Antonio Trigilio

Curriculum Vitæ

Personal information

first name Antonio
last name Trigilio

sex male
driving license B

Education

Nov. 2020 – today **Ph.D. in Accelerator Physics**.
Università degli studi "La Sapienza", Roma.
Ph.D. Stage with the Applied Radiation Physics Group.
Supervisor: Prof. Alessio Sarti.

Sept. 2017 – Oct. 2020 **Master's Degree in Physics**.
Università degli studi "La Sapienza", Roma: 110/110.
Particle and Astroparticle Physics Curriculum, course of study in English.
Master's Degree Stage with the Applied Radiation Physics Group on the MONDO project at SBAI Department.
Master's Thesis Title: "The MONDO secondary neutron tracker for particle therapy application: implementation of the event reconstruction algorithm".
Advisor: Prof. Riccardo Faccini. Co-Advisor: Dr. Michela Marafini.
Graduation date: 23/10/2020.

Sept. 2013 – July 2017 **Bachelor's Degree in Physics**.
Università del Salento, Lecce: 108/110.
Bachelor Stage at Università del Salento and CERN.
Thesis Title: "Misure di efficienza e ottimizzazione di un setup di MicroMeGaS".
Advisor: Prof. Edoardo Gorini.
Graduation date: 26/07/2017.

Ph.D. Schools

7-11 June 2021 **XXXII international seminar of nuclear and subnuclear physics "Francesco Romano"**.
The school, based in Otranto, Italy, offers lectures on various current topics in particle and astroparticle physics, including sessions dedicated to science communication.
During the final day, students are invited to give talks about their research activity.

11 Jan. – 5 Feb. 2021 **JUAS, Joint Universities Accelerator School**.
Course 1 - The Science of Particle Accelerators
Taught by leading figures in accelerator physics, JUAS holds five-week courses yearly at the European Scientific Institute (ESI) in Archamps, France, on the science, technology and application of particle accelerators, in partnership with CERN and 16 European universities. The courses serve as an academically accredited training activity for master and doctoral students.
At the end of the school, students are evaluated with a written exam.
Final grade: 15.29/20.

Training

2016 Study week at CERN Laboratories, Geneva, funded by the Faculty of Mathematical, Physical and Natural Sciences of Università del Salento, following measurements of MicroMeGaS performances done by the ATLAS group.

Research activity

My formation is primarily that of an experimental physicist specialized in detectors and accelerators for medical applications of radiation physics. I work in close collaboration with both physicists and engineers on the technological challenges and phenomenological investigation of particle therapy.

My first experience with a group of accelerator physicists was conducted for my Bachelor's Degree thesis under the Lecce ATLAS Group, with whom I worked on measures of efficiency and optimization of a MicroMeGaS detectors setup, intended to be installed for the major Large Hadron Collider upgrade, the High-Luminosity LHC. I also had the chance to spend a week at CERN laboratories following their research. I learned about the principles and technology of detectors for particle physics and gained confidence in computing methods for large data analysis using primarily the ROOT package. I calculated the efficiency of the detectors using signals produced by cosmic rays, together with an estimation of the apparatus intrinsic noise, and performed analysis on space and time resolution.

During my Master's Degree years, I became interested in medical applications of physics, particularly in the field of particle therapy; with the intent to pursue this interest, for my Master's thesis work, I joined the Applied Radiation Physics Group (ARPG) of "La Sapienza" University on the MONDO project, dedicated to the development of a tracker for the secondary neutrons produced during Particle Therapy sessions. My thesis title was "The MONDO secondary neutron tracker for particle therapy applications: implementation of the event reconstruction algorithm". Ultra-fast neutron production is considered an urgent issue for the evaluation of particle therapy efficacy, due to the additional dose they are responsible for. The MONDO innovative neutron tracker exploits the single and double elastic scattering of neutrons inside a matrix of plastic scintillator fibers to fully reconstruct the incoming neutron four-momentum.

I actively contributed to the writing and implementation of the reconstruction algorithm that will be used to process the considerable amount of data from the pixelated readout of the tracker. The algorithm, written in C++, has to work with a large number of readout channels and signals produced by protons of different energies (from very few fibers activated by protons of energy around 20 MeV, up to hundreds of fibers for high energy protons), taking into account also the detector noise contribution, and select interesting events that allows for a complete characterization of the secondary neutron population. For the first time in MONDO development, I was able to evaluate important parameters such as energy resolution, background rejection and detection capability without exploiting Monte Carlo truth information, and using only hardware parameters and measurable variables (proton track length and direction). This thesis work gave me the chance to develop computer skills and problem solving, acquire further knowledge of an experiment design and testing, and learn how to handle the output of simulations obtained with the FLUKA package. The most relevant results were presented as a recorded relation to the 106th National Congress of the Italian Physical Society, and an article on the same subject has been published on a dedicated number of the journal Nuovo Cimento C.

Currently, as a Ph.D. student in Accelerator Physics, I am continuing to collaborate with the ARPG on

the new frontiers of particle therapy. My research activity is now focused on therapy with electrons and investigation of the FLASH effect; this potentially revolutionizing technique involves electrons at energies of order 10-100 MeV to treat deep-seated solid tumors at very high dose rates (> 40 Gy/s) compared to conventional radiotherapy, with equal efficacy against tumors and better healthy tissues sparing. The FLASH effect mechanism and the possibility of implementing it in clinical practice, significantly reducing the duration of therapy sessions and opening up a new field of research of physics, biology and medicine, are under thorough investigation by both physical and medical communities. One of the most relevant challenges is to develop a compact instrument capable of monitoring the instantaneous beam intensity in FLASH regime, overcoming the limitations of standard monitoring technologies that, at high dose rate, suffer from saturation effects. I am working with the Flash-DC (Flash Detector beam Counter) project on the design, construction and testing of a preliminary device based on the air fluorescence physical principle.

I am also contributing to the important task of designing a new software tool, developed using GPU hardware, for fast planning of radiotherapy and Particle Therapy treatments. For this purpose I am now starting to learn the basics of GPU development using CUDA for NVIDIA hardware. This will be used to achieve a significant reduction in the processing time of the MC simulation and a fast optimization of the treatments.

Publications

1. Trigilio A. "New reconstruction algorithm for the fast neutron MONDO tracker", Il Nuovo Cimento **44 C** (2021) 16, DOI: 10.1393/ncc/i2021-21016-7.

Presentations and Attended Conferences

12-16 Sept. 2021 **Applied Nuclear Physics Conference - Prague, Czech Republic**.
Oral presentation: *MONDO: A scintillating fibre tracker for secondary neutron measurements in Particle Therapy*.

10 Sept. 2021 **Workshop S.I.R.R. Società Italiana per la Ricerca sulle Radiazioni - Napoli, Italy**.
Oral presentation: *FlashDC project: development of a beam monitor for FLASH therapy*.

14-18 June 2021 **9th International Conference on Radiation in Various Fields of Research - Herceg Novi, Montenegro**.
Oral presentation: *Prostate cancer FLASH therapy treatments with electrons of high energy: a feasibility study*. Abstract DOI: 10.21175/rad.abstr.book.2021.36.9

14-18 Sept. 2020 **106th National Congress of the Italian Physical Society - online**.
Presented recorded relation: *Preliminary characterization of a SPAD based sensor for the MONDO neutron tracker*. Awarded as best communication in the Biophysics and Medical Physics section by the scientific committee.

Computer skills

Good knowledge of programming languages C and C++. Basic knowledge of Python and Fortran.

Good familiarity with ROOT and FLUKA scientific softwares.

Rome, September 16, 2021