Guido Tempestilli

ABOUT ME

Current position

I'm a Master's student in Physics at Sapienza University of Rome enrolled in the "Fundamental Interactions" curriculum which grants a recognized degree in Italy, France, Sweden, and Hungary and is taught entirely in English.

Research interests

My research interests lie in Non-perturbative Aspects of Quantum Field Theory, mainly on strongly coupled systems which cannot be investigated by standard perturbative tools. Within the standard model of particle physics, this happens for Quantum Chromodynamics (QCD) at the low energy hadronic scale. Primary tools include Lattice field theories, the Large-N expansion and Conformal field theories. I am also interested in the topological sector and phase behavior of QCD, as well as the potential unification with String Theory.

EDUCATION AND TRAINING

[2015 – 2020] **Secondary School Diploma**

Liceo scientifico "Antonio Orsini" www.iisorsiniliciniap.edu.it

City: Ascoli Piceno | **Country:** Italy | | **Final grade:** 100/100 | **Level in EQF:** EQF level 4

[2020 – 2023] **Bachelor's degree**

Università di Roma "La Sapienza" www.uniroma1.it

City: Roma | **Country:** Italy | **Field(s) of study:** Natural sciences, mathematics and statistics: ● *Physics* | **Final grade:** 110/110 | **Level in EQF:** EQF level 6 | **Thesis:** Oscillazione di sapore leptonico nei neutrini solari e l'esperimento Borexino

1. Programming skills (C, C++, Python, Machine Learning)
2. Advanced Mathematics and Physics

[2023 – Current] **Master's degree**

Università di Roma "La Sapienza" www.uniroma1.it

City: Roma | **Country:** Italy | **Field(s) of study:** Natural sciences, mathematics and statistics: ● *Physics* | **Level in EQF:** EQF level 7

1. Curriculum focused on theoretical aspects of Fundamental Interactions with experimental insights. Strong emphasis is given to Quantum Field Theory which is recovered in great detail by the main courses.
2. 6-month laboratory work aimed at learning the experimental methods of particle physics.

LANGUAGE SKILLS

Mother tongue(s): Italian

Other language(s):

English

LISTENING C1 **READING** C1 **WRITING** C1

SPOKEN PRODUCTION C1 **SPOKEN INTERACTION** C1

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user

SKILLS

Programming

C | C++ | Python

Software

LaTeX | Microsoft Office | Garfield++ | Geant4 | ROOT@cern

O.S

Windows | Linux | macOS(UNIX)

PROJECTS

[05/2023 – 09/2023] **Bacherlor's thesis**

My bachelor's thesis focuses on the description of neutrino flavor oscillations, a phenomenon that occurs both in vacuum and matter, where it is enhanced by the MSW effect. In the Sun's core, nuclear reactions (the pp chain and the CNO cycle) produce electron neutrinos, whose flux is predicted by the Solar Standard Model. A groundbreaking Earth-based experiment, Borexino—conducted at the Gran Sasso National Laboratories—played a pivotal role in studying this process. My thesis provides an extensive discussion of Borexino, which performed a full-spectrum neutrino spectroscopy, from low to high energies, enabling investigations into the Sun's structure and neutrino flavor oscillation probabilities.

Since neutrino oscillations are not predicted by the Standard Model, Beyond Standard Model (BSM) theories are required to account for them. Additionally, this phenomenon is linked to CP violation and the neutrino mass hierarchy problem. Understanding neutrino oscillations may ultimately help determine whether neutrinos are Dirac or Majorana particles.

[02/2023 – Current] **Master's thesis**

Large-N QCD provides an alternative expansion to perturbation theory, offering a natural framework for understanding many non-perturbative aspects of the theory. However, its analytical properties still require comprehensive investigation. Furthermore, Large-N QCD has been shown to exhibit connections with string and conformal field theories.

On the numerical side, increasing the accuracy of glueball and meson spectrum computations in the large-N limit is crucial, as these studies serve as a valuable guide in the search for a potential string-theoretic formulation of QCD.

My thesis project focuses on implementing the Wilson flow method in an SU(N)-adapted Lattice QCD code and computing meson masses and excited states. This method, also known as the gradient flow method, is widely used in non-relativistic and finite-temperature QCD.

Ai fini della pubblicazione

F.to Guido Tempestilli
Roma, 25/01/2025