



Francesco Carenini

Curriculum Vitae

Personal data

Place of birth Seriate, Bergamo (BG)
Nationality Italian
Date of birth 15/11/1998

Contacts

email francesco.carenini2@unibo.it

Driving license

11/2017 Achievement of driving license, category B

Education

- from 11/2022 **International PhD College (selection procedure winner)**, Institute of Superior Studies, Bologna, Italy.
to present Full member of the International PhD College in Bologna. The International PhD College is an institution of excellence offering an interdisciplinary education to PhD students enrolled in a PhD program of Bologna University.
- from 11/2022 **Ph.D. in Astroparticle Physics (scholarship winner)**, Alma Mater Studiorum-Università di Bologna, Italy.
to present PhD student in Nuclear and Subnuclear Physics.
- from 09/2020 **Master Degree in Physics**, Università degli studi di Roma, La Sapienza, Italy.
to 10/2022 Particle and Astroparticle physics curriculum.
Final grade: 110/110 cum laude
- from 09/2017 **Bachelor Degree in Physics**, Università degli studi di Trieste, Italy.
to 09/2020 Final grade: 109/110
- 2012-2017 **High School Diploma in classical studies**, Liceo Classico Paolo Sarpi, Bergamo.
Final grade: 91/100

Networks and affiliations

from 06/2023 **Partner PhD of RIASISSU.**
to present The Italian Network of Students of Schools and Institutes of Advanced University Studies (RIASISSU) is the association that brings together all students of the Italian Schools of Advanced Studies.

Membership of International Scientific Collaborations

from 10/2021 **Full member of the KM3NeT Collaboration.**
to present Developing a neutrino flares search in a time-dependent likelihood framework with the KM3NeT/ARCA detector and characterising the time-dependent variation of the synchronisation latencies between the KM3NeT/ARCA Base-Modules. Member of both the regular and multimessenger online KM3NeT shift groups, responsible for the monitoring of the detector. Run Coordinator of data acquisition in 2023. Member of the Outreach Committee.

Activities within the KM3NeT Collaboration

from 11/2022 **Doctoral Thesis in Astroparticle Physics.**
to present Supervisor: Prof. Annarita Margiotta
Cosupervisor: Dr. Giulia Illuminati

from 10/2021 **Master thesis in Astroparticle Physics.**
to 10/2022 Defended on : October 21st, 2022
Title: *On the sensitivity of KM3NeT/ARCA towards high-energy neutrinos from Gamma-Ray bursts*
Supervisor: Prof. Silvia Celli
External-supervisor: Dr. Angela Zegarelli

Membership of other Scientific Societies

from 10/2021 **Associate member of the National Institute for Nuclear Physics (INFN).**
to present Firstly as a Master Student, then as a Ph.D. Student.

Roles of responsibilities

from 10/2023 **Run coordinator for the KM3NeT data acquisition.**
to 12/2023

Teaching experiences

A.Y. 2023/24 **Teaching assistant for the course of General Physics T-B**, Alma Mater Studiorum-Università di Bologna, Italy.
30 hours of teaching support to be given during the academic year 2023/2024, for the students of the first cycle degree program in Energy Engineering, Department of Industrial Engineering. Tasks include frontal teaching lessons, reception and preparation of written exam tests.

A.Y. 2023/24 **Teaching assistant for the course of General Physics T-B (A-K)**, Alma Mater Studiorum-Università di Bologna, Italy.
25 hours of teaching support to be given during the academic year 2023/2024, for the students of the first cycle degree program in Engineering Management, Department of Industrial Engineering. Tasks include frontal teaching lessons, reception and preparation of written exam tests.

A.Y. 2022/23 **Teaching assistant for the course of General Physics T-B**, Alma Mater Studiorum-Università di Bologna, Italy.

30 hours of teaching support to be given during the academic year 2022/2023, for the students of the first cycle degree program in Energy Engineering, Department of Industrial Engineering. Tasks include frontal teaching lessons, reception and preparation of written exam tests.

A.Y. 2022/23 **Teaching assistant for the course of General Physics T-B (A-K)**, Alma Mater Studiorum-Università di Bologna, Italy.

25 hours of teaching support to be given during the academic year 2022/2023, for the students of the first cycle degree program in Engineering Management, Department of Industrial Engineering. Tasks include frontal teaching lessons, reception and preparation of written exam tests.

International Schools

Jan. 2024 - **1st RESTART Camp on Soft Skills**, Bologna, Italy.

Feb. 2024 Leadership, Team Working and Public Speaking for a Research Career. The program also included elements of emotional intelligence, human communication and other fundamental relational/social skills. All participants from RESTART presented in a public event their research result, with the scope to make the presentation understandable also by the non experts.

September **ONSCI-Officina di Narrazione della Scienza Summer School**, Bologna, Italy.

2023 Theoretical lessons, laboratory activities and testimonies on the use of storytelling in scientific, informative or specialized seminars, in educational activities and public engagement.

from 06/2023 **International School in AstroParticle Physics 2023: Neutrino physics, astro-**
to 07/2023 **physics and cosmology**, Varenna, Lake Como, Italy.

Poster: "Untriggered flares search with the KM3NeT/ARCA neutrino telescope".

Organization of conferences and meetings

Member of the Local Organizing Committee for the ANTARES-KM3NeT Collaboration Meeting, 12-16 February 2024, Bologna, Italy.

Member of the Local Organizing Committee for the #1 WP7 Meeting: Implementation of multi-messenger liaisons, 24-25 May 2023, Bologna, Italy.

Third mission

Scientific and Cultural dissemination

02/2024 Participating to the Student Café 2024, orientation days dedicated to undergraduates who want to enroll in a degree program in physics at Bologna University.

from 02/2024 Member of the Outreach Committee of the KM3NeT Collaboration, in charge of
to present dissemination and communication of the KM3NeT science and technical progress.

from 06/2023 Leader of the Physics&Technology section within the Antropia project.
to 01/2024

from 11/2022 Member of the International PhD College in Bologna, developing co-working activities
to present and attending selected seminars and lectures, in order to realize a multi-disciplinary dissemination project.

from 12/2020 Writing scientific articles for dissemination and publishing videos for the educational to present project Antropia (www.antropia.it).

Publications

- [1] S. Aiello et al. "Embedded software of the KM3NeT central logic board". In: *Comput. Phys. Commun.* 296 (2024), p. 109036. DOI: 10.1016/j.cpc.2023.109036. arXiv: 2308.01032 [astro-ph.IM].
- [2] S. Aiello et al. "First observation of the cosmic ray shadow of the Moon and the Sun with KM3NeT/ORCA". In: *Eur. Phys. J. C* 83.4 (2023), p. 344. DOI: 10.1140/epjc/s10052-023-11401-5. arXiv: 2211.08977 [astro-ph.IM].
- [3] S. Aiello et al. "KM3NeT broadcast optical data transport system". In: *JINST* 18.02 (2023), T02001. DOI: 10.1088/1748-0221/18/02/T02001. arXiv: 2210.13328 [astro-ph.IM].
- [4] S. Aiello et al. "Probing invisible neutrino decay with KM3NeT/ORCA". In: *JHEP* 04 (2023), p. 090. DOI: 10.1007/JHEP04(2023)090. arXiv: 2302.02717 [hep-ex].
- [5] S. Aiello et al. "Searches for neutrino counterparts of gravitational waves from the LIGO/Virgo third observing run with KM3NeT". In: (Nov. 2023). arXiv: 2311.03804 [astro-ph.HE].
- [6] S. Aiello et al. "The Power Board of the KM3NeT Digital Optical Module: design, upgrade, and production". In: (Nov. 2023). arXiv: 2311.14872 [astro-ph.IM].
- [7] A. Albert et al. "Hint for a TeV neutrino emission from the Galactic Ridge with ANTARES". In: *Phys. Lett. B* 841 (2023), p. 137951. DOI: 10.1016/j.physletb.2023.137951. arXiv: 2212.11876 [astro-ph.HE].
- [8] A. Albert et al. "Search for neutrino counterparts to the gravitational wave sources from LIGO/Virgo O3 run with the ANTARES detector". In: *JCAP* 04 (2023), p. 004. DOI: 10.1088/1475-7516/2023/04/004. arXiv: 2302.07723 [astro-ph.HE].
- [9] A. Albert et al. "Searches for neutrinos in the direction of radio-bright blazars with the ANTARES telescope". In: (Sept. 2023). arXiv: 2309.06874 [astro-ph.HE].
- [10] Mathieu Lamoureux et al. "Follow-up of O3 gravitational wave events with neutrinos in ANTARES and KM3NeT telescopes". In: *PoS ICRC2023* (2023), p. 1506. DOI: 10.22323/1.444.1506.
- [11] Mathieu Lamoureux et al. "Hint for a TeV neutrino emission from the Galactic Ridge with the ANTARES telescope". In: *PoS ICRC2023* (2023), p. 1103. DOI: 10.22323/1.444.1103.
- [12] T. Unbehaun et al. "Prospects for combined analyses of hadronic emission from γ -ray sources in the Milky Way with CTA and KM3NeT". In: (Sept. 2023). arXiv: 2309.03007 [astro-ph.HE].

Computing skills

Operating systems macOS, Linux

Tools ROOT, Numpy, Jupyter, GitHub, GitLab

Languages C, C++, Python, Fortran, MATLAB

Document LaTeX, Microsoft Office packages

Communication skills

Italian, mother tongue.

English, Level B2.

-2020-2022 Master course at the University of Rome, La Sapienza, completely English taught

-04/2016: Cambridge Certificate

-2011: Summer stage in Winchester

Latin, as a written language.

-2012-2017: studied translation from Latin to Italian

Greek, as a written language.

-2012-2017: studied translation from Greek to Italian

Master thesis

- title On the sensitivity of KM3NeT/ARCA towards high-energy neutrinos from Gamma-Ray bursts
- supervisor Prof. Silvia Celli
- external-supervisor Dr. Angela Zegarelli
- description KM3NeT/ARCA neutrino telescope is located in the Mediterranean sea, 100 km off-shore Portopalo di Capo Passero in Sicily. It consists of several vertical string-like structures equipped with optical sensors, namely each string is made of eighteen Digital Optical Modules (DOMs), with in turn 31 photomultipliers (PMTs) each. Those PMTs measure Cherenkov radiation emitted by charged particles produced by neutrino passage in seawater and their subsequent interactions. Muons produced by charged current interactions travel through the volume of the detector and leave a track-like signature. KM3NeT reconstruction algorithms are able to infer the energy and direction of the incoming neutrino, starting from PMT information. In this context, the identification of neutrinos from Gamma-Ray Bursts (GRBs) would provide new insights into the physics of processes happening inside those sources, which are still poorly understood. The goal of this thesis project is to perform a statistical analysis, to determine which are the ideal parameters that optimize the discovery capability of ARCA to GRBs neutrinos. The analysis, conducted on track-like events, exploits Monte Carlo neutrino simulations performed for a transient point source, like a GRB, for ARCA in a 115-lines configuration, i.e. one instrumented Building Block (BB). Then, the detector response functions, as the effective area and the point spread function, are studied, in order to know how many signal and background events we may expect, given a certain flux, and with which angular resolution. As a final goal, the sensitivity of the ARCA detector, with 1 BB, to a point-like cosmic neutrino flux from GRBs is investigated in the muonic flavour.

Bachelor thesis

- title The mass-metallicity relation in galaxies and its interpretation
- supervisor Prof. Maria Francesca Matteucci
- co-supervisor Dr. Emanuele Spitoni

description The aim of this thesis project is to study the mass-metallicity relation in galaxies. This relation relates the mass of stars in galaxies to the relative abundance of oxygen in the interstellar medium, called metallicity, and has been studied taking into account the observational relation found by Curti et al.(2020). I've done a computational work, in which I studied different galactic evolution models and put constraints on them in order to reproduce the observational data. The results can be summarized as follows: it is necessary to assume that galaxies undergo phenomena of infalls and outflows of gas from the galactic system and that the parameters describing them change with stellar mass in galaxies; the comparison between these data and our theoretical models suggests that galactic winds must be more intense compared to what has been previously predicted in other studies; this new difference can be due to the more robust calibration method used in the observation of metallicity in galaxies by Curti et al. (2020). Then, it has been confirmed that models which include galactic flows can put constraints on the parameters, like infall and galactic winds, provided that the hypothesis of instantaneous recycling is still a valid approximation.

Other research activities

from 03/2021 **SFERA project.**
to 07/2021 Institute: Sapienza University.

Description: In the context of "Physics Laboratory II" master course, I have worked in a group of 4 people on the SFERA electromagnetic calorimeter. Main goal of our work has been the calibration of the apparatus, exploiting a ^{137}Cs radioactive source and studying the response of PMTs in terms of total collected charge. After that, we analyzed spectra of several sources (^{22}Na , ^{133}Ba , ^{60}Co) with the goal of analyzing the linearity of the response in terms of energy, focusing also on the correlation of signals coming from adjacent channels of the calorimeter. Finally we have estimated the time resolution of our detector fitting the pulse shapes provided by the digitizer.

from 12/2019 **Internship for students of Bachelor degree.**
to 04/2020 Institute: International Centre for Theoretical Physics (ICTP), Trieste, Italy.

Description: I wrote from scratch a genetic algorithm for the study of optimization problems, critically analyzing the results obtained and working with the Fortran programming language. In particular, I dealt with the problem of maximizing 1 in a binary string of 0 and 1 and I conducted a study on the parameters that appear in a genetic algorithm, namely the probability of reproduction, the probability of mutation, the length of the strings themselves and the number of individuals who are selected from time to time as being better than their population. The study has led to a choice of parameters that allows to approach an optimal solution, identified using a function, called fitness, that evaluates the goodness of individuals (binary strings) generated by the algorithm.

Other skills

Writing.

-2015-2017: Taking part to the course of editorial writing at the association "Il Paese che non c'è" in Bergamo.

-2014-2015: Taking part to basic and advanced creative writing course of the association "Il Paese che non c'è" in Bergamo.

Experiences

From April 2021: Plastic Free volunteer

From March 2021 to October 2022: Student Representative in Physics Department Council at the University of Rome, La Sapienza

11/2015-12/2015: Guide at the art exhibit "Lo Specchio attraversato" for the association "The Blank Contemporary Art", in Bergamo.

2015: Taking part to the regional selection of the International Philosophy Olympiads with a dissertation about Immanuel Kant.