LUCIA BANCI

Curriculum Vitae

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Lucia Banci is Professor of Chemistry at the University of Florence.

Degree in Chemistry, 110/110 cum laude, July 1978, University of Florence

She has published more than 440 research articles on peer reviewed journals, which received more than 28.000 citations, and she has solved above 150 protein structures.

H-Index 92 (Google Scholar), 76 (Scopus); 76 (WoS)

Lucia Banci is one of the founders and former Director of the Center of Magnetic Resonance (CERM) of the University of Florence. CERM is a center for research, knowledge transfer, and higher education of the University of Florence which is co-managed by the Consorzio Interuniversitario Risonanze Magnetiche di Metallo Proteine (CIRMMP) of which she is a member of the Board of Directors. The CERM/CIRMMP infrastructure features an impressive battery of NMR spectrometers. Lucia Banci is the Head of the Italian Core Center of the ESFRI Reasearch Infrastructure INSTRUCT, and a member of the INSTRUCT Executive Committee and of the Council.

Positions held (all at the University of Florence)

Coordinator of the International Doctorate in Structural Biology (2019-2023)
Director of CERM (Centro di Risonanze Magnetiche), University of Florence (2011-2017 and 2021-2023)
Professor of Chemistry (Faculty of Science) 1999-present
Associate Professor of Chemistry (Faculty of Science) 1989-1999
Associate Professor of Chemistry (Faculty of Pharmacy) 1987-1989
Tenured researcher - Tutor in Chemistry, Faculty of Sciences (1983-1987)
Postdoctorate 1978-1983

Honors and Awards

2023 **R.R. Ernst Prize for Magnetic Resonance**, by EUROMAR

2022 **Premio Internazionale «Prof. Luigi Tartufari»** by Accademia nazionale dei Lincei
2020 Elected **Honorary member of the National Magnetic Resonance Society of India** (NMRS)
2018 **Premio Scienza Madre** (first edition) international dedicated to Women in Research (awarded together with Emmanuelle Charpentier)
2017 **"Instruct Bertini Award"** for Integrated Structural Biology
2015 **«Fiorino d'Oro della Città di Firenze»** Gold Medal of the City of Florence
2015 IUPAC Award **«Distingushed Woman in Chemistry»**
2015 Elected **ISMAR Fellow**
2014 Elected **member of Academia Europaea**
2013 Appointed **Member of AcademiaNet**
2012 Elected **Member of EMBO** (European Molecular Biology Organization)
2011 Listed among the **45 Top Italian Female Scientists**
2004 **Joint Gold Medal of GIDRM** (Italian Group on Magnetic Resonance) and GIRM-SCI (Interdivisional Group on Magnetic Resonance of the Italian Chemical Society.
1998 **Premio Federchimica** – "Per un Futuro Intelligente"
1994 "**Raffaele Nasini" Medal** of the Inorganic Division of the Italian Chemical Society.

Committee Services

2022 Chair of the **Strategic Working Group "Health and Food" of ESFRI**
2018 Member of the ESFRI Working Group on Monitoring of Research Infrastructures Performance (2018-2019)
2014 Appointed Member of the **EMBL** and **EMBC** Councils (2014-present)
2014 Member of the **Strategic Working Group "Health and Food" of ESFRI** (2014-present)
2013 Member of the Scientific Committee for "Life, Environment and Geo Sciences" of Science Europe (2013-2015)
2011 Member of the ISMAR Council (2011-2014 and 2014-2021)
2009 Member of the ISGO (International Structural Genomics Organization) Executive Committee (2009-2018)
2009 Member of the Executive Committee of EUROMAR (2009-2014)
2008 Member of the HFSP (Human Frontier Science Program) Review Committee (20082012)
2006 Scientific Secretary of the Society of Biological Inorganic Chemistry (1999-2006)
2005 Societa' Chimica Italiana – Chair of the Chemistry of Biological Systems Division (2005-2006)
2000 Member of the ICMRBS Council (2000-2010)

Evaluation and Advisor Services

She is and has been member of evaluation committees for many Funding Institutions at the international level: Member of the HFSP (Human Frontier Science Program) Review Committee (2008-2012), of ERC Evaluation Panel, member of the international assessment committee Building Blocks of Life of the Netherlands Organization for Scientific Research (NOW) and ad hoc reviewer for EC (Cooperation and Marie Curie types of projects), DFG (German Research Foundation), EMBO (European Molecular Biology Organization), NIH (National Institutes of Health), NSF (National Science Foundation), AERES (French Evaluation Agency for Research and Higher Education), INSERM

(French National Institute of Health and Medical Research), as well as of several funding applications for many European and International Countries.

She is and has been member of Advisor Board of several European institutions. She has acted as external member of the PhD jury for a number of Euroepan Universities

At the national level she has been a member of ministerial commissions for the evaluation of research projects under the "Premiali" program of the FOE, she has been a member of the MIUR Evaluation Commission - PON RI 2014-2020 "Infrastructure enhancement". She was a member of ANVUR Chemistry GEV 03, for the VQR 2004-2010. At the local level she is a member of the "Research" commission of the Cassa di Risparmio di Firenze Foundation.

Journal Services

She is member of the Editorial Board of Scientific Reports and of Scientific Data and of the Editorial Advisory Board of *ACS Bio & Med Chem A*u. She has been member of the Editorial Board of: Journal of Magnetic Resonance, Biomolecular NMR Assignments, JBIC, Journal of Structural Proteomics, and of EurJIC (European Journal of Inorganic Chemistry). She is a referee of many international journals, among which there are PNAS (Proceedings of the National Academy of Sciences), JACS (Journal of the American Chemical Society), EMBO Journal, Nature Structural & Molecular Biology, Nature Chemical Biology, the Journal of Biological Chemistry.

Patents

- Use of matrix metalloproteinases, mutated and not mutated, for the preparation of pharmaceutical compositions, and mutated metalloproteinases with increased stability - **WO 2007020223 A1**
- Modified meningococcal fhbp polypeptides - **WO 2011051893 A1**

Conferences and Seminars

She has been invited to present lectures at many international and national congresses. A selection in recent years includes:

2023 Metals in Biology GRC, Ventura, CA, United States; XIIIth International conference NMR: a tool for biology, Paris, France; EUROMAR 2023, Glasgow, Scotland; BNMRZ Symposium on Future Perspectives of Biomolecular NMR, Garching, Germany; 11th HeCrA Conference, Larissa, Greece; **2022** Biophysical Society 66th Annual Meeting, San Francisco, CA, USA; Nobel Symposium on Bioinorganic Chemistry, Stockholm, Sweden; EMBO Lecture Course on Structure, dynamics and interactions in biomolecular systems using NMR spectroscopy, Berhampur, India; **2021** International Chemical Congress of the Pacific Basin Societies (PacifiChem); EUROMAR 2021; 7th EOC Symposium, Nankai University; **2020** 26th NMRS Conference, Rajkot, India; International On-line Bioinorganic Symposium (IOBS), Korea; EMBL Hamburg virtual user workshop; **2019** International Conference "NMR: a tool for Biology", Institut Pasteur, Paris, France;7th International Symposium on Metallomics, Warsaw, Poland; 44th FEBS Congress, Krakow, Poland; 2019 Cell

Biology of Metals Gordon Research Conference, Castelldefels, Spain; 19th International Conference on Biological Inorganic Chemistry (ICBIC-19), Interlaken, Switzerland; EUROISMAR 2019, Berlin, Germany, EMBO Global Exchange Lecture Course Santiago, Chile; **2018** 62nd Annual Meeting Biophysical Society (BPS18), San Francisco, USA, 43rd FEBS Congress, Prague, CZ; 39th Steenbock Symposium, Madison, Wisconsin, USA; 28th ICMRBS, Dublin, Ireland; **2017** 5th Symposium on Advanced Biological Inorganic Chemistry (SABIC-2017), Kolkata, India; 42nd Lorne Conference on Protein Structure and Function, Lorne, Victoria, Australia; Gordon Research Conference "Computational Aspects of Biomolecular NMR", Newry, ME, US; EUROMAR 2017, Warsaw, Poland; ISMAR 2017 Québec City, Canada; 42nd FEBS Congress, Jerusalem, Israel; **2016** 6th International Conference on Metals in Genetics, Chemical Biology and Therapeutics (ICMG 2016), Indian Institute of Science, Bangalore, India; Euromar 2016, Aarthus, Denmark; 27th International Conference on Magnetic Resonance in Biological Systems (ICMRBS), Kyoto, Japan; 42nd Conference on "In the Vanguard of Structural Biology: Revolutionizing Life Sciences", Naito, Japan; New Horizons and Emerging Biomedical Challenges for Biophysics (BBS 2016) Liverpool, UK; EUROMAR 2016·Aarhus, Denmark.

She has actively participated at many national meetings and advanced schools.

Organization of Conferences

She has been member of the Organizing Committee and of the Scientific Committee of several National and International Conferences.

Summary of career and scientific activities

Lucia Banci has a high international reputation for her original contributions and breakthroughs in Structural Biology and in biological NMR. She is recognized as world class leader in the characterization of functional processes in a cellular context with atomic resolution. She has addressed and unraveled many aspects of the biology of metal ions in biological systems, from their homeostasis processes to the trafficking and metal incoroporation in the final receiving proteins. She developed a molecular systems biology approach which integrates information on structural, dynamical, and interaction features of the biomolecules with the thermodynamic properties of the processes, so to have a unified picture of the pathways responsible of metal ion trafficking, with particular focus on copper transport and on the biogenesis of iron-sulfur cluster proteins.

After her initial work in theld of Inorganic Chemistry, where she characterized magnetic properties (such as magnetic coupling between metal ions, electron and nuclear relaxation, hyperfine coupling) of small complexes and biological cofactors, through EPR and NMR spectroscopies, she provided a strong contribution to the comprehension of relaxation phenomena of nuclear spins in paramagnetic systems. She is co-author, together with I. Bertini and C. Luchinat, of the book "Nuclear and Electron Relaxation", VCH, Wenheim, which presents a unified picture of the relaxation processes for nuclear and electron spins, combining a pictorial description of the relaxation processes for nuclear and electron spins with a rigorous mathematical presentation.

In the eighties, when recombinant DNA techniques produced a major revolution in the study of biological systems, she applied her background knowledge and expertise to the spectroscopic characterization, in particular through NMR spectroscopy and ^{1}H NMRD measurements, of paramagnetic metalloproteins, such as superoxide dismutase, alkaline phosphatase, carbonic anhydrase, iron-sulphur proteins, peroxidases, and of their mutants or derivatives modified by metal substitution. Advanced (in those days) NMR techniques, like NOE and 2D NOESY and COSY experiments on highly paramagnetic systems, were used for obtaining structural characterization of the active site of the paramagnetic metalloproteins and of their adducts with inhibitors. These studies allowed and are still allowing a deeper understanding of the structural and catalytic properties of the investigated proteins and enzymes and the correlation between structural features and functional and enzymatic behavior.

In the meantime, she developed approaches for molecular dynamics calculations applied to metal-containing proteins, in order to rationalize their structural and dynamical behavior when they are interacting with the solvent, to interpret the NMR data and to analyze the factors affecting the protein-substrate interactions. These calculations were applied to metalloproteins, where the presence of one or more metal ions requires, for a correct description of the system, the development of their force-field parameters, which is still one of the frontiers in this area of research. These force-field parameters were developed by Lucia Banci for several metal ion centers of various proteins.

In the ninenties, Lucia Banci developed spectroscopic and computational methodologies for the determination of solution structures of paramagnetic metalloproteins through NMR spectroscopy. The combined use of standard 2D and 3D experiments together with experiments tailored for systems characterized by broad signals spread over a large spectral width allowed the resolution of the first solution structure of a paramagnetic metalloprotein. This structure broke a dogma stating that, “solution structures of paramagnetic proteins could be never determined” This achievement took also advantage of the force field parameters she developed on metal ions. Her research in this area was devoted to the structural and dynamical characterization of several electron transfer proteins. Having optimized the methodology for structural determination of these “difficult” proteins, she then addressed and is addressing more challenging projects, such as the determination of the internal motions on very large time scales, the comprehension of the factors determining the folding of the protein and of those determining molecular recognition between two partners during the biological process, and the structural and dynamical features which lead to misfolding and protein aggregation. The answer to these fundamental questions is important for several aspects of Science.

After the Genome revolution, Lucia Banci has been an active player in Structural Genomics projects. Her approach was driven by the “function perspective” more than a broad coverage of genome products, as several Structural Genomics projects are organized. Target selection was focused on all the proteins involved in the pathways under investigation. In particular, she provided unique contributions to the understanding of the processes of copper transfers and of copper incorporation in a few systems, such as the Golgi system and cytochrome c oxidase. The latter process involves several proteins that were not structurally characterized before or not even identified. Through bioinformatic tools and browsing the available genomes she identified new proteins and for most

of them (new or already reported) she determined the structure and characterized the interaction with the metal cofactor and with the potential partners. From all these studies a picture of the various steps of copper transfer in cytochrome c oxidase has been obtained. She has also worked on the pathway of copper transfer from the soluble chaperone to the soluble domains of membrane Cu-binding ATPases, and then to the membrane-embedded metal binding site. Overall she provided unique contributions to the understanding of the processes of copper transport in the cell and its incorporation into the final targets. Within this frame, she has also addressed the weak, transient protein-protein interactions which are at the basis of a large number of biological processes. From her work a new feature of the interactome emerged, i.e. that a portion of the protein-protein interaction network is metal mediated. In other words, the interactions among proteins are mediated by metal ions. In the frame of this cellular, system-wide, approach she also addressed, within a structural and functional perspective, the processes of protein import in mitochondria and their folding and how these processes are tightly interconnected with those of metal transport and homeostasis as well as with electron transfer processes. Within this functional approach, she has also addressed the weak, transient protein-protein interactions which are at the basis of a large number of biological processes.

She has characterized and is characterizing proteins which are naturally unstructured, at least locally, as required by their function. This feature has profound effects on their properties and pattern of interactions. On the contrary, local structural disorder in naturally ordered proteins is appearing as one of the factors leading to toxic protein aggregates, whose formation is also triggered by metal or by the lack of native metal ions, in several cases. She is providing important contributions to the understanding of these processes.

She has a long time experience in the structural and functional characterisation of SOD1, more recently focusing on the mechanism and factors inducing protein aggregation. She has proposed a new mechanism for the latter process allowing the rationalization of the behavior all the SOD1 mutants relatated to ALS. She is now developing new strategies and identifying molecules which prevent this aggregation.

She has been pioneer in developing the field of “Structural Vaccinology”, a new and innovative strategy to design effective vaccines. Based on the knowledge of the structure of the antigens, of the location of the various epitopes and on the interaction mode with antibodies, new vaccines with very broad protection coverage can be designed and produced. This innovative approach has been successful.

Finally, she is now developing new challenging approaches for in cell NMR and for their exploitation for characterizing biomolecules directly in living cells with atomic resolution. Within this approach she is studying folding, protein maturation and metal uptake also through the coordinated expression of the various proteins involved. The most recent line of research, i.e in cell NMR is raising a very high interest in various scientific communities, either interested in new methodological advanchement in NMR or in the striking new knowledge obtained in biological processes. This innovative in cell NMR approach allows the detection of human individual proteins (a single one or more such as partner proteins) with atomic level resolution in living cells human cells. This approach is covering the bridge between cellular studies (which maintain the cellular

environment but lack atomic information) with structural characterization (which provides a detailedm, atomic level description).

Activities in Research Organizations, Research Evaluation, and Technology Transfer

Lucia Banci has gained significant experience in the management of research organizations. She was Director of CERM from 2011 to 2017, and re-elected for the 2021-2023 triennium. CERM/CIRMMP is a research, technology transfer and education center of the University of Florence and an institution of international importance in the panorama of research infrastructures. CERM/CIRMMP is dedicated to Magnetic Resonance spectroscopies and is one of the best equipped NMR centers worldwide, in terms of both the specificities of the various instruments and magnetic fields range, currently featuring the largest one. About 70 people belong to CERM/CIRMMP, including professors, researchers, post-docs, PhD students and technical and administrative staff.

Thanks to its high-level instrumentation, in some cases unique, and the skills of its researchers and technical staff, the infrastructure has been providing access to its instrumentation to external users, both academic and industrial, since 1994. Access has been and is supplied both at international, European and extra-European level, as well as at national level, becoming a reference center for many scientific communities for which nuclear magnetic resonance is an essential tool and/or research field. These scientific fields range from structural biology, to the development of new drugs and vaccines, to the implementation of new experimental methodologies, from the analysis of new materials to the analysis of metabolic profiles through a metabolomic approach. Over the past two decades, this has involved the presence and management of many users, who must be individually provided with both technical and scientific assistance for the organization and conduct of the experiments, as well as logistical support for the visit itself. Users from industry constitute a significant group of the infrastructure users. A significant example of the strategic relevance of the use of CERM/CIRMMP instrumentation and skills is given by the collaboration with Novartis Vaccines, now GSK, that, with the highly innovative approach of Structural Vaccinology, has allowed to optimize and validate the vaccine against Meningococcus B, also making a fundamental contribution to its registration. The relevance and uniqueness of the infrastructure at the international level is evidenced by the numerous European and non-EU researchers who ask to access the instrumentation, to develop collaborations or to carry out research at the center during their sabbatical.

Lucia Banci is a member of the Board of Directors of the Interuniversity Consortium for Magnetic Resonance of Metallo Proteins (CIRMMP), a governing body that has, among other things, decision-making power on all administrative matters of the Consortium. She is also a member of the Scientific Council of CIRMMP, contributing to the development of multi-year scientific plans.

Lucia Banci was one of the promoters and founders of the European infrastructure, Instruct-ERIC, which has the CNR as a Representative Body. She is the Head of the Italian Core Center and a member of the Instruct-ERIC Executive Committee and of the Council. She plays a key role in the management of the entire European infrastructure, which involves 15 countries and 12 centers, and which develops activities ranging from the provision of access to state-of-the-art instrumentation in the field of integrated structural biology, to an extensive and very articulated program of training,

and support programs for the development and technological advancement for the various methodologies for structural biology, and the development of international cooperation.

Since 2014 Lucia Banci is the Italian member of ESFRI's Strategic Working Group Health & Food, which has the task of developing the Roadmap for Research Infrastructures in Europe and monitoring the existing ones. The work carried out by the various Strategic Working Groups and the preparation of the European Roadmap on Research Infrastructures is also dedicated to the analysis of the general situation of research infrastructures in Europe and to the identification of any shortcomings or limitations. Within ESFRI Lucia Banci also contributed to the development of the definition of Key Performing Indicators (KPI) as the Italian member of the dedicated Working Group. The set of KPIs defined at European level constitutes an important tool for monitoring and quantifying the development of Research Infrastructures also at the national level.

Finally, Lucia Banci has been a member (2013-2015) of the Scientific Committee for “Life, Environment and Geo Sciences” of Science Europe as a representative of the CNR. Science Europe is an association that brings together the main public research organizations operating in Europe.

Lucia Banci's management work has also led to significant contributions to the technological transfer of the research results of the bodies which she directs or to whose management she contributes. She has set up and organized a Tuscany Infrastructure, Bio-Enable, a distributed infrastructure that offers services to companies, with particular attention to small and medium-sized enterprises. Bio-Enable involves, in addition to CERM as leader, the Institute of Neuroscience of CNR, the University of Siena and the Scuola Superione Sant’Anna.

She is one of the founders, and member of the Scientific Committee, of Giotto Biotech Srl, a spin off of the University of Florence. Giotto Biotech is a very dynamic reality in the field of biotechnology and molecular biology that integrates a wide portfolio of products, including customer-based, and supply of services, with innovative internal research projects to always develop new products to be supplied to the market.

During her career she has been Coordinator or Principal Investigator of numerous projects funded under the framework programs of the European Commission, as well as competitive national, regional and private institution projects. As an example, among those funded under Horizon 2020, there are iNEXT-Discovery and EOSC-Life, the MEDINTECH project of the Italian National Cluster for Life Sciences "ALISEI" and the coordination of the Regional Research Infrastructure project Bio-Enable.

Lucia Banci has extensive experience in evaluating research programs and projects at national and international level.

Lucia Banci is and has been very active in promoting gender balance in academic positions particularly in stimulating and motivating young female scientists in aiming to and working for achieving successful careers. On this respect she has been the promoter of the establishement of the Equal Oppurtunity Comittee of the University of Florence. Her attention to promote the active partecipation of women in scientific activities and in obtaining relevant positions is witnessed by the Faculty composition of CERM, directed by her already for the second term, which includes 6 women out of 13 members. She has supervised 44 PhD students, 25 out of whom are women.

In recognition of her leading role in developing policy for gender balance she has been invited to present her experience and her vision in several events. Within this frame, in 2016 Lucia Banci was included in the Group of "100 Experts", an initiative that aims to counter the fact that women are rarely consulted by the media as experts. To this end, with the support of the European Commission Representation in Italy, an online database of CVs of highly competent women in various fields of research has been established, available to the media to make it easier to identify specific skills when they must be consulted, and thus also contribute to combating stereotypes about research and STEM areas, often considered exclusively male competence.

Lucia Banci is engaged in scientific dissemination activities through initiatives aimed at the general public, on various aspects of research and its relevance and impact for society. In this regard, her activity is significant in the context of the "City of Florence Prize for Molecular Sciences", of which she has chaired, since 2012, the Scientific Committee and the award ceremony open to all citizens. The Prize brings to everyone's attention examples of cutting-edge scientific research and its direct fallout in fields of collective interest such as sustainable energy or health and how research contributes to the development of the country, building a bridge between scientists and the public. The winners are all leading figures in their research field, including some Nobel Prize winning scientists. The latest winner was Emmanuelle Charpentier who was awarded the Nobel Prize in Chemistry 9 months after receiving the Prize.

Since 2016 Lucia Banci has been a member of the Scientific Committee of the Genoa Science Festival, which over the years has increasingly become a point of reference for the dissemination of science, and an opportunity for researchers, young people, schools and families to meet. It has an international character, involving experts from all over the world, and is one of the largest events for the dissemination of scientific culture at an international level.