

# Marco Beleggia

Born 9/7/1972 (Italy) - MSc (Physics) 1996 - PhD (Physics) 2001

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Google Scholar public profile: <http://scholar.google.com/citations?user=vEqtF2MAAAAJ>

## EDUCATION

- **Ph.D. Physics**, University of Bologna, Italy (23/2/2001). Thesis title: *Transmission electron microscopy observation of electromagnetic fields*. Advisor: Prof. Giulio Pozzi. My PhD project was partially carried at the Hitachi Advanced Research Lab. (Japan). Supervisor: A. Tonomura.
- **M.Sc. Physics** (graduated *cum laude*) University of Bologna, Italy (14/6/1996). Thesis title: *Simulations of Foucault images of superconducting fluxons*. Advisor: Prof. Giulio Pozzi.

## RESEARCH INTERESTS - keywords

- Electron-matter interactions
- Nanoscale and quantum physics: spin, charge and their dynamics
- Shape- and finite-size effects in nanomaterials
- Dipolar interactions in colloidal systems, self-assembly
- Magnetic nanoparticles for biomedical applications
- Ferroelectrics, multiferroics, interfaces, complex oxides
- Quantum materials: topological spin textures
- Interface between physical, chemical, and life sciences
- Nanotechnology: fabrication — functionalization — characterization — application
- Synergy between electron-probe and photon-probe imaging techniques
- Aharonov-Bohm effect and quantized vortices in superconductors
- Single-molecule and radiation-sensitive materials imaging
- Semiconductor devices for energy harvesting and photonic applications

## SCIENTIFIC EXPERTISE - keywords

- Magnetism: analytical and numerical micromagnetism, hysteresis, nanoscale interactions, shape anisotropy, magnetic phase diagrams, nanostructured arrays
- Superconductivity: vortices, flux pinning, flux-line-lattice dynamics, field topography
- Semiconductors: p-n junctions, doping profiling, electric field topography, surface effects
- Electron optics, electron microscopy, image formation theory, light optics
- Electron holography and interferometry; phase contrast and phase retrieval
- Advanced electron microscopy and spectroscopy: Lorentz, EELS, STEM, HRTEM, in-situ/environmental, cryo-TEM
- Modelling of electromagnetic fields and simulation of electron microscopy images/signals
- Magnetic and ferroelectric nanostructures, multiferroics, strongly correlated electron systems
- Single-molecule imaging with electrons, radiation sensitive materials, electron phase plates
- Liquid-cell in-situ electron microscopy and holography
- Organic ice resist electron beam lithography
- Operation of Transmission Electron Microscopes (Philips CM30 and CM200, FEI Tecnai and Titan, Jeol 3000F, Jeol 2100F, Hitachi HF 3300, etc.).

## SCIENTIFIC PRODUCTION – METRIC

Sources: Google/Scopus/WoS; last update: Jun 2022

- Peer-reviewed articles: **109** Conf. Proc. & Misc.: **100+** Total citations: **3516/2455/2296**
- Review articles: **3** Book Chapters: **6** 5 year avg: **99.83** cit/yr (WoS)
- Invited talks: **40** Current *h-index*: **30/27/25** Most cited paper: **226/155/131** cit

## EMPLOYMENT HISTORY

**2022-curr.** *Dipartimento di Fisica, Informatica e Matematica, Università degli studi di Modena e Reggio Emilia,* IT

*Associate Professor (tenured) of Experimental Condensed Matter Physics*

**Focus:** Structured illumination (beam shaping) by tunable MEMS-based phase plates

**Teaching:** General Physics 1 for Chemists and Mathematicians (Bachelor -- laurea triennale); Laboratory of Electron Microscopy and Holography (Master; laurea magistrale)

**2009-2021** *Technical University of Denmark, DTU Nanolab* DK

*Associate Professor (tenured), head of the "Electron Matter Interaction" research group*

**Focus:** Modelling and image interpretation for the quantitative measurement of physical properties of magnetic and electronic nanomaterials. Teaching, supervision of B.Sc, M.Sc, Ph.D students and post-docs, management of projects and a research group.

**Achievements:** Developed an algorithm to measure magnetic moments and charges from holographic phase images with a sensitivity approaching a single Bohr magneton and a tiny fraction of the electron charge, respectively. Shape effects in nanomagnetism. Self-assembled dipolar ferromagnetism in magnetic colloids. Ferroelectricity in confined structures. Organic Ice Resists for the nanofabrication of quantum nanodevices and bio-hybrid structures.

**2014-2015** *Helmholtz Zentrum Berlin for Energy and Materials* DE

*Senior Scientist – at 50% with DTU from 01.03.2014 to 29.02.2016*

**Focus:** Development of models for the interactions between the electron beam and the sample and simulations of images/signals in the TEM/STEM-EELS/SEM aimed at extracting quantitative information from the experimental data. Image contrast mechanisms in He/Ne ion microscopes.

**Achievements:** Formulated a description for beam-induced charging of a finite object with neutralizing tunneling currents. Developed a model for beam-induced plasma effects in the ETEM.

**2007-2008** *University of Leeds, Institute for Materials Research* UK

*Royal Society Relocation Fellow in the group of R. Brydson*

**Focus:** Establishment of Electron Holography in Leeds as a complementary (to EELS, Lorentz-TEM, HRTEM, STEM, etc.) tool for nanoscale characterization of advanced materials.

**Achievements:** Procured and installed a custom-made electron biprism on the local Philips CM 200 FEG TEM. Initiated collaborative efforts with Physics (C. Marrows) on spintronics and development of tunable magnetic phase plates (Zernike phase contrast with electrons).

**2004-2007** *Brookhaven National Lab., Center for Functional Nanomaterials* USA

*Associate scientist (tenure-track) with Y. Zhu and in the nanomagnetism group (L. H. Lewis)*

**Focus:** TEM observation and characterization of magnetic and electronic nanomaterials. Charge distributions and material defects at grain boundaries in superconductors. Ferroelectrics and multiferroic materials. Analytical and numerical micro-/nano-magnetism.

**Achievements:** Development of magnetic phase diagrams for nano-rings, and of an analytical shape-shape magnetostatic interaction expression. Description of interfacial ferromagnetism in LaMnO-SrMnO multilayers. Interplay between dipolar and exchange couplings in ECC media.

**2002-2003** *Brookhaven National Laboratory, Materials Science Department* USA

*Research associate (post-doc) in the Nanoscale Structure of Advanced Materials group of Y. Zhu.*

**Focus:** TEM observation and characterization of nanostructures.

**Achievements:** Effect of shape anisotropy in phase computations and energetics of magnetic nanoparticles. Quantitative magnetization mapping of nanostructures by electron holography and micromagnetic simulations. Discovery and description of shape-induced ferromagnetic ordering in dipolar-dominated nanostructured systems.

**2001** *INFM – National Institute for the Physics of Matter* Italy

*Research fellow (post-doc) under the supervision of Prof. G. Pozzi.*

**Focus:** Phase computations for superconducting vortices and p-n junctions.

**Achievements:** Direct visualization of vortex pinning at columnar defects in high- $T_c$  superconductors by phase-contrast methods. Electron-optical description of pancake vortices.

**1996-2000**     **University of Bologna, Department of Physics**     **Italy**  
*Graduate student of Prof. G. Pozzi.*  
**Focus:** Phase contrast techniques for transmission electron microscopy and electron holography.  
**Achievements:** Development of a phase computation method for TEM observations. Applications to TEM image interpretation of superconducting vortices and p-n junctions.

## GUEST OR VISITING SCIENTIST APPOINTMENTS

**2022-curr.**     **DTU Nanolab**     **DK**  
*Adjunct Associate Professor at DTU Nanolab (proposed)*  
**Goals:** Co-supervision of Master and PhD students. Guest-lecturing in various DTU Nanolab courses. Collaborate with Nanolab scientists on modelling, signal analysis/interpretation, especially on the topic of coherent electron imaging. Collaborative research on the manipulation, synthesis and fabrication of magnetic nanoparticles for hyperthermia and power-electronics applications.

**2006-curr.**     **NINT – National Institute for Nanotechnology**     **Canada**  
*Visiting scientist in the group of M. Malac*  
**Focus:** Electron imaging of radiation sensitive materials and single molecules.  
**Achievements:** Assessed the benefits of Zernike-type phase plates in single-molecule imaging with Cs-corrected TEMs. Evaluated doses with bright-field, holography, Zernike, and electron nanodiffraction imaging modes. Invented and patented the "Hole free phase plate" device.

**2012-2014**     **Technical University in Berlin, Inst. of Optics and Atomic Physics**     **Germany**  
*Guest scientist in the group of Prof. Dr. Michael Lehmann*  
**Focus:** Electron holography of nanoscale charge distributions and electric fields. Confined nanostructured p-n junctions. Beam-induced potentials.  
**Achievements:** Extended the phase Laplacian approach for measuring charges to high-resolution Electron Holography for model-independent holographic chemical mapping.

**2007-2009**     **Brookhaven Nat. Lab., Cond. Matter Physics and Mat. Sci. Dept.**     **USA**  
*Guest scientist in the group of Y. Zhu*  
**Focus:** Magnetodynamics and interactions in nanostructured magnetic arrays.  
**Achievements:** Generalization of magnetic phase diagrams. Structure of magnetic vortex cores.

**1999-2000**     **Hitachi Advanced Research Laboratory**     **Japan**  
*Visiting scientist in the group of Dr. A. Tonomura.*  
**Focus:** Electron holography of superconducting materials. Vortex dynamics.  
**Achievements:** Development and application of a reconstruction system for electron holography. Measurement of penetration depth in high- $T_c$  superconductors by EH.

## TRAINING, PROFESSIONAL DEVELOPMENT

- **Habilitation to Full Professor**, Italy, Apr 2017.
- **Course** *How to prepare a successful proposal for Horizon 2020*, DTU, Oct 21, 2014.
- **Course** *The good application for the DFF (Danish Research Council)*, DTU, Sep 19, 2013.
- **Course** *UDTU*, Education in University Teaching, graduated in Aug 2011. UDTU is an 18 months program (250 h. workload) that included a project on my own teaching development.
- **Course** *Leadership Development for Principal Investigators*, U. Leeds, UK, Dec 4, 2007.
- **Course** *People Management for Postdoctoral Staff*, Faculty of Engineering, University of Leeds, Leeds, UK, Nov. 29-30, 2007.
- **International School** *Advances in Electron Microscopy in Materials Science*, organized by University of Lecce and ISUFI, Lecce, Italy, Sep. 10-20, 2001.
- **Summer School** *National School on Condensed Matter Physics*, organized by ISI Foundation and INFN, Villa Gualino, Torino, Italy, Sep. 4-15, 2000.
- **Course** *Quantitative High-Resolution Electron Microscopy and Electron Diffraction*, EUREM 2000 conference, Brno, Czech Republic, July 9-14, 2000.

- **International School Superconducting Materials: Advances in Technology and Applications**, International Advanced School “Leonardo da Vinci”, Bologna, Italy, June 29–July 10, 1998.
- **Course Digital Imaging, Microscopy and Microanalysis '97**, Cleveland OH, Aug. 10-14, 1997.
- **Course Modern Developments of Electron Microscopy in Material Science**, XX Conference of the Italian Society of Electron Microscopy (SIME), Rimini, Italy, Sep. 11-14, 1995.

## GRANTS, FUNDING HISTORY, AWARDS

- **DFF-FTP-2 ADELE** (2022), co-PI and WP leader, total budget DKK 6.2M (~€833k)
- **DFF-FTP-2 HiFMag** (2019), co-PI and WP leader, total budget DKK 6.1M (~€820k)
- **EUROSTARS SuperPower** (2019), co-PI and WP leader, €300k on a total budget of €1.25M.
- **H.C. Ørsted Fellowship Nanoscale interactions between electrons and ice: towards the ultimate resolution of ice lithography** (2017) for Ding Zhao, co-supervised with A. Han (DTU).
- **VILLUM Blocstipend** (~€180k, 2016) to support the 2-year project "Ice lithography and electron holography" with the full-time employment of Dr. Anna Elsukova 01/01/2017-31/12/2018.
- **Otto Mønsted Guest Professorship** (~€28k, 2015) to support a 3-month visit and collaboration activities with Prof. R. Budhani, summer 2018.
- **Otto Mønsted Guest Professorship** (~€28k, 2015) to support a 3-month visit and collaboration activities with Prof. M. Lehmann, Jan-Mar 2014.
- **H.C. Ørsted Fellowship Self-assembly dynamics of ferromagnetic nanoparticles in evaporating fluid** (2012) for Jelena Jordanovic, co-supervised with C. Frandsen (DTU Physics).
- **Otto Mønsted Guest Professorship** (~€25k, 2010) to support a 3-month visit and collaboration activities with Prof. G. Pozzi, Mar-May 2011.
- **Royal Society Fellowship Relocation Grant** (~£190k, 2007). Supported my research activities for two years (July 1<sup>st</sup>, 2007 to June 30<sup>th</sup>, 2009) at the University of Leeds, UK.
- Instrumental in acquiring and renewing a **Grant, U.S. Department of Energy (DOE FWP MA-015-MACA)**, ~\$2M/year, open ended. Supported my research at Brookhaven National Laboratory during 2002-2007 (Basic Energy Sciences, contract No. DE-AC02-98CH10886).
- **Early Career Award** (€1000, 2006), from Italian Society of Microscopy Sciences (SISM).
- **Prize Carla Milanese**, from Italian Society of Electron Microscopy (SIME), for the outstanding contribution presented at the MCEM 5th conference (March 1<sup>st</sup>, 2002).
- **Grant Young Researcher Project** from University of Bologna (€2500, year 2001) to support collaboration with HARL group of Dr. A. Tonomura, Japan.
- **Scholarship** from INFN on “Phase contrast electron microscopy techniques for the observation of quantized flux lines”, 02/1997 (refused due to incompatibility with Ph.D. project).
- Other grant or fellowship applications with good results:
  - 2012 **ERC Starting Grant** (€1.4M budget). Proposal ranked "B" (passed 1<sup>st</sup> threshold).
  - 2006 **EPSRC ARF Advanced Research Fellowship** (£778k budget). Proposal ranked 11 (after being interviewed in Swindon, UK), with 10 projects funded.
  - 2005 **EURYI European Young Investigator Awards** (€1.25M budget) Proposal ranked amongst the best 6 in Italy (across all scientific disciplines), with only the first 3 funded.

## INNOVATION – PATENTS

- “Charging of a hole-free thin film phase plate”. Patent US8785850-B2 (granted 2014-07-22); also submitted in Japan JP2011151019-A. M. Malac, M. Beleggia, M. Kawasaki, R. Egerton.
- “Quiet magnetic Velcro fastener”. D. Vokoun, M. Beleggia. CZ26401 (U1), 2014-02-12.
- “A method for creating structures or devices using an organic ice resist”. A. Han, M. Beleggia, W. Tiddi. Patent application WO2017191079 (priority# EP20160167903), 9 Nov 2017.

## TEACHING ACTIVITIES

- **Reader of General Physics 1 for Chemists and Mathematicians** (9 ECTS) B.Sc., 2022-curr
- **Reader of Laboratory of Electron Microscopy and Holography** (5 ECTS) Master, 2022-curr
- **Course responsible and lecturer Transmission Electron Microscopy for the characterization of advanced materials** (5 ECTS) M.Sc., 2014-2021, DTU

- **Co-lecturer** *Magnetism and Magnetic Materials* (10 ECTS, B.Sc. and M.Sc.), 2011-2020 Course shared between DTU and KU (Copenhagen University).
- **Course responsible and lecturer** *Transmission Electron Microscopy for Nanoscience* (5 ECTS, Ph.D. open to final year M.Sc.), 2010-2013, DTU
- **Organized and co-lectured** the *Basic and Advanced Transmission Electron Microscopy* special course at DTU Cen, 2009.
- **Co-lectured** *Processing and Properties of Inorganic Nanomaterials*, Nanotechnology M.Sc., University of Leeds, UK, 2007.
- **Instructor** for the tutorial workshop on *Electron Holography* at the Microscopical Society of Canada Annual Meeting, University of Alberta, Edmonton, Canada, 2007.
- **Instructor** for the pre-congress workshop/tutorial *Electron holography in Materials and Life Sciences* at the SCANDEM conference, Copenhagen, Denmark, 2013.
- **Instructor** for the pre-congress tutorial *Imaging magnetism with electrons* at the MRS fall meeting, Boston, USA, 2013.
- **Guest-lecturer** for a yearly short course (10 hours) on *Advanced electron microscopy techniques applied to nanoscience* to graduate students, U. Bologna (Italy), (2006-2009).
- **Lectured** to 4<sup>th</sup>-year physics undergraduate students on *Advanced calculus applied to electron-optics, phase retrieval and phase contrast techniques*. U. Bologna, Italy, 1999-2001.
- **Teaching Assistant** for courses *Electron Optics* and *Electron Microscopy*. Physics Department, University of Bologna, Italy, 1999-2001.
- **Taught** a 4<sup>th</sup>-yr physics undergrad. *Electron Microscopy Laboratory* course. U. Bologna, 2000.

## ACADEMIC and PROFESSIONAL ACTIVITIES

- **Conference vice-chair**, European Microscopy Conference 2020, Copenhagen, Denmark.
- **Chaired** several sessions at workshops and international conferences worldwide, on topics involving electron holography, magnetism and magnetic materials, advanced electron microscopy and materials characterization.
- **Member** (substitute) of COST action RADIOMAG TD1402, representing Denmark, 2014-2019
- **Associate Editor**, IEEE Magnetics Letters, 2020-curr
- **Editorial Board Senior Member**, IEEE Magnetics Letters, 2012-2019.
- **Committee chair**, Ph.D. A. Insinga, DTU Risø, DK, 2016.
- **External committee member**, Ph.D. Ioanna Antypas, U. Cambridge, UK, 2007.
- **Committee member**, Ph.D. S. Tandon, Carnegie Mellon University, USA, 2004.
- **Peer reviewer** for many high-profile scientific journals (including Phys. Rev. Lett., Nature Materials/Nanotech, Nanoletters, Nature). I review on average a paper per month at least.
- **Member** (or former member) of professional societies: Italian Society Microscopy Sciences (SISM), Microscopy Society of America (MSA), Materials Research Society (MRS), Royal Microscopical Society (RMS), Royal Society, IoM<sup>3</sup>, IEEE.
- **Panel member** of the Center for Functional Nanomaterials (Brookhaven National Laboratory, USA) Proposal Review Panel (PRP), 2008-2010.
- **Panel member** of the Royal Society International Travel Grant Panel, 2008-2013.

## SUPERVISORY ACTIVITIES

- **Supervised or co-supervised** undergraduate and graduate students in their Bachelor, Master or PhD projects, and post-docs in their research activities.
  - *F. Ubaldi*: TEM and modeling of p-n junctions, PhD Bologna University, Italy.
  - *S. Tandon*: Lorentz-TEM and phase simulations, PhD Carnegie Mellon University, USA.
  - *J. Lau*: Barrier energetics, reversal and magnetodynamics in patterned magnetic arrays. Columbia University (PhD project carried out at Brookhaven National Laboratory).
  - *H. Lei*: TEM of shape-controlled nanopatterned arrays and magnetic dots. Stony Brook University (PhD project carried out at Brookhaven National Laboratory).
  - *M.K. Hari*: Numerical micro- and nano-magnetism of spintronic circuits. MSc U. Leeds.
  - *Ó.D. Jóhannsson*: LLG-based micromagnetism of dipolar chains. Proj. DTU.
  - *N. Torstensson*: Magnetic steering of catalytic etching. BSc DTU.

- *A.F. Pedersen*: Micromagnetic simulations of planar Hall effect bridge. Proj. DTU.
- *J. Jordanovic*: Self-assembly dynamics of ferromagnetic nanoparticles in evaporating fluid. Postdoc DTU.
- *B.S. Baekke*: Polarization enhancement of ferroic NPs embedded in a matrix. BSc DTU.
- *T. Jahuo and E. Fogh*: Demagnetization factors for non-trivial shapes. Project, DTU.
- *N. Torstensson*: Timescale separation between spin relaxation and NP rotation. Proj. DTU.
- *B.S. Baekke*: Polarization profile in ferroelectric needles. Proj. DTU.
- *A. Insinga and D Cadario*: Neodymium magnetic systems optimization with a variational approach. Proj. DTU.
- *M.R. Almind and N.Ø. Langemark*: Visualizing magnetic fields of magnetite nanoparticles with off-axis electron holography. BSc DTU.
- *M.S. Yekta*: Nanowires for LEDs: characterization with Electron Holography. MSc DTU.
- *W. Tiddi*: Ice lithography for large-scale sub-10 nm patterning. PhD DTU.
- *B.S. Baekke*: Demagnetization effects in NiMnGa shape memory alloys. MSc DTU.
- *M.R. Almind and N.Ø. Langemark*: Micromagnetic simulations of magnetite octahedra. Project, DTU
- *A. Bay Andersen*: Quantitative characterization of magnetic vortex cores in magnetite nanoparticles using off-axis electron holography. BSc DTU.
- *M. Kure*: Dipolar ferromagnetism and ferrotoroidicity in nanoclusters. PhD DTU.
- *A. Hegelund Christensen*: Hysteresis heating of magnetic nanoparticles. BSc DTU.
- *A. Elsukova*: Ice lithography and electron holography. Postdoc DTU.
- *F. Durhus, M. Boisen, L. Wandall*: Simulations of magnetic particle aggregation. Proj. DTU.
- *Z. Abachri*: Imaging Skyrmion materials. MSc DTU
- *N. del Castillo Iniesta*: Organic Ice Lithography. Project DTU
- *C.E. Imbaquingo Munoz*: Magnetodynamic interactions between permanent magnets and solenoids. Project DTU
- *J. Ærøe Hyllested*: Realisation of Gas Electron Holography. PhD DTU
- *M. Zambach*: Design of magnetic nanocomposite materials for high-frequency power electronics. MSc DTU
- *R. Balakrishnan*: Visualizing Crystal Defects in Semiconductor Nanowires using Scanning Electron Microscopy. MSc DTU
- *M. Lützen*: Organic Ice Lithography for 2D materials. MSc DTU
- *A.R. van Roosmalen, M.V. Ademark*: Simulation of Organic IceLithography. BSc, DTU
- *C. Perez Espinar*: Numerical analysis of radiation losses from spin precession in micromagnetism. Project DTU
- *L. Gruener Hanson*: Modelling hysteresis heating of magnetic nanoparticle clusters in viscous liquids at finite temperature. Special course, DTU
- *M. Zambach*: HiFMag project; PhD DTU (co-supervised with C. Frandsen)
- *B. Nugraha Sanusi*: HiFMag project PhD DTU (co-supervised with O. Zhang)
- *Marcus Hufe*: Design, fabrication and implementation of electron phase plates for bioimaging. PhD DTU (co-supervised with P. Kempen)
- *Frederik Durhuus*: Langevin dynamics simulation framework for magnetic nanoparticle self-assembly. PhD DTU (co-supervised with C. Frandsen)
- **Managed** (interim) the Nanomagnetism research theme at Brookhaven National Laboratory, including supervision of a post-doc (Yi Ding) and coordination of scientific staff activity (D. Arena, M.A. Schofield, Y. Zhu), after the group leader (L.H. Lewis) accepted her current position as Head of the Chemistry Department, Northeastern University, Boston, USA.
- **Chair** (2009-17) of Center for Electron Nanoscopy's Teaching Panel, coordinating the department's efforts in "teaching according to our needs" (as per DTU mandate), training and outreach, and overseeing supervision of PhD students.
- **Head of research group** *Electron Matter Interaction* (2018-21): scientific management of ~20 researchers at various stages of their careers (PhD's, postdocs, junior and senior scientists).

## INTERNATIONAL COLLABORATORS

- G. Pozzi: phase contrast and phase retrieval microscopy techniques, optics
- Y. Zhu: electron diffraction, nanoscale characterization of advanced materials
- M. De Graef: electron crystallography, Lorentz-TEM, micromagnetism, phase retrieval
- M. Malac: nanolithography, EELS, Zernike phase plates for electrons
- R. Egerton: EELS, low-dose imaging of radiation sensitive materials
- G. Rowlands: fundamentals of micromagnetism, energetics of nanomagnets
- Y. Millev: spin reorientation transitions, renormalization group theory
- M. Freeman: time-resolved magneto-optical techniques
- R. Klie: STEM and atomic-resolved EELS, grain boundaries
- L. Lewis: magnetic materials, magnetic phase transitions, nanomagnetism
- D. Arena: synchrotron, element-specific time-res. X-ray spectroscopy and magnetic dichroism
- G. Matteucci: electron holography, foundations of quantum mechanics, Aharonov-Bohm effect
- L. Ferrari: phase transitions, statistical mechanics
- J. Davenport: first-principle calculations, Heisenberg models
- D. Vokoun: exchange-coupled composite media, magnetometry, magnetic forces
- J. Lau: magnetodynamics in shape-controlled nanostructured materials
- M. Schofield: electron holography, spin and charge distributions in materials
- Ch. Jooss: manganites, multiferroics, magneto-optical techniques, electrochemistry
- C.H. Marrows: spintronic, MBE sample growth, nanomagnetism, domain wall resistance
- R. Dunin-Borkowski: electron holography, magnetic vortices, phase retrieval
- R.M. Brydson: EELS, HR-TEM, nanomaterials, nanotechnology
- T. Kasama: electron holography, magnetotactic bacteria, physics of rocks and minerals
- C. Frandsen: self-assembled magnetic nanoparticles, Mossbauer spectroscopy
- R. Budhani: superconductivity, proximity effects, interplay with magnetism, Skyrmions
- E. Renstroem: life sciences, cellular biology, translational science
- A. Maigne: cryo-EM, e-beam/ice interactions, vibrational spectroscopy
- S. Hettler: charge-based phase plates
- K. Harada: electron holography, coherent electron imaging

## LANGUAGE SKILLS

- Italian (native)      English (fluent)      German, Danish, Spanish, Japanese, French (beginner)

## LIST OF PUBLICATIONS

### PEER-REVIEWED JOURNALS

1. "Foucault imaging of superconducting fluxons". T. Yoshida, M. Beleggia, J. Endo, K. Harada, H. Kasai, T. Matsuda, G. Pozzi, A. Tonomura. *J. Appl. Phys.* **85**, 4096-4103 (1999).
2. "Recent results in the interpretation of Interference and Lorentz images of vortices in superconductors". M. Beleggia, S. Fanesi, R. Patti, G. Pozzi. *Mater. Charact.* **42**, 209-220 (1999).
3. "A model for the interpretation of holographic and Lorentz images of tilted reverse biased p-n junctions in a finite specimen". M. Beleggia, R. Capelli, G. Pozzi. *Philos. Mag. B* **80**, 1071-1082 (2000).
4. "Electron microscopy of reverse biased p-n junctions". M. Beleggia, D. Cristofori, P.G. Merli, G. Pozzi. *Micron* **31**, 231-236 (2000).
5. "Observation of superconducting vortices using advanced electron microscopy techniques". M. Beleggia, R. Patti, G. Pozzi, in *Superconducting materials, Advances in Technology and Applications*, World Scientific Press, Ed. A. Tampieri, G. Celotti (2000).
6. "On the calculation of the phase shift of superconducting fluxons: from the isolated to the lattice case". M. Beleggia and G. Pozzi. *Ultramicroscopy* **84**, 171-183 (2000).
7. "Observation of superconducting fluxons by transmission electron microscopy: a new Fourier space approach for calculating the electron optical phase shift". M. Beleggia and G. Pozzi. *Phys. Rev. B* **63**, 054507 (2001).
8. "Influence of the specimen surfaces on TEM images of reverse-biased p-n junctions". M. Beleggia, G.C. Cardinali, P.F. Fazzini, P.G. Merli, G. Pozzi. *Inst. Phys. Conf. Ser.* **169**, 427-430 (2001).
9. "Phase shift and phase-contrast images of pancake superconducting vortices". M. Beleggia and G. Pozzi. *J. Electron Microsc.* **51**, S73 (2002).
10. "Direct Evidence of the Anisotropic Structure of Vortices Interacting with Columnar Defects in High-Temperature Superconductors through the Analysis of Lorentz Images". O. Kamimura, H. Kasai, T. Akashi, T. Matsuda, K. Harada, J. Masuko, T. Yoshida, N. Osakabe, A. Tonomura, M. Beleggia, G. Pozzi, Y. Nakayama, J. Shimoyama, K. Kishio, T. Hanaguri, K. Kitazawa, M. Sasase, S. Okayasu. *J. Phys. Soc. Jpn.* **71**, 1840-1843 (2002).
11. "TEM phase contrast images of reverse-biased p-n junctions: the effect of charged oxide layers". M. Beleggia, P.F. Fazzini, P.G. Merli, G. Pozzi. *Microscopia elettronica* **23(2)**, 37-42 (2002).
12. "Interpretation of experimental Lorentz microscopy observations of superconducting vortices in high-temperature superconductors with columnar defects". M. Beleggia, G. Pozzi, J. Masuko, N. Osakabe, K. Harada, T. Yoshida, O. Kamimura, H. Kasai, T. Matsuda, A. Tonomura. *Phys. Rev. B* **66**, 174518 (2002).
13. "A Fourier approach to fields and electron optical phase shifts calculations". M. Beleggia, P.F. Fazzini, G. Pozzi. *Ultramicroscopy* **96**, 93-103 (2003).
14. "Influence of charged oxide layers on TEM imaging of reverse biased p-n junctions". M. Beleggia, P.F. Fazzini, P.G. Merli, G. Pozzi. *Phys. Rev. B* **67**, 045328 (2003).
15. "Electron-optical phase shift of magnetic nanoparticles, part I: basic concepts". M. Beleggia and Y. Zhu. *Philos. Mag.* **83**, 1045-1055 (2003).
16. "Electron-optical phase shift of magnetic nanoparticles, part II: polyhedral particles". M. Beleggia, Y. Zhu, S. Tandon, M. De Graef. *Philos. Mag.* **83**, 1143-1161 (2003).
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55. "Demagnetization factors for cylindrical shells and related shapes". M. Beleggia, D. Vokoun, M. De Graef. *J. Magn. Magn. Mater.* **321**, 1306-1315 (2009).
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95. "Effect of molecular weight on the feature size in organic ice resists". A. Elsukova, D. Zhao, A. Han, M. Beleggia. *Nanoletters* **18**, 7576-7582 (2018).
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100. "The mean inner potential of liquid water". M.N. Yesibolati, S. Lagana, H. Sun, M. Beleggia, S.M. Kathmann, T. Kasama, K. Mølhave. *Phys. Rev. Lett.* **124**, 065502 (2020).
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102. "Electron beam patterning of vapor-deposited solid anisole", D. Zhao, B. Chang, M. Beleggia. *ACS Appl. Mater. Interfaces* **12**, 6436-6441 (2020).
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105. "Simulated clustering dynamics of colloidal magnetic nanoparticles". F.L. Durhuus, L.H. Wandall, M.H. Boiden, M. Kure, M. Beleggia, C. Frandsen. *Nanoscale* **13**, 1970-1981 (2021).
106. "Investigation of gas-electron interactions with electron holography". J. Aerøe Hyllested, M. Beleggia. *Ultramicroscopy* **221**, 113178 (2021).
107. "Coexistence and Coupling of Multiple Charge Orderings and Spin States in Hexagonal Ferrite". S. Cheng, X Li, Y. Liu, C. Xu, M. Beleggia, L. Wu, W. Wang, C. Petrovic, L. Bellaiche, J. Tao, Y. Zhu. *Nanoletters* **21**, 5782-5787 (2021).
108. "Off-axis electron holography measurements on radial i-p junctions in GaAs and radial heterojunction between amorphous C film and undoped GaAs", G.P.S. Balasubramanian, E. Lebedkina, N.I. Gosktas, K. Mølhave, R. LaPierre, E. Semenova, M. Beleggia and E.M. Fiordaliso. *Nanoscale*, under review (2021).
109. "Investigation of specimen charging in an Al<sub>2</sub>O<sub>3</sub> nanotip using off-axis electron holography in the transmission electron microscope", F. Zhang, M. Beleggia, V. Migunov, G. Pozzi, R.E. Dunin-Borkowski. *Ultramicroscopy*, under review (2021).
110. "Temporal dynamics of charge buildup in cryo-electron microscopy". M.T. Schreiber, A. Maigne', M. Beleggia, M. Wolf. *Ultramicroscopy*, under review (2021).
111. "Interpretation of mean free path values derived from off-axis electron holography amplitude measurements". C. Cassidy, M. T. Schreiber, M. Beleggia, J. Yamasaki, H. Adaniya, T. Shintake. *Micron*, under review (2022).
112. "Charge quantification on a silicon nitride membrane by off-axis electron holography". M.N. Yesibolati, H. Zun, M. Beleggia, N. Zaluzec, K. Mølhave. *Appl. Phys. Lett.*, in preparation (2022).

## BOOKS – BOOK CHAPTERS – INVITED REVIEW ARTICLES – Ph.D THESIS

113. "Transmission Electron Microscopy observation of Electromagnetic fields". M. Beleggia. *Ph.D. thesis*. University of Bologna, Italy (2001).
114. "Magnetic phase imaging with transmission electron microscopy". M. Beleggia and Y. Zhu. Chapter 7 in *Modern techniques for characterizing magnetic materials*, Y. Zhu (Editor), Kluwer academic, 2005.
115. "Electron holography of electromagnetic fields: recent theoretical advances". M. Beleggia, G. Pozzi, A. Tonomura. Chapter (TBD) in *Introduction to Electron Holography, Vol. 2*, E. Voelkl (Editor), submitted for publication in 2010 (publication of this book is currently on hold).
116. "Electron Holography of magnetic materials". T. Kasama, M. Beleggia, R.E. Dunin-Borkowski. Chapter 3 in *Holography – Different Fields of Application*, F.A. Monroy Ramirez (Editor), Intech, 2011.
117. "Lorentz microscopy and electron holography of magnetic materials". R.E. Dunin-Borkowski, T. Kasama, M. Beleggia, G. Pozzi. Chapter 6 in *Handbook of Nanoscopy*, pp 221-251, G. van Tendeloo, D. van Dyck, S. Pennycook (Editors), Wiley-VCH, 2012.
118. "Phase computations for Electron Holography of nanostructured magnetic materials". M. Beleggia. *Microscopie*, Anno IV - n. 1 (7), 37-47 (2007).
119. "Characterization of the JEM-2100F-LM TEM for Electron Holography and Magnetic Imaging". M.A. Schofield, M. Beleggia, J.W. Lau, Y. Zhu. *JEOL News* **42**, 2-7 (2007).
120. "The Physics of Shape". M. De Graef and M. Beleggia. Contract signed with World Scientific Publishing. Book in progress.
121. "ETEM studies of electrodes and electrocatalysts". Ch. Jooss, S. Mildner, M. Beleggia, D. Mierwaldt, V. Roddatis. Chapter 11 in *Controlled Atmosphere Transmission Electron Microscopy*, J.B. Wagner and T.W. Hansen (Eds.), Springer (2016).
122. "Gas-electron Interaction in the ETEM". J.B. Wagner, M. Beleggia. Chapter 3 in *Controlled Atmosphere Transmission Electron Microscopy*, J.B. Wagner and T.W. Hansen (Eds.), Springer (2016).
123. "Phase plates in the transmission electron microscope: operating principles and applications". M. Malac, S. Hettler, M. Hayashida, E. Kano, R.F. Egerton, M. Beleggia. *Microscopy* **70**, 75-115 (2021).

## INVITED TALKS and SEMINARS

- t1. "Dipolar Interactions and Shape Anisotropy in Magnetic Nanoparticles". M. Beleggia. Physics Department and National Institute for Nanotechnology, University of Alberta, Edmonton, Canada. August 8, 2003, invited seminar (hosts: Prof. M. Freeman and Dr. M. Malac).
- t2. "Dipolar Interactions and Shape Anisotropy in Magnetic Nanoparticles. Recent Developments of the Fourier-space approach for phase computations". M. Beleggia. Physics Department, University of Bologna, Italy, December 12, 2003, invited seminar (host: Prof. G. Pozzi).
- t3. "Observation of Dipolar Ferromagnetism by TEM techniques". M. Beleggia, S. Tandon, Y. Zhu and M. De Graef. Conf. of the Microscopy Society of America, Savannah, GA, Aug. 1-5, 2004, invited talk.
- t4. "Characterization of artificially patterned arrays of magnetic elements by Transmission Electron Microscopy", M. Beleggia, Meeting of the National Institute for the Physics of Matter, Genova, Italy, June 8-10, 2004, invited talk.
- t5. "Transmission Electron Microscopy of Vortices in Superconducting Materials". M. Beleggia. Iowa State University, Physics Department, April 15<sup>th</sup>, 2005, invited seminar (host: Prof. J.R. Clem).
- t6. "The phase diagram for magnetic nano-rings". M. Beleggia, J.W. Lau, M.A. Schofield, Y. Zhu, S. Tandon and M. De Graef. The Min., Met. & Mat. Society Annual Meeting, San Francisco, CA, Feb. 13-17, 2005, invited talk.
- t7. "Electron Holography of magnetic nanostructures", M. Beleggia, J.W. Lau, M.A. Schofield and Y. Zhu. Microscopy Conference 2005, Davos, Switzerland, Aug 28-Sep 2, 2005, invited talk.
- t8. "Electron Holography: how to explore the nanoworld with coherent electrons". M. Beleggia. National Institute for Nanotechnology, Edmonton, Canada. July 29, 2006, invited seminar (host: Dr. M. Malac).
- t9. "Magnetic phenomena at the nanoscale revealed by Electron Holography". M. Beleggia. Hitachi Advanced Research Laboratory, Hatoyama, Saitama, Japan. August 31, 2006, invited talk (host: Dr. K. Harada).

- t10. "Observing nanoscale phenomena with coherent electrons". M. Beleggia. University of Göttingen, Germany. December 18, 2006, [invited seminar](#) (host: Prof. Dr. Schönhammer).
- t11. "Electron Holography: a technique to explore the nanoworld". M. Beleggia. University of Leeds, UK. May 9, 2007, [invited seminar](#) (host: Prof. R. Brydson).
- t12. "Advanced Electron Microscopy and Holography: coherent electrons as a quantitative link to the physics of nanomaterials". M. Beleggia. U. of Antwerp, Belgium. Aug 28, 2007, [invited seminar](#) (host: Prof. G. Van Tendeloo).
- t13. "Electron phase retrieval with application to nanomaterials". M. Beleggia. University of Oxford, UK. Jan 21, 2008, [invited seminar](#) (host: Dr. A. Kohn).
- t14. "Phase contrast/retrieval as a quantitative link to the physics of nanomaterials". M. Beleggia. U. of Cambridge, UK. Feb 19, 2008, [invited seminar](#) (host: Dr. J. Barnard).
- t15. "Modelling the electron-optical phase shift: a quantitative link to the physics of nanomaterials". Denmark Technical University, Copenhagen, Denmark. Apr 14, 2008, [invited seminar](#) (host: Dr. R.E. Dunin-Borkowski).
- t16. "The electron phase and the physics of nanomaterials". INT-Karlsruhe, Germany, Apr 24, 2008, [invited seminar](#) (host: Prof. Dr. H. Hahn).
- t17. "Imaging shape effects in nanomagnetism with electrons". Risø DTU, Denmark, May 25, 2010, [invited seminar](#) (host: Dr. N. Pryds).
- t18. "Electron holography of magnetic nanostructures". U. Hamburg, Germany, Nov 2, 2010, [invited physics colloquium](#) (host: Prof. Dr. R. Wiesendanger).
- t19. "Electron holography: an extra set of eyes to probe the physics of nanomaterials". Humboldt University, Berlin, Germany, June 20, 2011, [invited seminar](#) (host: Prof. Dr. S. Fischer).
- t20. "Quantitative electron imaging of nanoscale potentials". Humboldt University, Berlin, Germany, June 8, 2012, [invited seminar](#) (host: Prof. Dr. J.P. Rabe).
- t21. "Practical hole-free phase plate imaging: advantages and pitfalls". M. Malac, M. Bergen, M. Kawasaki, M. Beleggia, R. Egerton, M. Shimizu, H. Furukawa. M&M meeting 2012, Phoenix AZ, USA, Aug 2, 2012, [invited talk](#).
- t22. "Electron holography of magnetic materials: state-of-the-art and future perspectives". M. Beleggia. MC 2013 conference, Regensburg, Germany, Aug 28, 2013, [invited talk](#).
- t23. "Quantitative mapping of nanoscale charge distributions in electronic nanostructures with advanced electron microscopy". M. Beleggia, Helmholtz Zentrum Berlin, Germany, Nov 28, 2013, [invited seminar](#) (host: Dr. S. Christensen).
- t24. "Dipolar ordering in self-assembled nanoparticle magnets revealed by electron holography". M. Beleggia, M. Varon, T. Kasama, V. Puentes, R.E. Dunin-Borkowski, R.J. Harrison, C. Frandsen. MRS Fall meeting 2013, Boston, USA, Dec 2, 2013, [invited talk](#).
- t25. "Quantitative mapping of nanoscale charge distributions in electronic nanostructures with advanced electron microscopy". M. Beleggia, HZB, Berlin, Germany, Nov 28, 2013, [invited seminar](#) (host: Prof. Dr. S. Christensen).
- t26. "Measuring nanoscale charge and spin distributions with electron holography: the quantitative link between structure and functionality". M. Beleggia, LMU, Munich, Germany, Dec 9, 2013, [invited seminar](#) (host: Prof. Dr. T. Bein)
- t27. "Interpretation of holographic phase shifts from polar interfaces, ferroelectric nanostructures and charged materials". M. Beleggia, Microscopy Conference, Goettingen, Sep 2015, [invited talk](#).
- t28. "Modelling holographic signals from ferroelectric nanostructures and polar interfaces". M. Beleggia, FEMMS conference, Lake Tahoe, Sep 2015, [invited talk](#).
- t29. "Measuring nanoscale charge and spin distributions with electron holography: the quantitative link between structure and functionality". M. Beleggia, University of Wuerzburg, Germany, Jan 13, 2016, [invited seminar](#) (host: Prof. Dr. M. Bode)
- t30. "Dember potentials on e-beam irradiated thin-films". M. Beleggia, AMTC5 conference, Nagoya, Japan, May 11-13, 2016, [invited talk](#).
- t31. "Phase plates: new designs and concepts". M. Beleggia, WE-Heraeus workshop, Bonn, Germany, Jun 19-23, 2016, [invited talk](#).

- t32. "Remote manipulation of intracellular magnetic nanoparticles for biomedical applications". M. Beleggia, IMFUFA seminar, Roskilde University, Denmark, Nov 23, 2016, [invited physics colloquium](#) (host: Dr. N. Bailey).
- t33. "Model independent measurement of multipole fields". M. Beleggia, Electron Holography Workshop, Feb 13-15, 2017, Saitama, Japan, [invited talk](#).
- t34. "Electron holography measurements of magnetic multipole and toroidal moments". Electronic phenomena studied in the nordic countries, Jul 3-5, 2017, Lund, Sweden, [invited talk](#).
- t35. "Magnetism of nanoparticle superstructures revealed by electron holography". NIST, USA, Dec 10, 2018, [invited seminar](#) (host: Dr. J. Lau).
- t36. "Beam induced polymerization of frozen organic molecules: a novel approach to nanofabrication". Microscopy Society of Canada 2019, Vancouver, May 22, 2019, [invited talk](#).
- t37. "Magnetism of nanoparticle superstructures revealed by electron holography". University of British Columbia, Vancouver, Canada, May 27, 2019, [invited seminar](#) (host: Dr. A. Maigne).
- t38. "Electron beam effects on organic ices". Brookhaven National Laboratory, USA, July 20, 2019, [invited seminar](#) (host: Prof. Y. Zhu).
- t39. "The role of theory and modelling in the development of electron microscopy". Center for Functional Nanomaterials, Brookhaven National Lab, Aug 26, 2021, [invited seminar](#) (host: Dr. Charles Black).
- t40. "Phase anti-matching and other semi-crazy ideas". QSORT meeting, September 1, 2021, [invited talk](#).

### CONFERENCE PROCEEDINGS

- c1. "Experiments on Foucault images of superconducting fluxons". T. Yoshida, J. Endo, K. Harada, H. Kasai, T. Matsuda, M. Beleggia, G. Pozzi, A. Tonomura. *Microsc. Microanal.* **3**, Suppl. 2, 507-508 (1997).
- c2. "Theoretical Foucault images of superconducting fluxons". M. Beleggia, G. Pozzi, K. Harada, H. Kasai, T. Matsuda, T. Yoshida, A. Tonomura. *Microsc. Microanal.* **3**, Suppl. 2, 509-511 (1997).
- c3. "One-dimensional theoretical Foucault images of superconducting fluxons". M. Beleggia, G. Pozzi, J. E. Bonevich, K. Harada, H. Kasai, T. Matsuda, T. Yoshida, A. Tonomura, Proc. 11th Eur. Congr. on El. Micr., Electron Microscopy **96(2)**, Comm. of Eur. Soc. of Micr. Publ. - Brussels, 105-106 (1998).
- c4. "Theoretical coherent Foucault images of fluxon lattice", M. Beleggia, G. Pozzi, K. Harada, H. Kasai, T. Matsuda, T. Yoshida. A. Tonomura. *Electron Microscopy 1998*, vol 2, Mat. Science 1, 531-532 (1998).
- c5. "Interpretation of holographic and Lorentz images of an array of reverse biased p-n junctions in a semi-infinite specimen". M. Beleggia, R. Capelli, and G. Pozzi. *Microsc. Microanal.* **5**, Suppl. 2, 954-955 (1999).
- c6. "A Fourier space approach for calculating the electron optical phase shift of superconducting fluxons", M. Beleggia, G. Pozzi and A. Tonomura. *Eurem2000 proceedings* **3(I)**, 127-128 (2000).
- c7. "On the calculation of the phase shift of a superconducting flux line lattice", M. Beleggia, G. Pozzi and A. Tonomura. *Microsc. Microanal.* **6**, Suppl. 2, 1032-1033 (2000).
- c8. "TEM phase contrast images of reverse-biased p-n junctions: the effect of charged oxide layers", M. Beleggia, P.F. Fazzini, P.G. Merli and G. Pozzi. *5th MCEM meeting proceedings*, 307-308 (2001).
- c9. "Image interpretation of magnetic domains in Nd<sub>2</sub>Fe<sub>14</sub>B hard magnets", M. Beleggia, M.A. Schofield, V.V. Volkov and Y. Zhu. *Microsc. Microanal.* **8**, Suppl. 2, 512CD (2002).
- c10. "Vortex modeling in High- $T_c$  anisotropic materials", M. Beleggia, J. Masuko, N. Osakabe, G. Pozzi and A. Tonomura. *Microsc. Microanal.* **8**, Suppl. 2, 528CD (2002).
- c11. "Phase contrast images of superconducting pancake vortices", M. Beleggia, G. Pozzi and A. Tonomura. *Microsc. Microanal.* **8**, Suppl. 2, 530CD (2002).
- c12. "Modeling of magnetic stripe domains by Fourier methods: Phase shift and phase-contrast images", M. Beleggia, P.F. Fazzini and G. Pozzi. *ICEM2002 proceedings* 307-308 (2002).
- c13. "Electron Holography and Micromagnetic Simulations for TEM magnetization mapping", M. Beleggia, M. A. Schofield, Y. Zhu, M. Malac, Z. Liu and M. Freeman. *Microsc. Microanal.* **9**, Suppl. 2, 778CD (2003).
- c14. "Phase Retrieval and Induction Mapping Artificially Structured Nanometric Magnetic Arrays", Y. Zhu, V.V. Volkov, M. Schofield, M. Beleggia, J. Lau and M. Malac. *Microsc. Microanal.* **9**, Suppl. 2, 308CD (2003).

- c15. "Measurement of Charge at Grain-Boundary Edge Dislocations in Ca-doped and Undoped YBCO by Electron Holography", M.A. Schofield, M. Beleggia, Y. Zhu, K. Guth, Ch. Jooss. *Microsc. Microanal.* **9**, Suppl. 2, 784CD (2003).
- c16. "On the Electron-Optical Phase Shift for Magnetic Nanoparticles", M. Beleggia, S. Tandon, Y. Zhu and M. De Graef. *Microsc. Microanal.* **9**, Suppl. 2, 316CD (2003).
- c17. "Understanding spatial distribution of electrostatic and magnetic potentials in materials". Y. Zhu, L. Wu, J. Taftø, M.A. Schofield, V.V. Volkov, M. Beleggia and J.W. Lau. Proceedings of the Scandinavian Electron Microscopy Society Conference, June 10-13, 2003, Oslo, Norway, pp. 35-36. (2003).
- c18. "Electron Shadow edge microscopy of reverse-biased p-n junctions", P.F. Fazzini, M. Beleggia and G. Pozzi, Proceedings of the 13th European Microscopy Congress, Antwerp, Belgium, August 22-27, 2004, Eds D. Schryvers and J.P. Timmermans. Vol II, ed. G. van Tendeloo, pp. 385-386 (2004).
- c19. "Comparison between discrete and semicontinuous layered models of superconducting vortices in high- $T_c$  materials for TEM observations", M. Beleggia, G. Pozzi and A. Tonomura, *Microsc. Microanal.* **10**, Suppl. 2, 514CD (2004).
- c20. "Observation of Dipolar Ferromagnetism by TEM techniques". M. Beleggia, S. Tandon, Y. Zhu and M. De Graef. *Microsc. Microanal.* **10**, Suppl. 2, 510CD (2004)
- c21. "Detection Limits and Resolution for Quantitative Phase Retrieval through Transport-of-Intensity", M.A. Schofield, M. Beleggia, V.V. Volkov and Y. Zhu. *Microsc. Microanal.* **10**, Suppl. 2, 506CD (2004).
- c22. "Developing an atomic scale model for grain boundary potentials in perovskite oxides using Z-contrast imaging and EELS", R.F. Klie, M. Beleggia, Y. Zhu, J.P. Buban and N.D. Browning. *Microsc. Microanal.* **10**, Suppl. 2, 268CD (2004).
- c23. "Phase shift of Reverse Biased  $p$ - $n$  Junction Arrays by Fourier Methods". M. Beleggia, P.F. Fazzini, G. Pozzi. *Microsc. Microanal.* **11**, Suppl. 2, 2074CD (2005).
- c24. "Theory of Phase Reconstructed Vector Field Electron Tomography". M. De Graef, M. Beleggia. *Microsc. Microanal.* **11**, Suppl. 2, 316CD (2005).
- c25. " $C_s$  corrected bright field TEM imaging of radiation sensitive materials". M. Malac, M. Beleggia, R. Egerton, Y. Zhu. *Microsc. Microanal.* **11**, Suppl. 2, 2150CD (2005).
- c26. "Electron Holography and Imaging capabilities of the JEOL 2100F FEG-TEM". M. Schofield, M. Beleggia, Y. Zhu. *Microsc. Microanal.* **11**, Suppl. 2, 570CD (2005).
- c27. "Optimized  $C_s$ -corrected Imaging of Radiation-sensitive High-resolution Objects". M. Malac, M. Beleggia, R.F. Egerton, Y. Zhu. *Microsc. Microanal.* **12**, Suppl. 2, 1458CD (2006).
- c28. "Superparamagnetic behavior of  $\mu$ m-sized permalloy disks". M.A. Schofield, M. Beleggia, J.W. Lau, Y. Zhu. *Microsc. Microanal.* **12**, Suppl. 2, 958CD (2006).
- c29. "Reversal Behavior of Patterned Ferromagnetic Elements". Y. Zhu, J.W. Lau, M. Beleggia, M.A. Schofield, V.V. Volkov, M. Malac. *Microsc. Microanal.* **12**, Suppl. 2, 956CD (2006).
- c30. "Measurements of functional response of nano-objects using advanced electron microscopy". Y. Zhu, T. Beetz, L. Wu, R.F. Klie, L. Huang, J.W. Lau, M.A. Schofield, V.V. Volkov, M. Beleggia, M. Malac. *Microsc. Microanal.* **12**, Suppl. 2, 540CD (2006).
- c31. "Dynamical effects in the study of supported nanocrystals using electron holography". R.E. Dunin-Borkowski, C.B. Boothroyd, M. Beleggia. *Microsc. Microanal.* **16**, Suppl. 2, 572-573 (2010).
- c32. "Measurement of the charge distribution along an electrically biased carbon nanotube using electron holography". M. Beleggia, T. Kasama, R.E. Dunin-Borkowski, G. Pozzi. *Microsc. Microanal.* **16**, Suppl. 2, 562-563 (2010).
- c33. "Convenient contrast enhancement by hole-free phase plate in a TEM". M. Malac, M. Kawasaki, M. Beleggia, P. Li, R.F. Egerton. *Microsc. Microanal.* **16**, Suppl. 2, 526-527 (2010).
- c34. "Dynamical response of catalytic systems in a  $C_s$ -corrected environmental transmission electron microscope". T. Hansen, R.E. Dunin-Borkowski, C.B. Boothroyd, M. Beleggia, J.B. Wagner. *Microsc. Microanal.* **16**, Suppl. 2, 592-593 (2010).
- c35. "Practical hole-free phase plate imaging: principles, advantages and pitfalls. M. Malac, M. Bergen, M. Kawasaki, M. Beleggia, R. Egerton, M. Shimizu, H. Furukawa. *Microsc. Microanal.* **18**, Suppl. 2, 484-485 (2012).
- c36. "Electron holography of dipolar magnetism in self-assembled nanoparticle chains". M. Beleggia, M. Varon, T. Kasama, R.E. Dunin-Borkowski, V.F. Puentes, C. Frandsen, R.J. Harrison. *Microsc. Microanal.* **19**, Suppl. 2, 1374-1375 (2013).



- c37. "The application of off-axis electron holography to electrically biased single GaN nanowires for electrical resistivity measurements". S. Yazdi, T. Kasama, M. Beleggia, C. Chiechonski, O. Kryliouk, J.B. Wagner. *Microsc. Microanal.* **19**, Suppl. 2, 1502-1503 (2013).
- c38. "Magnetic imaging with a novel hole-free phase plate". S. Pollard, M. Malac, M. Beleggia, M. Kawasaki, Y. Zhu. *Microsc. Microanal.* **19**, Suppl. 3, 250-251 (2013).
- c39. "Charging of phase plates and thin samples under electron beam irradiation". M. Malac, M. Beleggia, R.F. Egerton M. Kawasaki, M. Bergen, Y. Okura, I. Ishikawa, K. Motoi. *Microsc. Microanal.* **20**, Suppl. 3, 230-231 (2014).
- c40. "Evaluation of doping in GaP core-shell nanowire on junction by off-axis electron holography". S. Yazdi, A. Berg, T. Kasama, M. Beleggia, T.M. Borgstrom, J.B. Wagner. *Microsc. Microanal.* **20**, Suppl. 3, 288-289 (2014).

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### CONTRIBUTED TALKS – POSTERS – MISCELLANEOUS

- p1. "Theoretical coherent Foucault images of superconducting fluxons". M. Beleggia, G. Pozzi, K. Harada, H. Kasai, T. Matsuda, T. Yoshida. A. Tonomura. *SIME'97* (1998).
- p2. "Interpretation of holographic and Lorentz images of an array of reverse biased p-n junctions in a semi-infinite specimen". M. Beleggia, R. Capelli, D. Cristofori, P.G. Merli, G. Pozzi. *INFMeeting'98* (1998).
- p3. "Foucault imaging of superconducting fluxons". M. Beleggia, G. Pozzi, K. Harada, H. Kasai, T. Matsuda, T. Yoshida, A. Tonomura. *INFMeeting'98* (1998).
- p4. "Transmission electron microscopy phase contrast images of pancake superconducting vortices", M. Beleggia, G. Pozzi and A. Tonomura. *SCANDEM2001* (2001).
- p5. "Transmission electron microscopy phase contrast images of pancake superconducting vortices", M. Beleggia and G. Pozzi. *INFMeeting'01* (2001).
- p6. "Magnetic induction mapping of artificially structured magnetic arrays using advanced TEM techniques", V.V. Volkov, M.A. Schofield, M. Beleggia, M. Malac and Y. Zhu. *MRS02 Fall Meeting* (2002).
- p7. "Direct measurements of charge distribution at grain boundaries: mechanisms for current improvement in high- $T_c$  superconductors", Ch. Jooss, K. Guth, M.A. Schofield, M. Beleggia and Y. Zhu. *M2HTCS conference* (2003).
- p8. "Phase Contrast Images of Superconducting Vortices", G. Pozzi and M. Beleggia. *INFMeeting'03* (2003).
- p9. "Developing an atomic scale model of the grain boundary potential in Perovskite oxides by atomic resolution STEM and EELS", *American Ceramic Society meeting* (2003).
- p10. "Magnetic interactions between nanoparticles of arbitrary shape: a Fourier space approach", S. Tandon, M. Beleggia, Y. Zhu and M. De Graef. *TMS Meeting* (2004).
- p11. "Electron optical phase shift computations of magnetic nanoparticles". S. Tandon, M. Beleggia, Y. Zhu and M. De Graef. *MMM-Intermag meeting* (2004).
- p12. "Accurate measurement of charge distributions in superconductors using quantitative electron diffraction and holography". Y. Zhu, M.A. Schofield, L. Wu, J. Taftø, M. Beleggia and Ch. Jooss. *ECM meeting* (2004).
- p13. "The Equivalent Ellipsoid for Uniformly Magnetized Bodies". M. Beleggia, M. De Graef, and Y. Millev. *MRS Fall meeting* (2005).
- p14. "Energy barrier to vortex nucleation". J.W. Lau, J.K. Bording, M. Beleggia, and Y. Zhu. *MRS Fall Meeting* (2005).
- p15. "Demagnetization Factors for the Fluxgate Ring-Core". M. De Graef and M. Beleggia. *MMM meeting* (2005).
- p16. "Lorentz transmission electron microscopy determination of energy barrier to magnetic vortex nucleation" J.W. Lau, J.K. Bording, M. Beleggia, G.F. Newmark, and Y. Zhu. *MMM meeting* (2005).
- p17. "Retrieving of the complex degree of spatial coherence of electron beams". J. Carrasquilla-Alvarez, R. Castaneda, J. Garcia-Sucerquia, M.A. Schofield, M. Beleggia, G. Matteucci. International Centre for Theoretical Physics (ICTP) Preprint IC/2005/010 (2005). Available at [http://www.ictp.it/~pub\\_off](http://www.ictp.it/~pub_off).

- p18. "Quantitative domain wall width measurement with coherent shadow microscopy". M. Beleggia, M.A. Schofield, Y. Zhu, G. Pozzi. *ICM conference* (2006).
- p19. "Coherent Shadow Technique for the Investigation of Magnetic Domain Wall Widths". M. Beleggia, M.A. Schofield, Y. Zhu, G. Pozzi. *IMC-16 congress* (2006).
- p20. "Bright Field (BF) Zernike Phase Imaging of Individual Atoms at Low Dose in a  $C_S$ -corrected TEM. M. Malac, M. Beleggia, R.F. Egerton, Y. Zhu. *IMC-16 congress* (2006).
- p21. "Reversal Behavior of Patterned Ferromagnetic Elements". Y. Zhu, J.W. Lau, M. Beleggia, M.A. Schofield, V.V. Volkov, M. Malac. *IMC-16 congress* (2006).
- p22. "Towards Three-Dimensional Field Models for Reverse Biased P-N Junctions". F. Ubaldi, P.F. Fazzini, M. Beleggia, G. Pozzi. *IMC-16 congress* (2006).
- p23. "Electron holography and atomic resolution spectroscopy of correlated electron systems". M.A. Schofield, R.F. Klie, M. Beleggia, Y. Zhu. *MMM/Intermag joint conference* (2007).
- p24. "Nonlinear dynamics of the vortex core in magnetic dots". M. Beleggia, L. Huang, M.A. Schofield, Y. Zhu. *MMM/Intermag joint conference* (2007).
- p25. "Understanding local response by manipulation of ferromagnetic nano-elements in TEM". L. Huang, T. Beetz, M.A. Schofield, M. Beleggia, Y. Zhu. *MMM/Intermag joint conference* (2007).
- p26. "Three-Dimensional Field Models for Reverse Biased P-N Junctions". F. Ubaldi, G. Pozzi, P.F. Fazzini, M. Beleggia. *MSM XV conference* (2007).
- p27. "Local measurement of stray fields by electron holography. M. Beleggia, *EMAG 2007 conference* (2007).
- p28. "Electron and spin correlations in colossal magnetoresistive materials". Y. Zhu, J. He, T. Asaka, B.C. Budhani, Ch. Jooss, L. Wu, M.A. Schofield, M. Beleggia. *M&ST'07 conference* (2007).
- p29. "Magnetic Imaging and Reversal Mechanism of Patterned Ferromagnetic Elements". Y. Zhu, L. Huang, J. Lau, M.A. Schofield, M. Beleggia. *M&ST'07 conference* (2007).
- p30. "Electron dose computations for nanodiffraction imaging". M. Beleggia, M. Malac, R. Egerton, Y. Zhu. *34<sup>th</sup> General Annual Meeting of the Microscopical Society of Canada* (2007).
- p31. "Magnetic Imaging and Reversal Mechanism of Patterned Ferromagnetic Elements". Y. Zhu, L. Huang, J. Lau, M.A. Schofield, M. Beleggia. *MRS Fall meeting* (2007).
- p32. "Switching behavior of permalloy continuous film, discrete disks, and disk/film coupled structures". L. Huang, J. Lau, M.A. Schofield, M. Beleggia, Y. Zhu. *MRS Fall meeting* (2007).
- p33. "The two-spin model with dipolar interactions for the exchange coupled composite media". D. Vokoun, M. Beleggia, C.H. Lai, T. Rahman, H.C. Hou. *MMM meeting* (2007).
- p34. "Modelling kink vortices in high- $T_c$  superconductors". M. Beleggia, G. Pozzi, A. Tonomura. *European Microscopy Conference 2008*.
- p35. "The image intensity in Zernike mode with electrons". M. Beleggia. *European Microscopy Conference 2008*.
- p36. "Simulations of electron holographic observations of magnetic microstructure in exsolved titanomagnetites". M. Beleggia, T. Kasama, R. Harrison, J. Feinberg, R. Dunin-Borkowski. *AGU fall meeting 2008*.
- p37. "Occurrence and restoration of the vortex state in nanorings for magnetic phase plate development". M.K. Hari, M. Beleggia, R.M.D. Brydson. *EMAG 2009*.
- p38. "Kinked superconducting vortices in the transmission electron microscope". M. Beleggia, G. Pozzi. *Aharonov-Bohm and Berry Phase 50/25 Anniversary meeting, Bristol, UK, 2009*.
- p39. "Aharonov-Bohm phase shift analysis: transmission electron microscopy of multiply connected magnetized particles". M. Beleggia, Y. Millev, M. De Graef. *Aharonov-Bohm and Berry Phase 50/25 Anniversary meeting, Bristol, UK, 2009*.
- p40. "Measuring the magnetic moments of Co nanoparticles rings from their Aharonov-Bohm phase shift". M. Beleggia, T. Kasama, R.E. Dunin-Borkowski, J. Liu, A. Wei. *Aharonov-Bohm and Berry Phase 50/25 Anniversary meeting, Bristol, UK, 2009*.
- p41. "Quantitative magnetization states of colloidal systems via simplified-LLG and model-based fitting of phase images". M. Beleggia, A. Alpers, T. Kasama, H.F. Poulsen, C. Frandsen, M. Varon Izquierdo, V. Puentes, R.E. Dunin-Borkowski. *AMTC2 conference, Nagoya, Japan, 2010*.
- p42. "Coherent Foucault imaging in light of recent electron phase plate developments". M. Beleggia. *IMC17, Rio de Janeiro, Brazil, 2010*.

- p43. "Origin of bright-field TEM contrast enhancement by a hole-free phase plate". M. Malac, M. Beleggia, M. Kawasaki, R.F. Egerton, P. Li. IMC17, Rio de Janeiro, Brazil, 2010.
- p44. "The quantitative measurement of magnetic moments from phase images of nanoparticles and nanostructures". M. Beleggia, T. Kasama, R.E. Dunin-Borkowski. IMC17, Rio de Janeiro, Brazil, 2010.
- p45. "The changing shape of dykes during propagation explains the pattern of induced seismicity". E. Rivalta, M. Beleggia, T. Dahm. EGU 2011, Wien, Austria, 2011.
- p46. "Radiation damage of Au particles on amorphous Ge substrates". M. Malac, R.F. Egerton, J. Wang, S. Moreno, M. Beleggia. XXII IUCr meeting, Madrid, Spain, 2011.
- p47. "Imaging with a hole-free phase plate". M. Beleggia, M. Malac, R. Egerton, M. Kawasaki. EMC 2012, Manchester, UK.
- p48. "Towards the quantitative analysis of the electron holographic phase images of electrically biased metal tips". M. Beleggia, T. Kasama, G. Pozzi, R.E. Dunin-Borkowski. EMC 2012, Manchester, UK.
- p49. "Electron holography of dipolar magnetism in fine particle assemblies" M. Beleggia, T. Kasama, C. Frandsen, R.E. Dunin-Borkowski, M. Varon, V. Puntès, R. Harrison. ICFPM 2013, Perpignan, France.
- p50. "Dipolar magnetism in self-assembled nanoparticle materials revealed by electron holography" M. Beleggia, T. Kasama, C. Frandsen, R.E. Dunin-Borkowski, M. Varon, V. Puntès, R. Harrison. SCANDEM 2013, Copenhagen, Denmark."
- p51. "Phase shift of single-domain ferroelectric nanoparticles". B.S. Baekke, M. Beleggia. MC2013 conference proceedings, Regensburg, Germany.
- p52. "The influence of the electron beam on potentiometry of GaN". J.B. Park, T. Niermann, M. Beleggia, M. Lehmann. MC2013 conference proceedings, Regensburg, Germany.
- p53. "Environmental TEM study of manganite perovskite electro-catalysts for Oxygen evolution". C. Jooss, S. Raabe, D. Mierwaldt, J. Ciston, S. Yazdi, T. Kasama, M. Beleggia, J. Wagner, T.W. Hansen, Y. Zhu. MC2013 conference proceedings, Regensburg, Germany.

*Note: not tracked post 2013*

## References

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