Marta Fischetti

Education

2017-2021 **Ph.D. in mathematical models for engineering, electromagnetics and nano-sciences**, *Excellent cum laude*.
Title of thesis: Inter-fractional monitoring in Particle Therapy treatments with ^{12}C ions exploiting the detection of secondary particles: simulation studies and clinical trial results at the CNAO facility
Supervisors: Professor Alessio Sarti
"Sapienza", SBAI department, University of Rome

2015-2017 **Master's degree of Biomedical Engineering**, *110 cum laude/ 110*.
Title of thesis: *"Possible endo laparoscopic applications of a scintillating toroidal crystal for the identification of tumor residues in radio-guided surgery"* ("Possibili applicazioni endo laparoscopiche di un cristallo toroidale scintillante per l'identificazione di residui tumorali nella chirurgia radio-guidata"),
Supervisors: Professor Vincenzo Patera and Professor Riccardo Faccini
"Sapienza", University of Rome

2011-2014 **Bachelor in clinical engineering**, *95/110*.
Title of thesis: "Cardiac valvular engineering" ("Ingegneria valvolare cardiaca")
Supervisor: Professor Maria Grazia Bonicelli
"Sapienza", University of Rome

Research Performances

h index: 5 with 35 publications, in refereed international journals for a total of 31 citations (database: http://www.scopus.com)

Presentations: 7 presentations at national and international conferences (5 Oral Presentations and 2 Poster Presentation)

Attended Conferences

Sept. 2018, Oral Presentation **104° Italian Physical Society Congress - Arcavacata di Rende (Italy)**.
Characterization of secondary neutron production in particle therapy treatments with the MONDO neutron tracking detector

Spet. 2018, Oral Presentation **104° Italian Physical Society Congress - Arcavacata di Rende (Italy)**.
In-room characterization, using an anthropomorphic phantom, of a novel detector for on-line dose monitoring in light ions cancer therapy

Sept. 2018, Oral Presentation **Società italiana per le ricerche sulle radiazioni - Roma (Italy)**.
Rivelazione e caratterizzazione con il progetto MONDO di neutroni secondari ultraveloci prodotti in terapia con particelle.

Sept. 2018, Poster Presentation	**Società italiana per le ricerche sulle radiazioni - Roma (Italy)**. Use of a commercial CMOS sensor for beta particles detection
June 2019, Poster Presentation	**10th Young Researcher Meeting - Roma (Italy)**. Inter-fractional monitoring in Particle Therapy treatments with 12C ions exploiting the detection of charged secondary fragments
Sept. 2019, Oral Presentation	**International Conference on Medical Accelerators and Particle Therapy - Seville (Spain)**. Inter-fractional monitoring in Carbon ions Particle Therapy treatments with the Dose Profiler detector
June 2021, Oral Presentation	**European Congress of Medical Physics (ECMP) - Turin**. Inter-fractional monitoring in Particle Therapy treatments with 12C exploiting the detection of secondary particles: preliminary clinical trial results at the CNAO facility

Funded Projects

As principal investigator:

2018-2019	***"Avvio alla ricerca"***, *Young Researcher financing*, Research funding: "Performance evaluation of an iterative algorithm, MLEM, which uses a fast Monte Carlo code for online monitoring of the beam range in Particle Therapy". *"Sapienza", University of Rome* Funding: 1250€

As a member:

2019-2021	***"Grant INFN CNS5"***, *"PAPRICA" - The PAir PRoduction Imaging ChAmber*. Funding: 75k€
2019-2021	***"Avvio alla ricerca"***, *"Inter-fractional Monitoring with charged particles"*. Funding: 14k€

Research Activity

I joined the Applied Radiation Physics Group (ARPG) during my Master Thesis work in the framework of the CHIRONE project, which aimed to develop a probe for radio-guided surgery using beta minus radio tracers [10,12,14,19,21,33]. My contribution has been focused to the implementation of a prototype of laparoscopic probe, starting from the know-how gained with the surgery-related probe. I decided to continue my research activity within the ARPG collaboration also for my Ph.D thesis, changing the main topic to Particle Therapy (PT). I was involved in the INSIDE (Innovative Solution for monitoring in Hadrontherapy) project, actively contributing to the development of the Dose Profiler (DP) [16,23,30,32], an on-line treatment monitor for carbon ion treatments at CNAO (Centro Nazionale di Adroterapia Oncologica). The DP, which exploits the detection and the back-tracking of secondary charged particles emitted during a Carbon treatment, has been characterised using therapeutical beams impinging on different type of phantoms in different test-beams performed at CNAO, in which I gained experience in the operation of particle physics detectors in the context of a clinical environment.

The monitoring capability of the DP has been studied in the context of a clinical trial, performed with patients treated at CNAO, aiming to evaluate for the first time the multi-modal INSIDE monitoring performance in real cases. My main contribution was to demonstrate the potential of an innovative

monitoring technique for spotting morphological changes occurring in the patient among different fractions of a carbon ions treatment. The results of the trial (analysing 3 patients) are extremely promising and have been published on Nature - Scientific Reports in 2020 [9]. I also evaluated the technique expected performance by means of Monte Carlo studies based on the FLUKA simulation software and using, as input, the Computed Tomography (CT) scans of patients treated at CNAO. The plan validation related work has represented an excellent opportunity to improve my skills in handling the software for medical images (CT) analysis and the simulation software toolkits.

My interest in the PT field is also related to the proton RBE characterization. I am a member of the FOOT (FragmentatiOn Of Target) collaboration [2,3,7,8,17,18,20,22,25,26,31,34], which aim to evaluate the target fragmentation contribution to the proton Relative Biological Effectiveness (RBE) in the entrance channel in PT treatments.

My software-related work within the ARPG group involved also the implementation of tools and algorithms for the FRED (Fast paRticle thErapy Dose evaluator) fast GPU [13] based MC software package, in order to provide a fast backtracking of the charged particles produced in Particle Therapy treatments.

In the field of monitoring PT treatments by means of the detections of secondary radiation, I have also contributed to the MONDO collaboration, aiming for the development of a tracking detector for fast and ultra-fast secondary neutrons [11,15,16,27,28,29]. I had the opportunity to present my data and MC analysis related work in conferences and to publish it in peer-reviewed journals [29].

I had also the chance to put in use the know-how I gained with the Dose Profiler supporting a young national grant (PAPRICA, PAir PRoduction Imaging ChAmber), devoted to measure the nuclear recoil in the process of photons pair production, for photons of low energy (E < 10 MeV) produced in processes of nuclear de-excitation. The detector expected performances have been studied through a MC simulation and have been published in [5].

Publications

1. Colombi S. et al. "Enhancing the understanding of fragmentation processes in hadrontherapy and radioprotection in space with the FOOT experiment". In: *Physica Scripta* (2021). DOI: 10.1088/1402-4896/ac186b

2. Kraan, A.C. et al. Charge identification of nuclear fragments with the FOOT Time-Of-Flight system(2021).In: *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, DOI:10.1016/j.nima.2021.16520

3. Morrocchi M. et al "Performance Evaluation of the TOF-Wall Detector of the FOOT Experiment". In: IEEE Transactions on Nuclear Science (2020). DOI: 10.1109/TNS.2020.3041433

4. Toppi M. et al. "Monitoring carbon ion beams transverse position detecting charged secondary fragments: results from patient treatment performed at CNAO". In: *Frontiers in Oncology* (2021) DOI: 10.3389/fonc.2021.601784

5. Toppi M. et al. "PAPRICA: The Pair Production Imaging Chamber-Proof of Principle". In: *Frontiers in Physics* (2021). DOI: 10.3389/fphy.2021.568139

6. Fiorina E. et al. "Detection of Interfractional Morphological Changes in Proton Therapy: A Simulation and In Vivo Study With the INSIDE In-Beam PET". In: *Frontiers in Physics* (2021). DOI: 0.3389/fphy.2020.578388

7. Battistoni G. et al. "Measuring the impact of Nuclear Interaction in Particle Therapy and in Radio Protection in Space: the FOOT experiment". In: *Frontiers in Physics* (2021): DOI: 10.3389/fphy.2020.568242.

8. Galati G. et al. "Charge identification of fragments with the emulsion spectrometer of the

FOOT experiment". In: *Open Physics* (2021): DOI: 10.1515/phys-2021-0032.

9. **Fischetti M.** et al. "Inter-fractional monitoring of ^{12}C ions treatments: results from a clinical trial at the CNAO facility". In: *Scientific Report, Nature* (2020). pp. 20735. DOI:10.1038/s41598-020-77843-z

10. Collamati F. et al. "Radioguided surgery with β^- radiation in pancreatic Neuroendocrine Tumors: a feasibility study". In:*Scientific Reports* 10 (2020), p. 4015. DOI:10.1038/s41598-020-61075-2

11. Toppi M. et al. "The MONDO Tracker: Characterisation and Study of Secondary Ultrafast Neutrons Production in Carbon Ion Radiotherapy". In: *Frontiers in Physics* (2020). DOI: 10.3389/fphy.2020.567990

12. Collamati F. et al. "Stability and efficiency of a CMOS sensor as detector of low energy β and γ particles". In: *Journal of Instrumentation* 15,11 (2020). DOI: https://10.1088/1748-0221/15/11/P11003

13. De Simoni M. et al. "FRED: A fast Monte Carlo code on GPU for quality control in Particle Therapy". In: *Journal of Physics: Conference Series* 1548 (2020), p. 012020. DOI: 10.1088/1742-6596/1548/1/012020

14. Morganti S. et al. "Tumor-non-tumor discrimination by a β^- detector for Radio Guided Surgery on ex-vivo neuroendocrine tumors samples", In: *Physica Medica* 72 (2020), pp. 96-102, DOI: 10.1016/j.ejmp.2020.03.021

15. Gioscio E. et al. "Development of a novel neutron tracker for the characterisation of secondary neutrons emitted in Particle Therapy". In: *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* 958 (2019). pp. 162862. DOI: 10.1016/j.nima.2019.162862

16. Mattei I. et al. "Charged particles and neutron trackers: Applications to particle therapy". In: *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* 954 (2020). p.161229 DOI: 10.1016/j.nima.2018.09.064

17. Dong Y. et al. "The Drift Chamber detector of the FOOT experiment: Performance analysis and external calibration". In:*Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* 986 (2020), DOI: 10.1016/j.nima.2020.164756

18. Traini G. et al. "Performance of the ToF detectors in the foot experiment". In: *Nuovo Cimento della Societa Italiana di Fisica C* 43 (2020), DOI: 10.1393/ncc/i2020-20016-5

19. Collamati F. et al. "A DROP-IN beta probe for robot-assisted ^{68}Ga-PSMA radioguided surgery: first ex vivo technology evaluation using prostate cancer specimens". In: *EJNMMI Research* 10,92 (2020). DOI: https://doi.org/10.1186/s13550-020-00682-6

20. Mattei I. et al. "Measurement of 12C Fragmentation Cross Sections on C, O, and H in the Energy Range of Interest for Particle Therapy Applications". In: *IEEE Transactions on Radiation and Plasma Medical Sciences* 4, pp 269-282 (2020), DOI: 10.1109/TRPMS.2020.2972197

21. Collamati F. et al. "Characterisation of a β detector on positron emitters for medical applications", In: *Physica Medica* 67 (2019). pp. 85-90, DOI: 10.1016/j.ejmp.2019.10.025

22. Manuzzato E. et al. "A 16×18 Digital-SiPM Array with Distributed Trigger Generator for Low SNR Particle Tracking". In: *IEEE Solid-State Circuits Letters* (2019). pp. 75-78. DOI:10.1109/LSSC.2019.2934598

23. Traini g. et al. "Review and performance of the Dose Profiler, a particle therapy treatments

online monitor". In: *Physica Medica* 65 (2019). pp. 84-93. DOI:10.1016/j.ejmp.2019.07.010

24. Rucinski A. et al. "Secondary radiation measurements for particle therapy applications: Charged secondaries produced by 16O ion beams in a PMMA target at large angles". In: *Physica Medica* 64 (2019). pp. 45-53. DOI: 10.1016/j.ejmp.2019.06.001

25. Morrocchi M. et al. "Development and characterization of a ΔE-TOF detector prototype for the FOOT experiment". In: *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* 916 (2019).pp. 116-124. DOI: 10.1016/j.nima.2018.09.086

26. Montesi M. C. et al. "Ion charge separation with new generation of nuclear emulsion films". In: *Open Physics* 17 (2019). pp. 233-240. DOI: 10.1515/phys-2019-0024

27. Giacometti V. et al. "Characterisation of the MONDO detector response to neutrons by means of a FLUKA Monte Carlo simulation". In: *Radiation Measurements* 119 (2018). pp. 144-149. DOI: 10.1016/j.radmeas.2018.10.006

28. Mirabelli R. et al. "In-room performance evaluation of a novel online charged secondary particles monitor of light ions PT treatments". In: *2018 IEEE Nuclear Science Symposium and Medical Imaging Conference Proceedings* (2018). pp. 1-3. DOI: 10.1109/NSS-MIC.2018.8824552

29. **Fischetti M.** et al. "Characterisation of the secondary-neutron production in particle therapy treatments with the MONDO tracking detector". In: *IL NUOVO CIMENTO 41 C* 206 (2018). DOI: 10.1393/ncc/i2018-18206-5

30. De Simoni M. et al. "In-room test results at CNAO of an innovative PT treatments online monitor (Dose Profiler)". In: *IL NUOVO CIMENTO 41 C* 209 (2018). DOI: 10.1393/ncc/i2018-18209-2

31. Valle S. M. et al. "The FOOT (FragmentatiOn Of Target) experiment". In: *IL NUOVO CIMENTO 41 C* 41 (2018). p. 169. DOI: 10.1393/ncc/i2018-18169-5

32. Mattei I. et al. "Scintillating fiber devices for particle therapy applications". In: *IEEE Transactions on Nuclear Science* 65 (2018). pp. 2054-2060. DOI: 10.1109/TNS.2018.2843179

33. Morganti S. et al. "Position sensitive β^- Detector based on p-terphenyl scintillator for medical applications". In: *Journal of Instrumentation* 13 (2018). p. 07001. DOI: 10.1088/1748-0221/13/07/P07001

34. Andrey A. et al. "The foot fragmentation of target experiment"In: *Proceedings of the 15th International Conference on Nuclear Reaction Mechanisms, NRM 2018* (2018), pp. 305-311

Ph.D. School

14 Oct. - 31 Dic. 2020) **Scuola MRI Prof. Girolamo Garreffa - Metodi e Tecniche di Risonanza Magnetica**, Online.

The course, organized by the Sicilian School of Radiation Protection "S. Masculine", aims both to provide basic knowledge on the physical principles of magnetic resonance imaging and the instrumentation used to acquire MR images and to show the applications in the clinical setting also through the use of advanced MR techniques. In addition, recent applications of artificial intelligence in the field of MRI are presented.
https://sites.google.com/community.unipa.it/scuolamri2020

2018 **PRISMA School**, *University of Mainz*, Germany.

Photosensors and Signal Processing in Particle Detectors
https://indico.mitp.uni-mainz.de

Training Courses

2018	24 CFU for teaching qualification

Teaching Experience

2019-2020	**Assistant**, *for the course of Physics I (Classical Mechanics and Thermodynamics) for Mechanical Engineer students held by Prof. M. Rossi*, Sapienza University of Rome, Italy - SBAI Departments.
2018	**Co-supervisor of a Bachelor Student**, *from Sapienza University of Rome, Italy - Physics Departments.*
2010–Present	**Tutoring**. Private tutoring sessions for high school students on scientific subjects.

Languages

Italian	Mothertongue
English	British school B2 certificate