Part A. Personal Information

DATE	14/09/2016

Surname(s)	Varela del Arco	
Forename	Maria	
Social Security, Passport, ID number	52985864M (Spain)	
Sex	Female	
Age	42	
Researcher numbers	Researcher ID	E-2472-2014
	Open Researcher and Contributor ID (ORCID)	0000-0002-6582-7004

A.1. Current position

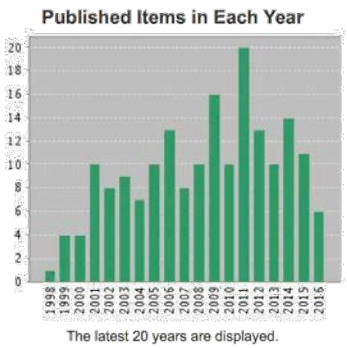
Post/ Professional Category	Associate Professor (Profesora Titular de Universidad)	
UNESCO Code	2211, 2202	
Key Words	Complex oxides; magnetism; electron microscopy & spectroscopy; thin films; superconductivity	
Name of the University/Institution	Universidad Complutense de Madrid	
	Department/Center	Física de Materiales / Facultad de CC. Físicas
	Full Address	Avenida Complutense s/n. Madrid 28040, Spain.
	Email Address	mvarela@ucm.es
	Phone Number	+34 91 394 4435
Start date	December 2010	

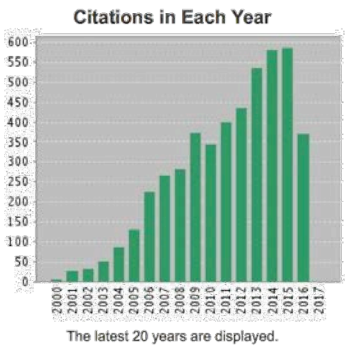
A.2. Education *(title, institution, date)*

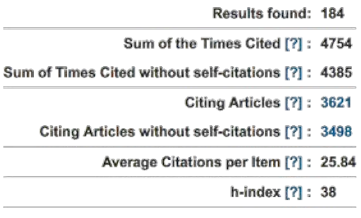
1997	Univ. Complutense, Madrid	*B. Sc. (Licenciatura)*	*Physics*
2001	Univ. Complutense, Madrid	*Ph. D. (Doctorado)*	*Physics*

A.3. Indicators of Quality in Scientific Production *(Source: Web of Science & SCOPUS)*

Total number of registered publications (Source: Web of Science):	184
Total number of conference communications (as presenting author):	398 (110)
Total number of invited talks / seminars:	78/ 41
Total number of citations (Web of Science):	4754
Individual impact factor (# citations / # papers, Web of Science):	25.84
H-factor (Web of Science):	38
H-factor / # years since PhD:	2.5







Source: Web of Science

Total number of papers in **first quartile (1Q) 2012-2015: >85%** (Source: SCOPUS)
Total number of papers in **first decile (1D) 2012-2015: >40%** (Source: SCOPUS)
Normalized impact factor 2012-2015: 3.59 (Source: SCOPUS)

Part B. Free Summary of CV

a) Research and professional appointments:

1) Universidad Carlos III de Madrid (UC3M, 1998-2002), (Leganés, Spain) Teaching assistant (*Ayudante de Escuela Universitaria*) in the Physics Dept. PhD Thesis dedicated to the growth and characterization of thin films and superlattices base don High Tc superconductors. Supervised by Profs. Carmen Ballesteros & Jacobo Santamaría. Graduated with honors (*premio extraordinario de doctorado*), July 2001.

2) Oak Ridge National Laboratory (ORNL 2002/14), (Oak Ridge, TN, U.S.A.), *Wigner Fellow* between 2002-2004, and Research Staff Member afterwards (Distinguished RSM 2014) in the STEM group in the Materials Science & Tech. Division. Specialist in advanced electron microscopy techniques including spherical aberration correction. Also, Adjunct Assistant Professor. Dept. of Physics & Astronomy, Univ. of Tennessee, 2006/08.

3) Universidad Complutense de Madrid (ever since 2009), Visiting Professor 2009-2010; Associate Professor (Profesora Titular de Universidad) since 2011. Responsible of a research group at the Physics School & Instituto Pluridiscipinar funded by the European Research Council **Starting Grant "STEMOX" & Proof-of-Concept "MAGTOOLS"**. The team (total of ten people over time, five currently) is dedicated to the research of cutting-edge materials (especially magnetic materials) by means of advanced electron microscopy & spectroscopy techniques.

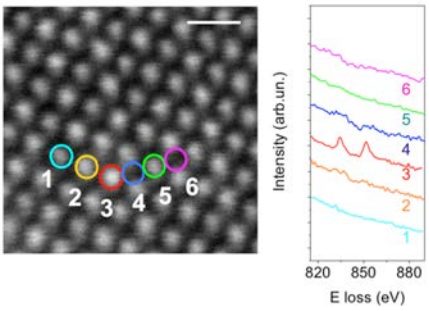


Figure 1: Detection of a single La atom within a $CaTiO_3$ matrix via atomic resolution EELS. Scale bar: 0.5 nm [10].

b) Some scientific highlights:

1. First ever direct detection of single atoms within a bulk material (2004). Singe atoms were detected within a bulk solid (La into a $CaTiO_3$ matrix) in real space. Measurements were acquired in a scanning transmission electron microscope (STEM) equipped with a spherical aberration corrector and an electron energy-loss spectrometer (EELS). The La $M_{4,5}$ absorption edge was measured with atomic resolution in real space (fig. 1) [10].

2. Studies of the interplay between superconductivity and magnetism in complex oxide superlattices (2003-2014). When antagonistic order parameters such as high Tc superconductivity and magnetism meet face-to-face, unexpected phenomena occur. By means of atomic resolution STEM-EELS, we studied $YBa_2Cu_3O_{7-x}$ / $La_{0.7}Ca_{0.3}MnO_3$ interfaces and found an unusual orbital reconstruction that gives rise to significant charge transfer across the interface. The ensuing electronic localization depresses both superconducting and magnetic properties at the interface [2].

3. Colossal ionic conductivity (2008-2010). Yttria-stabilized zirconia (YSZ) is a well-known ionic conductor for solid state fuel cells. When ultrathin YSZ layers are sandwiched epitaxially in between other materials, a colossal enhancement of the ionic conductivity can be measured near room temperature. YSZ modifies its structure in order to accommodate the lattice mismatch, giving rise to an O vacancy liquid state where carriers exhibit a large mobility [7, 8].

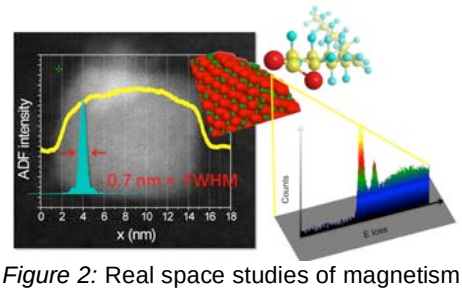


Figure 2: Real space studies of magnetism of magnetite nanoparticles using electron probes [5].

4. Exploring magnetism with sub-nm spatial resolution in real space. By STEM-EELS we achieved the first-ever atomic resolution mapping of the spin state of magnetic atoms. When O vacancies are present in thin cobaltite films, epitaxial strain can stabilize Co spin state superlattices not present in bulk [5,6]. Also, we demonstrated the first ever sub-nm mapping of magnetic properties based on electron chiral magnetic dichroism (EMCD). In magnetite nanoparticles, capping molecules can stabilize bulk-like surface magnetization at room temperature [9].

c) Mid-to-long term scientific-technical interests and objectives of research agenda:

- To push the frontiers of electron microscopy techniques, especially those regarding **imaging of magnetic properties** with high spatial resolution (using tools as EEL spectroscopic techniques including EMCD atomic resolution mapping).

- To apply these techniques to explore the properties of cutting-edge magnetic materials (particularly strongly correlated oxides such as those exhibiting colossal magnetoresistance).

- To study the structure, chemistry and electronic properties of low dimensional systems such as interfaces, nanoparticles, defects in 3D systems or also bidimensional materials. Special emphasis will be made on measuring physical properties in the relevant temperature ranges (e.g., low temperature) so systems can be observed in working conditions. Measurement of transport properties in the electron microscope will be explored as well.

Part C. Accomplishments

C.1. Publications, selection >200 (also references for section B)

[1] *"Insight into spin transport in oxide heterostructures from interface-resolved magnetic mapping"* F. Y. Bruno, M. N. Grisolia, C. Visani, S. Valencia, **M. Varela,** R. Abrudan, J. Tornos, A. Rivera-Calzada, A. A. Unal, S. J. Pennycook, Z. Sefrioui, C. Leon, J. E. Villegas, J. Santamaria, A. Barthelemy, M. Bibes. Nature Communications 6:6147 DOI: 10.1038/ncomms7306 (2015). Author 5/16.

[2] *"Competition between covalent bonding and charge transfer at complex-oxide interfaces".* J. Salafranca, J. Rincon, J. Tornos, C. Leon, J. Santamaria, E. Dagotto, S. J. Pennycook, **M. Varela.** Physical Review Letters **112,** 196802 (2014). Author 8/8.

[3] *"Insulating ferromagnetic $LaCoO_{3-\delta}$ films: a phase induced by ordering of oxygen vacancies",* N. Biskup, J. Salafranca, V. Mehta, M. P. Oxley, Y. Suzuki, S. J. Pennycook, S.T. Pantelides, **M. Varela.** Physical Review Letters **112,** 087202 (2014). Author 8/8.

[4] *"Nanoscale strain-induced pair suppression as a vortex pinning mechanisms in high-temperature superconductors".* A. Llordes, A. Palau, J. Gazquez, M. Coll, R. Vlad, A. Pomar, J. Arbiol, R. Guzman, S. Ye, V. Rouco, F. Sandiumenge, S. Ricart, T. Puig, **M. Varela,** D. Chateigner, J. Vanacken, J. Gutierrez, V. Moschalkov, G. Deutscher. C. Magen, X. Obradors. Nature Materials, **11,** 329-336 (2012). Author 14/21.

[5] *"Surfactant organic molecules restore magnetism in metal-oxide nanoparticle surfaces".* J. Salafranca, J. Gazquez, N. Perez, A. Labarta, S. T. Pantelides, S. J. Pennycook, X. Batlle, **M. Varela.** Nanoletters **12**, 2499-2503 (2012). Author 8/8.

[6] *"Atomic resolution imaging of nanometer sized spin-state superlattices in cobaltite films".* J. Gazquez, W. Luo, M. P. Oxley, M. Prange, M. A. Torija, M. Sharma, C. Leighton, S. T. Pantelides, S. J. Pennycook**, M. Varela.** Nanoletters, **11**, 973-976 (2011). Author 10/10.

[7] *"Origin of colossal ionic conductivity in oxide multilayers: interface induced sublattice disorder"*, T. J. Penycook, M. J. Beck, **M. Varela,** S. J. Pennycook, S. T. Pantelides. Physical Review Letters, **104** 115901 (2010). Author 3/5.

[8] *"Colossal ionic conductivity at interfaces of epitaxial YSZ/$SrTiO_3$ heterostructures".* J. García-Barriocanal, A. Rivera-Calzada, **M. Varela,** Z. Sefrioui, E. Iborra, C. Leon, S. J. Pennycook, J. Santamaría. Science, **321**, 676-680 (2008). Author 3/8.

[9] "*Direct measurement the low temperature spin-state transition in $LaCoO_3$,"* R.F. Klie, J.C. Zheng, Y. Zhu, **M. Varela,** J. Wu, and C. Leighton. Physical Review Letters, **99,** 047203 (2007). Author 4/6.

[10] *"Spectroscopic identification of single atoms within a bulk solid".* **M. Varela,** A. Lupini, H.M. Christen, A.Y. Borisevich, N. Dellby, O.L. Krivanek, P.D. Nellist, S.J. Pennycook. Physical Review Letters **92** 95502 (2004). Author 1/8.

C.2. Research Projects and Grants, selection

European Research Council Proof-of-Concept Grant: "MAGTOOLS: Software tools for fast, reliable analysis of magnetic materials in the electron microscope". Principal Investigator: María Varela. Amount: €150K. Dates: 6/2016 – 12/2017. This

program is aimed at developing software tools for the study of magnetic materials in the electron microscope.

Ministerio de Economía y Competitividad, MINECO MAT2015-66888-C3-3-R "Magnetismo en la Nanoescala: Explorando nuevas rutas (crecimiento y caracterización)". Principal Investigator: Maria Varela. €145K for 01/2016-12/2018.

European Research Council Starting Grant: "STEMOX: Under the light of electrons". Principal Investigator: María Varela. Amount: €1.7M. Dates: 11/2009 – 10/2015. This program was aimed at developing and applying new microscopy tools to the study of complex oxides, mainly magnetic materials.

US Department of Energy, Field Work Proposal "Electron Microscopy of Materials". Principal Investigator: Stephen J. Pennycook. Team members: 4. Amount: $2.5M/year approx., since 2004 until 2014. This program, developed at Oak Ridge National Laboratory was dedicated to explore the frontiers of electron microscopy techniques and to apply these techniques to cutting edge materials.

C.5. Other/ Professional Service

Supervision of students/postdocs:

PhD Theses supervised: 2; Master Theses supervised: 2
Postdoctoral researchers supervised: 9

Invited talks (total >70); American Physical Society March Meeting (2004, 2006); Materials Research Society Fall / Spring Meeting (2004, 2006, 2008); Microscopy & Microanalysis (2002, 2003, 2005-2009, 2011; 2014); Magnetism and Magnetic Materials (2010, 2013) and others.

Reviewer for (selected): Applied Physics Letters; Physical Review B; Physical Review Letters; Ultramicroscopy; United States Dept. of Energy, Office of Basic Energy Sciences; National Science Foundation; Army Research Office.

Societies: American Physical Society (APS), Materials Research Society, Real Sociedad Española de Física (RSEF), Microscopy Society of America, Sociedad Española de Microscopía, Electroceramic Society, European Microscopy Society.

Professional Service (selected):

- American Physical Society Topical Group on Magnetism and its Applications (GMAG). Member of the Executive Committee: Secretary Treasurer (2008-2011);
- Member of the IEEE Magnetics Technical Committee (2008-2011).
- Member of the Editorial Boards for: Applied Physics Letters and the Journal of Applied Physics (01/2010 – 12/2012); Micron (01/2016- 01/2018).
- 2013, 2014,2016 Magnetism and Magnetic Materials. Treasurer. Steering Committee.
- Microscopy Society of America, focus interest group on "Materials Research in an aberration free environment". Secretary /Treasurer.
- Conference organizer: American Physical Society, Microscopy Society of America, Magnetism and Magnetic Materials, Microscopy & Microanalysis and other meetings (>15).

Awards (selected):
- 2014: Burton Medal (Microscopy Society of America)
- 2009: European Research Council Starting Investigator Award
- 2002: Wigner Fellowship, Oak Ridge National Laboratory
- 2001 Award for Novel Researchers in Experimental Physics. Royal Spanish Physical Society.

C.6. Long term collaborators, selected: Steve Pennycook (Natl. Univ. of Singapore), Les Allen (Univ. of Melbourne, Australia), Xavier Batlle (Univ. de Barcelona), Christian Bernhard (Univ. Fribourg), Hans Christen, Matt Chisholm (Oak Ridge National Lab.), Manuel Bibes, Javier Villegas (CNRS Thales, France), Elbio Dagotto (ORNL/ Univ. of Tennessee), Allen Goldman (Univ. of Minnesota), Chris Leighton (Univ. of Minnesota), John Mitchell (Argonne Natl. Lab.), Terayasu Mizoguchi (Univ. of Tokyo), Sokrates Pantelides (Vanderbilt Univ.), Doug Perovic (U. of Toronto), Jacobo Santamaria, Jose M. González-Calbet (Univ. Complutense); Yuri Suzuki (Stanford Univ.), Masasi Watanabe (Lehigh Univ.).