



Matteo Sanguineti

Fixed-term researcher

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Education and training

2016

PhD in Physics

Search for GRB neutrino emission according to the photospheric model with the ANTARES telescope

University of Genoa - Genoa - IT

2016

PhD in Physics

Search for GRB neutrino emission according to the photospheric model with the ANTARES telescope - Très honorable

Université Paris 7 Diderot - Paris - FR

2012

Master's Degree in Physics Fundamental InteractionsAstrophysics

Measurement of ultra-high energy neutrino flux from Fermi bubbles with the ANTARES detector - 110/110 cum laude

University of Genoa - Genoa - IT

Academic experience

2018 - ONGOING

Researcher

University of Genoa - Genoa - IT

Collaboration KM3NeT-ANTARES experiments

2017 - 2018

Research fellow

INFN Genoa - CPPM Marseille - Genoa - Marseille - IT

KM3NeT-ANTARES experiment collaboration

2016 - 2017

Research fellow

University of Genoa - Genoa - IT

WHALESAFE experiment collaboration

Language skills

Italian

Mother tongue

English

Expert

French

Good

Teaching activities

- 2023 - ongoing Lecturer in Acoustic Physics for the Degree Course in Speech Therapy (2 Academic Years)
- 2022 - ongoing Lecturer in Astroparticle Physics for the Degree Course Master of Science in Physics (3 academic years)
- 2021 - ongoing Supervisor of 4 MSc theses in Physics
- 2018 - ongoing Lecturer in General Physics (Bachelor of Mechanical Engineering) (6 Academic Years)
- 2019 – ongoing Member of the Examination Committee for the Course in Nuclear Physics, of the Particles and Astrophysics 1 (5 Academic Years)
- 2019 – 2022 Coordinator Freshers Project for the three-year degree course in Mechanical Engineering
- AA 2017/2018 Co-Lecturer in General Physics (Bachelor's Degree in Mechanical Engineering)
- AA 2017/2018 Co-Lecturer in the Physics of Materials Laboratory (Bachelor's Degree in Physics of Materials)
- AA 2016/2017 Teaching assistance for the Experimental Physics course with Earth System Applications (BSc Geology)

Teaching and research activities in higher education

- 2019 - 2022 Lecturer in Particle Physics and Astro-Particle Multi-Messenger for the PhD Course in Physics (4 years)
- 2017 - today Supervisor of 5 PhD theses in Physics

Academic activity

- 2024 - today Member of the Physics Department Council - Commission regulation
- 2024 - today Representative of the University of Genoa in the Council Governing Board of the Inter-University Cetacean Research Centre
- 2019 - today Physics Department representative on the committee dissemination of the MFN School of Science.

Research projects

- 2023 - today **Principal Investigator** of the **ALICA** project funded through PRIN 2022. The project aims to study the background due to cosmic rays in KM3NeT for measurements of astrophysical interest and neutrino oscillations, and intends to carry out studies of cosmic rays and their cross sections.
- 2023 - today **Training coordinator** of the international KM3NeT collaboration. Responsible for and organiser of training activities for new members joining the KM3NeT collaboration.
- 2022 - today **Principal Investigator** of the **CLIC** project funded by the Prince Albert II of Monaco Foundation through the Pelagos Initiative call. The project is dedicated to the use of KM3NeT acoustic sensors for detector calibration and multidisciplinary applications, comparing data collected by KM3NeT on the French Riviera with acoustic measurements carried out in the Ligurian Sea.
- 2021 - 2022 **Principal Investigator** of the **Whale@KM3NeT** project (in collaboration with CNRS - CPPM Marseille) funded by the Italian-French University through the Galileo 2021 Call for Proposals. The project is dedicated to the use of KM3NeT acoustic sensors for detector calibration and multidisciplinary applications.
- 2021 - today Member of the **Institute Board** of the **ANTARES** collaboration.
- 2020 - 2021 **KM3NeT Run Coordinator**. Responsibility for coordination between shifters monitoring KM3NeT weekly and experts on individual detector components (2 shifts of 2 months - 4 months overall).
- 2016 - 2020 **Project manager** of the LIFE+ Natura 2000 project **WHALESAFE** and member of the **Technical Coordination Committee**.
- 2014 – today Member of the international collaboration KM3NeT
- 2011 – today Member of the international collaboration ANTARES

Research interests

KM3NeT is a **submarine telescope** designed for the detection of astrophysical neutrino sources; **ANTARES** is its predecessor which has been operational from 2008 to 2022.

The main activities I carried out within the KM3NeT-ANTARES collaboration include:

- **Sensitivity estimation of the KM3NeT-ARCA detector for high-energy point sources of neutrinos, search for neutrino fluxes from point sources with the ANTARES and KM3NeT detectors**

The study of potential point sources of neutrinos is one of the main objectives of KM3NeT. From the energy spectra of the photon flux measured by γ -ray detectors, the sensitivity of KM3NeT to these potential sources is studied. The significance of the measurement is maximised by considering the energy spectrum of the expected neutrinos and the angular extent of the source, and then deriving the measurement time required to confirm the presence of a neutrino flux from several promising sources. Numerous searches for neutrinos from point sources have been conducted by the KM3NeT and ANTARES collaborations.

- **Studying Cosmic Rays with KM3NeT (ALICA Project)**

The project aims to study the background due to cosmic rays in KM3NeT for measurements of astrophysical interest and neutrino oscillations, and also intends to carry out studies on cosmic rays and their cross sections.

- **Using KM3NeT acoustic sensors for detector calibration and multidisciplinary applications (CLIC Project)**

The KM3NeT detector being located in the depths of the sea is subject to the influence of currents. For this reason, an acoustic emitter-receiver system is used to reconstruct the position of all detector components. This system records all sound signals from the deep sea, so it can also be used to study cetaceans.

- **Study of a promising new gamma ray burst emission pattern and search for neutrinos at particularly bright gamma ray bursts with ANTARES**

Gamma ray bursts are intense flashes of gamma rays that can last from a few milliseconds to several tens of minutes; they constitute the most energetic phenomenon observed so far in the universe. The photospheric emission model of gamma ray bursts, although quite recent, has gained considerable interest within the international community. For this reason, I chose to study the photospheric model, which predicts high neutrino emission in a lower energy range than classical emission mechanisms. For the first time ever within the ANTARES collaboration, I used a special sample of 'raw' data recorded by the detector, which may have a higher information content, but are much more delicate to handle.

The analysis developed for this study led to a significant increase in detector efficiency in the energy range of interest, thanks in part to a signal reconstruction algorithm I developed specifically for this measurement. The research did not lead to the detection of neutrinos at gamma ray bursts, but it did allow an upper limit to be placed on the number of neutrinos emitted by these sources, both assuming the photospheric model and the classical emission models.

- **Studying the Moon and Sun's shadow with ANTARES and KM3NeT**

Pointing accuracy and angular resolution are fundamental characteristics of a neutrino telescope, so an accurate method of estimating them is crucial. One possibility is the measurement of the Moon or Sun's *shadow*, i.e. the atmospheric muon deficit measured in the direction of the celestial body, which is due to the absorption of cosmic rays .

I used the data collected from the ANTARES detector to show its correct pointing and directly measure its angular resolution.

The Moon's shadow was detected with a significance of 3.5σ , while the Sun's shadow was detected with a significance of 3.7σ .

In addition, I developed a simulation of the future KM3NeT detector to estimate the significance of the expected muon deficit.

- **Search for a neutrino flow from the Fermi Bubbles with ANTARES**

The Fermi-LAT telescope revealed a gamma-ray flux at two structures extending above and below the Galactic centre, the so-called Fermi Bubbles. The ANTARES telescope had excellent visibility of these two regions, so I chose to use the data recorded by the detector to search for a neutrino flux from this region of space. The number of neutrinos detected at the Fermi Bubbles is compatible with the expected background, but, in any case, I was able to establish an upper limit to the expected neutrino flux from this region of space.

- **Project manager of the WHALESAFE experiment**

WHALESAFE has developed a system to detect and track sperm whales in the Ligurian Sea. One of the aims of the project was to prevent collisions between cetaceans and ships in the area. An underwater acoustic sperm whale detection apparatus was connected in real time with the Harbour Master's Office. In the event of an alert, the marine authorities send out a real-time warning message to all vessels in the area indicating the expected surfacing point.