DICHIARAZIONE SOSTITUTIVA DI ATTO DI NOTORIETA'

Il sottoscritto dott. **Marco Mirra**

IN RELAZIONE ALLA DOMANDA DI PARTECIPAZIONE AL CONCORSO DEL BANDO N.20012/2018, CONSAPEVOLE DELLE SANZIONI PENALI PREVISTE DALL'ART. 76 DEL D.P.R. 28 DICEMBRE 2000, N. 445 PER IL CASO DI DICHIARAZIONI FALSE O MENDACI,

DICHIARA

che tutto quanto riportato nel seguente curriculum vitae corrisponde al vero.

Marco Mirra
CURRICULUM VITAE ET STUDIORUM

Education and Academic Qualification

- PhD in Fundamental and Applied Physics, University of Naples "Federico II", 21st April 2016, Supervisor: F. Ambrosino.
- Physics Master's Degree (Subnuclear and Astroparticle Curriculum), 110/110 cum laude, University of Naples "Federico II", 22nd March 2013, Advisor: F. Ambrosino
- Electronic Engineering Master's Degree, 110/110 cum laude, University of Naples "Federico II", 22nd July 2009, Advisor: N. Rinaldi
- Electronic Engineering Bachelor's Degree, 110/110 cum laude, University of Naples "Federico II", 23rd October 2006, Advisor: E. Napoli

PhD Thesis:

-**M. Mirra** , "CHANTI: a fast and efficient charged particle veto detector for the NA62 experiment at CERN", Physics PhD thesis project (2016)

Master's Theses:

-**M. Mirra** , "Simulation and test of the CHANTI detector for the measurement of the branching ratio of the ultra rare $K^+ \to \pi^+ \nu\bar{\nu}$ decay with the NA62 experiment at CERN", Physics Master's Degree thesis project (2013)
-**M. Mirra** , "A phase calibration procedure for closely spaced multi-tone signals fully compatible with on wafer measurements", Electronic Engineering Master's Degree thesis project (2009)

Professional experience

- (April 2019 - present) Researcher at the INFN – Napoli Section
- (June 2016 - March 2019) Research Fellow at the Physics Department "Ettore Pancini" of the University of Naples "Federico II"
- (July 2016 - June 2017) Fellowship (associated member of the personal) at CERN thanks to INFN-CERN associate programme
- (March 2013 - March 2016) PhD student in Fundamental and Applied Physics at the University of Naples "Federico II"

Responsibility

- NA62 Napoli team leader from 2020 to present
- Coordinator of the mechanical workshop service for the INFN-Napoli
- Convener of the "Intensity Frontier" section for the IFAE 2019 conference
- Member of the Local Organizing Committee for the Rare kaon decays workshop in Anacapri (May 2019)
- Responsible of the dark photon analysis in the NA62 experiment
- Responsible of the CHANTI simulation in the NA62 software framework
- Deputy coordinator of the CHANTI detector experts for the NA62 experiment
- Run Coordinator of the NA62 experiment at CERN during 2017-2018 data taking
- Expert of the development of the CHANTI online monitoring software for the NA62 experiment at CERN
- Expert of the trigger and data acquisition system of the NA62 experiment at CERN during 2016 data taking
- Expert of the online monitoring system of the NA62 experiment at CERN during 2016-2018 data taking
- Expert of the CHANTI detector of the NA62 experiment at CERN during 2014-2018 data taking

Conference Talks:

- International Conferences
  - ✓ **8th International Conference on New Frontiers in Physics** (August 2019, Kolymbari - Creta): "Search for exotic decays with NA62"
  - ✓ **8th International Conference on New Frontiers in Physics** (August 2019, Kolymbari - Creta): " KLEVER: an experiment to measure BR($K_L \to \pi^0 \nu\bar{\nu}$) at the CERN SPS"

- ✓ **Rencontres de Moriond – QCD session** (March 2019, La Thuile): **"**Search for an invisible vector boson from pi0 decays at NA62"
- ✓ **Rencontres de Moriond – QCD session** (March 2018, La Thuile): **"**Search for dark photons at NA62"
- ✓ **Light Dark Matter** (May 2017, La Biodola - Isola d'Elba): **"**Search for dark photon at NA62 in beam-dump mode"
- ✓ **Current trends in Flavor Physics** (March 31 2017, Paris, Francia): **"**Heavy neutral leptons searches from kaon experiments at CERN"
- ✓ **New Trends in High-Energy Physics** (October 4 2016, Budva, Becici, Montenegro): **"**Neutral pion form factor by the NA62 experiment"
- ✓ **XIIIth International Conference on Heavy Quarks and Leptons** (May 22-27 2016, Center for Neutrino Physics, Virginia Tech, Blacksburg, Virginia); "Search for $K^+ \to \pi^+ \nu\bar{\nu}$ at the NA62 experiment"
- ✓ **14th ICATPP conference on Astroparticle, Particle, Space Physics and Detectors for Physics Applications** (Villa Olmo, Como 2013): **"**The CHarged ANTIcounter for the NA62 experiment at CERN"

- ➢ Italian Conferences
  - ✓ **Incontri di Fisica delle Alte Energie** (IFAE 2017), Trieste: "Exotic particle searches at NA62"
  - ✓ **Incontri di Fisica delle Alte Energie** (IFAE 2014), L'Aquila: "Results and prospects on Kaon physics with the NA62 experiment at CERN"
  - ✓ **XCIX Congresso della Società Italiana per Fisica** (SIF 2013), Trieste: "The CHarged ANTIcounter for the NA62 experiment at CERN"

Conference Posters:

- ➢ International Conferences
  - ✓ **Frontier detectors for frontier physics** – 13th Pisa Meeting on Advanced Detectors, La Biodola -Isola d'Elba, May 2015: "The CHarged ANTIcounter for the NA62 experiment at CERN"

School attended:

- ➢ International school of subnuclear physics – 53rd Course: "The future of our physics including new frontiers", Erice, Italy, 24th June – 3rd July 2015
- ➢ 6th International School of Trigger and Data Acquisition (ISOTDAQ 2015), Brazilian Center for Physics Research (CBPF), Rio de Janeiro, Brasil, 28th January – 5th February 2015
- ➢ The 2014 CERN European School of High Energy Physics, Garderen, The Netherlands, 18th June – 1st July 2014

Technical skills summary:

- ➢ Programming: C, C++, MATLAB, LabVIEW
- ➢ Framework: CERN ROOT (statistical analysis), Geant4(Montecarlo simulation framework for radiation and particle interaction with matter)

- Electronics laboratory: VME and NIM standard experience, GPIB and CANbus protocol for the remote control of laboratory instruments; intense use of oscilloscope, signal generator, spectrum analyzer, multimeter, vector network analyzer, synthesizer.
- Operating Systems: Linux, Windows

Other:

- Tutor for the Physics International Masterclasses during the 2014 and 2015 editions
- Supervisor of the following thesis:
  - ✓ Bachelor's thesis: "Studio della vita media del K+ nell'esperimento NA62 al CERN", Giovanni Gaudino, Anno accademico 2018-2019, Università degli Studi di Napoli Federico II
  - ✓ Bachelor's thesis: "Studio della composizione del fascio adronico dell'esperimento NA62 al CERN", Siria Facciolli, Anno accademico 2018-2019, Università degli Studi di Napoli Federico II
  - ✓ Master's thesis: "Study of the $K^+ \to \pi^+ \nu\bar{\nu}$ decay with the NA62 experiment", Renato Fiorenza, Anno accademico 2018-2019, Università degli Studi di Napoli Federico II

Research activity

The following list summarizes the main topics of Dr. Mirra's research activity. For more details, you can refer to the section "Detailed research activity".

A. Novel calibration technique for microwave and radiofrequency devices
B. Construction of the CHarged ANTIcounter detector for the NA62 experiment at CERN
C. Performance of the CHarged ANTIcounter detector for the NA62 experiment at CERN
D. Studies on the efficiency of photon veto detectors for the NA62 experiment at CERN
E. Data analysis for dark photon search at NA62

Detailed research activity

A. During the Electronic Engineering Master's Degree thesis project, Dr. Mirra worked as Erasmus student at the University of Delft. He developed a new calibration technique for the characterization of microwave and radiofrequency devices working in non-linear regime fully compatible with on wafer measurements. In this kind of characterization, it is often required to excite the device under test using a large number of closely spaced sinusoids, with proper amplitude and phase in order to correctly mimic the cumulative distribution function of the communication standard under consideration. When the phase information of the input and output signals are required, e.g. for waveform reconstruction or behavioural model extraction, a phase calibration step is needed in order to evaluate the phase offset introduced by the hardware used for the characterization. In his thesis work, Dr. Mirra proposed a novel phase calibration procedure with its related hardware solution. The work has been presented at the 75th Microwave Measurements Conference (ARFTG) in 2010. During his Master's Degree thesis work, Dr. Mirra gained a good experience in the remote control of measurements instruments using Matlab programmes with GPIB protocol.

B. Since February 2012, Dr Mirra has been a member of the NA62 Collaboration. NA62 is an experiment based at the CERN North Area, the goal of which is to measure the branching ratio (BR) of the ultra-rare decay $K^+ \to \pi^+ \nu\bar{\nu}$. This flavour-changing neutral current weak decay is forbidden at

tree level in the SM. Its BR is expected to be of the order of ~10^{-10} and the goal of NA62 is to measure it with a 10% precision. Comparison of this measurement with the very precise SM prediction would confirm or exclude certain models for new physics.
Dr Mirra leads the simulation (by means of C++ libraries of the Geant4 toolkit) of a charged-particle detector system for NA62 to veto upstream inelastic interactions of the kaon beam (CHarged ANTIcounter), and played key roles in its development and construction. The detector consists of a series of six guard counters surrounding the beam and placed immediately after the silicon tracker. Each guard counter is made up of two layers, X and Y. Y (X) layer is composed of 24 scintillator bars arranged parallel to X (Y) direction. Each bar is triangularly shaped with a 1.7 mm diameter hole. In order to collect the light of the scintillator, a wavelength shifting (WLS) fiber is inserted into the hole of each bar. The fiber is mirrored at one side and is read by a Hamamatsu silicon photomultiplier (SiPM) at the other side. Dr. Mirra worked on the tests of the scintillator bars both in an auto-trigger configuration and in combination with a cosmic ray telescope. In this way information on both the bar global and local response was collected, and combined to define a quality criterion to accept/reject the single bar for the final detector assembly.
The CHANTI front-end (FE) electronics was developed in collaboration with an external designer; several tests on the front-end electronics has been performed by Dr Mirra with a LabVIEW automated acquisition system. Dr. Mirra was responsible for the calibration of the full CHANTI FE electronics chain, which was successfully used during the 2014 and 2015 NA62 runs.

C. During the NA62 runs in 2014 and 2015, Dr. Mirra actively participated to the data taking and was also CHANTI detector expert for more than two months. He presented several studies on the CHANTI data in the collaboration meetings. The data collected have been analyzed by means of the CERN Root library. Dr. Mirra evaluated CHANTI performance (time and spatial resolution, charged particle detection efficiency and accidental veto) and reported them in "*CHANTI: a fast and efficient charged particle veto detector for the NA62 experiment at CERN*", Journal of Instrumentation, Volume 11, P03029, March 2016.
For the 2016 NA62 run, Dr. Mirra served as Trigger and Data Acquisition (TDAQ) system expert for two weeks and Online Monitor system expert for three weeks as well as CHANTI expert for more than one month. In July 2016 he started his one year fellowship at CERN thanks to INFN-CERN associate programme in order to study the $K^+ \to \pi^+ \nu\bar{\nu}$ online selection performance on the first NA62 data. He was involved in the evaluation of the beam background for the main analysis $K^+ \to \pi^+ \nu\bar{\nu}$: kaon inelastic interactions in the silicon spectrometer, used to measure the kaon momentum itself, are a source of background if the additional energy goes undetected and either a prompt pion track is emitted and the vertex is wrongly reconstructed, or a long-lived particle (K_S or K^+) is produced almost parallel to the original K^+ and subsequently decays. The efficiency to detect pion interactions in the last silicon spectrometer station with CHANTI has been preliminary measured using non kaon events.

D. Dr. Mirra was also involved in the evaluation of the photon detection efficiency of one of the photon veto detector (named LAV, based on lead-glass technology) of the NA62 experimental apparatus. To this purpose, a $K^+ \to \pi^+\pi^0$ sample was selected, with one photon from the $\pi^0 \to \gamma\gamma$ decay hitting the liquid krypton electromagnetic calorimeter of NA62. Given the kaon, pion, and photon momenta, it is possible to select events in which the other photon from π^0 points towards the LAV detector to study its efficiency. Preliminary results were reported in the NA62 collaboration meetings.

E. Dr. Mirra worked on the research for an invisible vector boson A' from π^0 decays collected during the 2016 NA62 data taking. The analysis is based on the selection of a $K^+ \to \pi^+\pi^0$ sample and the search for an event topology with a K^+ in the initial state and a π^+ and one single γ in the final state.

Given the kaon, pion, and photon momenta, respectively P_K, P_π and P_γ, the squared missing mass $\left(P_K - P_\pi - P_\gamma\right)^2$ is expected to peak around the A' mass for the interesting decay $\pi^0 \to A'\gamma$ and around zero for the natural background due to $\pi^0 \to \gamma\gamma$ (branching ratio ~99%). Upper limits on the existence of the A' particle have been reported by the NA62 collaboration to the SPS and PS Experiments Committee (SPSC) in April 2017. These results were also shown by Dr. Mirra at the Rencontres de Moriond (QCD session) conference in 2018 and 2019. During the 2017, 2018 and 2019 NA62 collaboration meetings, Dr. Mirra presented several studies on the estimation of the upper limits on the existence of the A' and finally reported them in "*Search for production of an invisible dark photon in π^0 decays*", JHEP 05 (2019) 182 .

Concerning the 2017 NA62 data taking, Dr. Mirra was chosen as Run coordinator for the period 5th June – 26th June; he also served as CHANTI expert for two months and Online Monitor expert for two weeks. For the 2018 NA62 data taking, Dr. Mirra served again as Run coordinator from 9th July – 23rd July, as well as CHANTI expert and Online Monitor expert.