

Francesco Volpe

Associate Professor of Applied Physics

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Education

- Ph.D.** **Experimental Physics, *Summa cum Laude*** **2003**
Ernst Moritz Arndt Universität Greifswald (Germany)
Thesis at the Max-Planck Institut für Plasmaphysik (IPP), Garching (Germany):
Electron Bernstein emission diagnostic of electron temperature profile at W7-AS Stellarator. Advisors: H.P.Laqua and F.Wagner.
- Laurea (B.Sc.)** **Physics, 110 points out of 110, *cum Laude*** **1998**
University of Pisa (Italy)
Thesis at ENEA Frascati:
Collective Scattering of millimeter waves for ion temperature measurements in the FTU tokamak. Advisors: F.P.Orsitto and F.Pegoraro.
Electives: Plasma Physics, Statistical Mech., Quantum Field Theory, Experim. Particle Physics

Research

Areas of Expertise and Main Accomplishments

- **Magnetohydrodynamic Stability and Stabilization of Plasmas** - Used magnetic perturbations and/or Electron Cyclotron Current Drive (ECCD) for first:
 - Stabilization of a locked mode that would have otherwise caused a disruption [*Phys. Rev. Lett.* 2015]
 - Non-destructive measurement of error-fields from their interaction with rotating modes, at high β [*Nucl. Fusion* 2013 and 2014]
 - Stabilization of Neoclassical Tearing Mode (NTM) by ECCD pulsed and aimed in feedback with oblique Electron Cyclotron Emission (ECE) [*Phys. Plasmas* 2009]

- **Microwave Heating, Current Drive and Diagnostics of Plasmas** - First extension to overdense fusion plasmas, by means of Electron Bernstein Waves (EBWs), of the following techniques formerly restricted to low-density plasmas:
 - Temperature profile diagnostic by ECE [*Rev. Sci. Instrum.* 2003]
 - Generation and detection of heat waves, for heat transport studies [*Rev. Sci. Instrum.* 2003]
 - Ray tracing modeling, including mode conversions and 3D stellarator geometry [*Rev. Sci. Instrum.* 2003]
 - Electron Cyclotron Current Drive (with H.P. Laqua) [*Phys. Rev. Lett.* 2003]
 Also: first diagnostic (spinning mirror) for rapid angular scans of EBW emission, to measure the profile of safety factor, q [*Rev. Sci. Instrum.* 2010]
- **Stellarator Simplification**
 - First generation of rotational transform by tilted toroidal-field planar coils
 - First coil-misalignment inference from comparison of experimental and numerical flux-surfaces [*Plasma Phys. Contr. Fusion* 2016]
- **Electromagnetic Metamaterials**
 - First metamaterial lens of reverse chromatic aberration by design [*Optics Express* 2012]
- **Liquid Metal Walls**
 - First active electromagnetic stabilization of free-surface flows [*Magnetohydrodyn.* 2017]

Academic Appointments

- 2015 -date** **Associate Professor**
- 2012 -15** **Assistant Professor** Dept Appl. Physics & Appl. Math., **Columbia Univ.**, NY, U.S.A.
- Physics and control of locked modes, NTMs and their relation to disruptions (collab. with GA San Diego and several groups worldwide, under ITPA-WG11)
 - Error Field detection from mode interaction (collab. with KTH Stockholm and GA San Diego).
 - Stellarators: CIRCUS (new, to study coil-simplification), CNT (modified from earlier non-neutral experiment, to study high β stability, overdense heating, error fields and new diagnostics), TARALLO (conceptual, ion source for accelerators).
 - Waves in plasmas - New numerical methods and modeling of new microwave diagnostics of magnetic field.
 - Metamaterial lens of reverse chromatic aberration for microwave diagnostic.
 - Liquid Metal Walls - gravity-defying, free-surface, feedback-stabilized flows.
- 2012, summer** **Visiting Assistant Professor, Kyoto University, Japan**
- Built radiometer for EBW emission at Heliotron J.
- 2009 -11** **Assistant Professor** Engineering Physics Dept, **Univ. Wisconsin, Madison**, U.S.A.
- Physics and control of locked modes and NTMs at DIII-D (collab. GA San Diego).
 - Error Field detection from interaction with stable RWMs (collab. KTH Stockholm).
 - Magnetic barriers in plasma edge stochasticized by Resonant Magnetic Perturbations for Edge Localized Mode (ELM) in DIII-D (collab. GA San Diego).
 - NTM dependence on impurities and Lithium wall (collab. PPPL Princeton).
 - Full-wave modeling mode-conversions in Pegasus sph. tok. (collab. IPF Stuttgart).
 - Metamaterials of reverse chromatic aberration

Research Appointments

- 2008** **Staff Physicist, Max-Planck-Inst. für Plasmaphysik (IPP)**, Garching, Germany
- Electron Cyclotron Reson. Heating (ECRH) operator, ASDEX Upgrade Tokamak.
 - Fast version of TORBEAM beam/ray tracing code, for real-time use.
 - Feasibility of EBW Current Drive in RFX-mod reversed field pinch (with R. Bilato and IPF Stuttgart).
- 2007 -08** Oak Ridge Associated Univ. **Post-doctoral Fellow, General Atomics**, San Diego
2006 -07 Otto-Hahn Medal **Post-doctoral Fellow, General Atomics**, San Diego, U.S.A.
- Physics and control of locked modes and NTMs
 - Oblique and horizontal Electron Cyclotron Emission (ECE)
 - Spinning mirror Electron Bernstein Wave (EBW) emission (collab. UKAEA).
- 2006** **Adv. Training Sch., Max-Planck-Inst. Plasmaphys. (IPP)**, Greifswald, Germany
- Weakly relativistic dielectric tensor valid for arbitrary wavenumbers.
 - Incorporated EBWs and mode conversions in TRAVIS ray tracing (with N.Marushchenko). Interfaced code to EFIT tokamak equilibria (with Yu.Turkin).
- 2004 -05** **Physicist, Fircroft, UKAEA Fusion**, Culham, U.K.
2002 -04 **Post-doc, UKAEA Fusion**, Culham, U.K.
- Ray tracing, Fokker-Planck optimization of ITER ECRH Upper Launcher for NTM stabilization (with several groups worldwide).
 - EBW emission, heating (exp.) and current drive (num.) at MAST sph.tokamak. Spinning mirror for ang. scan of emission, for q -profile meas. and heating optimiz.
 - MAST Session Leader¹
 - Internal collaborations: 1) double-null-merging non-solenoid startup, 2) optics for MAST Interferom., 3) interpretation JET Interferometer signals during ELMs.
 - External: 1) Collective Thomson Scattering (CTS) at FTU (ENEA Frascati), 2) Ray tracing for mode-converted EBWs in TCV tokamak (CRPP-EPFL Lausanne).
- 1998-2002** **PhD student IPP**, Garching bei München, Germany
- EBW emission measurements at Wendelstein 7-AS (W7-AS) stellarator
 - Analytical solution of OX conversion
 - Ray tracing of mode-converted EBWs, applied to emission and current drive
- 1998, summer** **Fellow, Consorzio di Magnetofluidodinamica, Univ. of Trieste**, Italy
- 2D finite difference code for liquid metal flows of industrial interest
- 1997 -98** **Undergraduate student, ENEA**, Frascati (Rome), Italy
- Collective Thomson Scattering (CTS) at FTU tokamak.

¹A.k.a. physics operator, leads an experimental session, programs the coil-currents, gas injection, density and position feedbacks and gives directives to the pellet, heating and data acquisition operators. His/her aim is to create a plasma with certain characteristics of density, temperature, shape etc., agreed with the physicists in charge of the experiment.

Securing and Managing Research Funds

Total: > \$1,350,000

- 08/2017 - 07/2018** Department of Energy (DOE), Renewal of DE-SC0016372
“Island Rotation and Locking at DIII-D”
PI: Francesco Volpe. Co-PI: Andrew Cole. \$155,000
Post-doc started in 08/2017
- 08/2016 - 07/2018** National Science Foundation (NSF), PHY-1632802
“Modeling Ion Extraction from First Toroidal Electron-Cyclotron-Resonance Ion Source”
PI: Francesco Volpe. \$194,000
Post-doc started in 07/2017
- 08/2016 - 07/2017** Department of Energy (DOE), DE-SC0016372
“Physics and Control of Disruptive Locked Modes at DIII-D”
PI: Francesco Volpe. \$175,000
Trained 2 graduate students, 1 undergraduate. 1 PhD thesis. 1 journal paper.
- 07/2012 - 07/2016** Department of Energy (DOE), DE-SC008520
“Physics and Control of Locked Modes in the DIII-D Tokamak” (Early Career Award)
PI: Francesco Volpe. \$600,000
Trained 2 post-docs and 2 graduate students. 1 PhD thesis. 12 journal papers. 6 invited talks at int. conferences. 1 major software (eigspec). 1 database (locked modes and disruptions).
- 07/2011 - 07/2012** Department of Energy (DOE), DE-SC0006415
“Physics and Control of Locked Modes in the DIII-D Tokamak” (Early Career Award)
PI: Francesco Volpe. \$150,000
Trained 2 graduate students, 1 undergraduate. 2 journal papers.
- 05/2011 - 05/2012** Graduate School, Univ. of Wisconsin, Madison
“Electron Bernstein Wave Studies in the MST Plasma Experiment”
PI: Francesco Volpe. \$57,126
Calibrated MST radiometer. Built: low-noise amplifiers, hot/cold calibration source.
- 08/2010 - 09/2010** General Atomics
“Analysis of Locked Mode Control”
PI: Francesco Volpe. \$26,437
1 invited talk at international conference.

Pending:

- 06/2018 - 05/2021** Department of Energy (DOE), Pre-proposal PRE-0000012195 encouraged to proceed with full submission in response to Funding Opportunity DE-FOA-0001762
“Rotating and Locked Magnetic Islands in DIII-D: Advancements in Theory, Experiment and Control”
PI: Francesco Volpe. Co-PI: Andrew Cole. \$1,095,000

Honors, Fellowships and Awards

- 2015** Excellence in Fusion Engineering Award, Fusion Power Associates, USA
- 2012** Visiting Professorship in Kyoto University, Japan
- 2012** Finalist at ISSNAF Award for Young Investigators
- 2012** Torkil Jensen Award, General Atomics
- 2011** DOE Early Career Award
- 2007** Oak Ridge Associated Universities (ORAU) Fellowship
- 2003** Otto-Hahn Medal - thesis prize of the Max-Planck Gesellschaft (Germany)
- 2002** Marie Curie Individual Fellowship, European Commission Research Directorate

Publications and other Research Products

Publication and Citation Summary

7 journal articles under review

65 journal articles published

20 refereed IAEA conference papers

113 conference papers, reports and other publications

h-index = 14 and >600 citations according to ISI Web of Knowledge

(<http://www.researcherid.com/rid/D-2994-2009>).

h-index = 19 and >1,100 citations according to Google Scholar.

Selected Publications

Criteria for selection: *Physical Review Letters* and/or highly cited journal articles (≥ 25 citations).

For the full list of publications, please refer to <http://www.columbia.edu/~fv2168/Publ/1Pub.pdf>.

- F.A. Volpe, A. Hyatt, R.J. La Haye, M.J. Lanctot, J. Lohr, R. Prater, E.J. Strait, A. Welander
Avoiding Tokamak disruptions by applying static magnetic fields that align locked modes with stabilizing wave-driven currents
Phys. Rev. Lett., **115**, 175002 (2015)
- H. Meyer, R.J. Akers, F. Alladio, F. Volpe and 106 coauthors
Overview of Physics Results from MAST
Nucl. Fusion **49**, 104017 (2009)
- B. Esposito, G. Granucci, S. Nowak, F. Volpe and 10 coauthors
Disruption Control on FTU and ASDEX Upgrade with ECRH
Nucl. Fusion **49**, 065014 (2009)
- F.A.G. Volpe, M.E. Austin, R.J. La Haye, J. Lohr, R. Prater, E.J. Strait and A.S. Welander
Advanced techniques for neoclassical tearing mode control in DIII-D
Phys. Plasmas **16**, 102502 (2009)
- R. Prater, D. Farina, Yu. Gribov, R.W. Harvey, Y.R. Lin-Liu, E. Poli, A.K. Ram, A.P. Smirnov, F. Volpe, E. Westerhof, A. Zvonkov and ITPA Steady State Operations Topical Group
Benchmarking of codes for electron cyclotron heating and electron cyclotron current drive under ITER conditions
Nucl. Fusion **48**, 035006 (2008)
- V. Shevchenko, G. Cunningham, A. Gurchenko, E. Gusakov, B. Lloyd, M. O'Brien, J. Preinhaelter, A. Saveliev, A. Surkov, F. Volpe, M. Walsh
Development of Electron Bernstein Wave Research in MAST
Fusion Science & Technology **52**, 202 (2007)
- A. Mueck, L. Curchod, Y. Camenen, S. Coda, T.P. Goodman, H.P. Laqua, A. Pochelon, L. Porte, F. Volpe, TCV Team
Demonstration of Electron-Bernstein-Wave Heating in a Tokamak via O-X-B Double-Mode Conversion
Phys. Rev. Lett. **98**, 175004 (2007)

- W.A.Houlberg, C.Gomezano, J.F.Artaud, F.Volpe and 20 coauthors
Integrated Modeling of the Current Profile in Steady-State and Hybrid ITER Scenarios
Nucl. Fusion **45**, 1309 (2005)
- F.Wagner, S.Bäumel, J.Baldzuhn, F.Volpe and 49 coauthors
W7-AS: One step of the Wendelstein stellarator line
Phys. Plasmas **12**, 072509 (2005)
- H.P.Laqua, H.Maassberg, N.Marushchenko, F.Volpe, A.Weller, W7-AS Team, W.Kasperek and ECRH-Group
Electron-Bernstein-Wave Current Drive in an Overdense Plasma at the Wendelstein 7-AS Stellarator
Phys. Rev. Lett. **90**, 75003 (2003)
- F.Volpe, H.P.Laqua and the W7-AS Team
BXO mode-converted electron Bernstein emission diagnostic (invited)
Rev. Sci. Instrum. **74**, 1409 (2003)

Talk Summary

13 invited talks at international conferences, +4 invited talks by group members
51 seminars and colloquia
3 summer school lectures
44 contributed talks at international conferences

Selected Invited Talks at International Conferences

For the full list of talks, please refer to <http://www.columbia.edu/~fv2168/Publ/1Pres.pdf>.

- **Using 3D Fields to control Islands, aid ECCD-Stabilization and measure Error-Fields at DIII-D**
41st European Physical Society (EPS) Conf. on Plasma Physics, Berlin (Germany), June 2014
- **Advanced Techniques for Neoclassical Tearing Mode Control in DIII-D**
50th Annual Meeting, Division of Plasma Phys., American Phys. Society (APS), Dallas, TX, Nov. 2008
- **BXO mode-converted electron Bernstein emission diagnostic of electron temperature profiles at W7-AS Stellarator**
14th Topical Conf. High Temperature Plasma Diagnostics (HTPD), Madison, WI, July 2002

Patents

“Systems and methods for adjustable aberration lens”

US Publication No.: WO/2014/004918, US Publication Date: 03.01.2014

International Application No.: PCT/US2013/048337 International Filing Date: 27.06.2013

Teaching and Lecturing

Courses taught

at Columbia University:

Fall	2015 -17	APPH E4200x	Physics of Fluids	undergraduate level also taught remotely on Columbia Video Network (CVN)
Spring	2012 -17	APPH E4018y	Applied Physics Laboratory ²	undergraduate level
Fall	2012 -14	APPH E6101y	Plasma Physics I	graduate level

at the University of Wisconsin, Madison:

Fall	2009 & Spring	2011	ECE 525	Introduction to Plasmas	undergrad level
Spring	2010 & Fall	2011	NE 427	Nuclear Instrumentation Laboratory	undergrad level

Lectures given

- Lecture on “Locked Mode Disruptions: Stability, Dynamics, Control” at the 9th ITER International School, “Physics of disruptions and control”, 20-24 March 2017 Aix-en-Provence (France)
- Lecture on “Waves in Plasmas” at the Mirai Summer School, 9-10 August 2012, Suzukaji (Japan)
- Lecture on “Plasma Waves and Heating” at the IPP Summer University on Plasma Physics and Fusion Research, 22-26 Sept. 2008 Garching (Germany)

Research Advising, Group Members

Total of 55 people in the last 18 years, most of them in the last 9 years, both at Universities (Columbia Univ. and UW-Madison) and National Facilities (GA San Diego and IPP Garching).

Current Group

- Post-docs
 2. **Wilkie Choi** (2017-) *Island Rotation and Locking in DIII-D Tokamak*
 1. **Sharad K. Yadav** (2017-) *Modeling Ion Extraction from First Toroidal Electron-Cyclotron-Resonance Ion Source*
- Undergraduates (7)

Chengcheng Xin (2017-), **Jacob Austin** (2017-), **Shah Faisal Bin Mazhar** (2017-), **Tommy Polanco** (2017-), **Albert Tai** (2017-), **Jessica Li** (2016-), *all working on tilted toroidal-field coil torsatron (CIRCUS);* **Ruben Rui Diaz-Pacheco** (2015-) *also worked on CNT stellarator and liquid metal exp.*

Previous Group Members

- Scientists
 2. **Claudia Caliri** (2013-14) *Ion extraction from toroidal plasma-based ion source for accelerators*
 1. **Myunghye Choi** (2013) *Numerical Modeling of Waves in Plasmas*

² Laboratory of vacuum, microwaves, solid state, plasmas, superconductivity and optics.

- Visitors and unfunded collaborators
 3. **Orso Meneghini** (collaborated from GA San Diego, 2013)
Full-wave Feasibility Study of Mode-Conversion Oblique Reflectometry Imaging of q-profile
 2. **Xabier Sarasola** (visited Columbia from IPP Greifswald, 2012)
Operation of CNT as a Neutral Stellarator
 1. **Alf Köhn** (visited UW from IPF Stuttgart, 2010) *Full-wave Modeling of EBWs in Pegasus*
- Post-docs
 3. **Seyyed (Taha) M.H. Mirhoseini** (2015-16) *Control of liquid metal flows and walls*
currently engineering manager at RDO Induction
 2. **Erik Olofsson** (2012-14) *Physics and Control of Locked Modes at DIII-D*
currently a scientist at General Atomics
 1. **Daisuke Shiraki** (2012-13) *Physics and Control of Locked Modes at DIII-D*
currently a scientist with Oak Ridge National Laboratory (ORNL) seconded to DIII-D
- PhD Theses
 3. **Wilkie Choi** (2013-17) *Magnetic feedback control of 2/1 locked modes in tokamaks*
started a DOE-funded Columbia post-doc at DIII-D in Aug. 2017
 2. **Kenneth Hammond** (2012-17) *Heating and stability of neutral CNT stellarator plasmas*
currently at post-doc at IPP Greifswald, Germany
 1. **Ryan Sweeney** (2012-16) *Relationship between locked modes and disruptions in the DIII-D tokamak*, currently a Monaco Post-doctoral Fellow at ITER
- MSc students (11)

Michel Doumet (2013-14), **Anthony Clark** (2012-13), **Aileen Nielsen** (2012), **Chuteng Zhou** (2012), **William J. Capecchi** (2011-12), **Kent Haeger** (2011), **Sang-heum Kim** (2010), **Dinh Truong** (2010-12), **Sara Gallian** (2010), **Derek Thompson** (2009), **François Beau** (2009-10)
- Undergraduates (25)

Veronica Mulila (2017), **Tyler Cowan** (2016-17), **Justin Mann** (2015-17), **Ben Yehuda Israeli** (2013-17), **Yumou Wei** (2015-16), **Jacob B. Simmonds** (2015-16), **Alek Anichowski** (2015), **Lucas Randall Zeppetello** (2014-15), **Anji Zhao** (2014-15), **Omar Naziruddin Mahmood** (2014-15), **Elise Burch** (2013-14), **Yosef Kornbluth** (2013), **Adrian Febre** (2013), **Scott Massidda** (2012-13), **Samuel Reiss** (2010-11), **Mohamad Ali Bitar** (2010), **Kyle Luh** (2010), **Jonathan Jacquot** (2010), **Shifan Mao** (2009-11), **Jonathan Kessler** (2010), **Hans Rinderknecht** (2007), **2 groups of 2 students** (Technische Universität München, Plasma interferometry experiment (2000-01))

Service

Service to Columbia

- APAM Department Student Admissions and Financial Aid Committee member (2016-date).
- Applied Physics (AP) Program Committee member (2015-date).
- General AP Undergraduate Advisor (2015-date).
- Speaker & guide for Columbia Engineering Days on Campus, for admitted undergraduates (2014-date).
- Chair or member of 8 Thesis Defense committees and 6 Thesis Proposal committees (2012-date).
- Advisor of undergraduates majoring in AP, class of 2016 (2014-16).

- Organizer of weekly Plasma Physics Colloquia (2012-15 and 2016-date).
- Organizer of weekly APAM Research Conference seminars (2012-14).

Service to UW-Madison

Member of several Thesis Defense committees and Preliminary Examination committees (2009-11).

Community Research Leadership

- 2014** Member of National Stellarator Coordination Committee
- 2013-date** Invited Leader of International Tokamak Programmatic Activities (ITPA) Working Group 11, "Control of Locked Modes".

Conference Organization and Selection Committees

- *Member* of International Advisory Board of 5th and 4th International Conf. Frontiers in Diagnostic Technologies, Frascati (Italy), March-April 2018 and 2016
- *Member* of Program Committee of
 - 21th Workshop on MHD Stability Control, San Diego, CA (USA), Nov. 2016
 - 20th Workshop on MHD Stability Control, Princeton, NJ (USA), Nov. 2015
 - 19th Workshop on MHD Stability Control, Auburn, AL (USA), Nov. 2014
 - 18th Workshop on MHD Stability Control, Santa Fe, NM (USA), Nov. 2013
 - 16th Workshop on MHD Stability Control, San Diego, CA (USA), Nov. 2011
- *Chair* of Local Organizing Committee 15th Workshop on MHD Stability Control combined with "US-Japan Workshop on 3D Magnetic Field Effects in MHD Control", Madison, WI (USA), Nov. 2010.

Reviewer for Funding Agencies

- 2016 -date** National Science Foundation (NSF)
- 2011 -date** US Department of Energy (DOE)
- 2016** Research Foundation Flanders (FWO)
- 2016** Italian Scientists and Scholars of North America Foundation
- 2014** Chilean National Commission for Scientific and Technological Research
- 2013** Swiss National Science Foundation
- 2012** Helmholtz Stiftung (Germany)
- 2004** Czech Science Foundation

Reviewer for Journals and Book Publishers

- Regular referee, since 2003, for *Nucl. Fusion* and for *Plasma Phys. Control. Fusion*.
- Ad-hoc referee, since 2006, for other 18 journals and book publishers: *Appl. Phys. Lett.*, *Fusion Eng. Design*, *Fusion Sci. Technol.*, *IEEE Trans. Plasma Sci.*, *J. Appl. Phys.*, *J. Infrared Millim. Terahertz Waves*, *J.Phys.D: Appl. Phys.*, *J. Plasma Phys.*, *Phys. Lett. A*, *Phys. Plasmas*, *Phys. Rev. E*, *Phys. Rev. Lett.*, *Plasma Sci. Technol.*, *Plasma Sources Sci. T.*, *Radiation Eff. Defect S.*, *Rev. Sci. Instrum.*, *Springer Books*, *Waves Random Complex Media*.

Outreach

- 2016-date** Scientific advisor for "Blackout", a Sloan-awarded film on a nuclear fusion scientist, written and directed by Nick Singer

- 2014-date** School tours of CNT Plasma Laboratory.
- 2010-11** Judge at the CSEF and BSSEF Science Fairs (UW-Madison and Marquette University, Milwaukee, WI)
- 2006-07** "Scientist in the Classroom": lectures and demonstrations organised by PPPL and General Atomics in schools of Southern California
- 2004-05** Toured dozens of groups (hundreds of visitors) from schools, universities and general public around MAST and COMPASS tokamaks at Culham, UK.

Other Information

Professional Associations

- 2010 -date** US-BPO United States Burning Plasma Organization
- 2008 -date** APS American Physical Society and its Division of Plasma Physics (DPP)
- 2009 -16** UFA University Fusion Association
- 2011 -12** ISSNAF Italian Scientists and Scholars of North America Foundation
- 2011 -12** AAAS American Association for the Advancement of Science
- 2010 -11** IEEE Institute of Electrical and Electronics Engineers and its Microwave Theory and Techniques Society (MTT-S) and Nuclear & Plasma Sciences Society (NPSS)

Further Training Received

- *Project Management* (Greifswald, Germany, 2006),
- All major schools in plasma physics and controlled fusion:
Greifswald (1997), Trieste (1999), Carolus Magnus (2001), Culham (2004).
- Specialistic schools in plasma physics:
Ionospheric Plasma Physics (Greifswald, Germany, 2004), *MAST Session Leader¹ Training* (Culham, UK, 2004), EFDA "GOTiT" *Course on Gyrokinetics* (Garching, Germany, 2008), *Instabilities in Laboratory, Space and Astrophysical Plasmas* (UCLA, USA, 2008),
- Scientific software training:
FEMLAB (2004), LabView (2010), COMSOL (2010).
- Other:
Advanced Turbulent Flow Computations (CISM Udine, Italy, 1998), *Magnets, Cryogenics, Thermometry and Vacuum* (Oxford Instruments, UK, 2004), *Bayesian Analysis* (Culham, UK, 2005), STEM Education Scholars Program by CIRTLL (Nashville, USA, 2009), CERN Accelerator School on RF for Accelerators (Ebeltoft, Denmark, 2010).

Languages

Only most advanced class or certificate is indicated for each language.

- 1) **Italian** native
- 2a) **English** proficient (Certificate in English Language Skills (CELS) "Higher", English for Speakers of Other Languages (ESOL), University of Cambridge, 2004)
- 2b) **Spanish** proficient (Classes at University of California San Diego "Extension", 2006-07)
- 4) **German** proficient (*Zertifikat Deutsch*, Goethe Institut München, 2000)
- 5) **French** elementary (20% fluent on DuoLingo, 2016)

6) **Portuguese** elementary (17% fluent on DuoLingo, 2016)

7) **Japanese** elementary (Classes at Amity College New York and Kyoto University, 2012)