

E. M. studied Physics at the University of Pisa.

On 1989 he won a PhD position in Elementary Particle Physics and Structure of Matter School of Doctorate at the University of Pisa. During the PhD period he collaborated at researches in the Institute of Atomic and Molecular Physics of C.N.R. about "Kinetic Effects of Radiation on Atoms and Gases". The thesis contains the discussion of Light – Induced Drift experiments and of experiments of Resonance Radiation Pressure on a sodium atomic beam and on a sodium vapor in a cell (see, for example, Physical Review A 46 (7), pp. R3601-R3604). On October, 1992, he received in Rome the PhD degree.

During 1991 he got a permanent position as a Researcher in the University of Siena, in the group of Luigi Moi.

On March 2001 he got a position as an Associated Professor in the Faculty of Sciences of the University of Siena, where he was confirmed 3 years later.

In 2014 he got Habilitation to Full Professorship.

## RESEARCH ACTIVITY

He is co – author of about 100 papers on refereed reviews, of 35 refereed proceedings and of 1 international patent.

After the degree and PhD period, in Siena he substantially contributed to the development of a new Laser Spectroscopy laboratory where he started a research activity on Rubidium isotope separation by LID and on LID on lithium vapors, developing a new diode laser source (Optics Communications 107 (1-2) , pp. 83-87).

He also was a little bit involved in the laboratory of Laser assisted collisions among III group atoms (Journal of Physics B: Atomic, Molecular and Optical Physics 26 (15), pp. 2335-2344).

He personally found and studied in detail the Light-Induced Atom Desorption, LIAD, on rubidium and cesium (Physical Review A - Atomic, Molecular, and Optical Physics 60 (6) , pp. 4693-4700). During the next 30 years of activity, the LIAD effect has become an useful tool for application, as, for example, the development of atomic sources at low temperatures (Optics Communications 134 (1-6), pp. 121-126), their stabilization (Optics Letters 34 (17) , pp. 2643-2645), the Magneto – Optical Trap loading (Physical Review A - Atomic, Molecular, and Optical Physics 67 (5), pp. 534011-534016), the formation of metal nanoparticles (Physical Review Letters 97 (15), art. no. 157404, Optics Express 16 (2) , pp. 1377-1384, Laser Physics Letters, 11, 085902, (2014), Journal of Physics D Applied Physics 04/2015, OPTICAL AND QUANTUM ELECTRONICS, vol. 52, 102, 2020, ISSN: 0306-8919, doi: 10.1007/s11082-020-2208-y).

He contributed to the development of a second laboratory devoted to the studies of Laser cooling and trapping and of new spectral sources, in collaboration with INFN groups of Ferrara, Lecce e Bari (Journal of the Optical Society of America B: Optical Physics 18 (3) , pp. 335-339). He studied in this context experimental techniques for the optimization of the Magneto - Optical Trap (MOT) loading rate on a Sodium MOT (the only existent in Italy, Physical

Review A. Atomic, Molecular, and Optical Physics 64 (2), pp. 023412/1-023412/9, European Physical Journal D 13 (1), pp. 71-82) and on a Rubidium MOT (J. Chem. Phys. 141, 134201 (2014)).

He built a Francium Magneto – Optical Trap at the National Laboratories of INFN in Legnaro (Padua) (Optics Letters 34 (7), pp. 893-895, Physical Review A - Atomic, Molecular, and Optical Physics 78 (6), art. no. 063415). Francium is the best candidate for measurements of Parity non conservation in atoms, as a possible standard model low energy test. Moreover, this short lifetime radioactive atom is still poorly known in his energy level structure (Measurement Science and Technology 24 (1), art. no. 015201, Physical Review C - Nuclear Physics 71 (1) , art. no. 014609, Scientific Reports, 7, Article number: 4207 (2017), Optics Letters, 42(18), 3682-3685 (2017)). The experiment was closed due to the technical problems of the Tandem accelerator at LNL.

He started experiments of Coherence Population Trapping (CPT) on sodium, cesium and rubidium (Physical Review A - Atomic, Molecular, and Optical Physics 74 (1), art. no. 013811, Applied Physics B: Lasers and Optics 76 (6) , pp. 667-675, Physical Review A - Atomic, Molecular, and Optical Physics 66 (1) , pp. 125021-1250212). CPT is a purely quantum effect induced by bichromatic laser radiation on three level systems ( $\lambda$ - or V- type). He also studied (for the first time in Italy) CPT in nanocells (cells whose thickness is comparable with the laser wavelength, Laser Physics 18 (6) , pp. 749-755)). The effect has been successfully applied to Optical Atomic Magnetometry, with also the publication of an international patent (Proceedings of SPIE - The International Society for Optical Engineering 5830, art. no. 25 , pp. 150-158, CPEM Digest - Conference on Precision Electromagnetic Measurements, art. no. 4097284 , pp. 390-391).

Since 2013, he started a collaboration on photoionization of radioactive species in the framework of the SPES project of INFN, (Review of Scientific Instruments, 87, 02B708 (2016), Journal of Instrumentation, 11 C09001 (2016), NIM A [10.1016/j.nima.2018.09.148](https://doi.org/10.1016/j.nima.2018.09.148) (2018), REVIEW OF SCIENTIFIC INSTRUMENTS, vol. 93, 083001, 2022, ISSN: 0034-6748, doi: 10.1063/5.0078913, APPLIED SCIENCES, vol. 13, 309, 2023, ISSN: 2076-3417, doi: 10.3390/app13010309). He has been indicated as the scientific responsible of the SPES Laser Laboratory. Beyond the photoionization measurements under SPES, the ISOLPHARM collaboration studies the feasibility for a Radiopharmacy facility at LNL (PHYSICA SCRIPTA, vol. 97, 024004 (2022) ISSN: 0031-8949, doi: 10.1088/1402-4896/ac48a7).

He is collaborating since 2016 to INFN "Axioma" project, later "Demiurgos", later "Phydes", devoted to the search of dark matter at low energy (Review of Scientific Instruments, 88(11), 113303 (2017), JOURNAL OF INSTRUMENTATION, vol. 15, C03004, ISSN: 1748-0221, doi: 10.1088/1748-0221/15/03/C03004, NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH. SECTION A, ACCELERATORS, SPECTROMETERS, DETECTORS AND ASSOCIATED EQUIPMENT, vol. 958, 162434 (2019) ISSN: 0168-9002, doi: 10.1016/j.nima.2019.162434).

He has participated since 2020 to measurements of Vacuum Magnetic Birefringence (project [VMB@CERN](https://vmb.cern.ch), THE EUROPEAN PHYSICAL JOURNAL. C, PARTICLES AND FIELDS, vol. 82, 159 (2022) ISSN: 1434-6044, doi: 10.1140/epjc/s10052-022-10100-x).

## COLLABORATIONS

He worked in the following international laboratories:

Institut für Angewandte Physik, Universität Bonn, on 1996 and 1997, in the Dieter Meschede group (experiments on high sensitivity magnetometry based on CPT);

Max-Planck-Institut für Kernphysik, Test storage Ring, Heidelberg, in collaboration with Rudi Grimm group, participating to many beam times in the period 1996 – 1998, for the study of laser cooling of ionic beams (Li<sup>+</sup>, Be<sup>+</sup>).

Physics Department , University of Southern Denmark, Odense, on 2003 and 2004, in the Horst – Gunther Rubahn group (study of pulsed LIAD on sodium atoms)

Institute of Electronics, Bulgarian Academy of Sciences, Sofia, on 2007 and 2008 in Stefka Cartaleva group (CPT experiment in coated cells).

Institute for Physical Research, Armenian Academy of Sciences, Ashtarak, in David Sarkisyan group (2013, precision laser spectroscopy measurements in Cs nanocells in presence of high magnetic fields)

Institute of Engineering, Division of Advanced Applied Physics, Tokyo University of Agriculture and Technology (2015, measurement of desorption from coated glasses and surface study via XPS techniques)

He is referee for the following journals: The Physical Review A, Physical Review Letters, Optics Letters, Optics Express, IEEE Transactions on Instrumentation and Measurements, The European Physical Journal D, Applied Optics, Applied Physics B, Optics and Laser Technology, Optical Materials, Journal of Modern Optics, Canadian Journal of Physics, The Journal of Chemical Physics, Optical and Quantum Electronics, Sensors and Actuators: A. Physical, Journal of the Optical Society of America B, Europhysics Letters, Review of Scientific Instruments, Scientific Reports.

## CO-ORDINATION

He was one of the organizers of the VI EPS European Conference on Atomic and Molecular Physics hold in Siena since 14th to 18th of July 1998 with the participation of about 600 researchers. He edited the "Book of Abstracts" publication.

He was the coordinator of various local projects, financed by the University of Siena.

He was the coordinator of the "Coherent Optics Sensors for Medical Applications – COSMA" project, financed by EU for 2012 – 16.

He has been one of the spokespersons of the Francium/Weak Atomic Transition Detection – WADE project at LNL.

He was nominated in the period 2002 – 2005 as Vice – Director of the Siena Physics Department.

On September 2004 (until April 2008) he was elected Coordinator for Physics, Computer Science and Mathematics of the “Tuscany School of Specialization for Secondary School Teachers – SSIS”.

In the period 2006 – 2022, he was responsible of “Scientific Degree Project – Physics” for the University of Siena.

He was elected in November 2012 as a member of the Academic Senate of Siena University for three years.

He was nominated in 2017 by the UniSiena Rector as a “Delegato” to the Training of Secondary School Teachers, and confirmed by the new Rector in 2022.

Since 2001 he has been in the group of coordination of the first (batchelor) degree in Physics and Advanced Technologies. In december 2018, he has been elected as the President of the departmental Joint Students Professors Commission.