Curriculum Vitae Marco Toppi

PERSONAL INFORMATION

Name: Marco Toppi

Date of Birth: 10/10/1983

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CURRENT AND PREVIOUS POSITIONs

10/2022 – now	Researcher (RTD B), SSD PHYS-01/A Dipartimento di Scienze di Base a Applicate per l'Ingegneria (SBAI) Sapienza Università di Roma – Italy
01/2020 – 10/2022	Researcher (RTD A), SSD PHYS-01/A Dipartimento di Scienze di Base a Applicate per l'Ingegneria (SBAI) Sapienza Università di Roma - Italy
03/2016 – 2019	Post.Doc at the Laboratori Nazionali di Frascati (LNF) of INFN *Development of integrated technologies for monolithic pixel trackers,* (within the ALICE experiment at LHC)
11/2014 – 2016	Post.Doc at the Laboratori Nazionali di Frascati (LNF) of INFN *Nuclear Techniques applied to Medical Physics*

EDUCATION

- PhD in Physics - Excellent: *Fragmentation measurements with the FIRST experiment*, Physics Tor Vergata University, Rome – Italy - PhD Supervisors: Prof. Annalisa D'Angelo, Prof. Vincenzo Patera
- Master Degree in Physics - 110/110 cum laude. *Study of the electric discharge in gases by analyzing waveforms induced in RPC with gaps of various sizes* - Physics Tor Vergata University, Rome – Italy - Master Supervisor: Prof.Rinaldo Santonico, Dr. Barbara Liberti
- Bachelor Degree in Physics - 108/110. *Forme di Dinamica Relativistica* - Physics Tor Vergata

University, Rome – Italy - Master Supervisor: Prof. Emanuele Pace

ACADEMIC QUALIFICATIONS AND TRAINING

- **ASN (Abilitazione Scientifica Nazionale)** for Associate Professor in *Experimental Physics of Fundamental Interactions and Applications – FIS01 02/A1 (now PHYS 01/A)*, awarded by the Italian Ministry of University and Research (MUR), [2023].
- **QuID** (Qualità e Innovazione della Didattica) diploma: *Pedagogical and methodological training for university teaching at Sapienza University, completed in 2025*

SCIENTIFIC RESPONSIBILITIES AND COORDINATION ACTIVITIES

2023 – now **Physics Coordinator** of the FOOT collaboration

2023 – now **Local responsible at SBAI and Substitute PI for the project "reSPECT: Towards a new family of nuclear imaging gamma detectors" –** Funding: 304 keuro. PRIN U 40: PROGETTI DI RICERCA DI RILEVANTE INTERESSE NAZIONALE – Bando Prin 2022 - Decreto Direttoriale n. 104 del 02-02-2022 - Prot. 2022Z72Y3K

2023 – now **Local responsible at SBAI and Substitute PI for the project "CETRA: an innovative imaging tool for adaptive IOeRT" –** Funding: 216 keuro. PRIN U 40: PROGETTI DI RICERCA DI RILEVANTE INTERESSE NAZIONALE – Bando Prin 2022 PNNR - Decreto Direttoriale n. n. 1409 del 14-09-2022 - Prot. P2022LCYEW

2021 – 2023 **FlashDC** (Flash Dosimeter Counter) - "Progetti di Gruppi di Ricerca 2020" of Regione Lazio (150 keuros). Responsible for the WP1: Detector development of a dosimeter for FLASH radiotherapy.

2021 – 2022 **Deputy Software Coordinator** of the FOOT collaboration

2020 – 2022 **3DIT**: 3D plastIc scintillaTor - University calls for research, SAPIENZA University, (10keuro), I work at the characterisation of 3D printed samples of organic-metallic scintillator for low cost, high rate SPECT imaging.

2019 – 2021 **PAPRICA** (Pair PRoduction Imaging ChAmber) - INFN CSN5 national project (75keuros). Local Coordinator for the experiment at LNF

TEACHING ACTIVITIES AND SUPERVISION OF STUDENTS

2023 – now Professor of the course of General Physics for the Degree course of "Ingegneria Informatica e Automatica" in the faculty of I3S (Sapienza University)

2023 – 2024 Professor of the course of Experimental Physics Laboratory for the Degree course of "Ingegneria Meccanica" in the faculty of ICI (Sapienza University)

2020 – 2023 Professor of the course of General Physics 2 (Electromagnetism and Optics) for the Degree course of ICI and I3S at Latina (Sapienza University)

2020 – now Co-Supervisor of 3 Master Students in Physics (Sapienza University)
Supervisor of 1 Master Student in Physics (Sapienza University)
Thesis referee of 1 Ph.D Students in Physics (Turin University)

EDITORING AND REVIEWING ACTIVITIES

2023 – now Reviewer of International Scientific Journal: Nuclear Physics A
2022 – now Associate Editor and Review Editor for Frontiers in Physics
2020 – now Reviewer of International Scientific Journal: Journal of Instrumentation JINST
2016 – 2024 Referee as Institute Review Committee for ALICE collaboration

MEMBERSHIPS OF SCIENTIFIC SOCIETIES

2019 – now Member of the FOOT collaboration [https://web.infn.it/foot/en/home/]
2016 – 2024 Associate Member of CERN as member of the ALICE collaboration in LNF
2016 – 2024 Member of the ALICE collaboration @ CERN
2011 – 2016 Member of the FIRST collaboration (FIRST – Fragmentation of Ions Relevant for Space and Therapy)

EXPLOITATION, COMUNICATION AND DISSEMINATION

Activities performed at the Laboratori Nazionali di Frascati (LNF) in the years 2012-2018 for: guided visits program for high school students, organization of the dissemination event of Notte dei Ricercatori, organization of the High School Student Summer , organization of the High-School Teacher Seminars

RESEARCH ACTIVITIES

My research focuses on the field of **Nuclear Physics** and its application to the field of medical physics and in particular to Particle Therapy and Space Radioprotection. The bulk of my research activity, since my PhD, was focused on the study of the nuclear fragmentation and in the development of new detectors. Within the ALICE collaboration I studied light flavour production for the understanding of the Quark Gluon Plasma. I took care of the development and production of the Inner Tracking System (ITS2), the actual vertex detector of ALICE, based on silicon monolithic pixel sensors (ALPIDE)

For the total number of publications, I can quote:

- **h-index of 50** with more than 360 publications in refereed international journals for a total of more than 8000 citations (https://www.scopus.com/authid/detail.uri?authorId=56266672500)
- **5** publication as first author and **3** publication as corresponding author (excluding conferences' proceedings)

Research activity overview

During my career I worked both on data analysis (for fragmentation cross section measurements and for measurement of light flavour hadrons production with ALICE apparatus) and in detectors development. I made my experience in a national and international collaboration environment focused on R&D activities, facing both hardware and software challenges related to such applications.

I started my PhD research work in the **FIRST international collaboration** (Fragmentation of Ions Relevant for Space and Therapy), which aimed to measure the double differential cross sections (in angle and energy) of ^{12}C ions nuclear fragmentation process occurring in thin targets at energies of interests both in the field of particle therapy and in the field of radiation protection in space. I perform the analysis of charged fragments emitted at a small angle, taking care of the measurement of the differential cross sections as a function of the angle and the kinetic energy of the emitted fragments. The analysis has been published in Physical Review C [9] and I presented the results at several international conferences.

After my PhD I continued my work with a research fellow, joining the ARPGroup (Applied Radiation Physics Group) at SBAI Department (Rome, Italy), to work on nuclear fragmentation measurements at the energies of interest for PT applications. In this context my activity was divided among two different and complementary objectives:

- Performing the measurement of differential fragmentation cross sections induced in the patient tissue by ions of energies of interest in PT applications. To perform such measurements, I joined **the FOOT (FragmentatiOn Of Target) collaboration** and within FOOT I worked both on detectors, data acquisition and data analysis performing the first fragmentation cross section measurement of a 16O beam at 400 MeV/n impinging on a C [2]. Thanks to my work in detector and tracks reconstruction I gained the position as deputy coordinator of the FOOT software. Since 2023, I have been coordinating all the ongoing analyses in my current role as Physics Coordinator of the FOOT collaboration [1].
- Performing the *measurement of the secondary particle emission induced by a primary hadrontherapy beam*, with the aim of designing an **online monitor** capable of measuring the beam range inside a patient [6]-[8]. I started developing **tracking detectors** working on a scintillating fibre device - the *Dose Profiler* - for the detection of charged secondary particles emitted during ^{12}C ions treatments. The DoseProfiler was designed to be used as an on-line monitor and has been installed at the CNAO (National Center of Oncological Hadrontherapy) center (Pavia, Italy). *The Dose Profiler is now used within a* ***clinical trial*** *at CNAO with 20 enrolled patients and the first results* ***ever obtained of an on-line monitoring of ^{12}C ions treatments*** *have been published in [8].*

In 2016 I moved to “Laboratori Nazionali di Frascati” (LNF) of INFN (“Istituto Nazionale di Fisica Nucleare”, Italy), working on the upgrade of the **ALICE experiment**, i.e. to its Inner Tracking System (ITS) for the Run 3 of the LHC. The ITS consists of layers of Monolithic Active Pixel Sensors (MAPS) ALPIDE (ALice PIxel DEtector) detectors for which I contributed to the development, pre-production and production phase. I was the local production responsible for the detector test and readout in LNF.
In the same period, I’ve also taken care of the analysis of the measurement of the transverse momentum spectra of light flavour hadrons (pions, kaons and protons) produced in different colliding systems pp, p-Pb, Pb-Pb and Xe-Xe at different energies in the LHC, within the Light Flavour Physics Working Group of ALICE, of interest for the understanding of the properties of the Quark-Gluon Plasma (QGP). Two papers in which I gave a significant contribution in the analysis of the data acquired with the TOF (Time-Of-Flight) detector of ALICE producing TOF standalone transverse momentum spectra for pions, kaons and protons have been published in [4] and [5]. My work of analysis and detector development in ALICE is documented in different invited and attended conferences and seminars where I presented my results [d, e, f, g, h, i].
The experience in the ALICE collaboration have been fundamental to strengthen my knowledge in the detection techniques of nuclear and particle physics. In 2018 I had the chance to put in use the know-how I gained on tracking MAPS detectors in the Particle Therapy field supporting a young national grant (PAPRICA, PAir PRoduction Imaging ChAmber), devoted to the detection of prompt photons emitted in PT treatments, to monitor the range of the beam in the patient. Within PAPRICA, I have been in charge of the LNF group coordination for the development of the tracking detector based on APLIDE sensors for e+e- pairs reconstruction vertexes. The final detector and its expected performances have been published in [7].

My experience with detectors is also completed by my master degree thesis about studying and improving the performances of single and multi-gaps RPCs detectors within the ATLAS RPC group of the University of Rome Tor Vergata. A part of the work of my thesis has been published in [10].

SCIENTIFIC PRODUCTS (selected publications)

1. Ridolfi R., **Toppi M.** et al (FOOT collaboration) “*Angular differential and elemental fragmentation cross sections of a 400 MeV/nucleon 16O beam on a graphite target with the FOOT experiment*”, (2025), accepted in PRC 6 June 2025, https://journals.aps.org/prc/accepted/10.1103/nmw9-ldrm

2. **Toppi M.** et al (FOOT collaboration), "*Elemental fragmentation cross sections for a 16O beam of 400 MeV/u kinetic energy interacting with a graphite target using the FOOT ΔE-TOF detectors*". Front. Phys. 10:979229. doi: 10.3389/fphy.2022.979229
3. Battistoni G. et al. (**Toppi M.** corresponding author), *"Measuring the Impact of Nuclear Interaction in Particle Therapy and in Radio Protection in Space: the FOOT Experiment"* Frontiers in Physics 8 (2021) 568242 doi: 10.3389/fphy.2020.568242.
4. Acharya S. et al. (ALICE collaboration), "Production of charged pions, kaons, and (anti-) protons in Pb-Pb and inelastic pp collisions at sNN =5.02 TeV", Physical Review C, 2020, 101, 4, doi: 10.1103/PHYSREVC.101.044907
5. Acharya S. et al. (ALICE collaboration), Multiplicity dependence of π , K, and p production in pp collisions at √s=13 TeV. *European Physical Journal C* Volume 80, Issue 81 August 2020 Article number 693. 10.1140/epjc/s10052-020-8125-1
6. **Toppi M.** et al., "Monitoring carbon ion beams transverse position detecting charged secondary fragments: results from patient treatment performed at CNAO", Front. Oncol. doi: 10.3389/fonc.2021.601784.
7. **Toppi M.** et al., *"PAPRICA: The Pair Production Imaging Chamber-Proof of Principle"*. Front. Phys. 9 (2021) 568139. doi: 10.3389/fphy.2021.568139.
8. Fischetti M. et al. (**Toppi M.** corresponding author), *"Inter-fractional monitoring of 12C ions treatments: results from a clinical trial at the CNAO facility"* Scientific Reports 10 (1) (2020) 20735 doi: 10.1038/s41598-020-77843-z.
9. **Toppi M.** et al. (FIRST Collaboration), *"Measurement of fragmentation cross sections of 12C ions on a thin gold target with the FIRST apparatus"*, Phys. Rev. C 93 (2016) 064601, doi: 10.1103/PhysRevC.93.064601.
10. Aielli G. et al. "*Improving the RPC rate capability"*, JINST 2016 doi: 10.1088/1748-0221/11/07/P07014.

Seminar and Conferences

(a) Invited talk at the SIF (111° congresso nazionale), *"Status of the FOOT experiment and first results"*
(b) 59th International Winter Meeting on Nuclear Physics, Bormio, 26/01/2023, *"Status of the FOOT experiment and first measurements of 16O fragmentation cross sections on C target"*

(c) PANIC 2021, Online, 5-10/09/2021, *"Measurements of 16O fragmentation cross sections on C target with the FOOT apparatus"*.

(d) ICNFP 2019, Creta, 21-29/08/2019, "*Multiplicity and energy dependence of light charged particle production in ALICE at the LHC"*.

(e) Sapienza University of Rome 2019, **Invited** Seminar, *"Silicon Pixel detector technologies for basic and applied research applications, from CERN to PT experiments"*.

(f) TIFPA 2018, **Invited** Seminar, *"The ALICE Inner Tracking System upgrade"*.

(g) First International DMEG Workshop 2019, Salerno, 10-11/7/2019, **Invited** talk *"Spectra Measurements with MRPC based Time Of Flight system in ALICE"*

(h) SIF 2019, L'Aquila, 23-27/9/2019 "*The upgrade of the ALICE Inner Tracking System"*

(i) INFN-LNF, 11/12/2019, **Invited** Seminar: *"Multiplicity and energy dependence of light charged particle production in ALICE at the LHC"*

(l) 54th International Winter Meeting on Nuclear Physics, Bormio, 25-29/01/2016, *"Measurements of 12C ions fragmentation cross sections on a thin gold target with the FIRST apparatus"*. Proceeding: PoS(BORMIO2016)035.

(m) 12th International Conference on Nucleus-Nucleus Collisions, Catania, 21-26/06/2015, *"Measurement of secondary particle production induced by particle therapy ion beams impinging on a PMMA target"*. Proceeding doi:10.1051/epjconf/201611705007 EPJ Web Conf. 117, 05007.

(n) NUBA Conference Series: Nuclear Physics and Astrophysics, Antalya, Turkey, 15-2/09/2014, *"Measurements of 12C ion fragmentation on thin carbon target from the FIRST collaboration at GSI"* Proceeding in doi:10.1088/1742-6596/590/1/012035 J. Phys. Conf. Ser. 590, 1, 012035.

Quanto dichiarato in queste pagine corrisponde a verità, ai sensi degli articoli 46 e 47 del D.P.R. 445 del 2000

Autorizzo il trattamento dei miei dati personali ai sensi del Decreto Legislativo 30 giugno 2003, n. 196 "Codice in materia di protezione dei dati personali".

DATA, 18/06/2025

FIRMA