ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Department of Physics
Alma Mater Studiorum-Università di Bologna
Viale Carlo Berti Pichat, 6/2
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Calandriello Gennaro
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Dear Application Committee,

Motivation

I am writing to express my deep interest in applying for the PhD program in Physics at the esteemed University of Bologna. My passion for understanding the fundamental phenomena that drive us through Universe has been an abiding force throughout my academic journey, pushing me to delve deeper and transcend traditional boundaries. I have been fascinated by the way the Universe shapes our understanding of reality and the creative capacity of human mind to comprehend the fabric of the cosmos.

The University of Bologna, with its centuries-old tradition of scientific exploration and intellectual freedom, is the perfect venue to pursue my academic aspirations. The legacy of the great minds of the past is a powerful tool for framing the future.

Research Interests

My research interests span a wide array of topics, at the core lies a deep fascination with quantum field theories and non-perturbative methods to explore them. I am captivated by the idea of studying numerical approaches, from the Standard Model to quantum gravity, via e.g. Causal Dynamical Trangulation or other techniques capable of encoding the curvature on lattice.

Furthermore, I am interested in the development of new algorithms for generating configurations in lattice field theories, both through Monte Carlo and Machine Learning techniques. I am currently working on a project to apply gauge equivariant flow-based models to pure gauge and QCD theories, to find possible improvements in efficiency and scalability, to avoid some well known numerical problems (as the Critical Slowing Down or the sign problems) and to learn new possible complex patterns in data.

Another line of research that I am passionate about is Quantum Chaos. I have numerically solved the time-dependent and time-independent Schrödinger equations in presence of certain potentials (classically known to induce chaotic behavior) to explore the emergence of chaotic phenomena at the quantum level. This work has deepened my interest in the interplay between Quantum Mechanics and Chaos Theory, two intriguing aspects of modern physics.

Personal Qualifications

I bring a strong academic background and a diverse set of skills to the PhD program at the University of Bologna. I have gained significant experience in programming and demonstrated an ability to rapidly assimilate new concepts, a critical asset in the dynamic field of theoretical physics.
Recently I worked on simulating SU(3) and SU(2) field theories, implementing HeatBath, Metropolis, OverRelaxation algorithms, and incorporating an Higgs field in SU(2). These experiences have nurtured my creativity and problem-solving abilities.

I bring a broad academic background encompassing General Relativity, theories of gravitation, cosmology and Complex Systems. This diverse exposure has equipped me with a comprehensive understanding of the theoretical foundations of these fields, further fueling my interest in numerical investigations of Nature's law.

I am confident that my passion for physics, combined with my theoretical knowledge, practical experience and creativity, will enable me to make contributions to the PhD program in Physics at the University of Bologna. I would be exhilarated to engage with the intellectually vibrant scientific community of the Alma Mater Studiorum, opening intriguing and engaging discussions across a wide array of scientific topics.
I eagerly anticipate the opportunity to contribute to the intellectual life of your esteemed institution as I embark on this exciting journey of discovery and learning.

Sincerely,

Gennaro Calandriello,
Department of Physics,
University of Pisa, June 18 2023