

# LUCIA BANCI

## Curriculum Vitae

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### Address

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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 460 research articles on peer reviewed journals, which received more than 30.000 citations, and she has solved above 150 protein structures.

**H-Index** 94 (Google Scholar), 78 (Scopus); 78 (WoS)

She is within the **Top 2% scientists** of the Stanford List, since its start (2019) up to now

**ScholarGPS** - Top percentage ranking (without self-citations) 0.08% in all specialities, 0.15% in Chemistry

**Lucia Banci** is a founding member of the Center for Magnetic Resonance (CERM) at the University of Florence, a Center for research, knowledge transfer, and higher education, which is co-managed by the Consorzio Interuniversitario Risonanze Magnetiche di Metallo Proteine (CIRMMP). The CERM/CIRMMP infrastructure boasts a state-of-the-art array of NMR spectrometers. Lucia Banci serves as the Head of the Italian Core Center of the ESFRI Research Infrastructure INSTRUMENT-ERIC and is a member of its Council and of its Executive Committee.

### 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

- 2024 **Honorary Doctorate** by the Department of Pharmacy, University of Patras
- 2024 **G. Barone Medal** from Italian Chemical Society, Biological Systems Division
- 2023 **Richard R. Ernst Prize** for Magnetic Resonance
- 2022 International Award “**Luigi Tartufari**” from **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 «**Distinguished 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** (2022-present)
- 2022 Member of the Executive Committee of **ENC, Experimental NMR Conference** (2022-present)
- 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 (2008-2012)
- 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 a 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 Panels, member of the international assessment committee Building Blocks of Life of the Netherlands Organization for Scientific Research (NOW), of Portuguese Unit projects of FCT, 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 Institutions for many European and International Countries.

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

She is and has been a member of the Advisory Board of several academic Institutions.

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 has been 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 Au*. She has been member of the Editorial Board of: *Journal of Magnetic Resonance*, *Biomolecular NMR Assignments*, *JBIC*, *Journal of Structural Proteomics*, and of *European Journal of Inorganic Chemistry* (EurJIC). She serves as a referee for numerous international journals, including *Science*, *Proceedings of the National Academy of Sciences* (PNAS), *Journal of the American Chemical Society* (JACS), *the 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 of them in **recent years** includes:

**2024**, ENC Experimental NMR Conference, Asilomar, CA, United States, 30<sup>th</sup> ICMRBS, Seoul, Korea, 9<sup>th</sup> ISM, London, UK, CEUM Rjeka, Croatia, EMBL NMR Practical Course Grenoble, France, EMBL Practical Course Membrane proteins, Hamburg, Germany, **2023** Metals in Biology Gordon Research Conference, Ventura, CA, USA; NMR in Biology, Paris, France; EUROMAR, Glasgow, UK, **2022** Biophysical Society 66th Annual Meeting, San Francisco, CA, USA; Nobel Symposium on Bioinorganic Chemistry, Stockholm, Sweden; Experimental NMR Conference (ENC), Orlando, USA; EMBO Lecture Course “*Structure, dynamics and interactions in biomolecular systems using NMR spectroscopy*” Brahampur, India; Chemistry towards Biology, Bratislava, Slovakia; NMR in Biology, Paris, France; Iron-sulphur Protein conference, Sainte Maxime, France; 44<sup>th</sup> ICCS, Rimini, Italy **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, Aarhus, 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 a member of the Organizing Committee and of the Scientific Committee for several major international and national conferences.

### **Summary of the scientific achievements and of the managerial activities**

Lucia Banci has a high international reputation for her original and pioneering contributions and breakthroughs in Structural Biology and in biological NMR. She is recognized as world class scientific leader in the characterization of functional processes in a cellular context with atomic resolution,

and is making and has made high impact contributions to research, technological innovation, and gender equality in science.

Her innovative use of advanced NMR techniques challenged the prevailing belief that solution structures of paramagnetic proteins could not be determined. This milestone, along with the force-field parameters she developed for metal-containing systems, significantly advanced the field of metalloprotein characterization.

Her work unraveled the structural dynamics of electron transfer proteins, protein folding mechanisms, and the molecular recognition processes underlying biological interactions. She has made pivotal contributions to understanding protein misfolding and aggregation, especially in the context of toxic aggregates triggered by metal imbalances, with important implications for neurodegenerative diseases.

In the era of Structural Genomics, Lucia Banci took a function-driven approach, focusing on proteins involved in critical pathways, particularly those related to copper transfer in systems like the Golgi and cytochrome c oxidase. She uncovered previously unidentified proteins and mapped out copper transfer mechanisms, contributing unique insights into metal-mediated protein-protein interactions and cellular metal homeostasis.

A recognized global leader in atomic-resolution characterization of cellular processes, she has made significant advancements in understanding the role of metal ions in biological systems. Her work spans the homeostasis, trafficking, and incorporation of metal ions into the final receiving proteins, particularly focusing on copper transport and iron-sulfur cluster biogenesis. Lucia Banci has developed a molecular systems biology approach that integrates the structural, dynamic, and thermodynamic properties of biomolecules, providing a comprehensive view of metal ion trafficking pathways.

Her groundbreaking work in Structural Vaccinology has paved the way for designing more effective vaccines by leveraging structural insights into antigen-antibody interactions. This innovative approach has proven highly successful, with the breakthrough contribution to the design and optimization of the vaccine against Meningococcal B meningitis.

She has also spearheaded the development of in-cell NMR, enabling the direct characterization of biomolecules in living cells at atomic resolution, its applications to study protein folding, maturation, and metal uptake within living cells. This breakthrough technique has been instrumental in advancing drug screening directly within human cells, bridging cellular studies with detailed structural analysis. Her cutting-edge approach, including the use of fluorinated and selectively labeled amino acids in human proteins, is enhancing our understanding of biological processes and creating new avenues for drug development.

Lucia Banci stands out also as a prominent figure in the realms of research management, technological innovation, and gender equality advocacy. As the Director of CERM/CIRMMP at the University of Florence, Banci has helped shape one of the world's most advanced research centers specializing in Magnetic Resonance spectroscopy. The facility, renowned for its diversity of instruments and magnetic field range, serves academic and industrial users worldwide, contributing to fields such as structural biology, drug development, and material science. A notable achievement

during her leadership includes the successful collaboration with Novartis Vaccines (now GSK) in providing a key contribution in the development of the Meningococcus B vaccine through advanced Structural Vaccinology.

Beyond her directorial role, Banci has been instrumental in the creation and management of Instruct-ERIC, a European research infrastructure supporting integrated structural biology. She also chairs the ESFRI Strategic Working Group on Health & Food, where she helps shape European research infrastructure policies. Her expertise extends to fostering international cooperation and advancing technological innovation in the scientific community.

Lucia Banci's impact extends to technology transfer and the promotion of entrepreneurship. She established Bio-Enable, a regional infrastructure designed to support small and medium-sized enterprises, and co-founded Giotto Biotech Srl, a dynamic biotech spin-off from the University of Florence. These initiatives reflect her commitment to translating research into practical applications and services.

Lucia Banci is a strong advocate for gender equality in science. She has actively championed the advancement of women in academia, establishing, among several other activities, the Equal Opportunity Committee at the University of Florence and supporting female scientists throughout her career. Under her leadership, CERM has maintained a balanced faculty, with women in key positions. Her advocacy has earned her prestigious accolades, including the "Distinguished Woman in Chemistry" award and inclusion in the "100 Experts" initiative aimed at amplifying women's voices in STEM.

Additionally, Banci has a deep commitment to science outreach. She has chaired the "City of Florence Prize for Molecular Sciences," which brings science closer to the public by highlighting research that benefits society. Her involvement in the Genoa Science Festival, one of the largest international science communication events, further underscores her dedication to engaging the broader community with scientific advancements.

Through her leadership in research, dedication to technological progress, and tireless efforts to promote gender equality, Lucia Banci has made lasting contributions to science, policy, and society.

Through her leadership in research, commitment to technology transfer, and advocacy for gender equality, Lucia Banci has made a lasting impact on the scientific community and beyond.

## Scientific Activities

Lucia Banci's early career in Inorganic Chemistry laid the foundation for her work, where she explored magnetic properties of small complexes and biological cofactors through EPR and NMR spectroscopy. She provided a strong contribution to the comprehension of relaxation phenomena of nuclear spins in paramagnetic systems. She co-authored the seminal book *Nuclear and Electron Relaxation* with I. Bertini and C. Luchinat, providing a rigorous yet accessible description of nuclear and electron spin relaxation phenomena.

In the 1980s, as recombinant DNA technology revolutionized biological research, she applied her expertise to the spectroscopic analysis of paramagnetic metalloproteins, elucidating their structural and catalytic properties. Advanced, at the time, NMR techniques such as NOE, 2D NOESY, and COSY were applied to highly paramagnetic systems to characterize the active sites of metalloproteins and their adducts with inhibitors. These studies provided, and continue to provide, deeper insights into the structural and catalytic properties of these proteins and enzymes, revealing key correlations between their structural features and functional or enzymatic behavior.

In the meantime, she developed new 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 have been 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 1990s, 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 NMR signals spread over a large spectral width allowed the resolution of the first solution structure of a paramagnetic metalloprotein. This breakthrough overturned the long-held belief that solution structures of paramagnetic proteins could never be determined. This achievement took also advantage of the force field parameters she developed on metal ions. Her research in this area focused on the structural and dynamic characterization of several electron transfer proteins.

After optimizing the methodology for these challenging proteins, Lucia Banci expanded her work to even more complex projects. These include exploring internal motions over large time scales, understanding the factors that govern protein folding and molecular recognition between partners in biological processes, and investigating the structural and dynamic features leading to protein misfolding and aggregation. Her contributions to these fundamental questions are critical to advancing multiple scientific fields.

Following the Genome Revolution, Lucia Banci became a key contributor to Structural Genomics projects. Her approach focused on the 'function perspective' rather than broad genome coverage, as many Structural Genomics projects were 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. Using bioinformatics tools and genome browsing, she uncovered new proteins and elucidated their interactions with metal cofactors and partner proteins, mapping the steps of copper transfer within cytochrome c oxidase.

She further explored copper transfer pathways from soluble chaperones to membrane-bound Cu-binding ATPases and their metal-binding sites, offering unique insights into cellular copper transport and its incorporation into target proteins. In doing so, Lucia Banci also addressed weak, transient protein-protein interactions that underpin numerous biological processes. Her research revealed a novel aspect of the interactome: a portion of the protein-protein interaction networks is mediated by metal ions, underscoring the crucial role of metal ions in facilitating these interactions.

Through her system-wide, cellular approach, she investigated protein import into mitochondria and their folding, demonstrating how these processes are intricately linked with metal transport, homeostasis, and electron transfer pathways. Her work also provided valuable insights into the structural and functional significance of transient protein-protein interactions in these processes

She has extensively studied proteins that are naturally unstructured, at least in part, as required for their function. This intrinsic disorder profoundly influences their properties and interaction patterns. Conversely, local structural disorder in otherwise well-ordered proteins has been identified as a key factor in the formation of toxic protein aggregates, often triggered by metal imbalances or the absence of native metal ions. Her research has made significant contributions to understanding these aggregation processes.

Lucia Banci has long been involved in the structural and functional characterization of SOD1, with recent work focusing on the mechanisms and factors inducing protein aggregation. She proposed a new mechanism for protein aggregation allowing the rationalization of the behavior all the SOD1 mutants related to ALS. She is now developing new strategies and identifying molecules which prevent this aggregation.

Her groundbreaking work in Structural Vaccinology has paved the way for designing more effective vaccines by leveraging structural insights into antigen-antibody interactions. 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 proven highly successful.

Lastly, she has pioneered innovative approaches for in-cell NMR, enabling the characterization of biomolecules within human living cells at atomic resolution. Her work continues to expand the applications of this technique. Through in-cell NMR, she is studying protein folding, maturation, and metal uptake, including the coordinated expression of related proteins. This emerging field has garnered significant attention from scientific communities interested in both methodological advancements in NMR and the groundbreaking insights it provides into biological processes.

In-cell NMR allows the detection of individual human proteins, including their interactions with partner proteins, within human living cells at atomic resolution. This approach bridges the gap between cellular studies, which maintain the natural cellular environment but lack atomic detail, and structural characterization, which offers detailed atomic-level descriptions. A key application of



this technique is its use in screening drug candidates directly in living human cells. It enables the monitoring of drug incorporation and target binding in real time, making it a powerful tool for drug development.

She is currently advancing this method by developing techniques for incorporating fluorinated amino acids, as well as non-standard and selectively labeled amino acids, into human proteins within living cells. These specialized labels allow the application of high-resolution NMR experiments directly on living cells, further pushing the boundaries of this cutting-edge field

## **Leadership in Research, Technology Transfer, and Gender Equality**

Lucia Banci stands out as a prominent figure in the realms of research management, technological innovation, and gender equality advocacy. She served as Director of CERM at the University of Florence from 2011 to 2017 and was re-elected for the 2021–2023 term. Lucia Banci has helped shape one of the world's most advanced research centers specializing in Magnetic Resonance spectroscopies, featuring the widest range of magnetic field instruments, including the largest available. With approximately 90 members, CERM/CIRMMP provides access to state-of-the-art equipment for academic and industrial users on a global scale. The center supports diverse fields, including structural biology, drug and vaccine development, new experimental methodologies, and metabolomics.

A notable achievement of the strategic relevance of the use of CERM/CIRMMP instrumentation and skills is given by the collaboration with Novartis Vaccines (now GSK) that, through the highly innovative approach of Structural Vaccinology, has allowed to optimize and validate the vaccine against *Meningococcus B*, and to make 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 apply for access the instrumentation, to develop collaborations or to carry out research at the center during their sabbatical.

Lucia Banci was one of the promoters and founders of the European infrastructure, Instruct-ERIC. She is the Head of the Italian Core Center and a member of the Instruct-ERIC Council and of the Executive Committee. 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 Strategic Working Group Health & Food, and from 2022 the Chair of it. She plays and has played a critical role in developing the various European Roadmaps for Research Infrastructures, identifying gaps in the European Research Infrastructures

Landascape, and defining Key Performance Indicators (KPIs) to monitor infrastructure development. Her involvement in ESFRI further highlights her influence in shaping European research policy. Through her leadership roles, she has contributed significantly to the development of international collaborations, as well as the technological advancement of research infrastructures.

Lucia Banci's expertise extends to her involvement with Science Europe, an association that brings together the main public research organizations operating in Europe, where she served on the Scientific Committee for Life, Environment, and Geo Sciences from 2013 to 2015.

Banci's leadership has also driven significant advancements in technology transfer. She established Bio-Enable, a distributed infrastructure offering services to small and medium-sized enterprises (SMEs) in Tuscany. Additionally, she co-founded Giotto Biotech Srl, a dynamic biotechnology company that integrates customer-focused services with innovative research projects, continually developing new products for the market.

Throughout her career, Lucia Banci has been Coordinator or Principal Investigator of numerous projects funded under the framework programs of the European Commission, as well as of competitive national, regional and private institution projects.

Lucia Banci is also a staunch advocate for gender equality in science, actively promoting gender balance in academic positions. As the founder of the Equal Opportunity Committee at the University of Florence, she has inspired and mentored young female scientists, with nearly 60% of her PhD students being women. Under her leadership, CERM's faculty includes 10 women out of 22 members, with three full professors—all women. Her efforts have earned her prestigious accolades, including being the first Italian Chemist to receive the "Distinguished Woman in Chemistry" award from IUPAC in 2015 and the "Premio Scienza Madre" in 2018.

Banci's commitment to breaking gender stereotypes in STEM is further reflected in her inclusion in the "100 Experts" initiative, which promotes the consultation of women experts by the media. This initiative, supported by the European Commission, aims to combat stereotypes about women in research fields.

In addition to her scientific achievements, Banci is dedicated to public science dissemination. She chairs the Scientific Committee of the "City of Florence Prize for Molecular Sciences," which highlights cutting-edge research's societal impact, such as sustainable energy and public health. Since 2016, she has also been a member of the Scientific Committee of the Genoa Science Festival, a leading event for international scientific outreach that connects researchers, young people, schools, and families, fostering a broader appreciation of science.