Curriculum Vitae et Studiorum

of

Marcello Messina

PERSONAL INFORMATION

Name:	Marcello Messina
Birthday:	[redacted]
Birthplace:	[redacted]
Citizenship:	[redacted]
Languages:	Italian (mother tongue) English (fluent) French (good)
Professional Address:	[redacted]
Phone Num.:	[redacted] (LNGS laboratory)
Phone Num.:	[redacted] (Italian mobile)
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Present position:	Primo Ricercatore at LNGS
ResearcherID:	U-5632-2018
ScopusID:	7102980618
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CURRICULUM STUDIORUM

- July 1988: High School Diploma at the *Liceo Scientifico Statale* in Aversa (Caserta), Italy.
- October 1995: *Laurea in Fisica* at the University Federico II of Napoli, Italy, with mark: 110/110 "Magna cum Laude". Title of the Thesis: "Ottimizzazione delle prestazioni del calorimetro dell'esperimento CHORUS e studio della risposta elettromagnetica e adronica".
- September 1997: *International School of Nuclear Physics, 19th Course: Neutrinos in astro, particle and nuclear physics*, held at the Scientific Culture Center *E. Majorana*, Erice, Italy.
- September 1998: *Summer Student School On High Energy Physics in memory of Bruno Pontecorvo*, held at the Joint Institute For Nuclear Research University Center, in Dubna, Russia.
- March 2000: Defence of the *Ph.D Thesis in Physics: New limit on $\nu_\mu \to \nu_\tau$ oscillations in the CHORUS experiment.*

FIELDS OF INTEREST

Experimental elementary particle physics, astrophysics and nuclear physics.

SPECIFIC COMPETENCES

Physics:

Neutrino reactions and oscillations, Dark Matter direct search, nuclear interactions, relic neutrinos.

Experimental techniques:

Particle detectors: TPC, doule-phase noble gas TPC, calorimeters, light detecting devices, cryogenics and ultra vacuum systems, tracking devices.

Computing:

Programming languages: Fortran, C, C++;
Operative systems: Windows, Mac OS X, Linux;
Simulations: Monte Carlo GENAT4;
Others: Latex, Word, Excel, ROOT, COMSOL, Mathematica

PROFESSIONAL RECORDS

- 1996-1999: *Ph.D. fellowship* at the University of Naples Federico II.
- February-June 1999: fellowship *A. della Riccia* for research activities at CERN.
- 1999-2002: *Post-Doctoral* position at the University Federico II of Napoli.
- October 2002-2006: *Post-Doctoral* position at the ETH-Zurich.
- October 2006-2011: *Oberassistent* position at the University of Bern.
- October 2011-2017: *Research Scientists* at the Columbia University.
- February 2014: Qualified in Italy as *Associate Professor*.
- Selected by the Giunta-INFN as Distinguished Scientist, in a group of five, proposed to the Italian Research Ministry to be appointed on a position of "Primo Ricercatore". See document attached "deliberaGiuntaINFN2016"
- August 2017-2018: *Senior Research Scientists* at the New York University in Abu Dhabi.
- November 2018 February 2019: Visiting Scientist at Gran Sasso Science Institute.
- February - April 2019: Visiting Professor at the E. Amaldi Center in Roma Sapienza University.
- may 2019: Primo Ricercatore INFN at LNGS

SUMMARY OF SCIENTIFIC PUBLICATIONS

From 1995: co-author of more than 150 (h index 45) papers between articles on International Journals, conference proceedings and monographic papers.

TALKS AT INTERNATIONAL WORKSHOPS and CONFERENCES

1. Invited talk at *The XXXIV Rencontres de Moriond session devoted to Electroweak Interactions and Unified Theories*, Les Arc, France 13-20 March, 1999,
   Latest Results from the CHORUS Neutrion oscillation experiment.
   Published in the Proceedings.

2. Invited talk at *V Recontres du Vietnam*, Particle Physics and Astrophysics, Hanoi, Vietnam 5-11 August, 2004,
   Future applications of the liquid Argon TPC.
   Published in the Proceedings.

3. Invited talk at *Istanbul 4-Seas-Conference* Instanbul, Turkey, 5-10 September, 2004,
   Review on Long Baseline neutrino oscillation Experiments.

4. Invited talk at Pre-meeting at *International Conference of Cosmic ray 2005* Mumbai, India, 1 August, 2005,
   Future application of liquid Argon Time Projection Chambers on medium and large scale.

5. Invited talk at *9th ICATPP Conference on Astroparticle, Particle, Space Physics, Detectors and Medical Physics Applications*, Como, Italy, 17-21 October, 2005,
   Status report of ArDM Project: a New Direct Detection Experiment, based on liquid Argon, for the Search of Dark Matter
   Published in the Proceedings.

6. Invited Talk at *HEP 2007, Europhysics Conference on High Energy Physics*, Manchester, England, 19-25 July, 2007,
   Probing Low Energy Neutrino Backgrounds with Neutrino Capture on Beta Decaying Nuclei.
   Published in the Proceedings.

7. Invited Talk at *NNN08, International Workshop on Next Nucleon decay and Neutrino detectors*, Paris, France, 11-13 September, 2008,
   A process to detect neutrinos of vanishing kinetic energy by means of unstable target nuclei.

8. Invited Talk at *CERN workshop on New Instruments for Neutrino Relics and Mass*, Geneva, Switzerland, 18 December, 2008,
   Experimental challenges towards the detection of relic neutrinos with unstable nuclei.

9. Invited Talk at *Frontiers in Theoretical Neutrino Physics*, Paris, France, 16-19 March, 2009,
   Experimental challenges towards the detection of relic neutrinos with unstable nuclei.

10. Invited Talk at *Réunions pléniéres du GDR NEUTRINO*, Paris, France, 27-28 April, 2009,
    Experimental challenges towards the detection of relic neutrinos with unstable nuclei.

11. Invited talk at *The Future of Neutrino Mass Measurements: Terrestrial, Astrophysical, and Cosmological Measurements in the Next Decade*, Seattle, USA, February 8-11, 2010,
    Experimental challenges towards the detection of relic neutrinos with unstable nuclei.

12. Invited Talk at *PPC 2010: IV International workshop on the interconnection between particle physics and cosmology*, Turin, Italy, 12-16 July, 2010,
The T2K experiment in the context of LBL neutrino physics.

13. Invited Talk at *2nd International Workshop towards the Giant Liquid Argon Charge Imaging Experiment (GLA2011)*, Jyväskylä, Finland, 05-10 June, 2011,
Report on the ARGONTUBE project under execution at the University of Bern.

14. Invited Talk at *TIPP 2011, Technology and Instrumentation in Particle Physics*, Chicago, USA, 08-15, June, 2011,
A global R&D program on liquid Ar Time Projection Chambers under execution at the University of Bern.
Published in the proceedings.

15. invited Talk at *High Voltage in Nobel Liquids*, Chicago, USA, 08-09, October, 2013,
The High Voltage in the XENON Project
Published in the proceedings.

16. Invited Talk at *VULCANO Workshop 2014, Frontier Objects in Astrophysics and Particle Physics*, Vulcano Island, Italy, 18-24, May, 2014,
Recent results from the XENON100 experiment and future goals of the XENON project.
Published in the proceedings.

17. Invited Talk at *TIPP 2014, Technology and Instrumentation in Particle Physics*, Amsterdam, The Netherlands, 02-06, June, 2014,
Electron drift over $1m$ *with a dual-phase Xe TPC for the XENON Dark Matter search program.*
Published in the proceedings.

18. Invited talk at IBS-MultiDark Joint Focus Program,Daejeon, Korea, 13 October, 2014,
Latest results from the XENON100 detector and future goals of the XENON project

19. Invited talk at TAUP2015, Topics in Astroparticle and Underground Physics, Turin, Italy, 7 September, 2015,
Cosmological Relic neutrino detection, Only a Dream?

20. Invited talk at IDM2016, Identification of Dark Matter, Sheffield, UK, 18 July, 2016,
Review of scintillation properties of the Liquefied Noble gases

21. Invited talk at Compact Stars in the QCD phase diagram V, LNGS-L'Aquila, Italy, 25 May, 2016,
LNGS, a laboratory with the vocation of the Dark Matter.

22. Invited talk at NOW2016, Neutrino Oscillation Workshop, Otranto, Italy, 4 September, 2016,
Status of WIMP Dark Matter searches.

23. Invited talk at IFAE2017, Incontri di Fisica delle Alte Energie, Trieste, Italy, 20 April, 2017,
Status of WIMP Dark Matter searches.

24. Invited talk at COSMO-17, 21st International Cosmology Conference, Paris, France, 28 August, 2017,
The first XENON1T results.

25. Invited talk at VULCANO Workshop 2018, Frontier Objects in Astrophysics and Particle Physics, Vulcano, Italy, 20 May, 2018,
The PTOLEMY project: from an idea to a real experiment for detecting Cosmological Relic Neutrinos.

26. Invited talk at Seventh Workshop on Theory, Phenomenology and Experiments in Flavour Physics, Capri, Italy, 8 June, 2018,
Latest results of 1 tonne x year Dark Matter Search with XENON1T

27. Invited talk at 2nd World Summit on Dark Side of the Universe, Guadeloupe, France, 23 June, 2018,
Latest results of 1 tonne x year Dark Matter Search with XENON1T

28. Invited talk at WIN2019 Conference, Bari, Italy, 2nd of June, 2019
The PTOLEMY experiment, a path from a dream to a challenging project

29. Invited talk at ICHEP 2020, 40th international conference on High Energy Physics, Prague, Czech 28 July, 2021,
The PTOLEMY experiment to look at the first second of the Universe

30. Invited talk at Neutrino 2022, The XXX International Conference on Neutrino Physics and Astrophysics, Seul, Korea 30 of May, 2022,
The PTOLEMY New Results and Status

31. Invited talk at, PTOLEMY: capturing relic neutrinos to study the first second of the Universe, LHC days in Split, Island of Havr, Croatia, Sept. 30th to Oct. 4th,

TEACHING EXPERIENCES AT GRADUATE AND POST-GRADUATE LEVEL

Lecturer of courses:

- Physics I for Engineers: Kinematics and Dynamics of a point-like body, Dynamics of a system of particles, Dynamics of a rigid body and Thermodynamics.
  Second University of Naples "SUN", Italy, **2000, 2001**.
- Physics II for Engineers: Electrostatic and Magnetostatics in the vacuum and in the matter, Electrodynamics, Wave propagation and Special Relativity.
  Second University of Naples "SUN", Italy, **2000**.
- Physics I for Software Scientists: Kinematics and Dynamics of a point-like body, Dynamics of a system of particles, Dynamics of a rigid body and Thermodynamics.
  ETH-Zurich, Switzerland, **2002, 2004, 2005**.
- Physics II for Software Scientists: Electrostatic and Magnetostatics in the vacuum and in the matter, Electrodynamics, Wave propagation in vacuum, electrical circuits and Special Relativity.
  ETH-Zurich, Switzerland, **2002**.
- Physics III for Physicists: Electrostatic and Magnetostatics in the vacuum and in the matter, Electrodynamics, Wave propagation in vacuum, electrical circuits, Special Relativity and introduction to Statistical mechanics.
  ETH-Zurich, Switzerland, **2003**.
- Physics IV for Physicists: Introduction to Quantum Mechanics, black body radiation, quantization of atomic levels, Compton scattering, positronium annihilation, Schroedinger equation in cartesian and spherical coordinates and its eigenfunctions, spin, time evolution of wave packets, Dirac formalism, introduction to molecular Physics and Ammoniac molecule oscillation modes.
  ETH-Zurich, Switzerland, **2003**.
- Physics I for Mechanical Engineers: Kinematics and Dynamics of a point-like body, Dynamics of a system of particles, Dynamics of a rigid body and Thermodynamics, Electrostatic and Magnetostatics in the vacuum, Electrodynamics, Wave propagation in vacuum, electrical circuits and Special Relativity.
  ETH-Zurich, Switzerland, **2004**.
- Particle Physics for Physicists: Relativistic Kinematics, scattering, fundamental interactions, hadron decay phenomenology, CP violation and meson mixing, overview of particle experiments, introduction to cosmology and connections with astroparticle physics.
  Bern University, Switzerland, **2007, 2008, 2009, 2010**.
- Lecturer at the laboratory class for *Bachelor* for the realization of a Frank and Hertz experiment.
  Bern University, Switzerland, **2006, 2007, 2008, 2009, 2010, 2011**.

- Visiting Professor at GSSI, teaching the lectures on Cryogenic Light detectors,
  GSSI-post graduate school, L'Aquila **2020, 2021**

- Visiting Professor at GSSI, teaching lectures on "Direct Neutrino Mass measurement"
  GSSI-post graduate school, L'Aquila **2023**

- Teacher

Supervision of students:

- Master thesis of Roberto Santorelli, Naples University Federico II, March 2001.
- Master thesis of Valentina Gallo, Naples University Federico II, May 2005.
- Ph.D thesis of Biagio Rossi, Bern University Switzerland, November 2006.
- Ph.D thesis of Eike Frack, Bern University Switzerland, July 2007.
- Bachelor thesis of Ramon Stucki, Bern University, September 2009.
- Ph.D thesis of Fatih Bay, Bern University, Switzerland, September 2008.
- Ph.D thesis of Hugo Palacios Contreras, Columbia University, USA, 2011.
- Master theis of Federico Virzi, University fo Roma, Sapienza, Italy, 2021.

SUMMARY OF MY ACTIVITIES IN THE RESEARCH FIELD

CHORUS experiment:
search for $\nu_\mu \rightarrow \nu_\tau$ oscillations at the CERN SPS.

In the framework of this experiment I conducted my Ph.D. thesis. In particular I studied the performance of the lead/fibers CHORUS calorimeter. I took care of the measurement of the calibration constants and had the responsibility of the hardware work related to the detector. I also worked on the main neutrino oscillation analysis and on the study of events originated form charmed meson production and decay.

OPERA experiment:
search for $\nu_\mu \rightarrow \nu_\tau$ oscillation in the CNGS "CERN to Gran Sasso" neutrino beam.

I was involved in the early studies for the experiment design in view of the editing of the experiment proposal. I supervised a student for her Master thesis work.

ICARUS experiment:
study of solar, atmospheric, supernova and accelerator neutrinos; search for proton decay and for other rare astroparticle processes at the Gran Sasso Laboratory.

I have been involved in the analysis of the first data recorded on surface with the T600 detector. I actively participated in the design of the ICARUS detector upgrade (magnetized muon spectrometer) and participated in several $R\&D$ activities connected to the project.

ArDM experiment:
$R\&D$ study for a liquid Argon TPC detector for Dark Matter searches.

I took part in the design of the detector and in the studies of the background from material radioactive contamination.

T2K experiment:
search for $\nu_\mu \rightarrow \nu_x$ neutrino oscillation in disappearance mode and $\nu_\mu \rightarrow \nu_e$ oscillation in appearance mode.

As Bern group coordinator, I had the responsibility of the high-precision B-field map measurements conducted with a dedicated automatic device. I participated in the 280 m near detector commissioning and in the preliminary data analysis with neutrino events.
In collaboration with colleagues from CNRS (Lyon) and from ICRR (Tokyo) we proposed to the KEK scientific committee, and got approved, the construction of a calorimeter (LEM) for the monitoring of the low energy tail of the core of the T2K neutrino beam. As analysis duty, I was appointed by the T2K collaboration for the coordination of the search of the Δ^{++} particle in the neutrino data of the close detector.

Neutrino Astronomy:
Cosmological neutrino background detection.

In collaboration with two colleagues we published two papers (JCAP06(2007)015, PHYSICAL REVIEW D79,053009 (2009)) where a novel idea for the detection of cosmological neutrinos was presented an discussed. Those papers triggered a revival of the discussed on relic neutrino detection.

PTOLEMY project:
Experimental program for proof of principle of a future relic neutrino experiment search.

The experimental program of this project is based on the idea proposed in a paper where I am co-author with Gianpiero Mangano and Alfredo G. Cocco (JCAP06(2007)015). In this paper a target loaded with tritium is considered to detect relic neutrinos. The energy of the electron produced in the neutrino capture is measured with unprecedented resolution by mean of a Transition Edge Sensors (TES). The R&D program has received the approval of the LNGS Scientific Committee and the set up of the experimental area is starting. I am serving as Co-spokesperson of the project.

LAGUNA EU project:
Feasibility study of large underground, liquid based detectors for astro-particle physics in Europe.

The LAGUNA project is funded by the European Community in the framework of the FP7 program. I have been the coordinator of the Bern group activities.

NA61/SHINE experiment:
Studies of hadron-hadron interactions at high energy at the CERN SPS.

I had the co-responsibility of designing and building the forward time of flight (ToF) sub-detector aimed at increasing the geometrical acceptance of the apparatus. The ToF featured a time resolution of 120 ps. I was the coordinator of the Bern group.

XENON experiment for Dark Matter search:
Direct search of Weakly Interacting Massive Particles as possible candidates to explain the Dark Matter problem.

After the XENON collaboration has set the best limit on the search of the Dark Matter by running a detector with an active mass of almost 100 kg, the collaboration with the new detector of active mass of $\sim$ 1 tonne (XENON1T) aims at definitively address the long standing question of the Dark Matter existence or prepare the stage for the next step. In this project I have leading roles and I coordinated the construction of the cryostat and of the TPC. The design of the XENON1T detector has the nice feature of embedding already the upgrade to the next generation detector. In fact, by replacing only the active part, i.e. TPC, and adding more Xe while simultaneously exploiting all the service devices of the XENON1T detector the upgrade to the XENONnT detector with an active mass of almost 8 tonnes is possible with a modest budget if compared to scale of the project. The best limit on direct Dark Matter search has been just presented to the international community after 1 tonne x year exposure of the XENON1T and published on PRL.

MOST RELEVANT COLLABORATIONS:

Prof. Elena Aprile, Columbia University;
Prof. Fernando Calle, Politecnico de Madrid
Prof. Gianluca Cavoto, Universitá di Roma Sapienza
Dott. Alfredo G. Cocco, INFN-Naples;
Dott. Gianpiero Mangano, INFN-Naples;
Prof. André Rubbia, ETH-Zurich;
Porf. Carlo Rubbia, CERN;
Prof. Christofer G. Tully, Princeton University;
Prof. Takashi Kajita, Tokyo University.
Dott. Roberto Santorelli, CIEMAT-Madrid

LEADING ROLES:

- **Design and construction of a prototype Time Projection Chamber** with cryogenic liquids , namely a mixture of LAr and LN, for the study of the drift properties of ionization electrons.
- **Design and construction| of a medium size liquid Argon Time Projection Chamber** to study multi-photon interactions processes induced by UV laser beams.
- **Realization of the forward Time of Flight** detector for the NA61 experiment at CERN.
- **Realization of a** $5\ m$ **long drift LAr Time Projection Chamber** for the study of very long drift (ARGONTUBE project).
- **Construction of a computer controlled device** for the high precision measurement of the magnetic field of the T2K magnet, in collaboration with the CERN magnet group.
- **Design and construction of a very high voltage Cockroft-Walton** generator to be operated in liquid Argon for the ARGONTUBE detector.
- **Design and leading of the construction of the counter planes** of an off-axis neutrino monitor (LEM) operated on the T2K neutrino beam.
- **Convener (shared with prof. Marc Schuman)of the Time Projection Chamber Working Group** of the XENON1T experiment from Dec. 2011 to the completion.
- **Convener (Shared with prof. Elena Aprile) of the Cryostat Working Group** of the XENON1T experiment form Dec. 2011 to the completion.
- **Coordination of the R&D program at the Columbia University** to develop a multi-ton Dark Matter detector for the XENON experiment, from Dec. 2011 to the completion.
- **Convener of the Speaker Board** of the XENON project from Nov. 2013 to Feb. 2016.
- **Commissioning manager of the XENON1T** experiment from Apr. 2014 to Sept. 2016.
- **Operation manager of the XENON1T** experiment since April 2016 to July 2017.
- **Technical Coordinator (shared with Dr. Auke Petr)of the XENONnT**.
- **Spokesperson (shared with prof. Chris Tully)** of the PTOLEMY project.

MEMBER of COMMITTEES :

- Member of the LNGS selection committee of "Assegni di Ricerca", 2019-2021.
- Member of the selection committee for a PhD position in astroparticle physics at GSSI, L'Aquila, 2019.
- Member of the INFN "Commissione II" as LNGS coordinator.
- Member of the 60% review panel, required by DOI, of the DUNE-SP Photon Detector System.
- Member of the University of L'Aquila, Gran Sasso Science Institute and -Laboratorio nazionali del Gran Sasso, Joint Colloquium program.

PARTICIPATION in SCIENTIFIC EVENTS:

- Member of the organising committee of the workshop: "ATLAS Overview Week 2008", held at the University of Bern, Switzerland, July 7-11, 2008
- Speaker at the: "SCHOOL on FLAVOUR PHYSICS ", held at the University of Bern, Switzerland, June 21 - July 2, 2010
- Member of the scientific committee of the International Neutrino Summer School 2011, held in Geneva, Switzerland, July 2011.
- Member of the scientific committee of the NNN2011 workshop, held in Zurich, Switzerland, November 2011.
- Convener of the High Energy Oscillation Session of NOW2012 workshop, held in Otranto, Italy, September 2012.

OUTREACH ACTIVITIES ("Attivitá di terza missione"):

- Interview on Linea Verde Life TV-Show, Rai1, as representative of the LNGS, on 15/04/2023.
- Interview on Repubblica TV on Dark Matter, `https://video.repubblica.it/next/alla-ricerca-della-materia-oscura/221629/220835`.
- Interview on TG3/TGLeonardo on XENON1T, `http://www.rai.it/dl/RaiTV/programmi/media/ContentItem-511c0ba2-0bec-4f82-8459-d8c46c9955cc-tgr.html#p=0`.
- Interview on the occasion of XENON1T inauguration, `https://www.youtube.com/watch?v=hh9O7s-6hnk`.
- Interview on "Repubblica", May 14th 2016.
- Interview on "Corriere della Sera", `https://www.youtube.com/watch?v=sKpdt-WpGRo`, July 7th 2020.
- Author of the "Editoriale" and co-author of "Il Neutrino protagonista di storie singolari", on the e-journal `http://accastampato.it/` Issue n. 9, September 2012.
- Interview on Dark Matter on Rai Italia, `http://www.rai.it/dl/RaiTV/programmi/media/ContentItem-e853e83c-8cb9-4657-be87-fda437edb35e.html#p=`.

- Interview on the occasion of XENON1T preparation, `https://www.raiplay.it/video/2015/07/Superquark-del-23072015-2c1c6699-806b-496a-8120-968ff1f31545.html` (SuperQuark time 1:41:11).
- Participation the to the LNGS Open Day and "SHARPER-Notte EUROPEA dei Ricercatori", as claimed by the letter attached to the application form.
- Guide for group of visitors (Italian/English).

REFEREE ACTIVITY:

- Nuclear and Instruments Method A (NIMA)
- Journal of High Energy Physics (JHEP)
- Journal of Instrumentations (JINST)
- Journal of Cosmology and Astroparticle Physics (JCAP)
- Physical Review Letter (PRL)
- Physical Review D (PRD)
- European Physical Journal C

L'Aquila, 04, October 2024

Primo Ricercatore INFN at LNGS
Co-tehcnical Coordinator of the XENONnT
Marcello Messina