Benedetta Kalemi

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ABOUT ME

I am an ambitious and dedicated astronomer and astrophysicist based in the vibrant city of Rome. With a Master of Science degree from Sapienza University of Rome, my academic journey has been propelled by a passion for exploring the mysteries of the cosmos. Specializing in Observational Cosmology and Experimental Astrophysics, I have acquired a comprehensive understanding of the knowledge that we have today on the universe and the methods used to study it. My commitment to advancing scientific knowledge drives me to seek new discoveries and contribute to the ever-evolving field of astrophysics. During my academic tenure, I had the invaluable opportunity to undertake an internship at the European Space Agency, where I gained hands-on experience in cutting-edge research and development initiatives within the realm of space exploration. This experience not only enriched my knowledge but also honed my practical skills, further fueling my aspirations to make significant contributions to the field of astrophysics.

EDUCATION AND TRAINING MSc in Astronomy and Astrophysics

Sapienza University of Rome [2021 – 2024]

City: Rome
Country: Italy
Field(s) of study: Astronomy and Astrophysics
Final grade: 110/110 cum laude
Thesis: CubeSat-Based Calibration Strategy for CMB polarization Experiments: Optimized Design and Testing of a Helmholtz Cage

During the course I studied mostly Observational Cosmology, Experimental Cosmology and Astrophysics and Computational Astrophysics. My final thesis explores the critical role of calibration in Cosmic Microwave Background (CMB) experiments, focusing on the challenges of obtaining accurate polarization maps and their significance in cosmology. Through measuring B modes in the CMB, the study elucidates the potential to affirm or challenge the Inflation Theory, a cornerstone of our understanding of the universe's origin. Furthermore, it underscores the broader implications of precise telescope calibration, such as verifying aspects of the Standard Model through the measurement of mixed EB modes. The thesis provides a comprehensive review of current calibration methods and discusses their strengths and weaknesses. A significant portion of the research centers on the CUBIQU (CubeSat for I,Q,U) ESA project, particularly examining the calibration and testing of the Attitude Control and Determination System (ACDS) using a Helmholtz cage to simulate the geomagnetic field in Low Earth Orbit (LEO). The need for unprecedented precision in position and attitude determination in the CubeSat realm underscores the importance of this endeavor. The classical model of the Helmholtz cage is explored, along with strategies to enhance the uniformity of the magnetic field it generates, including the development of a compact
4-coils model for constrained spaces. After rigorous simulations, optimizations, and testing, the thesis demonstrates a close alignment between measurements and calculations, paving the way for further improvements and the implementation of the optimized 4-coils model for testing a 3U calibrator CubeSat. Looking ahead, the research aims to expand measurements into two

and three dimensions, necessitating the addition of coils along the x and y axes to create a comprehensive three-dimensional magnetic field.

BSc in Physics

Sapienza University of Rome [2018 – 2021]

City: Rome

Country: Italy

Field(s) of study: Physics

Final grade: 110/110

Thesis: Birifrangenza Cosmica: tra difficoltà sperimentali e possibili implicazioni teoriche

During the course I studied mostly classical and modern theoretical physics, computational physics and experimental physics.

High School Diploma

Scientific High School "Galileo Galilei" [2013 – 2018]

City: Potenza

Country: Italy

Final grade: 100/100

LANGUAGE SKILLS

Mother tongue(s): **Italian**

Other language(s): **English** | **Spanish**

PUBLICATIONS

Novel nulling spectropolarimeter design for polarization measurement of the cosmic microwave background

[2022]

Following the current Phase 3 of Cosmic Microwave Background (CMB) polarization measurements, focused on detecting the B-mode, there arises a demand for new experiments boasting higher sensitivity, enhanced control over systematic effects, and the ability to discriminate polarized contaminants. Leveraging the transfer matrix function method, we have devised an innovative experimental setup functioning as a nulling spectropolarimeter. This optical configuration exhibits the capability to extract the spectral information solely from the linear polarization component of the incident radiation while effectively filtering out unpolarized radiation. Our presentation encompasses the optical design, highlighting its principal features, along with an end-to-end forecast simulation pertaining to absolute polarization angle measurement. Such measurement holds paramount importance for forthcoming experiments aimed at capturing CMB B-mode signals.

CONFERENCES AND SEMINARS Tech Talk: An innovative Helmholtz cage design for the CUBIQU project

[European Space Agency - ESA, Madrid]

During my internship at the European Space Agency (ESA), I had the opportunity to give a Tech Talk to the community, in which I presented the CUBIQU project and the results of my work. My presentation began by outlining the main objective of the project, which is the calibration of the QUIJOTE telescope using CubeSats to measure the B-modes of the cosmic microwave background (CMB). I then shared the results of my research, which focused on the development of an innovative and highly optimised Helmholtz cage model. This model accurately simulates the Earth's geomagnetic field and is a valuable tool for evaluating the behaviour of CubeSat magnetorquers in orbit.

WORK EXPERIENCE Intern

European Space Agency - ESA [01/03/2023 – 01/09/2023]

City: Madrid

Country: Spain

Tutors: Xavier Dupac, Julio Gallegos Alvarado, Marcoz Lopez Caniego Altarria
During my six-month internship, I focused on CubeSat attitude determination and contributed to the design of a Helmholtz cage. My work was part of the CUBIQU project, which aims to calibrate the QUIJOTE telescope for the purpose of measuring the polarization of the cosmic microwave background (CMB) using CubeSats.

Intern

Sapienza University of Rome [01/03/2022 – 25/09/2022]

City: Rome

Country: Italy

Tutor: Giuseppe D'Alessandro
During this internship I studied the design af a nulling spectropolarimeter for polarization measurement of CMB, indeed I simulated the latter instrument with Python. My purpose was to estimate the entity of polarizers' emission, that is the main systematic effect affecting this instrument. The results about the wire grids emission at different temperatures were so interesting. One of the results of this work is published in https://doi.org/ 10.1117/12.2626789.
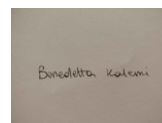
DIGITAL SKILLS

Python, C, R, LATEX, Matlab, Arduino, Raspberry Pi / Microsoft Office / Linux, Windows / Zemax - Optic studio, TINA (Toolkit for Interactive Network Analysis)

COMMUNICATION AND INTERPERSONAL SKILLS Team working ORGANISATIONAL SKILLS Writing laboratory reports
Making oral scientific presentations Latex type-setting

Roma, 29/03/2024

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