

Curriculum vitae

Personal information:

Name: Michela Marafini
Date/place of birth: 12/06/1982, Rome, Italy
Nationality: Italian

Current/past positions:

2016-2018: **Ricercatore Tempo Determinato (RTD)** with Museo Storico della Fisica e Centro Studi e Ricerche Enrico Fermi, at University of Rome La Sapienza
2015-2016: **Grant Young Researchers** with INFN Gruppo V, at INFN Roma 1
2011-2015: **Postdoctoral grant** with Museo Storico della Fisica e Centro Studi e Ricerche Enrico Fermi, at University of Rome La Sapienza (Prof. Vincenzo Patera)

Education:

2008-2011: **Ph.D. in Physics**, University of Paris 7 (APC Laboratory) (supervisor Prof. T.Patzak)
2004-2007: **Master Degree in Physics**, 110/110 cum laude, University of Roma Tre (supervisors Prof. F. Ceradini and Prof. Thomas Patzak).
2001-2004: **Bachelor Degree in Physics**, full marks, University of Roma Tre (supervisor Prof. A.Tonazzo).

Scientific Charges:

2015- : National Responsible of the INFN MONDO Project.
2008-2011: I was in charge of the design the Memphyno prototype and lead the assembly team. During the realization of I had the responsibility of the associated economic resources.

International Collaborations:

From 2015: **CERN, Geneva**; Collaboration with RD51 groups in development on optical GEM readout;
From 2013: **HIT, Heidelberg**; measurement design, installation, commissioning, data taking and analysis of the NCS@HIT experiment at proton, ^{12}C , ^4He , and ^{16}O beams of therapeutically interest. The experiment was focused on the fragmentation of the therapeutical beams and measurement of charged and neutral secondary particles produced in PMMA phantom;
From 2012: **GSI, Darmstadt**; installation and commissioning, data taking and analysis of an experiment at ^{12}C , 220 MeV/nucleon beam for the measurement of the prompt gamma and charged secondary particles fluxes from PMMA phantom to be exploited for dose monitoring purpose;
Summer 2012: **CNAO, Pavia**; experiment at proton beam at CNAO facility (Centro Nazionale di Adroterapia Oncologica) and data analysis. The data taking was focused on the measurement of the prompt gamma and charged secondary particles fluxes from PMMA phantom to be exploited for dose monitoring purpose
2008-2011: **TUM, Munich**; design and feasibility studies of a next generation neutrino experiment; development of new electronics and photo-sensors;
2008-2011: **LAGUNA Collaboration (UK, Spain, France, Finland, Poland, Romania, Italy)**; I collaborated with several Laguna institutions to address the feasibility of a new European research infrastructure hosting a deep underground neutrino detector. In particular, I evaluated the performances of the MEMPHYS detector in the different possible underground sites.
2008-2011: **EUROnu Project** (European Commission FP7 Design Study: *A High Intensity Neutrino Oscillation Facility in Europe*) I actively participated to the evaluation of the performances of the MEMPHYS detector with different kind of possible future neutrino oscillation facilities.
2007-2011: **APC, Paris**; Design and Construction of the Memphyno prototype. Design and feasibility study of MEMPHYS experiment;
Summer 2004: **CERN, Geneva**; Development and test of the commissioning procedure for the MDT detectors in the ATLAS experiment;

Main research activity:

- I started the **Ph.D.** focusing my research on the **neutrino oscillation** investigations. I worked for a megaton water Cherenkov project (MEMPHYS) in the context of the LAGUNA collaboration and the EUROnu European project. In particular, I studied a possible next generation detector for neutrino measurement: θ_{13} and mass hierarchy. I worked on the realization of the Memphys Prototype – MEMEPHYNO - in order to study and implement the electronics developed for the Laguna detectors (PARISROC, LAL-ORSAY) [14]. The prototype, a 7 ton water Cherenkov tank, has been totally constructed at the APC laboratory (Paris 7). The design of the prototype has been developed thanks to my work in collaboration with the APC electronics and mechanics division. I designed and realizing a $2 \times 2\text{m}^2$ muon hodoscope readout by Maroc boards to test photomultiplier tubes and read-out electronics with cosmic rays. I had the chance to follow the Memphyno project from the beginning up to its realization. Memphyno is right now used to test the Parisroc electronics and the photo-detectors needed by the LAGUNA collaboration. During the realization of the prototype I had the responsibility of the associated economic resources.
- In 2011 I decided to continue my activity on **particle detection** and **photo-sensor devices**, but in a different context: **particle therapy (PT)**. I moved to **ARPGGroup** at La Sapienza Università di Roma (S.B.A.I. Department) to work on a project funded by a Centro Fermi. The main goal of my research activity was the integration of neutral and charged secondary particles detection in a single device capable of monitoring the dose delivered to patients during hadrontherapy treatments. Since 2011 I am one of the coordinator of the construction of such an on-line dose profiler, which is foreseen put in operation at CNAO at the end of 2016. My initial work was related to the study of secondary particles productions, aiming to a precise measurement of both rates and emission profile spectra, for charged particles and photons (prompt and PET- γ) [1,2,3]. Afterwards I focused my activity on the design of the device needed to perform the backward tracking of the photons and charged particle (mainly protons) produced by the beam in the patient with the aim to reconstruct the Bragg Peak (BP) position [6,7]. This new technique, which I proposed, should be able to match, in routine treatments, the required precision for a wide application of monitoring devices in therapy centers. In all the different phases of my work, I addressed both hardware and software issues: I built and tested the detectors needed for the secondary fragments production measurements and I followed the data analysis and the writing of the several papers we wrote. During this period I worked to a innovative extended energy range calibration of our LYSO crystal detectors at ENEA laboratory with an AmBe source. The results, that extend the energy calibration range of those crystals up to several MeV, have been published [5]. Since 2014 I have focused my work on the test of the first components of the on-line profiler, and in particular I organized the tests of the scintillation fibers of several size: those studies allowed to perform the first efficiency calculations of the new dosimeter. I take place to several test beam experiment with proton and carbon-ion beams in different particle therapy centers.
- My interest in the **development of new detectors** has led me to work with **different crystals and scintillating materials to study their detection properties**. During 2012 I studied the characterization of the Cherenkov light emitted by the TeO₂ crystals [10]. During 2011-2012 my research activity was also focused on the measurement of the transparency and attenuation length of the p-terphenil (plastic scintillator). This study led to the design of an innovative probe for radio-guided surgery based on p-terpenyl, for which international patent is now pending. The corresponding results have been published [4,11].
- In 2013 I take place to the HIT data taking (ULICE program) and I personally take care of the experimental setup consumption and realization. The test beam outcome has been the study of the different **secondary particle emissions** (Four papers are in preparation). Since 2014 I have been responsible of the forward fragmentation analysis.
- Since 2013 I have started a new research effort devoted to the study of the secondary radiation type that is most challenging from the experimental point of view: the **neutrons produced in PT treatments**. In 2014 I submit a proposal to grant applications (funded by the Italian government and the INFN) for a **neutron-tracking detector** to be used in particle therapy center in order to characterize the secondary neutron productions. The so-called **MONDO project** won the founding and in 2015 with a more detailed detector design I won a SIR (MIUR founding). Since 2015 I am the

national INFN responsible of MONDO and the coordinator of the project.

- The first year of work for the MONDO project has been very productive and I develop two different new approaches to detection: a **triple-GEM** with **optically readout** and a new **SPAD array sensor** developed in collaboration with FBK.

Research Performance:

- **Publications:** 20 publications in refereed international journals with over 90 citations (h index of 4 [ISI database]);
- **Presentations:** 12 presentations at international conferences and several talks at national and international collaboration meetings.
- **Patent:** 2013: Granted patent request, PCT [Patent Cooperation Treaty], PCT/IT2014/000025, for a “Beta radiation probe for the intra-operative identification of tumor residuals”(see [4]).
- **Career supervision:** I co-supervised 3 Ph.D. students. I co-supervised 4 master degrees students and I have been the co-supervisor several (8) bachelor degree students.

Grants and funding:

- 2015, 2018, “MONDO (Monitor for Neutron Dose in hadrontherapy)”, 539K€ funding by SIR program (MIUR).
- 2015, 2017, “MONDO (Monitor for Neutron Dose in hadrontherapy)”, 150K€ funding and contract grant from INFN G5 (Young Researcher Grant).

Grants as member of research group:

- 2013, 2014, “RDH (Research and Development in Hadrontherapy)”, 460K€ grant, I am part of “Dose Monitoring for Hadrontherapy” Work Package V and “Nuclear Fragmentation Studies for Hadrontherapy” Work Package VI.

Publication list:

Representative papers have been selected.

Citations are taken from the Web Of Science database, excluding self-citations.

- In Particle Therapy work (without the Ph.D. supervisor):

1. C. Agodi, et al. *“Precise measurement of prompt photon emission from 80 MeV/u carbon ion beam irradiation”*, **JINST 7 (2012) P03001 (6 citations)**
2. C. Agodi, et al. *“Charged particle’s flux measurement from PMMA irradiated by 80 MeV/u carbon ion beam”*, **PMB. 57 (2012) 5667 (6 citations)**
3. C. Agodi, et al. *“Study of the time and space distribution of β^+ emitters from 80 MeV/u carbon ion beam irradiation on PMMA”* **NIM B 58752 (2012) (1 citations)**
4. E. Solfaroli Camillocci et al. *“A novel radioguided surgery technique exploiting β^- decays”* **NAUTURE, Sci. Rep. 4, 4401 (2014) doi: 10.1038/srep04401**
5. Bellini et al. *“Extended calibration range for prompt photon emission in ion beam irradiation”*, **NIM A, 745C (2014), pp. 114-118**
6. L. Piersanti et al. *“Measurement of charged particles yields from PMMA irradiated by 220 MeV/u ^{12}C beam”* **PMB 59 (2014) 1857-1872 (3 citations)**
7. I. Mattei, et al. *“Prompt- γ production of 220 MeV/u ^{12}C ions interacting with a PMMA target”*, **JINST 10 (2015), P10034**
8. M. Marafini et al. *“High granularity tracker based on a Triple-GEM optically read by a CMOS-based camera”*, **JINST 10 (2015) 12, P12010 doi: 10.1088/1748-0221/10/12/P12010**
9. M. Marafini et al. *“MONDO: a neutron tracker for particle therapy secondary emission fluxes measurements”*, **NIM A 5824 doi : 10.1016/j.nima.2015.10.109**
10. F. Bellini et al. *“Measurements of the Cerenkov light emitted by a TeO₂ crystal”*, **JINST 7 (2012) P11014 (1 citations)**
11. M. Angelone et al. *“Properties of para-terphenyl as detector for alpha, beta and gamma radiation”*,

- In the LAGUNA collaboration:

12. LENA Collaboration (M. Wurm *et al.*) "*The next-generation liquid-scintillator neutrino observatory LENA*", **Astropart.Phys.** **35 (2012) 685-732 (71 citations)**
13. The EUROnu Project (T.R. Edgecock *et al.*) "*The EUROnu project*", **Phys.Rev.ST Accel.Beams** **16 (2013) 021002 (9 citations)**
14. MEMPHYS Collaboration (L.Agostino *et al.*) "*Study of the performance of a large scale water-Cherenkov detector (MEMPHYS)*", **JCAP** **1301 (2013) 024 (9 citations)**
15. MEMPHYS Collaboration (L.Agostino *et al.*) "*Future large-scale water-Cherenkov detector*", **Phys.Rev.ST Accel.Beams** **16 (2013) 061001 (3 citations)**
16. MEMPHYS Collaboration (J.L.Borne. *et al.*) "*MEMPHYS Project*", **NIM A** **639 (2011) 287-289 (3 citations)**
17. MEMPHYS Collaboration (M.Marafini *et al.*) "*Physics with the MEMPHYS detector*", **Acta Phys.Polon.** **B41 (2010) 1733-1748 (1 citations)**
18. MEMPHYS Collaboration (M.Marafini) "*Site studies and R&D for a water Cherenkov Megaton detector in Europe*" **Nucl.Phys.Proc.Suppl.** **229-232 (2012) 432**
19. MEMPHYS Collaboration (J.L.Borne. *et al.*) "*The MEMPHYS project: A large scale water-Cherenkov detector in Europe*", ***Venice 2011, Neutrino Telescopes*** **451-453**
20. LAGUNA Collaboration (Jan Kisiel *et al.*) "*The LAGUNA project: Towards the giant liquid based detectors for proton decay searches and for low energy neutrino astrophysics*" **PoS EPS-HEP2009 (2009) 283**
21. LAGUNA Collaboration (D.Angus *et al.*) "*The LAGUNA design study- towards giant liquid based underground detectors for neutrino physics and astrophysics and proton decay searches*" **arXiv:1001.0077**

International Conferences:

- June 2015, Montenegro. "*Measurement of charged particle yields from therapeutic beams in view of the design of an innovative hadrontherapy dose monitor*" talk at RAD Conference.
- May 2015, Osaka, Japan. "*MONDO Project*" talk at Space Radiation and Heavy Ions in Therapy Symposium 2015.
- September 2014, Krakow, Poland. "*The INSIDE Project*" talk at II Symposium on Positron Emission Tomography. Contribution on ACTA POLONICA Proceeding.
- February 2016, Vienna, Austria. "*MONDO Project*" Poster Contributions at VCI annual conference. Contribution on Proceeding.
- February 2016, Geneva, Switzerland. "*MONDO Project*" Poster Contributions at ICTR-PHE 2016 conference.
- May 2015, La Biodola, Isola d'Elba, Italy "*MONDO Project*" Poster Contributions at 13th Pisa Meeting on Advanced Detectors. Contribution on NIMA Proceeding.
- October 2011, Valentia, Spain. "*Measurement of Prompt Photons, Gamma PET and Charged Particles Production from 80 MeV/u Carbon beam on PMMA target*". – Poster Contribution at IEEE 2011. Contribution on IEEE Proceeding.

Seminars:

Representative seminars after Ph.D. (2011)

- 03/2015 - "*MONDO Project*", at INFN Roma.
- 17/2/2014 - "New online methods to monitor dose profiling in particle therapy treatments" at INFN Roma "*Novel particle physics applications*".