

## Curriculum vitae

### PERSONAL INFORMATION

Family name, First name: Mirabelli Riccardo

### CURRENT AND PREVIOUS POSITIONS

Since 09/2021

#### **Researcher Post-Doc**

*“Ottimizzazione e sviluppo di metodiche di rilevazione per studi di biodistribuzione di radiofarmaci marcati con emettitori beta-”*

*(Optimization and development of detection methods for beta- radiopharmaceuticals biodistribution studies)*

Supervisor: Prof. D. Rotili

**Dipartimento di Chimica e Tecnologie del Farmaco,  
“Sapienza” - Università di Roma, Rome, Italy  
INFN - Sezione di Roma Scientific Association**

11/2019-08/2021

#### **Researcher Post-Doc**

*“Development of low energy radiation detectors for medical application”*

Supervisor: Prof. R. Faccini

**Dipartimento di Fisica, “Sapienza” - Università di Roma, Rome, Italy  
INFN - Sezione di Roma Scientific Association**

### EDUCATION

11/2016-02/2020

#### **Ph.D.** in Accelerator Physics (XXXII cycle) - *Excellent*

*“Development of a new tracking device for characterisation and monitoring of ultra fast neutron beams”*

Supervisor: Prof. V. Patera and Dr. M. Marafini

**Dipartimento di Scienze di Base e Applicate all’Ingegneria (SBAI),  
“Sapienza” - Università di Roma, Rome, Italy  
INFN - Sezione di Roma Scientific Association**

11/2014-10/2016

#### **Master Degree** in Physics - *110/110 cum laude*

*“Caratterizzazione di un prototipo di tracciatore per l’esperimento MONDO”*

*(Characterisation of a tracker prototype for the MONDO experiment)*

Supervisor: Prof. R. Faccini and Dr. M. Marafini

**Dipartimento di Fisica, “Sapienza” - Università di Roma, Rome, Italy  
INFN - Sezione di Roma Scientific Association**

09/2011-11/2014

#### **Bachelor Degree** in Physics - *110/110*

*“Rivelatori per Scintigrafia (SPECT Detectors)”*

Supervisor: Prof. R. Faccini and Dr. M. Marafini

**Dipartimento di Fisica, “Sapienza” - Università di Roma, Rome, Italy  
INFN - Sezione di Roma Scientific Association**

## TEACHING ACTIVITIES

- 2019 - 2020 Course of *Scientific Computation* for foreign students [10 hours]  
**Dipartimento di Fisica, “Sapienza” - Università di Roma, Rome, Italy**
- 2018 – 2019 *Assistant* for the course of *Physics I (Classical Mechanics and Thermodynamics)* held by Prof. A. Sarti for Mechanical Engineer students. [40 hours]  
**Dipartimento di Scienze di Base e Applicate all’Ingegneria (SBAI), “Sapienza” - Università di Roma. Rome, Italy**
- 2017 – 2018 *Assistant* for the course of *Physics II (Electromagnetism and Optics)* held by Prof. M. Migliorati for Space and Astronautical Engineer students. [40 hours]  
**Dipartimento di Scienze di Base e Applicate all’Ingegneria (SBAI), “Sapienza” - Università di Roma. Rome, Italy**
- 2017 – 2018 *Assistant* for the course of *Math OFA (Obblighi Formativi Aggiunti)* for students with formative debts. [40 hours]  
**Dipartimento di Fisica, “Sapienza” - Università di Roma, Rome, Italy**
- 2014 – 2015 *Assistant* for the course *Electronics Laboratory (Laboratorio di Segnali e Sistemi)* for Physics students. [150 hours]  
**Dipartimento di Fisica, “Sapienza” - Università di Roma, Rome, Italy**

## SUPERVISION OF STUDENTS AND POSTDOCTORAL FELLOWS

- From 2018 *Supervised*: 1 Master Student and 4 Bachelor Students from Dipartimento di Fisica, “Sapienza” - Università di Roma, Roma, Italy

## EDITORING and REVIEWING ACTIVITIES

- 2021 - Reviewer of International Scientific Journal: **Scientific Reports**  
2020 - Reviewer of International Scientific Journal: **Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms**

## PUBLIC COMPETITIONS

- Eligible of INFN Call 23523/2021 for the professional profile of III professional level Researcher with permanent employment contract, for research activities in the field of experimental nuclear physics (CSN III).

## RESEARCH PERFORMANCES

My research focuses on developments of new detectors and on application of nuclear physics detection techniques to different fields, in particular to the medical one. Both Particle Therapy and Nuclear Medicine fields offered me the opportunity to investigate different detection strategies and devices.

- **h index of 8** with **~45 publications** in refereed international journals for a total of about **185 citations** (database: <http://www.scopus.com>);
- **4 publications** in refereed international journals as **first author** and **3 as corresponding author**;
- **10 presentations** at national and international conferences and workshops;

## MAJOR COLLABORATIONS

- 2021- **VUB - Vrije Universiteit Brussel**  
<sup>90</sup>Y-based radiofarmaceuticals biodistribution studies on small animals (S. Hernot, P. Covens, I. Remory)
- 2019 - **IFO - Istituti Fisioterapici Ospedalieri - Istituto Nazionale Tumori Regina Elena**  
 Collaboration activities within WIDMApp Project. Detector calibrations and measurements on test phantoms and patients. (B. Cassano, G. Iaccarino, A. Soriani)
- 2019 - **Policlinico Universitario Agostino Gemelli - Università Cattolica del Sacro Cuore**  
 Development of new radoopharmaceuticals. Tests of the introperative  $\beta$  probe with  $\beta$ - and  $\beta^+$  radioisotopes. (A. Giordano, T. Scotonella)
- 2019- **IEO - Istituto Europeo di Oncologia**  
 Ex-vivo and In-vivo tests of  $\beta$  Radioguided Surgery on Intestine Neuroendocrine Tumors with <sup>90</sup>Y-DOTATOC and <sup>68</sup>Ga-DOTATOC. In-Vivo test on Prostatic Tumors with <sup>68</sup>Ga-PSMA.
- 2017 - **CNAO - Centro Nazionale di Adroterapia Oncologica, Pavia.**  
 Member of INSIDE project.  
 Activities with carbon and proton beam facility (M. Pullia):  
Monitor for low intensities beam development. Characterisation of low intensity beam (beam width, number of particles in bunches, beam deviation).  
 Measurements of 12-C Fragmentation Cross Section on C,O and H.
- 2016 - **FBK - Fondazione Bruno Kessler.**  
 Development of the SBAM electronic readout (L. Gasparini, M. Perenzoni) for the MONDO project: collaboration activities in the design phase, in the development of the acquisition software and in the electronic calibration test of the device.  
Visiting student in September 2019: Development of the SBAM sensor DAQ and GUI system, measurements on first sensor prototype.
- 2017 - 2020 **TIFPA - Trento Institute for Fundamental Physics and Application.**  
 Member of the SPARE project for the measurement and characterisation of active and passive shield for space radiation protection (C. La Tessa, F. Tommasino).
- 2017-2020 **CREF - Musei Storico della Fisica e Centro Studi e Ricerche E.Fermi**  
 Scientific association: Activity in Experimental Neutron Physics (QMN beam monitor development, fragmentation measurements for radio protection in space) and in CMOS sensor development.

## FUNDED PROJECTS

### • as Principal Investigator:

- 2021 - **Avvio alla ricerca** (Young Researcher financing) - “Sapienza” - Università di Roma  
 “Sviluppo di un rivelatore innovativo per la misurazione della biodistribuzione in piccoli animali di radiofarmaci marcati con Y90 (Development of an innovative detector for biodistribution measurements of Y90-labeled radiopharmaceuticals in small animals)”. Funding: 3000 euro.
- 2017 – 2018 **Avvio alla ricerca** (Young Researcher financing) - “Sapienza” - Università di Roma  
 “Misura della risoluzione temporale del sistema ToF dell’esperimento FOOT (FragmentatiOn On Target) basato su un calorimetro phoswich (Measurement of the ToF system resolution for the FOOT experiment based on a phoswitch calorimeter)”. Funding: 1000 euro.

- *as a Member:*

- 2020 – 2023 **Progetti Medi Sapienza** - “Sapienza” - Università di Roma “*Nanomaterials for nanomedicine: from chemical synthesis to applications*”. Funding: 15 keuro.
- 2020 – 2023 **INFN CSN V Experiment** - “*WIDMAPP: Wearable Individual Dose Monitoring Apparatus*” - Responsible of the Working Package 3: Measurement on test phantoms.
- 2018 – 2021 **Progetti Medi Sapienza** - “Sapienza” - Università di Roma “*SOLE: Secondary photons OnLine monitor Experiment*”. Funding: 12 keuro.
- 2018 – 2020 **Premiale 2016.** “*SPARE (Space Radiation Shielding)*” - Funding 1.432 Meuro. The project main goal is to build irradiation facilities in two INFN laboratories (TIFPA and LNL) for experimental tests (using high-energy proton and neutron beams) of physical (active and passive shielding materials) and biomedical (hibernation) countermeasures for human space exploration. I am part of WP400 “*Detectors*”, working on the QMN beam monitor.

## RESEARCH ACTIVITY

My research activity is mainly devoted to the development of new technologies in the context of the **applied nuclear physics**.

In all the different phases of my work, I have faced and overcome different hardware and software challenges: I built and tested detectors needed both for the secondary fragments production measurements and primary beams characterisations, performed the data analysis and published the results on peer-reviewed international journals.

I develop and characterize new device for nuclear medicine application.

I also gain some experience in signal processing, both with commercial electronics (NIM/VME) and custom electronics thanks to the synergy work performed in my career with FBK.

### Nuclear Fragmentation in Particle Therapy and Radioprotection in Space:

I joined the ARPG (Applied Radiation Physics Group) during my Master Thesis in Particle Physics and I decide to continue my work in the collaboration also for my Ph.D thesis.

My main activity concerns **the development of a tracking device for fast and ultra-fast secondary neutrons detection for applications in Particle Therapy and in radio-protection in space**: I collaborate on the construction of the MONDO prototype at “Sapienza” Università di Roma - SBAI department in close collaboration with the mechanical service. I participate to the data taking campaigns with electrons at Beam Test Facility of INFN-LNF and with protons at the Trento Proton Therapy Centre experimental room. In parallel, in collaboration with Fondazione Bruno Kessler (FBK), I work at **the development of the electronic readout of the MONDO experiment**, a new SPAD array sensor. I am collaborating with the FBK engineers in the design phase, in the development of the acquisition software and in the electronic test of the device.

Since 2017 I am also responsible of **the implementation of the readout system in the FLUKA Monte Carlo simulation** of the MONDO detector.

In the context of the SPARE (SPAcE Radiation Shielding) project (*Premiale MIUR*), aiming at the development of a new Quasi-Monoenergetic Neutron facility at INFN-LNL and at the characterisation on different shielding material for radio-protection in space both for charged and neutral particle, I am the responsible of the simulation studies of MONDO as **fragmentation neutrons detector and beam monitor for QMN beams**.

The work carried out within the SPARE collaboration both in detector development and simulation studies has been presented in my Ph.D. thesis.

I am also the responsible of the Monte Carlo studies of the possible application of **MONDO as an**

**online monitor exploiting the detection of secondary prompt photons emitted in Particle Therapy treatments.** This research has been supported by the “Sapienza” within the SOLE: *Secondary photons OnLine monitor Experiment* project (Progetto Medi Sapienza). Moreover, using the knowledge acquired with MONDO, I participated to the development of the Dose Profiler detector (INSIDE collaboration).

In 2017 I have worked on the construction of an on-line tracker monitor for the CNAO therapy center and I participated to the calibration and commissioning of the device. The measurements campaign was aimed to **characterise the low intensity carbon ion and proton beams** that could be provided to the users of the new experimental room that will be completed at CNAO in the next few years.

From 2016 to 2019 I was a member of the **FOOT (INFN-CSN III)** collaboration, devoted to the Relative Biological Effectiveness (RBE) proton measurements for PT applications and radio-protection measurements for space applications. My work in the collaboration has been focused on the test of the “Start Counter” time detector performances. I also gave an important contribution to the R&D work aimed to **develop a phoswich detector** made by the combination of fast plastic scintillator and BGO crystal.

### **New Technologies in Experimental Particle Physics and Nuclear Medicine:**

I also carried out R&D activities for the development of **new detectors and technologies**.

Since 2018 I am involved in the TOPS (Time Of flight Plastic Scintillators) project, a collaboration with scientists of different backgrounds (chemists, solid state physicists, particle physicist, ecc.) for the realisation of **new fast plastic scintillators**. I am in charge of new scintillators time resolution measurements with different readout systems. I participate to the calibration data taking of the new plastic scintillator sample with m.i.p. particles, radioactive sources and with light ions (protons and carbon ion) beam at CNAO.

I contributed on a project in which **radio-guided surgery can be performed by means of a novel probe exploiting the detection of  $\beta$  radiation**. In particular I collaborate to the feasibility study for expanding the application cases of the  $\beta$  probe to gynecological tumor with F18 based radiofarmaceuticals uptake.

I am also the person in charge for the development a **multi-channel** version of the existing probe. I am collaborating at the design phase and I am conducting the campaigns of measurements for its characterization.

I am also collaborating at the In-vivo tests of  $\beta^+$  Radioguided Surgery on Intestine Neuroendocrine Tumors with 68Y-DOTATOC and on Prostate Cancer with 68Ga-PSMA: I am one of the person in charge at the development of the final design of the  $\beta$  laparoscopic probe and I am also one of the responsible of the analysis of the data obtained in the experimentation.

I am also the responsible for the realization of **a new detector for small-animal bio-distribution measurements with  $\beta^-$  radiofarmaceuticals**. The device, after its realisation, will be used for the validation of a new class of  $^{90}\text{Y}$ -based radiofarmaceuticals.

Within the **WIDMApp project (INFN - CSN V)**, devoted to the precise determination of absorbed dose in Molecular Radio Therapy through an innovative system of wearable photon counters, **I am the responsible of the measurements campaigns of the detector on different phantoms** of the in order to test the feasibility of the whole system.

### **SCIENTIFIC OUTCOME**

- **Conferences and Seminars - Oral Presentations**

- (I) 06/2022 **World Congress on Medical Physics and Biomedical Engineering**, Singapore, *"Feasibility study of a Wearable Individual Dose Monitoring Apparatus for Internal Dosimetry in Targeted Radionuclide Therapy"*.
- (II) 11/2020 **XIX SIRR (Società Italiana Ricerca sulle Radiazioni) National Congress**, Online, *"Feasability study of a Wearable Individual Dose Monitoring Apparatus for Molecular radionuclide therapy"*
- (III) 09/2019 **105 Italian Physical Society Congress**, L'Aquila, Italy, *"MONDO tracker for secondary ultra-fast neutron characterization in Particle Therapy"*
- (IV) 09/2019 **FATA2019: Fast Timing Applications for nuclear physics and medical imaging workshop**, Catania, Italy *"TOPS Project: Development of New Fast Timing Plastic Scintillators"*.  
Contribution on: Nuovo Cimento della Societa Italiana di Fisica C, 43 (1), art. no. A17. DOI: 10.1393/ncc/i2020-20017-4
- (V) 11/2018 **IEEE Nuclear Science Symposium and Medical Imaging Conference**, Sydney, Australia, *"In-room performance evaluation of a novel charged particles monitor of light ions PT treatments"*.
- (VI) 06/2018 **World Congress on Medical Physics and Biomedical Engineering**, Prague, Czech Republic, *"Particle Therapy secondary neutrons characterisation with the MONDO project"*.
- (VII) 09/2017 **103 Italian Physical Society Congress**, Trento, Italy, *"Study and design of a Drift Chamber for the FOOT experiment"* & *"MONDO neutron tracker characterisation by means of proton therapeutical beams and Monte Carlo simulation studies"*
- (VIII) 05/2017 **8th Young Researchers Meeting**, Cagliari, Italy, *"MONDO: A tracker for the characterization of secondary fast and ultrafast neutrons emitted in Particle Therapy"*.  
Contribution on IOP Conf. Series: Journal of Physics: Conf. Series 956 (2018) 012013 doi: 10.1088/1742-6596/956/1/012013
- (IX) 09/2016 **102 Italian Physical Society Congress**, Padova, Italy, *"MONDO: a neutron tracker for particle therapy secondary emission fluxes measurements."*.  
Special mention for the best presentation in "Medical Physics and Biophysics session".  
Contribution on IL NUOVO CIMENTO 40 C (2017) 99 DOI 10.1393/ncc/i2017-17099-0

- **Poster Presentations**

- (i) 07/2018 **NDRA2018 - Summer School in Neutron Detectors**, Riva del Garda (TN), Italy, *"Secondary neutrons characterization in Particle Therapy with the MONDO tracker"*.
- (ii) 10/2017 **SQUAD2017 - Advanced School on QUAntum Detectors**, Trento, Italy, *"The SBAM sensor for the MONDO experiment"*.

## ATTENDED SCHOOL

- **Ph.D Schools**

07/2018        **NDRA2018 - Summer School in Neutron Detectors**, Riva del Garda (TN), Italy  
 10/2017        **SQUAD2017 - Advanced School on QUAntum Detectors**, Trento, Italy;  
 01-02/2017    **JUAS 2017 - ESI - Joint Universities Accelerator School**, Archamps, France.  
 Final examination: graduated (Top 8).

- **Scientific courses**

2014            **GraSPA 2014 - Summer School in Particle and Astroparticle Physics**,  
 Annecy-le-Vieux, France, LAPP scholarship for excellent student.

07/2015      *Re-writing Nuclear Physics textbooks: 30 years of radioactive ion beam physics,*  
Pisa, Italy, INFN scholarship for excellent students in Nuclear Physics.

## OUTREACH

2018 - 2019      **LAB2GO**, Rome, Italy,  
Internship for High School student (Alternanza scuola-lavoro) in Physics laboratories.  
*Tutor* for the student of "Ignazio Vian" High School [40 hours]

05/02/2019      Training Course Event for **FameLab2019**  
Museo Storico della Fisica e Centro Studi e Ricerche E.Fermi, Rome, Italy,

2014 - 2015      **Scuola Sperimentale di Comunicazione della Scienza (Experimental School on Science Communication)**, asSaggi bookshop Rome, Italy [45 hours]  
Course organised by asSaggi bookshop in collaboration with MaddMaths! and EPS.

Rome,  
3 Oct 2022

**Riccardo Mirabelli**

**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".**