)
- Interviewed by the journalist Sylvie Coyaud in the program “Le Oche” of the “Radio Popolare” national radio broadcast (<http://www.radiopopolare.it/podcast/le-ocche-di-ven-0304/>)
- Interviewed twice by Radio Zammù broadcast of the Catania University <http://www.radiozammu.it/cnnp2017-prof-ri-agodi-cappuzzello-a-catania-per-condividere-e-spingere-oltre-la-conoscenza.htm>
- Author of one article in the “Bollettino di Ateneo” journal of the Catania University (<http://bollettino.unict.it/articoli/la-risonanza-gigante-di-pairing>)
- The scientific article *F. Cappuzzello et al. Nature Communications 6 (2015) 6743* was the object of a dedicated blog in the “La Repubblica D” national on-line news-paper, moderated by the journalist Sylvie Coyaud (<http://ocasapiens-dweb.blogautore.repubblica.it/2015/04/03/le-ocche-9-good-vibrations/>)
- Co-Author of F. Cappuzzello, D. Carbone, M. Cavallaro, A. M. Muoio “La Risonanza Gigante di Pairing nei nuclei atomici: un nuovo ballo di gruppo”, published by Scienze e Ricerche N.39 (2016). <http://www.scienze-ricerche.it/?p=11152>
- Speaker of tens of accompanied visit of the MAGNEX spectrometer at the INFN-LNS

Catania, 8 Gennaio 2019

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